University of Novi Sad
Technical faculty “Mihajlo Pupin”
Zrenjanin, Republic of Serbia

I International Conference - Process Technology And Environmental Protection (PTEP 2011)

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Zrenjanin, 7th December 2011.

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Lecturer:
MSc. Dragica Ivin, Technical faculty “Mihajlo Pupin”, Zrenjanin, Republic of Serbia

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Organizing Committee:

INTRODUCTION

Department of Mechanical Engineering and Technicalfaculty "MihajloPupin" from Zrenjanin have started the organization of I InternationalConference - Process Technology And Environmental Protection (PTEP 2011) in 2011.

Scientific theme of the conference PTEP 2011 covers all areas of process engineering and environmental protection. That can be identified and the basic objectives: innovation and expansion of knowledge engineers in process industries and environmental protection;support researchers in presenting the actual results of research projects; establishing new contacts with leading national and international institutions and Universities; popularization of the Faculty and its leading role in our society - environment, in order to attract the best young population to study at Technicalfaculty "MihajloPupin"; cooperation with organizations, public companies and industry.

Within this Collection of papers are presented all accepted papers received for I InternationalConference - Process Technology And Environmental Protection (PTEP 2011). The papers are divided into the following sessions: Session 1: Process Technology, Session 2: Engineering Environmental Protection, Session 3: Design and maintenance of process plants, Session 4: Basic operations, machinery and processes, Session 5: Reengineering and project management, Session 6: Process management, Session 7: Students' papers.

We wish to thank Zrenjanin Town Hall, Regional Chamber of Commerce, Ministry of Education and Science Republic of Serbia and Technical faculty "Mihajlo Pupin" from Zrenjanin, University of Novi Sad for the support and for their active role concerning the organization of I International Conference - Process Technology And Environmental Protection (PTEP 2011). We are also expressing our gratitude to all authors who have contributed with their papers to the organization of our first Conference PTEP.

We would like our Conference to become a traditional meeting of researchers, every year. We are open and thankful for all useful suggestions which could contribute that the next, International Conference - Process Technology And Environmental Protection (PTEP 2012) become better in organizational and program sense.

President of the Organizing Committee
Prof. Ph.D Dragiša Tolmač

Zrenjanin, December 2011.

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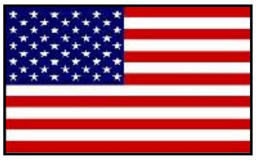

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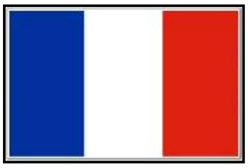

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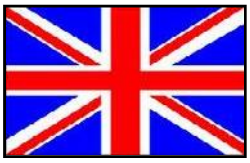

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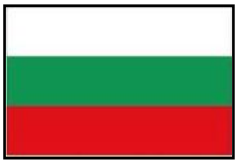

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CONTENTS

SESSION 1: Process Technology

PROCESS ANALYSIS OF BIOMASS PELLETS PRODUCTION

Gluvakov, Z., Brkić, M., Janić, T.
Faculty of Agriculture, University of Novi Sad, Novi Sad
E-mail: mbrkic@polj.uns.ac.rs

Abstract: Since in today's modern times, when we tend to use the renewable energy sources because of its inexhaustible resources and ecological importance, each country, depending on their natural resources, is looking in direction to steer the technology for energy production. Serbia should, on the base of that principle, turn to the branch of energy production that is the most dominant as a resource, which is biomass. It is estimated that of the total renewable energy resources biomass makes about 63%.
This paper introduces the process of pelleting biomass in the pelleting plant of "Eko pelet" in Bački Petrovac, founded in 2009. Existing biomass pelleting line is based on the line for pelleting hops, which dates from 1980. On the above mentioned plant, monitoring and analysis of the processes of energy production from biomass pellets, and analysis of plant investment cost and price of energy pellets was carried out .
Following the plant, the procedure of line for pelleting wheat-straw was described and analised, which was not the case in Vojvodina in the past, since there was no succesfull production of such pellets. It had to be mixed with sawdust in proportion: 30% of straw and 70% of sawdust. So, by using special openings of the matrix, the basic problem in the process of pelleting wheat-straw was solved: an adequate fragmentation of the material, compression material pressure, temperature and moist content of the material were achieved.
Key words: energy, biomass, pelleting, pellets, cost

INTRODUCTION

The need for energy continuously increases and requires mobilization of all available technologies, because almost all people's acitivities on Earth are based on using some kind of available tipes of energy. Today, we usually divide all tipes of energy as renewable and non-renewable. The mentioned tipes of energy are used today, but their contribution in energy balance is different in different countries. The share of renewable energy resources with relation to non-renewable is often and significantly changing in total energy balance. (Gvozdenac et al, 2010, Brkić et al, 2006). Every country in the world tries, by using different mechanisms, to increase the share of renewable energy resources in their balance, aware of the fact that funds of non-renewable energy resources are limited and insufficient to satify the increasing needs for energy. On the other hand, non-renewable or conventional tipes of energy are environmentally unfavorable (Stankovic et al, Brkić et al, 2008b, Janić et al, 2009).
Reneable sources are inexhaustible energy resource, emerged by the energy of the Sun, by which emerged the most of other sources of energy: energy of biomass, winds, water flows etc. Of all renewable energy resources, the biggest contribution in the future is expecting of biomass, because of quantity of energy that is periodically renewed as well as relatively low costs of production, i.e. colleciting. (Janić, 2009, Brkić et al, 2005). Biomass is, therefore, the theme of many institutions and individuals, who, by their commitment, try to emphasize its potential and necessity for possession of technics and technologies for its using. Step forward in this domain is possible only with well-designed and arranged policy for using renewable energy resources (Brkić i Janić et. a, 2009b).
Increasing of energy efficiency is also contemporary and almost universal task for all plants, and is a permanent subject of interest in designing new plants. In relation to this, the aim of this work is to analize the biomass energy pellets production process, to increase the energy efficiency of this biofuel. The area for biofuel using is wide because heating energy as product can be used in different ways. Therefore, a special attention is payed to necessity for development of adequate plants for production and combustion of biomass from agriculture that would work in regimes of satisfactory environmental, energy and economical efficiency, which purchase price would justify their building, and their servicing and maintenance would not be complicated.

MATERIAL AND METHODS

Raw materials that can be used for pelleting are: granary and oil plant straw, corn and bean stalk, fruit seeds and peels, branches of pruned trees and vine etc.

Wheat straw consists of the same elements as other solid natural fuels (annual and perennial biomass and fossil residues). These are: carbon (C), hydrogen (H), oxigen (O), nitrogen (N), sulphur (S), mineral matters (A) and moisture (W) (Brkić et al, 2006).

Basic matters that wheat straw consists of are: cellulose 36%, hemicellulose 25%, lignin 18%, organic components 8%, salts 6% and mineral matters 7% (Brkić et al, 2009).

Collecting data concerning biomass pelleting procedure was carried out in the pelleting plant of firm "Eko pelet" in Backi Petrovac. This plant was built in 1980 and its primary purpose was hop cones pelleting. In 2009, it was readapted for straw and sawdust pelleting.

Fig. 1 shows the technological scheme of hop pelleting. After delivery, material is sent to breaking (first part of the scheme), than to drier (second part, i.e. the middle part of the scheme) for removing of extra moisture from the material and after that to pelleting (third part of the scheme). By certain corrections and adaptations, the actual hop pelleting plant is adpted for production of biomass energy pellets (third part of the scheme).

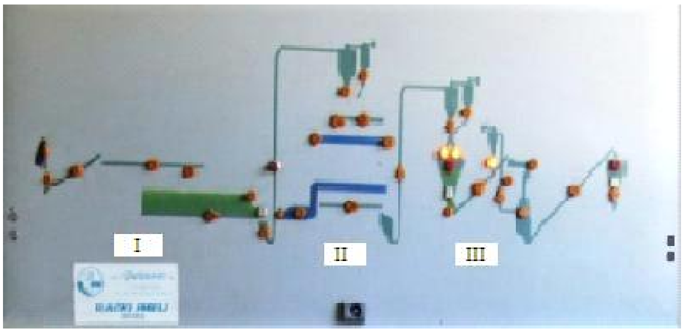

Figure 1. Technological scheme of hop pelleting. I part: admission and fragmentation of material, II part: drying, III part: pelleting process

During making of this work the method of literarure review and analyzing method were used, i.e. literature concerning subject area was collected and elaborated (Brkić et. al, 2009), production process of biomass energy pellets was analyzed (Brkić et al, 2008a), operating of biomass pelleting plant "Eko pelet" in Backi Petrovac was monitored in operating conditions, prospectus material from producer of equipment was collected, technological scheme of wheat straw pelleting was drawn, technological scheme was described, collected data ware disccused and actual conclusions drawn.

RESULTS AND DISCUSSION

Analysis of pellet production plant operating

The line for pelleting agriculture biomass was put in operation in 2009, at SC "Eko pelet" in Backi Petrovac. The actual line for pelleting is based on the hop pelleting line from 1980. The equipment producer is Dutch firm CPM. The equipment was installed in big concrete hall. The straw pelleting line (Fig.2) consists of: palleting material receiving plateau, forklift for delivering material, roll bale disintegrator, (power 7,5 kW) produced in "Metalac Ostojić", Obrenovac (pos.1), for chopping material up to 12 mm. A dispenser makes a large air-stream that directly, through vertical tube, inserts material into a cyclone (pos.2). Material gravitationally falls into two hammer mills (power 2x18,5 kW), where it is additionally chopped up to 3-5 mm (pos.3). Chopped material from the mills gravitationally falls into a bin (pos.5). By using a worm mixer (pos. 4) material is further sent to stripped transporter (pos. 6) which takes it to pelleting press CPM (power 55 kW) with dosing device and conditioning (moisturizing) device (pos. 7). Under the press there is a cooler for pellet cooling (pos. 8). Pellets are exempt from the cooler by vibro plate (exempter) and through stripped transporter (pos. 9) carried to bin for enlarging pellets (poz.10). From the bin, pellets are falling down over the doser on vibro sieves (pos.11) in order to remove waste impurities, and after which they come into sacks on electronic scale (pos. 12) and packing machine with vacuum device. Packed pellets are arranged on pallets and stored. The sacks are made of PVC foil.

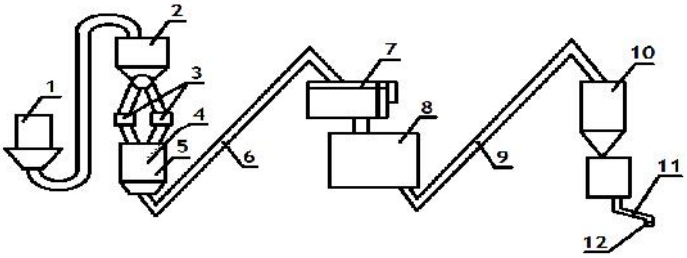

Figure 2. Pelleting line for wheat-straw in "Eko pelet" in Backi Petrovac (1.disintegrator, 2. cyclone, 3. hammer mill, 4. mixer, 5. bin, 6. stripped transporter,7. pelleting press CPM with conditioner, 8. air cooler, 9. stripped transporter,10. bin, 11. vibrational transporter with sieves, 12. elecronic scale)

Electric power of the plant: disintegrator 7,5 kW, hammer mills 2x18,5 kW, bin (worm mixer) 1,1 kW, stripped transporter 2,2 kW, pellet mill 55 kW (conditioner with worm transporter 1,1 kW, pellet cutter 0,5 kW), cooler (ventilator) 1,1 kW, cyclone for dust removing 2,2 kW, stripped transporter 2,2 kW, doser 0,5 kW i vibro sieves 1,1 kW. Total power of the whole line is 112 kW.

Meterial, i.e. wheat straw before entering the production process has moisture content of 14% to 15%, while the final product, i.e. pellets after the production process has moisture content of 8% to 10%. Compression (pressing) of the material causes moisture evaporation. Because of that sometimes it is needed to add water into conditioner in oreder to obtain the optimal content of the pressing material. Unfortunately, this process is done manually and it could be automatised. Pelleting press CPM (Fig.3) is of a stable construction, consisted of a basket, conditioner, doser, worm transporter, doser and working tool matrix. Mass of the press is about 3t and matrix about 150kg. After entering of the chopped material into the pellet mill basket, it is necessary to moist it by conditioner in order to accomplish more comact pelleting. The matrix (Fig. 4) is in a ring shape with two thrust cylinders. The ring matrix is rolling, and cylinders for mass thrusting through openings are still. The matrix has 9 lines of openings with diameter of 6, 7 or 8 mm. Total number of openings is 1200. Working temperature of ring matrix is about 130 ˚C. Matrix dimensions are 500 x 100 x 70 mm. Press performance is 400 kg/h of wheat energy pellets.


Figure 3. Pelleting press CPM **Figure 4**. Ring matrix

The shape of the opening (hole) on the matrix is: internal cone opening Ø 8, 9, 10 mm and length of 3 mm, middle cylindric part for pellet forming: Ø 6, 7 or 8 mm and length of 28 mm, external cylindric part for pressure relief on the pellet (expansion) Ø 6,5; 7,5 and 8,5 mm and length of 39 mm. Total opening length is 70 mm. Fig. 5 shows the longitudinal section of the matrix opening.

Through the cone opening (Fig. 5) enters the chopped mass suppressed by cylinders. The mass is suppressed inside the cylinders. Further suppression is done in the narrowed matrix opening (Ø 6, 7, 8 mm), depending on opening diameter. After this opening, the mass comes to the extended opening (Ø 6,5;7,5;8,5 mm), where it is being expanded, the pressure in the mass is relieved and pellet easier comes out through the opening. This shape of the opening completely suits the wheat pellet production (Brkić et. al, 2009a).

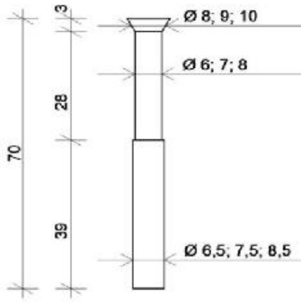

Figure 5. Longitudinal section of the matrix opening

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During visiting the plant, the first thing that could be visually determined was that the reception of production raw material was not adequate. Material should be protected from weather conditions, since in the case of raining, the moisture content in the material would significantly increase, and it could not be used in the production process. After increased moisture content, it is necessary to dry the material, and use it only afterwars. Additional drying of the material increases energy consumption and extends the pellet production process. In the plant, they use temporary solution by putting nylon foils on the stacks, and winds usually blow them away. Therefore, it is necessary to provide safe reception of material, for example, by building marquees that would protect the material. Building marquees for a number of stacks would be a significant investment.

Since the plant dates from 1980, from time to time appers a problem in difficult repair and maintenance. The problems also are impossible repair of actual and purchasing of new spear parts, because there are no such parts on the market. The plant then comes to situation of bying new equipment and that is a big investment.

Wheat straw pelleting process was monitored on the plant. During this process, there were no constraints. Employees on the plant told us that there were no problems during wheat straw pelleting process, but they came up with some during process of soy straw pelleting. The problems occurred during additionl chopping of the material, since soy straw has specific structure, i.e. contains a lot of fibres that obstruct sieves. This problem could be solved by replacing hammer mills with knives that could cut the cellulose fibres in soy straw.

Analysis of plant investment cost and exploitation expenses

Agriculture producers are lacking money for decades, except for few ones, who can not buy necessary biomass pelleting machines and equipment for cash. Those who wants to build a pelletin plant can hardly get favourable credits. The government does not encourage production, does not release producers from taxes and contributions, even it is case of biofuel production. In the EU countries, producers who decrease production of carbon-monoxide are encouraged, and those who emit it in the atmosphere are punished because of global warming (Brkić and Janic, 1998, 2007 and 2010).

For biomass peletting plant, it is necessary to purchase additional equipment. Cost price are: disintegrator about 2.000 euros, transporters about 2.000 euros, forklift about 4.000 euros, manual forklift about 200 euros, two matrix + cylinders about 5.500 euros (one matrix costs 1.500 euros, and cylinders about 500 euros) and hammer mill abot 1.600 euros. We can make a conclusion that it is necessary to invest about 17.300 euros in actual plant in order to start with biomass energy pellets production process.

Cost of new jumbo sacks of 1100kg is 500-600 dinars, while secondhand sacks cost 200-300 dinars. PVC sacks, depending on a producer, cost between 2,5 and 5 dinars.
Concerning that the pressing pellet technology is based on pressing without connective appliances, we can not exclude the costs of electric energy. Monthly expenses for electric energy are 55.000 dinars.
The plant works one shift every day, except Sunday. Actual production scale allows work in only one shift. Four employees work in one shift. Each employee is educated in the same way so that all of them can do all kinds of work in the plaant for energy pellet production.
The palnt has planned to investin new equipment, in a near future. The plans are oriented to purchasing of one more pellet mill and one briquette machine, whih are additional expenses and bigger production scale. Therefore, we can conclude that the number of working shifts will increase, as well as number of employees.

Analysis of energy pellets cost

The cost of final product is formed on the base of production expenses. Inevitable factors that are part of cost formaing are: type and cost of raw material, means of collecting material, techniques af collecting, transport and storage, types of pressing lines, pressing technologies, type of package, line performance, number of employees, object and equipment value, credit interest etc (Brkić et al, 2009, Brkić i Janić, 2009a).
The cost of energy pellets in “Eko pelet” plant, in Backi Petrovac, depends on all above mentioned factors, as well as raw material that final product is made from. Purchase price of roll bales is 37 euros/t, while market price of wheat straw pellets is 120 euros/t. The plant also produces fir pellets whose purchasing price is higher than wheat straw and is 80 euros/t. thus we can conclude that the final product also has higher market price which is 160 euros/t. Mentioned costs consider value-added tax of 18%. The plant owner consider that value-added tax should be stimulative, i.e. 8%, as it is in agriculture.
Fir pelleting is a very slow process, for one working hour 100kg of pellets are produced. Wheat straw pelleting is more profitable, since for one shift (eight working hours) 2,5 – 3 t of pellets are produced, that is 312 -375 kg for one working hour. Therefore, the pellet production is based strictly on wheat straw pelleting in order to satisfy the needs on the market.
Pellets are primarily used for export on the market of EU countries. Now, the largest export markets are Slovakia and Sweeden. 10% of total production goes to Serbian market. From the above mentioned we could conclude that, unlike Serbian market, production and using of this energy resource in the EU are wide and these countries are large importer of biomass energy pellets. This should be used as a chance for domestic producers and use such a favourable situation for pellet export (Brkić i Janić, 2009a).
We cannot exclude the fact that pellets for European market must be produced by European standard CEN or by standards of the country they are exported to (Brkić et al, 2008b). The cost of the pellets for European market is 100 euros for bulk export, 200 euros for pellets packed in big sacks and 300 euros if packed in small sacks.

CONCLUSION

Technological – technic procedure for biomass energy pellets production in the world, as well as in our country is practically solved, and the issue of its economy and competitiveness in relation to other energy resources is less questionable (Brkić et al, 2007).
On the base of the results and analysis following conclusions can be drawn:

- Using biomass from agriculture for agriculture increases the level of energy autonomy in agriculture. Agriculture is a sort of production where costs for used energy are less than produced energy (Brkić et al, 2005),
- Using biomass in the bale shape as an alternative source of heat and electric energy is very perspective, since its cost is the lowest (five times lower than disel fuel, concerning fuel-oil and three times lower than earth gas) (Janić et al, 2008),
- Biomass pelleting is still very expensive and there are few reasons for that: large labour force participation, big biomass loss, increased labor force costs, increased electric energy costs, expensive maintenance of pelleting equipment etc. (Brkić et al, 2008),

● Pellet production costs depend on: type of raw material, collecting techniques, type of pressing line, pressing technologies, line performance, type of package, object and equipment value, transport and storage (Brkić et al, 2008),

● Biomass pelleting is not profitable when used in own economy, pellets are only profitable when placed on market (Brkić et al, 2008).

● Profit on production and selling of pellets is still unsignificant for Serbian market. In order to expand this kind of production and make it profitable the help of country, banks and donors is necessary. Credit interest rates should not be so high, since investments can be returned in a short period, especially if goods are exported to European market (Brkić et al, 2009),

● Expanding this sort of exploitation for now is slow, mostly because of unavailability of this energy resource for wide using and lack of standards for pellet production. By removing these disadvantages, a serious progress could be made with applying this project (Brkić et al, 2008).

At the end, it should be emphasized that the energy wheat straw pellets production plant „Eko pelet" in Backi Petrovac, where hop pelleting line was adapted for wheat straw or wood pellets production works successfully, efficiently, rationally, profitable and economically. In this plant, work four employees and the owner, who provides sources for five families and sources for the plant maintenance and expanding. In the past there were no successful wheat straw pellet production in Vojvodina. It had to be mixed withU Vojvodini do sada nije bilo uspešne proizvodnje peleta od pšenične slame. It had to be mixed with sawdust in proportion: 30% of straw and 70% of sawdust (Brkić et al, 2010). So, by using special openings of the matrix, the basic problem in the process of pelleting wheat-straw was solved: an adequate fragmentation of the material, compression material pressure, temperature and moist content of the material were achieved.

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THE APPLE PULP WASTE USED AS A NOURISHING BASE BY ASPERGILLUS NIGER

Mojsov, K.
University "Goce Delcev"Stip, R. Macedonia
Technological-technical Faculty, Probistip
E-mail: kiro.mojsov@ugd.edu.mk

Abstract: The aim of this work was to develop a low cost process for apple pulp utilization. This actual waste from food and agriculture industry was used as a nourishing base by Aspergillus niger MK-15. The apple pulp combined with corn flour and simple mineral salts was utilized as a nourishing base by submerged production of pectinolytic enzymes by the fungus Aspergillus niger MK-15. Different concentration on apple pulp (1%; 2%; and 3%, w/v) and different pH initial on the bases (4; 5 and 6) were studied. All other process parameters such as inoculation, mixing, aeration, temperature, fermentation time were same. The growth of the microorganism and synthesis of pectinolytic enzymes were performed in 500 ml flasks (100 ml base) with rotational shaking (200 rev min-1) on a rotational laboratory shaker, at 30 ^{o}C within 120 h. Concentration of inoculum: suspension of 2. 10^6 spores ml-1 up to 3 days old (added 3 ml, or 6. 10^6 spores). Endo-pectinolytic activity, based on change in the viscosity of the reaction mixture (0.35% pectin solution, buffered at pH 4.5 in 0.1 mol l-1 citrate), was determined using Ostwald viscometer.. Biomass production was measured as dry weight (DW), (mg ml-1).
Results of different concentration on apple pulp gived maximal endo- PcAc (31,50 IU ml-1) with 1% apple pulp, and the growth of the microorganism (dry weight) showed maximum dry weight (18,2 mg ml-1) on initial pH on bases- 4, during from 48 h.
From results can be see that the apple pulp waste from food and agriculture industry can be used as inexpensive base (carbon source) for industrial production on pectinolytic enzymes by Aspergillus niger. The best concentration on apple pulp was 1 % (w/v) and initial pH on base 4. Pectinolytic enzymes play an important role in food processing industries and alcoholic beverage industries. These enzymes degrade pectin and reduce the viscosity of the solution so that it can be handled easily.
Key words: apple pulp, fermentation, pectinolytic enzymes, Aspergillus niger

INTRODUCTION

The pressed apple pulp is actual waste from food and agriculture industry and because the aim of this work was to develop a low cost process for apple pulp utilization. Accordingly this production of pectolytic enzymes based on submerge state bioprocessing by Aspergillus niger of this actual waste, was developed.
The utilization of microbial enzymes has found broad technological application in different industrial processes. Fungal pectolytic enzymes are used in the food industry for the production of fruit juices, olive oil and wine to increase yields and in the clarification of juices and wines [5], [11].
These enzymes are usually produced on solid or submerged fermentation [3], [6], [12]. Submerged fermentations generally produce smaller quantities of secretory enzymes and solid fermentations are not susceptible to automation. For the industrial production of pectinolytic enzymes it is important to improve the fermentation conditions, for better production of extracellular enzymes on inexpensive carbon sources such as apple pomace, citric peels, pectin or other agricultural wastes which contain appreciable quantities of pectin [1], [2], [7], [8], [9]. The most authors describe the use of an optimized medium composition to increase the enzyme content [4], [6], [10].

MATERIAL AND METHODS

Micro-organism

The microorganism used in this work was the fungus *Aspergillus niger MK-15*, which was isolated from soil as a highly active producer of pectinolytic enzymes and was maintained on slant agar according to Czapek with 2% pectin. Spores from 3 days old agar slants were collected by adding sterile distilled water to each slant. The spores suspension was adjusted to a final concentration in the culture medium of 6. 10^6 spores ml-1.

Media and fermentation procedure

The medium for Aspergillus niger MK-15 was prepared by adding different concentration of apple pulp (1%; 2%; and 3%, w/v) and different pH initial (4; 5 and 6) to the basic medium of the following composition : corn flour- 0,5% (v/v); $(NH_4)_2HPO_4$- 0,7% (v/v); KH_2PO_4- 0,1% (v/v); $MgSO_4.7H_2O$- 0,05% (v/v); and KCl- 0,05% (v/v);. The base was previously sterilized by autoclaving at 121 ^oC for 30 min. The pressed apple pulp first are dry and after are mill to the ground apple pulp particles with the diameter under 0,315 mm.. The refuse apple pulp had the following content: moisture 10÷12 %, ashes 3÷5 %, proteins 6÷6,2 %, and pectin 9÷10 %.

The growth of the microorganism and synthesis of pectinolytic enzymes were performed in 500 ml flasks (100 ml base) with rotational shaking (200 rev min-1) on a rotational laboratory shaker, at 30 ^oC within 120 h.

Enzyme assay

Endo-pectinolytic activity, based on change in the viscosity of the reaction mixture (0.35% pectin solution, buffered at pH 4.5 in 0.1 mol l-1 citrate) at 30 ^oC, was determined using Ostwald viscometer. The degree of degraded pectin (A) under known amount of filtrate(enzyme) was calculated with the formula: A= 100 **.** (Ts-Tt)/(Ts-Tw) where Ts is the flow time of the substrate control. Tt is the flow time of the test and Tw is the flow time of water. 1 U was defined as the amount of enzyme which catalyses hydrolyse of 1 g pectin per 1 h at 40 ^oC. 1 IU is the amount of enzyme which catalysees hydrolyse of 1 μmol pectin per 1 min at 40 ^oC. 1 U= (1 **.** 10^6)/(176 **.** 60) = 94,696 IU where 10^6 –transfer of (g) into (μg); 176- stands for the conditional meaning of the pectin molecular mass; 60- calculation of the enzyme activity per min.

Biomass production measurements

Biomass production was measured as dry weight (DW). After filtering, the retained cell mass was dried at 100 ^oC to constant weight.

RESULTS AND DISCUSSION

Results of different concentration on apple pulp (Fig.1), gived maximal endo- PcAc (31,50 IU ml-1) with 1% apple pulp, compared with endo-PcAc (28,24 IU ml-1) with 2% and endo-PcAc (24,50 IU ml-1) with 3% apple pulp.

Results of different initial *pH* on bases (Fig.2), gived maximal endo-pectinolytic activity (endo-PcAc) (31,50 IU ml-1) on *pH=4* compared with endo-PcAc (29,00 IU ml-1) on *pH=5* and endo-PcAc (25,74 IU ml-1) on *pH=6.*

The growth of the microorganism (dry weight) (Fig. 3 and Fig.4) showed maximum dry weight (18,2 mg ml-1) on 1% concentration of apple pulp and initial *pH* on bases- 4, during from 48 h compared with maximum dry weight (14,5 mg ml-1) on 2%, and (14,0 mg ml-1) on 3% concentration of apple pulp, during by 72 to 96 h. Dry weight (15,2 mg ml-1) on *pH*-5 and (13,9 mg ml-1) on *pH*-6, during by 72 to 96 h.

The results gived that the concentration of apple pulp and *pH* on bases had a pronounced effect on the biosynthesis of pectinolytic enzymes and growt by Aspergillus niger MK-15. From results it became clear that on the biosynthesis of pectinolutic enzymes optimal concentration on apple pulp is 1% (w/v) and optimal *pH*=4 during of 96 h, and for the growth on microorganism optimal concentration on apple pulp is 1% (w/v) and pH=4 during of 48 h.

The results presented here as optimal concentration on apple pulp and *pH* on the medium with a inexpensive refuse apple pulp as a carbon source for maximal enzyme production by *Aspergillus niger MK-15* will be of commercial importance for using refuse apple pulp.

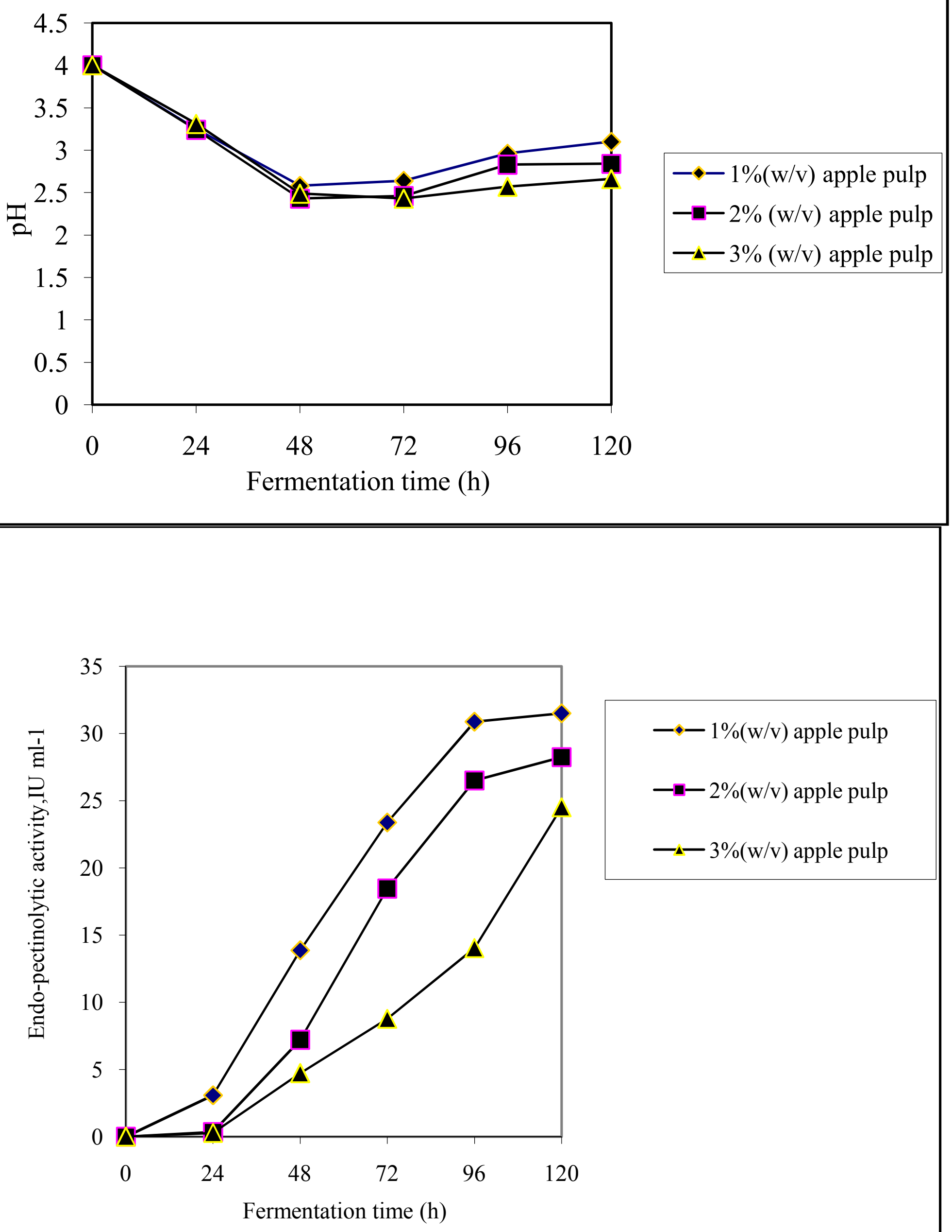
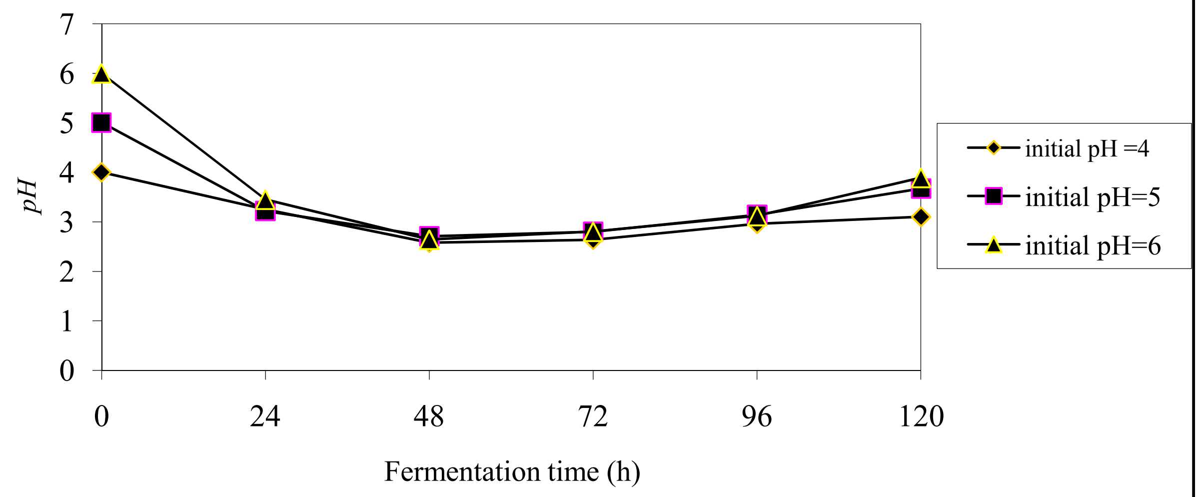


Figure 1. The influence of different concentration apple pulp on bases on biosynthesis of endo-pectinolityc enzymes by Aspergillus niger MK-15. pH starting-4



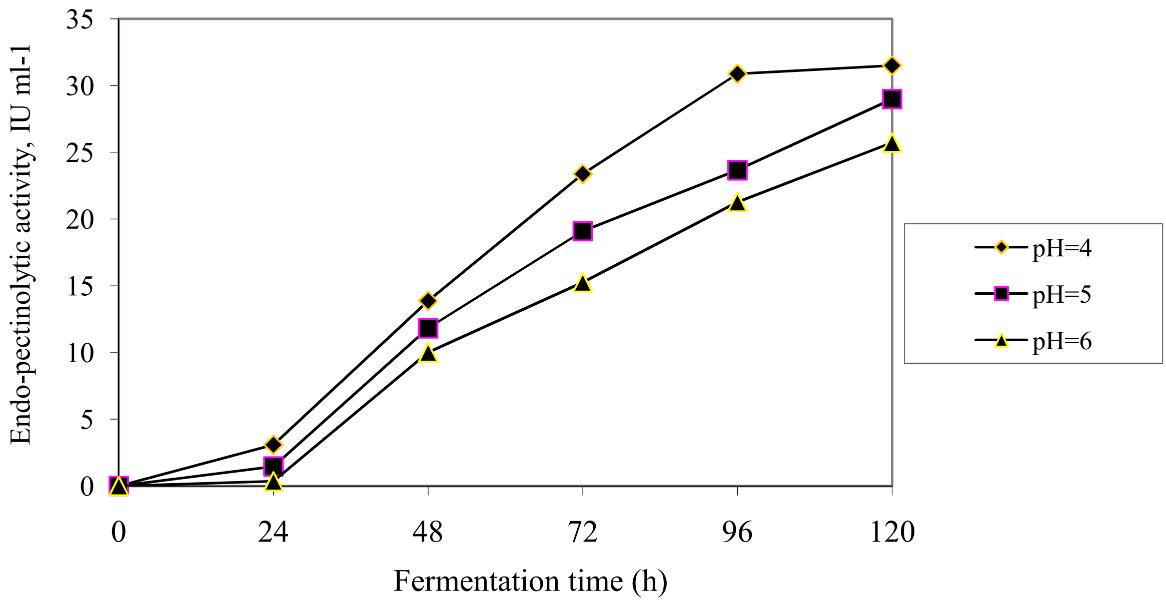


Figure 2. The influence of different pH on bases on biosinthesis of endo-pectinolytic enzymes by Aspergillus niger MK-15

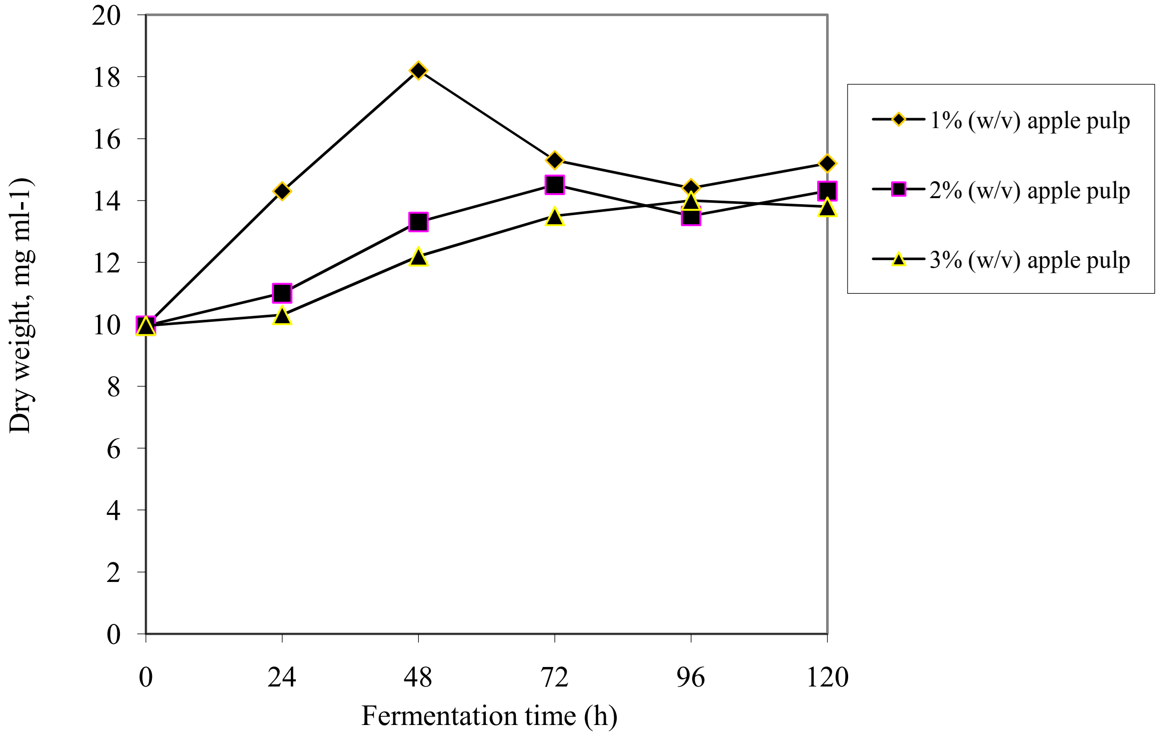


Figure 3. The influence of different concentration apple pulp on growth by Aspergillus niger MK-15

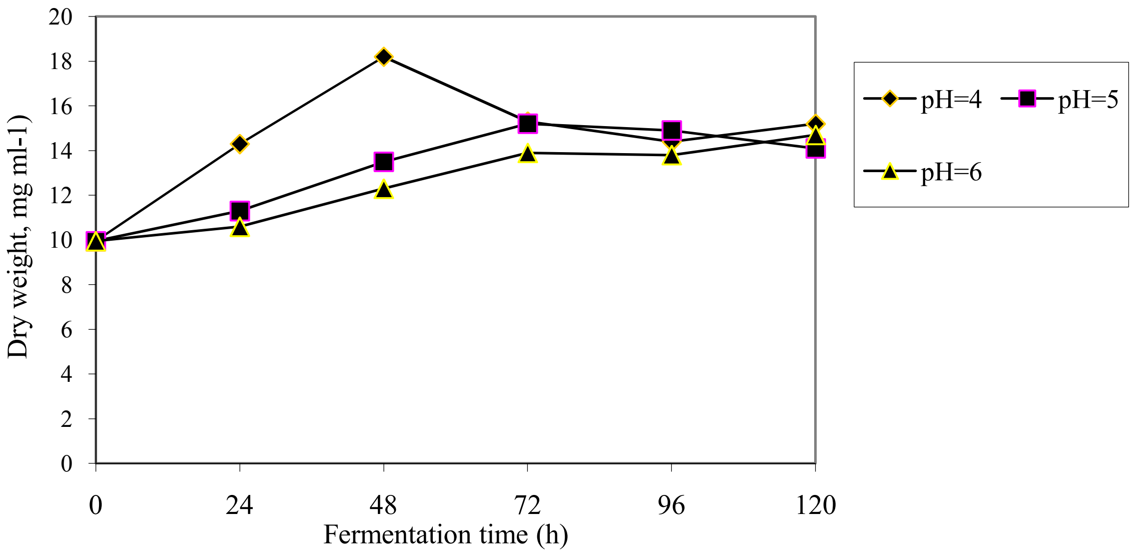


Figure 4. The influence of different initial pH on bases on growth by Aspergillus niger MK-15

CONCLUSION

Microbial enzymes are routinely used in many environmentally friendly and economic industrial sectors. Pectinolytic enzymes play an important role in food processing industries and alcoholic beverage industries. The production of food enzymes related to the degradation of different substrates. These enzymes degrade pectin and reduce the viscosity of the solution so that it can be handled easily. As this residue is renewable and in an abundant supply, it represent a potential low cost material for microbial enzyme production. The significance of this agro-industrial residue as material for pectinolytic enzyme production is highlighted in this article. The results presented here will be of commercial importance for using pressed apple pulp as a carbon source for production of pectinolytic enzymes in submerged fermentation.

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THE EFFECT OF PECTOLYTIC ENZYME TREATMENTS ON RED GRAPE MASHES OF *VRANEC* ON THE MICROBIOLOGICAL QUALITY OF WINES

Mojsov, K.
University "Goce Delcev"Stip, R. Macedonia
Technological-technical Faculty, Probistip
E-mail: kiro.mojsov@ugd.edu.mk

Abstract: The paper investigates effects of pectolytic enzyme treatments on red grape mashes on the microbiological quality of wines and wine stability with counting of the presence yeast cells (Saccharomyces cerevisiae), after incubation on Sabourald-maltose agar. Also wine samples were investigates of the presence moulds and other bacteria, as and dangerous bacteria Salmonella and Shigella, Staphylococus aureus, Proteus spp., Sulphite-reducing clostridy and Escherichia coli.
In all wine samples the results showed that have yeasts Saccharomyces cerevisiae. Saccharomyces is not regard as spoilage organism only if it is found in the wrong place at the wrong time (e.g. in a bottle of semi-sweet wine) causing re-fermentation, meanwhile the better is to have less. Pectinolytic enzyme preparation Trenolin Rot DF showed the best results.
Key words: pectolytic enzymes, red grape *Vranec*, microbiological quality of wines, microbial spoilage in wine

INTRODUCTION

Vranec is a variety of red grape cultivated in Republic of Macedonia. It is capable of producing high quality red table wines in this country. Although the composition of the grape depends on its variety, the soil and the climatic conditions, there is little variation in the actual cell structure of the plant.
Enzymes play a definite role in the ancient and complex process of winemaking. From the pre-fermentation stage, through fermentation, post-fermentation and aging, enzymes are the major driving forces catalysing various biotransformation reactions [9]. Pectolytic enzyme preparations have been used for over 60 years in fruit juice production. These enzymes play a mayor role in fruit juice technologies. Protopectinases, polygalacturonases, lyases and pectin esterases are among the extensively studied pectinolytic enzymes. Protopectinases catalyze the solubilization of protopectin. Polygalacturonases hydrolyze the polygalacturonic acid chain by addition of water and are the most abundant among all the pectinolytic enzymes. Lyases catalyze the trans-eliminative cleavage of the galacturonic acid polymer. Pectinesterases liberate pectins and methanol by de-esterifying the methyl ester linkages of the pectin backbone. The largest industrial application of pectinases is in fruit juice extraction and clarification. Pectinolytic enzymes added to macerated fruits before the addition of wine yeast in the process of producing red wine resulted in improved visual characteristics (colour and turbidity) as compared to the untreated wines. Enzymatically treated red wines presented chromatic characteristics, which are considered better than the control wines. These wines also showed greater stability as compared to the control [7].
The winemaking process is a complex ecological niche where the biochemistry and interaction of yeasts, bacteria, fungi and the viruses play a pivotal role in the final product. These microorganisms involved are at the core of the winemaking process, whether for good or ill [5]. The main microorganisms associated with wine spoilage are yeasts, acetic acid bacteria and lactic acid bacteria. Winemaking processes include multiple stages at which microbial spoilage is likely to occur. One must attemt to reduce the numbers of microbes in the juice and on the equipment. This is achieved through processing the pulp by applying food hygiene practices and following the hazard analysis critical control point (HACCP) system. The second stage of microbial spoilage may occur during fermentation because at this stage, the fruit juice contains both the natural flora of the fruit and fora that may be harboured by the wine cellar and its equipment. This may render the wine unacceptable, since the spoilage can include bitterness and off-flavours (mousiness, ester taint, phenolic, vinegary, buttery, etc.), as well as cosmetic problems such as turbidity, viscosity, sediment and film formation. The major spoilage organisms of the yeast genera include *Brettanomyces, Candida, Hanseniaspora, Pichia* and *Zygosaccharomyces*. The genera of lactic acid bacteria include *Lactobacillus, Leuconostoc* and *Pediococcus*, while the acetic acid bacteria genera are *Acetobacter* and *Gluconobacter* [6].

The spoilage caused by yeasts is important because they cause refermentation, ester formation, hydrogen sulphide and volatile sulphur compounds, volatile acidity, the formation of volatile phenols, mousiness, film formation, deacidification and the formation of ethyl carbamate. *Saccharomyces* is regarded as spoilage organism only if it is found in the wrong place at the wrong time (e.g. in a bottle of semi-sweet wine) causing re-fermentation. Schizosaccharomyces pombe has been associated with wine spoilage when growing in bottled wine and forming a sediment at the bottom of the bottle [3].
The spoilage caused in wine by lactic acid bacteria is associated particularly with acetification of the wine through the production of acetic acid, mousy taints, bitterness, ropiness, buttery flavour and increased viscosity of the wine [8], [10].
The main spoilage caused by acetic acid bacteria is associated with oxidation of the ethanol to acetaldehyde and eventually acetic acid. Gram-negative acetic acid bacteria require oxygen for growth. They carry out incomplete oxidation of alcohols, leading to the accumulation of organic acids as end products [1], [2].
Yeasts play a central role in the spoilage of beverages. A few species are capable of spoiling beverages. These can survive and grow under stress conditionswhere other microorganisms are not competitive. This investigates uses the wine industry as a case study where serious microbiological problems are caused by yeasts. The effect of pectolytic enzyme treatments on red grape mashes are discussed on the microbiological quality of wines, the susceptibility of wine to spoilage yeasts and wine stability based on scientific knowledge and industrial practices for monitoring yeast contamination i.e. for monitoring the presence of yeast.

MATERIAL AND METHODS

Commercial pectolytic enzyme preparations

- Vinozym Vintage FCE, Novozymes A/S, Bagsvaerd, Denmark; 2, 3, 4, and 5 g/100 kg grapes
- Rohapect VR-C, AB Enzymes GmbH, Darmstadt, Germany; 2, 3, 4, and 5 g/100 kg grapes
- Trenolin Rot DF, Erbslöh Geisenheim AG, Geisenheim, Germany); 10, 15, 20, and 25 ml/100 kg grapes

These enzyme preparations are derived from cultures of Aspergillus niger which is a species accepted as G.R.A.S. (Generally Recognized As Safe) [4].

Grape samples for laboratory trials

The grape cultivar Vranec (*Vitis vinifera*), cultivated in the Ovce pole vineyard, the Povardarie region, was harvested at optimal maturity (2009 vintage), at 200-220 g l^{-1} sugar, 6.5-7.5 g l^{-1} total acids, and pH from 3.1 to 3.3, and transported to the private winery “Imako Vino” Stip, Republic of Macedonia.

Wine samples. Microvinification

Wines were prepared in the laboratory of winery “Imako Vino” Stip.Grapes was weighed, crushed/destemmed and divided in 5 liters plastic fermentation tanks. Red grape mashes were macerated for 6 hours (18-20 °C), with addition on one commercial pectolytic enzyme preparation. After addition of SO_2 (50 ppm) and yeast (*Saccharomyces cerevisiae*) NEUTRE SC (Lallemand)(200 mg kg^{-1} grape), was applied maceration time of 5 days (~25 °C). After the maceration, the pomace was removed. All wines were plunged twice daily to completion of fermentation. Control trial was in all same with experimental trials only no added pectolytic enzyme preparation. All treatments were performed in duplicate.
The bottled wines (0.5 l) were stored at 4–6°C.

Determination of the total yeast cells

The effect of pectolytic enzyme treatments on red grape mashes on the microbiological quality of wines and wine stability were investigated with counting of the presence yeast cells (*Saccharomyces cerevisiae*), after incubation on Sabourald-maltose agar.
1 ml wine sample was added to Sabourald-maltose agar base for yeasts and moulds in petri dish. After keeping the samples at room temperature (thermostat) for 3-5 days were counted the presence yeast cells (cells/ml wine).
Sabouraud-maltose agar: peptone (1.0%), maltose (4.0%), agar (2.0%).

Determination of bacteria

Salmonella and Shigella, Staphylococus aureus, Proteus spp., Sulphite-reducing clostridy and Escherichia coli.

***Salmonella and Shigella*in 25 ml.** 25 ml wine sample was added in Erlenmeyer with 225 ml Selenite broth. After keeping the samples at 37 °C (thermostat) for 24 hours with eza were transplanted at SS base for *Salmonella and Shigella* and placed 24-48 hours at 37 °C.

Selenite broth: peptone (o.5%), lactose (0.4%), Na-selenite (0.4%), Na-phosphate (1.0%).

***Staphylococus aureus*in 0.1 ml.** 1 ml wine sample + 9 ml physiological solution=10 ml wine solution

1 ml from wine solution are put at BAIRD PARKER base for *Staphylococus aureus,* and are keep in thermostat 24 hours at 37 °C.

BAIRD PARKER AGAR: tryptone (1.0%), meat extract (0.5%), LiCl (0.5%), yeast extract (0.1%), agar (2.0%).

***Proteus spp.* in 0.1 ml.** 1 ml from wine solution are put at SS base for *Proteus spp.,* and are keep in thermostat 24-48 hours at 37 °C.

SS agar: peptone (5.0 g), meat extract (5.0 g), lactose (10.0 g), egg salts (8.5 g), natrium citrate (8.5 g), natrium thiosulphate (3.5 g), ferric citrate (1.0 g), agar (13.0 g), neutral red (0.023 g), brilliant green (0.00033 g).

***Sulphite-reducing clostridy*in 0.1 ml.** 1 ml from wine solution are put at sulphite agar base for *Sulphite-reducing clostridy,* and are keep in thermostat 24-48 hours at 37 °C.

Sulphite-reducing bacteria usually produce black colonies as a result of the reduction of sulphite to sulphide, which reacts with the iron(III)salt.

Sulphite agar: tryptone (15.0 g), yeast extract (10.0 g), distilled water (750 ml), water (aqua fontis) (250 ml).

***Escherichia coli*in 10 ml**. 10 ml from wine solution are put at liquid MAC CONKEY base (5 ml) for *Escherichia coli,* and are keep in thermostat 24-48 hours at 44 °C. After this, with eza are transplants at pink red egg yolk agar, and are keep in thermostat 34-48 hours at 44 °C. *Escherichia coli* grow as red or pink colonies.

MAC CONKEY AGAR: peptone (20.0 g), synthetic detergent (5.0 g), sodium chloride (5.0 g), lactose (10.0 g), neutral red (0.07 g), agar (12.0 g).

RESULTS AND DISCUSSION

Yeasts and bacteria are part of the natural microbial ecosystem of wine and play an important role in winemakingby reducing wine acidity and contributing to aroma and flavour. They can cause numerous unwelcome wine spoilage problems, which reduce wine quality and value.

Enzymes play an important role in winemaking. The application of industrial enzyme preparations in the wine industry is a common practice.They have been used to increase juice yield, filtration rate, rate of settling, and clarity of wines besides some microbiological implications.

The effect of pectolytic enzyme treatments on red grape mashes on the microbiological quality of wines and wine stability were investigated with counting of the presence yeast cells (*Saccharomyces cerevisiae*), after incubation on Sabourald-maltose agar, as shown in Table 1.

In all wine samples the results showed that have yeasts *Saccharomyces cerevisiae* from 400 to 2000 cells/ml. *Saccharomyces* is not regard as spoilage organismonly if it is found in the wrong place at the wrong time (e.g. in a bottle of semi-sweet wine) causing re-fermentation, meanwhile the better is to have less. Pectinolytic enzyme preparation Vinozym Vintage FCE showed yeasts *Saccharomyces cerevisiae* from 487 to 953 cells/ml wine, Rohapect VR-C from 1900 to 1953 cells/ml, and Trenolin Rot DF from 240 to 567 cells/ml depend of used doses and contol trial “no-enzyme addition” (433 cells/ml). Pectinolytic enzyme preparation Trenolin Rot DF showed the best results.

In all wine samples the results showed that have not the growth of unwanted bacteria as *Salmonella and Shigella, Staphylococus aureus, Proteus spp., Sulphite-reducing clostridy and Escherichia coli.*

Table 1. The effect of pectolytic enzyme treatments on red grape mashes of *Vranec* on the microbiological quality of wines

Enzyme preparations	Dose (g or ml/100kg grape)	[a]Yeasts, *Saccharomyces cerevisiae* (cells/ml)	[a]Bacteria, *Salmonella and Shigella; Staphylococus aureus; Escherichia coli; Sulphite-reducing clostridy;Moulds and other bacteria,* (cells/ml)
Vinozym Vintage FCE	2 g	953 ± 41	0
	3 g	933 ± 47	0
	4 g	533 ± 47	0
	5 g	487 ± 19	0
Rohapect VR-C	2 g	1907 ± 82	0
	3 g	1913 ± 66	0
	4 g	1900 ± 82	0
	5 g	1953 ± 52	0
Trenolin Rot DF	10 ml	240± 33	0
	15 ml	417 ± 23	0
	20 ml	513 ± 34	0
	25 ml	567 ± 34	0
Control-no added enzyme	0	433 ± 47	0

Note: [a]The values are average from 3 replicates ±SD

The largest industrial application of pectinases is in fruit juice extraction and clarification. Pectinolytic enzymes added to macerated fruits before the addition of wine yeast in the process of producing red wine resulted in improved visual characteristics (colour and turbidity) as compared to the untreated wines. These wines also showed greater stability as compared to the control (Revilla and Gonzalez-san jose, 2003). The concepts of the susceptibility of wine to spoilage yeasts and wine stability are based on scientific knowledge and industrial practices for monitoring yeast contamination. A discussion on acceptable levels of yeasts and microbiological criteria in the wine industry is supported by data obtained from wineries, wholesalers, and the scientific literature.

CONCLUSION

Significance and impact of the study is that pectolytic enzyme treatments on red grape mashes had a pronounced effect on the microbiological quality of wines and wine stability. Results from comparison of effects of pectolytic enzyme preparations in winemaking on the microbiological quality of wines can contribute to a better orientation in the choice of suitable enzyme preparations in wine industry.

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THE ANALYSIS OF THE SIMILARITIES AND DIFFERENCES IN THE PROCESS OF THE HARDENING OF THE CARBON STEELS AND AlMgSi ALLOYS

Stojadinović, S. , Pekez, J.
[1]University of Novi Sad
Technical Faculty "Mihajlo Pupin", Zrenjanin
E-mail: jpekez@yahoo.com

Abstaract: In the paper are given the results of the analysis of the similarities and differences in the process of the hardening of the carbon steels and AlMgSi alloys. On the basis of the analyzed it can be ascertained that: a) there is the similarity of the process at the obtaining of the supersatuated solid solutions and b) there is the principled difference in the solid solutions obtained by hardening as well as their further treatment.
Key words: hardening, improving, aging, mechanical properties.

INTRODUCTION

On the basis of the long-standing work in the field of the thermomechanical treatment of the carbon steels and AlMgSi alloys[1-6] it has been perceived that the phenomenon of hardening of the cited alloys has been equated. Meanwhile, there are not only the subtle, but as well as the substantial differences in the process of the hardening of the mentioned alloys. The objective of this paper is to analyze the similarities and differences that appear at the treatment of these alloys.

STEEL HARDENING

The hardening is a complex procedure of the heat treatment, that consists in: a) steel heating from 30^0 C to 50 ^{0}C over A_3 line, with the hypoeutectoid steels, from 30^0C to 50 ^{0}C, respectively with hypereutectoid steels (figure 1); b) through heating at the necessary temperature over $A_1$and c) fast cooling, with the aim of obtaining a supersaturated, but homogeneous, solid carbon solution in ferrit, to get the martensite structure, respectively (figure 2) [7].

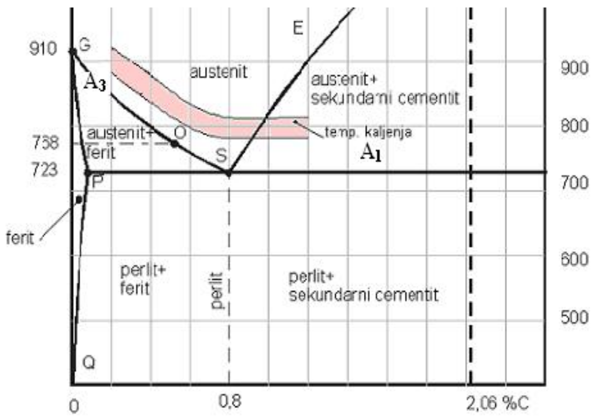

Figure1. The temperature of the hardening area of the carbon steels

The cooling process should be performed so that the austenite transformation has to start and finish in the martensite area. Martensite that is being created in such process of the hardening of the carbon steels has fine acicular structure and hardness,of the line size from 60 to 65 HRC. In all the cases after hardening, except with high alloy austenite steels, follows always low or high temperature improving (hardening with subsequent tempering). The purpose of the improving is to provide to the quench – hardened steel besides high strength as well as high tenacity(ductility), by heating under A_1 line, through heating and air cooling or oil cooling.

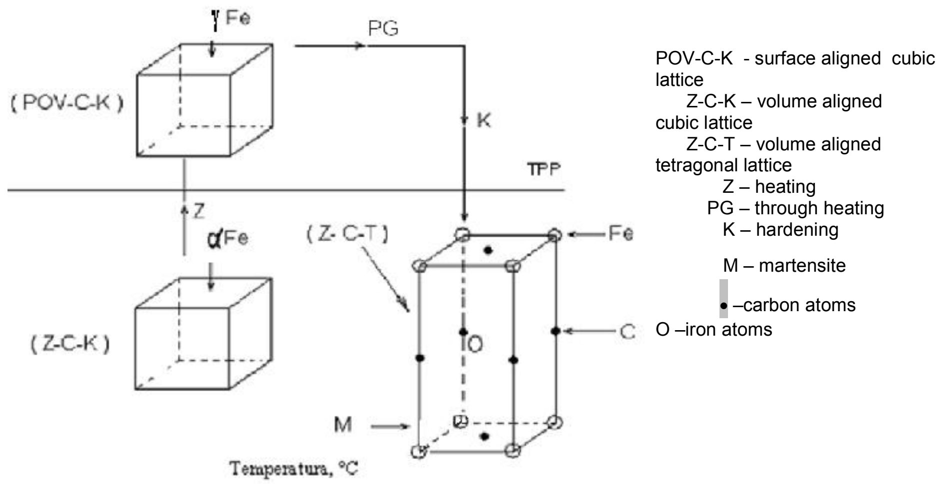

Figure2. The diagrammatic display of the structure change at hardening

HARDENING OF ALMGSI ALLOYS

Hardening of AlMgSi alloys is, also a complex procedure. It consists of: a) alloy heating at chosen temperature between the solvus and solidus lines (figure 3, point c); b) solution annealing (treating) at that temperature, and c) fast cooling till the room temperature, with the objective to obtain, also, homogenous but supersaturated and solid solution of aluminum by silicon and magnesium atoms, i.e.to obtain a supersaturated but solid solution (figure 3) [7].

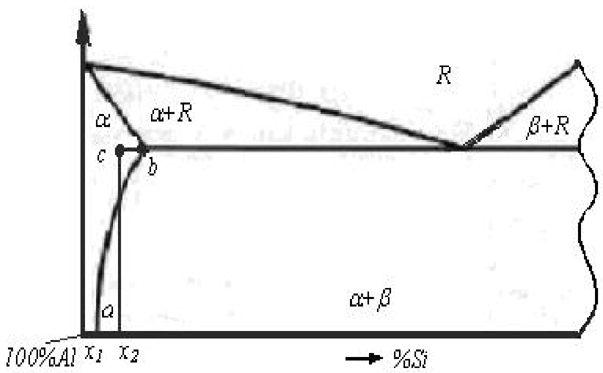

Figure 3. The diagram of phases Al-Si
(x_1 and x_2 – balanced and unbalanced solubility of silicon in aluminium)

The alloy in the form of the supersaturated solid solution is in high power state. Since the alloy in this state is unstable, it spontaneously gravítate to pass (turn) into lower power state, through decomposition of the solid solution to the metastable or equilibrium state. The driving force for the separation of the metastable (coherent, or half – coherent particles), or equilibrium (incoherent particles) is the phase of the energy reducing of the given system, and it is called: aging.
Aging is the fundamental stadium in the process of strengthening these alloys, i.e. in the process of increasing their characteristics of strength, together with keeping the high values of plasticity. During the aging which can be natural (at the room temperature) and artificial (at higher temperatures, under the solvus line, figure 3, ab line), appears precipitation, i.e. the segregation of the precipitates particles. Depending on the nature of the interface between the created particles and the basis, the particles are divided on: coherent, half – coherent and incoherent (figure 4 a, b and c) [7].

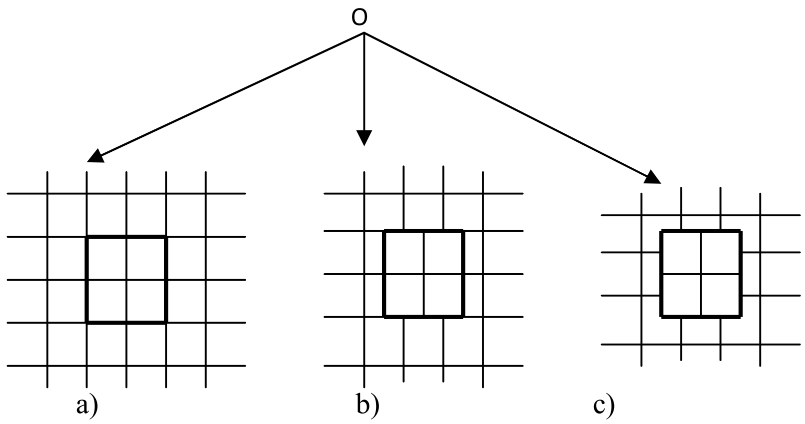

Figure 4. Diagrammatic display of the change of the interface between the particle and basis in the aging process(o – basis; a) coherent, b) half – coherent and c) incoherent particle of the secondary phase)

The greatest effects of strengthening, as a rule, set up the coherent and partially, i.e. half – coherent particles, since: a) through separating they elastically deform the basis lattice and b) by their number and physical presence act as obstacles for the motion of the dislocations. The strengthening effects are inasmuchas more expressed, if the alloy composition is closer to the maximal dissolving power (solubility) of Si (to the point b in figure 3) and insofar as the cooling (hardening) in the area α of the solid solution is being performed faster. If during the artificial aging are exceeded the optimal conditions (time, temperature), the mechanical properties decline, and the alloy is overaged.

ANALYSIS AND DISCUSSION

In the process of steel hardening appears polymorphic transformation, that is double α/γ transformation (figure 2). In the process of the hardening of AlMgSi alloys happens only the phase transformation (figure 3).
In both cases has been obtained a homogenous, but supersaturated solid solution. In the meantime, at the steel hardening the obtained martensite is very hard and brittle, so that the semifinished article is being only after the subsequent tempering (drawing) brought into useable exploitation state [1-4].
During the hardening of AlMgSi alloys, the obtained supersaturated α solution is plastic („soft“), so it is being used for the plastic deformation of the semi – finished articles into desired shape (e.g., extruding ingots into the adequate semi – finished articles – profiles). Only after the plastic deformation of the "soft" supernaturated solid solution of the given alloy, by aging (most often through the artificial one) happens the strengthening of semi – finished articles through precipitates [5; 6].

CONCLUSION

On the basis of the set objective, processed data, performed analysis and discussion, it can beconcluded:

1. The similarity between the hardening of steel and AlMgSi alloys is in heating to the single phase area, through heating and very fast cooling after the through heating temperature. As well as that similarity is also in the fact that the obtained supersaturated solid solution is being processed through the heat treatment.
2. The difference between the hardening of steel and AlMgSi alloys is in the next: a) during steel heating for hardening is being performed polymorphic transformation, but with AlMgSi only the phase change; b) the obtained martensite with steel is very hard and brittle, and the obtained α solid solution with AlMgSi alloys is "soft", i.e. can be processed by plastic deformation; c) by additional tempering (hardening with subsequent tempering) of martensite has been obtained a

serviceable semi – finished article, i.e. the semi – finished article of less hardness, but better toughness; d) by later heating most often plastically deformed supersaturated solid solution of AlMgSi alloys appears the strengthening of the obtained sefi – finished articles, i.e. increasing of the characteristic of hardness, with keeping good longitudinal extension.

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CONSTRUCTION MATERIALS WITH FLY ASH MANUFACTURING AND THE PROCESS ENVIRONMENTAL EFFECT

Terzić, A. [1], Pavlović, Lj. [2], Radojević, Z. [1], Miličić Lj. [1],
[1]Institut For Materials Testing, Vojvode Mišića Bl. 43, Belgrade, Serbia
[2]Institute For Technology of Nuclear and Other Raw Mineral Materials, Franchet d'Esperay st.76, Belgrade, Serbia
E-mail: anja.terzić@gmail.com,

Abstract: Fly ash, as one of main residues in coal combustion in thermal-plants, represents high threat and can be hazardous for environment. High production of the fly ash, also, opens question of problematic storage of such waste material. Recycling and application of fly ash in industry of construction materials is, probably, the best and the most economic solution for previously mentioned problems. Fly ash can be used as component in manufacturing of following construction materials: cement, mortar, concrete, bricks, floor and wall tiles and various other types of construction ceramics. In such materials, fly ash is used as either substitution for bonding agent (due to its pouzzolanic behavior) or as replacement for fine fractions of aggregates. Replacement coefficient in a fly ash based construction material depends on fly ash chemical composition and grain size distribution, but commonly used replacement coefficient is between 20 and 40 %. Investigation conducted in this paper is concerned with dependence of mechanical properties and quality of fly ash based construction materials in correlation with chemical composition, grain size distribution and replacement coefficient of fly ash.
Key words: fly ash, recycling, construction ceramics, mechanical properties, replacement coefficient.

INTRODUCTION

Fly ash, originating from thermal plants, represents a huge ecological and financial contemporary problem. It is not seldom that fly ash storage requires wide ground-areas formerly decreed as area for agrarian or building purpose. Fly ash depots are constantly increasing in size. Hence there is no possible solution for fly ash depots covering, environment is at constant and alerting risk of air, water and soil pollution. Storage expenses, as well as expenses of water and air refining are perpetually increasing with each passing year. West European countries achieved noticeable results in fly ash mass-application. In Serbia, amount of fly ash originating from thermal plants is measured by millions of tones. Namely, approximately 6 - 7 millions of tones per year are being produced. At the beginning of the 21st century, all Serbian plants had increased solid fly ash particles emission. Measured amount of solid fly ash particles was 10 times, or more, higher than minimal amount regulated by European Standard (50 mg/m^3). In certain thermal plants electro-filters produced gases with extremely high solid particles concentration: 1000 - 2000 mg/m^3,[1]. In year 2003, a project concerning innovation and restoration of electro-filters was introduced. Year 2004 marked the start of electro-filters working-regime adjustment according to European Standards and Regulations. The goal of the running project is to repair all electro-filters in Serbian thermal plants and to adjust their working-regime in accordance with solid particles emission level given in book of European Regulations. All listed above should be accomplished by the end of year 2011, [1]. Various recent investigations proved that fly ash is scarcely used as secondary raw material in Serbia, [1]. The exploatation of fly ash as secondary raw material is the only sustainable solution for the problem of fly ash disposal. Only building materials industry can use sufficiently large amounts of fly ash.
Since the fly ash is crushed coal combustion residue from thermal plants furnaces, quality and chemical composition of such residue depend on applied type of coal and electro-filters working regime. Temperature of fly ash emergence is usually between 1000 and 1200 ºC. Particles are spherically shaped sizing from 90 to 200 µm. Literature offers various suggestions for the fly ash classification, but most commonly used classification is that of RILEM, [2]. Fly ashes are categorized in following four groups: (1) acidic type (50 % SiO_2, 25 % Al_2O_3); (2) alumo-silicate type (40 - 50 % SiO_2, 17 - 25 % Al_2O_3); (3) basic type (40 - 50 % CaO, 2 - 5 % SiO_2, 7 - 8 % Al_2O_3) and (4) high-sulfate and high-basic types (26 % SO_3, 33 % CaO, 4 % Al_2O_3, 3 % SiO_2). First two types of fly ash show pouzzolanic (bonding) effect, while second two types have either small or absolutely no pouzzolanic characteristics.

Concerning building materials industry, different types of the fly ash can be used in following applications:
1. Fly ash with high SiO_2 content has significantly manifested pouzzolanic activity. This fly ash when combined with CaO and $Ca(OH)_2$ (originating from hydration of cement minerals - alite and belite) establishes hydraulic chemical compounds. These compounds are calcium-hydro-silicates. Thus, this type of fly ash can be used in concrete as cement replacement.
2. Basic type fly ash contains oxides which are components used cement production (SiO_2, CaO, Al_2O_3, Fe_2O_3). Thus, this type of fly ash can be used as one of the components in cement manufacturing with one limitation factor: applied fly ash can not contain high level of calcium-sulfate and alkali oxides (Na_2O and K_2O),[3].
3. Fly ash can be used as component material for various light aggregates manufactured by means of compacting, bricketting and pelletization,[4].
4. Fly ash, as light-weighted material, can be built in dams and banks (regardless of fly ash chemical composition and physic-mechanical properties of the soil) or used in road constructions, soil stabilization, protection of river and lake banks, protection of plastic-clay soil layers, tailings and non-stable sand ground.[5].
5. Building materials which can be designed and manufactured with addition of fly ash are light aerated concretes, building blocks, lime-silicate elements (gas-concrete), ceramic elements,[6,7] (bricks, tiles, pipes), glass-ceramics,[8].
6. Fly ash can be used as filler in refractory concretes, filler for asphalt mixtures (instead of lime flour), raw material for injection mixtures, metallurgical sand, etc.

MATERIALS AND METHODS

In this paper, results of investigation of chemical, mineralogical and mechanical characteristics of fly ash have been presented, evaluated and discussed. Investigated fly ashes have different origin and thusly their chemical and mineralogical compositions as well as grain-size distributions vary. Three different types of investigated fly ash are, here, labeled as FA_1, FA_2 and FA_3.
Chemical analysis of fly ash samples and crushed samples of fired composites was performed by means of XRF method (XRF spectrophotometer ED 2000 - *Oxford*). X-ray powder diffraction patterns of fly ash samples were obtained using a *Philips* PW-1050 diffractometer with λCu –Kα radiation and a step/time scan mode of 0.05 º/1s. The differential analysis (DTA) of fly ash samples was performed with a *Shimadzu* DTA – 50 apparatus. Approximately 30 mg of a sample was used for a DTA testing and α-Al_2O_3 (corundum) powder as reference sample. The heating temperature range was from 20 up to 1100ºC at heating rate of 10 ºC/min. The morphology of fly ash was characterized by scanning electron microscopy method using *JEOL* JSM-6390 Lv microscope. The original fly ash powder (without further grinding) was used as sample. The samples were covered with gold powder for better reflection to be obtained and measurements performed. SEM microphotographs were recorded at three different magnifications: 500x, 1000x and 1500x.
Bulk density and compressive strength were investigated on the fly ash samples. These characteristics were determined in accordance with classic laboratory procedure which is analog to the procedure applied in case of cement investigation. Namely, samples of cement-mortar with fly ash replacement factor 30 %, were shaped to fit dimensions 40x40x160 mm. Pouzzolanic activity was estimated by mechanical characteristics determination method. Investigated samples were prepared as plastic mortar composites containing hydrated lime ($Ca(OH)_2$), fly ash, standard sand and water in mass ratio 1 : 2 : 9 : 1.8. Sample dimensions for flexural and compressive strength testing were 40x40x160 mm. Thermal properties were investigated with thermo-microscope E.LEITZ WETZLAR with Pt-Rh thermo-elements and maximal heating temperature T = 1600ºC. Pressed fly ash samples (cubically shaped, dimensions 5x5x5 mm) were submitted to thermal treatment within temperature range from 20 to 1400 ºC. By means of gradated ocular of thermo-microscope the sample shape-change was followed and transformation from cubical into spherical shape was noted.
Investigation of the preparation-mass for construction ceramic (ceramic composites in further text) was conducted in accordance with standard laboratory procedure. Water absorption, porosity, impact resistance and flexural strength were determined. Sintering level of composites was evaluated by means of thermo-microscope investigation.

RESULTS AND DISCUSSION

Chemical and mineralogical characteristics of fly ash

Chemical analysis of fly ash was performed by means of XRF and results are given in table1.

Table 1. Chemical analysis of fly ash samples FA_1, FA_2 and FA_3

Oxide	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	P_2O_3	SO_3	Na_2O	K_2O	MnO	CO_2	LI
FA_1	57.46	17.75	10.48	0.52	6.97	1.97	0.02	1.06	0.36	0.59	0.03	0.09	2.94
FA_2	53.49	21.28	6.20	0.56	7.61	2.75	0.03	0.77	0.44	1.21	0.03	0.25	4.92
FA_3	58.22	18.18	6.85	0.57	8.71	2.30	0.02	1.29	0.50	1.16	0.03	0.11	1.84

Conclusion based on chemical analysis, given in tab. 1., is that content of oxides SiO_2, Al_2O_3, Fe_2O_3 and CaO has highest share in composition of all three fly ash composites, while other oxides are present in traces. Loss of ignition is not high, which highlights the fact that organic matters are not present in investigated fly ash samples. FA_2 sample has the highest loss of ignition (4.92 %). SiO_2 content was higher than 50 %, while content of Al_2O_3 was in range 17 - 25 % in all investigated samples. Thus, all three fly ash samples FA_1, FA_2 and FA_3 can be classified as alumo-slicate ashes. Therefore, all investigated fly ash samples show pouzzolanic behavior. CaO content and content of sulfates are relatively low.

Results of mineralogical analyses are given in figure 1.

As result of clay components containing coal particles phase transformation on elevated temperatures, amorphous and crystalline phases were formed. These phases have different chemical compositions which, as well as phase ratio, influence fly ash final characteristics. XRD diffractograms highlight high amount of amorphous matter within all investigated samples. Identified crystalline phases were: quartz, hematite and small amount of mullite and anhydrite. The only defined peaks on diffractogams relate to quartz. Sample FA_1 shows the lowest level of crystallinity while the sample FA_3 has the most noticeable quartz peak on diagram.
Processes which were taking place during fly ash thermal treatment were identified by means of DTA method (figure 2.). All DTA curves have a small peak at approximately 200 ºC which corresponds to the volatilization of the water mechanically bonded in form of H_2O molecule. Peak showing at approximately 500 ºC is exothermic and characteristic for fly ash. Exact peak values are as follows: (FA_1) 533.85 ºC; (FA_2) 522.45 ºC and (FA_3) 522.54 ºC. Exothermic hump corresponds to the transformation of organic matter present in fly ash samples. Second endothermic peak is distinctly visible and located at approximately 900 ºC: (FA_1) 936 ºC, (FA_2) 928.53 ºC and (FA_3) 919.17 ºC). This peak is induced by presence of alumo-silicates.

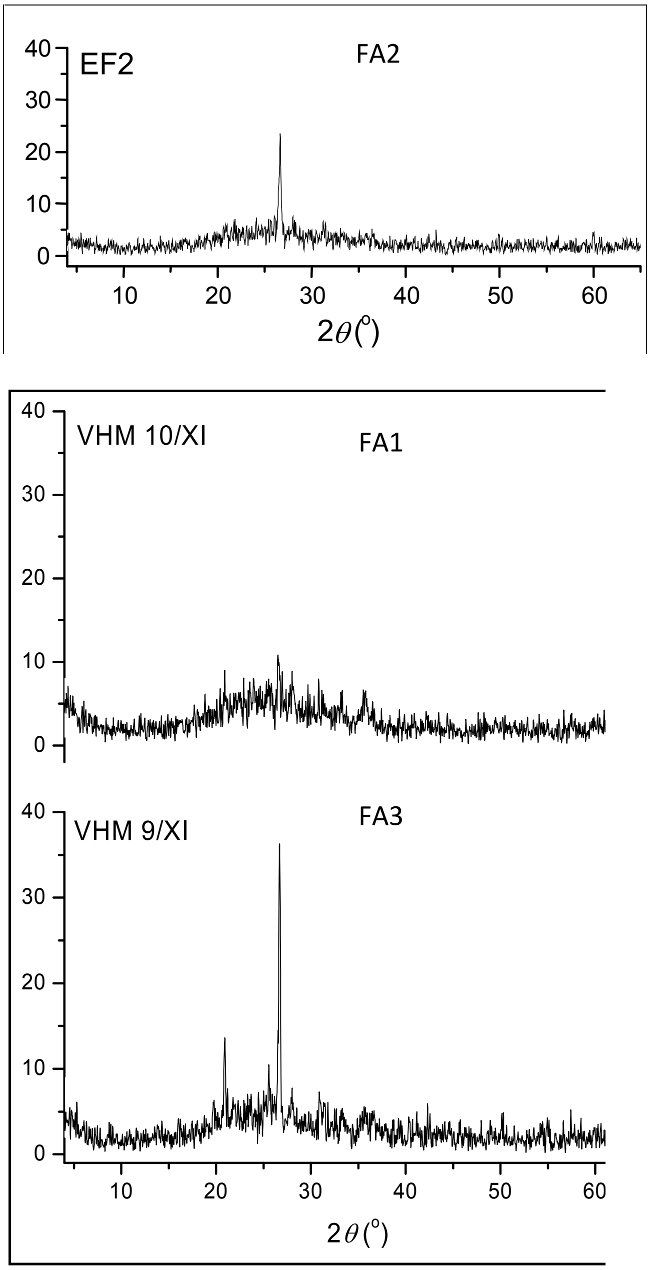


Figure 1. XRD diffractograms of FA_2, FA_1 and FA_3 sample

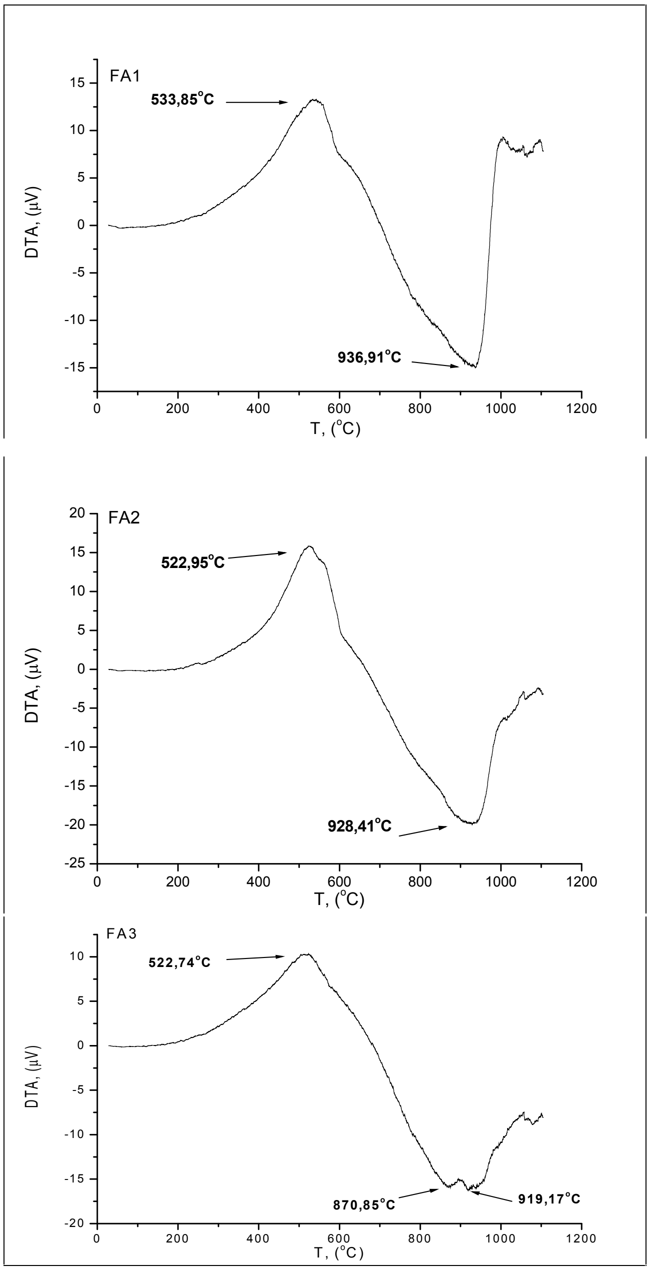


Figure 2. DTA diagrams of FA_1, FA_2 and FA_3 sample

Mechanical and thermal characteristics of fly ash

Investigated mechanical properties of fly ash samples are given in table 2.

Table 2. Results of investigation of mechanical properties of fly ash samples

Mechanical properties	FA_1		FA_2		FA_3	
Bulk density (g/cm^3)	2.18		2.20		2.17	
Compressive strength (MPa)	4.50		4.60		7.70	
Flexural strength (MPa)	1.50		1.50		2.20	
Puzzolanic activity (MPa)	com.str.	flex.str	com.str.	flex.str	com.str.	flex.str
	4.50 12.50	1.50 4.20	4.60 16.20	1.50 4.30	7.70 15.30	2.20 4.90

Values of bulk density are approximately same for all investigated fly ash samples. FA_3 sample has the highest vales of compressive and flexural strength. The highest puzzolanic activity is obtained for FA_3 sample. Grinding of a sample would induce rise in both flexural and compressive strength, but also in pouzzolanic activity. This phenomenon can be explained by increasing of specific area of fly ash due to grinding.
Results of thermo-analysis are presented in table 3.

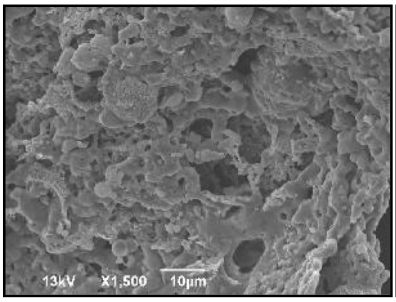
Table 3. Results of thermo analysis of fly ash samples

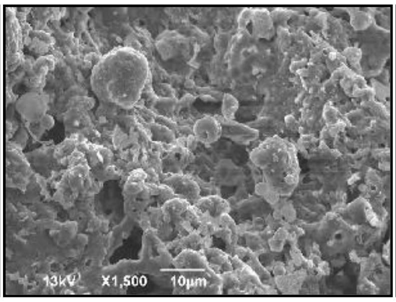
Thermo property	FA_1	FA_2	FA_3
Initiation of sintering (ºC)	1190	1170	1165
Melting point (ºC)	1280	1260	1255
Spherical shape formation (ºC)	1350	1320	1310
Liquefying point (ºC)	1362	1330	1315
Sintering interval (ºC)	80	70	70

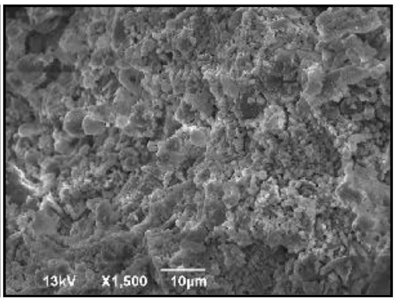
Obtained results of thermo properties investigation are similar for all three fly ash samples. However, sample FA_1 showed slightly better thermal behavior.

Microstructural analysis of fly ash

Figures 3., 4. and 5. show SEM microphotographs of FA_1, FA_2 and FA_3 fly ash samples, respectively. It can be seen that each fly ash sample is a composition of grains of different sizes, shapes and colors. Such diverse composition of fly ash is in relation with varieties in its chemical and mineralogical composition. Most of the grains in the mixture are spherical or rounded, although irregularly shaped grains are also present, as well as the grains composed of various layers or grains which include numerous pores and voids. Grain porosity is evidently present. Pores are small and rounded and they are becoming visible only with 1500 x optical zoom. The presence of pores on grains was expected due to high water absorption of fly ash. Grains are intersected with pore channels which increase water absorption. Specific needle-shaped mullite crystals can be seen on SEM microphotographs. Mullite originates from clays which are usually associated with coals.







Figures 3, 4. and 5. SEM microphotographs of fly ash FA_1, FA_2 and FA_3

Fly-ash based ceramics

Possibilities of the fly ash application were investigated on experimental ceramic mass whose chemical composition was analog to the ceramic mass traditionally used in industry of building materials. Experimental samples of the ceramic composites were prepared with addition of fly ash FA_3 which showed the best physic-mechanical properties and the lowest loss of ignition. Results of the investigation showed that fly ash based ceramic composites with good performances can obtained. Such ceramic composites can be used as a base mass for tiles, bricks or pipes. The only problem which occurred during the investigation was heterogeneity of fly ash composition and high content of Fe_2O_3 which caused dark-red color of the final ceramic product. Chemical composition of the composite was further corrected by addition of clay and/or quartz sand. Mineralogical analysis of clay showed two main minerals: kaolinite and illite. The analysis also showed high amount of feldspar and quartz. Chemical composition of clay is given in table 4.

Table 4. Chemical composition of clay used in ceramic composites

Oxide	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	LI
%	49.27	29.31	3.20	0.28	0.58	1.43	0.20	1.85	14.11

Three experimental ceramic composites were prepared: CC_1 (containing 100 % of fly ash), CC_2 (containing 80 % of fly ash and 20 % of clay) and CC_3 (containing 70 % of fly ash, 20 % of clay and 10 % quartz sand). Preparation of each mixture was conducted in ball-mill with “wet” working regime. Grinding lasted for 4-6 hours until residue on sieve was 2-3 % according to DIN 100. Afterwards, super plus of water/moist was removed and precipitation of the samples was tested according to actual standards. Composite samples were cylindrically shaped (radius 12 mm, length 250 mm). Samples were dried in climate-chamber at 105 ºC before firing in the laboratory furnace, in oxide atmosphere, at 1150ºC with 1.5 h delay at maximum temperature. Chemical analysis and physic-mechanical tests (sintering level - *S*, water absorption - W_a, porosity – *P,* impact resistance - f_i, flexural strength – f_f) were performed on the fired samples (table 5. and table 6., respectively).

Table 5. Chemical composition of fired ceramic composites

Oxides (%)	SiO_2	Al_2O_3	Fe_2O_3	TiO_2	CaO	MgO	Na_2O	K_2O	LI
CC_1	62.36	19.84	4.72	0.80	6.72	2.40	0.37	1.37	0.06
CC_2	52.93	24.22	5.21	0.55	12.60	1.40	0.37	1.37	0.17
CC_3	56.97	24.87	6.10	0.65	8.40	2.00	0.37	1.37	0.32

Regarding chemical composition, ceramic composites belong to alumo-silicates ceramics group. Fe_2O_3 content in the ceramic composites was above expected level: 4.72 – 6.10 %. Thus, color of the fired brick was dark-red.

Table 6. Physic-mechanical propreties of ceramic composites

Property	W_a (%)	P (%)	S (%)	f_f(MPa)	f_i(MPa)
CC_1	2.85	0.07	83	20	10.5
CC_2	2.81	0.06	84	22	11.2
CC_3	2.71	0.05	85	24	12.4

Sample CC_1 showed highest water absorption due to the increased porosity of fly ash grains (as seen on fig. 3.). In a composite, addition of fly ash will require higher amount of water for achieving given level of workability. By adding clay, or both clay and quartz send level of water absorption will be reduced. At the other side, addition of fly ash reduces apparent porosity, because its grains are small and spherical and they enable better „packing" of the particles in the composite structure and leave smaller empty spaces behind. Flexural strength and impact resistance are increasing with addition of clay, as well as clay and quartz sand.

CONCLUSION

Fly ash is potentially hazardous for living environment, thus, it is necessary to recycle it. Most economic manner of fly ash recycling would be its application in industry of building and other ceramic materials. Fly ash can be applied either as substitution for bonding agent or as fine size aggregate/filler in various ceramic composites.

Here investigated fly ashes didn't have any organic matter impurities and they can be classified alumo-silicate ashes group, i.e. they have well manifested pozzolanic/bonding properties. All investigated fly ashes have satisfying grain-size distribution and good mechanical properties, with accent on significant compressive strength. Milling of fly ash would result in even better properties. SEM analysis pointed out on increased fly ash grain porosity which can cause higher water absorption during the preparation of ceramic composites.

Three ceramic composites were prepared: CC_1, CC_2 and CC_3. Conclusion was made based on ceramic composites properties investigation: namely, all three composites showed satisfying physic-mechanical characteristics. The most applicable composite was the one based on the combination of fly ash, clay and quartz sand (CC_3).

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LAMINATING POLYURETHANE ON TEXTILES

Kovačević, S.,Ujević, D. [1],Horvat-Varga,[2]S.,Brlobašić Šajatović, B.[1]
University of Zagreb, Faculty of Textile Technology,
[1]Department of Textile Design and Management,
[2]Čateks d.d., Zrinsko-Frankopanska 25, 40000 Čakovec, Croatia
E-mail:stana.kovacevic@ttf.hr

Abstract: New types of polyurethane coated on textiles allow versatile use of final products. Polyurethane coating in the form of paste or thermal joining with the woven fabric, knitted fabric or nonwovens allows creating multilayered materials or composites with exceptionally good properties adapted to their application. This paper describes physical mechanical properties of multilayered materials composed of a base textile component and coated polyurethane. In the laminating process the portion of the components and the conditions during coating was varied. According to the results obtained multilayered materials differ in all tested properties. Regression straight lines and correlation relationships between individual physical mechanical properties of multilayered materials are shown. It can be claimed that several properties of the produced multilayered materials are mutually dependent with a relatively high correlation.
Keywords: multilayered materials, polyurethane coating, substrate lamination, textiles, material properties

INTRODUCTION

The impact of industry globalization, supplier and consumer requirements as well as new technologies changes the market and increases the use of polyurethane-coated textiles. The key factor of polyurethane efficiency is its versatility and high durability. Abrasion resistance and strength are mostly higher in relation to other polymers. Polyurethane has good adherence property which can be enhanced by addition of cross-linking agents. Fragility caused by the action of light can be reduced [1, 2].

Polyurethane chemical composition is constantly developed, new types of polyurethane additives emerge.

Polyurethane polymer is mostly used for coating because it allows a versatile application. Depending on the usage, nonwoven, woven or knitted fabric can be used for coating. Nowadays companies adapt to new challenges, they endeavor to expand the domestic and world market; thus, it is understandable that great efforts are made to develop new products and to improve their properties. Garments designed for specific applications, such as protective clothing against rain and wind, medical blankets, filters, corsets are mostly made of artificial polymeric materials.

POLYURETHANE (PU) ARTIFICIAL LEATHER

Polyurethane artificial leather is a polymer material consisting of substrate and PU coating; they differ in their raw material. The substrate is mostly a textile product providing strength, stability, comfort and other properties desirable for a specific purpose. The advantage of these multicomponent products belonging to composite materials is that a target product is relatively easy to obtain for the specific purpose, and it has different characteristics of the internal and external component. Such different properties of the same material cannot be achieved on a classic single layer textile or leather product. This is the reason why PU artificial leather is continuously developed and used for different purposes.

Substrate for coating polyurethane polymer

The substrate can be a woven, knitted or nonwoven material; in its selection the most important role play raw material composition, strength, dimensional stability, elongation and other construction parameters. The substrate type for coating depends first of all on its purpose. It is important that the characteristics of the substrate comply with the requirements of the final product. The parameters essential for the substrate characteristics are:

- Physical-mechanical properties such as breaking force, elongation at break, surface area, fabric construction, density etc.

- Yarn type is mostly synthetical, filament or texturized where the texturized yarn exhibits good adhesion because of short protruding fibers and excellently bond with the coat, but in case of making thin polymer materials tiny fibers or broken filaments can penetrate the surface and cause water permeability of the material.
- Dimensional stability.
- Adhesion, absorption - the substrate should have good binding properties so that the coat can penetrate the substrate sufficiently, and binding characteristics can be enhanced by adding a binding agent into the substrate pretreatment or into the PU coat.
- Pretreatment - agents such as softeners and dyes can negatively affect the subsequent processing stage such as water repellent finish and antibacterial finishing treatment can increase the properties of the finished product.
- Thermal stability - PU coat requires high temperature for creating a film; consequently, the substrate should withstand high temperatures.
- Substrate uniformity - uniform substrate thickness is a particularly important property for the purposes of subsequent treatments.

Polyurethane

Polyurethane (PU) is a polymer formed through reactions of the polyaddition of isocynate and alcohol. Its characteristic is a urethane group (-NH-CO-O-). Depending on the manufacturing process, polyurethanes can be tough, rigid, soft and elastic. Its main characteristic is its versatile use. It can be coated to textile, leather, in solution, dispersion, with a low solvent content or without it, as chips or powder. By variation of polymer structures softness or hardness can be obtained. An important property of polyurethane is durability or material preservation which is especially important for environment. PU has very good friction resistance and high strength. It has a wide range of application. It con be found all around us; it is used for manufacturing mattresses, floors, varnishes, glues, insulation materials, car seats, children's toys, protective clothing etc. [5-9].

PU coating

For PU coating a type of basic polymer, type, among and portion of individual components, additives, polymerization, functional additives, coating method and UV resistance are important. The selection of a polymer is exceptionally important for the success of the finished product, and the composition of the coat is determined according to the application of the finished material.
The coat consists of a basic polymer and an additive. In selecting the basic polymer the following properties are important: thermoplasticity, mechanical polymer properties, possibility of making a film, rigidity, good adhesion, resistance to friction, conductivity, resistance to solvents and hydrolysis, resistance to UV radiation and high temperature of melting point.
There are two basic types of coating: direct and indirect.
There are different coating techniques such as blade coating technique, roller coating technique, foam coating technique, spray coating technique, transfer method, engraving technique, impregnation coating etc.
The selection of the methods depends on the product to be produced, coating characteristics and economic factors.
The indirect transfer method was used in making artificial leather. The concept of this method includes PU coating to the paper, laminating the substrate to the coat with paper, drying, cooling and finally separating the paper from the finished product.
Coating is done on the production line consisting of four heads. The machine manufacturer is RECOMO, the manufacturer of the software package is ELTECO, and the manufacturer of coat measuring device is SOTER [10, 11].
The coating line is fully automated and computer-controlled using the Movicon program.
Process parameters are entered into the computer controlling the manufacturing process. It is possible to store all the parameters during the process. The values of individual parameters during the artificial leather manufacturing process are graphically represented in diagram form, for each head separately.

Time is mostly plotted on the x-axis, and the value of parameters (coat thickness, temperature and speed) is plotted on the y-axis. Maximum working width of coating is 2.2 m.
The paper used as the carrier for coating is drawn in at the infeed of the machine. Head 1 has a roller with the blade for coating polyurethane over the paper. The blade is on the pneumatic cylinder which can be raised or lowered. Depending on the blade position, it can be used as the so-called air blade or roller blade. By bringing the blade to a certain height, coat thickness is defined. The air blade can adjust coat thickness in an interval from 5 to 7 g/m^2 of dry coat, and the roller blade can adjust from 5 to 20 g/m^2 of dry coat. When coating PU to the substrate during the artificial leather manufacturing process three coating procedures are used in succession. The first and second coating can be equal or they may differ in coat composition and quantity. It is important to maintain the same thickness of individual coats in order to ensure the satisfactory quality of the finished product. The third coat serves as a binder between the polymer coat and the substrate. To achieve a high-quality of the material, it is important to dose the solvent correctly in the binding coat. Too little solvent in the binding coat causes the binding agent to swell instead of its dissolving, which results in poor binding the material to the substrate. If there is too much solvent in the binding coat, too rapid dissolution of the binding agent is caused, resulting in too great a penetration of the PU coat into the substrate. The final result is too great material rigidity [12].

EXPERIMENTAL

Technical properties of the tested artificial leather

The artificial leather in question was made at the Company Čateks dd Čakovec, Croatia. It was designed to be used for protective clothing of adults and children: raincoats, jackets, overalls, trousers, waistcoats and windcheaters. Testing samples were made using changes in coat composition and conditions of the coating process.

Table 1. Components of coat, polymers, additives, binders and their properties

Name	Type	Form	Property
Larithane MS 132	Aromatic polyester	Colorless solution	Resistance to friction
Laripur 065/85	Polyester	Slightly yellow chips	Easy stretching
Sanitized TPL 20-2	Additive	Yellow-brown solution	Antimicrobial and antifungicidal action
Vithane S20	Modified silicone polymer	Colorless solution	Good coat uniformity
Vithane ACR		Turbid solution	Good coat uniformity
Tinuvin 765	Additive	Slightly yellow solution	Resistance to light and UV radiation
Larithane MA 80	Aromatic polyester binder	Colorless solution	It allows gluing the coat and knitted fabric, good resistance to hydrolysis
Larithane CL 1	Aromatic cross-linking agent	Solution	Good binding properties, high stability to hydrolysis and washing
DMF	Solvent		

Three different samples were made, each in two colors, a total of 6 material samples. From each sample per colors 20 samples spread over a surface area of about 100 m^2, making a total of 120 samples. Breaking force and elongation at break were tested in the length direction (in warp direction) and in the width direction (in weft direction), and the number of samples was doubled.
The tested substrate (knitted fabric) was used in the artificial leather manufacturing and the samples of artificial leather after coating. PU polymers, additives and binders are coat components with different properties (Table 1). PU polymers, additives and binders as well as their properties used in making

samples are illustrated in Table 1. Agents, pigments and the distance between rollers and paper for each sample are shown in Table 2.

Samples I an II differed only in Vithane polymer which enhances coat uniformity. The first sample had Vithane S20, the second sample had Vithane ACR. Sample III had the same components with the same portions as sample II and they differed only in the conditions of the coating process. The distance between the roller and paper on the unit for laminating the substrate on head 4 in making samples 1 and 2 amounted to 0.65 mm, while for sample III the distance was 0.5 mm, whereby a stronger imprint of the binder into the substrate was obtained, resulting in a stiffer handle of the material for sample III (Table 2).

Table 2. Applied agents, pigments and the distance between the rollers and the paper per each sample

<table>
<tr><th colspan="2" rowspan="3">Samples</th><th colspan="3">Agents</th><th colspan="2">Pigments per colors</th><th rowspan="3">h
(mm)</th></tr>
<tr><th rowspan="2">Name</th><th colspan="2">Portion (%)</th><th rowspan="2">Name</th><th rowspan="2">Portion
(%)</th></tr>
<tr><th>Blue</th><th>Yellow</th></tr>
<tr><td rowspan="2">I</td><td>Blue</td><td rowspan="2">Vithane S20
Larithane MS 132
Laripur 065/85
Sanitized TPL 20-2
Tinuvin 765
DMF</td><td rowspan="2">0.18
31.03
44.33
0.17
0.53
13.30</td><td rowspan="2">0.18
30.70
43.85
0.18
0.53
13.16</td><td>Pigments –S
S1251 (Blue)
S1052 (Black)
S1153 (Pink)
S1001 (White)</td><td>5.32
1.77
0.71
2.22
0.45</td><td rowspan="4">0.65</td></tr>
<tr><td>Yellow</td><td>Pigments –S
S1858 (Yellow)
S1152 (Red)</td><td>5.26
6.14
0.01</td></tr>
<tr><td rowspan="2">II</td><td>Blue</td><td rowspan="2">Vithane ACR
Larithane MS 132
Laripur 065/85
Sanitized TPL 20-2
Tinuvin 765
DMF</td><td rowspan="2">0.88
30.81
44.01
0.18
0.53
13.21</td><td rowspan="2">0.87
30.49
43.55
0.17
0.52
13.06</td><td>Pigments –S
S1251 (Blue)
S1052 (Black)
S1153 (Pink)
S1001 (White)</td><td>5.28
1.76
0.70
2.20
0.44</td></tr>
<tr><td>Yellow</td><td>Pigments –S
S1858 (Yellow)
S1152 (Red)</td><td>5.23
6.10
0.01</td></tr>
<tr><td rowspan="2">III</td><td>Blue</td><td rowspan="2">Vithane ACR
Larithane MS 132
Laripur 065/85
Sanitized TPL 20-2
Tinuvin 765
DMF</td><td rowspan="2">0.88
30.81
44.01
0.18
0.53
13.21</td><td rowspan="2">0.87
30.49
43.55
0.17
0.52
13.06</td><td>Pigments –S
S1251 (Blue)
S1052 (Black)
S1153 (Pink)
S1001 (White)</td><td>5.28
1.76
0.70
2.20
0.44</td><td rowspan="2">0.50</td></tr>
<tr><td>Yellow</td><td>Pigments –S
S1858 (Yellow)
S1152 (Red)</td><td>5.23
6.10
0.01</td></tr>
</table>

h - distance between the roller and the paper on the unit for laminating the substrate (mm)

Testing the samples of knitted fabric and artificial leather

Breaking forces and elongation at break of the samples in the length direction and in the width direction were tested according to the standards: ISO 1421:1998; EN ISO 1421:1998. Tests were performed on the dynamometer made by Thuringer Industriewerk Raustein, Germany. It operates on the principle of constant elongation speed.

The distance between the clamps was adjusted to 200 mm, and before tightening the lower clamp the specimen was loaded by preloading which depended on the surface mass of the fabric. The speed of loading or elongation was adjusted in such a way that the break occurred within 60±10 seconds, and the movement speed of the lower clamp amounted to 100 mm/min.

Resistance to water penetration was tested according to ISO 811 standard on the Pfaff water impermeability tester. The coefficient of resistance to water penetration represents a relationship of pressure when the first water drop penetrates the sample.
Resistance of the coat delamination from the substrate was tested in accordance with ISO 2411 standard. using the dynamometer made by Thuringer Industriewerk Raustein, Germany. The test specimen occupied a vertical position. The substrate of the test specimen was fastened in the upper stationary clamp and the coat was fastened in the lower movable clamp. The movement speed of the lower clamp was 100 mm/min. The prepared test specimens were subjected to the action of tensile force until the delamination of layers over a length of at least 100 mm.

TEST RESULTS

A synthetic white knitted fabric (PA 6.6), which had been treated antibacterially, was used as the substrate for coating. By testing the properties of the knitted fabric used as the substrate for coating the data obtained are given in Table 3.

Table 3. Results of testing technical characteristics of the knitted fabric

Tested parameters		Knitted fabric	
		$\overline{x}$	CV *(%)*
Elongation at break in the width direction (in warp direction) *(%)*		71	2.82
Elongation at break in the cross direction (in weft direction) *(%)*		105	1.90
Breaking force in the width direction *(N)*		331.42	3.03
Breaking force in the cross direction *(N)*		157.06	3.69
Density *(threads / 10 cm)*	wales	120	2.48
	courses	130	2.17
Shrinkage *(%)*	widthwise	3.1	5.37
	crosswise	2.07	6.77
Raw material composition		Polyamide 6.6	
Knitted fabric width *(cm)*		164	
Surface mass of the knitted fabric *(g/cm^2)*		86	
Knitted fabric thickness *(mm)*		0.5	
Yarn count *(tex)*		7.8	

$\overline{x}$ - mean value, CV – coefficient of variation (%)

Table 4. Tested values of samples I, II and III per colors

Tested parameters		Sample I		Sample II		Sample III	
		Blue	Yellow	Blue	Yellow	Blue	Yellow
m (g/cm²)	$\overline{x}$	163	167	167	168	170	172
	CV	2.43	1.89	0.79	1.06	1.25	0.98
d (mm)	$\overline{x}$	0.49	0.49	0.47	0.47	0.46	0.46
	CV	0.02	0.01	0.02	0.02	0.025	0.03
F_d *(N)*	$\overline{x}$	461.23	434.81	487.21	466.80	510.92	491.44
	CV	2.77	4.65	2.37	3.76	1.96	2.04
$F_š$ *(N)*	$\overline{x}$	203.32	177.35	216.01	203.41	230.47	219.51
	CV	3.47	3.33	3.77	2.66	2.84	2.79
ε_d *(%)*	$\overline{x}$	106.00	98.67	110.00	103.67	98.00	87.00
	CV	1.89	1.17	0.91	0.56	1.02	2.30
$\varepsilon_š$ *(%)*	$\overline{x}$	250.33	237.33	260.00	238.02	235.17	240.10
	CV	0.80	0.24	0.42	0.38	0.43	0.69
V_n *(Pa)*	$\overline{x}$	51.25	50.41	52.01	51.51	53.43	52.71
	CV	16.15	12.31	10.66	8.51	11.44	13.5
S_1 *(N/5cm)*	$\overline{x}$	62.02	58.46	62.61	52.22	66.57	65.49
	CV	1.93	1.97	0.92	1.92	1.54	1.57
S_2 *(N/5cm)*	$\overline{x}$	42.32	34.57	41.09	38.64	42.35	40.71
	CV	3.58	1.01	2.73	1.3	0.24	2.5

m - surface mass of the sample *(g/cm²)*, *d* - sample thickness (*mm*), F_d - breaking force in the width direction *(N)*, $F_š$ - breaking force in the cross direction *(N)*, ε_d - elongation at break in the width direction *(%)*, $\varepsilon_š$ - elongation at break in the cross direction *(%)*, V_n - water impermeability of the sample *(Pa)*, S_1 - resistance to the delamination of the coat from the substrate in the length direction (*N/5cm*), S_2 - Resistance to the delamination of the coat from the substrate in the width direction (*N/5 cm*)

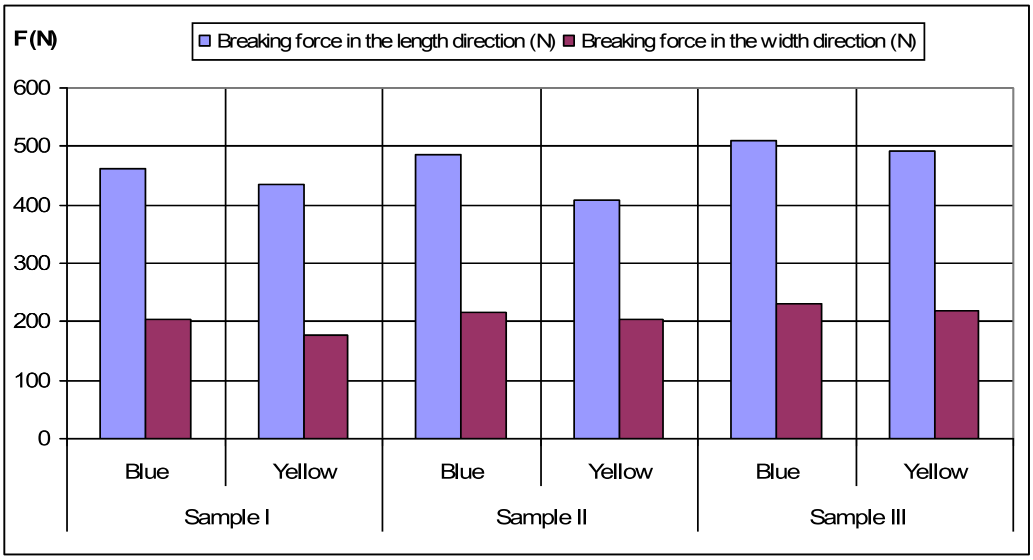

Figure 1. Breaking forces in the length and width direction of the sample
F - breaking force in the length and width direction of the sample (N)

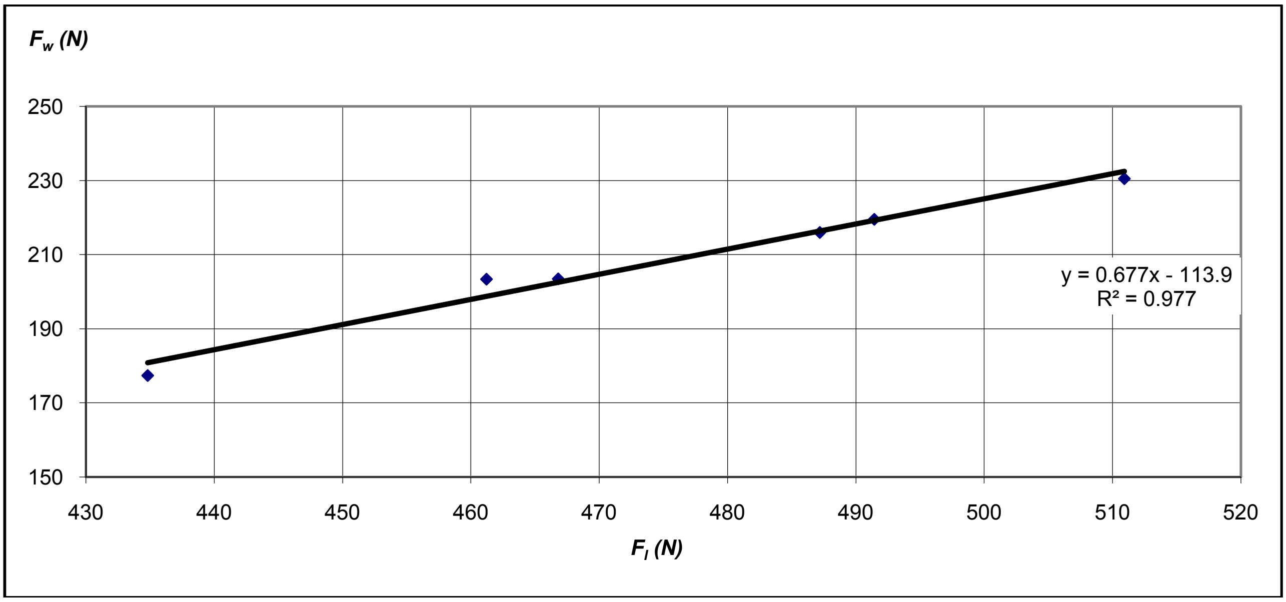

Figure 2. Coefficient of variation and regression straight line between the breaking forces in the length and width direction of the sample
F_l- breaking force in the length direction of the sample *(N)*, F_w - breaking force in the width direction of the sample *(N)*

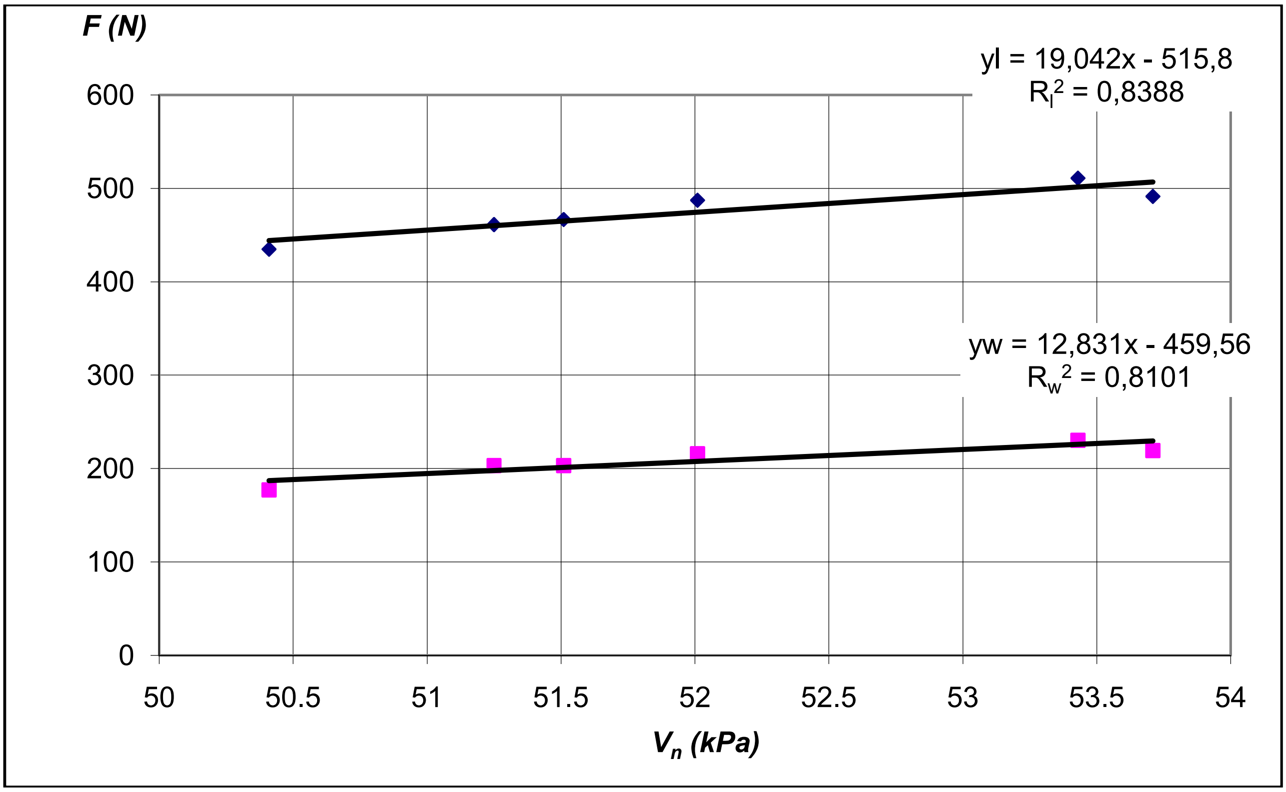

Figure 3. Coefficient of correlation and regression straight line between breaking forces and water impermeability R_l- coefficient of correlation between breaking force *F(N)* in the length direction of the sample and water impermeability of the sample V_n *(kPa)*, R_w- coefficient of correlation between breaking force *F (N)* in the width of the sample and water impermeability of the sample V_n *(kPa)*

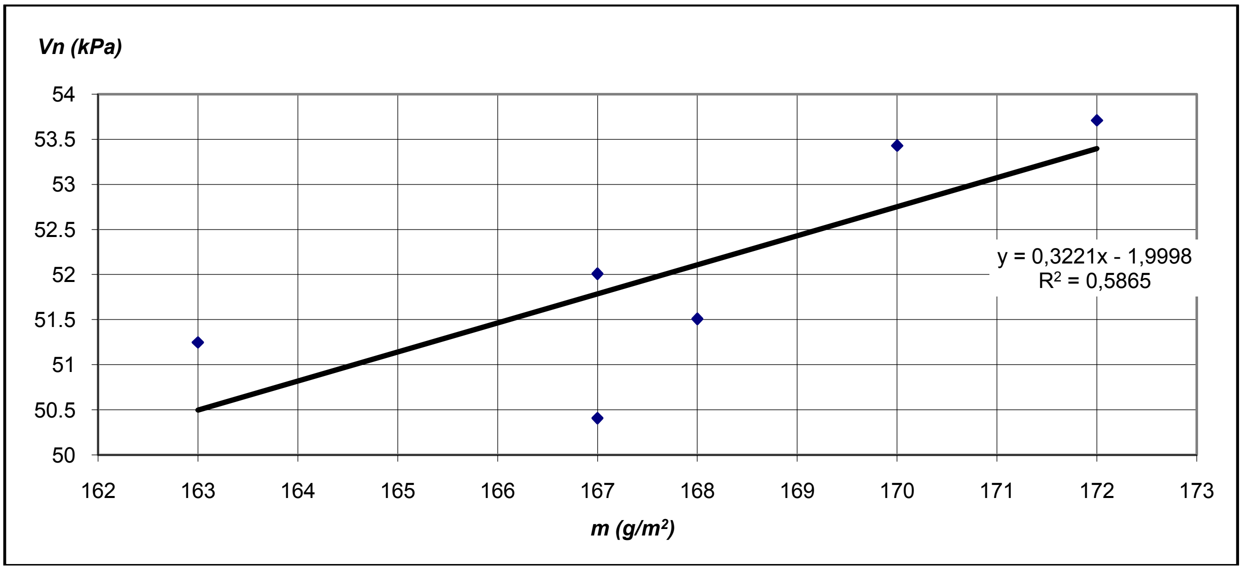

Figure 4. Coefficient of correlation and regression straight line between sample mass and water impermeability *Vn* - water impermeability (*kPa*), *m* - surface mass (g/m^2)

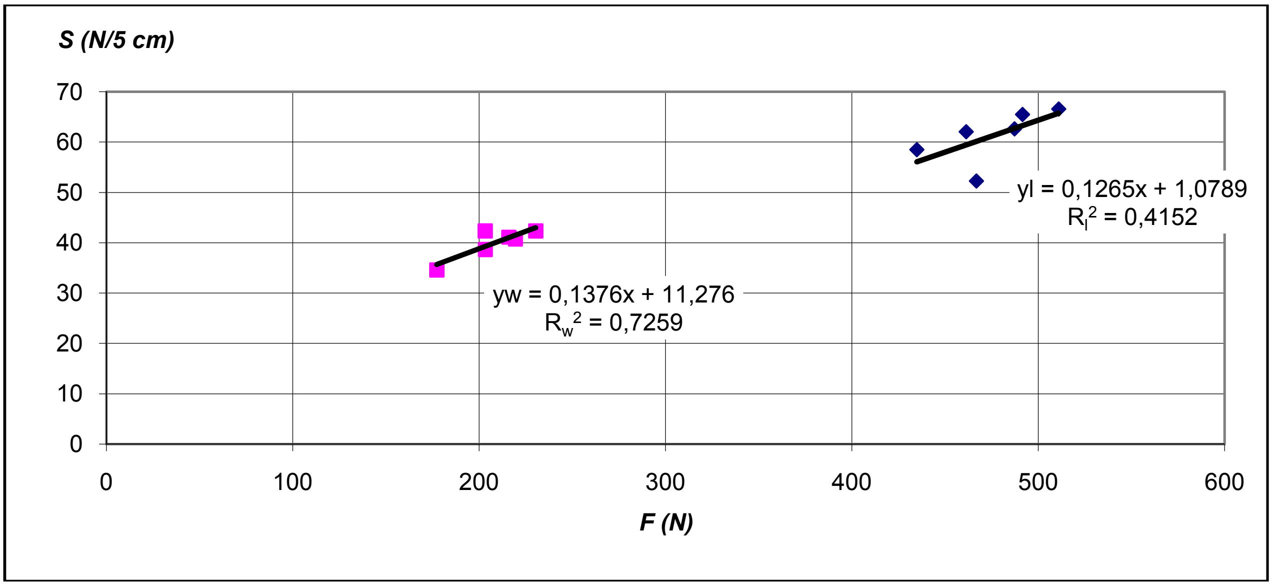

Figure 5. Coefficient of correlation and regression straight line between breaking forces coat delamination from the substrate R_l - coefficient of correlation between breaking force *F (N)* in the length direction and resistance to coat delamination form the substrate *S (N/5 cm)*, *Rw* - coefficient of correlation between breaking force *F (N)* in the width direction of the sample and resistance to coat delamination from the substrate *S (N/5 cm)*.

DISCUSSION

The subject matter of this paper is to investigate physical and mechanical properties of artificial leather with substrate consisting of knitted fabric and PU coat. In making the artificial leather samples for the said investigation were made, with changes in coat composition and conditions in the production process. The impact of the additives Vithane S20 and Vithane ACR with equal components and portions (samples I and II) (Tables 1 and 2) was examined. Likewise, the impact of the distance between the coating roller and the paper on the quality and hardness of the material was examined.

The knitted fabric as a basic substrate for all three samples of artificial leather has the same properties listed in Table 3.

Properties of samples of artificial leather in three different samples in blue and yellow color (Tab. 4) were examined. Surface mass of the artificial leather is greater in yellow samples. The coefficient of mass variation is the greatest in sample I where Vithane S20 is used in the coat. This means that it does not achieve a good uniformity of the coat as in the case of Vithane ACR used on the coat of samples II and III. It is worth mentioning that the surface mass is the greatest in sample III. This means that a smaller distance caused a higher mass pressure and the penetration of the coat into the knitted fabric so that the first layer of the coat partially or completely filled the interspace of the yarn and fibers in the knitted fabric and thus increase the total coat. This assertion was justified by other examined parameters such as sample thickness, breaking force and water impermeability. The thickness of each sample is different, but within the sample it is the same for each color. Sample I has the greatest thickness, while sample III has the smallest thickness (Table 4).

The breaking force in the width direction of the sample is almost twice as great than the breaking force in the width direction in all samples (Table 4, Fig. 1). All blue samples have a higher breaking force in the length direction of the sample despite the fact that the surface mass of blue color was lower in all samples. This means that color affects breaking force. The breaking force in the length direction of the sample is also higher for the blue samples. Sample III has the highest breaking force in the length and width direction of the sample. Sample I has the highest coefficient of variation of breaking forces on the tested samples in the length and width direction as well as in the case of mass, which confirms the fact that additive Vithane S20 produces a non-uniform coat.

Elongation at break did not always follow the course of breaking forces (Table 4). It applies to sample III which has the lowest elongation at break, and the highest breaking force. This occurrence was expected because by pressing the coat in the knitted fabric more rigid artificial leather was obtained, the strength of which increased, but elongation decreased. Elongation at break in the width of the sample is several times higher than elongation at break in the length direction. The elongation at break of the knitted fabric contributed to this occurrence where a difference in the elongation at break between courses and wales could be observed. Anisotropy of the artificial leather expressed in breaking strength and elongation at break is not only caused by the knitted fabric, but also by the coat which establishes a stronger bond in the width direction of the sample.

There is a difference in water impermeability between samples and colors (Table 4). Sample III has the highest water impermeability which contributed to the penetration of the coat between fibers and yarn into the knitted fabric, leading to filling the porous section of the fabric. Water impermeability is higher for blue color in all samples. For this parameter coefficient of correlation is the highest on sample I.

The resistance of coat delamination from the substrate in the length direction is greater for blue color in each sample (Table 4). It is worth mentioning that the greatest resistance is observed in sample III where it was expected that the coat is more strongly bonded to the substrate because the penetration of the coat into the knitted fabric structure contributed to it. The resistance of the coat delamination from the substrate in the width direction is also greater for blue color in all samples. However, the resistance in the width direction is lower in all samples and colors. Sample III also has the highest resistance, but blue sample I has the same resistance as the blue color of sample III.

Hence, sample III has the highest water impermeability, the highest breaking force in the width and length direction and the greatest mass. The coefficients of variation are similar for each sample. A certain deviation is observable in sample I, caused by greater coat nonuniformity.

The coefficient of correlation in the linear regression between the breaking forces in the length direction of the sample and the breaking forces in the length direction is very high, amounting to R=0.9887 (R^2=0.9775), Figure 2.
The coefficient of correlation between the breaking forces in the length direction of the sample and water tightness is R_l=0.9159 (R_l^2=0.8388), and between the breaking forces in the sample width and water tightness is slightly lower R_w = 0.9001 (R_w^2=0.8101), indicating a very strong relationship between these two parameters (Fig. 3). According to regression straight lines and their equations a certain increase in water impermeability with rising breaking forces can be observed.
The coefficient of correlation between surface mass and water impermeability is R=0.7658 (R^2=0.5865), indicating a certain connection between these two parameters (Fig. 4).
The coefficient of correlation between the breaking forces in the length direction of the sample and the resistance of coat delamination from the substrate is R_l=0.6444 (R_l^2=0.4152), while between the breaking forces in the width direction of the sample and the resistance of coat delamination from the substrate it higher, amounting to R_w=0.8520 (R_w^2=0.7259), Fig. 5. It is worth emphasizing that values are scattered into two separate groups, according to the direction of investigating breaking forces.

CONCLUSION

According to the results obtained it can be concluded:
Color affects the surface mass of artificial leather. Yellow color has a higher surface mass than blue under the same manufacturing conditions and for the same raw materials of their portions. The surface mass increases by a higher pressure of the coat onto the substrate.
Breaking force in the length direction of the artificial leather is almost twice as much as breaking force in the width direction. The blue samples in relation to the yellow samples have a higher breaking force in the length direction despite the fact that the surface mass is lower.
Breaking force in the width direction is also higher for blue samples. Sample III again has the highest breaking force as it has a higher coat pressure on the substrate.
Elongation at break does not always follow the movement of breaking forces. The sample with a higher pressure of the coat onto the substrate has the lowest elongation at break.
Elongation at break in the length direction is several times higher than the elongation at break in the width direction. The substrate affects the anisotropy of the artificial later, knitted fabric in this case, and the coat which by its coating over the substrate orientates the molecules so that they make a stronger connection in the width direction of the sample.
Water impermeability is also changed by changing the manufacturing conditions, by changing the distance between the rollers and the paper during laminating the knitted fabric and by changing color.
Using a higher coat pressure or a smaller distance between the rollers and the paper produces rigider and stronger artificial leather, higher breaking force and higher water impermeability, but lower elongation at break.
The resistance of coat delamination from the substrate in the length and width direction is higher for blue color. Sample III having a higher pressure of the coat on the substrate has a higher resistance.
Sample I containing Vithane S20 has the highest coefficient of variation among all tested parameters, indicating a slightly less uniform coat caused by Vithane ACR.
From the relationship between the tested parameters represented as the coefficient of correlation for the linear regression it can be concluded that there are relatively strong bonds, especially between the breaking forces in the length and width directions and between breaking forces and water impermeability.

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SESSION 2: Engineering Environmental Protection

FREQUENCY AND POWER CONTROL FOR PIEZOELECTRIC ULTRASONIC CLEANING TRANSDUCERS

Burány, N.
College of Dunaújváros, Hungary
E-mail: burany.nandor@gmail.com

Abstract: Ultrasonic cleaning is a widely accepted technique in industrial, medical and many other applications. Parts immersed in aqueous media are treated with sound waves. Electromechanical actuator is used to produce the sound waves. Power electronic generator supply the actuator with sinusoidal voltage of appropriate frequency and amplitude. This paper gives the description of an ultrasonic generator built and tested by the author, with accent on actuator modelling, frequency synchronization and power control.
Keywords: Ultrasonic cleaning, piezo transducer, ultrasonic generator, frequency control, power control.

INTRODUCTION

The use of high frequency sound waves to remove a variety of contaminants from parts immersed in aqueous media is very efficient. The contaminants can be oil, grease, polishing compounds and mould release agents. Materials can be cleaned include metals, glass, ceramics. Typical application found in metal industry are removing chips and cutting oils from cutting and machining operations, removing buffing and polishing compounds prior to plating operations and cleaninggreases and sludge from rebuilt components for automotives and aircraft applications.
Ultrasoniccleaning is powerful to remove contaminants, yet gentle enough not to damage the substrate. The use of ultrasonic’s incleaning has become increasingly popular due to the restrictions on the use of chlorofluoro carbons such as 1.1.1.-trichlorethane as a solvent used in vapour-degreasing process. The use of ultrasonic’s enables the cleaning of intricately shaped parts. Despite the higher cost of equipment for ultrasoniccleaning, it has proved economical for numerous applications.
Ultrasonic transducers used for cleaning are mainly based on piezoelectric effect, but some units based on magnetostriction are also available. Piezoelectricity is the charge which accumulates on surfaces of solid materials (notably crystals, certain ceramics, and some biological matter) in response to applied mechanical stress. The word piezoelectricity means electric charge resulting from pressure. Piezoelectricity is the direct result of the piezoelectric effect.
The piezoelectric effect is understood as the electromechanical interaction between the mechanical and the electrical state in crystalline materials with no inversion symmetry. The piezoelectric effect is a reversible process. The materials exhibiting the direct piezoelectric effect (the internal generation of electrical charge resulting from an applied mechanical force) also exhibit the reverse piezoelectric effect (the internal generation of a mechanical strain resulting from an applied electrical field). For example, lead zirconate titanate crystals will generate measurable piezoelectricity when their static structure is deformed by about 0.1% of the original dimension. Conversely, those same crystals will change about 0.1% of their static dimension when an external electric field is applied to the material.
Piezoelectricity is found in useful applications such as the production and detection of sound, generation of high voltages, electronic frequency generation, microbalances, and ultrafine focusing of optical assemblies. It is also the basis of a number of scientific instrumental techniques with atomic resolution, the scanning probe microscopes and everyday uses such as acting as the ignition source for cigarette lighters and push-start propane barbecues.
In this research, piezoelectric transducers are used for industrial ultrasonic cleaning equipment. Standard transducers for this application [1] are shown in fig. 1. Appropriate number of transducers are built in a sound box immersed in a cleaning tank or glued to the tank bottom to achieve the necessary acoustic power for cleaning. Power electronic generators for driving piezoelectric transducers are built and tested by the author. Synchronization and regulation problems and solutions are reported in this paper.

Figure 1. Typical piezoelectric transducers for ultrasonic cleaning equipment.

THE ULTRASONIC TRANSDUCER MODEL

The industrial ultrasonic transducers have to be supplied by sinusoidal or near sinusoidal current and voltage. Appropriate frequency and amplitude of the supply is essential, to achieve the required level of ultrasound power density in the cleaning tank.

To build and appropriately regulate an ultrasonic generator loaded by a piezoelectric transducer, the transducer model is needed. This modeling is an interdisciplinary task, requiring mechanical, acoustic and electric approach [2]. From different models in the literature, the Butterworth-Van Dyke approach [3,4] shown in Fig.2 is used in this work.

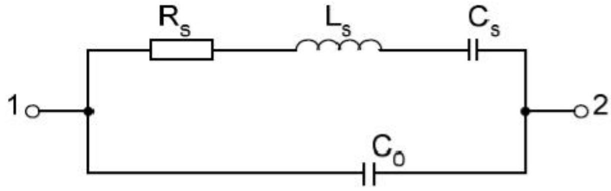

Figure 2. The Butterworth-Van Dyke model of the piezoelectric actuator

This model integrates the electrical, mechanical and acoustic elements in a simple, lumped electric circuit. The acoustic load of the transducer and all internal losses are represented by the series resistance R_S. Elements C_S and L_S models the series resonance effect usual by transducers, C_0 stands for the piezoelectric crystal capacitance and takes part in parallel resonance.

The resulting input impedance of the equivalent circuit and the same for a real transducer could be derived in the form:

$$Z_s = \frac{\left(R_s + j\omega L_s + \dfrac{1}{j\omega C_s}\right)\cdot\dfrac{1}{j\omega C_0}}{R_s + j\omega L_s + \dfrac{1}{j\omega C_s} + \dfrac{1}{j\omega C_0}}$$

This impedance exhibits series and parallel resonance on the following frequencies, respectively:

$$\omega_n = \frac{1}{\sqrt{L_s C_s}}, \qquad \omega_l = \frac{1}{\sqrt{L_s \dfrac{C_s C_0}{C_s + C_0}}}.$$

This behavior, described by impedance amplitude and phase diagrams for a real transducer [5] is shown in Fig. 3. The series resonance is obvious at f_n and the parallel resonance (antiresonance) is at f_l. The impedance is capacitive both at low and high frequencies and becomes partly inductive between the two resonant frequencies.

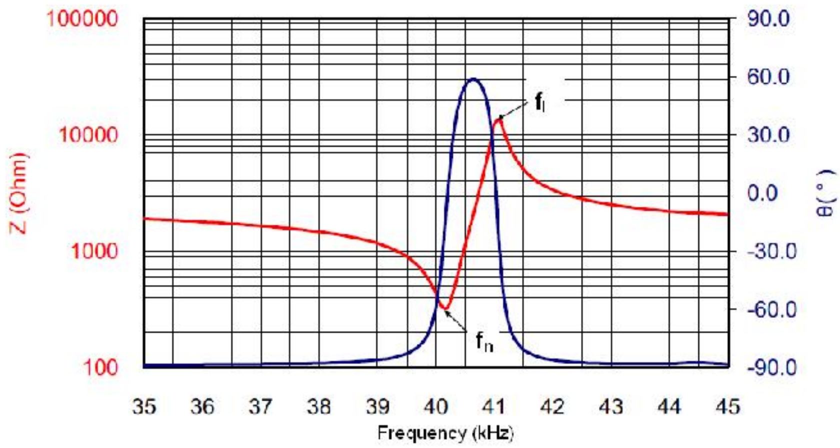

Figure 3. Impedance characteristics of the piezoelectric transducer

Maximal power transmission to the series resonant circuit and the acoustic load is achieved at the series resonant frequency. Unfortunately, at this frequency, there is a large capacitive component of the input impedance which loads the ultrasonic generator by significant reactive power. This reactive power have to be compensated to achieve optimal use of the generator output power. Generators usually produce square wave voltage output, in this case compensation with an external series inductor is acceptable. This way, large switching current peaks are avoided, the sinusoidal output current is in phase with the voltage. For a current output generator the compensation have to be done by an external parallel inductor. In this case, the square wave output current have to be in phase with the sinusoidal output voltage.

THE ULTRASONIC GENERATOR

The ultrasonic generators built during this work are of half bridge configuration with capacitive voltage divider C2,C3 at the input (Fig.4). The buck converter (Q1,D5,L1, C2,C3,RS) supplying the half bridge is necessary for power regulation. The buck converter is supplied from 230V, 50Hz mains through a bridge rectifier (D1-D4), the input voltage is filtered by C1. The half bridge (Q2,Q3) converts the intermediate circuit DC voltage to a square wave output with alternate positive and negative pulses with duty cycles 50%-50%.

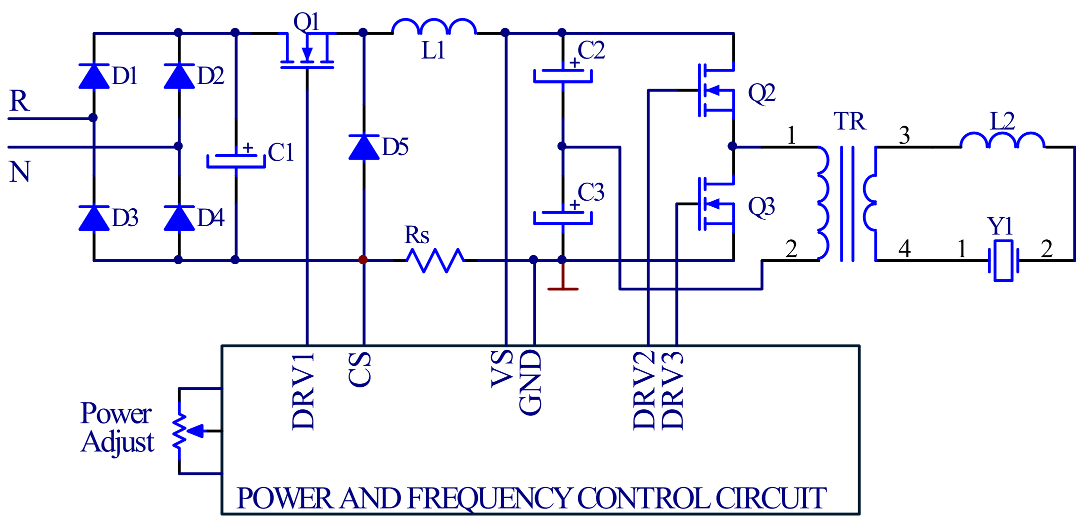

Figure 4. Block diagram of the ultrasonic generator

The half bridge output voltage is connected to the transformator (TR) primary. The role of the transformator is to isolate the transducer from mains and to adjust the load impedance to the source to achieve the appropriate power range. The compensating inductor L2 is placed between the secondary and the transducer load. Leakage inductance of the transformator could be integrated in the compensating inductor L2.
Frequency adjustment is made by tracking the maximum power point obtainable at series resonance where the transducer impedance is minimal and appear to be a pure resistance. It is not necessary to actually calculate the impedance, instead the output voltage and the output current of the buck converter stage is analyzed through signals VS and CS. The maximum power point is at the frequency where the load resistance of the buck converter is minimal. Load resistance is determined as the ratio of the DC output voltage and the DC output current of the buck converter.
Power regulation is done by current feedback on the buck converter. Reference current is determined by the power adjustment potentiometer. The same circuit is acceptable for protection of the power transistors in the buck converter (Q1) and in the half bridge (Q2,Q3).

RESULTS AND DISCUSSION

Nominal power of the generators built in this project were between 100W and 1000W, supplying from 2 to 20 parallel connected piezoelectric transducers. In all cases the operating frequency was around 30kHz. The efficiency of the generator is around 90%.

CONCLUSIONS

From the results of the experimental investigation, the following conclusions are drawn:

- efficient ultrasonic generators for piezoelectric transducers can be built as a buck converter followed by a half bridge inverter,
- the power regulation could be done by current feedback on the buck converter,
- bridge frequency adjustment based on tracking the buck converter load resistance is feasible.
- the ultrasonic cleaning is a very efficient and environmentally friendly process.

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CALCULATEDPOLLUTANT EMMISION CONCENTRATIONSBASED ON REGISTERED NUMBER OF VEHICLESON THE BUSY ROADSIN THE CITY OF NIS

Đordjević, A.[1], Radosavljević, J.[1], Raos, M.[1], Gosnić-Ignjatović, A.[2]
[1] University in Niš, Faculty of Occupational Safety
[2] High School ''9 Maj'', Nis
E-mail: amelija.djordjevic@znrfak.ni.ac.rs

Abstract: The paper presents calculated emission concentrations of standard pollutants (CO, NO_x, C_nH_m,) based on the registered number of vehicles at the busiest intersections in Niš. Based on the calculated emission concentrations of these pollutants and by using the dispersion model, we calculated immission concentrations at distances of 15m and 100m from the point of occurrence.
Key words:traffic, pollutants, hydrocarbons, CO, NO_x, SO_2, air quality

INTRODUCTION

Analysis and solution of problems of air pollution requires a multidisciplinary approach in the analysis of phenomena, conditions, processes, and effects on the environment.
Analysis of air quality in major urban areas reveals a causal connection and dependence of air quality on the physical volume of industrial production, operation of boiler plants in industry and heating plants, and frequency of traffic.
The paper analyzes dispersion of emitted pollutants from the combustion of motor vehicle fuel. The analysis begins with the primary hypothesis that there is a correlation between the frequency of motor vehicles and the concentration of emitted pollutants caused by burning vehicle fuel. Informative value of this hypothesis is based on the knowledge of basic combustion conditions for internal combustion engine fuels and their chemical composition. It is important to determine the motion flow for concentrations of emitted pollutants so that measuring points in the air quality monitoring network could be properly selected, which is the aim of the paper. Proper monitoring of concentrations of pollutants present in air from mobile sources allows for appropriate measures to protect and preserve the environment to be taken.
Mobile sources of pollution are all motor vehicles that use fuels such as gasoline, diesel fuel, Liquefied Petroleum Gas (LPG), and kerosene. Combustion of fuel causes transformation of chemical into mechanical energy. This transformation is accompanied by emission of gaseous pollutants and solid particles. The quantity of emitted pollutants during motor vehicle operation depends on the completion of fuel combustion, fuel composition and quality, engine type, driving conditions, and vehicle load.

CHEMICAL COMPOSITION OF FUEL

Use of liquid propellants causes emission of pollutants that affect air quality in urban areas. Liquid fuels are the result of fractional distillation of crude natural oil. They represent a heterogeneous mixture of various gaseous, liquid, and solid hydrocarbons with different chemical composition. They can also contain sulfur and nitrogen organic compounds. Chemical analysis revealed that elemental composition of oil is variable. Carbon may occupy 81-87%, hydrogen 10-14%, sulfur 0-6%, oxygen 0-7%, and nitrogen 0-2%. Oil can contain negligible quantities of phosphorus (about .01%), iron, nickel, aluminum, potassium, vanadium, sodium, calcium, magnesium, and others.
The chemical composition of particles emitted during combustion of liquid propellants is mostly of non-organic origin and is conditioned by the complexity of composition of the liquid fuel. In addition, it was found that combustion of liquid fuel results in emission of trace elements, which comprise 189 different substances that contribute to air pollution. Concentration of trace elements emitted during combustion of liquid fuel depends primarily on the physicochemical characteristics of substances contained in the fuel, of their concentration in the fuel, combustion conditions, but also of combustion temperature. Combustion temperature determines the degree of vaporization of specific pollutants that are part of the fuel and directly causes concentration of these pollutants in products of combustion.

Combustion of liquid fuel causes emission of sulfur oxides, whose concentration is a function of percentage of elemental sulfur in the fuel. In the process of combustion, 95% of the sulfur in the fuel is oxidized to SO_2, 1-5% is oxidized to SO_3, and 1-3% is released as sulfates and included in the composition of emitted particles.

The products of combustion of liquid fuels also contain nitrogen oxides. Nitrogen oxides in the combustion products imply mixtures of NO and NO_2. Out of the total formed concentration of NO_x, 95% is in the form of NO. The concentration of nitrogen oxides contained in combustion products depends exponentially on the temperature of combustion, percentage of nitrogen in the fuel, and the square root value of the concentration of oxygen present in the combustion process. The total amount of nitrogen oxides formed during the combustion process is the sum of nitrogen oxides resulting from oxidation of nitrogen and atmospheric oxygen and from oxidation of nitrogen by oxygen, which is part of the fuel mixture. The percentage of formed nitrogen oxides produced by oxidation of nitrogen and oxygen varies in the 20-90% range.

Conditions and efficiency of combustion of liquid fuels also affect CO emission. Control of combustion conditions can reduce the concentration of CO in products of combustion. Carbon monoxide is emitted during incomplete fuel combustion.

Generally, the concentration of organic compounds emitted in products of combustion of liquid fuels is small. Organic compounds formed during the process of combustion of liquid fuels are mixtures of volatile organic compounds, semi-volatile organic compounds, and condensed organic compounds. Volatile organic compounds occur in the vapor phase and belong to the class of hydrocarbons. Products of combustion, primarily from organic compounds, yield open-chain hydrocarbons, as well as oxidized hydrocarbons of low molecular weight and aromatic compounds.

Products of combustion of liquid fuels usually contain all alkanes, alkenes, aldehydes, carbonic acid, substituted benzene (benzene, toluene, xylene, ethylbenzene), polycyclic organic compounds, polynuclear aromatic hydrocarbons, etc. In terms of air pollution, emissions of formaldehyde are specially monitored. Formaldehyde occurs as a result of oxidation of hydrocarbons at high temperatures. If combustion is more complete, emitted formaldehyde concentration is higher. Formaldehyde is present in the vapor phase in products of combustion of liquid fuel.

Worldwide, as well as in our country, natural gas is increasingly used as alternative fuel to propel vehicles. Natural gas is a mixture of hydrocarbons, sulfur hexafluoride, nitrogen, and helium. The composition of natural gas is dominated by hydrocarbons, which can be classified into aliphatic and aromatic hydrocarbons. The aliphatic hydrocarbons include alkanes (methane, ethane, propane, butane), alkenes (ethylene, propylene), alkynes (acetylene, propylene), and aromatic hydrocarbons include benzenoid (benzene, toluene, xylene) and non-benzenoid hydrocarbons (naphthalene, anthracene).

Combustion of natural gas yields the following compounds: NO_x, CO, CO_2, CH_4, N_2O, volatile organic compounds, SO_2 in low concentrations, and particles. These compounds and particles are emitted together with the waste gas generated during combustion of natural gas.

In the process of natural gas combustion, formation of nitrogen oxides occurs by means of three different mechanisms. In the largest concentration, nitrogen oxides are formed by the reaction mechanism of oxidation of nitrogen with oxygen present in combusted air at high temperatures. Nitrogen oxides formed by this mechanism are known as thermal nitrogen oxides since their formation is caused primarily by high temperatures. The total concentration of emitted thermal nitrogen oxides is directly dependent on the concentration of oxygen, temperature, and time of nitrogen exposure to the combustion process. Another mechanism of forming nitrogen oxides occurs in the initial part of the combustion of natural gas as a product of reaction of nitrogen and hydrocarbon radicals. Compared with the concentrations of nitrogen oxides generated by the previous mechanism, concentrations of nitrogen oxides formed by reaction of nitrogen and hydrocarbon radicals are significantly smaller. The third mechanism of nitrogen oxide formation is of particular importance for air pollution. There are very small concentrations of nitrogen oxides due to the reaction of certain compounds that contain nitrogen and comprise natural gas.

The level of CO and CO_2 generated during combustion of natural gas is directly caused by combustion efficiency. Reduction in combustion efficiency increases the concentration of CO and CO_2 during emission. Unlike CO and CO_2 emissions, which are primarily caused by combustion efficiency, emission level of SO_2 is primarily determined by the percentage of sulfur in natural gas. Since the percentage of sulfur in natural gas is small, there is no emission of higher concentrations of SO_2 during the combustion of natural gas.

In the products of natural gas combustion, the following organic compounds occur in smaller concentrations: anthracene, benzene, benzo(a)pyrene, benzo(g,h,i)pyrene, butane, chrysene, dichlorobenzene, ethane, formaldehyde, hexane, naphthalene, pentane, propane, pyrene, toluene, etc. Emissions of organic compounds formed by natural gas combustion, depends primarily on the efficiency of the combustion process, combustion temperature, time of exposure of gas to maximum combustion temperatures, and chemical properties of natural gas.

Depending on the conditions of combustion, particles usually below 1 μm in diameter may be emitted with the products of combustion. Fuel combustion in conditions where excess air ratio is larger than 1 ($\lambda>1$) may increase the concentration of particles in the emission.

EMMITED MASSES OF POLLUTANTS AT THE BUSIEST ROADS IN THE CITY OF NIS

Studies of traffic flows in Nis in the basic road networks revealed a high flow of vehicles on main city roads. In the east-west directions, the primary importance in the frequency of traffic is given to Emperor Constantine Boulevard, Nemanjic Boulevard, Dr Zoran Djindjic Boulevard, General Milojko Lesjanin Street, and Dimitrije Tucovic Street; in the north-south direction, these are February 12 Boulevard and Jovan Ristic Street. These roads are also the busiest. In addition to the inner-city connection of residential and work areas, they are also links to “external” traffic (city entrances and exits). On access and inner-city roads passenger cars dominate with a share of 50% to 80% of all road users.

The contribution of means of transport to air pollution in urban areas can be monitored by registering motor vehicles in a traffic network per unit of time. To calculate short-term daily emissions of pollutants emitted by motor vehicles, we apply the physical equation:

$$E_{NN} = \left(Q_{PA} \cdot EF_i + Q_{LTV} \cdot EF_i + Q_{TTV} \cdot EF_i\right) \cdot l \,, \tag{1}$$

where: E_{NN} – emission by components [g/vehicle per day], Q_{PA} – number of passenger vehicles in the traffic flow [vehicle/day], Q_{LTV} – number of light commercial vehicles in the traffic flow [vehicle/day], Q_{TTV} – number of heavy goods vehicles in traffic flow [vehicle/day], l – street length [km], E_{FI} – emission factor of i^{th} polluting substance.

Emission factor of i^{th} polluting substance is calculated by the following equation:

$$EF_i = A + B \cdot \log \upsilon \tag{2}$$

where: EF_i – mass of emitted i^{th} polluting substance in exhaust gases from certain categories of vehicles in the function of distance traveled [g/km], A and B – coefficients given in the software application “Statistica for Windows”, based on four pairs of points defined by x, y coordinates, υ – Dragiša Tolmač.

Table 1 shows numerically defined locations where motor vehicles were counted for the period from 9am to 8pm in 2008. We calculated the mass of emitted pollutants for the adopted speed of 42.5 km/h for passenger cars and 26.6 km/h for light commercial vehicles and heavy goods vehicles. The spatial position of locations where motor vehicle counting was conducted is shown in Figure 1.

Table 1. Calculated mass of emitted pollutants and structure of traffic flow at the monitored locationsin the city of Nis

location number	Location	Emission (kg)			Number of vehicles			
		Carbon (II)-oxide (CO)	Hydrocarbon type CxHy	Nitrogen oxides (NOx)	Passenger cars	Buses	Light commercial vehicles	Heavy goods vehicles
1	Municipal Office “Božidar Adžija”	3.935	0.682	0.788	463	13	3	2
2	Nemanjić Blvd. (near “Zona I” shopping mall)	1.769	0.312	0.368	205	4	5	2
3	Municipal Office “Mediana”	1.250	0.224	0.268	144	3	4	2
4/a	Dr Zoran Djindjic Blvd.	2.356	0.401	0.458	275	12	3	/
4/b	Dr Zoran Djindjic Blvd.	2.952	0.512	0.586	344	12	5	1
4/c	Dr Zoran Djindjic Blvd.	2.404	0.420	0.482	279	11	6	1
5	Elementary school “Vozd Karadjordje”	2.629	0.449	0.509	308	11	2	/
6	Kralj Milan Square	2.689	0.477	0.543	309	26	2	1
7	Elementary school “Radoje Domanovic”	2.546	0.455	0.536	293	13	6	3
8	Obilićev Venac Street (near SIMPO)	1.176	0.202	0.238	138	/	2	1
9	Car Dusan Street	1.628	0.277	0.323	192	/	1	1
10	“Crveni Krst” Municipality	2.586	0.476	0.573	294	17	7	5
11	Corner of February 12 Blvd. and Air Force Blvd.	1.727	0.325	0.395	194	13	8	4
12	Ledena stena – Post Office No.9	2.607	0.487	0.602	295	15	7	7
13	Palilulska rampa (Palilula railway barrier)	1.516	0.262	0.305	177	4	2	1
14	Kosovke Devojke Street – Dormitory	1.333	0.233	0.271	155	4	3	1
15	Somborska Street	0.671	0.121	0.144	77	3	2	1
16	Knjazevacka Street – Post Office No.3	2.299	0.539	0.647	344	10	9	5

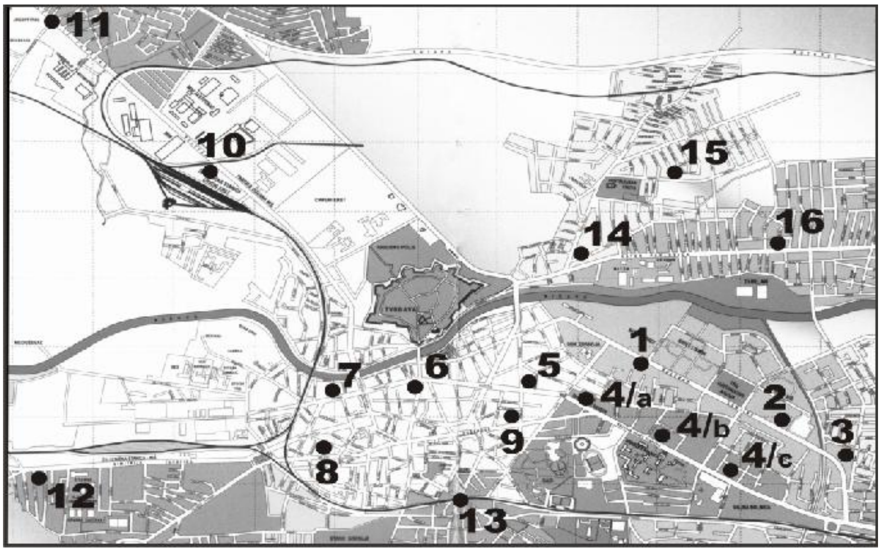

Figure 1. Position of locations where traffic count was conducted in 2008

Overview of the calculated mass of emitted pollutants from exhaust gases of motor vehicles on the roads where transport vehicles were monitored from 9am to 8pm in 2008 is presented in Figure 2.

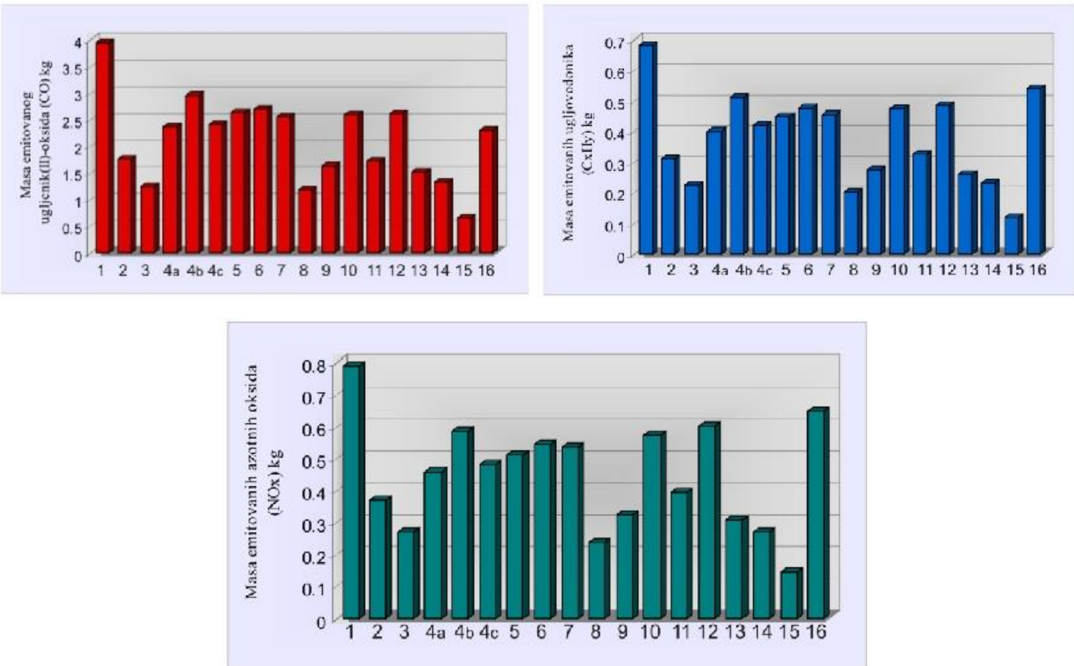

Figure 2. Mass of emitted pollutants CO, NO_x and C_xH_y at locations marked with serial numbers in Table 4.21

Based on the calculations of mass of emitted pollutants for the given period from 9am to 8pm (Table 1), as shown in Figure 2, we can conclude that the total emitted mass of carbon (II)-oxide is 38.073 kg, of hydrocarbons 6.854 kg, and of nitrogen oxides 8.036 kg. The largest mass of carbon (II)-oxides, hydrocarbons, and nitrogen oxides is emitted at location 1 (Municipal Office "Božidar Adžija") and it constitutes about 10% of the total calculated mass of emitted pollutants in the analyzed territory. The minimum calculated mass of pollutants emitted in exhaust gases of motor vehicles was at location 15 (Somborska Street). On the basis of calculations given in Table 1, we can also conclude that the mass of carbon (II)-oxide emitted in exhaust gases of motor vehicles is the highest compared to the mass of other analyzed emitted substances.

CALCULATION OF IMMISSION CONCENTRATIONS OF POLLUTANTS EMITTED ON THE BUSIEST ROADS IN THE CITY OF NIS

On the basis of emission concentrations of pollutants, it is possible to calculate immission concentrations of pollutants emitted from line (mobile) sources near the ground along the wind direction by use of air dispersion models (SCREEN).
Table 2 shows the calculated fifteen-minute immission concentrations of pollutants emitted from motor vehicles at monitored locations in the city.

Table 2. Calculated fifteen-minute immission concentrations of carbon(II)-oxides, hydrocarbons, and nitrogen oxides on busy roads in Nis

No.	Location	Immission concentration [mg/m^3]			Distance from source [m]
		CO	C_xH_y	NO_x	
1	Municipal Office “Božidar Adžija”	35.66	6.157	7.115	15
		1.72	0.185	0.214	100
2	Nemanjić Boulevard (near “Zona I” shopping mall)	16.00	8.472	3.322	15
		0.481	2.818	0.0999	100
3	Municipal Office “Medijana”	11.29	2.022	2.420	15
		0.339	0.061	0.073	100
4/a	Dr Zoran Đinđić Boulevard	21.28	3.623	4.134	15
		0.639	0.109	0.124	100
4/b	Dr Zoran Đinđić Boulevard	26.64	4.622	5.288	15
		0.801	0.139	0.159	100
4/c	Dr Zoran Đinđić Boulevard	21.69	3.793	4.354	15
		0.652	0.114	0.131	100
5	Elementary school “Vožd Karađorđe”	23.72	4.500	4.597	15
		0.713	0.135	0.138	100
6	Kralj Milan Square	24.29	4.305	4.898	15
		0.730	0.129	0.147	100
7	Elementary school “Radoje Domanovic”	22.99	4.110	4.841	15
		0.691	0.123	0.146	100
8	Obilicev Venac Street (near SIMPO)	10.64	1.819	2.144	15
		0.319	0.055	0.064	100
9	Car Dusan Street	14.70	2.502	2.916	15
		0.442	0.075	0.088	100
10	“Crveni Krst” Municipality	23.31	4.297	5.174	15
		0.701	0.129	0.155	100
11	Corner of February 12 Blvd. and Air	15.59	2.932	3.566	15

	Force Blvd.	0.469	0.0881	0.107	100
12	Ledena stena – Post Office No.9	23.53	4.394	5.434	15
		0.707	0.132	0.163	100
13	Palilulska rampa (Palilula railway barrier)	13.65	2.364	2.755	15
		0.410	0,071	0.083	100
14	Kosovke Devojke Street – Dormitory	12.02	2.104	2.445	15
		0.361	0.0632	0.073	100
15	Somborska Street	6.092	1.088	1.300	15
		0.183	0.033	0.039	100
16	Knjaževačka Street – Post Office No.3	20.71	4.863	5.783	15
		0.623	0.146	0.174	100

Calculated immission concentrations of pollutants from exhaust gases of motor vehicles are close to or above the immission limit values (ILV) prescribed by positive legislation of the Republic of Serbia for small distances from the source of emission. Concentrations are significantly reduced as the distance form emission source increases and they drop below the ILV at a distance of 50 to 100 meters.

CONCLUSION

Based on monitoring of the number of vehicles on the busiest roads in Nis we can conclude the following:
Fifteen-minute concentrations emitted by combustion of fuel in internal combustion engines are high and longer emission can lead to serious deterioration of air quality in Nis.
By analyzing the flow of movement of the concentration from the source up to 100m away, and by using the "Screening air dispersion model", we found that the concentrations rapidly decrease as they move away from the place of emission. Concentrations of pollutants monitored at a distance of 15m from the point of emission are high and on the busiest roads they range from: 35.66mg/m^3 - 10.64mg/m^3 for CO; -, 1.819mg/m^3 - 6.157mg/m^3 for CxHy; 7.115 - 2.144mg/m^3 for NOx.
For distances up to 100m, concentrations are reduced by 95% to 97%, which suggests that in the immediate vicinity, along the roads, it is recommended to form a green belt and avoid construction of residential buildings.

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A POSSIBILITY FOR INCREASE ENERGY EFFICIENT OF GREENHOUSE CONSTRUCTIONS

Topić, M.R. [1];Ćuprić, Lj.N.[2]; Topić, R.G.[3]
[1]University of Belgrade, Faculty of Mechanical Engineering,
[2]University of Belgrade, Faculty of Forestry,
[3]Certified designer, Srbijagas, Belgrade.
E-mail: rtopic@mas.bg.ac.rs

Abstract: In this paper are defined facilities with protected space – "greenhouses". Several aspects are discussed in order to increase energy efficiency and environment protection: microclimate of the workspace (physiological, meteorological and technical factors), specific of construction (composition of construction), constructive and technological characteristics (corresponding coefficients), and balancing and defining energy regime of greenhouse (for mathematical modeling).
Key words: Greenhouse, coefficient of boundary surface, microclimate, albedo

INTRODUCTION

Knowledge that for successful growth, besides the Sun light, plants need heat, results in a longer vegetation period. For that purpose garden beds are built with canals filled with hot water, or garden beds are filled with animal manure, whose long lasting fermentation process develops heat. Also, small plants are protected with big clay jars during cold whether, while especially cold sensitive plants are planted in the boxes and moved inside during the winter. Glass production technology has been already known in Romanian empire. They produced different products of glass like jewelry and dishes. On the other hand, the production of the flat transparent glass was so expensive that, glass hasn't yet been used for covering windows of building. The idea of "winter garden" starts from Ancient times, but new age broth intensive development of conservatories. Even at the time of ancient Greece and Rome, special care was taken to the growing plants. Together with luxury villas they designed gardens too and they paid special attention to gardening. In middle of XIX century development of conservatories construction achieved the top. The first huge public glass house was built on 1842 and 1846 in Regent Park in London.
Today, energy management is focused on promotion of energy efficiency measures and use of renewable energy sources, which means usage of clean technologies with low effects on environment, in the aim of environment protection. The principle of sustainable development in general means: savings of all kind of energy consumption, energy efficiency in all aspects of human activities (civil engineering, industry, transport etc.) and significant increase the share of renewable energy sources and implementation of numerous measures for environment protection.

MATERIAL AND METOD

In the context of sustainable development, sustainable facility construction must ensure durability, quality design and construction with the financial, economic and environmental acceptability. Energetically and ecologically sustainable facility construction tends to:

- Decrease "loss" of heat in facility using better thermal protection of external elements and favorable ratio of surface and volume of the building.
- Increase thermal benefits in a facility by using better orientation and Sun energy.
- Use renewable energy sources in facilities (biomass, Sun, wind, biogas, heat pumps etc.).
- Increase energy efficient of thermo energetic systems.

Application of energy efficient construction is to be achieved:

- Financial savings in reduced bills for heating and electricity.
- Cheaper and better performing processes and a longer life span of the facility.
- Contribution to the protection of the environment and reducing carbon emissions into the environment.
- Contribution to the effects on global climate changes.

Facilities with protected space – "greenhouses"

Buildings with protected space are different according to their purpose, character of technological process, level of mechanization and automation, heating methods, construction solutions and used construction materials. The formation process of thermal regime is very complex. The main purpose of greenhouses is to provide products for population in period when it is not possible on the open land. Basic elements of a facility for growing plants are: area for growing plants, construction of boundary surfaces and system of providing the microclimate in facilities.

Workspace microclimate in greenhouses

The term microclimate in facilities with protected area covers all broadly climate factors. Those are all physical characteristics and chemical composition of the air, before all temperature and relative humidity. Also, climate includes air flow and space lighting. Several groups of factors have influence on the climate: physiological, meteorological and technical factors. Physiological factors are related to the requirements of plants in terms of temperature and relative humidity inside the facility, content of carbon dioxide, air flow velocity and brightness inside facility. Meteorological factors are related to influence of outside conditions (open-air climate): Sun radiation, air temperature and relative humidity, wind speed, precipitations whose influences are affected on the border surfaces and ventilation systems. Technical factors are related to facility dimensions and shape of space (constructive and technological characteristics), thermal characteristics of soil: thermal diffusivity, specific heat capacity, relative soil humidity and systems for providing microclimate conditions (ventilation, heating and lighting). The thermal comfort zones exist for different plants.

Particularities of the greenhouse construction

One of the very important factors of greenhouse construction is right choice of facility location. The area suitable for facility constructing should have larger number of sunny days during winter and early spring months, long lasting cloudy weather or very often foggy days are not welcome, as well as frequently blow of strong and could winds. The therein should be flat or slightly inclined toward south. The greenhouse construction consists of: foundations, parapets and support elements, with pillars, roof-tier and beams. Walls and roof cover are made of glass or plastics. In generally, those facilities are buildings with different shape and dimensions, made of different materials: concrete, bricks, metal, wood, glass and plastic materials. The foundations are usually made of concrete, rarely of stone. The parapet is high approximately 20 to 30 cm, rarely up to 50 cm, made of concrete of bricks. High parapet is not appropriate because it casts longer shadows in the interior during winter months when the apparent path of movement of the Sun is low. Supporting construction, pillars and roof-tier are prefabricated steel, reinforced concrete, rarely wood elements. The most suitable material is steel; supporting elements are made of steel are with the smallest cross sections, so the interior of the building is minimum shaded. The slope of the roof plane towards horizon is 25^0 to 40^0, which means that inner angle on the gabled roof ridge has to be between 100^0 and 130^0, letting solar radiation to fell perpendicular to surface of the roof, which prevents light transmission. That is the best position for production. The difference of angle values is a consequence of latitude of the site where the greenhouse is built. For Serbia, the inner angle of the ridge has to be approximately 130^0, in other words the roof slope is approximately 25^0 towards horizon. The walls of the greenhouse are panels made of the flat clear glass 2.5 to 3 mm thick. For roof cover the same glass panels are used, but 4 to 5 mm thick. Roof and wall elements of glass are joined with auxiliary holders, usually made of the same material like the main construction of the facility. The distance between auxiliary holders is approximately 40 to 60 cm, same as the width of glass panels. Overlapping is way for continuing glass panels on the roof.

Methods and systems to providing the facility microclimate in the narrower sense

Greenhouse facilities have a number of characteristics that should be taken into account in solving the task of providing microclimate conditions:

- A "loss" of heat because of low thermal resistance of boundary surface made of glass or polymer foils and also, because of the considerable air infiltration (10% to 40 %);
- Harsh change in the regime of thermal load in 24 hours, in a season and in a year;
- Low thermal stability of facility caused by small thermal inertia of boundary surface;
- High requirements for microclimate parameters' values, agro technically determined.
- The necessity of performing technological operations which requires additional heat consumption (thermal treatment of soil layer, soil heating, watering etc.)

For those reasons proper selection of methods and systems for the supply of heat is of great importance, as this defines economic efficiency of the greenhouse facilities. Costs for heating in winter time reach 30% to 40 % of the total exploitation costs in vegetables growing. Greenhouse facilities can be heated using solar energy, bio energy materials and various technical ways, which application provides better protection of the environment.

The basic methods for providing microclimate in facility

Basic methods of providing the facility microclimate are: solar heating, biological heating and technical heating. The power of heating system is defined for stationary night regime conditions in accordance to differences between designed air temperatures (external and internal), where the external is selected as the average perennial temperature of the coldest days and nights. The second important criterion is the average wind velocity. The basic methods of heating systems are: heating with warm water, heating with steam, heating with hot air, gas heating, combined heating, and the use of secondary energy sources (usage of already used fluids).

Structural and technological characteristics of greenhouses

Structural and technological characteristics of greenhouses are: the coefficient of boundary surface k_{bs}; the coefficient of "volume" k_v; the number of air changes k; the working surface radiation level; boundary surfaces transmittance. Floor area within the facility, known as the inventory of the surface, is A_f; the area where plant are growing, which is useful area, is A_u; the boundary area of construction, which includes the area of boundary surfaces of walls and roof and which is the heat transfer surface is A_{bs}. Boundary surfaces of greenhouse facility include the supporting structure and the transparent elements. The "loss" of heat trough boundary surface of greenhouse facility depends of the value of A_{bs}. So one of the most important criteria for evaluation of the greenhouse structural perfection (optimum) from thermo technical point of view is the coefficient of boundary surface k_{bs}, which shows the number of times the area of boundary surface is greater than the area of the floor within the facility.

$$k_{bs} = \frac{A_{bs}}{A_f}, \qquad (1)$$

The value of k_{bs} varies between 1 and 2. The smaller coefficient value means more perfect greenhouse facility, from thermo technical point of view.
The ratio between total area of the facility walls and the area of the floor within the facility is coefficient of volume:

$$k_v = \frac{M}{A_f}, \qquad (2)$$

The values of coefficient of volume depend of the cross section shape of the facility. That ratio strongly affects the microclimate conditions in facility. The smaller the difference between the value of the coefficient and plant height, is the better utilization of facility interior is. The roof slope is the other important constructional characteristic. Very important thermo physical characteristic is albedo, or reflection coefficient, which shows the ability of reflecting power of a surface. Albedo depends on

the state of surface (smooth, rough, clean), physical nature of material, Sunbeams falling angle and a number of the others factors.
The characteristic of temperature regime of greenhouse facility interior, which is the result of the complex heating system, is the following criteria:

$$\Delta t_m = \frac{t_{ai} - t_{ao}}{t_{aiibs} - t_{ao}} \tag{3}$$

where t_{aiibs} is the average value of the air temperature beside inner side of baundary layer, t_{ai} is the temperature of workspace and t_{ao} is the temperature of the open air.
The most perfect greenhouse heating system with optimal working volume has Δt_m=1

THE RESULTS AND DISCUSION

Defining the working conditions of buildings with protected space and calculation

For providing microclimate in greenhouse facilities, it is neccesery to obtain a quanitative appraisal of parameters, temperature and humidity, air composition, light regime and the other regimes, which determine the process of heat and mass transfer in the facility interior and soil. For solving this task it is necessary to set up a system of equations, which describes process of heat and mass transfer. In this a greenhouse facility, as an object with protected space, is analyzed as a unique energy system.

Balancing and defining the energy regime of the protected facility space

In thermo technical calculation of facility with protected space, greenhouse, a number of assumptions is made:

- The influence of plant growth on humidity regime in interior is neglected (during the night plant transpiration process is insignificant);
- The screen form by plants, between soil surface and transparent surface, doesn't affect the radiation flux of soil toward boundary layers;
- For the soil surface temperature the average value is used;
- The process of heat and mass transfer inside and outside of facility are considered as stationary.

The calculation of energy regime of a greenhouse facility for determining the thermal power of the heating system is made for the cold period of the year. Thermal flux and power, also humidity flows, are reduced to 1 m^2 of the inventory area of the facility, so they will have prefix "surface" in their names. The scheme of energy balance in facility with the protected space, in the widest sense, is shown on Figure 1. The thermal balance of greenhouse facility, with assumption that there is no precipitation on any of the boundary surfaces, is defined with following equations:

1. The equation of thermal balance for greenhouse facility is:

$$q_{sgps} + q_{spg} + q_{azd} + q_{sz} = q_{kpssgp} + q_{zssgp} + q_p + q_{zvv} \tag{4}$$

where $q_{sgps}$is the surface thermical flux, the surface thermal power of the greenhouse interior heating system, given in W/m^2, $q_{spg}$is the surface thermal flux, the surface thermal power of the floor heating system, given in W/m^2, $q_{azd}$is the surface thermal flux acumulated in the ground during the day, given in W/m^2, $q_{sz}$is the surface thermal flux from solar radiation, given in W/m^2, $q_{kpssgp}$is the surface thermal flux of convective heat transfer from the outside of the boundary surfaces, given in W/m^2, $q_{zssgp}$is the surface thermal flux of radiation from outside of the baundary surfaces, given in W/m^2, $q_{zz}$is the surface thermal flux through the soil, given in W/m^2, $q_{zz}$is the surface thermal flux for ventilation air heating, given in W/m^2.

2. The equation of thermal balance for the soil surface is:

$$q_{gepz} + q_{azd} + q_{spg} + q_{kppz} = q_p + q_{ivz} + q_{zpz}, \tag{5}$$

where $q_{gepz}$is the surface thermal flux of heating elements placed on soil surface, given in W/m^2, $q_{kppz}$is the surface thermal flux of concective heat transfer on soil surface, given in W/m^2, $q_{zpz}$is the surface thermal flux of radiation on soil surfaces, given in W/m^2.

3. The equation of thermal balance for the boundary surface is:

$$q_{kpugp} + q_{zugp} + q_{kugp} = q_{kpssgp} + q_{zssgp}\,, \tag{6}$$

where $q_{kpugp}$is the surface thermal flux of convective heat transfer on the inner side of the boundary surfaces, given in W/m^2, $q_{zugp}$is the surface thermal flux of radiation from the inner side of boundary surfaces, given in W/m^2, $q_{kugp}$is the surface thermal flux with condensation on inner side of the boundary surfaces, given in W/m^2.

4. The equation of humidity balance for the facility space is:

$$w_{ge} + w_{vlv} = w_{kgp} + w_{vev} \tag{7}$$

where W_{ge} is the surface humidity flow, which evaporates from the soil, given in kg/(m^2·s), W_{vlv} is the surface humidity flow, which comes from air humidification, given in kg/(m^2·s), W_{kgp} is the surface humidity flow, which condensate inside of the boundary surfaces, given in kg/(m^2·s), W_{vev} is the surface humidity flow, which ventilation air carries out, given in kg/(m^2·s),

Thermo technical calculation and determine a mathematical model

The purpose of the thermo technical calculation of the greenhouse facility is determination of the basic thermo technical characteristics of the heating system, to provide required parameters of microclimate depending on outside climate factors and construction parameters of the greenhouse facility. Calculations determinate required power of the workspace and the soil heating systems in greenhouse, also the average temperature of soil surface and boundary surfaces.
The equation system of heat and humidity balancing is defined for the night period, taking into account following assumptions:

- There is no plants in the facility,
- All processes of heat and mass transfer are stationary,
- The thermal resistance of some layers of transparent boundary surfaces are neglected (R=0),
- The values of the boundary surfaces and the soil temperature are used as the average values reduced to 1 m^2 of their area.
- The air changes are realized only through infiltration of the outdoor air.

The equation system, based on simplified but sufficiently accurate scheme of the greenhouse facility, which is presented on Fig. 1, includes following relations:

1. The equation of the thermal balance of the greenhouse facility (4):
   $$q_{sgps} + q_{spg} + q_{azd} + q_{sz} = q_{kpssgp} + q_{zssgp} + q_{p} + q_{zvv}\quad,$$
2. The equation of the thermal balance of the soil surface inside greenhouse facility (5):
   $$q_{gepz} + q_{azd} + q_{spg} + q_{kppz} = q_{p} + q_{ivz} + q_{zpz}\,,$$
3. The equation of the thermal balance on boundary surfaces (6):
   $$q_{kpugp} + q_{zugp} + q_{kugp} = q_{kpssgp} + q_{zssgp}\,,$$
4. The equation of the humidity balance of greenhouse interior (7):
   $$w_{ge} + w_{vlv} = w_{kgp} + w_{vev}$$

The scheme on Figure 1 also includes symbols for the temperature and the humidity of the inner air (t_{vu},φ_{vu}), the temperature and relative humidity of the external air (t_{vs},φ_{vs}), the wind velocity (v), the temperature of the soil surface and boundary surfaces(t_{pz}, t_{gp}) and ventilation air flow ($\dot{L}_v$).

CONCLUSION

Calculations based on the mathematical model here presented, which could be used for development of the appropriate software, determine the basic thermo technical characteristics of the greenhouse facility heating system, such as: total surface thermal power of the greenhouse facility workspace and soil heating system, the average temperature of the soil surface and boundary surfaces etc. Thermo technical characteristics of the greenhouse facility heating system have to provide required microclimate parameters depending on:

- Physiological factors: temperature, relative humidity, air flow velocity and brightness inside facility,
- Meteorological factors: outside conditions, solar radiation, the temperature and relative humidity of the external air, wind speed and precipitations,
- Technical factors: facility dimensions and shape of space (constructive and technological characteristics) and thermal characteristics of the soil: thermal diffusivity, specific heat capacity, relative soil humidity and systems for providing microclimate conditions (ventilation, heating and lighting),

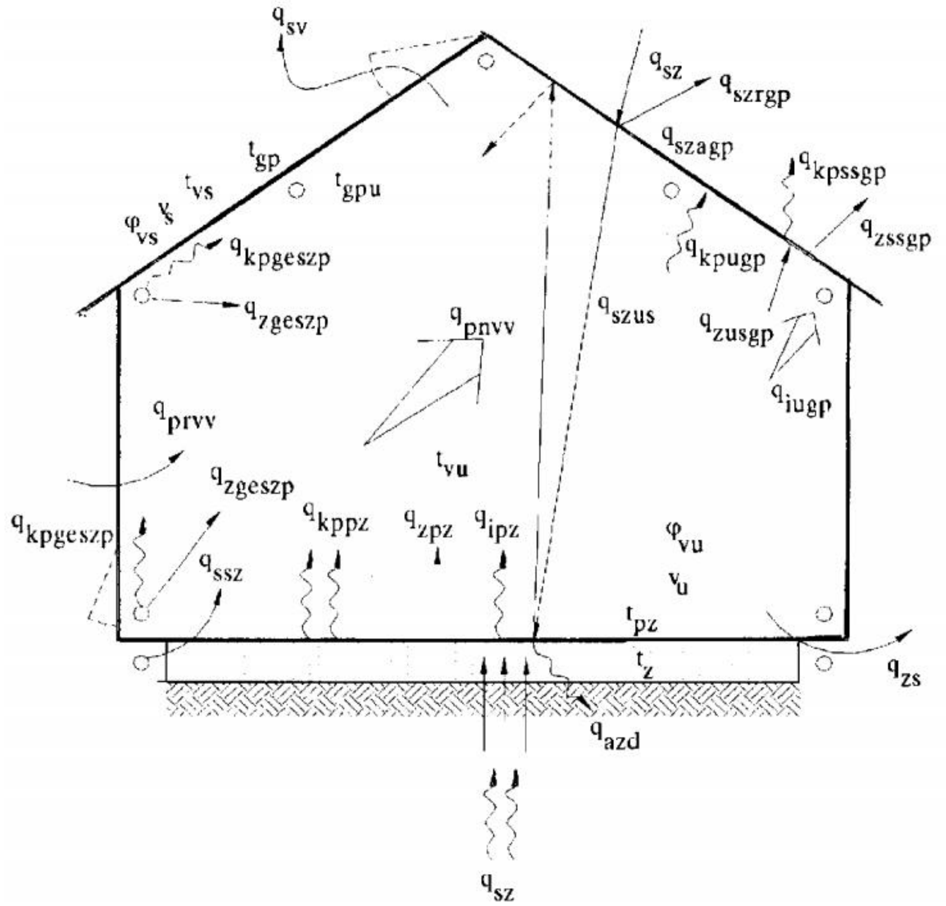

Figure 1. General scheme of the energy balance of the greenhouse facility

q_{sz} – the surface thermal flux of Sun radiation; q_{szus}- the surface thermal flux of Sun radiationthat reached the inner space of greenhouse facility; q_{szrgp}- the surface thermal flux of Sun radiationthat is reflected from the boundary surfaces; q_{szagp}- the surface thermal flux of Sun radiationthat absorbed in the boundary surfaces; q_{szrpz}- the surface thermal flux reflected from soil surface inside greenhouse facility; q_{azd}- the surface thermal flux absorbed in soil; q_{oz}- the surface thermal flux which comes from the soil; q_{kppz}, q_{zpz}- the surface thermal fluxes of convection and radiation from soil surface; q_{ipz}- the surface thermal fluxfor evaporation on the soil surface; q_{kpugp}, q_{zusgp},q_{iugp} – the surface thermal fluxes of convection, radiation and condensation on the inner side of the heated surface,respectively; q_{kpssgp}, q_{zssgp} - the surface thermal fluxes of convection and radiation heat transfer from the external side of the boundary surface, respectively;q_{zs}- the surface thermal flux which comes through the soil inside greenhouse; $q_{kpgeszp}$, q_{zgeszp}- the surface thermal fluxes of convection and radiation heat transfer from the heating elements of the workspace heating system, respectively; q_{zz}- the surface thermal flux of the soil heating system; q_{vpipv}– the surface thermal flux of the air caused by natural and forced ventilation; q_{sv} - the surface thermal flux of theexternal air; t_{vs} ,t_{vu} , t_z– the temperatures of the external and internal air and the soil, respectively; t_{gps} ,t_{gpu} ,t_{pz} - the temperatures of the external and internal sides of the boundary surfaces and the soil surface;

Several assumptions are included in presented mathematical model:

- There are no plants in the facility,
- All processes of heat and mass transfer are stationary,
- The thermal resistance of some layers of transparent boundary surfaces are neglected (R=0),
- The values of the boundary surfaces and the soil temperature are used as the average values reduced to 1 m^2 of their area.
- The air changes are realized only through infiltration of the outdoor air.

Also, additional assumptions, commonly used for calculations of greenhouse facility thermo technical parameters, are:

- The temperature of the interior air in facility is equal to the minimal allowed,
- Relative humidity of the air interior air in facility is 60 %.

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EKG UNIT TECHNICAL SPECIFICATIONS

Tolmač D., Blagojević, N.
University of Novi Sad
Technical Faculty "Mihajlo Pupin", Zrenjanin, Serbia.
E-mail: blagojevicnina@yahoo.com

Abstract: This paper provides a description and technical characteristics of ECG devices in medicine. Data is a block diagram device as well as technical requirements. Given a schematic view of the causes of interference and eliminating the interference in ECG measurements. And data are given for the proper use EKG machine and solutions to problems that may occur at the same time.
Keywords: ECG machine, medical, technical characteristics.

DESCRIPTION

We will explain briefly the parts that there should have been recording the electrical activity of heart muscle, and then we will concentrate on the fundamental difficulties in shooting and opportunities for their smajenje or elimination. First we will explain each block in the Figure 1.

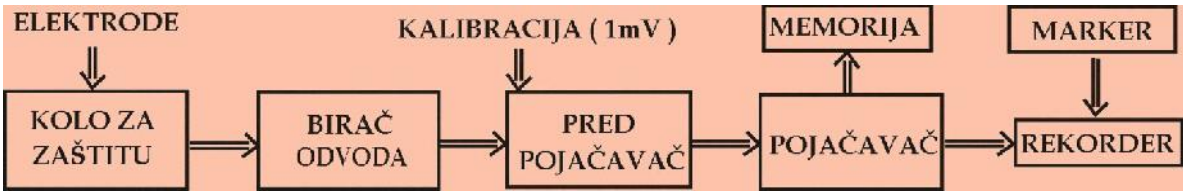

Figure 1. Block diagram of the recording device ECG

Blocks for insulation and protection. This part of the device that prevents current that can endanger the patient comes to the electrode, and prevents any accidental damage large input devices.
b)A voter drain. Each electrode is connected to a voter drain. The voter determines which electrode or electrodes are connected to the corresponding amplifying elements.
c)Calibration block. Calibrated signal generator has a voltage of 1mV intensity. This generator is switched to the input predpojačavača mechanical key switch.
d)Predpojačavač. Predpojačavački degree must have a big impact (A = 2000), high input impedance of the differential (Zul> 10M) and a common signal (Zul> 100M), and a large common factor suppressing signals (CMRR> 100dB). Use the instrumentation amplifier (differential amplifier with three operational amplifiers). For most devices the range of enhancements made to this part of the ECG device.
e)Amplifier. This amplifier is used for adjusting the output voltage of the applied input circuit printer or monitor. The alternating current (AC) provides deflekciju amplifying level jet on a monitor or printer in the desired range. The amplifier is intended to suppress the DC offset potential that comes with predpojačavača. It also has the ability to set the device to show zero signal (offset adjustment of the output signal).
f)Recorder. To display the signals used oscilloscope or a printer with a thermal head. The printers use a special circumstance mechanism regulating the speed of strip thickness and line records.

TECHNICAL REQUIREMENTS

We'll mention the standards prescribed for the ECG device:

1.Linearity and distortion. The deviation from linearity must be less than 5% of the output signal (peak to peak) for the signals that are recorded on a printer (screen) between 5 and 50 mm. To divert less than 5mm deviation must not exceed 0.25 mm in the frequency range of 0.05 to 100 Hz.
2.Input range. Input signals should be less than 10mV (peak to peak).

3.Input impedance and current. Input impedance between terminals must not be less than 5M While everyone else takes the measurements should be grounded. The instrument must not allow the larger current of 1mA is in the patient circuit.
4. Central connection. Robust network should have a central terminal (terminal) and not lead to greater signal distortion than 2%. The central terminal is not me that has a May impedance of 3.3 M.
5. Reinforcement. The device should have three ranges of gain: 5.10 and 20mm/mV the output amplifier.
6. Frequency range. Frequency response should be flat to +0.5 dB in the range of 0.14 to 25Hz. For signals with amplitude less than or equal to 5mV output at 25Hz sine excitation with constant amplitude 100Hz should not be reduced by more than 3dB.
7. Common factor suppressing signals (CMRR). For each position of the drain with the voters to gain 10mm/mV and all leads related to 50Hz and 220V power with a drain that is grounded and a drain that has a capacity of 22pF in series or 100k deflekcija must not exceed 20mm.
8. Calibration. Calibration signal intensity standardinim 1mV to be built for each amplification.
9. Write speed. Standard write speed is 25mm / s. It should be available and the speed of 50mm / s. The accuracy of speed must be in the range of 2%.
10. Exit. Output impedance must be less than 100. The output voltage should be in the range of 1V.
11. Marking the event. Manually controlled marker should be installed on the device.

In clinical applications of ECG devices, there are several difficulties. Before the others will show schematically the reasons for interference measurements. Displayed noise emanating from the phenomena can not be eliminated to reduce the choice of components pravilinim, connecting the patient and the appropriate equipment and ensuring the quality of grounding.

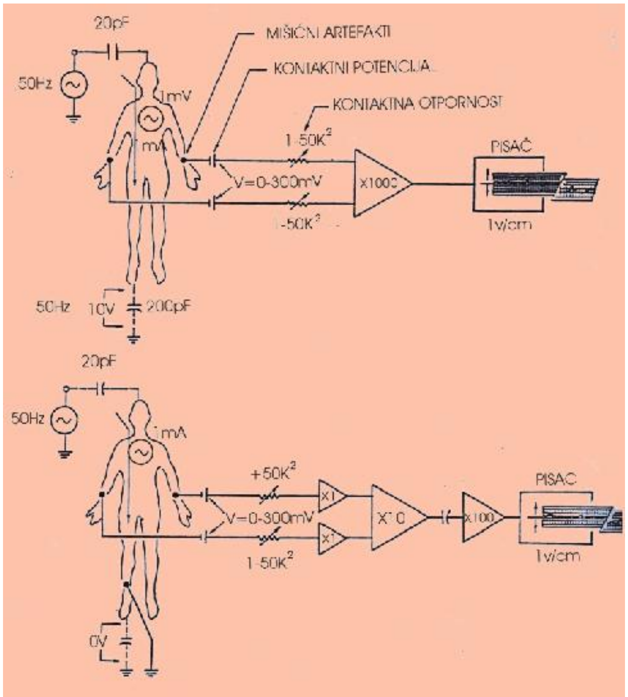

Figure 2. Schematic view of the causes of disturbances (above), and eliminate the interference (bottom) in ECG measurements

1.Frequency distortion and saturation signal clipping and distortion. Frequency distortion caused by amplitude flatness nedovoljnje transfer characteristics in the range of measurements. Distortion leads to a change in the signal in the frequency range jedom, a well-amplifies the signal in another frequency range. Offset single electrode or insufficiently well-adjusted gain can lead to part of the signal does not see the right way.

2. Removal of leads generated voltage circuits to ground. In some cases the patient is in addition to ECG electrodes and connected with another electrical device that has its ground (Figure 3). Because of this connection comes to the emergence of a common voltage, which in case the suppression factor is not large enough, an enhanced artefact. It is important that both devices are connected to the same ground, because then I can create these circuits. One possibility for By eliminating these difficulties is the use of battery-powered ECG unit with no grounding.

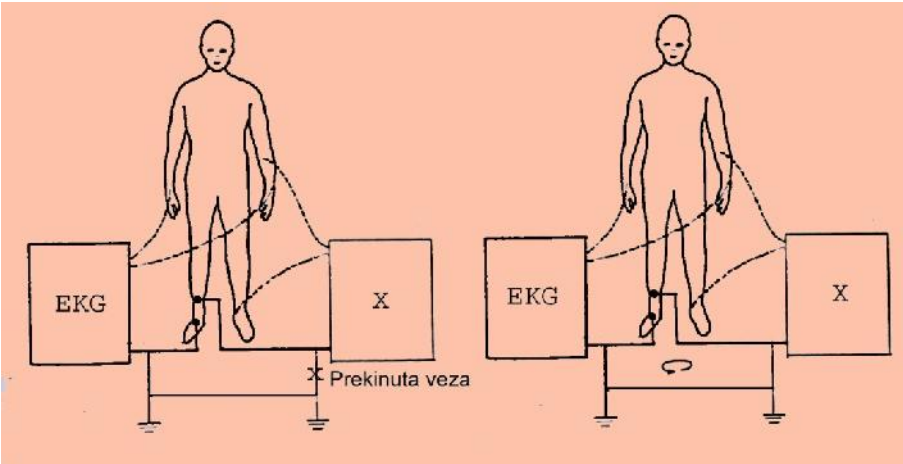

Figure 3. Creating a circuit from the application of devices that have the same grounding

3. Open drain connection. It has been said that all leads that are not used should be grounded. If it happens that some of the drain is not grounded, can be induction of an external electromagnetic field to come to a permanent stream diversion.

4. Artifacts due to sudden and large change in electric field. In some applications of the subject which is connected to ECG and the stimulator (eg defibrillator) that generates an electric pulse of high intensity which acts on the chest. Usually this phenomenon is manifested by sudden moving stream from the working regime. This shift is caused by rapid saturation of the amplifier and take time to recover after saturation of the amplifier (Figure 4).

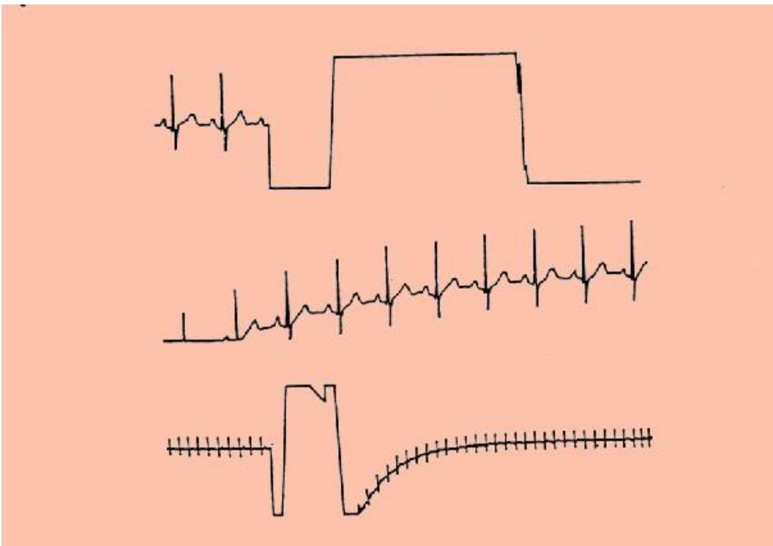

Figure 4. The effects of sudden and large changes in foreign electric field ECG recording

5. ECG interference with other electrical devices. The main obstacle in the record the interference phenomena due to the presence of other electromagnetic phenomena.

CONCLUSION

Today, the medical instrumentation in mass use, and every day more complicated and sophisticated, so that for its implementation must have at least some basic technical skills.

Medical personnel must know how to properly implement electronic medical instruments, so it will not happen to an ECG machine is used for example. due to poor calibration, because all those who are least familiar with the encyclopaedic know that this device is very easy to solve this problem. The doctor has to set an accurate diagnosis and prescribe the proper treatment. The clinical engineer must be responsible for the correctness and accuracy of electronic instruments, needs to know to maintain, and calibrate and interpret the data that these instruments provide.

This work includes all the necessary data for proper handling ECG machine and featured solutions for problems that may occur at the same time.

Therefore, continuing the advancement of knowledge is the strongest source of successful work. Today no modern hospital, clinic or medical center can not imagine my office without successful clinical engineers.

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BIOGAS PRODUCTION OF BIOMASS FROM THE ASPECT OF ENVIRONMENTAL PROTECTION*

Milunovic, S., Curcic, S.
University of Kragujevac, Serbia
Technical faculty, Svetog Save 65, 32000 Cacak
E-mail: smilunovic@tfc.kg.ac.rc

Abstract: The basic guidelines in the management of biomass, with special emphasis on the biogas production from biomass as starting raw material are given in this paper. Benefit of this kind of biomass use is the protection of the environment due reduced broadcasting carbon dioxide into the atmosphere.
Key words: biomass, biogas, environmental protection.

INTRODUCTION

The energy sector in Serbia is at a crossroads. The expected deficit in energy supply and the need for modernization of energy resources was initiated by the need for planning new energy capacity. Energy efficiency, savings and renewable energy sources represent a great opportunity to develop the Serbian energy sector. Serbian economy is more energy demanding 2-3 times more than the EU average. The biggest final energy consumer - industry has great potential for improving energy efficiency, and to technical potential to 28%, and economic potential up to 18%. There are large opportunities for improving energy efficiency in households. Our country has great potential in renewable energy. Their share could be up to 10% national electricity production. In Table 1 given the existing situation shares some EU member states in the use of renewable energy sources in electricity production and set expectations for them in 2010.

PREREQUISITES FOR THE USE OF RENEWABLE ENERGY SOURCES

For building an energy system in accordance with the principles of the EU energy strategy, South East European states should:
• adapt legal regulations and promote renewable energy and environmental protection,
• create an energy system that will provide sustainable, competitive and secure energy,
• define or possibly adapt existing energy strategies,
• find a chance for reduce unemployment through the installation of new energy systems,
• develop research in the field of energy and using renewable energy sources,
• start with a more significant energy production from renewable sources according to the strategy of the EU (20% of energy from renewable sources by 2020),
• all short-term measures incorporate in the vision of energy sector development,
• include in the concept of sustainable economic development of energy policy measures,
• design and encourage diversification sources and energy technologies,
• strategic support for the efficient use of energy (and educational),
• support the strategic use of renewable energy sources,
• supporting strategic research and development of clean and efficient technologies,
• engage in European demonstration projects in the field of new technologies,
• priority must be on the interests of society - people (customers),
• develop projects of education programs, especially for children.

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Table 1. Renewable energy source in the European Union

Country	Existing situation 1997 (%)	Expectations 2010 (%)
Austria	70.0	78.1
Belgium	1.1	6.0
Denmark	8.7	29.0
Finland	24.7	31.5
France	15.0	21.0
Greece	8.6	20.1
Ireland	3.6	13.2
Italy	16.0	25.0
Luxembourg	2.1	5.7
Netherlands	3.5	9.0
Germany	4.5	12.5
Portugal	38.5	39.0
Spain	19.9	29.4
Sweden	49.1	60.0
United Kingdom	1.7	10.0
Total EU 15	13.9	22.1

Key role in the implementation of these measures should have: public, media and people, permanent pressure on the state and other levels of government, local policy initiatives and policies on energy and energy efficiency and environmental aspects.

BIOMASS AND ENERGY FROM BIOMASSS

When we talk about biomass as a renewable fuel, it is understood matter made of plant mass in the form of products, byproducts, or waste residues and plant mass, defined in Table 2 According to the physical condition, with influence in the way of using energy, biomass is divided into solid, liquid and gas.

The solid biomass include residues from crop production, pruning residues from horticulture and viticulture, forestry residues, herbal mass of fast growing plants - in the English-speaking countries known as Short Rotation Coppice (SRC), especially high-growth forests, part of selected municipal waste, remains from the wood processing industry, remains from the primary and secondary processing of agricultural products, and more.

Liquid biomass including liquid biofuels - vegetable oils, biodiesel and bioethanol.

Biogas is a gaseous biomass, which can be produced from animal residues or power plants (grass and corn silage), but as a raw material can also be used other waste materials. Gaseous and liquid biomass represent the products of gasification, ie solid biomass pyrolysis.

Directive 2001/77/EC gives the definition of Biomass: Biomass is the biodegradable fraction of products, waste and residues from agriculture (including vegetal and animal substances), in forestry and the corresponding industry, as well as the biodegradable fraction of industrial and municipal waste. This definition of biomass given in the Directive at the level of the initial definition expecting that countries will define more precisely what is meant by the term biomass. Also, this directive recommends that municipal waste mixture does not include the term "biomass" for purposes of this Directive.

In view of the existence of a very large number of waste material, which to some extent includes biomass, but in addition consist harmful and dangerous substances, the developed countries generally define the term biomass like fuel that can be considered as a clean fuel, without harmful and dangerous substances in it. The term biomass means a renewable energy source involves material which is usually composed of plant mass, including products, byproducts, wastes and residues and plant mass, but without the harmful and dangerous substances, which can be found in a painted and otherwise chemically treated wood, the processes in the wood processing industry.

One very precise defining, what is the biomass as a renewable energy source means, and what is not, prepared by Germany, in its document Biomass Ordinance on Generation of Electricity from Biomass (Biomass Ordinance - Biomass V) since June 2001.
The total annual production of biomass crops in Serbia is over 12.5 million tons per year. Produced biomass potential of some "major" culture, its heat potentials and saving possibilities of liquid fuels are given in Table 3.
Biomass is part of a closed carbon cycle. Carbon from the atmosphere used in the process of plant photosynthesis, the incineration of carbon is released back into the atmosphere as carbon dioxide (CO2). As long as it respects the principle of developing renewable (plant as many trees as are cut down) this form of producing energy has no significant impact on the environment.

Table 2. Description of materials that are or are not in the concept of "biomass" in terms of using as renewable energy sources

Include the term "biomass"	Does not include the term "biomass"
Plants and parts of plants	Fossil fuels
Fuel from plants and parts of plants, which all components and intermediate products produced from biomass	Peat coal
Residues and by-products of vegetable or animal origin in agriculture, forestry and commercial production of fish	The mixture of urban waste
Biological waste, such as biodegradable waste in the food process industry, biodegradable material remains from the kitchen, separated bio-waste from households and firms, biodegradable waste from wood industry and from natural environment maintenance. It is essential that this type of waste has a calorific power of at least 11,000 KJ / kg (environmental criteria)	Wood residues containing polychlorinated biphenyls or polychlorinated terphenyls, mercury and other harmful substances that, during thermal utilization of wood, emit in amounts higher than allowed
Gas produced from biomass in gasification or pyrolysis and other products, as a result of these processes	Paper, cardboard
	Drainage waste
Alcohol, as fuel, produced from biomass, whose components and intermediate products also produced from biomass	Textile
	Parts of the animals body
Waste wood from wood processing and from industry of wood materials	Gas from landfill in the soil
Biogas produced by anaerobic fermentation, where in fermentation are not included materials in the non-biomass and in which no more than 10% parts by weight of drainage waste	Gas obtained by treatment of drainage waste

Table 3. Potential produced biomass from some "major" culture, its heat potentials and liquid fuels saving possibilities

Number	Types of biomass	Lowest heating value (MJ/kg)	Relation to light heating oil * (kg/l)	Possibilities for heating oil saving (10*l)
1.	Wheat straw	14.00	3.41	872
2.	Barley straw	14.20	3.46	119
3.	Oats straw	14.50	3.54	7
4.	Soybean straw	15.70	3.83	84
5.	Corn residues	13.50	3.29	2173
	* In the thermal power of light fuel oil from Hd = 41000 KJ/kg			

Biomass often called carbon neutral fuel, but it can still contribute to global warming. This happens when you disturb the balance of cutting and planting of trees, such as in deforestation or urbanization of green areas. When biomass is used as fuel instead of fossil fuels, it emits the same amount of CO2 into the atmosphere. Carbon from the biomass that makes up approximately 50% of its mass is already part of the atmospheric carbon cycle. Biomass absorbs CO2 during its life cycle and releases it back into the atmosphere when using for energy. In fossil fuel it is different, because in them stand

out from the long-term carbon storage, which would otherwise have been forever captured and released into the atmosphere.
Energy from biomass can be obtained in various ways: (1) by direct burning to obtain thermal energy (wood, plant residues, wood waste), (2)-digestion processing of animal waste (manure) into biogas, (3) processing of biomass into alcohol (ethanol) or vegetable oils production.

Biomass potential in Serbia

Serbia with an area of 88 361 km2, of which forest covers about 24 000 km2, while about 45 000 km2 of agricultural land, has an extremely high energy potential in biomass. In Serbia, on average, each year produces about 12.5 million tons of biomass, of which only in Vojvodina, about 9 million tons of which are 15-20 years ago and began the construction of facilities for the use of biomass for energy purposes. However, because of general situation in the country, has ceased to encourage the construction of such facilities. The energy that could be obtained by using this source is 2.68 million tons of oil equivalent, which would save about 60 million euros a year on account of imports. It was built several plants to use biomass as fuel in Vojvodina.
In Serbia, there have been no significant results in the use of biomass as energy source in spite of large existing potential. A shared commitment of the domestic economy and research institutions, through demonstration projects, in order to create conditions for more farms use their own biomass residues for energy production. Aware of the importance of renewable energy sources, Serbia signed the application form the International Renewable Energy Agency - IRENA (INTERNATIONAL RENEWABLE ENERGY AGENCY), at the Founding Conference in Bonn, held January 2009.

BIOGAS FROM BIOMASS

In agriculture, there are large amounts of crop residues which can be partly used for energy purposes. It is unacceptable to completely remove all plant residues from the soil so as not to disturbed impoverished soil and the natural cycle of circulation substances in it. Often, because of ignorance of what to do with plant remains, it is burned in the fields, which is very harmful. Biomass from animal production (livestock manure) is also an excellent energy source. Energy obtained from liquid manure during operation emits no harmful gases that are produced during combustion of conventional fossil fuels, thereby contributing to greater environmental protection. For example, about 10 to 12 kg of liquid manure from 4 to 10% dry substance is required to obtain 1 m3 of biogas. The biggest problem is actually investing in systems to produce biogas. If the energy invested in the exploitation and processing of an energy higher than the output energy of the fuel, the exploitation of is deadweight loss. The goal, in fact, is to create a system that supports itself (Figure 1). For this process, the balance of biogas production from which they receive a certain amount of electricity and thermal energy is given in Table 4.

Table 4. The balance of biogas production from which we receive electrical and heating energy

Substratum	The quantities t / day	Ss substance (%)/ss organic substance (%)	Methane production (m^3/kg)
Organic waste from households	33	20/17	0,306
Waste from food industry	29,5	15/13,5	0,471

TECHNICAL SYSTEMS FOR PODUCTION AND USE OF BIOGAS

Large biogas plant for cofermentation

In recent years the construction of these facilities has contributed to a significant increase in mean absolute and installed electrical power from the biogas plant. In these plants are processed and osoka cosubstrates from farms and, if possible, cosubstrates from industry. The owners of these plants are

usually co-operatives - more farmers associations and potential heat users.
The usual mix ratio of osoka and cosubstrates is between 3:1 and 2:1. Fermented mass is given to farmers, and they throw is on agricultural land. For such a large biogas plants are typical standing vertical fermentors of enameled steel or concrete with a centrally placed stirrer that continuously drives. Fermentors have the capacity 1000-5000 m3, and the ratio of height - diameter between 1.1 and 1.5 [6].

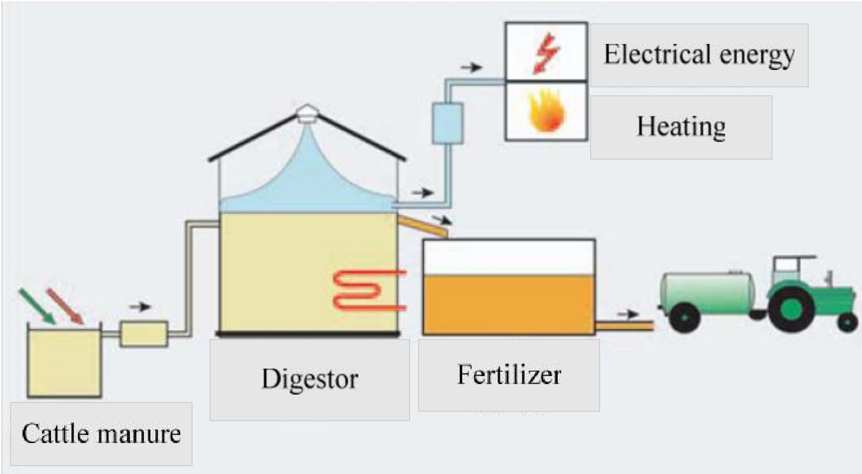

Figure 1. Scheme of processes and plants for processing of manure and organicmanure and biogas obtaining

Economy of biogas production

Rentability of biogas plants depends on many factors. These are primarily:
- availability and yield of the substrates,
- substrate preparation costs or salary due to the receipt cosubstrates,
- plant operating costs and investment incentives,
- efficiency of energy use,
- amount of compensation for delivered electric power and
- possibilities for heating energy sale.

Keymer [7] after evaluating a number of systems in practice and the model calculations, concludes that biogas plants working on the farms with up to 100 conditional cattle, which are processed only osoku from cattle or pigs, can not be economical to exploit. In the case of larger biogas plants (2000 conditional cattle) addition to reduced silage corn company earnings in almost all tested cases. Investments that are required to do so could be compensated only in individual cases and then if possible the efficient use of energy resulting from or to effectively get at least 30% of waste heat. A detailed calculation of cost-effectiveness and cost effectiveness of so-called renewable resources of energy plants, which are used as kosupstrat, shows that with the exception of corn silage maize fate of the mix, the whole plant silage and wheat, even with highly valuable power plants and high yields in the field of this procedure is not worth it [9]. This is primarily a consequence of the high cost of production of these plants and a lot of great work on the preparation for cofermentation. The main point on which can be based profit improvement of the enterprise in agricultural biogas plant work is increase the power level of efficiency, increase of methane production, reduction of investments for an aggregate of coupled heat and electricity production and reduce costs for breeding and production of renewable raw materials.
The trusted statements of economy biogas plants can be given only if we observe each individual plant. The general conclusion that can be achieved, and without taking into account the incentives, a substantial income tax, which results only from fees obtained for the sale of electricity.
Detailed analysis of the economy of a large centralized plants for cofermentation in conditions in Denmark showed LYHNE (2004) [10]. The owners of these plants are mostly farmers associations and potential users of heat. Income is generated from fees for takeover of waste that make cosubstrat

and sales of energy. In addition, biogas plants and profiting from it as tax free sales of heat. The fee for delivered electricity in this case is 3.6 cents / kWh. Specific investment costs of production showed a significant reduction in the effect of increasing the biogas plant (Table 5). Based on this analysis indicates that even in these conditions is not profitable plant work only with the operation for liquid waste fermentation.

Table 5. Consideration of cofermentation economy in the centralized biogas plants in Denmark

Capacity of processing	m^3/day	300	550	800
The specific investment costs	€/m^3year	55	44	37
The specific transport costs	€/m^3 year	2,1	2,1	2,4
Specific plant costs	€/m^3 year	7,2	5,5	4,7
Total costs for transport and plant work	€/m^3 year	7,3	7,6	7,1
Cosubstrates level to cover costs	%	21	13	10
Biogas production for cover costs	m^3 biogas/ m^3 substrat	34	27	25

ECOLOGICAL ASPECTS

Frequent bad weather conditions (extreme drought, fires, floods and temperature disorders) were observed an increasing number of warning and expert reports on the planetary climate change and global warming. The increased content of carbon dioxide in the atmosphere created during the industrial era fossil fuels, causes increase of surface air temperature mean significant climate change. In addition, the latest studies of the atmosphere show that the climate might change and the larger scale and much faster than is currently the case. The latest data show that when levels of atmospheric carbon dioxide becomes doubled (about 500 ppm) compared to preindustrial time medium temperature increase on Earth will be 2.0 ± 0.6 ° C (in less precise forecasts of 2.8 ± 1.2 ° C), which is expected between the 2030th and 2050. year. Models clearly point to two main causes of global warming - increased levels of carbon dioxide and cutting of tropical forests.

On the other hand, there are those who believe that these data are not facts but fabrications and that spread hypotheses about catastrophic risk has no scientific basis. Their arguments are as follows:

1) no developed theory about climate and we dont no precize how certain climate generated,
2) there is no evidence that CO2 atmospheric pollutant that any increase in its concentration causes a global increase in temperature, even the opposite,
3) can not be modeled in advance future climate changes,
4) there is no scientific consensus about climate change caused by human activities,
5) temperature in the last century is not grown with dangerous speed and reached a dangerous level,
6) the IPCC is more political than scientific body that has not provided persuasive evidence of the measurable impact of human activity on global climate,
7) CO2 from human activities represent only 3% of total natural flux and the guy with the oxygen in the Earth's biosphere involved in the metabolism of the planet,
8) CO2 increase for 200-1000ppm is useful for plant growth, and that higher level can have harmful environmental effects.

Proponents of other thesis believe that CO2 is a minor greenhouse gas, responsible for about 26% (8 ° C) of the total greenhouse effect (33 ° C), of which more than 25% can be attributed to human activities. Water steam is the most common atmospheric greenhouse gas (minimum 70%).

CONCLUSION

By enabling into the European integrations Serbia accepts commitment for reducing CO2 emissions to the atmosphere. Using biomass instead of liquid fuels for energy production significantly reduced

environmental pollution. Combustion of biomass not only does not increase the CO2 content in the atmosphere and creates no greenhouse gases but combustion does not produce any harmful ash.
According to the modern world experience and research, considered that the renewable energy especially biomass and wood waste will speed up the trend of its use of the current 0.15% to about 1.3% by the end of the decade, it must be admitted, an impressive ratio. Installations for the production of energy from biomass in the future will enable progress in the development of ecology, agriculture, energetics, and the whole economy, each region who choose to use them.

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DEGRADATION OF POLYMERIC MATERIALS

Djapic, N.
University of Novi Sad
Technical Faculty "Mihajlo Pupin", Zrenjanin, Serbia
E-mail: djapic@tfzr.uns.ac.rs

Abstract: Plastic materials for single use represent much of the solid waste. In recent years, glass was replaced by plastic materials and as a result of that raised a need for the degradation of the plastic packaging materials. Degradable plastic packaging materials are: biodegradable polymer fillers, additives (photoactivators, chemically related units of the polymer system) and water – soluble synthetic polymers. The UV radiation is dominant factor affecting the durability of polymeric materials. The degradation caused by UV radiation is photodegradation. The study of the photodegradation phenomena is essential for the better understanding of polymeric materials degradation. The study reports the effect of UV-rays on the photodegradation of ethylene – ketone copolymers.
Key words: polymeric materials, photodegradation

INTRODUCTION

The amount of plastic for single use is continuously increasing. Per year, 23 million tones of plastic materials are produced globally [1]. In addition, apart to polymeric materials, in the solid waste is, also, present: paper, waste from fruit and vegetables, metals, glass, textiles, rubber and leather. Fruit and vegetables litter are the only solid waste subject to biodegradation. Solid plastic waste is remarkable and its recycling mechanism should be addressed.

THE MECHANISM OF POLYMERIC MATERIALS BIODEGRADATION AND DEGRADATION

Microbial biodegradation of polymeric materials

The mechanism of polymeric materials biodegradation can undergo using bacteria, fungi and their enzymes. At high temperatures, elevated humidity and the presence of oxygen the biodegradation goes faster. The polymeric materials with its physico – chemical properties are inert systems and there is a need to create conditions for increasing the contact surface in order to lower their molecular weight. The polymeric materials that are susceptible to biodegradation are: aliphatic polyesters and polyurethanes. Biodegradation of polyesters is possible with the enzyme esterase that hydrolyzes the ester bond. The caprolacton polymeric material is susceptible to biodegradation with enzymes. The polycaprolacton loses 95% of its mass during a year when left beneath the ground surface [2]. Polyhydroxybutyratevalerates are subject to biodegradation as well as polyamides obtained from ε - aminohexanoic acid [3]. The polymeric materials that are not subject to biodegradation due to their high molecular weight are: polyethylene, polypropylene, polyvinyl chloride, polystyrene and vynilketones. Degradation of polystyrene, after labeling with radioactive isotope ^{14}C, produces $^{14}CO_2$ [4]. Adding fillers or biodegradable compounds, that cause oxidation, can enhance the degradation of polymer materials. The degradation mechanism is the oxidation of the fillers that are activated after the contact with salts from the soil or water, which results in creating peroxides. The peroxides initiate degradation of the polymer chains and reduce the molecular weight to the extent at which microorganisms can initiate the decomposition. The degradation of polymers results in the formation of CO_2 and H_2O.
The biodegradation mechanism of polymeric materials (paraffins), in which microorganisms are involved, involves the oxidation of carboxylic acids formed by beta-oxidation and reactions with co-enzymes [5].
The polyethylene biodegradation, by photooxidation, accelerates the processes that cause the formation of low polymer units, which increase the specific surface area of the polymer matrix and increase the formation of polar hydrophilic carboxyl groups [6]. The polymers biodegradation is limited to bio – oxidative processes of fatty acids. The fatty acids, which can be oxidized by enzymes that can oxidize the unsubstituted β - carbon atoms, to the carbonyl group will enter the citric acid

cycle. The acetyl coenzyme - A is part of the citric acid cycle and becomes a source of energy for microorganisms (Figure 1).

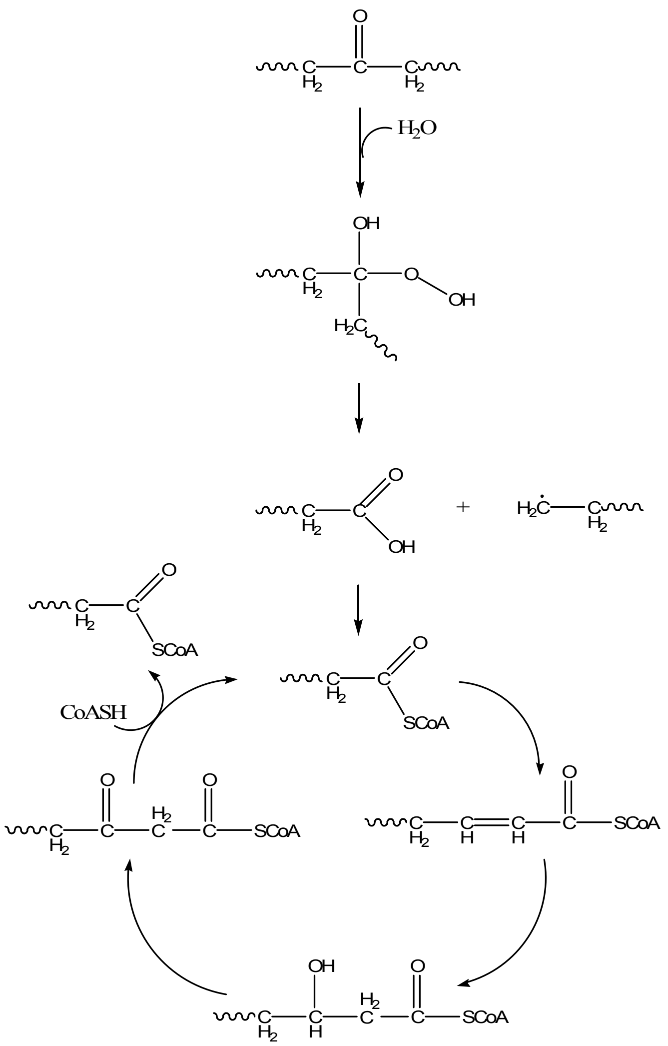

Figure 1. The mechanism of biodegradation of polyethylene [6, 7]

Photodegradation of polymeric materials

The ultraviolet (UV) emition of the solar spectrum (290-320 nm) leads to the photodegradation of the polymeric materials. This oxidation mechanism leads to splitting of the primary C – H bond in the polymer material. The photodegradation occurs by the activation of the polymer macromolecule initiated by the absorption of a photon of light by the polymer [8]. A polymer macromolecule can be activated bylight to its excited singlet or triplet state. When the energy of the absorbedUV light is sufficiently high the chemical bond breaks down, the photolysis starts and two radicals are formed. In an inert atmosphere, radicals can either recombine or abstract hydrogen from the polymer backbone. In thepresence of oxygen, the photooxidation takes place. The latter process consists of threemain steps: the initiation stepinvolves free radical formation, in the second step – propagationthe free polymer radicals react with oxygen (polymer oxy- andperoxy-radicals are formed, the rearrangementsand chain scissions can take place) and in the last step – terminationinvolves the recombination of different radicals.

The second photodegradation mechanism is the photolysis of carbonyls, known as the Norrish reaction of type I and II (Fig. 2 and 3). A common chromophore, which often participates in the initiation of photodegradation, is the carbonyl (C=O) group, either present as a ketone, aldehyde or

ester group. This group can be present in the polymer structure both as a part of the repeating unit (polyester) or as a defect (polyolefins). It can also be part of an impurity.
The Norrish type I reaction is a photocleavage of the bond at the α-position to the carbonyl group generating two radicals: acyl and alkyl. The acyl radical can subsequently undergo decarbonylation:

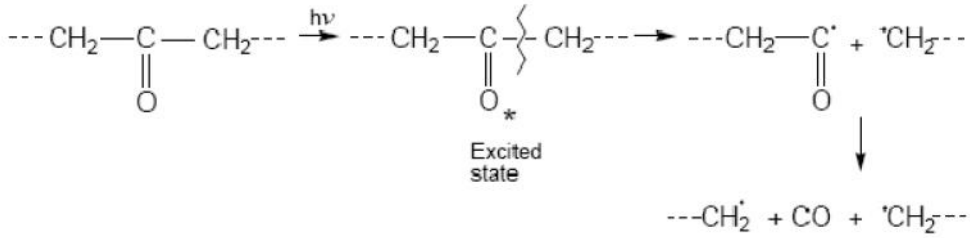

Figure 2. Photodegradation mechanism known as the Norrish I

The Norrish type II reaction is a non-radical intramolecular process, in which the hydrogen is transferred from the γ-position to the oxygen of the carbonyl. This results in decomposition into a molecule with an unsaturated end group and a molecule that contains, after enol/keto tautomerization, a carbonyl end group.

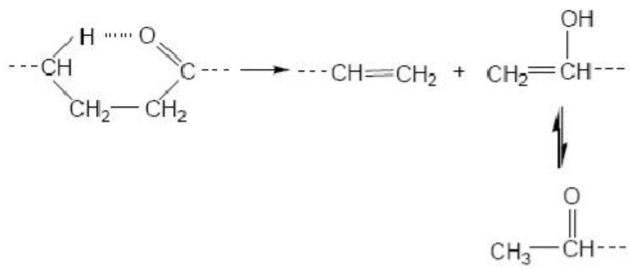

Figure 3. Photodegradation mechanism named Norrish II.

By this mechanism, large polymer molecules are decomposed, leading to a reduction in strength of polymeric materials. Photolysis processes begin on the surface of the polymer and take place near the surface and a factor, which should be taken into account, is the proportion of crystalline and amorphous phases, because the absorption of oxygen takes place in amorphous phase. The traces of volatile compounds: carbonyls or peroxides produced during the refining process also affect the photodegradation process. The mechanism of polymer materials photodegradation is based on the photochemical processes of the following systems: ketone / carbonyl, ethylene / CO and the antioxidant / photoactivator. The ketone / carbonyl system (ECOLYTE), obtained by copolymerization of ethylene and styrene with comonomers which contain ketones, is a polymer where at the end of the polymer chain an unstable chromophore group is bonded and needs low energy to be initiated. The degradation speed is proportional to the ketone contribution in the copolymer.
The ethylene copolymer with carbon monoxide (CO) is obtained by polymerization of ethylene with CO, as a comonomer, at high pressure. The photodegradation speed depends on the content of CO.
The aromatic ketones (for example benzophenone) have been proven to be effective photoactivators which become biradicals in excited state, when in the polymer chain the hydrogen is removed and thus further photooxidation is initiated. The photoinitiator can be metal complexes or titanium and zirconium chelates, which can be used along with ketones [9].

MATERIAL AND METHODS

Polymer materials were purchased from the local supplier of polymers.
Samples of 50 x50 mm were used for UV-soaking. The UV-irradiation of the samples was carried out using an array of UV fluorescent lamps emitting light in the region from 280 to 320 nm. The temperature of the samples during UV exposures was 40°C and the relative humidity was 35 %. An untreated polymer material sample was used for the purpose of comparison. The physico-chemical

structural changes in the irradiated samples were monitored by Fourier transform infrared (FT – IR) spectrophotometer. The infrared transmission spectra of the studied ethylene – ketone samples were obtained with ATI-Mattson FTIR spectrophotometer in the region between 400 and 4000 cm^{-1}. Data were analyzed between 1300 and 1800cm^{-1}, the values of carbonyl index (C.I) were calculated as the ratio of the absorbance (A) at the two wave numbers [10]:

Carbonyl index (C.I) = A_{1710} / A_{1380}. (1)

The peak at 1710 cm^{-1} corresponds to the absorption from the presence of carbonyl group, which is a by-product of the oxidation of the studied polymeric materials. The band at 1380 cm^{-1} was taken as a reference peak.

RESULTS AND DISCUSSION

The decomposition of polymeric materials under UV exposures is presented in Table 1. The results show that the carbonyl group content influences the photodegradation of the polymeric materials. The mechanism under which the polymeric materials are decomposed is the photocatalytic degradation of the composite films by Norrish type I photocleavage which is the main initiation step of the photodegradation of the ET/CO copolymers. The degradation process spatially extends into the polymer matrix through the diffusion of the active oxygen species and once the carbon-centered radicals are introduced in the polymer chain, their successive reactions lead to the chain cleavage.

Table 1. Photodegradation of ET/CO copolymers, investigations on composite films with the thickness of 2mm

Polymer	**% CO**	**Time of decomposition**
LDPE	-	8 months
ET/CO	1	2 days
ET/CO	13	½ day

Table 2. Photodegradation of ethylene/ketone copolymers

Copolymer	**% of ketones in comonomer**	**C. I release**
ET/CO	1% CO	1.1
ET/ketone	2% methylvynilketone	4.2
ET/ketone	2% methylisopropenyl ketone	8.4

The behaviour of the exposed copolymers to UV-radiation in air can be attributed to the uptake of oxygen, formation of carbonyl, hydroxyl and vinyl groups; water and carbon oxides [11]. This may be observed from the IR-transmission spectra of the copolymers investigated. Considering the IR-spectra of the investigated copolymers and analyzing the data between 1300 and 1800 cm^{-1}, the values of the carbonyl index (C.I) release were calculated according to Eq. (1) and are presented in Table (3). From Table (3) it is found that ratios highly depend on the composition of copolymers. The high efficiency of carbonyl groups as photodestabilizer is due to its UV- absorptivity and the reaction of the polar groups present on the surface with the free radicals formed present in the copolymers investigated. Thus, the higher presence of carbonyl groups is an advantageous in case when degradable polymeric materials are needed [13]. Therefore, the use of these copolymers, in proper amounts, gives an excellent improvement in physicochemical properties of investigated copolymers exposed to UV-radiation.

CONCLUSION

The photodegradable plastic is cheaper than biodegradable. The photodegradable plastics are degradated only by light and the process does not take place when photodegradable polymer enters the soil or water. The photodegradable polymers after the addition of some granulate can be extruded into thin films, which can have the mechanical properties equivalent to conventional films. The biodegradable polymers include starch as an additive to the polymer matrix. High moisture absorption by the starch makes it difficult to recycle these polymeric materials. The solution can be in the application of cellulose acetate starch.

The future of plastics depends on the technology, consumer opinion and legislation. Taking into account the increasing pollution of the environment there is a need for the rational use of plastic and paper. The production of polymer materials uses less energy than paper production. The pollution of water is less during the plastic production than in the case the of cellulose production [14]. In developing environmental awareness for or against the plastic it should be taken into account, all the informations, about environmental pollution of: polymer materials, paper, textiles, etc. The legislation is faster than technological development, so a large number of legislative solutions will provide optimal solutions for the protection of the environment.

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SOLAR ENERGY POTENTIAL ON THE TERRITORY OF AP VOJVODINA

Lambić, M., Pekez, J.
Technical faculty „Mihajlo Pupin“, Zrenjanin
E-mail: jpekez@yahoo.com

Abstract: The paper shows potential of solar energy in Vojvodina. The aim of this researches is to point out the necessity of creating an enabling environment for promoting solar energy and the gradual removal of barriers to stronger penetration in the energy market.
Keywords: potential, solar energy, Vojvodina

INTRODUCTION

A quick advancement in renewable energy production in the countries where political will has matured enough to make a decision to follow this direction, shows that abandoning the fossil fuels usage is a real perspective [1]. Renewable energy has the potential to play an important role in providing energy with sustainability to the vast populations in developing countries who as yet have no access to clean energy [2]. All member countries of the EU have the obligation to increase the share of renewable energy sources in their electricity production and to set their objectives – how many renewable energy sources in relation to the total consumption they want to develop in the following period.

The goal of the new Serbian Energy Sector Development Strategy [3] is to build a sustainable energy system with balanced development of relations between environmental protection, competitiveness and security of energy supply, which will enable energy supply to Serbian citizens and economy, under the conditions of uncer tain situation in the global energy market and with scarce local energy resources.

From the energy sector point of view, solar radiation presents a resource that is available for use and the substitution of considerate quantities of conventional energy forms. Its limited use is caused by technological and economical problems. It is a huge energy source with which demand for the energy can be covered for a very long time.

SOLAR POTENTIAL IN AP VOJVODINA

Of radiation from the Sun radiating on the Earth, whose power density reaches the values from 970 to 1.030 [W/m2] - the useful radiation quantity on the unit of free orientated area, depends on its orientation (should be oriented towards south), on its angle (it is preferred to have Sun beams reaching the receiver at the angle closest to normal (direct), so the radiation - the density of the power can be bigger), on the construction and energetic characteristics of the solar energy receiver, part of the day, part of the year, time of insolation, atmospheric conditions and other. The power of solar radiation changes during day, month and year. Its value depends on geographical position, conditions of the atmosphere and other.

The potential of solar energy presents 16,7% of overall usable potential of Renewable Energy Sources (RES) in Vojvodina. The energy potential of solar radiation is for about 30% bigger in Vojvodina than in Central Europe.

The number of sunny hours in Vojvodina goes from a bit less than 2.000 hours (western part) up to 2.100 hours (eastern part). According to "*Valentin Energie Software -TSol Pro 4.5*" the average annual value of global radiation for horizontal surface is between 1.294 kWh/m^2 on the north of Vojvodina and 1.350 kWh/m^2 on the south of Vojvodina, and 1.281 kWh/m^2 on the west and up to 1.294 kWh/m^2 on the east of Vojvodina. This shows that on the same source, the average yearly value of sun radiation over a horizontal area for the territory of AP Vojvodina is around 1.300 kWh/m2. The average daily energy of global solar radiation on horizontal surface at the territory of Vojvodina goes from 1,0 – 1,4 kWh/m^2 during January, and from 6,0 - 6,3 kWh/m^2 during July. At the territory of Vojvodina, the annual average of daily solar radiation energy on the surface leaned towards south under the angle of 30° results with 4,0-4,6 kWh/m^2.

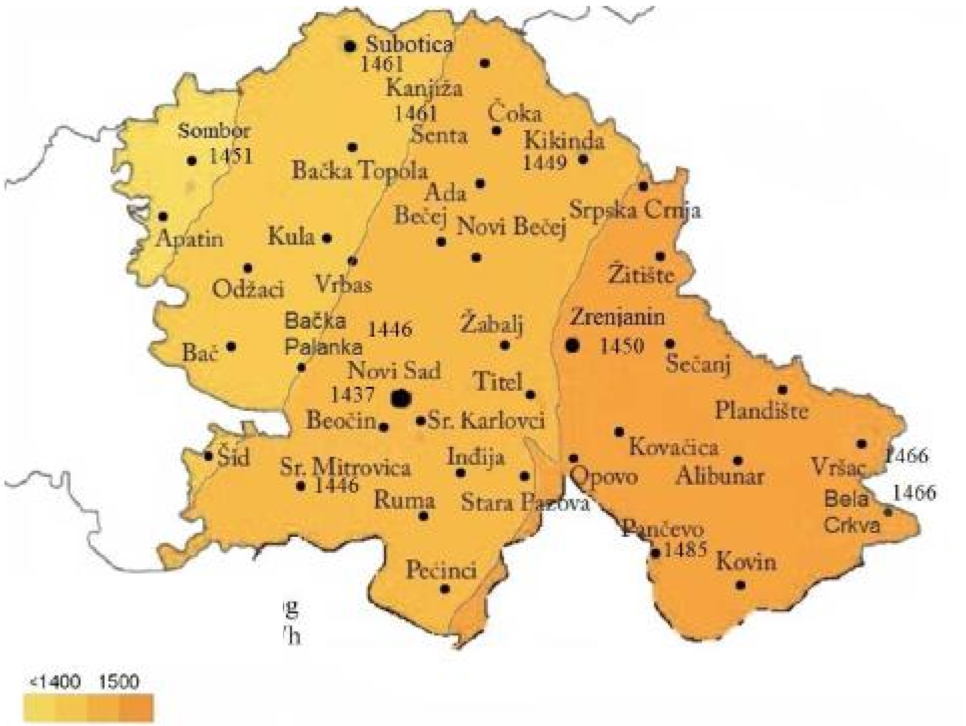

Figure 1. Yearly average of daily global energy radiation (in kWh/m2) on a surface at the angle of 450 for Vojvodina

The average daily energy of global radiation on even surface during winter period goes from 1,0 Wh/m^2 on the north of Vojvodina to 1,45 kWh/m2 on the south of Vojvodina (December - January) and up to 3,55 (March), and during summer period between 5,70 kWh/m^2 on the north and 6.85 kWh/m^2 on the south (June - August). According to meteorological measuring made in the span of 30 years in ex Yugoslavia, the values of radiating energy on some horizontal surface are larger from estimation values (according to *Valentin Energie Software -TSol Pro 4.5*) for about 9 to 12%.
In the conditions of irradiation in Vojvodina - depending on the season and atmospheric conditions - the intensity of global radiation in afternoon hours can vary from 200 do 1.000 W/m^2. The relation of direct and diffuse radiation depends on geographical and microclimatic conditions. Diffuse radiation on the level of average for entire year makes 40-60% of global radiation, where during winter this participation is bigger.
Solar energy collector, is put under a certain angle and oriented to the south in the aim of getting maximum energy effects. Due to the relative position of the Sun to the place where the receiving surface is located and its changing positions in the course of a day, month and year, it is necessary to provide the immovable receivers with the right orientation and the maximum exposure of the receiving surface to the Sun, and by this to achieve better energy result. But if accommodating conditions do not permit ideal south orientation, it is not necessary to insist on them, it is possible to position the same into a slightly turned position (towards south), without a big energy loss. In that way, for example, for places in Vojvodina, the deviation of solar collector from ideal south orientation of 15 to 30^0 lessens the quantity of radiation energy for about 5 to 10 % (respectively).
For the territory of Vojvodina a suitable angle for some south oriented surface (of solar collector) for the maximum "catch" of solar radiation during the whole year, is an angle of around 40 to 45^0, and for solar collectors that are mainly used during warmer periods of year (late spring, summer and early autumn), that is when better effects are expected in that period, the optimal angle is around 30^0. For solar collectors where better energy effects are expected in a colder year period (late autumn, winter and early spring) the optimum angle of solar collectors is around 60^0. So, for example, for a surface laid at the angle of 300 the annual value of radiated energy is bigger for about 13-14% - in comparison to horizontal surface.

Since the angle covered by the Sun's ray with its horizontal projection changes during day, month and year - the optimum angle of static receiving surface presents compromise solution according to which this angle suits medium angle for a certain period of exploitation during a year (Table 1) . The dependence of the angle of receiving surface - the solar energy receiver (in relation to the horizontal surface) from the season for achieving maximum energy effect on the static receiving surface in that specific period is given. For the territory of AP Vojvodina, a suitable angle of some south oriented surface (solar collector) for the maximum "catch" of solar radiation during the whole year equals the angle of around 40 to 45^0, and for solar collectors that are mainly used during warmer seasons (late spring, summer and early autumn), that is when better effects are expected in that period, the optimal angle is around 30^0.
For solar collectors where better energy effects are expected in a colder year period (late autumn, winter and early spring) the optimum angle of solar collectors is around 60. So, for example, for a surface laid at the angle of 30^0 the annual value of radiated energy is bigger for about 13-14% - in comparison to horizontal surface. For a surface at the angle of 450 annual value of irradiated energy is bigger for about 12 to 13% - in comparison to horizontal surface.

Table 1. The optimal inclination of the statical acceptance surface for realizing of maximal energetic efficiency of the sun radiation in specific periods during the year- for 45° latitude

<table>
<tr><th rowspan="2">Month of the year</th><th colspan="4">Potreban nagib statične prijemne površine (^{o})</th></tr>
<tr><th>For the month of the year</th><th>For season (year period)</th><th>For winter and summer semester</th><th>For the entire year</th></tr>
<tr><td>Januar</td><td>66</td><td rowspan="3">60 do 50</td><td rowspan="3">oko 60</td><td rowspan="12">40 do 45</td></tr>
<tr><td>Februar</td><td>57</td></tr>
<tr><td>Mart</td><td>45</td></tr>
<tr><td>April</td><td>34</td><td rowspan="3">30 do 20</td><td rowspan="3">oko 30</td></tr>
<tr><td>Maj</td><td>26</td></tr>
<tr><td>Juni</td><td>22</td></tr>
<tr><td>Juli</td><td>26</td><td rowspan="3">30 do 40</td><td rowspan="3"></td></tr>
<tr><td>Avgust</td><td>34</td></tr>
<tr><td>Septembar</td><td>45</td></tr>
<tr><td>Oktobar</td><td>57</td><td rowspan="3">60 do 70</td><td rowspan="3">oko 60</td></tr>
<tr><td>Novembar</td><td>66</td></tr>
<tr><td>Decembar</td><td>70</td></tr>
</table>

CONCLUSION

Vojvodina has available resources of solar energy on a level quite above the European average, with favorable season schedule. Its efficient and long-term use is necessary to be elaborated in the shortest period coming. To intensify the use of solar energy in Vojvodina, a favorable climate for the development of domestic industry should be created. In present conditions as well, equipment of suitable quality could be produced in small batches and of a suitable price, less than of that from the import.

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BASIC ELEMENTS OF RECYCLING TIRES

Tolmač, D., Prvulović, S., Pavlović, M., Dimitrijević D.
University of Novi Sad
Technical Faculty "Mihajlo Pupin", Zrenjanin, Serbia.
E-mail: tolmac@tfzr.uns.ac.rs

Summary: Recycle to make economic gains, and gains in reducing pollution.Upotrebom recycled to save natural resources and saves energy. Recycling creates less air and water pollution than the primary production of raw materials. Recycling saves storage space, create new jobs in companies engaged in the collection, production and distribution of recyclable materials, saving considerable resources and the environment. In the work considered the basic technology of recycling tires. Given a pattern of technological lines for recycling tires, as well as the basic pattern cutting machine tires - Schredder and machinery for extracting strings from car tires with basic information.
Keywords: Recycling, tires, machinery.

INTRODUCTION

It is estimated that the Republic of Serbia is currently in use around 1.6 million cars, with an average age between 16 and 17. Serbia will soon face the problems and the amount of approximately 1.6 million tons of waste materials of various kinds, among which there are hazardous substances. Generation of automotive waste takes place successively, through the dynamic renewal of the fleet and of course generating waste in the exploitation of maintaining a car. In any case, it is a very large quantity of waste utilization of which would be the optimal way to plan.
In Serbia there are not enough regulation system, which creates conditions for the development of recycling cars. The result is a weak development of the industry. World experience shows that material recycling is one of the most dynamic industries in developed countries.
In order to ensure effective recycling of motor vehicles is necessary to create an appropriate legal framework and basic infrastructure requirements, which would undoubtedly contribute to its development by attracting investments and establishment of technological resources in accordance with the regulations. Also, the introduction of system solutions in the field of automobile recycling contributes to the renewal of the fleet and consequently reduce emissions of harmful substances, increase road safety and saving energentskih and raw material resources.
The current situation in Serbia can be characterized as a lack of organization in the field of recycling of metals with the exception of collecting and recycling its initial (selection, cutting and crushing).

RECYCLING TECHNOLOGY

The procedure is 100% environmentally friendly, ie. no adverse impact on the environment. In such a recycling process creates no waste no further substance, everything is usable, and it is extremely important that there is no accompanying environmental pollution - of air, water or soil. Studies have shown that the mechanical recycling process much better for the environment and the nature of combustion for energy purposes. It is through the recycling of rubber granules, which enters the cycle of re-use, preserve natural resources. Solving the problem of accumulated waste tires is at the same time the environmental, energy and economic viability. In Figure 1, is given technology scheme recycling of tires, in Figure 2, data extraction machine wire, and in Figure 3, given the machine for cutting tires - Schredder.

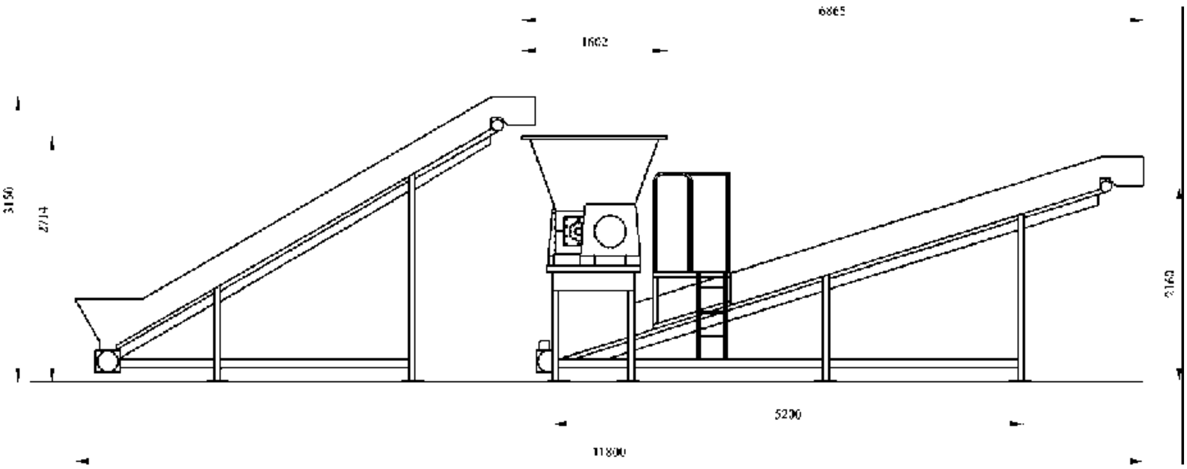
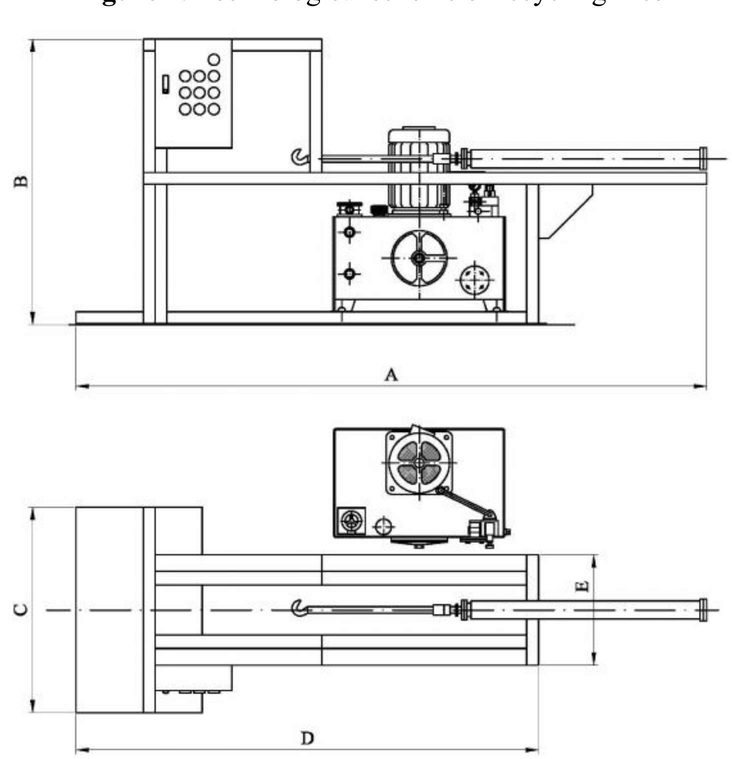
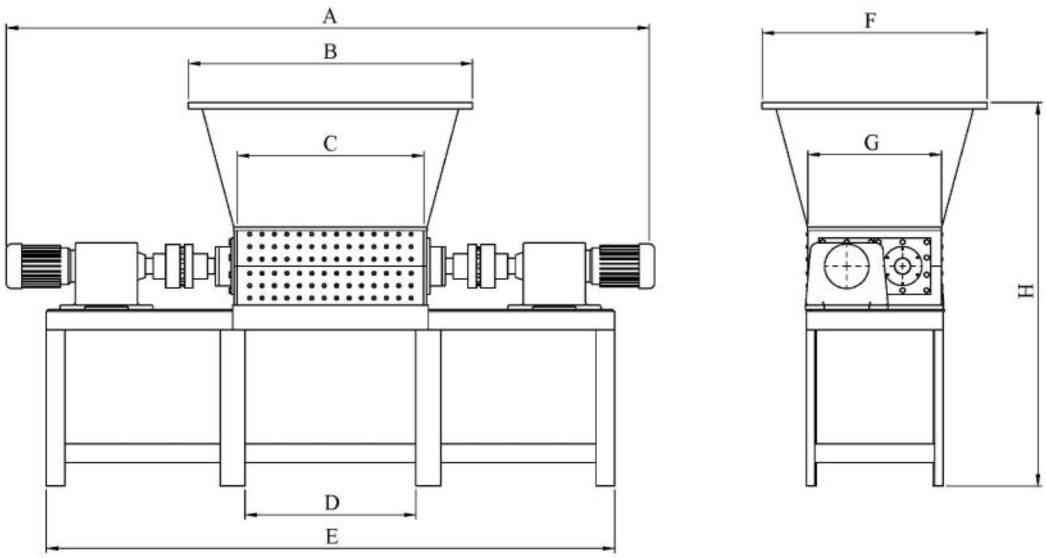


Figure 1. Technological scheme of recycling tires



Model no.	PTH-1200	PTH 800
Maximum pressure (MPa)	15	15
Maximum tire diameter (mm)	1200	800
Capacity (pcs / h)	15	60
Engine power (kW)	18.5	11
Weight (kg)	2500	2300

Figure 2. Machine for removing wires



Model	PT 7.5	PT 22	PT 37	PT 45
Engine power (kW)	7.5 + 7.5	22 + 22	37 + 37	45 + 45
Total weight (kg)	3.000	6.300	12.500	13.700
Capacity (kg / h)	500	1.200	2.000	2.500

Figure 3. Shredder - a machine for cutting tires

Input of raw materials

Feedstock consists of passenger tires, commercial, freight, labor and other vehicles that had passed life because of wear or damage, and can no longer be used for the purpose they were intended. Tires working machines whose dimensions are larger than these can also be processed but it is necessary to pre-cutting.

Products of the recycling process

The primary product of the recycling process the rubber granules, and this process is often called granulation process. The standard size of granules ranges from 1 mm to 4 mm. Granule size is determined by settings on the equipment and it is possible to produce granules of various dimensions of the above. Clean obtained granulate is 99.9%, ie. rubber granulate obtained was purified from 99.9% of released steel and textiles. The mass of granules is obtained (55 to 65)% by weight of the tire front.

Secondary product of this process is that makes steel wire (25 to 30)% by weight of the tire. Separation is performed by a magnet which separates a short piece of wire that caused by cutting and further fragmentation of the tire during the process.

The tertiary product of the process of the textile fibers comprise about 10% by weight of the tire. Separation of textile fibers is accomplished with the strong hood. Air filtration systems aspiratorskog is derived from the bag filter and subsystem for self-cleaning filters and the quality of the air is discharged into the atmosphere (up to 10mg/m3 dust) in accordance with current EU regulations.

The granulation

Granulation process is a mechanical tire processing - cutting. During the process carried out several stages of cutting, ie. Cutting that tire at the beginning of the process of gradually decreasing (chopped) to the size of granules. Steel wire and textiles included in the composition of Tyre, also in the process are so fragmented and separated from each other and the primary product (rubber granules). Separation of components is performed and the influence of the magnet effect of air flow.

The main and virtually the only source of energy that this process uses the electricity. To perform the process is not using any chemical reagents or thermal reaction, so there are no unwanted by-products of such processing. Simply put, the tire is separated into its component parts (rubber, steel and textiles) without affecting the physical and chemical properties of the constituent elements themselves.

CONCLUSION

Republic of Serbia is also facing the problem of used motor vehicles. For now, their recycling is done sporadically and very unorganized and incidental to the environment. The way to overcome this situation is the adoption of adequate legislation and implementation of integrated and sustainable model of recycling vehicles at the end of their life cycle.
Since operators have to be deployed on the territory of Serbia, so that the citizens of their old cars can be submitted at the nearest recycling center which will be issued the certificate on the basis of which can be achieved certain benefits when purchasing a new car. In this way, the action will involve all those involved in recycling batteries, waste oil, antifreeze, glass, plastic and everything that makes a car, and it is necessary to invest a total of around 20 million Euros.

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IONISATION AIR IN MICROCLIMATE

Škobalj, D. [1], Voloder,A. [2], Umičević S. [3]
[1,3]Fakultet za primenjenu ekologiju Futura, Beograd
[2]Mašinski fakultet, Sarajevo
E-mail: p.skobalj@gmail.com

Abstract: Heating, ventilation and air-conditioning systems of a closed space are used with us mainly for getting a comfortable temperature, determined less defined purity of air and favorable relative air humidity. To the condition of electricity in the air no demands are made although it is known and scientifically proved that the unnatural state of the air electricity has got a harmful influence to many physiological processes with people and animals.
The theme deals with a subject of shortcoming of the little negative ions in the air what is the feature of the present day city planning and industrial life medium. Described are the reasons of disorder of the natural air electricity condition, consequences the negative ion short coming has got to a physiological process with people and the way how to remove a deficiency of the negative ion in our everyday microclimate.
Key words: heating, ventilation, air–condition, air electricity, negative ions

INTRODUCTION

Urban areas in past centuries was burdened by infectious diseases and food shortages, and now the urban environment is characterized by industrial and domestic waste, and an unnatural environment, which causes problems in humans and other diseases.
It is well known problem of polluted atmosphere of big cities and industrial settlement with the damaging consequences of such an atmosphere to life and health, but less talked about and written about the harmful and unnatural indoor microclimate where man lives and works. This is all the more important because most people most of his time at home or at work. The air is often abnormal in these areas and damaging, especially in buildings of modern construction, especially during the heating season, and an adverse effect on the life and health.
In addition to adverse external influences on microclimate of residence and work have an important impact design solutions and construction materials used in the construction and equipping of facilities. And with an already built facility is an important technical and human enlightenment. One can not significantly influence the improvement of the microclimate of residence, but often their housing and working environment to make healthier and more comfortable to live, if you know the root causes that undermine the natural and healthy relationships.
Engineers have so far approached the problem of micro-climate almost always from the point of comfort. Comfortable air temperature and less favorable relative humidity with a number of air changes, the main point of almost all the project solutions and detailed heating and ventilation.
I believe, and practice to try and implement that microclimate should be approached from a hygienic point of view. The air in enclosed spaces should be as much as possible to match the physiological needs of man, and that the air temperature is far less significant than is generally realized.
Adjusted relative air humidity and favorable state of electricity in the air, and some clean air (without a trace of harmful gases, dust and microorganisms) are the main quality parameters of the microclimate with hygienic point of view.
Parameter of purity and the relative humidity is given to us in practice the importance of these parameters generally deserve, of course, within technical and financial capacities and individual objects. However, the importance of the state of electricity in the air is completely absent here, so it all the more surprising that this issue is to take great care in all the technically advanced countries in the world around us.

THE IMPORTANCE OF THE STATE OF ELECTRICITY IN THE AIR

The man lived thousands of years in the wild and its electricity is biologically depending on atmospheric electricity. Man produces its own electricity and has its own electric field, and is in constant dependence of the electrical events in the surrounding atmosphere.

Generally speaking, most people in the so-called. "Bad weather" physically and psychologically feels more or less bad, and for a period of "good weather" the other way around. Our feeling is mostly in liaison with the state of electricity in the atmosphere.
In the atmosphere, always electric flow takes place between the ionosphere and the earth's surface. Ionosphere is an electric conductive layer of our atmosphere (about 80 km above ground level) in which the action of ultraviolet emissions from the sun and cosmic rays, mostly ionized (have become good conductors of electricity, and with positively charged ions). The country carries a negative charge and is a good guide electricity. The air between the earth and ionosphere is weaker Guide electricity, and earth, air and ionosphere acting as a large electrical capacitors.
Positive ionosphere at about 300,000 volts higher potential than the earth. During good weather electric field is directed from the positively charged ionosphere toward the negatively charged earth. The electrical currents in the atmosphere during nice weather, and electrical discharge, lightning and thunder, the storm just as important for our life and health as well as oxygen. According to the day the atmosphere of the globe produces about 200 million lightning.
The dry atmosphere of our apartments this natural electrical flow vanishes, and the air ions are predominantly positively charged.
Dry air causes the creation of various static electricity. Each of us has experienced an unpleasant electrical discharge in contact with grounded objects, especially after walking on synthetic carpet or polished parquet flooring. As we are not experienced in rural homes.
This synthetic electricity is predominantly positive sign and its appearance will be more harmful to speak.
I will give data tests "of the Institute of Textile Technology," the United States, which states that the simplest and most reliable method of avoiding the accumulation of static electricity generously wetting the air. The acetate silk, nylon or static charge remains an hour of air humidity of 40% and 70% of disappearing in the shortest time.
Such a disordered state of electricity in our homes and workspaces inevitably reflects badly for most people. A similar thing happens in nature before the weather changes or the so-called. "Föhn" (hair is dry wind in the northern sub-Alpine regions).
What are ions? Ions are electrically charged atoms or groups of atoms. Ions are formed when an atom or group of atoms loses or receives one or more electrons. If an atom loses an electron positive ion occurs, otherwise it gets negative.
In order to clarify the movement of ions in the atmosphere will use research-Poles Tyczka Maczynski-Montenegro. They followed the movement of ions across a wide area of the mobile ion.
Ions are classified into major and 0.0005 kg, 0.0005 kg of medium to 0.01, and 0.01 to 1.2 kg of small (kg is the unit of mobility of ions - limiting the mobility of ions).
Statistical analysis showed that the concentration of ions during the course of the day, day after day to a great extent dependent on weather conditions, the ion density (number of ions per cm3 of air) and polarity index values and the size distribution of ions. Especially this sudden change in atmospheric conditions which precede disorders, transient atmospheric fronts, especially cold with thunder and lightning. Significant activity of the sun, wind speed, air humidity, etc..
An interesting comparison of the mean concentrations and distribution of ions in a rural air to those in urban air. The differences are pronounced. If we determine the value of 100% for the concentration of ions in the rural air, then the corresponding value in the urban air of small ions is 61% and 171% for large. A similar difference in polarity and index.
If we compare the values of the concentration of ions in confined areas with those in the atmosphere, can be noted a big difference. The difference is dependent on various conditions, eg, types of ventilation, heating, number of people and others.
The results show explicitly reduce the density of small ions in the "beleaguered" rooms compared with the outside air.
If the high density of small ions in the atmosphere with 100% mark, then the corresponding mean value for the study, where there are 5 people together, be without heating and with open windows, 92%, with heating and ventilation through the windows 71%, with heating and no ventilation through the windows (all windows closed) 51%. During the day the concentration of small ions decreases

properly, while quite large ions increases. Polarity index value indicates a certain increase pozitivniih dominant ions in the room during the day.
Small negative ions of oxygen breathing as a kind of catalyst, which explains its important influence on human organism. Some recent studies show that negative ions of oxygen increased lung function. The strong concentration of positive ions in the air reduces blood pressure in the alveoli of the lungs, and increases the partial pressure of CO_2.
The consequence of this reduction in lung capacity is reduced physical and mental activity, and body creates a stress hormone, called serotomin, which is a common cause of disease in various kinds of neurotic and psychosomatic nature.
In nature, an increase of positive air ionization preceding the change of time, which explains the increased sensitivity of many people who claim to have "little barometers" and that they can predict weather changes. This increased positive joniziranje oxygen molecules is not only in the time preceding the time change, but it is a daily occurrence in the polluted air of large cities.
High humidity and dust are mostly positively charged and there is a neutralization of negative ions of oxygen in the air. After a long quiet time in polluted cities are usually so-called government. "Static fan", and people always feel bad.
In the polluted atmosphere of our cities of these ions are rapidly reduced to a value of 250 or less per 1 cm^3 of air and negative ions is more or less nearly disappear in the dry atmosphere of our homes and workspaces.
Our vital force of life and our happiness is dependent on the state of electricity and the amount of negative ions in the air. This is often the cause of the disease of modern urban man, such as neurosis, depression, migraine, fatigue, blood disorders, allergies and many more.
The situation is even much worse if the room in which we live in is called. "Faraday cage". The premises were built of reinforced concrete structures, steel and wire tangle around the room the room isolated from the impact of atmospheric electricity. It is not uncommon to encounter in practice in a highly adverse effect of the environment on humans, especially in people who have raised sensitive.
Disturbances in the balance of electricity in our microclimate may result from different causes, so it is useful to list the major:

- In process of time, as we described before: Föhn, Sirocco, Mistral, Lugo, and others. These winds are partly similar and partly different meteorological characteristics of which many people suffer,
- Due to changes in weather and atmosphere before the storm,
- Due to air pollution: industrial steam, car exhaust, combustion products of various furnace and boiler, and other particulate matter (in 1 liter of urban air is 3-17 million such particles),
- Due to the use of synthetics: carpets, wallpaper and curtains, nylon clothing, synthetic fibers in clothing, lacquer on the floor and furniture, etc.,
- The concrete and metal structures (Faraday cage-ev),
- The installation of ventilation and air conditioning (when the air flows along the metal walls, electrically positive compress),
- Due to the presence of a relatively large number of people in a small space,
- From the internal processes in the room: heat, smoke cigarettes, TV and other electrical devices.

The importance of small negative ions of oxygen on the human body
Interesting studies have Dr. M. Hajos from the National Institute of Rheumatology and Physiotherapy in Budapest on the activities of ions in the upper respiratory tract diseases. I quote some of his observations, and indicate the results achieved in the test apparatus for the production of negative ions. The report says:
"On the basis of meteorological observations, we found that due to continuous air flow in acute inflammation of the mucous membranes turn into chronic problems if they are exposed over a long period of unfavorable atmosphere. In most cases, particularly in the allergy positive ions are responsible for maintaining air symptoms. By examining the microclimate in the respiratory tract resorts came to the conclusion that improving the health of the patient depending on the concentration of negative ions in the air. When negative polarity is increased activity of the nasal mucous membrane, then the negative ions have also bactericidal, sedative and hipotonizirajuće property. "

The tests were carried out with various machines for the production of negative ions in the air in the period since 1976. to 1996. year. In allergic diseases, bronchial asthma with bronchitis, sinusitis patients were treated with a water ionizer, three months to eight hours a day. The results were positive in 52 of 71 cases. In further tests showed the well-asthmatic therapeutic effect as
substantially reduce the inflammation of mucous membrane, reducing the occurrence of fever, 30% reduction in the use of drugs, and general subjective improvement of patients.
In acute infectious diseases the treatment of patients with negative ions has proven to be very effective. Were compared in two outbreaks of influenza Institute: epidemic 1986/87. when the treatment was a classic, and outbreaks in December 1989. when used ionization.
Commenting on the results of comparing therapeutic results and the duration of the two outbreaks of the author concludes: "It is obvious that the same diseases and other therapeutic conditions, treatment of negative ions on one side caused the recovery, while the other kept the spread of influenza."
According to the interpretation of Professor Sulmana there are three types of reactions to climate characterized by dry air to the lack of negative ions of oxygen:
First Reducing kotakolamina syndrome causes fatigue in 44% of respondents. The difficulty from year to year increase, which causes hypotension, drowsiness, apathy, fatigue, depression, reduced concentration, and cases of hypoglycemia.
Second Irritability syndrome in 43% of cases. The effects are: insomnia, nervousness, tension, migraine, rapid heartbeat, heart pain, klimakterične disorders, rhinitis, conjunctivitis, laryngitis, feringitis, trahitis, vertigo.
Third Hyperthyroidism and a mixture of symptoms from the first and 2 type of reaction, or hypersensitivity to heat, cold, problems with blood flow, sweating, diarrhea, allergic reactions, skin redness, acne, weight loss despite increased appetite.
In general ionization have multiple beneficial effects on human life indoors, because the system I describe all the advantages of good ionization.
First Thorough and complete cleaning of air through the deposition of almost all the particulate matter in air (dust, smoke particles from smoke, pollen, etc.) and removal of odors and toxic substances that appear next to them.
Second The reduction or removal of bacteria, viruses and other agents of decay contained in the air. It is possible that the air conditioning in various places gather organic matter (dead flies, grease, etc.), especially in poor maintenance, and is suitable under the influence of temperature and humidity that reigns there, multiply and develop harmful microorganisms (Legionnaires disease), and the installation of ionization in these devices especially useful.
Third Scientific research is a comprehensive and proven beneficial effect on people with very different functions and processes, such as: respiratory tract stimulation in the throat, mucous secretion, defense, mitigation and treatment of colds, inflammation of the airways from the nose to the bronchial asthma and allergic tendencies upper respiratory tract, a positive effect on nervnovegetativni system, enhancement of defensive substances against infections, increase the transfer of vitamin C, B1, B2, catalytic improvement of absorption of oxygen in the lungs to support the heart, the regulation of blood pH, reducing blood pressure in hypertension, reducing the impact of time as a cause of stroke and embolism, the trend favors the treatment of wounds and burns after the operation, reducing sensitivity to weather changes (headache, migraine, neurosis, dizziness, etc.). In the literature all the more common scientific assumption that the negative ions in the air act positively to prevent the development of cell membranes of cancer because the tumor cells show a lack of negative potential of the cell membrane.
4th Keeping and raising mental conditions, and improving the general condition, mental balance, concentration ability, increase working effect, and will to work, reducing claustrophobia, increasing resistance to external influences (stress).
5th The use of ionization is reduced demand for air humidifier, and relative humidity can be lower.
6th High performance improve air quality in areas where we stay has led to many cases to unnecessary medication and this is an ideal biological removal of disorders plaguing our lives and health.

IONIZATION OF AIR

Ionization devices that are artificially produced small negative ions of oxygen in the air. Work on the principle of quiet high-voltage grid and the outbreak of the needle (electrode) to several thousand volts.
With the broadcast of negative ions are produced and the various accompanying chemical combinations, which can be harmful to human health, and can be produced only in the range of biologically compatible.
These are primarily various nitrogen oxides and ozone. Any such device should be specified numeric value as ozone and nitrogen oxide products, if possible approval of a competent institution. If the smell of ozone, it is already toxic concentrations, and the device should be excluded from use. Each device should be also indicated the capacity of producing negative ions, and the size of the room is provided. Capacity is measured in the number of negative ions produced per second. If the device does not reject the data on the capacity and by-products of harmful gases, such a device is not safe and it is better not to use it. Good ionization the appropriate design, this paper does not make any noise or smell and consume little electricity. For an average apartment requires a installed capacity of 20-30 W. Ionization does not require maintenance other than periodic cleaning of dust deposition and the other electrode. Are constructed so that there is no danger of the touch voltage, due to the protective resistor that is embedded into the mains phase.
In size and ionization structure can be classified for use:

- In apartments,
- Larger areas such as: schools, offices, hospitals, restaurants, shops and the like,
- Installation of air conditioning and ventilation devices, and
- For installation in cars.

For apartments and other enclosed areas these devices are usually appropriate structures with or without the filter, and placed in the room according to the manufacturer's instructions. Ionization must have sufficient capacity to achieve the ionization effect. The risk of overdosing is hardly possible, since both ions are concentrated in the area increases the absorption surface of walls and other objects in the room.
Apparatus for air conditioning and ventilation devices are special structures and basic functions in addition to removing some of the drawbacks of these devices which has already been discussed. Car ionizer is especially useful for professional drivers, because we know that the car Faraday cage. Car ionizer reduces fatigue and increases ability to concentrate.

CONCLUSION

In the polluted atmosphere of big cities always cyclonic state government with a pronounced lack of negative ions in the air, and closed offices, in a tin box in the cars or homes with reinforced concrete walls (Faraday cage) the situation is even worse. Central heating, air conditioning systems, televisions, monitors, cigarette smoke and low relative humidity in the air cause a dramatic lack of negative ions.
A pleasant stay in air-conditioned space is assumed as similar conditions to those in the most pleasant nature. It is very difficult to achieve, but it will be easier if we apply the understanding of the compromise solutions to micro-climate in which we reside and what was better.

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A GLOBAL INDICATORS IMPACT LANDFILL ASH AND SLAG ON THE ENVIROMENT AT THE POWER PLANT "NIKOLA TESLA" OBRENOVAC

Živković Z.
Thermal Power Plant ″ Nikola Tesla ″ Obrenovac
E-mail: zoran.zivkovic.zile@gmail.com

Abstract: The hydraulic transport of ash and its storage on large areas, ash deposits surrounded by settlements and cultivable soil requires constant supervising and protection. A long standing experience on the matter of „NIKOLA TESLA"A –and B , power plant ash deposits points out certain problems that could occur as a consequence of wind erosion and water pollution. In order to reduce the negative effects of ash and slack on air and water ,certain protective measures were taken during the phase of projecting. The existing protection systems ,such as drain pits, water spray systems and biological measures require constant development and maintaining.
Key words: Ash deposit, wind erosion, biological recultivation, drain pits, auscultation.

INTRODUCTION

Thermal Power Plant ″ Nikola Tesla ″ A and B with a total installed capacity of **2920MW** use coal from the surface mines of the Kolubara – tamnava river basin. The Calorific value of coal is **6000 - 8000 kJ / kg**, average moisture content is 43 - 53% and 20% of ash. The total sulfur content is 0.5%.Flue gases are purified by solid particles in the **electrostatic precipitator**. Despite mounting precipitators with the degree of dusting from 98.5 to 99.83%, which have reduced emissions of solid particles in the atmosphere, problems occur regarding transport, disposal and storage of large amounts of ash in open landfills – ash dumps.

The technology of ash disposal

In normal operation the ash deposits are exploited by one active cassette , and the others are passive, temporarily suspended. The construction of embankments, of large fractions of ash, hydrocyciling of ash, storage space is created on an active cassette . The first floors of embankments were built of soil, or sand from the Sava river. With successive changes in these places leads to equally filling the active cassettes with ash.
The passive cassettes are protected by biological ways, seeding of perennial grasses. Since the active cassette is largely under a water mirror from dry surfaces, beaches, as from the bank which is under construction, it can come to the lifting and spreading of ash at relatively low wind speeds, if the spray system is not in function.Many years of experience in the exploitation of coal ash showed that there may be negative impacts of landfills on air quality and surface and underground water.

THE TECHNICAL DATA OF DUMPS

Landfill A TENT occupies about 400ha and it is placed near the Sava river.
It is planned that by the end of the working life of the power plant, deposited ash will surpass the initial elevation by more than 40m. Landfill TENT B extends to 600h. Here it is planned toovershoot the initial elevation by 29m.

Table 1. Offers the basic technical data on the landfill of TENT A and B

	TENT A		TENT B	
Surface (ha)	400		400 + 200**	
The amount of ash x106 (m3/god)	3,1		2,6 – 3,4	
The planed camber (m)	40		29	
Project number of drainage wells	60		92	
The current number of drainage wells	60		16	
	Floor numbers	elevation heig ht (m)*	Floor numbers	elevation heig ht (m)*
cassette I	5	73 / 91	3	78,5 / 86
cassette II	8	73 / 101	3	78,5 / 86,5
cassette III	5	73 / 91		

* home / current
** area provided for the cassette III, which has never been used

AIR POLLUTION PREVENTION: To the spreading of ash due to wind erosion may occur from dry surfaces and embankments of active cassettes, at relatively low wind speeds, in cases where there had been no spraying and biological protection of the embankments.
This phenomenon is due to unfavorable physical - chemical properties of ash .In order to prevent wind erosion of ash on landfills the following precautionary measures are taken.

Maintaining water mirrors

The technology of ash disposal sites with frequent changes to the unloading area enables most of the area of cassettes to be in a moistened state, which prevents the lifting and spreading of ash. With the equal discharge of volume form the cassettes, leads to forming a flat surface with a gentle slope towards the interior of the cassettes. Small changes in the amount of toppings (with pile) of liquid mirror leads to them increasing or decreasing. In regulating to the size and position of the water mirror, care must be taken not to endanger the stability of the embankment.

Spraying with water

The basic principle of this method of protection is to make the surface layer more stable by bringing it in contact with water increasing the adhesion force which prevents particles from spreading under the influence of wind.
The spray system consists of: spraying pumps, a network of spraying the perimeter and intersecting embankments, a network for spraying active cassettes on dry surface and a network for spraying passive cassettes.
The spray system is used in the period from March to November and under adverse weather conditions (dry weather accompanied by wind). In winter the system is disassembled and drained due to low temperatures.

Biodiversity protection measures

Since ash as a surface is unfavorable for the growth of many plants, special attention is paid to the selection of plant species tolerant to this type of substrate. Irrigating and fertilizing encourages the growth and development of plants. These measures can be grouped into temporary and permanent measures.

a) Temporary measures - planting grasses

These temporary measures are conducted on flat surface passive cassettes. In addition they are also implemented on active cassette embankments successively with building the dikes. In addition to sowing grass there are also practices in growing **Tamarix** wickers on flat surfaces and passive cassettes on the outer perimeter slopes and embankments partition.

Tamarix has been successfully grown without watering, thanks to its highly developed root system that reaches the water in the dermis.

When sowing a grass mixture is applied that is tolerant in terms of chemical composition of ash. The cover that is formed consists of leading and accompanying plant species. The leading varieties are: wheat, rye, barley, and the accompanying red fescue, alfalfa, red clover, couch grass and so on. The leading types of plants have a role to ensure its aboveground part shade and retain moisture in the substrate. The highly branched root system prevents the spreading of ash and uncovering the unsprouted and recently sown grass.

The accompanying plant species have a role to continue the vegetation in the future. The optimal time for the spring and autumn sowing is April or September. It is very important to carry out grass sowing at the optimum time. Any delay is risky for the establishment and further development of plants which significantly reduces the effects of protection.

It is also very important to carry out the sowing time in the interim period, in moving from one to another cassette. Then large surface areas of 100 - 200 ha remain unprotected until a biological cover is formed. An important role in the formation and maintenance of a biological cover has an irrigation system, since the ash as a substrate has a high water infiltration capacity, and is characterized by high evaporation. The biological cover must be regularly watered, to allow plants to ensure sufficient substrate moisture, but care must be taken to prevent evaporation of fertilizer.

b) Long-term measures - protection from the wind:

Planting a poplars belt is a permanent form of protection. The leading role have Canadian poplar. This area has been erected around the site on the lower floors, and in particular is enhanced to a populated area and is constantly updated with new seedlings that can foster.

In order to improve the existing methods of recultivation, next to planting perennial grasses, afforestation will be carried out to already existing and newly built embankments.

These activities as well as resolving issues related to protection of the final elevation and the final use of the landfill will be defined by the detailed design reclamation of coal ash and slag TENT A and B.

PREVENTING THE POLLUTION OF SURFACE AND GROUNDWATER

In the hydraulic transport of ash and slag more than in other ash disposal technology, there are problems regarding pollution of groundwater and surface water. The essence of the problem is soluble ash components, because the water leaving the landfill contains soluble pollutants. From the standpoint of water pollution control, undoubtedly the most important is sulfate ion ($SO4^{-2}$) due to its high prevalence in the ash and the property that it is hardly associated with the land. Because of these properties sulfate ion can be used as a ″giant ″ tracer, whose monitoring also determines by the migration of contaminated water from the ash dump to the surrounding aquifer.

As for the sanitary impact, most important are heavy metals. Among them stands out arsenic (As) due to its toxicity, and a feature that it expands very well with the sandy clay. This means that the low permeability layer beneath the landfill is a good defense against penetration of arsenic in the aquifer, which has a limited life span, but gives a great reserve in time to appropriate safeguards.

In normal operation, regulating the position of the overflow pile columns provide the needed time of deposition of ash particles on the active cassettes of ash. On the road from the landfill discharge to the lake, virtually all the ash of the turbidity settles down and clear water from the lake is drained into the Sava River coating indirectly or directly. Hydraulic transport of water that enters the landfill accumulation, infiltrates the aquifer through the bottom of the landfill. The water flow is through a layer of ash deposit, and then through sand-gravel that serves as a filter. Water from

the aquifer is evacuated by a series of drainage, tubular wells, built along the edge of the landfill. Each well is equipped with a submersible well pump, with which the water is discharged into the sewer or drainage tube channel. The landfill TENT A project stipulated and built 60 drainage wells. Currently only 7 wells are in function. The landfill TENT B project envisages construction of 92 wells, up to now16 wells have been made, and 6 are in function. The number of wells will increase in line with the exploitation of the landfill.
The work of the appropriate number of wells (in accordance with the project) will enable the prevention of the negative impact of wastewater on groundwater in terms of preventing waterlog and chemical pollution of groundwater in the hinterland of the landfill.

MONITORING THE IMPACT OF LANDFILS ON SURFACE AND GROUNDWATER

In order to take adequate protective measures, supervising the quality of waste water and monitoring the impact on surface and groundwater, as well as systematic technical monitoring of landfills, which is a legal obligation.
Monitoring the impact of landfill on surface and ground water is being controlled by physical and chemical parameters of water (monitoring well, rural wells, the river Sava). This monitoring is carried out internally and by authorized institutions. The Control Program which is implemented in cooperation with the competent authorities was made with the Belgrade water management at the request of the water inspection.
TENT B made recording of the quality of groundwater in the surrounding ash disposal site prior to construction of the landfill, the existing situation. This data is vital for monitoring the impact of the landfill during the exploitation of groundwater quality.

Analysis of results

Waters from coal dumps have increased salt content, sulfate, and arsenic, and are alkaline nature. Proper discharge of the suspension of water and ash and regulating the spills achieved a satisfactory effect is mainly ash and slag deposits. Overflow and discharge of drainage water from the landfill into the river Sava met the existing legislation and this does not disturb other class watercourses.
Monitoring the impact of landfill on groundwater is done primarily by analyzing the content of sulfate and arsenic in groundwater. Comparing the results obtained by these parameters with maximum allowable concentrations, MDK drinking water (witch for sulfate is 200mg/l, and for arsenic 50µ/l),

TENT-B:

While recording the zero level of the quality of groundwater in piezometers and in rural wells, it was found that they did not meet criteria for drinking water. Namely the water wasn't correct in a bacteriological aspect and because an increased content of manganese was confirmed in the study during the exploitation. These results were not in connection of the impact the landfill had. In terms of impact, local pollutants are to blame (stalls, septic tanks) as well as chemical composition of the soil.
The content of sulfate and arsenic in groundwater during operation of the landfill varies depending on level of groundwater and distance from the landfill. There was a small increase in sulfate content, in rural wells and piezometers in the vicinity of the landfill, compared to the zero state. All results of sulfate and arsenic content are below MDK.

TENT-A:

At this location has been no zero status groundwater quality test .On the basic of the results groundwater quality(piezometers),during exploitation found that the content of sulphate and arsenic varies depending on the groundwater level and distance from landfill.An increased content of sulfate occurs in theperiod of low water in theSava river, and leads to connection with the influence of the landfill, and depressions (mine) that are full of ash.

MONITORING THE IMPACT OF ASH DISPOSAL ON AIR QUALITY

Total emission control of sedimentary material is performed at 36 measuring points which are in settlements around the power plant and in the vicinity of landfills. The total sediment matter must be regarded in the context of the impact of emissions fuel gas particulate and the appearance of wind erosion on ash from landfills. Measurement results on the measuring points around the landfill are used to track effectiveness of the measures of protection taken during operation on the landfill.
Analysis of results:
Table 2 shows the percentage of data average monthly emissions total sediment matter that are crossing the border value of emission(GVI), 450mg/m²/day.

Table 2. Percentage data for imis total sediment matter compared to GVI

YEAR	≥450mg/m²/day		≤450mg/m²/day	
	All measurments place	Table number place	All measurments place	Table number place
2003	10,81	7,75	89,19	92,25
2004	31,83	23,79	68,17	76,21
2005	46,76	39,00	53,25	61,00
2006	66,13	62,33	33,87	37,67
2007	40,6	34,33	59,4	65,67
2008	28,9	16,84	71,1	83,16

Percentage of data average monthly emissions is similar for next year,the data service enviroment thermal power plant –A.
Comparing the results obtained by the average monthly imis total sediment matter with GVI, 450 mg/m²/day concluded:
-Present particle air pollution
Highest percentage data that exceeds GVI is in the interim period and it ranges from 32% to 66% -To the becoming of high air pollution of total sediment matter was due to lack of funds witch led to late biological recultivation.

AUSCULTATION

Auscultation is done by field collection data by visual monitoring of all activity and occurrence on and around the landfill (moistening, leakage ,erosion of the embankment, drainage work ,etc....).
Auscultation include processing and interpreting data examinations and the results ostained measurements and other methods.Would be most appropviate development information system ash dump.

CONCLUSION

The enviromental program started modernization in 2002 an is planned to finish in 2012.
Program is based on study the impact environmental, and includes:
1-Preparation of project documentation.
2-upgrade precipitators facilities.
3-changing technology transport and ash disposal.
4-Change system wastewter managment.
5-Desulphurization flue gases.
6-Implementation standards **ISO 1400**.
7-Complete moritoring the emissions.
8-**Very important reduction emissions of nitrogen oxides in combustion boilers.**
Hydraulic transport of ash in open landfills and landfill which occupy large areas and are located near the village seek a permanent ecological supervision. Preventing wind erosion of ash is performed using protection systems: water mirrors, spraying water when dry and windy and biological reclamation.

New low water system collection, transportation and disposal ash and slag used mixture of ash and water compared **1:1** instead of **(1:10).** New **thickened** waste transport will multiply reduced surface active tray and will be resistant to the removal of wind, with drastic reduction amounts water ,there fore impact will be reduced on groundwater. **With previous20 million tons to 2 million tons per year.**Work of drainage wells that make safety curtain around the ash increases the stability of the embankment, preventing chemical pollution of groundwater around the landfill.

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ENERGY POTENTIAL OF GEOTHERMAL RESOURCES AND POTENTIALS OF BIOMASS USE IN SERBIA

Šinik,V.
Technical Faculty „Mihajlo Pupin” Zrenjanin, Serbia
E-mail: sinik.vladimir@gmail.com

Abstract: The topic of this paper will be the spatial distribution of thermal and geothermal sources in our country and the possiblities and advantages that can be achieved by them and a biomass resource. The territory of the Republic of Serbia has extremely large geothermal potentials . The estimates that have been given by the different institutions, in the favourable thermal zones in Serbia, in the last ten years, show the possiblities of its direct and indirect use for heating of the objects, for purposes of sport and recreation and in the agriculture.

INTRODUCTION

The thermal energy of the Earth is therefore immense, but only a fraction could be utilized by mankind. So far our utilization of this energy has been limited to areas in which geological conditions permit a carrier (water in the liquid phase or steam) to 'transfer' the heat from deep hot zones to or near the surface, thus giving rise to geothermal resources; innovative techniques in the near future, however, may offer new perspectives in this sector. See Figure 1 for a sketch of the inner structure of the Earth.

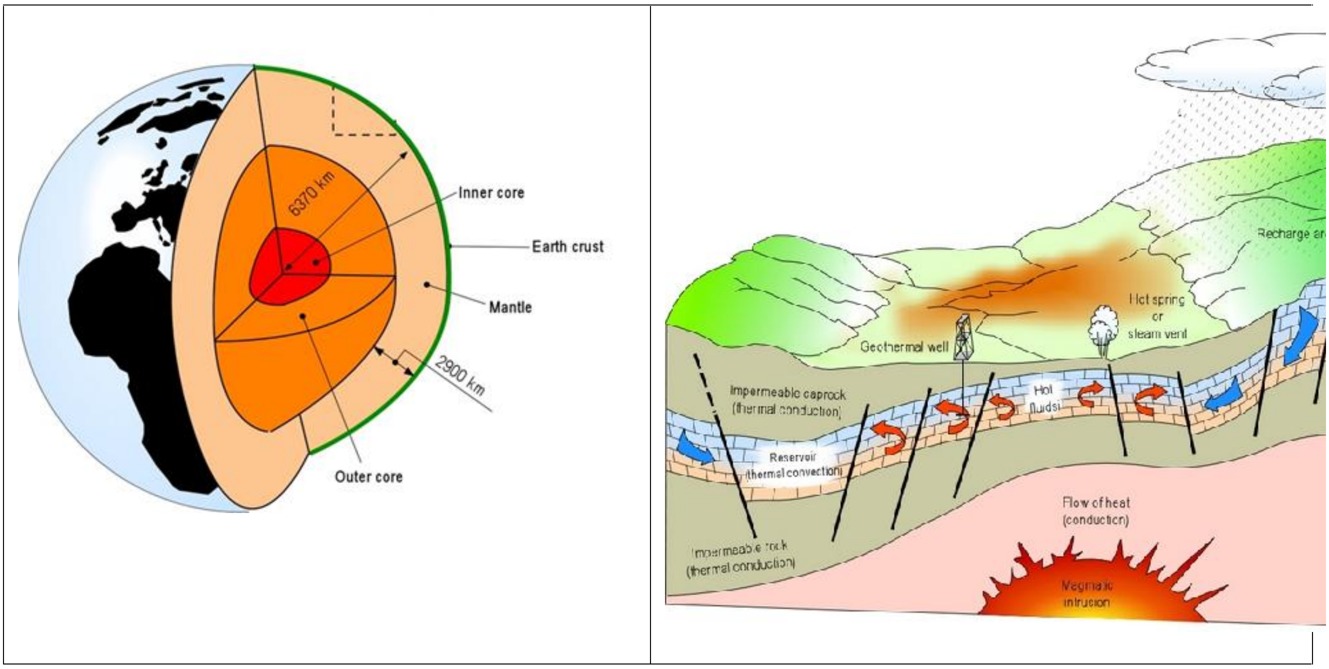

Figure. 1 a Sketch of the inner structure of the Earth , 1.b schematic representation of an ideal geothermal system

What is a geothermal system and what happens in such a system? It can be described schematically as 'convecting water in the upper crust of the Earth, which, in a confined space, transfers heat from a heat source to a heat sink, usually the free surface' (Hochstein, 1990). A geothermal system is made up of three main elements: a heat source, a reservoir and a fluid, which is the carrier that transfers the heat. The heat source can be either a very high temperature (> 600 °C) magmatic intrusion that has reached relatively shallow depths (5-10 km) or, as in certain low-temperature systems, the Earth's normal temperature, which, as we explained earlier, increases with depth. The reservoir is a volume of hot permeable rocks from which the circulating fluids extract heat. The reservoir is generally overlain by a cover of impermeable rocks and connected to a surficial recharge area through which the meteoric

waters can replace or partly replace the fluids that escape from the reservoir through springs or are extracted by boreholes. The geothermal fluid is water, in the majority of cases meteoric water, in the liquid or vapour phase, depending on its temperature and pressure. Over the past half-century, use of geothermal energy, a natural resource from deep in the earth, has boomed. Along with contributing a clean power source to their surrounding communities, geothermal power plants have found themselves in a battle to contribute to the nation's power grid, maintain a healthy relationship with the public, and preserve the environment. Geothermal energy is a resourceful way to generate electricity, but it is not yet an adequate way to provide electricity for many largely populated areas. The importance of researching and improving this field lies within the energy crisis. Does geothermal energy offer a real solution? Around the globe, volcanism is a geologic process that allows for the production of geothermal energy. Movement of the earth's crust and hot rock interaction with groundwater create a unique setting that allows humans to harvest the earth's internal thermal energy. However, few regions of the world have ideal settings to utilize this natural process efficiently.
Serbia must take full advantage of incentives and foreign development funds to promote the use of renewable energy sources. As we develop this green industry, we must ensure it is profitable and that there are no limitations on the sale of equipment, technology and products. The supplement touches on an array of benefits for the use of biomass, including cost savings, export markets, and the economic development potential associated with this renewable energy source. Moving forward, Serbia must build on its efforts to offer incentives, implement policy and facilitate investment for biomass. Everything else is simple. We have the expertise and enterprise skills to be successful.
Geothermal energy is everywhere beneath the surface of the earth. The earth's interior is an enormous thermal reservoir of energy, which can be utilized if favorable geological conditions exist. There is a considerable potential for geothermal energy installations in Serbia that may be used for residential, commercial, institutional and industrial applications. By 2015, an intensive research and development program could replace the use of at least 500 000 tones of imported liquid fuels annually.
Existing exploitation in Serbia (86 MW) is symbolic, although according to the geothermal resources, Serbia belongs to more affluent nations. The exploitation and development of geothermal energy must intensify due to the following factors: political tensions in fossil fuel-producing countries, fluctuations on the fuel market, constant deficiency in nuclear and fossil fuels, deterioration of the environmental conditions and increasing financial demands for environmental protection. The most important exploitation of geothermal resources in Serbia is expected for heating and/or cooling of rural and urban communities and for development of agriculture and tourism.

ENERGY POTENTIAL OF GEOTHERMAL RESOURCES

Geothermal characteristics of Serbia are very interesting as a consequence of geological composition of the terrain and favorable hydrological and geothermal characteristics of the landscape. Geothermal flow density represents the main parameter used to estimate the geothermal potential at a certain location. This parameter represents the amount of thermal energy flowing each second through the area of 1m2 of the earth's interior and reaching the surface of the earth. The value of this parameter in the major part of Serbia is higher than 60 mW/m2, which represents the average value of geothermal flow density in the continental part of Europe. The highest values of this parameter were recorded in the Panonia valley, central parts of southern Serbia and in central Serbia.
There are 160 natural sources of geothermal waters with temperatures above 15°C in the mainland (excluding the Panonian basin). The highest temperature is recorded in Vranjska banja (96°C), followed by Jošanička banja (78°C), Sijerinska banja (72°C) etc. The total abundance may be illustrated by the total flow rate of these geothermal water resources, which is 4000 liters per second (l/sec). According to the latest findings, there are 60 resource locations of geothermal water with temperatures above 15°C, while the\ depth of the water reservoirs is estimated at 3000 m. Total amount of heat accumulated at geothermal deposit sites in Serbia, up to 3 km of depth, is two times greater than the amount of heat that may be generated by burning all available coal reserves in Serbia Figure 2 shows the map of geothermal resources of Serbia.

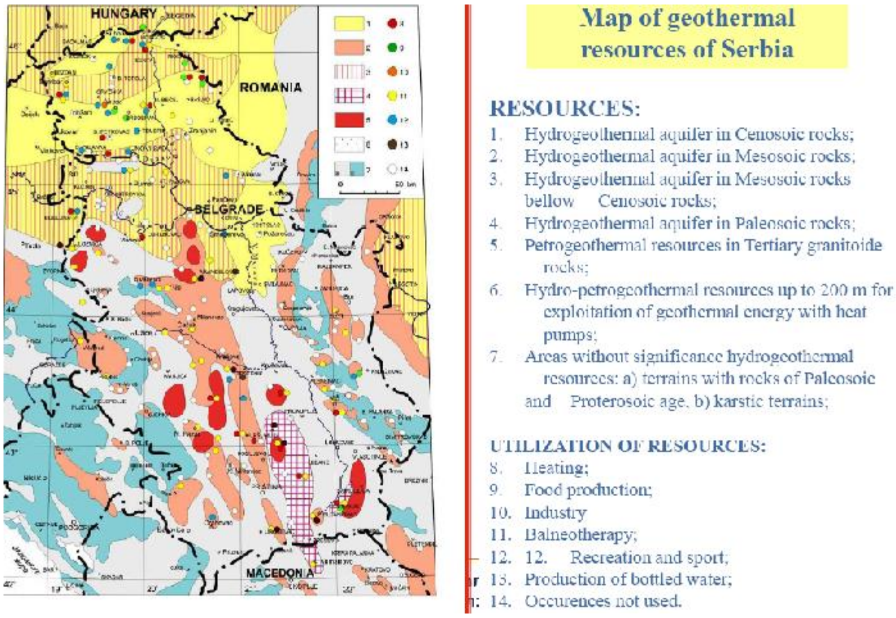

Figure 2. Map of geothermal resources of Serbia

The flow rates at 62 artificial geothermal water sources, i.e. geothermal borings, just in the province of Vojvodina, is around 550 l/sec, estimated heat power is around 50 MW, while the estimated thermal power at 48 geothermal borings in the other parts of Serbia is 108 MW. There are also possibilities for exploitation of geothermal energy from dry rocks, i.e. rocks that contain no underground water. Initially the water is pumped into rocks at a certain depth and pumped out after certain period of time, when an adequate temperature is achieved. Extracted heated water may be used for heating buildings, for example,
although no such use has been planned in the near future due to the modest exploitation of more promising thermal water resources.

BIOMASS AND BIOGAS ENERGY. POTENTIALS OF BIMASS

Biomass is plant or animal matter (hence organic resources) that can be used to produce energy through different processes. The energy of plant matter is pre-captured by the plants in the photosynthesis, transforming the sunlight into chemical energy and providing the base for the environmental chain. During the photosynthesis, plants combine carbon dioxide from the air and water from the ground to generate carbohydrates, which form the building blocks of biomass. In this way, the solar energy is stored in the chemical bonds of the structural components of biomass. This energy can be extracted using different methods. On the other hand, the main source of energy from animal sources mainly comes from cattle manure. Using biomass (or fuels or wastes derived from biomass) as a source of energy entails burning it to yield heat that can then drive engines or generate electricity. The energy in biomass is chemical in nature; it does not suffer from the problem of intermittency that is inherent to wind and solar resources. In this respect, biomass more clusely resembles fossil fuels than it does other renewables since fossil fuels are simply fossilized biomass. Figure 3 shows the understanding the renewable energy resource – biomass.

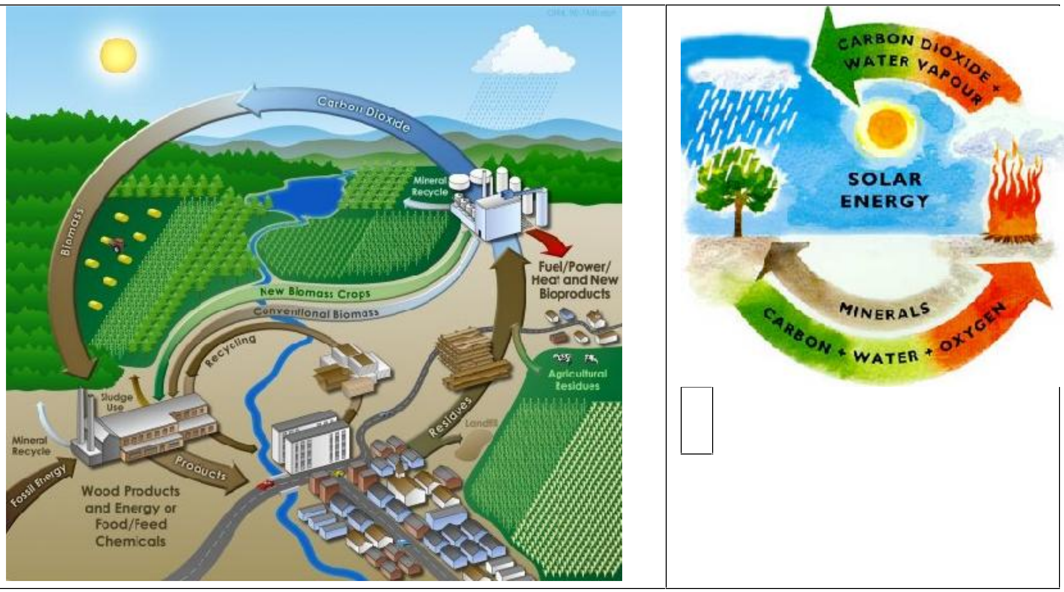

Figure 3. Understanding the Renewable Energy Resource - BIMASS

For most of the recorded history, biomass was mankind's principal energy source, mainly in the form of wood used for cooking and heating while, with the industrial revolution, fossil fuels captured this dominant role. Today, biomass still accounts for 15% of worldwide primary energy consumption, but, significantly, this fraction is much higher in developing nations than in developed ones. Perhaps the most important factor about biomass' potential role in the energy sector is that, again unlike most renewables, stiff competition will always exist for both the biomass and the requisite land resource to grow it. Also, there are five possible means of biomass usage: food, feed, fiber, forage, and fuel. Fuel - growing biomass to burn it – will normally be the least valuable on this list. Even among wastes derived from biomass, higher value applications may diminish their use as fuel: manures have value as fertiliz-ers; waste paper can be recycled; cottonseed hulls find their way into oil drilling muds, wood chips into landscape mulches, restaurant greases into pet food. Although many specialists have envisioned a role for biomass in which it is grown extensively and solely for fuel (energy crops), it is probable that this can only happen with at least some valued dual use or co-product derived from the crop.

A wide variety of sources, are included in the biomass concept such as:

• Agricultural waste: includes agricultural residues such as cereal straw, fruit trees trimmings, leaves, etc.

• Agricultural crops: such as sugarcane, sugar beet, corn and sweet sorghum, currently commercialized for energy use.

• Energy crops: crops of fast growing, including both herbaceous plants (sorghum, thistle, sweet potato, etc) and trees (willow, hybrid poplar, etc).

• Forestry waste: including under-utilized wood, logging residues, imperfect commercial trees or non-commercial trees, thinnings, etc.

• Industrial waste: considering those industries whose residues are of organic nature, such as beverage industry, food industry, etc.

• Municipal waste: although the municipal solid waste usually contains a variety of potentially toxic materials such as creosote-treated wood, batteries that contain mercury, and other hazardous products, there are residues such as paper or purifying plants residues that can be used as biomass source.

The picture 4. shows the remains of agricultural production and the picture 5. remains of two fruit production ii participation in the total area of forest communities in Serbia.

The chemical composition of biomass varies among species and sources, although an average composition of biomass would be about 25% lignin and 75% carbohydrates or sugars. The lignin fraction consists of non-sugar type molecules linked together in large low dimensional sheet like structures. The carbohydrates portion is formed by many sugar molecules linked together in long chains or polymers such as cellulose and hemi-cellulose. In the plant construction, the cellulose is the structure and the lignin ‘the cement’.

Some of the benefits of promotion of biomass for energy production are as follows:

• Erosion prevention.
• Reduction of fire danger.
• Protection of wildlife and other components of biodiversity.
• Reduced emissions from power systems running on biomass fuels because of the chemical composition of biomass compared with fossil fuels
• Reduction of greenhouse gases.
• Employment creation
• Economic benefits in rural areas.

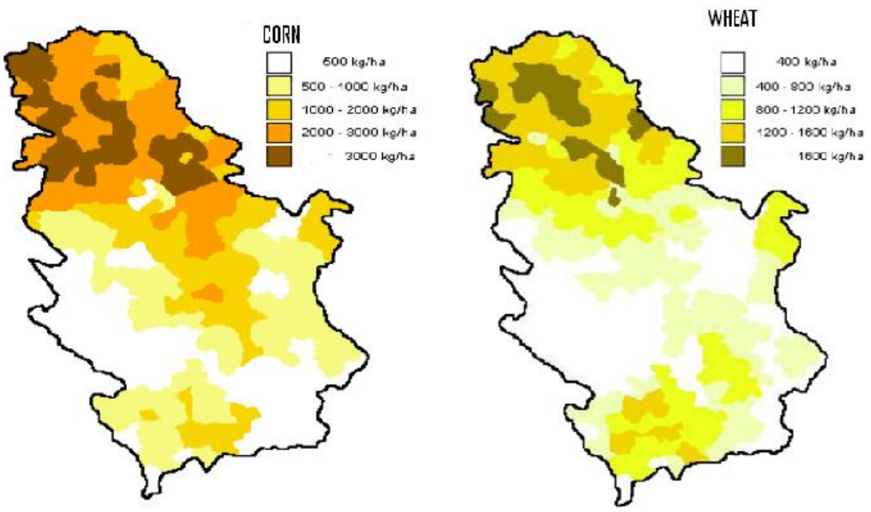

Figure 4. The remains of crop production

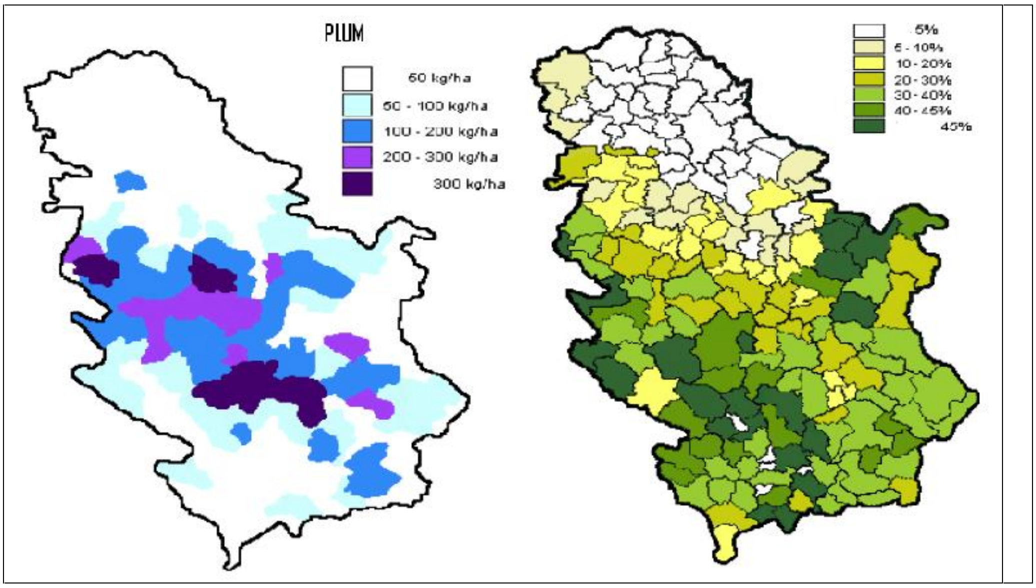

Figure 5. The remains of fruit production and participation in the total forest area of the municipality

Serbia is well positioned to take advantage of growing commercial interest in renewable energy by developing its biomass industry. Biomass consists of biological material derived from wood, waste and alcohol fuels. Serbia boasts a supply of agricultural and wood waste biomass that is equivalent to 2.7 million tons of oil. Serbia’s biomass resources represent 63% of total renewable energy potential in the country as its territory comprises 30% forest and 55% arable land. Biomass is a low cost commercial and residential heating source and is increasingly in demand by EU markets. In January

2008, the European Commission published the 20 20 by 2020 package of measures, which proposes a 20% reduction in EU greenhouse gas emissions and a 20% increase in the proportion of final energy consumption from renewable sources. Both targets are to be reached by 2020. Biomass offers considerable economic benefits. It has the potential to meet 30% of Serbia's energy needs while offering employment benefits to local communities in forested regions, which, amongst others, include Prijepolje, Priboj, Kuršumlija, Majdanpek, Kučevo, Žagubica, Bor and Boljevac. Since these communities are located in some of the most underdeveloped regions in Serbia, employing the local population in activities related to wood waste could lead to a significant increase in jobs. Moreover, wood waste biomass could potentially serve as a substitute for fossil fuels, which Serbia currently imports. Biomass utilization also opens the door to technology development, particularly for Serbian firms that produce stoves and boilers for the residential market and those that manufacture large industrial boilers.

The utilization of biomass also benefits the environment. Biomass decreases greenhouse gas emissions, substituting the use of traditional fossil fuels, which are polluting. Biomass contributes to better wood waste management, which prevents river and soil pollution, and increases the share of renewable energy consumption in Serbia. The Project has through these activities supported the firms enclosed in this publication to increase sales of boilers and pellets. In the last year alone, approximately 250 boilers and stoves were sold in the residential biomass market in Serbia through these efforts. The Project also supported forest management company that subsequently invested $9 million in a pellet manufacturing plant in Serbia. The Serbia Competitiveness Project also works on improving the existing policy environment to promote greater utilization of biomass in Serbia as better utilization of wood waste requires a policy framework that further enhances market development. The Project and other stakeholders are involved in providing input to the Government that will facilitate the implementation ofmeasures that promote renewable energy resources in Serbia – including biomass. Specifically, Serbia should set renewable energy targets similar to those existing in the EU, finalize and adopt incentives for residential and industrial biomass boilers. These measures can be incorporated into a Biomass Action Plan currently being developed by the Ministry of Mining and Energy and presented for adoption in the second quarter of 2010.

CONCLUSION

Geothermal energy is considered the most valuable natural resources, that does not require any kind of conversion, any additional investment in its use. No negative environmental implications, does not pollute the environment in perspective could be incorporated into primary energy resources in Serbia. Also, processing of biomass requires minimal investment in processing, but is due to its extremely high heat capacity and therefore has found wide application in many resorts.

The prospect of using these two energy resources is based on the controlled use of resources at specific locations in order to avoid irrational use of this valuable natural resource. Only in this way it is possible to improve the energy industry and thus improve the energy picture of the republic of Serbia.

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SESSION 3: Design and maintenance of process plants

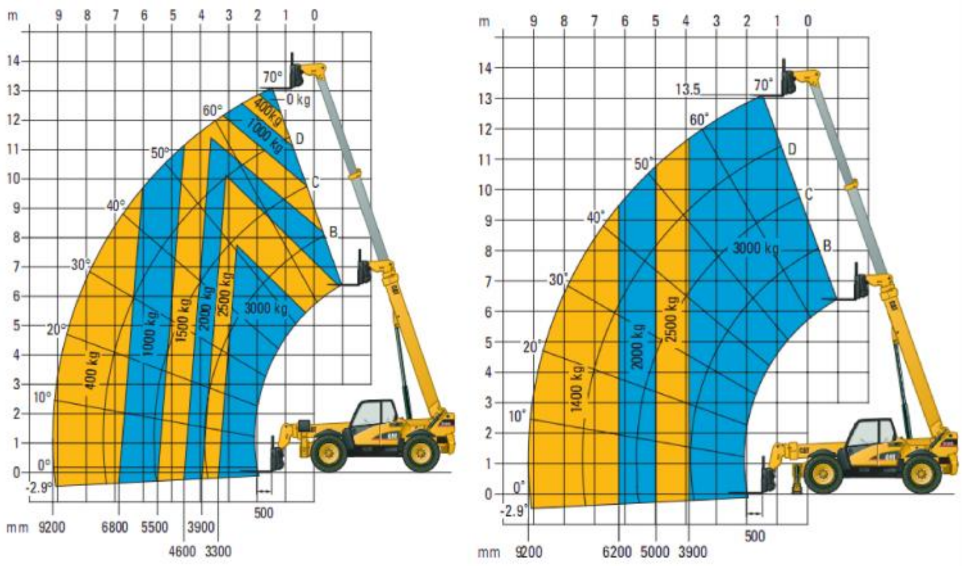
STRESS-STRAIN ANALYSIS OF THE TELESCOPIC CRANE

Milutinović M., Milić D., Trifković S., Radić N.
University of East Sarajevo
Faculty of mechanical engineering, East Sarajevo
E-mail: m.milutinovic82@gmail.com

Abstract: In the real conditions damage of machines are very common. The cause of such damages is usually the human factor. Fortunately, the damages that can occur are not unsolvable and there is a possibility of their repair. In this is researched one such case, where is TH360B telescopic crane damaged because of inattention of operator. The analysis of the stress state in the console was made based on recommendations loads and dimensions of crane, on the basis of which it is determined that the real loads can not damage the crane. After the damage reconstruction, measuring of stress and strain in the characteristic cross-section was made, based on which it was established that crane meets the initial conditions.
Key words:telescopic crane, strain gauges, damage, stress, strain.

INTRODUCTION

TH360B Telehandler Telescopic crane shown in Figure 1 has the possibility of variation of angles with load variations. Figure 1 shows the different loads during lifting (Fig. 1a) and lowering the load (Fig. 1b). In this paper a case of lifting the load was observed. The variation of angles during lifting and lowering loads ranging from 2.9° to 70°, therewith that changing of these angles depends on value of load and boom length.



a)Lifting load b)Lowering load

Figure 1. Telescopic crane TH360B, variation of angles, length of boom and value of load

CALCULATION OF STRESS

After repair the damage, stress and strain were measured using of strain gauge, at the distance of 1150 mm from the load (Figure 2).

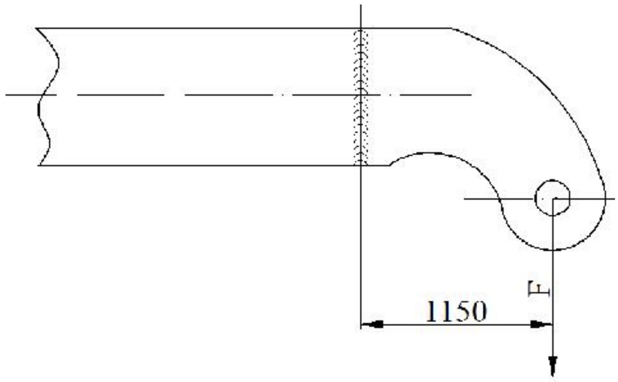


Figure 2. The position of the weld in relation to load

Because of the simpler calculation, it is used simplified cross-section of the console at the place of weld. Figure 3 shows the real (Fig. 3a) and simplified cross-section (Fig. 3b).

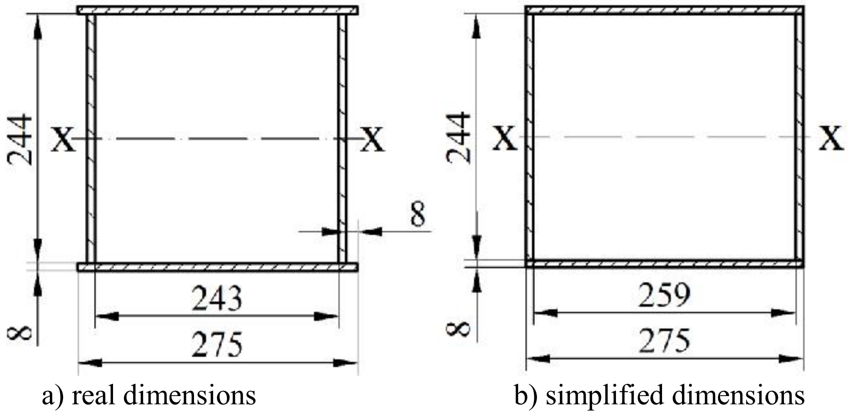


Figure 3. Cross-section dimensions

The section modulus for a simplified cross-section is:

$$W_x = \frac{BH^2 - b \cdot h^2}{6} \tag{1}$$

Maximum bending stress:

$$\sigma_{f\max} = \frac{M_{f\max}}{W_x} \tag{2}$$

The loads that were used in calculations and measurements are:

$$\begin{aligned} F_1 &= 4218,3\text{N} \\ F_2 &= 20502,9\text{N} \end{aligned} \tag{3}$$

The bending stress is calculated for given load and the angle $\alpha = 10^{\circ}$

$$\begin{aligned} \sigma_{f1} &= \frac{M_{f1}}{W_x} = 904,16 \frac{\text{N}}{\text{cm}^2} \\ \sigma_{f2} &= \frac{M_{f2}}{W_x} = 4394,64 \frac{\text{N}}{\text{cm}^2} \end{aligned} \tag{4}$$

The bending stress is obtained for the angle of $\alpha=35^o$

$$\sigma_f = \frac{M_{f1}}{W_x} = 752,07 \frac{\mathrm{N}}{\mathrm{cm}^2} \tag{5}$$

and for the angle of $\alpha=50^o$

$$\sigma_f = \frac{M_{f2}}{W_x} = 2867,67 \frac{\mathrm{N}}{\mathrm{cm}^2} \tag{6}$$

STRESS MEASUREMENTS IN THE ZONE OF THE WELD

The stress measurements may be different. In this study, it is used the method of strain gauge. A strain gage is a sensor whose resistance varies with applied force. It converts force, pressure, tension, weight, etc., into a change in electrical resistance which can then be measured.
Reliability of measurement results by this method depends on several factors and very important requirement for obtaining the accurate results of the measurement is correctly glued strain gauge to the surface of mechanical structures.
To obtain the best measurement results is needed to define the exact places for strain gauges, before the gluing strain gauges and measuring. The figure 4 provides a disposition glued strain gauges in relation to the edge of the console.

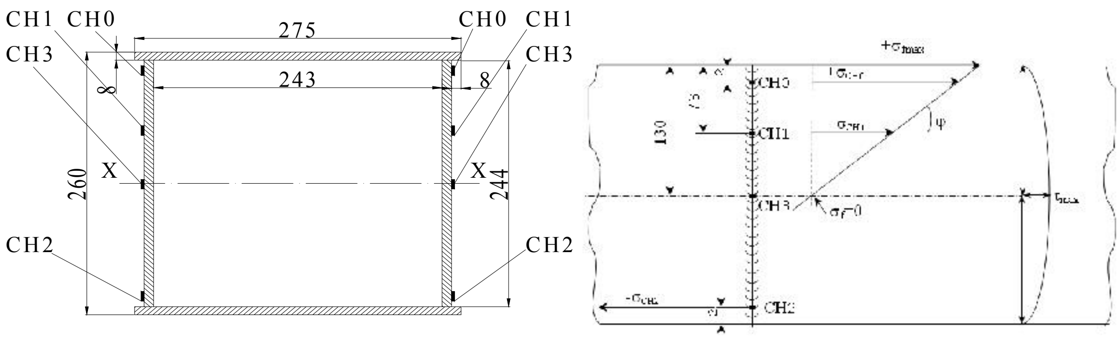


Figure 4. Disposition of strain gauges on the cross-section

The measurement process is performed for each loadF_1=4218,3 N with variation of angle of 10^o and 35^o and boom length 8600 mm, respectively for load F_2=20502,6 N with variation of angle of 10^o and 50^o and boom length 4450 mm.

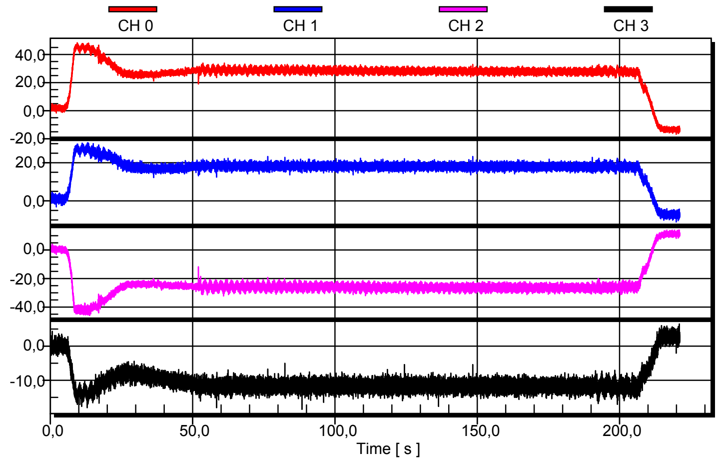


Figure 5. The measured values of ε for the load F_1 = 4218,3 N, l = 8600 mm and α = 10 °

Figure 5 shows the measured strain values by the boom length of 8600 mm and the angle of α= 10° at a load of F_1= 4218,3 N.The table 1 shows the values of strain.

Table 1. The measured values of ε for the load F_1 = 4218,3 N, l = 8600 mm and α = 10°

	CH0	CH1	CH2	CH3
max	45μm/m	28μm/m	-42μm/m	-15μm/m

Also for the load F_1 = 4218,3 N with the boom length of 8600 mm and the angle of α = 35° values are given in the figure 6 and in the table 2.

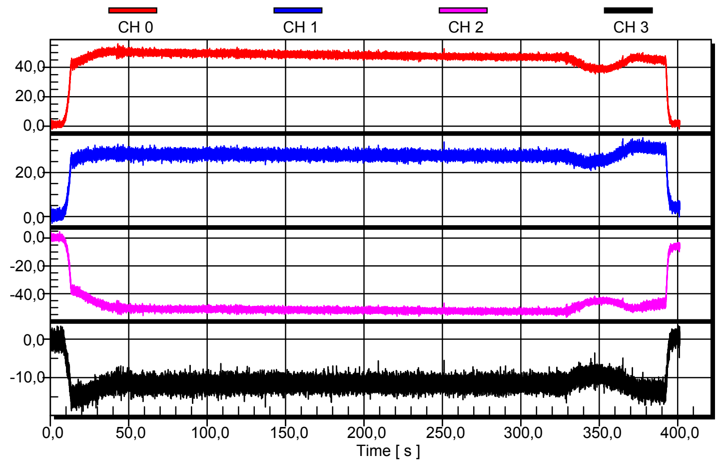


Figure 6. The measured values of ε for the load F_1 = 4218,3 N, l = 8600 mm and α = 35°

Table 2. The measured values of ε for the load F_1= 4218.3 N, l = 8600 mm and α = 35°

	CH0	CH1	CH2	CH3
max	49μm/m	29μm/m	-51μm/m	-15μm/m

The strains have been obtained at the same way for the load F_2=20502,6 N for angles α=10°and α=50°, whose values are shown in the tables 3 and 4.

Table 3. The measured values of ε for the load F_2=20502,6 N, l=4450mm and $\alpha = 10°$.

	CH0	CH1	CH2	CH3
max	220μm/m	129μm/m	-212μm/m	-170μm/m

Table 4. The measured values of ε for the load F_2=20502,6 N,l=4450mm and $\alpha = 50°$.

	CH0	CH1	CH2	CH3
max	227μm/m	133μm/m	-238μm/m	-62μm/m

For the results of measurements can be calculated the bending stresses

$$\begin{aligned} \sigma_{\overline{CH0}} &= \varepsilon \cdot E = 945 \frac{\mathrm{N}}{\mathrm{cm}^2} \\ \sigma_{\overline{CH1}} &= \varepsilon \cdot E = 588 \frac{\mathrm{N}}{\mathrm{cm}^2} \\ \sigma_{\overline{CH2}} &= \varepsilon \cdot E = -882 \frac{\mathrm{N}}{\mathrm{cm}^2} \\ \sigma_{\overline{CH0}} &= \varepsilon \cdot E = 315 \frac{\mathrm{N}}{\mathrm{cm}^2} \end{aligned} \tag{7}$$

The results are obtained for other measurements at the same way.

THE ANALYSIS OF MEASUREMENTS RESULTS

The measurement results are obtained on the basis of symmetrically distributed strain gauges to the axis x, i.e. the axis of boom.The strain gauges CH0 make one measuring point, where is the strain gauges glued to the farthest point on the boom side.The strain gauge CH0 is set to measure the highest stress in the boom, which would lead to the destruction. In the same way, strain gauges CH1 are set, which make the second measuring point, and then the CH2 and CH3 strain gauges that make the third and fourth measuring points.The strain gauge CH1 is set to one quarter of the console cross-section and used for measuring stress, and also for the verification of linear stress distribution in the boom.The strain gauges CH2 are glued symmetrically to the x axis with the strain gauges CH0 because of the stress verification and the measured stress value in the strain gauge CH2 should have the same value as in the strain gauge CH0, only they have different sign.
The strain gauge CH3 is a rosette and it is set to the neutral axis of bending and it is used for measuring the maximum shear stress, which is caused by the bending moment. The results obtained by measuring with the strain gauges are completely consistent with the results obtained by computer. The figure 7 shows one of several diagrams that are obtained experimentally. It was carried out of variations of angles (10^o, 35^o and 55^o), length of the booms (2650, 3400, 4450 and 8600m) and the loads (430 kg and 2090 kg), in order to obtain the diagrams.

THE VERIFICATION OF MEASUREMENT RESULTS

Besides the obtained analitical and experimental values, it was carried out numerical verification by finite element method.Figures 7 and 8 shows the finite elements for the the angle of 10°, the length of 1650mm and the load of 4218,3 N. The analysis for the other angles, lengths and loads was made at the same way.It can be seen that there are no critical areas where the boom fracture occurred in work conditions, respectively when lifting load.

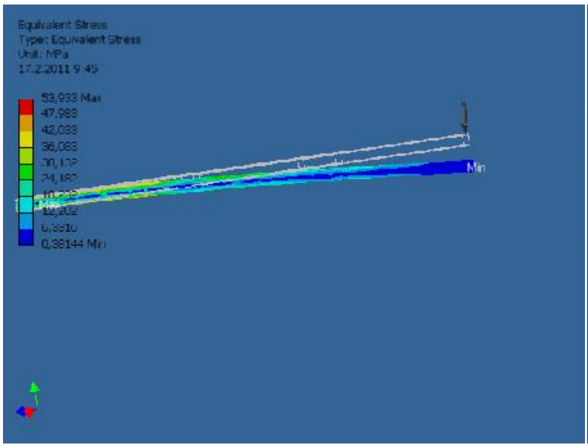


Figure 7. Stress of the boom due to load 4218,3 N, length of 8600 mm and the angle of 10°

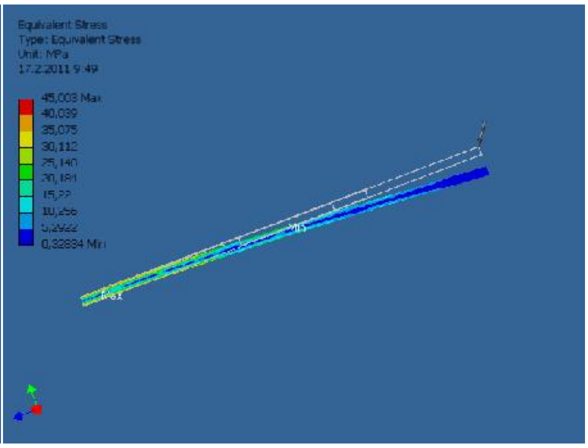


Figure 8. Stress of the boom due to load 4218,3 N,length of 8600 mm and the angle of 35°

The stress state at the console by extracted third part by length of 4450 mm was determined in the same way (Figure 9 and 10).

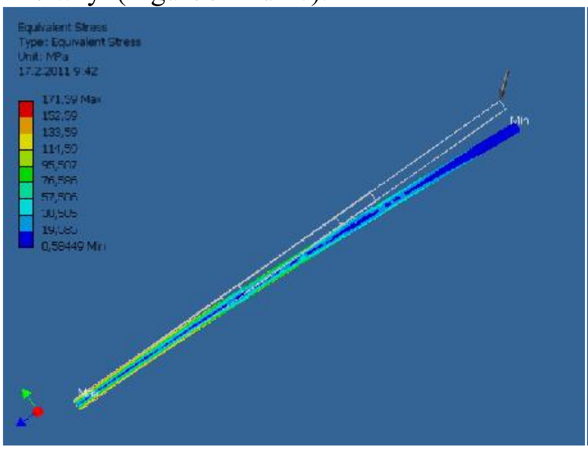


Figure 9. Stress of the boom due to load 20502,6 N, length of 4450 mm and the angle of 50°

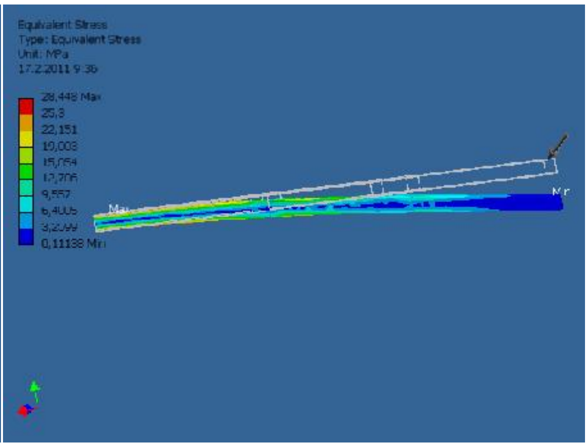


Figure 10. Stress of the boom due to load 20502,6 N, length of 4450 mm and the angle of 10°

According to obtained diagrams, it can be established that normal stress of the boom increases with increasing the angle of lifting, and there is reducing of the bending stress.Also, from the given diagrams, it can be determined that the loads on the boom will not lead to deformation of the boom, which leads to the conclusion that the damages are caused by the human factor.
Furthermore, we have the diagram of the safety factor, that is only shown for the the load of 20502,6 N by the angle 10° (Figure 11).

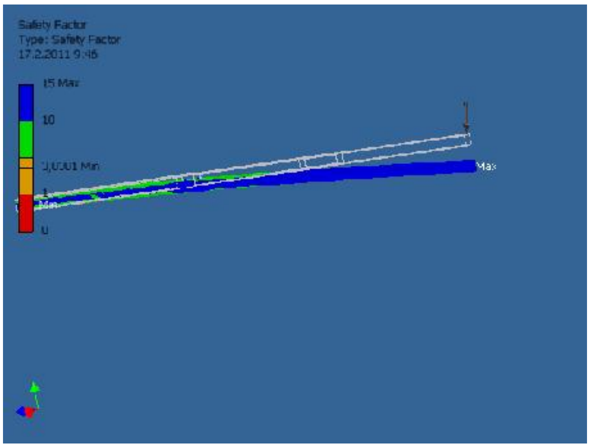


Figure 11. The safety factor at a load of 20502,6 N, length of 4450 mm and the angle of 10°

CONCLUSION

On the basis of analitical and experimental results, as well as results obtained by finite element method, it achieved to the conclusion that the stress-strain changes in the boom of crane during changes of lifting angle and loads, there is no significant changes which lead to deformation of the boom.Damages that occurred in the boom and were the reason for these investigations, have not occured due to loads which are analyzed in a very unfavorable conditions, but have caused due to incorrect crane handling.The normal stress is very low compared to the total size of the bending stress and that stress does not effect to the deformation which are occurred in the boom. Changes of the boom angles does not significantly effect on the intensity of bending stress because of the specific form of its end and working organs.

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MAINTENANCE IMPROVEMENT PROJECTS

Halep, A.
Zenica, BiH
E-mail: amir_halep@yahoo.com

Abstract: This work represents a review of activities to be carried out during the execution of an maintenance improvement project. It is pointed out the importance of education as a key factor in the realization. Also it is explained the procedure of an maintenance improvement project.
Key words: maintenance, maintenance audit, maintenance improvement

INTRODUCTION

Modern business requires a decreasing costs. Maintenance costs are significant part in the overall costs of the organization so management in all well-run organizations trying to reduce maintenance costs, while at the same time the reliability of equipment must be within defined limit. In this sense, interest in contemporary solutions in the theory and practice of maintenance becomes increasingly larger. At given moment management of an organization may decide to initiate the maintenance improvement project with aim to assure world class maintenace in their organization.

PROCEDURE

Regardless of whether the maintenance improvement project carried out by own employees or with the help of the consulting organization activities should be done in the same sequence:

1. make quality education for all persons involved in the maintenance process
2. evaluate the current state of maintenance
3. create a plan to improve maintenance
4. evaluate the plan and eventual refinement
5. implement a plan to improve maintenance
6. evaluate implementation of improvement plan
7. ensure continuous improvement of maintenance in the future.

This sequence of activities assure good results. Every activity is important for success of the project.

EXPLANATION

The first step in the realization of the maintenance improvement project is implementation of quality education for all persons involved in the maintenance process. Quality education is critical to project success. In order to improve maintenance, it is necessary to make certain changes. Spontaneous and natural reaction of people to a new and unknown is the resistance. On the contrary, if people are properly informed process of accepting flowing smoothly. Further, in order to introduce new solutions people need to be trained for them. It is important that education be adequately performed because of poorly implemented and poorly organized education has more harm than good. In fact, even if the conduct of training by our own staff that is free of external trainers loss occurs due to loss of working hours of employees during training. The loss is of course even more, if you engage paid, and poor external trainers. Apart from material losses even greater damage occurs by trained employees can possibly get contradictory and confusing or even inaccurate and irrelevant information. However, as already stated, a quality education is compulsory. Training is conducted on two levels: training for manufacturing workers and training for managers. The next step after the training is to evaluate the current state of maintenance. During evaluating it is necessary to get the answers to the following ten questions and the corresponding sub-questions:

1. What is the current organization of maintenance?
    a) centralized or decentralized maintenance
    b) obtain an organizational chart
    c) the total number of maintainer and qualification structure

2. How is conducted preventive maintenance?
    a) are plans for preventive maintenance created
    b) how are plans for preventive maintenance created
    c) how are plans for preventive maintenance implemented
3. How is conducted predictive maintenance?
    a) which methods of condition monitoring are implemented
    b) list of instruments and devices
    c) are plans for condition monitoring created
    d) how are plans for condition monitoring created
    e) how are plans for predictive maintenance implemented
    f) who performs condition monitoring
4. How is the maintenance planned?
5. How are monitored cost and performance of maintenance?
6. What is the system of work orders?
7. How is done equipment classification and categorization of critical equipment?
8. How is monitored the remaining work (backlog)?
9. How is managed spare parts and maintenance materials?
10. How is solved maintenance audit?
    a) who does the audit of maintenance
    b) the methodology of audit of maintenance

On many issues it is often the answer is very short. For example, the question "What is the system of work orders?" In many organizations to get the answer "We do not have a system of work orders." In some organizations may have a system of work orders, but it was inadequate or there is only theoretically. After evaluating the current situation it is necessary to create a plan to improve maintenance and to make its possible revision. According European Standard EN13306:2001 maintenance is "Combination of all technical, administrative and managerial actions during the life cycle of an item intended to retain it in, or restore it to, a state in which it can perform the required function." Also, preventive maintenance (PM) is "maintenance carried out at predetermined intervals or according to prescribed criteria and intended to reduce the probability of failure or the degradation of the functioning of an item" and predictive maintenance (PdM) is "condition based maintenance carried out following a forecast derived from the analysis and evaluation of the significant parameters of the degradation of the item." Corrective (reactive, curative) maintenance is "maintenance carried out after fault recognition and intended to put an item into a state in which it can perform a required function." World class maintenace require relationship between corrective and PM&PdM 80/20 (Pareto's principle) [4]. This means that at most 20% of maintenance may be corrective. This relationship is achieved by quality planning and implementation of the PM&PdM maintenance. Maintenace organization is also important. A lot of maintenance departments are organized for corrective maintenance demands but world class maintenance require organization according maintenance activities [7]. Maintenance organization according maintenance activities is shown in Fig 1.

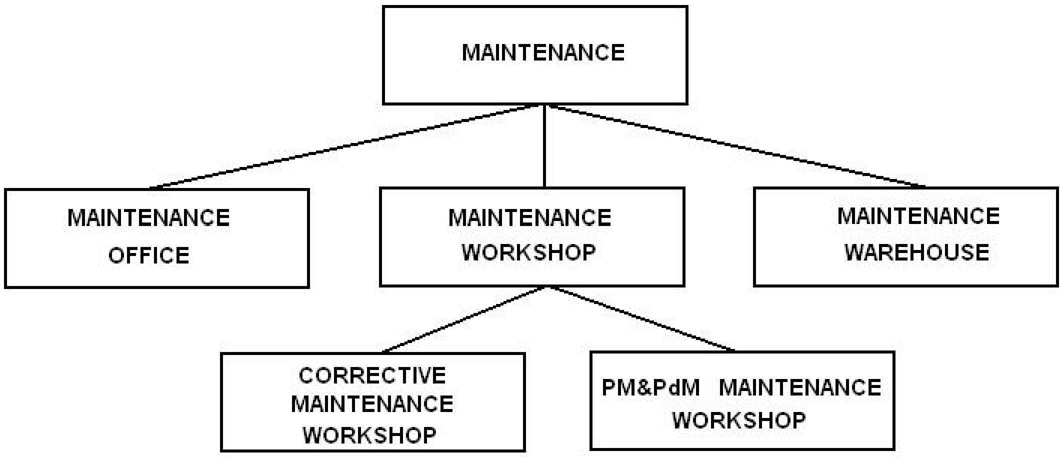

Figure 1. Maintenance organization according maintenance activities

Maintenance planning and scheduling is core of the maintenance effort because it provides for reliable delivery of all the other activities. There is often confusion between functions of planning, coordination and scheduling. These three activities are closely related and are usually performed by the same person, but they are distinct parts. Planning is advanced preparation of maintenance jobs so they can be performed in an effective manner. Maintenance plan is answer to the question “How to do maintenance job ?” but maintenance schedule is answer to the question “When to do the job ?”. Weekly schedules are created by Maintenance Office and daily schedules are created by Workshop Supervisor(s). Lord Kelvin once said “If you can not measure it, you can not improve it” so if we can not measure maintenance we can not improve it. Fundaments of maintenance preformance measurement is set by the British engineer Victor Zvi Priel in his paper "Twenty ways to track maintenance performance", published 1962nd year. Today we have maintenance preformance measurement defined by European Standard EN 15341:2007. The final and very important step of the project is to ensure continuous improvement of maintenance in the future.

CONCLUSION

Maintenance is an increasing portion of operational costs so it is seen as the last opportunity for major operational improvement. Most organizations continually search for any means by which to improve their maintenance function. Organization must be successful in maintenance improvement, if they are to survive and thrive.

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TESTING THE STABILITY OF PORTAL CRANE

Ristić, M.,Kočić, M.,Vasović, I.,Milutinoić, Z.,Ilic, O.,Obradović, J.
Institute Goša, Belgrade, Serbia
E-mail: marko.ristic@institutgosa.rs

Abstract: The paper presents the results of the analytical and numerical methods analysis of the portal crane load of 6.3t operating in specific conditions. This type of crane is widely used in the ports, shipyards, warehouses pieces or bulk materials, manufacturing, etc. As a working device, crane uses a hook, an electromagnet, with a special grab bucket tray. In this paper, is discussed the effect of maximum loads and loads of extra activities such as the impact of the wind loads and structural stability. Method of finite elements is used in numerical simulation. The results show that the portal cranes load of 6.3t is stable and can besafely use in conditions that are prescribed in practice.
Keywords: crane, load, wind, simulation, stability

INTRODUCTION

Portal cranes usually work outdoors and in hard environmental conditions and are among the most driving classes. They are used in shipyards, ports, warehouses, various civilian and military purposes: in the factories, the timber industry, foundries and steel mills. The ranges are between 15-40m and higher ranges when they are called loading bridges and range up to 200m. Portal cranes are working with and without overhangs. Working device is using a hook, an electromagnet, with a special grab bucket tray. On the supporting construction of portal cranes operate of the following loads: loads that act independently from the crane and its work: the vertical load from the weight of the payload, a horizontal load of its own weight, wind load, snow load, thermal loads. Loads emanating from the movement of cranes: all kinds of dynamic loads, loads of miter angles, assembly loading, load resistance movement. [1] The construction is based on the following requirements for cranes: If the wind speed, measured at the highest point hoists, growing and striving to reach the critical wind speed of 36 m/s, crane must be provided or its configuration should transformed into a safe configuration. As the methods or means are providing different and require a certain period of time to activate (the locking devices in separate locations on the track cranes, rail clamps with manual or auto switch), so must be selected lower secondary level wind speed. Every element which does not tighten the supporting structure placed in the stream with its longitudinal axis of the wind normal to the direction of flow, can become unstable aeroelastic. The construction should be designed to work in conditions with no wind and in work, and also to be safe in non-working conditions, wind, or wind above the allowed volume. Portal Crane consists of: steel structure, mechanism of movement, trolley winch drum, power cords and electrical closet with frequency regulatory (Fig.1).
According to standard FEM 2m class 9511 says that the cranes working hours per day, or that it raises loads per shift.

Figure 1. Model of portal crane

CARACTERISTIC AND METHODS

Technical characteristics of the cranes, which are the subject of analysis: the cranes rated load 6300 kg, the range between the legs of the portal is 20 m, reach the overhang of legs 8m rigid, flexible retrieval of the overhang of legs 8m, range of wheels on the front-side carrier 4 m, lifting height 10 m, the speed of the portal (frequency controlled) to 32 m / min, speed winch trolley 20 / 6,5 m / min, speed of lift 4 / 1, 25 m / min. [1]

Portal cranes can be used in military and civil purposes applied to the conditions laid down and where is operation safe. For cranes that are used in the region, where wind speed Vref ≥ 36 m / s, the contracts must be special conditions. Cranes, used in different regions must be constructed according to the conditions applicable to these different regions. When the cranes installed or used for longer periods in areas based on the local topographic configuration higher than normal non-working wind speed equivalent stationary and static pressures wind out of service, calculated according to the corresponding expressions must be modified in accordance with meteorological data or aerodynamic considerations.

The elastic stability is a phenomenon related to the behavior of structural elements under pressure. If the elements are stable structures, it is the size of the load that causes their deformation within changing character of their role in the construction. In contrast, losses of elastic stability, comes to the appearance of significant deformation of structural elements (there are additional bending moments), so that the fracture design comes with significantly less load than one that meets the criteria of evidence voltage.

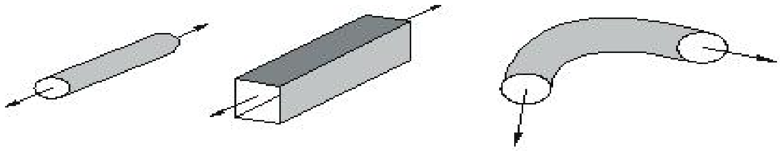
The characteristics, which describe the appearance and deformation under the impact of the static and dynamic loads, are the most important for exploitation safety of the complex metal structures. The testing methods, used in this paper finite element method (FEM) and permissible stresses of the metal structures, are well known. The properties, obtained by this calculation, describe the global mechanical behavior of the construction. [2] Numerical simulation of stress distribution on the same model and same condition is presented, too. Finite element method (FEM) was chosen to simulate operating conditions (boundary conditions and load). The SAP 2000 (Computer Aided Three-dimensional Interactive Application) software package has been used for generating finite element meshes, three-dimensional finite elements [1, 3, 4]

FINITE ELEMENTS METHOD

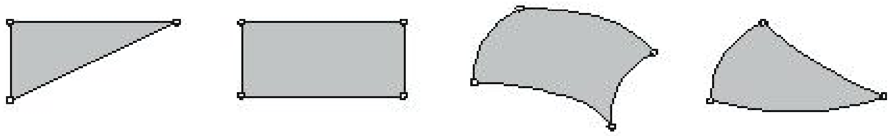
Finite element method (FEM) is among the most important methods of numerical analysis and among them a special place, because of its simple mathematical and physical formulations, so and for of the existence of a large number of programs for computers. The basic idea of this method is based on the natural discretization of continuum (constant mean). So, instead of analyzing the body, a deformable continuum with an infinite number of degrees of freedom analysis, a discrete model is made of interconnected finite element with a finite number of degrees of freedom.Finite element method is characterized by a wide range of applications, a simple analysis of environmental effects on the structure (mechanical and temperature loads, boundary conditions, etc.). The problems are solved using the FEM implemented through several phases:

- Discretization of continuum
- Interpolation choice functions,
- Determination of the characteristics of elements,
- Forming a network of equations for finite element
- Solving systems of equations,
- Calculation of the necessary impact.

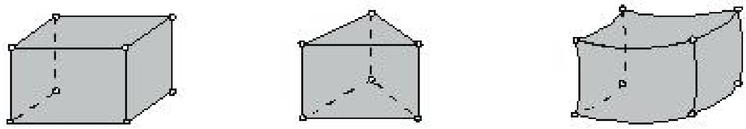
When calculating a deformable body using finite elements, the basic task is a discrete choice of model that the approximates best state of stress and strain and boundary conditions. In discretization of the continuum can be used one type of element or combination of types, you must take care of their agreement and network density, which is a real occasion. All finite elements are connected to common nodes to form the original structure. Due to the existence of a large variety of problems, structural shapes, geometric size and influence of machine design to date have been developed many types of finite elements (Fig. 2). [5]



a- one-dimensional finite elements (line)



b- two-dimensional finite elements (plane)



c- three dimensional (spatial)

Figure2. The main types of finite element

METHOD YEALD STRESS

In the calculations of strength in body parts, are the most common method of evaluation sizing of the strength of machine parts, made in the most authoritative calculation stress is compared to yield stress. Strength should be satisfied if the highest stress is less than allowed, and that is:
Yield stresses are calculated based on its characteristic resistance of the materials and the recommended safety level. The static streght of yeald stresss are taken in calculationas the authoritative characteristic of material. The most common materials are given in tables of characteristics for of tensile stress and tensile strength for the most marked yield stress and for yield stress (border unit elongation), tenaciously materials. Whether the calculation is done in relation to the tensile strength or yield stress can introduce two static security levels, as follows:
Sm- level security against breakage and St.- level security against plastic deformation.
Allowable stresses can now be presented by the following relations:

$\sigma_d = R_m / S_m$, $\sigma_d = R_{eH} / S_t$, |.

For other types of stress, such as pressure, shear, bending, torsion and buckling stresses are allowed values and other necessary data on the yield stress, as well as, the method calculation of static strength what are given separately for each type of machine parts and assemblies. [3, 4, 5]

RESULTS AND DISCUSSIONS

Analytical verification of the main girder

As discussed in this paper, it will be considered the main carrier in the most responsible elements. As already mentioned in introduction, the main load of portal cranes can be: its own load, load at boot, the effect of vertical inertial forces, and inertial forces at work. Net weight of the load forces are all parts of the cranes that are in operation, with the exception of its own load when lifting. Individual parts of the projected portal cranes are as follows: The carrier weights of 83.04 kN, when lifting loads consist of the payload and its own part to accept the payload, as well as parts of the supporting elements, raising the maximum load of cargo, and its nominal capacity is FQ = 63 kN.
The effect of vertical inertial forces is determined as follows. substrates budget adopted in accordance to DIN 15018, the effect of vertical inertial forces are the cranes working class, taking over the

coefficient of lift ψ and the coefficients of its own workload φ. Net loads are multiplied by a coefficient of its own workload φ which is determined especially for mid speed and quality built path. Since the maximum speed V_f portal ≤ 32 m / min, the ratio of its own load is: φ = 1.1 Projected portal crane that can run on stock sheets for making boats in the shipyard, the military warehouse in the defense industry factories to raise the appropriate class H2. The loads are multiplied by the corresponding raise the ads of raising class ψ.

The main load is the additional load from the wind and there are two cases: a working wind - crane in operation, the wind storm - crane out of service. It is assumed that the wind seems to work construction in the horizontal direction by pressing their influence. In this case the crane can be trusted to work when wind speed is:

$$v_v = 50,8 \frac{km}{h} = 14,1 \frac{m}{s}$$

The stopping pressure in this case is:

$$q_v = \frac{v_v^2}{1,6} = \frac{14,1^2}{1,6} \approx 125 \frac{N}{m^2}$$

The geographical zone II winds, where wind may occur with stop storm wind pressure qv = 700 N/m2 for structures exposed to wind up to 10m from the ground, the corresponding wind speed storm wind is:

$$v_v = 120 \frac{km}{h} \quad q_{V\max} = \frac{V_v}{1.6} = \frac{120}{1.6} = 0.700$$

In this case the platform should be out of service and the main girder to withstand the following loads:

$$F_{V1\max} = \chi \cdot A_1 \cdot q_{V\max} = 1.4 \cdot 35.28 \cdot 0.7 = 34.574 kN$$

χ - shape coefficient of the surface on which are acts on wind
A_1 - Surface of the main beams exposed to the wind

The main load under the influence of the payload and the winch are calculated based on checking, stress state checks are carried out with the factored principal load that is:

$$F = \psi \cdot F_Q + \varphi \cdot F_G = 80.359 kN$$

F_G - Weight winches
F_Q - Weight of cargo

The total bending moment of the main girder is given for two cases: first case loads, factored moment loads from due the middle of the span between the legs and under its own weight and the reaction supports the middle of the span between the legs and the results are the same.

$$M_{1F} = \frac{F \cdot L}{4} = -49398.7\, kNcm .$$

The second case load is a load on the overhang of stiff legs:

$$M_{f3} = 76442 kNcm .$$

In the third case load overhang load on the elastic legs:

$$M_{f2} = 76442 kNcm .$$

Checking the stress of the main girder is made and the stress due to the overall bend in the middle range between the legs:

$$\delta_{x1} = \frac{M_{f1}}{W_x} = 7.9742 \frac{kN}{cm^2} .$$

For the stress on the overhang of stiff legs are:

$$\delta_{x2} = \frac{M_{f2}}{W_x} = 12.339 \frac{kN}{cm^2} .$$

Stress in the elastic leg overhang is:

$$\delta_{x3} = \frac{M_{f3}}{W_x} = 12.339 \frac{kN}{cm^2} .$$

Allowed stress is:

$$\delta_{dop} = \frac{R_e}{v} = 23.667 \frac{kN}{cm^2}$$ for steel - S355J2G3

$R_e = 35.5 \frac{kN}{cm^2}$ - Yield stress

υ=1.5 - Level of security of the first case the load

How is $\sigma_x < \sigma_{dop}$ the working stress is less than allowed, so the design criteria satisfy a stresses. The influence of the local bending of the main girder following situations occurs the lower zone of the main girder trolley range with a winch. A touch point is near to the free edge of the band profile, so that the belt as a specific console, is locally loaded in bending, as shown in Figure 3

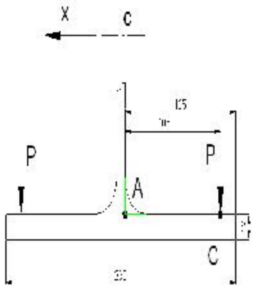


Figure 3. Load the lower belt of the main girder

The influence of local control in bending points, shown in Figure 4

$$\sigma_U^A = \sqrt{\left(\delta^A{}_{xl}\right)^2 + \left(\sigma_{Zu}^A\right)^2 - \sigma_{Zu}^A \cdot \delta^A{}_{xl}} = 8.199 \frac{kN}{cm^2} \le \delta_{dop},$$

$$\sigma_U^C = \sqrt{\left(\delta^C{}_{xl}\right)^2 + \left(\sigma_{Zu}^C\right)^2 - \sigma_{Zu}^C \cdot \delta^C{}_{xl}} = 13.576 \frac{kN}{cm^2} \le \delta_{dop},$$

$$\delta_{dop} = \frac{R_e}{v} = \frac{35.5}{1.5} = 23.667 \frac{kN}{cm^2}.$$

Allowable voltage S355J2G3 obtained from analytical testing shows local bending collected with a maximum bending.

Deformation of the main girder and the overhang of the main girder deflection, when the carts are on the overhang of legs is elastic: f_p=2.591 cm.

Carrier deflection when the carts are on the overhang of the rigid legs is : f_p=1.423 cm.

Carrier deflection when the carts are in the middle of the range is: f_p=2.59 cm.

Elastic stability is a phenomenon related to the behavior of the structural elements under pressure. If the elements are stable in structures, size of the load causes their deformation within indispensable character of their role in the construction. In contrast, loss of elastic stability comes to the appearance of significant deformation of the structural elements (there are additional bending moments), so that the fracture design comes with significantly less load, than the one that meets the criteria of evidence stresses.

Normal stress due to bending is:

$$\delta_{max} = \frac{M_{f1}}{I_{xprof}} \cdot y_{max} = -7.098 \frac{kN}{cm^2},$$

$$\delta_{min} = \frac{\left|M_{f1}\right|}{I_{xprof}} \cdot y_{min} = 1.662 \frac{kN}{cm^2}$$

Yield stress buckling voltage is:

$$\delta_{uz} = C_\delta \cdot k_p \cdot R_e = 28.45 \frac{kN}{cm^2}.$$

So, we can conclude that the stability of the plate against buckling provided.

Numerical simulation

Displacement, load and stress state in characteristic sections - nodes and reaction support structure that supports a portal crane are using the finite element method. Portal crane that supporting structure is modeled by linear finite element type beams. Eccentricity line system that supports structure is simulated by introducing so-called fictitious elements – beam, type finite elements which stiffness is much higher than the stiffness of the elements supporting structure. Reactions of the pillars supporting structure were determined by using the boundary element. Finite element model of portal crane support structure, Figure 6, contains 204 nodes and 232 finite elements of type beams.

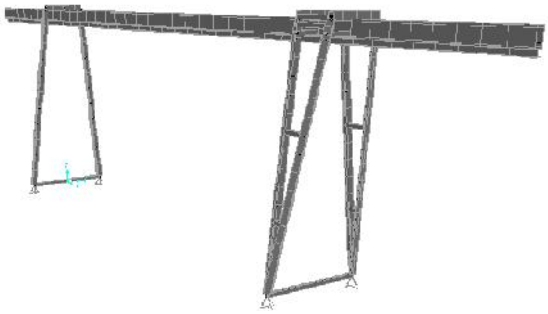


Figure 4. Model cranes and display fixtures

Static calculations (voltage identification field and moving support structure) are derived for four typical load cases:
I - The main load due to the effects of payload, winches and work the wind in the middle range,
II-loaded trolleys that are located at the end of the overhang of legs rigid; load bearing construction work is exposed to wind,
III-loaded trolleys are located at the end of the overhang with elastic legs; supporting structure is exposed to wind work,
IV-crane is out of service, supporting structure is exposed to storm winds.
Analysis of calculation results for each case of loads and shows the following: the main girder due to the effects of payload winches and wind is acting in the middle range. The intensity of the main load in the middle of the range of 85.5 kN, a wind load is 8.05kN, momentum in the middle between the legs is 49942 kNcm. The biggest shift is in the middle range at the 21st node is 2.54cm (Figure 5)

Figure 5. Deformation of force in the middle

The II case load is considered the case when the carts with load placed at the end of the main girder, legs and a solid supporting structure is exposed to wind business. The intensity of the main load on the overhang at the end of the rigid legs 85.5 kN, a wind load is 8.05kN. Moment on the main girder above rigid pillars is 76553 kNcm. The biggest move at the end of the main girder at the 76st node is 1.47 cm (Figure 6).

Figure 6. Deformation of cranes from the force at the end of the rigid legs

The III case load includes: carriages are loaded at the end of the main girder at the elastic legs, supporting structure is exposed to working wind. The intensity of the main load on the main girder at the end of the elastic leg is 85.5 kN, a wind load is 8.05kN Wind, Moment on the main girder at elastic legs 76.55 kNcm. The largest shift at the end of the main girder at the 71^{st} node is 2.58cm (Figure 7).

Figure 7. Deformation of cranes from the force at the end of the elastic leg

The IV case load that includes the situation is analyzed when the crane is out of service and supporting structure is exposed to storm wind. There is a major load, crane is in operation, such as when strong winds are not recommended to play the jack-up. Wind load of storm wind is 38.36kN. Deformation obtained by numerical simulation is shown in (Figure 8).

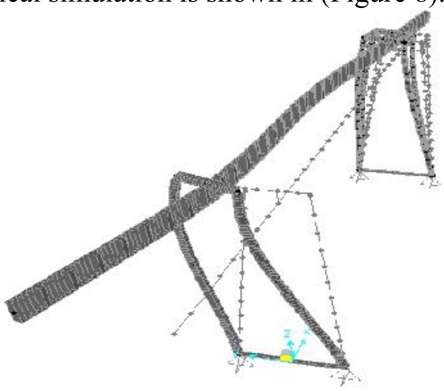


Figure 8. Deformation of cranes from the effects of storm wind

CONCLUSION

This study examined the portal crane rated load 6.3t which is widely used in civilian and military purposes. The aim of this study was to examine work conditions and types of portal cranes, which are often used in different working the conditions and storm wind that occurs in areas where the blowing speed of wind is up to speed of 36m/s. Comparative use of the analytical and numerical methods and the results are in agreement and crane can be safely used for safe operation equipment and manpower.
This paper analyzed the stability of portal crane load of 6.3t, which is widely used in civilian and military purposes. The aim of this study was to examine the influence of ambient conditions for safely use of portal cranes, which are often used in different working conditions, specially under storm wind blowing with speed up to 36m/s. The results of comparative use of the analytical and numerical methods are in agreement and show that the crane can be safely used under mention conditions.

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STUDENT HOUSING DESIGN IN RESPECT TO LIGHTING REQUIREMENTS IN NIS

Ilić, O.[1], Jovanović, A.[2], Obradović, J.[1], Ristić M. [1], Kočić M. [1]
[1]Institute Goša, 35 , Milana Rakića str., Belgrade, Serbia,
[2]Faculty of Civil Engineering and Architecture, University of Niš, 14 Aleksandra Medvedeva Str, Niš
E-mail: olivera.ilic@institutgosa.rs

Abstract: The existing studen housing facilities in Serbia,built in the period when the energy issues were considered less important, consume large amounts of energy needed for cooling, heating and air-conditioning. Day light should be considered not only as a possibility for reduction of the energy consumption, but also as an important factor for achieving good physiological development of young.
The student dorm objects in Nis were analyzed in regards to sustainability of the dorms and daylight implementation in particular.
Key words:day lighting, student dorms, sustainable design

INTRODUCTION

Majority of the student dorm buildings in Serbia were built in the second half of the 20th century, at the time when energy issues were not present in the legal acts, which would imply their use by architects and other engineers in the early design process and during the exploitation. But nowadays, in the era of environmental, energy and economic crisis architecture has become one of the primary objectives of environmental reform in which a role of light should not be underestimated.
Artificial lightning is a major electricity consumer. Besides the electrical energy needed for bulb functioning, the use of artificial lightning creates heat gains which increase the need for space cooling and ventilation, respectively electrical energy for operation of the cooling system.
Both in historical and contemporary architecture, day light plays a significant role. Day lighting is important for achieving good physiological development of young which combined with spatial characteristics of the living space, contributes to healthy environment thus better conditions for achieving social dynamics among young people. In the USA, a series of daylight studies were performed by the Heschong Mehone Group. For these studies, data from 21.000 students in three districts were evaluated. The researchers found that students with the most daylighting in their classrooms progressed 20% faster on math tests and 26% on reading tests in one year than those with the least. And students that had a well-designed skylight in their room, one that diffused the daylight throughout the room and which allowed teachers to control the amount of daylight entering the room, also improved 19-20% faster than those students without a skylight [3].
On the other hand, by exposing the building façade to outer influences, especially on the southern exposures, unwanted solar gains in summer will occur and therefore overheating problems during warm periods of the year. This is especially present in continental climates. Moreover, in this climate conditions large window surfaces contribute to heat loss, especially in winter.
It is needed to evaluate the performances of the student dorm buildings at present and to conclude to what extent to incorporate methods of sustainable design in the design process of new built dorms.

AIMS AND METHODS

The method used comprise analysis of the student dorm in Nis in respect to light parameters' values and comparison to standards for this type of buildings found in literature and requirements found in assessment methods for sustainable design. An analysis was done of 2 student dorms different in terms of building volumes and different room orientation. The quality of day lighting and visual comfort in student rooms, common rooms, reading and drawing rooms as well as in hallways and corridors is to be determined.
Measurements were made by using the lux light meter and were done at 12 am on March, 20th 2011, on a clear sunny day.
The first dorm, "Pavilion 4"is a twelve storeys high building, situated in a not dens populated urban tissue. Analysis was done at two separate floors, one at the middle of the building height, the third floor, the other at the top floor.

At the second dorm, “Pavilion 2”a five storey building along with social rooms in the basement, the measurements were done at the third floor.
In addition, a questionnaire, comprised questions about overheating problems, the periods when they occurred, satisfaction with visual comfort condition during different seasons of the year and times of the day, was presented to the dorms’ dwellers regarding the level of visual comfort. The data was then synthesized in respect to different façade orientation of the dwellers’ rooms and common spaces.
The aim is to determine the quality of day lighting and visual comfort in student dorms in Nis and to give design recommendations in respect to daylight for students housing buildings.

DAY LIGHTING IN STUDENTS DORMS – CONDITIONS DETERMINATION

When designing students dorms areas attention must be focused on different situations that involve various visual requirements. A key element in this process is understanding the criteria of functionality, the perception of shape and contrast.
There are few parameters which indicate quality and quantity of light in interior spaces.
The illumination intensity, measured in lux(lx), represents the basic point at which to start evaluating the quality of lighting in building’s space. However, this is not considered to be a determining parameter, due to the nature of light , then the lighting intensity contrast between different zones in an architectural space, followed by glow properties of the source, glare prevent, shadow disposition and colour climate in the room. [4]Another important factor includes color temperature and color rendition. Color rendition marked effect of a light source on the appearance of the color of a particular product [4]. Color temperature determines whether the object would seem warm or cold.

Table1. Dorm rooms’ artificial light’s requirements by JKO [5], page 64

Type of room	lighting intensity (by JKO in lx	colour of light t-warm color, b-white color of light, d-daylight colour	colour reproduction levels (1-4)	glow level (level of commodity with glare presence)
Hallways, stairs, lobbies, storage rooms	60	t,b	1,2	-
Entrance zones to rooms	60	t	1,2	-
Rooms	250	t	1	2
Bathrooms	120	t	1	-
Kitchens (kitchen work zones)	250(500)	t,b	1	2
Studying zone within rooms	500	t, b	1	-

Different authors suggest that the daylight factor should be desired at the level of at least 50 percent of the floor surface of the room, and not just as parameter for minimal room illumination intensity. [6]
Dayliht autonomy is a measure of how often (e.g. percentage of the working year) a minimum work plane illuminance threshold of 500 lx can be maintained by daylight alone. In contrast, the UDI(useful daylight illuminance) scheme is founded on a measure of how often in the year daylight illuminance within a range are achieved. Real daylight illuminance in building vary enormously, much more than is suggested by variations in predicted daylight factors.

Requirements by Assessment Methods for Sustainable Design

Energy performance ranking of buildings is necessary in order to include both visible (elements clearly visible on the building, such as PV panels) and invisible (such as energy efficiency) components of the "green" architecture. Two leading certification systems are BREEAM and LEED.

Regardless of the differences in these evaluation systems, which primarily arise because of different legal framework on which these systems are based, both of them indicate the necessity of involving experts and standards in the early stages of design in order to achieve energy efficiency of buildings. Also, both schemes encourage the market to improve the design of buildings and to use renewable energy sources. These programs provide developers a number of different areas, among them and interior lighting, to consider when considering the sustainability of their projects.
In evaluating lighting in multi-residential buildings BREEM gives points for providing sufficient amount of daylight; providing views to the exterior; reducing problems associated with flares through installation of adequate controls; reducing the risk of health problems associated with blinking of fluorescent lights (which is a prerequisite for obtaining the certificate); lighting design in accordance with best practices for visual performance and comfort and for providing users an easy and simple access to lighting controls in each relevant area of the object. At least 80% of floor area in the residential areas must be adequately daylit as follows [7]:
- In kitchen areas an average daylight factor of at least 2% must be achieved.
- All living rooms, dining rooms and studies must achieve a minimum daylight factor of at least 1.5%
- 80% of the *working plane* in each kitchen, living room, dining room and study must receive direct lightfrom the sky.
At least 80% of floor area in communal areas and/or non-residential *occupied spaces* are adequately daylit as follows:
- An average daylight factor of 2% or more.
-plus either a uniformity ratio of at least 0.4 or a minimum point daylight factor of at least 0.8% (spaceswith glazed roofs, such as atria, must achieve a uniformity ratio of at least 0.7 or a minimum point daylight factor of at least 1.4%); or a view of sky from desk height (0.7m) is achieved and the room depth criterion $d/w + d/hw < 2/(1-rb)$ is satisfied.
In addition, artificial lighting has a significant role in the total electricity consumption, so is hereby assessed and certified under Energy area.
In the area of interior lighting quality LEED promotes comfort, the use of daylight, view of the exterior and the reduction of the night sky light pollution. Since lighting plays an important role in the overall demand for energy, lighting is also estimated trough energy efficiency of the building. For new constructions it is required a minimum daylight illumination level of 25 footcandles in at least 75% of all regularly occupied areas. Measurements must be taken on a 10-foot grid for all occupied spaces and must be recorded on building floor plans.It is also required to achieve direct line of sight to the outdoor environment via vision glazing between 2’6” and 7’6” above finish floor for building occupants in 90% of all regularly occupied areas. Requirements for existing buildings are to achieve a minimum of a daylight factor of 2% (excluding all direct sunlight penetration) in spaces occupied for critical visual tasks. It is also required to provide glare control for all windows where direct sunlight would interfere with normal activities.

STUDENT DORMS IN NIS

Research shows that not all of the rooms have the adequate amount of the light. Moreover all common rooms, kitchens and halls receive little sunlight. The other remarkable note is that at higher floors, illumination intensity rapidly rises so that the rooms on the last floors (10th – 12th) are over exposed to sunlight and unpleasant for stay and work, partially caused by absence of any kind on shades.
Reading rooms and other work rooms within the dorms are with southern exposure and are overexposed to daylight and sunlight in summer in particular and exceed the lighting requirements’ values described in the previous chapters of the paper.
Small fenestration of hallway and staircase spaces in Pavilion 4, compared to the floor surface, leads to small light intensity which requires additional artificial light use during the day. Nevertheless, Pavilion 2 dorm typology comprises large window surfaces compared to hallway surface which contributes to larger illumination intensities.

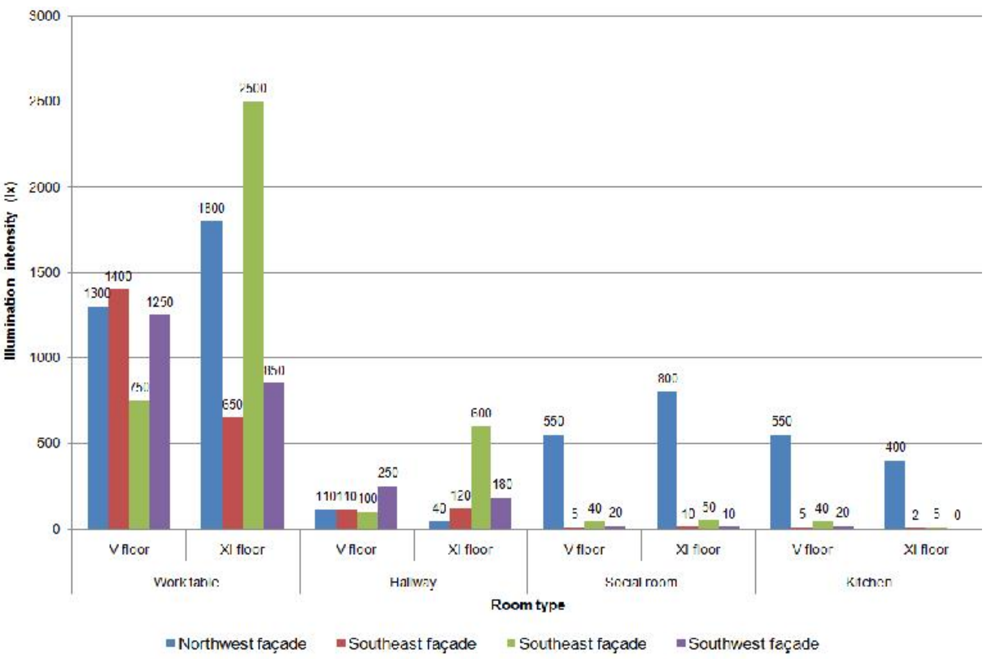

Figure 2. Values of daylight illumination intensity(in lux) in Student dorm "Pavilion 4"

A short interview about the problems of the overheating caused by direct sunlight in the rooms, having one wall covered with windows from edge to edge, and from the height of 1,2 meters up to the ceiling, shows that this causes unsustainable air temperatures during large number of the months, from the early spring (April and May) to the beginning of the fall (October), and the direct sun exposure goes from 10am to 6pm, depending on the orientation of the building's facade. The students cover the windows with the aluminium film, or in some cases use the thick paper in order to reduce overheating. As a further the amount of light is drastically reduced, causing additional lighting sources necessary. [9]

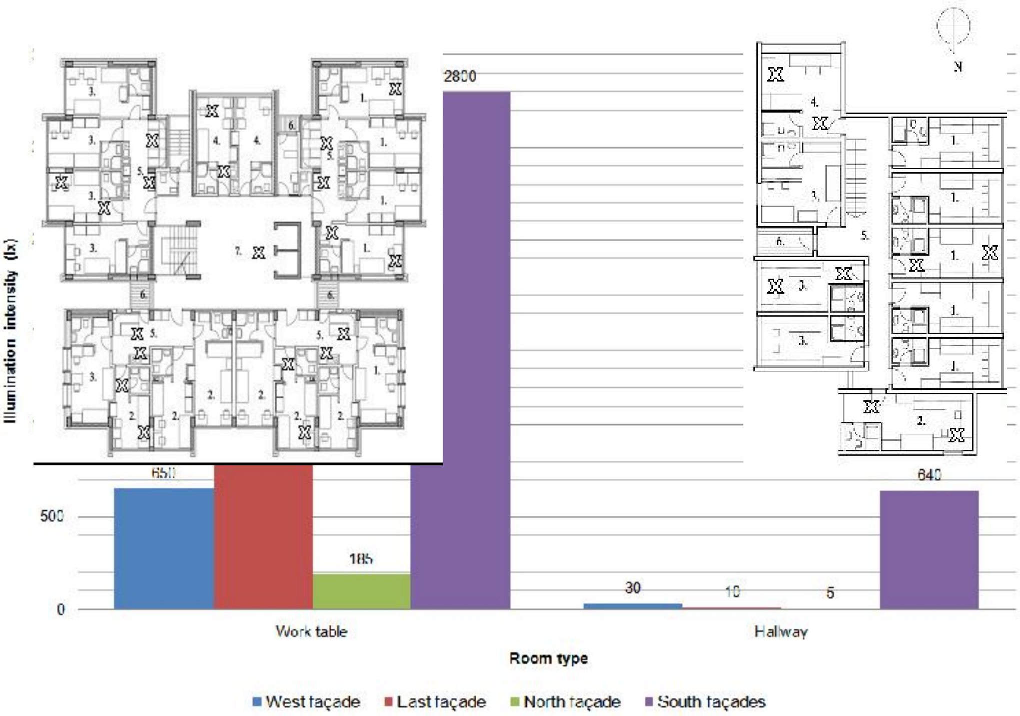

Figure 3. Values of daylight illumination intensity (in lux) in Student dorm "Pavilion 2"

The rooms having windows on the north-western façade are said to be the most comfortable places for living and studying in the dorm, according to students' response. This is due that during almost all days during the year even though they lack direct sunlight, are considered to be well naturally illuminated because of large fenestration and therefore are pleasant for work.
Finally, in "Pavilion 2", thanks to the surrounding buildings and the smaller height of the building, the influence of the direct sunlight is still less uncomfortable than in "Pavilion 4". The overheating appears only on the last floors, and the most comfortable rooms are, regardless to the side, in the first 3 floors. [9]

RESULT OF THE ANALYSIS AND DISCUSSION

By far, the best source of light we know is the sun, which gives off free, full-spectrum light all day long. Designers of student dorms, that are LEED or BREEAM certified, tried to increase the level of natural light, which is not only an important factor for human's health and wellbeing but also an important factor in energy saving strategy, trough strategic design and placement of windows and skylights and by choosing light colors and reflective materials for walls, ceiling and floor.
According to the analysis of dorms in the paper, dorms should be built with no more than four storeys, with southern exposure of student rooms and other common rooms covered with shades in order to decrease the unwanted solar gains and overexposure to day lighting. The student dorm rooms at northern sides are favourable since they offer enough light intensity for studying year round and are protected from direct sunlight during the warmer parts of the year. The use of day and sun lighting in common rooms, hallways and in where possible in the building, is one of the measures to gain solar access in the winter period and to decrease the energy bills needed for artificial lighting. Common rooms and hallways should be well naturally illuminated and this remains the issue in the future design to be properly re-examined.

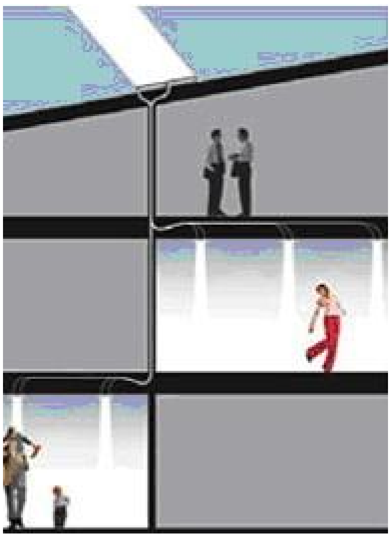

Figure. 4. The hybrid solar lighting technology [13]

To maximize building's energy efficiency new technologies have been developed. Sunlight can be harvested on the roof and then "piped" inside the building via fiber optics and other light channeling technologies during the day or emitted at night light, powered by the solar panels. Some of this technologies are sunpipes ,the hybrid solar lighting, fluorosolar.

CONCLUSION

Unlike active system which can be applied to any house, passive system is the house itself. It allows for better exploitation of the building only with measures implemented at an early stage of design. Day light should be considered as a possibility for reduction of the energy consumption.

As shown in this paper, the existing student housing facilities consume large amounts of energy needed for cooling, heating and air-conditioning. Fortunately, there are certain recommendations, related to the early planning awareness of sustainable methods, that can help reduce this consumption in the future designs. Designing dorms following the patterns described, would lead to better understanding of day light potential and an increase in dorm aesthetic possibilities, allowing for greater involvement of new glass materials and ideas for shading models which add to the dorm architecture.

A carefully planned and implemented lighting concept will have positive and direct effect on students life, while resulting in long-term savings in operating and maintenance costs.

ACKNOWLEDGMENTS

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THE DEVELOPED MODEL OF EXPERIMENTAL TABLE FOR TESTING THE RELIABILITY OF AGRICULTURAL CARDAN SHAFTS

Ašonja, A.[1], Gligorić, R.[2], Desnica, E.[3]
[1]The Serbian Academic Center, Stevana Mokranjca 18/31, Novi Sad, Serbia
[2]University of Novi Sad, Faculty of Agricultural, Novi Sad, Serbia
[3]University of Novi Sad, Technical faculty "Mihajlo Pupin", Zrenjanin, Serbia
E-mail: aleksandar.asonja@gmail.com

Abstract: This paper presents a developed model of experimental table for testing the reliability of agricultural cardan shafts. The aim of this study was to design the experimental table, which will allow testing of all types of agricultural shafts with single or double Z or W work performance. With this solution very quickly will be get the assessment time of using cardan shafts by the application of methods for rapidly testing. The advantage of the developed model of experimental table is certainly a possibility (during the examination) to apply the identical test conditions in which the cardan shafts are exploited, such as the ability to change the angle of the output and input shaft, the ability to change the load on the output shaft and ability to can change the speed of input shaft.
Key words: experimental table, cardan shaft, needle bearing, reliability

INTRODUCTION

The agricultural production is a specific activity in comparison to other industries. It is used for agricultural machines work in the unfavorable conditions, while engaged mainly seasonal. During this period, they are very extensively used in the agro-technical processes: sowing, reaping, harvesting and so on. The cancellation of any vital part of the agricultural machine (for example: cancellation of rolling bearing on cardan shaft) is actually cancellation of the whole machine. And if all this happens, for example, during the harvest, losses of deadlocks are very high and far they can overcome the cost of rolling bearing, cardan shaft and machinery in general [1,2].
Modern agricultural machinery constantly increasing masses, working procedures and speed, which means the larger installed engine power, higher speed and higher working loads of machine parts, which adversely affects their reliability. Any increase in the reliability of rolling bearings of propeller shaft, means increasing confidence of level shafts to, as well as driving and operating machinery as a whole. Initial damage to rolling bearings, without modern measurement equipment and appropriate methods can not be diagnosed. It is therefore important to explore possibilities for diagnostics of roller bearings in order to replace the new time, and thus prevent further damage to the cardan shaft and all other parts in the engine system [10].
In cases where the angle of rotation shafts is more than 30^0, the driven shaft angular velocity increases rapidly and the increasing inertial forces and inertial moment to the values that can lead to breakage of drive shaft. It is therefore permissible limit rotation angle of the shaft with a wrist up to 30^0 [6,7].
By experimental studying the axial forces in the central shaft connection, it was concluded that the rotating moment causes bending inward forks tine, and increased speed causes to bend outward [5]. As a result, bending fork tine causes a non-negligible axial forces in the cardan joints.

MATERIALANDMETHODS

Technical caracteristics of experimental table

Nowadays, in the world there are a number of experimental structures of different tables for testing the reliability of shafts. All experimental tables can be divided into two groups: devices that operate on the principle of closed-circuit strength and devices that operate on the principle of open-circuit power. And certainly the most famous in the market experimental tables are American companies MTS and the German company Schenck [4,9].
Experimental table for testing agricultural shafts designed to operate on the principle of open-circuit power, where is the brake in addition to the drive circuit and the experimental cardan shaft. For a given mechanical device it was applied the mechanical brake, specially designed for this purpose.

By applying a given technical solution or experimental table for testing the reliability of agricultural shafts (Fig.1) it is possible monitoring the behavior of all types of shafts (single or double with a Z or W work performance) during operation in different modes. The advantage of the developed model of experimental table is certainly a possibility that during the application of identical test conditions in which the drive shafts are exploited in the field, such as the ability to change the angle of the output and the input shaft (and under conditions where the angle shafts α_1 and α_2 match, and when they coincide different), ability to change the load on the output shaft and the ability to change the speed of the input shaft [3].

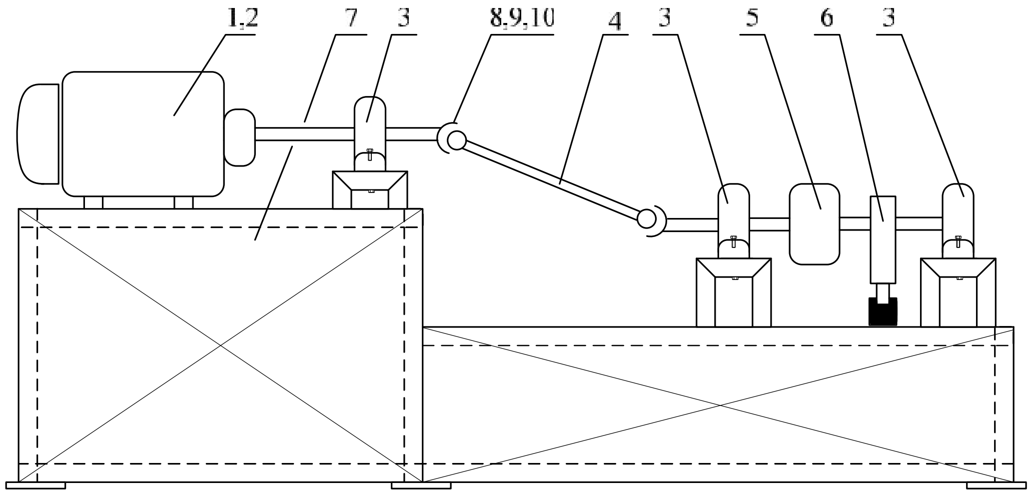

Figure 1. The experimental table for testing the reliability of cardan shafts

The basic elements of experimental table, fig.1, are: part of the drive (electric motor) 1, buncher 2, supports 3, cardan shaft 4, mechanical brake 5, the torque sensor 6, construction of table 7, sensors for measuring temperature 8, the sensors for measuring vibration sensor 9 and sensor for noise measurement 10.
With mechanical brake 5 it can assign a certain value of braking moment, i.e. moment of load of the output shaft with belt toothed gear on the bench. Size of the moment load is obtained by reading directly from a digital bridge amplifier.

Dynamic parameters for testing the reliability

The examination of agricultural cardan shafts designed to experimental table are focused on testing the needle bearing in universal joint crosses. Set consists of diagnostic tests of some dynamic parameters, such as rotation speed, noise, vibration and temperature. For all its work on such device may be performed monitoring of basic dynamic parameters of the test circuit, where the collected data are continuously stored in a central computer.
On a given experimental table part of the drive is the part of motor from which the input speed can be continuously changed through buncher. For testing of agricultural shafts typically it is used 540 r/min at the entrance of the drawn returned. Size of torque, which simulates the load that the agricultural machine tools transferred to the drive shafts, carried out on the device with belt toothed gear which defines also the braking torque.
The temperature is measured by the needle bearings tensometric encoder (converter), the bearing caps with thermal resistor, while the piezoelectric vibration measures converter stored before and after the joints. In the course of the working surface of the bearing wear (wear), resp. heated so that the vibration increases. Sensor noise is located near the driveshaft joint.

Method for accelerated reliability testing

For reliability testing shafts used some of the accelerated testing methods shafts. One of the main tasks of testing the reliability and timeliness of information. ie. obtaining the necessary results in the shortest period of time, much faster than they would achieve this by monitoring circuits in normal operation.
Accelerated testing of individual components can be accomplished in several ways: by increasing the level of workload, increasing the speed load changes (such as speed or frequency of communication load) and a combination of these two basic alternatives. Each of these methods can very effectively short the time during interrogation, but can also lead to large errors, especially if it exceeds a certain critical threshold. Significant increase in workload could be substantially change the working conditions (in relation to the real conditions of exploitation), so that the malfunction of the test rig is completely different from those that obtain in normal use. Similarly, high-speed changes in workload may in certain cases, to significantly change the conditions for cooling, lubrication and so on. Which in turn can lead to totally unrealistic conditions. It is therefore very important that the so-called accelerated factor, which represents the ratio of work time in normal use and the T_e experimental table, unit T_1, adopts a very cautious, maintaining the previous analysis of influential factors.

$$U = \frac{T_e}{T_1} \tag{1}$$

In most cases, especially when it comes to examining the major structural components or whole accelerated factor has a value of $2 \div 5$, while the examination of certain elements can reach high values, over 100 or more (for example, in testing the gear pulsators, roller bearings, etc.) [8].

RESULTSANDDISCUSSION

Reliability tests of agricultural shafts (diagnostics of needle bearings), the date the terms of use, it should be pointed primarily to the shortcomings mentioned in the mechanism of exploitation, based on which will be able to define the scope for further exploitation (through a lifetime of needle bearings) to increase the reliability of shafts.
Scientific results of the reliability of shafts should be pointed out: improving work processes that use agricultural machinery drive shafts, the ability to predict the life of the needle bearings cardan shafts, boosting confidence level shafts, cardan shafts to the effects of instability of working and auxiliary machines and consider the possibility of using results of the other propeller shafts.
The social results of the reliability of shafts should be pointed out: increase the economic efficiency of agricultural machinery and agro-technical operations, which employ a drive shafts and improve safety conditions for machine operators.
The main advantage of the essence of experimental table for testing agricultural shafts is its originality, simple and low cost manufacturing. In addition it is possible to use different types of spinning and cardan change the input and output angles to the shaft is a simple and practical. Adaptation elements for the connection can be achieved by examining any type of drive shaft, with the limitation specified dimensions and load range. Thanks to these advantages, it is possible to easily remove the gear and track changes to its contact surfaces. At the same time, by appropriate sensors, bridge amplifier and a computer, it allows for continuous monitoring modes and their possible changes.

CONCLUSION

The originality of this technical solution for testing the reliability of agricultural shafts is the possibility of continuous monitoring diagnostic parameters (temperature, vibration, noise, etc.) for different operating conditions.
The main advantages of this device are: compactness and rigidity of construction, choice in a wide range of loads, a simple change of the input speed and load changes, the ability to establish working regimes with high accuracy and the possibility of continuous monitoring of the studied parameters.

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TOTAL PRODUCTIVE MAINTENANCE

Stupar, S. [1] **Radovanovic, Lj.** [2]
[1] The University of Western Ontario, London, Ontario, Canada
[2]University of Novi Sad,Technical Faculty "Mihajlo Pupin", Zrenjanin
E-mail: stupar.sasha@gmail.com

Abstract: Total Productive Maintenance - TPM is program for maintenance wich include new concept of defining of technic system maintenance. The goal of TPM program is addition of manufacture. Technical systems maintenance can be realized in many ways with several different solutions, and TPM is strategy and new philosophy.
Key words: total productive maintenance, policies

INTRODUCTION

Total Productive Maintenance (TPM) is a maintenance program concept. . The TPM program closely resembles the popular Total Quality Management (TQM) program. The goal of the TPM program is to markedly increase production while, at the same time, increasing employee morale and job satisfaction. Many of the same tools such as employee empowerment, benchmarking, documentation, etc. are used to implement and optimize TPM [1].
TPM brings maintenance into focus as a necessary and vitally important part of the business. It is no longer regarded as a non-profit activity. Down time for maintenance is scheduled as a part of the manufacturing day and, in some cases, as an integral part of the manufacturing process. It is no longer simply squeezed in whenever there is a break in material flow. The goal is to hold emergency and unscheduled maintenance to a minimum.

GOALS OF TPM

TPM aims to establish good maintenance practice through the pursuit of next goals of TPM [2]:

(1) Improve equipment effectiveness: examine the effectiveness of facilities by identifying and examining all losses which occur - downtime losses, speed losses and defect losses.

(2) Achieve autonomous maintenance: allow the people who operate equipment to take responsibility for, at least some, of the maintenance tasks. This can be at :

- the repair level (where staff carry out instructions as a response to a problem);
- the prevention level (where staff take pro-active action to prevent foreseen problems); and the
- improvement level (where staff not only take corrective action but also propose improvements to prevent recurrence).

(3) Plan maintenance: have a systematic approach to all maintenance activities. This involves the identification of the nature and level of preventive maintenance required for each piece of equipment, the creation of standards for condition-based maintenance, and the setting of respective responsibilities for operating and maintenance staff. The respective roles of "operating" and "maintenance" staff are seen as being distinct. Maintenance staff are seen as developing preventive actions and general breakdown services, whereas operating staff take on the "ownership" of the facilities and their general care. Maintenance staff typically move to a more facilitating and supporting role where they are responsible for the training of operators, problem diagnosis, and devising and assessing maintenance practice.

(4) Train all staff in relevant maintenance skills: the defined responsibilities of operating and maintenance staff require that each has all the necessary skills to carry out these roles. TPM places a heavy emphasis on appropriate and continuous training.

(5) Achieve early equipment management: the aim is to move towards zero maintenance through "maintenance prevention" (MP). MP involves considering failure causes and the maintainability of equipment during its design stage, its manufacture, its installation, and its commissioning. As part of the overall process, TPM attempts to track all potential maintenance problems back to their root cause so that they can be eliminated at the earliest point in the overall design, manufacture and deployment process.

MAINTENANCE POLICIES

The modern view of maintenance is that it is all about preserving the functions of physical assets. In other words, carrying out tasks that serve the central purpose of ensuring that our machines are capable of doing what the users want them to do, when they want them to do it. The possible maintenance policies can be grouped under four headings visions [3].

1. Corrective - wait until a failure occurs and then remedy the situation (restoring the asset to productive capability) as quickly as possible.
2. Preventive - believe that a regular maintenance attention will keep an otherwise troublesome failure mode at bay.
3. Predictive - rather than looking at a calendar and assessing what attention the equipment needs, we should examine the 'vital signs' and infer what the equipment is trying to tell us. The term 'Condition Monitoring' has come to mean using a piece of technology (most often a vibration analyser) to assess the health of our plant and equipment.
4. Detective - applies to the types of devices that only need to work when required and do not tell us when they are in the failed state e.g. a fire alarm or smoke detector. They generally require a periodic functional check to ascertain that they are still working.

Preventative maintenance (PM) procedures had been in place for some time and PM was practiced in most plants. Using PM techniques, maintenance schedules designed to keep machines operational were developed. However, this technique often resulted in machines being over-serviced in an attempt to improve production.

Manufacturer's maintenance schedules had to be followed to the letter with little thought as to the realistic requirements of the machine. There was little or no involvement of the machine operator in the maintenance program and maintenance personnel had little training beyond what was contained in often inadequate maintenance manuals.

The need to go further than just scheduling maintenance in accordance with manufacturer's recommendations as a method of improving productivity and product quality was quickly recognized by those companies who were committed to the TQM programs. To solve this problem and still adhere to the TQM concepts, modifications were made to the original TQM concepts. These modifications elevated maintenance to the status of being an integral part of the overall quality program.

IMPLEMENTATION OF TPM

In actual fact, implementing TPM is a dramatic organisational change that can affect organisation structure, work-floor management system, employee responsibilities, performance measurement, incentive systems, skill development and the use of information technology. No wonder the success rate of such large-scale change is less than 30% for most organisations [4].

Difficulties faced in TPM implementation:

- Typically people show strong resistance to change.
- Many people treat it just another “ program of the month ” without paying any focus and also doubt about the effectiveness.
- Not sufficient resources (people,money,time,etc.) and assistance provided
- Insufficient understanding of the methodology and philosophy by middle management
- TPM is not a “ quick fix ” approach, it involve cultural change to the ways we do things
- Departmental barrier existing within Business Unit
- Many people considered TPM activities as additional work/threat

To begin applying TPM concepts to plant maintenance activities, the entire work force must first be convinced that upper level management is committed to the program. The first step in this effort is to either hire or appoint a TPM coordinator. It is the responsibility of the coordinator to sell the TPM concepts to the work force through an educational program. To do a thorough job of educating and convincing the work force that TPM is just not another "program of the month," will take time, perhaps a year or more.

Once the coordinator is convinced that the work force is sold on the TPM program and that they understand it and its implications, the first study and action teams are formed. These teams are usually

made up of people who directly have an impact on the problem being addressed. Operators, maintenance personnel, shift supervisors, schedulers, and upper management might all be included on a team. Each person becomes a "stakeholder" in the process and is encouraged to do his or her best to contribute to the success of the team effort. Usually, the TPM coordinator heads the teams until others become familiar with the process and natural team leaders emerge.
The action teams are charged with the responsibility of pinpointing problem areas, detailing a course of corrective action, and initiating the corrective process. Recognizing problems and initiating solutions may not come easily for some team members. They will not have had experiences in other plants where they had opportunities to see how things could be done differently. In well run TPM programs, team members often visit cooperating plants to observe and compare TPM methods, techniques, and to observe work in progress. This comparative process is part of an overall measurement technique called "benchmarking" and is one of the greatest assets of the TPM program [5].
The teams are encouraged to start on small problems and keep meticulous records of their progress. Successful completion of the team's initial work is always recognized by management. Publicity of the program and its results are one of the secrets of making the program a success. Once the teams are familiar with the TPM process and have experienced success with a small problem, problems of ever increasing importance and complexity are addressed.
The operator must to take an active part in the maintenance of the machine. This is one of the basic innovations of TPM. The attitude of "I just operate it!" is no longer acceptable. Routine daily maintenance checks, minor adjustments, lubrication, and minor part change out become the responsibility of the operator. Extensive overhauls and major breakdowns are handled by plant maintenance personnel with the operator assisting. Even if outside maintenance or factory experts have to be called in, the equipment operator must play a significant part in the repair process [6].

CONCLUSION

Today, with competition in industry at an all time high, TPM may be the only thing that stands between success and total failure for some companies. It has been proven to be a program that works. It can be adapted to work not only in industrial plants, but in construction, building maintenance, transportation, and in a variety of other situations. Employees must be educated and convinced that TPM is not just another "program of the month" and that management is totally committed to the program and the extended time frame necessary for full implementation. If everyone involved in a TPM program does his or her part, an unusually high rate of return compared to resources invested may be expected.
Introducing and implementing TPM is not like a standard project, which normally has a starting, and an end that seldom exceeds one year. Rather, TPM is a long range
“ living program ” which can take more than few years to implement and enjoy the lasting benefits when the whole organisation has become strategy focused instead of evaluating one new program after another before implementing TPM thoroughly.
The dual goals of TPM are zero breakdowns and zero defects; this obviously improves equipment efficiency rates and reduces costs. It also minimises inventory costs associated with spare parts.
Apparently, successful TPM implementation can achieve better and lasting result as compared to other isolated program because there is an ultimate change in people (knowledge, skills, and behaviour) during the progress. However don't underestimate the tremendous efforts required to make that change happened and last.

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FUNCTIONAL AND WORK EFFICIENCY OF HOME INSIDE GAS INSTALLATION

Šiljak, M.
High technical school for professional studies in Požarevac
E-mail: milesiljak@yahoo.com

Abstract: Homeinside gas installationincludes required and optional elements from the principal shutting tube closer on home gas switch up to the final bleed of combustion product into atmosphere i.e. home gas appliances.
From home inside gas installation cannot be expected more than from its functional efficiency and it will reach its functionality if it works efficiently parallel only.
With this paper, for the first time, a general theory on functional and work efficiency on technical systems in the field of gas installation is implemented.
In time period, when gas is a respected energy element and gas supply is in trend, accepting representative characteristics i.e. functional and work efficiency in gas installation applied in home inside gas installation and along with comparative analyze on valid regulations, an operative contribution on improvement of gas technical theory and practice is presented.
Functional and work efficiency of home inside gas installation are imposed as not alternative features giving also real possibility to recognize technical, technology, ecology and economical suitability of observed “subject”, i.e. the home inside gas installation.
Key words: Functional efficiency, work efficiency, home inside gas installation

INTRODUCTION

Humanity is every day faced with antagonistic reality on parallel increase of demand on heat and decrease of stock of conventional energy resources such as coal, oil and natural gas. Therefore heat is to be imperatively produced and used but on technically possible, technologically feasible, ecologically accepted and economically justified way only that are finally, rationally, effectively and efficiently controlled.
In a complex thermo technical process, besides others, a singularity is recognizable under general name “home“ that means “family residential building“.
A man in his house existentially shows his primary needs for heat to make food (cooking/baking), to prepare sanitary hot water and/or to heat his home.
Natural gas is accepted energy element to be used to satisfy his needs to heat his home [7]. To realize it, it is necessary previously to provide infrastructural preconditions and afterwards adequate home gas installation (HIGI).
In Serbia gas infrastructural preconditions are in progress thus real possibilities are reached to include more and more consumers. Structure of natural gas consumers in the Republic of Serbia in 2008 as per characteristic groups and their participation in total consumption of natural gas (Table 1).
Above mentioned figures undoubtedly show that the “household” group, as per number and participation in total natural gas consumption, is conditionally respectable and it deserves adequate attention and treatment with a note that increased number of the group consumers is expected in the future.
In this paper an attention is paid to HIGI on description of its functional and work efficiency as representative but universal features, criteria characteristics that obviously contribute to the improvement of theory and practice of gas technical but also to the culture of natural gas use.

Table 1. Structure of natural gas consumers in the Republic of Serbia as per categories [5]

Ord. no	Category of consumers	Realized in 2008 (in 000 Sm3)	Participation (u %)
1	Retailers (except JP "SRBIJAGAS", Novi Sad)	386.410	16,2
2	**Households**	**80.701**	**3,4**
3	Distant heating systems	412.265	17,3
4	Others	1.501.905	63,1
5	Total	2.381.282	100,0

HOME INSIDE GAS INSTALATION

By regulation on gas and hydrocarbon pipe line transport [and supply of hydrocarbon [2] especially by regulation act 2. certain important terms are defined besides them the following:

- point 10): “inside gas installation are: gas conduit, connecting conduit, appropriate shutting, regulating and safety accessories and equipment that starts behind outlet fire protection cock of measuring-regulating station or behind outlet connecting conduit of measuring-regulating set where gas is supplied to customer and with final channel top for combustion bleed except appliances”;
- point 11): “appliances are apparatus with open flame where gas and liquid hydrocarbon connected to inside gas installation are burnt”.

It is important to note that these mentioned formulations of regulation acts and points are controversial as per their contents, meaning and composition understanding but must be respected whilst in force.

Respecting regulations but also respecting experience, logic and profession rules, as much as possible and permitted, (HIGI) [3, 4] might be defined. HIGI is a compositional entity, projected for needs of subject family building, composed of connecting, conducting, mountings and auxiliary elements, that safety and timely, sufficient quantity of natural gas is provided to all connected appliances but limited in area between points where distributor supplies and consumer receives natural gas of all connected appliances and at the end with final conduit of combustion product into atmosphere. Schematic interpreted HIGI as per previous formulation (figure 1).

Natural gas distributor, as direct intermediary in natural gas delivery to consumers, besides others is obliged, at any point of natural gas takeover, to deliver contracted quantity of natural gas, of certain quality and under certain pressure during contractual period.

Natural gas consumers, i.e. buyer, besides others, is obliged to provide HIGI through alghoritm regulated procedure, based on that it will safetly utilize taken quanity of natural gas and thus satify its needs for heating the subject building during contractual perod.

Distributor and consumer, both within its attribution, are obliged to check and maintain the installation and equipment in good condition during contractual period where mutual obligations and rights are regulated and all surely must be in life [3,4].

It is indisputable that HIGI is restricted, circled and not alternative composition entity integrating compulsory with natural gas appliances into an active system entity, i.e. into a technical system, namely into home gas system HGS composed of two compatible subsystems. Any of subsystem may be further structurally and compositionally decomposed and analyzed up to single indivisible components.

Being on this paper subject the attention shall be further paid on HIGI as subsystem of home gas system while appliances as the second subsystem of unique technical system shall be subject of other theme discussions. Shematic review of structurally arranged HIGI subsystem (figure 2).

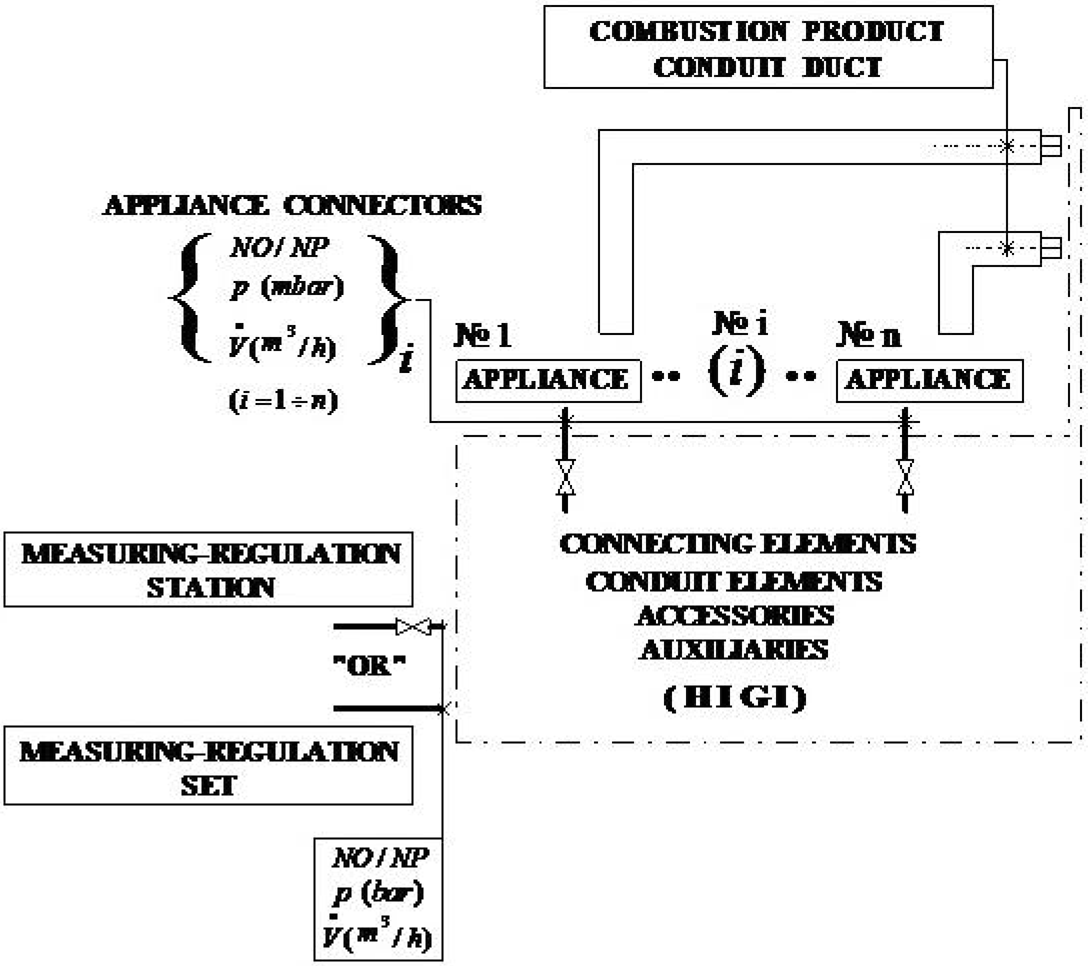

Figure 1. Schematic review of home inside gas installation

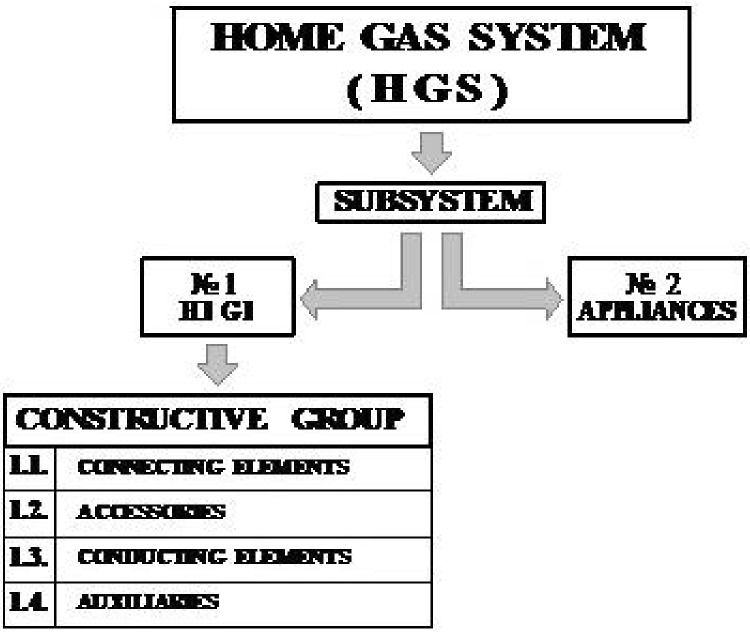

Figure 2. Structural arrangement of home gas system

Constitutive group

By connecting elements, thread or flanged, the components are connected hermetically, permeable but split or by welding they are not split. Any connection must support acting load. In the phase of HIGI projecting, any connection is defined as per type and characteristics and in the application phase they should be provided and installed on their appropriate places on regular ways.

Constructive group

In the HIGI project phase, depending on project task, the needed shutting, regulation and/or safety accessories are defined as per type and characteristics and in the HIGI application phase they should be proveded and afterwards installed on appropriate places on regular ways.

Constructive group

Conducting elements, pipes, tubes and phase parts make an area net composed of parts and branches, of defined lengths and defined surfaces of conducting cross sections. By conducting elements the hermetic and directed conduction of certain quantity of natural gas is provided from the spot of receive up to all spots where it is used. In the HIGI project phase, as per any section and any natural gas appliance, the following are defined:

- type of conducting elements;
- inside cross conduct element;
- middle natural gas speed through the conducting element;
- drop of pressure due to overcome of line and local resistance at natural gas circulation in conducting element.

In the application phase of conducting element net installation it is necessary, as per project solution, to install the net and provide to be hermetic, its conductivity and disposition stability.

Constructive group

While finishing the HIGI, besides mentioned constructive groups, the auxiliaries are paralel participants. These are firstly supports, insulation parts, spans and protectiong tubes. In the HIGI phase all auxiliaries are defined as per type, their characteristics and instalation spots, thus in the installation phase it is necessary to provide their regular installation.

CONCEPT OF FUNTIONAL AND WORK EFFICIENCY

When function and work efficiency is issued then “subject” must be firstly presented for its definition, i.e. the “object” must be defined. [8].

The presented object may be single component or multi component and thus some hierarchy levels of these efficiencies differ, i.e. system, sub system, partial, particular and singular functional namely work efficiency differ.

Any object has its own purpose meaning among others such object is designed and qualified to fulfill all designed requirements.

Generally, concept of functional efficiency (FE) of a certain “object” means that its concept design, complexity , resource competence and active use for what it is purposed it is its in work life.

Functional efficiency of the “object” is based on its project process, formed during its designing installation, and maintained during its exploitation. Any act that results in loses degradation or exceed of its manifestation for what the “object” is created is called “error”.

Generally, concept of work efficiency (WE) of a certain “object” means its operative conditions enabling under life and when necessary to fulfill its requirements completely. [8].

Work efficiency of “object” is formed when it is designed and installed. Acts resulting in loss of work efficiency is called “failure”.

Work efficiency is directly connected to a theory and practice of engineering reliability [6]. Work efficiency should be analyzed only if functional efficiency of the “object” is previously provided. Often some transit “object” exploitation regimes may result in wrong impression that “object” has both FE and WE even although it does not have at that moment.

FUNCTIONAL AND WORK EFFICIENCY OF HIGI

Home inside gas installation as per its structure, contents, purpose and potential danger on environment safety with a fact it is to be used by persons being poorly trained, is surely going to be subject of analyze on functional and work efficiency.
Since home inside gas installation as a sub system of home gas system (HGS) consisting of constitutive groups and single components will have different sub system, partial and particular functional and work efficiency.
Project solution on home inside gas installation of the subject building, besides others, must be technically possible, technologically feasible, ecologically accepted, energetic rational and economically justified. The installed HIGI in a subject building must not deviate from the project solution except for changes on project solution improvement that may be done with agreement of the HIGI designer only.
Sub system functional efficiency of HIGI means its conceptual sense, structural arrangement and contents completeness within its competence providing in that way a safe receive of natural gas quantity, of certain pressure, afterwards safe flow up to the connected appliances and to any appliance separately with appropriate natural gas quantity and pressure. Algebra sum of natural gas quantity sent to home inside gas appliances must not be neither higher nor lower than totally natural gas quantity received from distributor.
Acts resulting in lost of FE subsystem, i.e. HIGI functional efficiency are called “errors”.
Partial functional efficiency of constitutive group, participating into creation of HIGI, menas it is compatibile in a subsystem and competete in a taken role within HIGI.
Particular functional efficiency of single building component, participating in creation of appropriate constitutive group means that compatibility is built into appropriate constitutive group and competences is at taken operative activities.
Analogically to functional efficiency definition the work efficiency is also defined on the level of subsystem, constitutive group and single building component, namely the subsystem, partial and particular work efficiency are different. Starting from general formulation of work efficiency of the “object” we reach some appropriate definitions.
Subsystem work efficiency of HIGI means its operative status that provides unconditionally availability to be used in the whole and operatively when necessary in its life.
Partial work efficiency of constitutive group, participating in creation of HIGI, means its status enabling it operative active with taken role in HIGI when necessary in its life.
Particular work efficiency of single building component participating in creation of appropriate HIGI constitutive group means its operative status enabling it completely active when necessary in its life.
Acts that result in lost of appropriate WE on some of possible hierarchy levels are called “failures”.
In practice, different acts may occur, endangering subsystem, partial and/or particular functional and/or work efficiency. The following characteristic samples will present above mentioned.

Sample 1

Designer designed HIGI for 50 KW appliances but their real total power is 80 KW.
Obviously it is the “error” of designer. That failure caused absence of HIGI functional efficiency and such HIGI cannot meet needs of home gas installation where is integrated.

Sample 2

A designer designed HIGI providing proper subsystem efficiency. A work contractor provided all necessary material and equipment to complete HIGI in subject building as per the project. On single building component, type „accessories“, on its housing, an arrow shows required direction of natural gas flow.
An installer during HIGI installation completely installed the HIGI properly as per the project but the mentioned single building component type “accessories” was installed opposite the required arrow of natural gas flow on “accessories” housing.
Obviously it was “error” of installer that resulted in absence of natural gas flow, namely, caused absence of partial functional efficiency of constitutive group 1.2., i.e. caused absence of HIGI subsystem functional efficiency.

Sample 3

A designer designed HIGI providing indisputable subsystem functional and work efficiencies. A work contractor worked HIGI as per the project in the way not endangering HIGI subsystem functional and work efficiencies. Home inside gas installation is successfully used for a long time.

During exploitation, at certain moment, an appliance connected to the HIGI stopped working. By check and diagnostics it was concluded it was stop of supply of natural gas due to clog in the tube caused absence of partial work efficiency of constitutive group 1.3., because of “failure” causing absence of HIGI partial work efficiency.

CONCLUSION

In a professional style, two respectable but universal features were accepted and afterwards applied in home inside gas installation not previously used in gas technical theory and practice.

Numerous home inside gas installations and their participation in consumption of natural gas in Serbia as well as expected further progressive trends contributed to select the “object” and results reached in subject discussion justified such efforts.

Hypothesis was confirmed on constant two-way interactions between all building entities on all levels and inside of them, and thus essentially affects subsystem, partial and particular functional and work efficiencies entities and finally subsystem of HIGI.

By subject discussion the gas technical theory and practice were improved but also reached a base for other numerous researches for improvement of technical and technological values of HIGI.

New entries were introduced and their meaning was pointed out that should contribute to better understanding of gas technical and more clearly communication within profession.

From all above presented it undoubtedly ensures that home inside gas installation should be “inspired” with subsystem, partial and particular functional and work efficiencies and with proper exploitation and maintenance to keep on appropriate level due to complete and safe use of HIGI subsystems.

The subject discussion will confirm its justification if initiates professional public only on professional reactions for what we sincerely hope.

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METHODS OF MAINTENANCE IN STEAM TURBINES

Stanković, N.[1], Adamović, Ž.[2], Milisavljević, B.[1]
[1]Higher Education Technical School of Professional Studies in Novi Sad
[2]Technical Faculty "Mihajlo Pupin", Zrenjanin
E-mail: stankovic@vtsns.edu.rs

Summary: In this paper we defined the methods of maintenance in steam turbines being the following: methods of preventive maintenance, methods of maintenance according to condition and methods of corrective maintenance, as well as experimental follow-up of particular parameters.
Key words: methods of maintenance, experimental control, steam turbine.

INTRODUCTION

As a basic parameter that characterizes the methods of maintenance in steam turbines, we can accept the character of information on technical condition and reliability of steam turbines which will be applied in determination of periodicity and extent of planned activities (methods) of maintenance.
Method of maintenance can be defined as an algorithm of activities with the aim of bringing steam turbines in the condition that will enable reaching the goals of corporation, predicting at the same time the possibility of production delay.
Therefore, maintenance should be organized in such a way that it reaches maximal efficiency and that one of the criteria is met: not the least possible direct costs of maintenance, but the least possible total costs of maintenance (both direct and indirect ones). One of classical way of management of system technical condition is that it works until its failure, after which a repair should follow. Such a way of management of system technical condition cannot be applied to steam turbines due to the risk that their components are damaged and also due to the possibility that the operators and maintainers be injured, as well as the occurrence of production delay. In order to evade such way of maintenance, it is necessary the selection of preventive maintenance of steam turbines that consists of planned interventions (methods) at particular time intervals. The problem that occurs during preventive maintenance is the definition of technical condition of turbine components. On the basis of the given technical condition, we can determine the intervals of interventions (methods) of maintenance.
Such an approach to maintenance enables the definition and selection of methods for maintenance of steam turbines: Methods of preventive maintenance in steam turbines, Methods of maintenance according to condition with the control of parameters and level of reliability and, Method of corrective maintenance in steam turbines.

METHODS OF MAINTENANCE IN STEAM TURBINES

Method of corrective maintenance in steam turbines

In the method of corrective maintenance (on the basis of the occurrence of system failure), steam turbine continues its functioning until the moment of failure. As a rule, with the occurrence of failure there also occurs sudden plant outage. After the failure, the damaged component is replaced by a new one or is fixed. Therefore, stochastic time of usage of plant components also causes stochastic time duration in failure. These times are mutually independent. The dissipation of time in failure caused by maintenance as well as its duration are relatively high, so the moment of failure is not possible to predict; therefore, the possibilities of organizational and technological preparations are limited.
The advantages of corrective maintenance:
- Total usage of "reserve usability".
- No need for knowledge of laws of system damage.

The disadvantages of this type of maintenance are:
- Sudden system outage, and the terms of failure cannot be predicted in advance, which is not good for more complex systems like steam turbines due to the fact that they can cause great turbine damages,
- All failures have to be operatively removed, therefore, there is great probability that longer delays caused by maintenance process will appear, and
- The impossibility of planning of periodicality and cyclicality of maintenance.

Generally speaking, we can say that corrective maintenance of steam turbines is consisted of an array of activities necessary for turning of the condition “in failure” into the condition “in function”, with the aim of performing of criteria function within limits of permissible deviation.
In this case, there are no previous actions that are undertaken in order to prevent plant failure.
The basic task after the occurrence of failure is to provide necessary working capacity of the plant as soon as possible.

Methods of preventive maintenance of steam turbines

Speaking of the method of preventive maintenance of steam turbines we refer to the renewing of the plant component by some method of preventive maintenance. After undertaken preventive activity (method) of maintenance technical-exploitative characteristics of plant components are reduced within limits which are required for a new plant. Preventive methods of maintenance are intended for for replacement or renewing of inoperative (worn out) component of the plant by an identical operative one (new or previously repaired one), review of plant component, reconstruction of a plant part for the purpose of better maintenance.
Preventive maintenance in steam turbines is consisted of the whole array of requirements (methods) necessary for prevention of the occurrence of “in failure” condition, i.e maintenance of criteria function parameters within limits of permissible deviation in the longest possible period of time.

Methods of maintenance according to the condition of steam turbines

Maintenance according to the condition of steam turbines is a form of preventive maintenance which strategy of decision making on maintenance activities is based on periodical and continual control of technical condition of steam turbines in the process of their exploitation. According to the results of diagnostic control, decisions are made about the necessary term and extent of the planned maintenance activities.
Maintenance according to the condition of steam turbines is a diagnostic process that enables establishing of technical condition of the controlled components in steam turbines, i.e it denotes mechanical “health” and enables permanent planning of maintenance activities (replacement or repair of steam turbine components) based on real technical condition, in that way enhancing the period of effective work of steam turbines and eliminating unnecessary delays. It is conducted in such a way that we primarily perform diagnostic control of technical condition at particular time intervals independent of the conditions of the damage of steam turbine components, and afterwards, depending on technical condition, we undertake activities of maintenance on a steam turbine component, or it still remains in exploitation process.
During each diagnostic control of technical condition of steam turbines, it should always be decided whether the plant component is to be incorporated again, repaired or put out of further use. From this we can deduce that for the plant components that can be maintained there should be several limitations of worn out condition, i.e usability.
Knowledge of permissible worn out condition represents one of the prerequisites for a quality and economical undertaking of maintenance activity, and also a prerequisite for the application of maintenance methods according to condition to steam turbines. There are possibilities of the application of greater number of methods of maintenance according to condition to steam turbines, in which particular necessary conditions must be present. Those methods are classified into two groups (maintenance according to condition with parameters control and level of reliability control).
Maintenance according to the condition of steam turbines with parameters control suggests permanent or periodical control and technical parameter measurements which are used for establishing technical plant condition. Decisions about maintenance activity is made when the values of the controlled parameters reach “the limit of usability”, i.e. pre-critical level.
Maintenance according to the condition of steam turbines with the control of reliability level consists of collecting, processing and analysis of data on reliability level and elaboration of decision about necessary plant maintenance activities after lowering reliability level.
This maintenance represents a very successful method of management of plant maintenance processes which is aimed at preventing the occurrence of “in failure” condition and returning to the “in operation”

plant condition (parameters control), along with providing maximally possible plant period and minimally possible expenditures.

THE DESCRIPTION OF A STEAM TURBINE

Experimental measurements of particular parameters are performed on a steam turbine K-300-240 in "*Gacko* Power Plant" in Gacko.

Steam turbine K-300-240 is a condensing type with inter-overheating, with the power of 300 [MW] and intended for immediate (direct) starting of alternating current generator at the speed of 3000 [^{o}/min]. The turbine is an aggregate with one shaft and consists of three cylinders. Fresh steam from the boiler is introduced into two separately set steam chambers in which there are high pressure automatic bolts out of where through seven regulation high pressure cylinder valves via conductive pipes it comes into high pressure cylinder. From high pressure cylinder the steam is returned to inter-overheating in boiler, and then via intermediate pressure automatic bolts and two intermediate pressure regulation valves it enters general jet chamber of intermediate pressure cylinder. For steam elimination of inter-overheating during closing of intermediate pressure regulation cylinder valves there are two confluence valves which conduct inter-overheating steam into condenser.

Basic steam parameters are:

- The pressure of primary steam 240 [bar]
- The temperature of primary steam 545 [^{o}C]
- Steam pressure at the output of high pressure cylinder 43,9 [bar]
- Steam temperature at the output of high pressure cylinder 305 [bar]
- Steam pressure after inter-overheating at the output of intermediate pressure cylinder 39 [bar]
- Steam temperature at the output of intermediate pressure cylinder 545 [^{o}C]
- Steam temperature on the turbine exhaust 40 [^{o}C]
- Nominal steam flow through turbine is 930 [t/h]
- Pressure in turbine condenser is 0,072 [bar]
- The flow of cooling water through condenser is 3600 [m^2/h].

Turbine has eight non-regulated deductions of steam which purpose is to heat feed water in low pressure heaters, feed water tank and high pressure heaters till the calculated temperature of 274 [^{o}C], as well as to start the turbo driven feed pump which power is 12 [MW] in a plant turbine. Turbine has thirty-nine degrees of pressure, out of which twelve degrees are the results of high pressure, twelve degrees of intermediate pressure and fifteen degrees of low pressure.

EXPERIMENTAL FOLLOW-UPS OF STEAM TURBINE K-300-240

Continual follow-up and analysis of vibration level of turbo-aggregate (steam turbine and generator)

On all the bearings of a turbo-aggregate we placed sensors for measurement of absolute and relative vibration level in a steam turbine which continually provide information on the vibration level during turbo-aggregate operation. Vibration level is followed in both digital and diagram forms. Data computer processing system applying "OVATION Westinghouse" programme, enables the follow-up and analysis of vibration level in historical trend during the least period of last six months. Measurements and continual follow-up of the level of absolute, vertical and horizontal vibrations on seven turbo-aggregate bearings is performed on a turbo-aggregate, i.e. five turbine bearings and two generator bearings. On all the turbo-aggregate bearings there is placed a pair of sensors for measurement of relative vibration of rotor in relation to bearing. Sensors are placed under the angle of 45^o and enable the follow-up of the amplitude of relative vibrations of each bearing, as well as the follow-up of the shape of orbits along which turbo -aggregate axes in a bearing move. Orbits shape represents a significant diagnostic data by which help we can determine dynamic condition of a turbo-aggregate.

Aiming at follow-up of the vibration level and quality analysis of the cause of vibration occurrence in the process of maintenance according to the condition of a turbine, it is necessary to observe complete turbo-aggregate, due to the fact that turbine and generator vibrations are in a direct link, because their rotors are linked by rigid coupling. Changes in the distribution of masses, i.e. disbalance of rotor, non-

centeredness of rotor axes in relation to bearing axes, different thermal strains in particular zones and alike are transmitted from one plant to another, therefore it is necessary to perform the follow-up and analysis of vibration level for the entire turbo-aggregate.
Warning about the increase of vertical or horizontal absolute vibration is issued for the value of 7,5 [mm/s], and that represents the limit of vibration level for unlimited long-term turbo-aggregate operation. The level of vibration speed ranging from 7,5 [mm/s] to 11,8 [mm/s] is considered to be unsatisfactory for longer continual operation, but can be in operation for a limited period of time until an adequate opportunity for performing a corrective action appears. The vibration level above 11,8 [mm/s] is considered to be of sufficient strength to cause turbo-aggregate damage, therefore on the appearance of vibrations on any of the turbo-aggregate bearings above the mentioned level it is necessary to disconnect the turbine and remove the matter which caused the increase of vibrations.

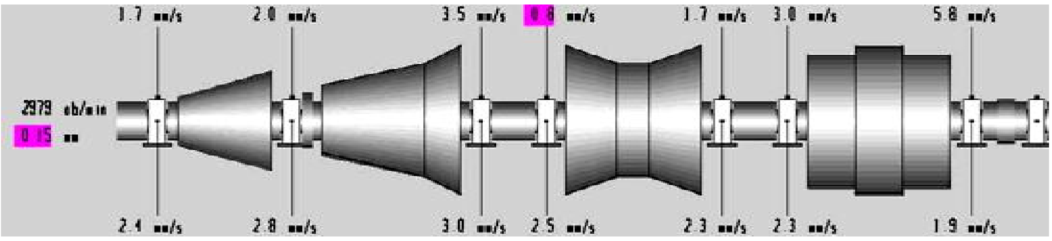

Figure 1. The follow-up of current level of absolute vibration in digital form

Figure 1 represents the scheme of the follow-up of current absolute vibration level in digital form.

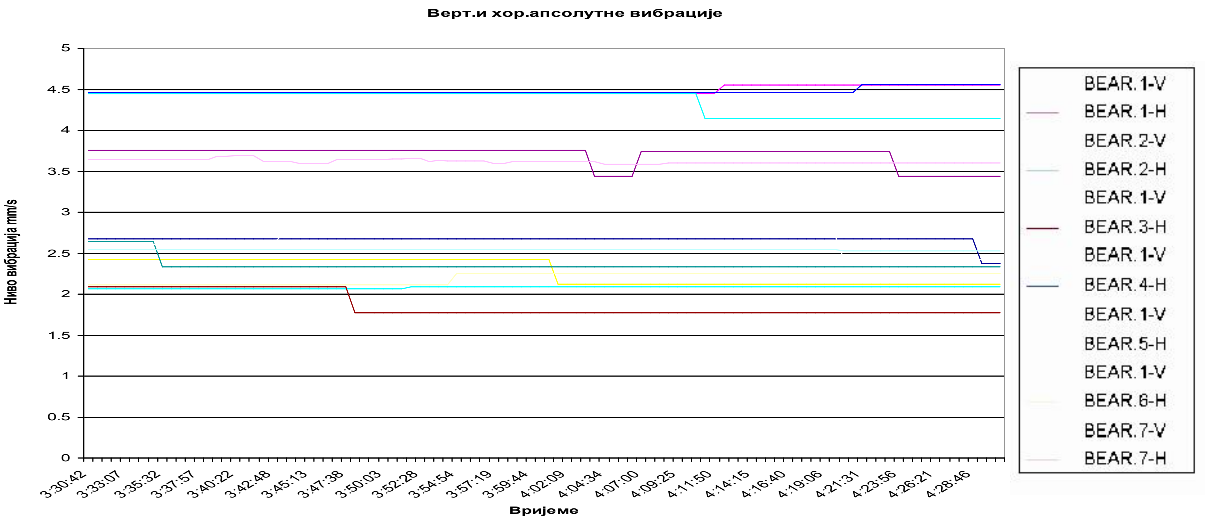

Figure 2. Diagram of absolute vibration level in mm/s dependant on time t

Figure 2 represents the diagram of absolute vibration level in mm/s dependant on time t for bearings 1-7 in both vertical and horizontal directions.

Measurement of quality parameters of turbine oil

Oil system of turbo-aggregate consists of two separate systems, like the following:

- Oil system for turbine lubrication, and
- Oil system for turbine regulation.

Oil system for turbine lubrication uses AGIP OTE 32 oil type, and consists of the following major sub-systems:

- Major oil reservoir (MOR),
- Pumps for lubrication of turbines (two pumps of alternating current where one is working and the other a reserve, and two pumps of direct current which are also reserves),
- Exhaust fens of oil steams for exhausting oil steams, where one exhausts out of oil reservoir and the other of confluence pipelines of turbine oil,
- Oil coolers for oil temperature regulation (three pieces),

- Accessory armature and electro-contact manometers for regulation of the defined limits of basic parameters of oil lubrication like pressure and temperature,
- Centrifuges for oil filtering.
- Basic parameters which are followed in the system for turbine lubrication consist of the following elements:
- Follow-up and analysis of basic oil parameters like: pressure, temperature and quality,
- Follow-up of oil level in MOR and, when necessary, oil refill. Oil refill always goes in the “filthy” part of MOR, due to the possibility that impurities can also be found in new oil.
- Major oil reservoir is divided into two parts, “filthy” one and “clean” one, by the help of sieves placed into two rows. These sieves are intended for for collecting mechanical impurities found in oil. Sieves are cleaned when needed, when there occurs the difference in levels between the “filthy” and “clean” part of MOR. Sieves are placed in frames and while cleaning they are taken out of MOR and transferred to a particular place where they are cleaned by compressed air, after which they are replaced to their original positions. Sieves are cleaned one at a time, so that there is always one row of sieves that prevents the filthy oil to penetrate the clean one.
- Follow-up of possible events of oil leakage in oil system and their prevention,
- Cleaning of oil that is gathered inside collecting canals around bearings,
- Follow-up of fen exhaust operation of oil steams out of MOR and confluence pipelines,
- Drainage of water from oil which is sedimented at the bottom of MOR,
- Oil filtering by the help of centrifuges via which water and impurities of turbine oil are separated,
- Follow-up of oil quality by methods based on measurement of particular oil characteristic changes is performed once a day by sampling oil and its further processing in central laboratory
- Physicochemical changes that are being followed on a daily basis are the following:
- Oil viscosity at different temperatures,
- Ignition temperature,
- Neutralization number (acid numbers),
- Water content,
- Mechanical impurities,
- Foaming tendency,
- Density.

In Tab. 1 we presented the results of the analysis of AGIP OTE 32 turbine oil performed on 01.14, 2011.

Table 1. Results of analysis of turbine oil quality

Oil characteristic	Method	Results
Viscosity at 40 ^oC	BAS ISO 3104	30,70 [mm^2/s]
Viscosity at 100 ^oC	BAS ISO 3104	5,39 [mm^2/s]
Viscosity index	BAS ISO 2909	110
Neutralization number	ISO 6618	0,04 [mg KOH/g]
Ignition temperature	ISO 2592	226 [^oC]
Water content according to KF	BAS EN ISO 12397	1,463 [%]
Mechanic impurities	Visually	None
De-emulsification 54 ^oC	ISO 6614	Satisfactory
Foaming tendency	ASTM D 892	Satisfactory
Density	ASTM D 5002	856,8 [kg/m^3]

Comment: Turbine oil possesses good physicochemical characteristics and the presence of moisture is evident, but it does not affect de-emulsification and foaming.

In Figure 3 we presented the scheme of steam turbine lubrication with all the important parameters that are being followed in turbine operation, as well as sub-systems by which help management and surveillance applying “Ovation Westinghouse” computer programme is conducted according to the presented scheme.

In Tab. 2 we presented the parameters that are being continually followed on the surveillance system monitor.

Table 2. Current process parameters according to Figure 3

Temperature of white metal radial bearings							
Bearing	N1	N2	N3	N4	N5	N6	N7
Temperature [°C]	58	60	73	62	60	64	77
Temperature of oil on confluence from radial bearings							
Bearing	N1	N2	N3	N4	N5	N6	N7
Temperature [°C]	48	48	56	54	56	56	49
Temperature of white metal segments of axial bearings (non-operative)							
Segment Number	1	3	5	7	9	10	
Temperature [°C]	48	47	49	49	47	47	
Temperature of white metal segments of axial bearings (operative)							
Segment Number	1	3	5	7	9	10	
Temperature [°C]	60	60	59	54	52	58	
Oil pressure at elevation 6 [m]							1,51 [bar]
Oil pressure at turbine axis (elevation 9 [m])							1,21 [bar]
Oil Temperature in MOR							40 [°C]
Sub-pressure in MOR							17,8 [mbar]

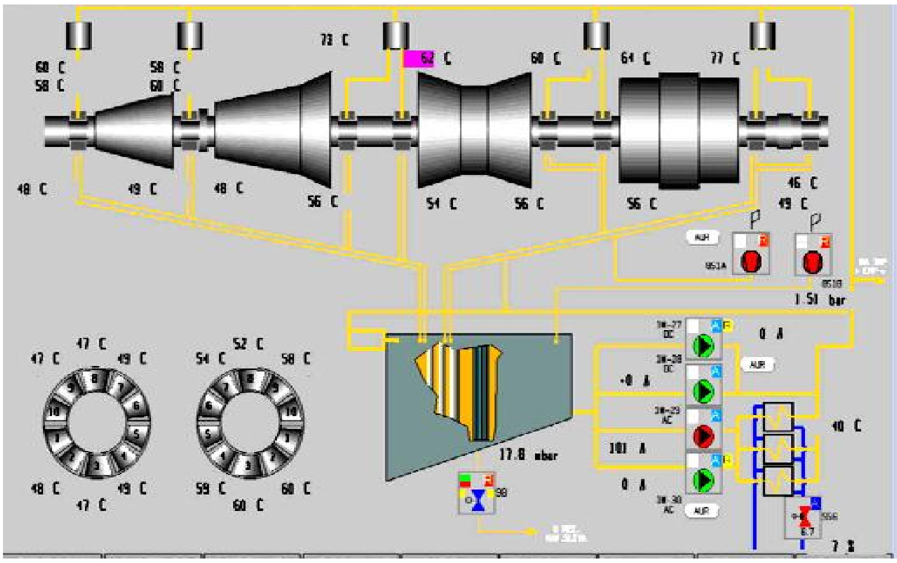

Figure 3. Lubrication scheme of turbine K 300-240

In Table 3 we presented the results of analysis of FYRQUEL-L regulation oil quality performed on January 14, 2011.

Oil system for turbine regulation utilizes FYRQUEL-L oil type, and the system consists of the following major sub-systems:

- Regulation oil reservoir (ROR),
- Turbine regulation pumps (two pumps of the types driven by alternating current engines, out of which one is working, and the other is a reserve),
- Exhaust fans of oil steams for oil steams exhausting from oil reservoir, out of which one is working, and the other is a reserve,
- Oil coolers for oil temperature regulation (two pieces),
- Accessory armature, and electro-contact manometers for regulation of defined limits of basic parameters of oil lubrication like pressure and temperature, and
- Electro-hydraulic servo-engines which use regulation oil and work as executive organs of stopping and regulation valves of a turbine.

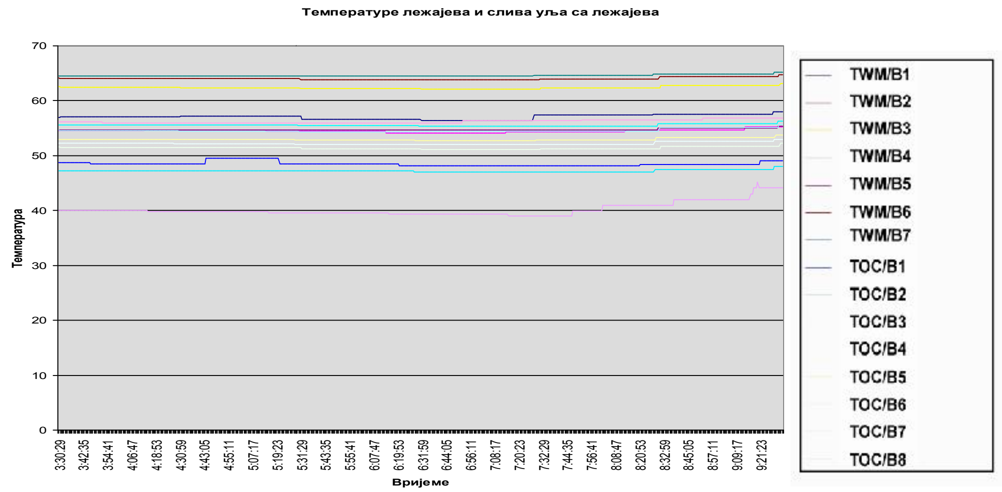

Figure 4. Diagram of bearing temperature and oil confluence dependant upon time t

Figure 4 gives graphic presentations of the temperature of the white metal of bearings 1-7 and the temperature of oil on the confluence with bearings 1-8.

On Figure 5 we presented turbine regulation scheme with all the elements of oil system for turbine regulation.

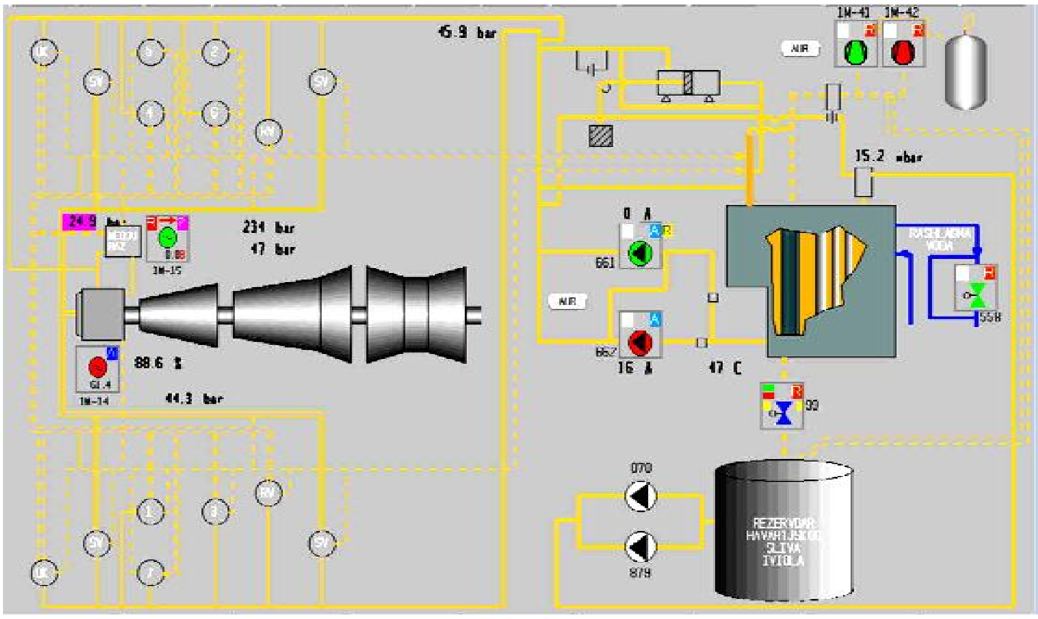

Figure 5. Turbine regulation scheme with all the elements of oil system

Basic parameters which are required in the system for turbine regulation are the following:

- Follow-up and analysis of basic oil parameters like: pressure 46 [bar], temperature 45 + 50 [^{o}C],
- Level, quality,
- Follow-up of oil level in ROR and, when necessary, oil refill,
- Oil refill always goes in "filthy" part of ROR, due to the possibility that impurities can also be found in new oil,
- Regulation oil reservoir is divided into two parts, "filthy" one and "clean" one, by the help of sieves placed into two rows,
- These sieves are intended for collecting mechanical impurities found in oil.
- Sieves are cleaned when needed, when there occurs the difference in levels between the "filthy" and "clean" part of ROR.
- Follow-up of possible events of oil leakage in regulation oil system and their prevention,
- Follow-up of fen exhaust operation of oil steams out of ROR,
- Follow-up of oil quality by methods based on measurement of particular oil characteristic changes is performed once a day by sampling oil and its further processing in central laboratory.

- Physicochemical changes that are being followed on a daily basis are the following:
- Visual appearance,
- Specific weight at 20 [^{o}C],
- Oil viscosity at 40 [^{o}C] and 100 [^{o}C],
- Ignition temperature,
- Neutralization number [mg KOH/g],
- Water content, and
- Content of mechanical impurities.

Table 3.Results of the analysis of regulation oil quality

Oil characteristic	Methods	Results
Viscosity at 40^o C	BAS ISO 3104	50,18 [mm^2/s]
Viscosity at 100^o C	BAS ISO 3104	5,47[mm^2/s]
Viscosity index	BAS ISO 2909	-
Neutralization number	ISO 6618	0,17 [mg KOH/g]
Ignition temperature	ISO 2592	264 [^{o}C]
Water content according to KF	BAS EN ISO 12397	0,503 [%]
Mechanic impurities	Visually	None
De-emulsification 54 ^{o}C	ISO 6614	Satisfactory
Foaming tendency	ASTM D 892	Satisfactory
Density	ASTM D 5002	1134,1 [kg/m^3]

Comment: Regulation oil possesses good physicochemical characteristics and the presence of moisture is evident, but it does not affect the de-emulsification and foaming.

CONCLUSION

The application of the mentioned methods to maintenance of steam turbines has to be based upon comprehensive knowledge of reliability characteristics of plant components, good organization of providing necessary information, wide application of means and methods of technical diagnostics, along with providing high exploitation technology of a plant.
Beside that, it is necessary to apply good organization, planning and management of maintenance function in corporation, along with the formation of service for technical diagnostics and informatics with the help of a computer.

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DEVELOPMENT OF METHODS REMOTE MAINTENANCE SYSTEM FOR MACHINE TOOLS

Prvulović,S., Tolmač, D., Matić M.
University of Novi Sad,Technical Faculty ''Mihajlo Pupin'', Serbia
E-mail: prvulovicslavica@yahoo.com

Abstract: This paper introduces a system for machine toolmanufacturers to monitor andmaintain their customers' machine tools remotely. Two communication options are discussed to physically connect thousands of machine tools worldwide to the manufacturer's server. XML file format is used to send the machine tool status. To process and store huge amount of incoming data, a parallel processing strategy is applied to improve the conventional sequential way. With the established network and collected data, applications such as remote maintenance, monitoring and preventive maintenance are presented. The developed system can reduce customers' machine downtime and the manufacturer's service cost.
Key words: diagnostics, maintenance, machinery, remote control

INTRODUCTION

The aim of this paper is development of high-performance CNC machine tool controller for a long time.. One of the most important demands we must meet is that, once the machine tool is installed and is working at a customer's factory, it must not
break down.
Delivery of machine tools in the world is always present, which is expected in the foreseeable future.Currently, whenever problems occur with machine tools, service man must visit the customers' plants to troubleshoot and resolve them. To deal with this situation, the first step is to improve product quality to reduce the number of potential service calls. The second is to increase the efficiency of the service itself. In order to do so, the ideal solution is to acquire the customers' machine tools operating status, perform diagnostic and analysis remotely at manufacturers' service base and conduct necessary preventive maintenance instantly online. [8]. It is obvious that the current communication technology, such as the Internet, provides the full possibility to connect the manufacturer and the customers' machine tools together. [9].
Then, by analyzing collected information via network, the manufacturer can identify the hardware or software source of the quality issue and further actions can be taken to rectify any problems. However, since many factories are not equipped with the Internet or other communication links, and do not have the technology for monitoring multiple machines at the same time, most machine tools are still not connected to a network.
By monitoring the operating status of newly released products, machine tool manufacturers are able to control the quality of new products on a vast scale. In addition, they can notify the customers about the operating status of their machines based on the collected information, which is of important to the customersown
production management.[2]
As of today, a lot of researches and practice have been proposed to develop remote monitoring and maintenance system (RMMS), also known as Intelligent Service System.

THE REQUIREMENTS OF A RMMS

To develop a RMMS for machine tools application, a certain specific requirements are added in addition to primitive specifications:

- Whenever a problem occurs with a machine tool, the operator must be able to notify the manufacturer immediately. Automatic notification during unmanned operation should be possible as well.
- The manufacturer must be able to obtain the details of the situation from a remote location worldwide.
- Access security must be guaranteed. It is not acceptable to allow malicious attack over the Internet.

- It must be possible to do quality analysis from collected machine tools' operating status. For example, the alarm details and operating history give a hint if the operator follows the proper procedure.
- The collected data must be available to customers so that they can make use of it in their production management system.
- It must prevent as many potential breakdowns as possible of machine tools through timely preventive maintenance [7]

NETWORK AND SYSTEM STRUCTURE

The communication between the manufacturers and their customers' machine tools is the key to establishing a successful RMMS. Generally, machine tool manufacturers can use the customers' Internet connection installed at their factory [9,2].. In this case, a group of machine tools can be connected to the Internet using LAN. Meanwhile, these machine tools are equipped with a firewall and anti-virus software to prevent viruses or other damages via the Internet. This method is usually used for large, reasonably well-equipped factories. However, there are many customers who have many machine tools but without a network to connect them to the Internet. In this case, another solution is applied.
By mounting a communication device with mobile phone technology on each machine tool, a group of machine tools can be connected to the manufacturer server through a mobile phone network. The biggest advantage of this solution is that the system can be available as soon as the machine tools are installed at the customer's factory. Fig. 1 shows the connection between the communication device and the CNC controller of machine tool.

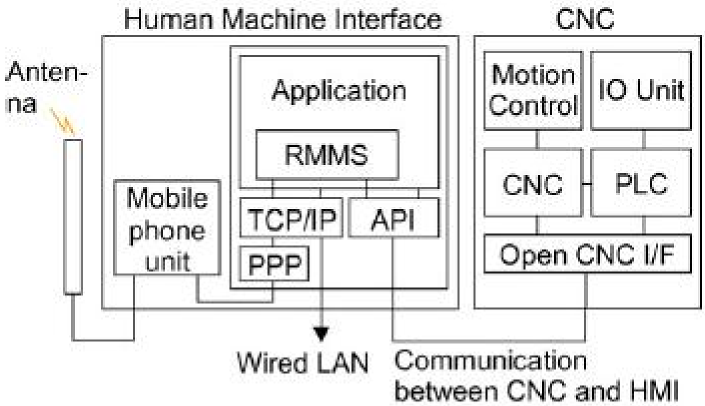

Figure 1. The connection between the communication device and the HMI of CNC

HMI of CNC on each machine tool controls the communication between itself and the remote manufacturer's server via TCP/IP protocol. The server of the Remote Maintenance Service Department of manufacturer is the centralized base, which processes thousands of communication requests from customers' machine tools. We are connecting over 8000 machine tools using this network.
Based on the network, a RMMS can be physically established. Fig. 2. As seen in this figure, the service agent can conduct either remote monitoring or maintenance over customers' machine tools from a remote service center [6]. In addition, the customer can also take advantage of this system by accessing information, such as NC programs, for their own production management.

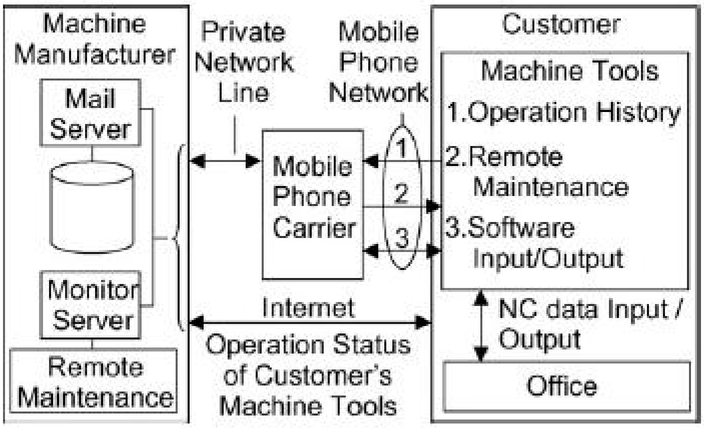

Figure 2. The developed remote monitoring and maintenance system

DATA COMMUNICATION AND STORAGE

In the established RMMS, email notification is the major method to transfer the operating status of remote machine tools to the manufacturer's server. Three important issues need to be clarified. First, in order to reduce the high communication costs and assure security, the connection is established only if it is necessary. Second, a standardized data format is used to exchange information. Third, a specific sampling rate is set for all machine tools to periodically send the operating status without losing data. The workflow of RMMS is as follows: whenever a machine tool's status is changed, such as 'Power ON/OFF', 'Cycle Start/ Stop', 'Machining in progress', 'Machining complete', 'Alarm occurred', etc., the operating information, time and attribute information is recorded. This information is stored in a buffer area of the CNC [4]. The CNC sends out an email in three occasions: the buffer reaches a specified level; a specified amount of time has passed since the previous data transmission; or an emergency situation occurs. For security reason, the communication data will be encrypted before transmitted as email. Each email has a unique title to identify a particular machine tool. After receiving the encrypted email, the server of the machine tool manufacturer will decipher it and store the record in the database under the title. Fig. 3 shows a snapshot of data communication within the RMMS. Various customizable reports and/or charts can be created base upon collected data.

The information sent from the machine tools is represented in XML file format, in which each individual record is encapsulated by tags. The information includes operating status during the past sampling cycle ('Power ON/OFF', 'Cycle Start/Stop', 'Machining complete', etc.), program number when the cycle start, alarm numbers when error occurs, and operation status of major components, such as the spindle, ATC, turret, and so on.

Usually the manufacturer's server process the incoming emails in three sequential steps: extracts emails from inbox, analyzes contents and stores records into the database. Due to the huge amount of emails sent from thousands of machine tools every sampling cycle, the load balancing and parallel processing techniques are needed. In particular, the process of incoming emails and the database are divided into several stages to avoid any congestion between the second step of analysis and the third step of data storage. All the stages are working at the same time, as shown in Fig. 4. By doing so, these two steps processing can be done in parallel.

The distribution of the intervals between data arrival is considered to be random because it is determined by the time when the machine tool is turned on. To impose the strictest conditions, the exponential distribution is used for the distribution of the data processing time. The number of emails arrived per hour is l, the number of emails that can be processed per hour is μ.

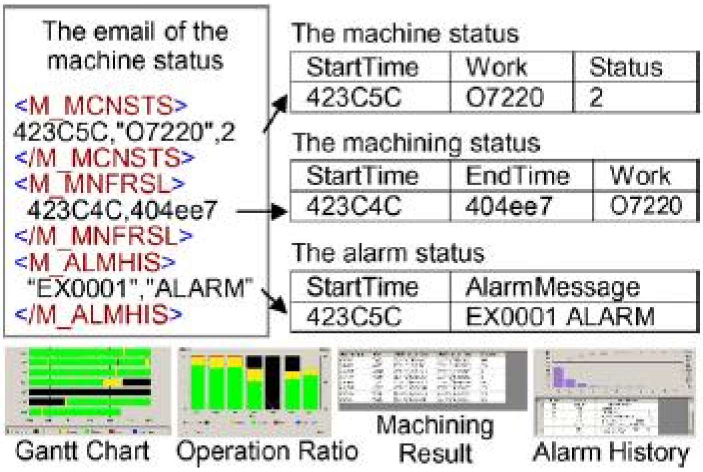

Figure 3. Data communication snapshot of RMMS

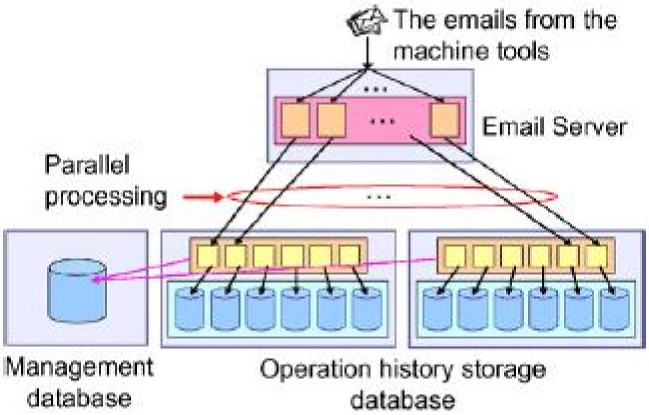

Figure 4. Parallel processing of incoming emails

Then, the usage ratio r is calculated using the following equation:

$$\rho=\frac{\lambda}{\mu} \quad (1)$$

The length of the waiting list, Lq, which is the number of unprocessed emails in the server, is calculated using Eq. (2) from queuing theory:

$$L_p = \frac{\rho 2}{1-\rho} \quad (2)$$

ρ must be less than 1. If ρ ≥1 , it indicates that the number of arrived emails exceeds the server's processing capacity. As a consequence, the number of emails to be rocessed will continue to increase. In the developed system, 8000 emails arrive per hour because sampling rate is one hour. We also measured that one server can process 1300 emails per hour. Thus the sequential processing is obviously not acceptable. By parallelly processing email with multiple servers, the number of processable emails per hour will increase in proportion to the number of servers. In this case, we need more than seven servers.

REMOTE MONITORING AND MAINTENANCE

Based on the established network and the database with collected data from remote machine tools, the RMMS provides following benefits to the manufacturer: maintenance without sending serviceman using remote monitoring and preventive
maintenance using remote diagnosis.

Remote monitoring and maintenance

In the conventional customer service mode, whenever a problem occurs with a machine tool, the customer contacts the manufacturer to ask for service. After receiving the detailed problem report from the customer, the manufacturer's serviceman will visit the customer to investigate the cause and resolve the problem [7].With developed RMMS, remote maintenance becomes possible. The manufacturer's serviceman can access the CNC unit of customer's machine tool at a service center. Most problems can be fixed instantly after analyzing the data inside the CNC . The updated service procedure is summarized as follows [1,38].

When an alarm occurs on a customer's machine tool, a service request email is sent to the manufacturer from this machine. This email contains the information of the alarm, the machine tool and the customer identification. During unmanned operation, there could be some delays in contacting the manufacturer since the operator may not realize that there is a problem and the machine tool has stopped for a while. With this system, the machine tool will send a service request automatically when an alarm occurs and is not cancelled within a specified time. After the machine tool manufacturer receives the service request, the serviceman will check the condition of the machine using remote maintenance function of RMMS. This function investigates the cause of the problem and verifies it by inputting/outputting data, sometimes with the support of the remote screen of customer's machine tool.

If the customer has screens which they do not want the machine tool manufacturer to see, they can change the settings to do so.

Security protection is also considered in the remote maintenance function of the RMMS. An authentication server is set up as a relay point so that the machine tool manufacturer can do remote maintenance from any service center located at different places. The authentication server allows remote maintenance to be carried out only when the IP address of the machine tool that sends the maintenance request matches its global IP address stored in the service base. This feature also prevents remote maintenance of the customer's screen from unauthorized sources.

In addition, the developed RMMS uses compression technology which makes it possible to switch remote CNC screens of machine tool quickly without any problems. Thus, it won't interference the ongoing maintenance being conducted via the Internet or mobile phone network.

Diagnosis and preventive maintenance

Preventive maintenance is another big benefit of the developed RMMS. Our research proposes methods to prevent machine tool from breakdown by accurately assessing the parts life of many machine tool existed in the field. For example, by monitoring the operating status of spindles, ATC, turret indexing, NC batteries, etc, the machine tool manufacturer can predict the potential malfunction of these parts and notify the customer when preventive maintenance is required [5]. Generally, different part has different index to predict its lifetime. For instance, the spindle, tool changer motor and turret indexing motor uses their rotation number, the feed axes use movement distance, the CNC battery use machine tool usage time, and so on.

The machine tool manufacturer monitors those machines which parts usage has exceeded their designed lifetime. This diagnosis information is used to conduct preventive maintenance or breakdown analysis. Here we use the CNC battery as an example. When the voltage of the CNC battery is low, a 'Low battery voltage' alarm generally occurs. If the battery is not replaced timely, the internal CNC data (NC parameter, program, etc.) will be lost. For this reason, the information of elapsed time since the last battery change is very important. The RMMS keep counting this data and stored it in the database of manufacturer's server. The manufacturer will remind the customer to change the battery if it was not replaced within a specified time.

For spindle's case, its rotation number is counted. Most commercial available spindles today are using ball/roller bearings. The designed lifetime of high-speed type spindle bearings is between 10,000 and 20,000 h at maximum speed. If a replacement is not prepared near the end of the spindle's lifetime or it is not conducted when this point is reached, the machining quality will become a critical problem due to deterioration in accuracy, abnormal noise or even spindle seizures. This problem has occurred many times before. Therefore, it is important to provide early spindle preventive maintenance to solve the problem instead of taking days or even weeks to recover from machine tool breakdown. With that, the operating ratio of machine tools in the market can be dramatically increased.
On the other hand, providing reliable preventive maintenance by accurately monitoring product lifetime allows preparation of swift countermeasures when the designed lifetime is reached. Normally, the product life of ball/roller bearings depends on the spindle speed and the load. If the calculated design life $= L_{std}$, the bearing life under the condition from time t1 to time t2 (L_{t1-t2}) can be calculated using an equation shown in (3). And the ratio of reduction in life to it (R_{dec}) can be expressed as (4). With this system, the machine tool's control unit sends the reduction in product life to the manufacturer, and the manufacturer can calculate how much life remains in the customer's spindle.According to the conventional rolling bearing life equation, which is based on the theory of Lundberg and Palmgren, the bearing life is
in inverse proportion to the pth power of bearing load.

$$L_{t_1-t_2} = (t_2 - t_1) * \left(\frac{n_0}{\int_{t_1}^{t_2} ndt}\right) * \frac{\left(\frac{\int_{t_1}^{t_2} ndt}{\int_{t_1}^{t_2} F^p * ndt}\right)}{\left(\int_0^{L_{std}} n_0 dt / \int_0^{L_{std}} F_0^p * n_0 dt\right)} * L_{std} \quad (3)$$

$$R_{dec} = 100 * \frac{t_2 - t_1}{L_{t_1 t_2}} \quad (4)$$

where L_{t1-t2} is the bearing life under the condition from time t1 to time t2 (h), Lstd is the design life time for spindle bearings assuming no-load and maximum spindle speed (hours).R_{dec} is the ratio of reduction in life to L_{t1-t2} (%), n is the spindle speed (min^{-1}), F is the spindle load (N), n_0 is the maximum spindle speed (min^{-1}) , F_0 is the no-load running load at maximum spindle speed (N), and p = 3 (for ball bearings), 10/3 (for roller bearings).

CONCLUSION

In this paper, a RMMS is developed to conduct remote monitoring, diagnose and aintenance service for thousands of machine tools linked to a central server via either internet or mobile phone network. A data process model has been proposed to deal with the large amount of data received from the machine tools. These data is represented in XML format and sent to the server via email. A parallel processing strategy is applied to increase the speed of extracting, analyzing and storing of these incoming data. Practical application results of the developed system shows that both the machine tool manufacturer and their customers can benefit from this system. It has been proven that the RMMS is capable to prevent machine tool stoppages through its faster maintenance. Moreover, this system can provide valuable data to the machine tool customer for their product management. Future research will be focused on the data mining of the large amount of collected data for CNC machine tool prognostics management system.

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MAINTENANCE DIAGNOSTIC MODEL FOR VENTILATION MILL OF THERMAL POWER PLANT

Radovanovic, Lj., Adamovic, Z.
Technical Faculty "Mihajlo Pupin", Zrenjanin
University of Novi Sad
E-mail: ljiljap@tfzr.uns.ac.rs

Abstract: The paper presents the maintenance diagnostic model that includes the set of rules for the determination of the diagnostics regime of the system components in the real process of the exploitation and decision making on the necessities for their replacement or for the necessary maintenance frame based on the information on the current technical condition of the system.
Diagnostic model is proposed for testing of ventilation mill in Kostolac B power plant. The significance of the benefit of the model was underlined and it's contribution to the reduction of the standstill of the technical system (ventilation mill), which in return gives a higher level of usage, and the productivity of the thermal power plant.
Key words: maintenance diagnostic model, power plant, ventilation mill

INTRODUCTION

The deficiencies of traditional policy and strategies of corrective and preventive technical system maintenance, have, lately, initiated the development and the introduction of new maintenance process models according to the condition and practise [1].
Time exploitation of the technical system i s influenced by many factors, and they can be divided into three groups: exploitation, organization and technical system failure. The usage of these systems depends on the frequency of the failure occurance and of the time duration of the standstill [2].
Because of this the element of maintenance is more and more important, and it can be said that the maintenance, today, is the process that enables the technical condition and the reliability management within the entire life cycle of the system. Further, the goals of maintenance, among others, penetrate the sphere of business economics, so it is presented in a form of rationalization and it is measurable. Because of all this, the current science explores the maintenance process and rises it to the higher level of significance in the business and society.
Demands for a greater reliability, that are set before the modern technical systems, result in the fact that the measures of their reliability in the conditions of real exploitation are connected to the great time consumption, material and funding. This is why the processes of quicker research are being intensively developed and implemented, whose goal is to decrease the cost of the system exploitation [2].
The current maintenance systems show more and more deficiencies that are seen in different forms, which leads to the overstepping of the duration of planned and unplanned standstills, which questions the reaching of the planned projected effects and the instability of the resource spenditure range and total financial resources.
In the general analisys of recent documents [1], [2], [3], [4], [5], [6], [7], [8] and [9] preventive maintenance processes, proactive maintenance, maintenance according to condition, technical diagnostics and total maintenance are being reviewed.
This paper includes development a diagnostic maintenance model that can be applicable to technical systems in industry of our country.

DIAGNOSTIC MAINTENANCE MODEL

Diagnostic maintenance model, adapted to the needs of our industry is present at Figure 1.[1]

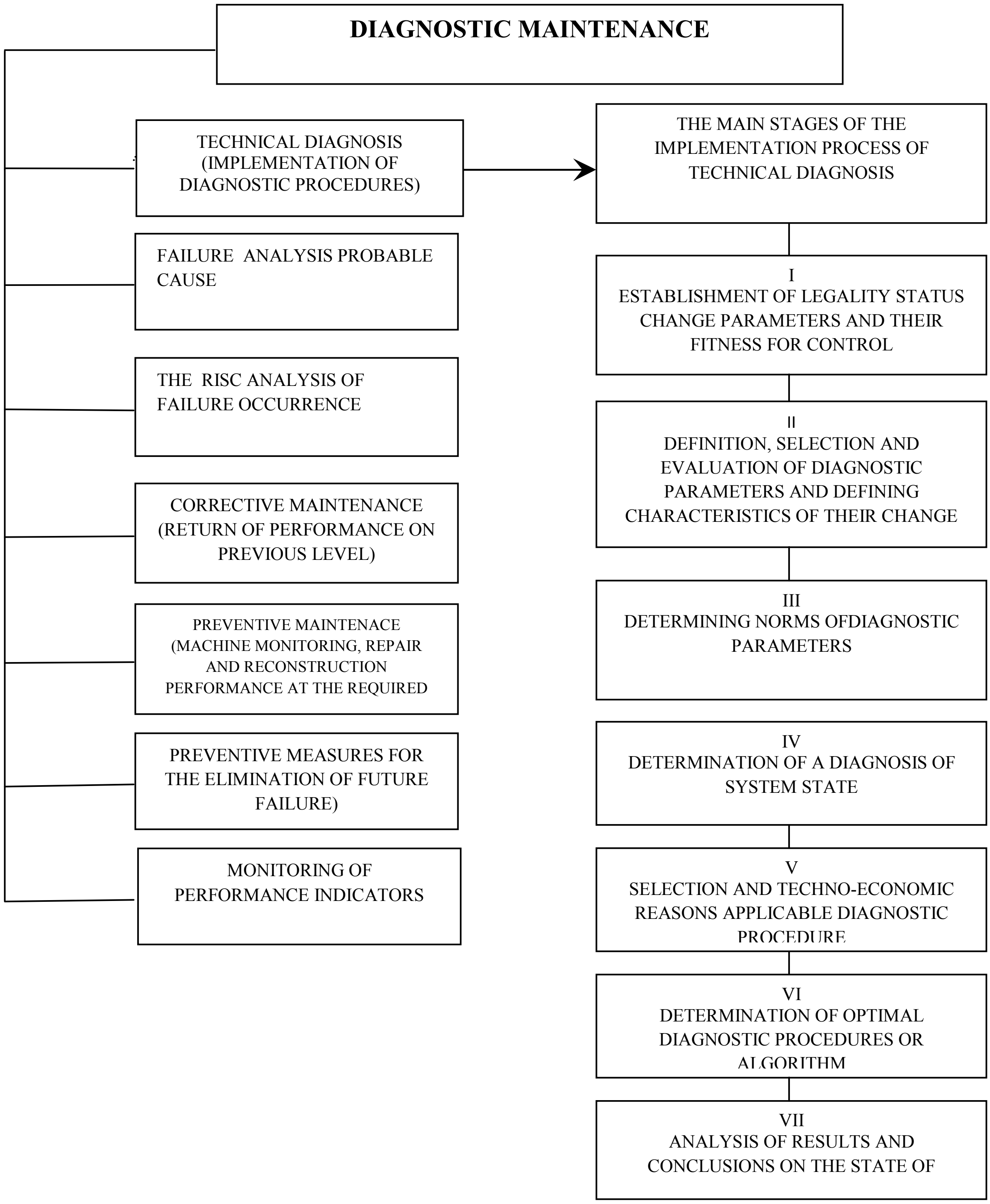

Figure 1. Diagnostic maintenance model

[1]This model is create in the doctoral dissertation research by Ljiljana Z. Radovanovic entitled Maintenance Methodologies and their Application in Industry (University of Novi Sad, Technical faculty "Mihajlo Pupin", Department of Industrial Engineering, Zrenjanin, Serbia).

Technical diagnostics deals with the recognition of the system condition with certain accuracy in a given moment. Based on the form of the technical state, that must be determined, the diagnostics determines:

- System accuracy check,
- System working ability check,
- System functionality check and
- Failure check (place, form and cause).

The diagnostics can be set through the discovery of the failure cause, setting the values of certain parameters (dissassembled and assembles system) and comparation with allowed (nominal) values. During the selection of the system diagnostics parameters it is necessary to determine the character of their relationship with the condition parameters. One or more diagnostic parameters can define only one condition parameter. The selection of the diagnostic parameters (ρ) is done based on these criteria: informativity, relative relation, acceptance, variation and correlation.

Informativity

As a measure of implied uncertanty of the technical system (diagnostics object) in theory the information serves for the entrophy:

$$H(x) = -\sum_{i=1}^{m_s} p_i \cdot \log_2 p_i$$

where:

m_s - the number of probable conditions od system "X_i",
p_i - the probability that the system"X_i" will take this condition as well.

Based on the given the number of information on the technical condition I_k equals:

$$I_k \to D = H(D) - E(D/K)$$

where *H(D/K)* - full conditional entrophy of system *"D"* compared to the system *"K"*.

Informitivity of the diagnostics parameter (or "diagnostic weight") can be measured by the number of information on technical state that includes this parameter:

$$I_k = H(\varepsilon) - H_k$$

where:

$H(\varepsilon)$ - total system entrophy,
H_k - system entrophy after the technical diagnostics was performed.

The greater informitivity of the diagnostics parameter I_k includes smaller entrophy H_k and more information on system condition that are in the diagnostics parameter. Information mean value can be used not only for the selection of diagnostics parameters (ρ) but even for the measure of effectivity of diagnostics control.

Relative relation

Relative relation of parameters can be defined in this way [2]:

$$M_d = \frac{\rho_{\max} - \rho_n}{\varepsilon_2 - \varepsilon_n} = \frac{\Delta \rho}{\Delta \varepsilon}$$

where M_d should be as big as possible, should move towards its maximum.

The research [3] show that the most suitable relation is $M_d > 2.3$.

Acceptance

Between diagnostics parameters and the parameters of technical condition there should exits the needed acceptance, or, the monotonous growth or decrease of ε a certain change of ρ should conform with, or reversable proportion can occur as well.

Variation

The variation represents the deviation of the diagnostics parameters from the mean statistics value.

Correlation

In solving given tasks as a measure of connectivity between diagnostics and condition parameters we can include correlation index *r* (in this case *r* is the level of connection between ε and ρ).

For the evaluation of the gained results reliability criteria can be used μ_R [10]:

$$\mu_R = \frac{r \cdot \sqrt{N_p}}{1 - r^2}$$

where: N_p - number of marked pairs.

The research [3] show that the gained result can be considered satisfactory if $\mu_R > 2.6$.

We have addopted linear regression in this paper, or the regression line define by the equation:

$$\varepsilon = a_1 \cdot \rho + b_1$$

where:

a_1, b_1 - regression line course index.

Data collecting process and production of many index values of correlation and line course (a_1, b_1) can be done through application of specified computer programs.

The intense development of computer technology has enabled qualitatively new approach to the problem of automatic technology process performance, and automatic diagnostic system condition control.

The principal scheme of the process computer system for the system control is shown on Figure 2.

The automatic surveillance, in a described method, can include: bolster temperature, bolster vibration, oil pressure and temperature, rotor vibration (own), axial rotor shift, relative rotor extension, bolster plate dilatation, reservoire oil level, generator stator iron and copper temperature, water temperature, suction pump pressure drop, water flow, etc.

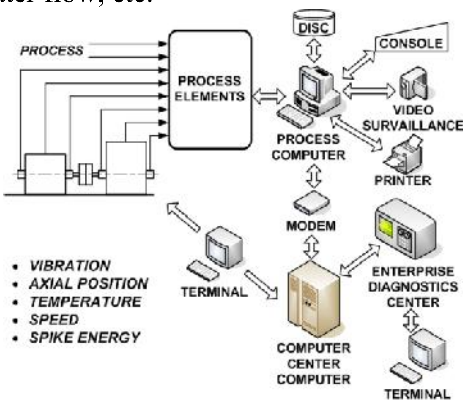

Figure 2. Sytem condition automatic monitoring system configuration

The most of the methods of technic diagnostics can be presented as the systematic monitoring:vibration, thermic condition, lubricant control, corrosion, etc, that inlude a wide range of application, while some methods are used with special kinds of technical systems. Today, in the world industry, in 80% of cases for the analisys of the system condition vibration method is used, specially at power transmition. With the equipment that is in function of the technological process - surface exploitation with discontinued technology, that has working processes in the production, the vibration method is suitable with the rotation machines etc.

During the selection of the diagnostics it should be noted that the diagnostics should comply with the demand of objectivity, uniformity and repeatebility.

It is necessary to secure that the conclusion on technical condition should not depend on the subjective characteristics of the diagnostics specialists and other external factors, that during the repetition of the diagnostics always the same results are gained.

The basic diagnostics means that are used in the power plant today can be divided into three basic groups:

- Installed (for the continual condition control),
- Movable (for the control of more different systems), and
- Stationary (located in diagnostics centers).

FAILURE MONITORING OF THE VENTILATION MILL IN THERMAL POWER PLANT

In Kostolac B power plant, coal is ground in the ventilation mills. The system includes eight ventilation mills of EVT N 270.45 type, with a nominal capacity of 76 t/h of coal. Each mill is directly connected to the burner system consisting of four levels; two bottom, main burners of coal powder mixture and two upper or secondary burners. The construction and geometry of the ventilation mill and the mixture channel along with the wear process of vital parts significantly affect the energy efficiency of the plants. In Kostolac B power plant eight fan mills are used. The odd numbered mills have channels with blinds and also channels with built-in centrifugal separators [11].

Failure monitoring of ventilation mill in period before revitalization, from 2006 to 2010. year, includes next phases of research:

- Analysis of causes that lead to the damage (analysis of weak points in the mill ventilation) before revitalization,
- Analysis of maintenance costs,
- Monitoring and analysis of repairing the mill before the period of revitalization,
- Operational maintenance service preparation for execution of the process of revitalization,
- The proposal of a diagnostic model for testing,
- Determining the nature, extent and causes of material with non-destructive testing methods.

It is proposed use of diagnostic maintenance model (Figure 1) for testing of ventilation mill in period of revitalization.

CONCLUSION

Use of diagnostic maintenance model includes these advantage:

- Simplicity - the model is very simple and does not demand the knowledge of complex mathematics and statistics;
- It does not include just two conditions „operational“ and „failure“ as all recent models of maintenance. Instead it takes into account the laws by which the conditons change;
- Based on the experimental function of the technical diagnostic change of the elements and/or system;
- Does not include the discreete process of the transformation of the element and/or the system form one condition to another;
- Can be applied to the comlex parts of the system with gradual condition change, which is important for the power plant;
- Enables that the technical condition of the system can be determined in every moment;
- Enables decision making on the periodic diagnostic control of the technical condtion of the system;
- Enables decision making on the necessary maintenance activities;
- Adjustable to the application of the informational technologies;
- Supported by the eminent and accepted scientific methods like analysis, statistics, etc.

The presented results for the diagnostic maintenance model, as well as other results which not presented here, show that model is most efficient for the elements or the entire system with high risk of failure [12].

ACKNOWLEDGMENTS

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WIND ENERGY AND HYDROELECTRIC ENERGY AS ALTERNATE ENERGY SOURCES WITH PARTICULAR REFERENCE TO SERBIA

V. Šinik
University of Novi Sad
Technical Faculty "Mihajlo Pupin", Zrenjanin, Serbia
E-mail: sinik.vladimir@gmail.com

Abstract: This paper describes the principle of obtaining electricity from wind energy and from small watercourses. Small hydro is one of the most valuable answers to the question of how to offer to isolated or rural communities the benefits of electrification. It can answer to the many of the more complex problems of energy supply. The importance of small hydroelectricity and energy of winde growth to fill the gap of decentralised production and for private and municipal activity production, for sale to the general grid of electricity delivery or alternatively to furnish energy to the industry or even to isolated zones. Small hydropower, with its multiple advantages as low-cost and reliable form of energy, is in the forefront of many countries to achieve energy self-sufficiency.

INTRODUCTION

In some countries the energetic situation is still characterised by a strong dependence of external energy. In order to fill the gap of the primary energy need that is most imported, it is required another type of energy production (e.g. thermal or nuclear), however, much more polluted sources. Generally speaking, the policy in most of countries is devoted to assure additional generating energy from renewable, according to environmental constrains. Hydropower schemes can contribute with a cheap source, as well as to encourage the development of small industries across a wide range of new technologies.
The energy of flowing water is the most readily available, renewable and clean source of electricity. The hydraulic power is one of the oldest energy forms of mankind, namely used for irrigation and industry. Nowadays, small hydro is one of the most valuable answers to the question of how to offer to isolated rural communities the benefits of electrification and of progress, as well as to improve the quality of life. Undertakings with multiple proposes, in particular water drink and irrigation systems take the advantage to install small or micro hydro schemes in existing local difference topographic levels or using a difference piezometric head along a pipe. These systems must be able to response to some operating constrains, such as fluid looping or closed circuit (e.g. by using reverse pump-turbine).
Now as well as in the future, the energy of the wind has proven to be one of the most important renewable energy sources. The main reasons are: unlimited energy supply, possibility of conversion into electrical energy by means of wind turbines, the cost of electricity generated by wind power reduces in proportion to increasing wind energy use, environmentally-friendly method of energy generation, small requisite land

HIDRO ENERGY AND HYDROELECTRIC POWER

The hydroelectric power plant utilises a natural or artificial fall of a river and enhances the main advantages comparing with other electricity sources, namely saving consumption of fossil, fuel, or firewood, being self-sufficient without the need of imported components. Small hydropower schemes do not contribute for greenhouse effects or atmospheric pollution and for resettlement, since happen with large dams, offering a decentralised electrification at low running cost and long life.
The net head (Ho) of a small hydropower plant (Figure 1) can be created in quite number of ways, being the most known the following two types: building a dam across a stream in order to increase the water level just above the plant; or diverting part of the stream, with a minimum of headloss, to just above the plant.
The hydroelectricity production is an energy conversion process in which the water is an efficient vehicle of transmission and transformation of the gravity potential flow energy in mechanical and

electric energy. In this way, the available potential energy or gross head (Hg) will be converted through the main following components of the hydropower system (Figure 2):

- Reservoir: constitute a storage form of the available potential energy;
- Conveyance system that includes the intake, conveyance circuit (i.e. canal, penstock, galleries and tailrace or outlet) where part of the available energy is converted into kinetic energy, being part transformed into reversible flow work capacity (pressure head), and another part dissipated in heat (by fluid viscosity), yielding in the net or useful head (Ho).
- Hydraulic turbine: where the net head is totally converted into kinetic energy of the flow that by impact on the runner (for impulse turbines), allows converting it into the rotor speed of the turbomachine. The turbine discharge variation induces effects on kinetic energy flow variation and on pressure work in the turbine runner (for reaction turbines).
- Generator rotor: the mechanical energy transmitted to the shaft maintain the speed of the rotor producing electric energy according to electromagnetic laws;
- Linkage line to the grid: the electric energy is driven and transformed in order to connect to the grid that it will be transported to long distances and for posterior users' distribution.

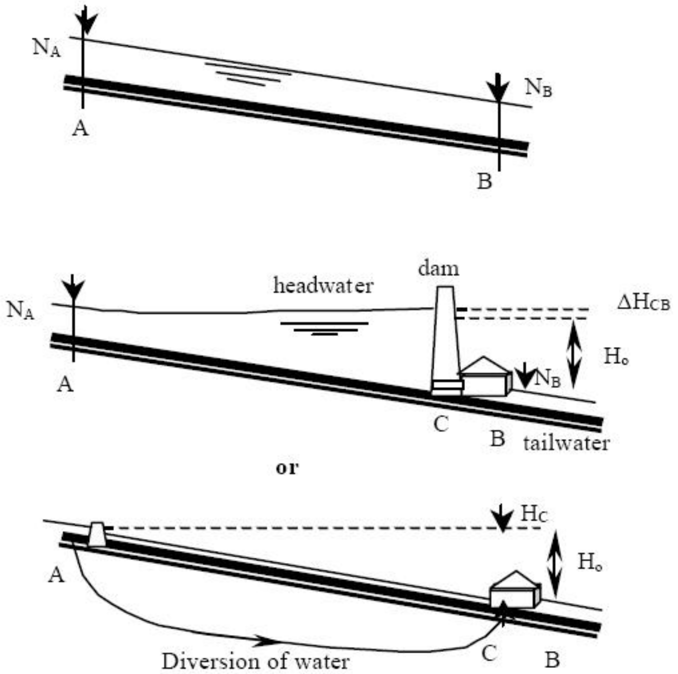

Figure 1. Different types of hydropower schemes

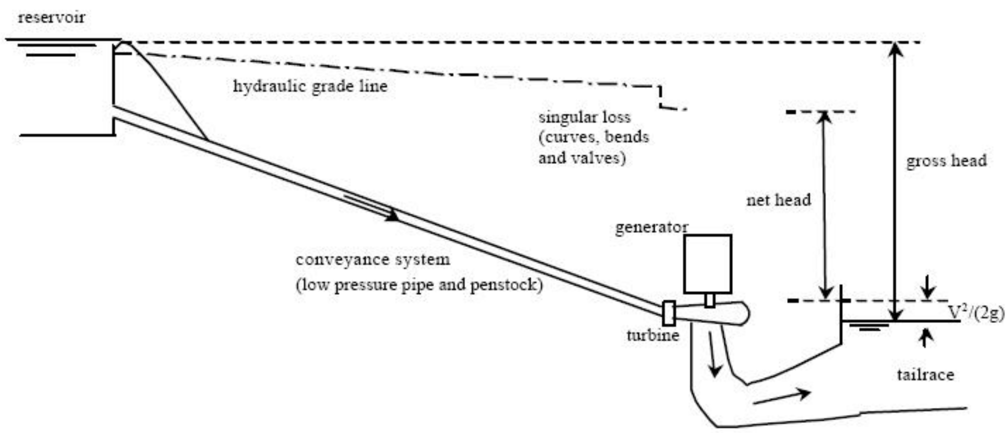

Figure 2. Components of a hydropower scheme

The basic hydropower principle is based on the conversion of a large part of the gross head, Hg (m), (i.e. net head Ho (m)) into mechanical and electrical energy:

$$H_o = H_g - \Delta H_{AB}$$

being head losses along the total conversion system expressed by □HAB (m). The hydraulic power Po (kW) and the corresponding energy Eo (kWh) over an interval time □t (h)
will be respectively:

$$P_o = \rho g \, Q \, H_o$$

$$E_o = \rho g \, Q \, H_o \Delta t$$

where Q (m3/s) is the discharge diverted to the powerplant. The final power (PF) delivered to the network is smaller than the available hydraulic power (Po):

$$P_F = \eta \, P_o$$

where *h* is the global efficiency, resulted of the multiplication of partial efficiencies from the successive transport and conversion phases (*h*□□1) (Figure 3).

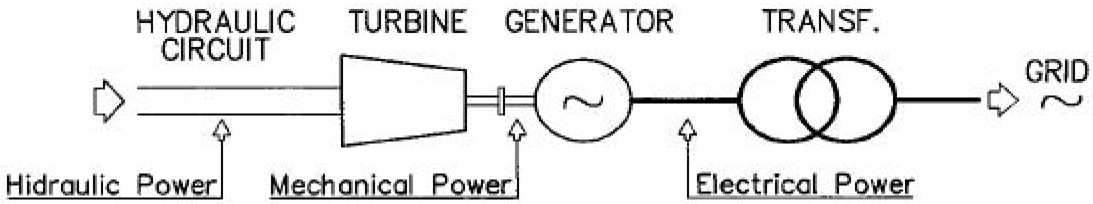

Figure 3. Power conversion scheme

SMALL-SCALE HYDROELECTRIC POTENTIALS OF SERBIA

The total estimated hydroelectric potential of Serbia is around 31 000 GWh per year. The major part of that potential (around 62%) is already exploited since favorable economic and cost effective indicators justify the construction of large capacity facilities. The rest of the hydro potential may be exploited through the construction of small and more expensive systems. Some estimates of the small-scale hydropotential which encompasses micro and mini hydroelectric power plants under 10 MW, indicate that small scale water resources offer capacities of around 500 MW and annual power generation of 2 400 GWh. Half of that potential is located in the region near Užice, Niš and Kragujevac, where it can be utilized by numerous small-scale power plants with the total capacity of around 340 MW, distributed to around 700 locations. where it can be utilized by numerous small-scale power plants with the total capacity of around 340 MW, distributed to around 700 locations. Investing in this energy sector will depend on government initiatives and state subsidies for renewable energy research and development. Also, legislative rules and regulations should be made to attract private capital. Figure 4 shows the hydropower potential of small rivers Serbia

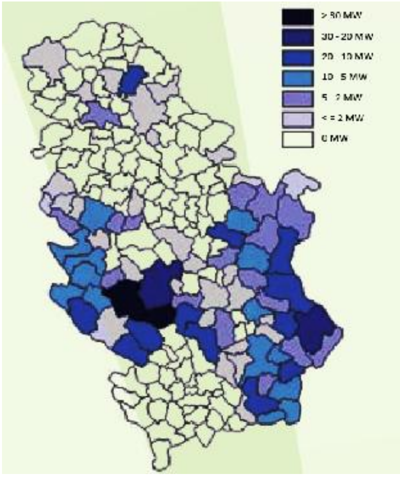

Figure 4. Hydropower potential of small rivers Serbia

Preparation and construction of hydroelectric plants is a long and laborious process and, since private investment funds are not expected to grow at a satisfactory rate, it is expected that only one half of planned small scale hydro projects will be realized in the next ten years.

Although less important in the energy sense, contribution of small-scale hydro to the energy industry is strategically much more important, both from the aspect of reliability and flexibility of operation, as well as from the aspect of enhanced economic opportunities for local residents. Moreover, the technology of power generation is essentially nonpolluting and releases no heat, such that adverse environmental impacts are negligible and, for small installations, may be totally eliminated.

Hydropower generation is a non-consumptive, utilizing renewable resource, which is made continually available through the hydrological cycle by the energy of the sun. It is non-polluting and releases no heat. Even small hydro installations replace fossil fuel exploitation (close to 1.4kg per each kWh of produced electricity) or the use of natural gas. In the remote areas, using relatively simple technology small hydro industry can be a catalyst in mobilizing productive resources and creating improved economic prospects for local residents. Small hydro usually provides more local employment in construction of civil works than in case of large-scale projects.

THE ENERGY OF THE WIND

Wind is simply air in motion. It is caused by the uneven heating of the Earth's surface by radiant energy from the sun. Since the Earth's surface is made of very different types of land and water, it absorbs the sun's energy at different rates. Water usually does not heat or cool as quickly as land because of its physical properties.An ideal situation for the formation of local wind is an area where land and water meet. During the day, the air above the land heats up more quickly than the air above water. The warm air over the land expands, becomes less dense and rises. The heavier, denser, cool air over the water flows in to take its place, creating wind. In the same way, the atmospheric winds that circle the Earth are created because the land near the equator is heated more by the sun than land near the North and South Poles.Today, people use wind energy to make electricity. Wind is called a renewable energy source because the wind will blow as long as the sun shines.

Now as well as in the future, the energy of the wind has proven to be one of the most important renewable energy sources. The main reasons are:

• Unlimited energy supply
• Possibility of conversion into electrical energy by means of wind turbines
• The cost of electricity generated by wind power reduces in proportion to increasing wind energy use
• Environmentally-friendly method of energy generation
• Small requisite land

Energy crises, significant reduction of fossil fuel resources and enormous increase in pollution across the planet have stimulated growth of wind turbines production in the last 30 years at an almost equal pace as the computer industry. Increased wind turbine reliability and the in-roads into world markets would mean that the future for the technology is bright. Figure 5 shows the average power and wind energy in Serbia.

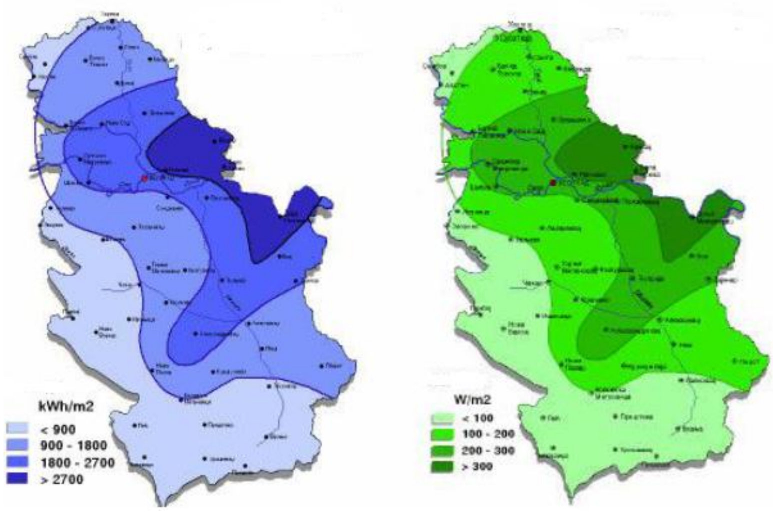

Figure 5. The average power and wind energy in Serbia.

STRUCTURE OF WIND ENERGY CONVERSION SYSTEMS

Like old-fashioned windmills, today's wind turbines use blades to capture the wind's kinetic energy. Wind turbines work because they slow down the speed of the wind. When the wind blows, it pushes against the blades of the wind turbine, making them spin. They power a generator to produce electricity. Most wind turbines have the same basic parts: blades, shafts, gears, a generator, and a cable (Fig.6). (Some turbines do not have gearboxes.) These parts work together to convert the wind's energy into electricity.

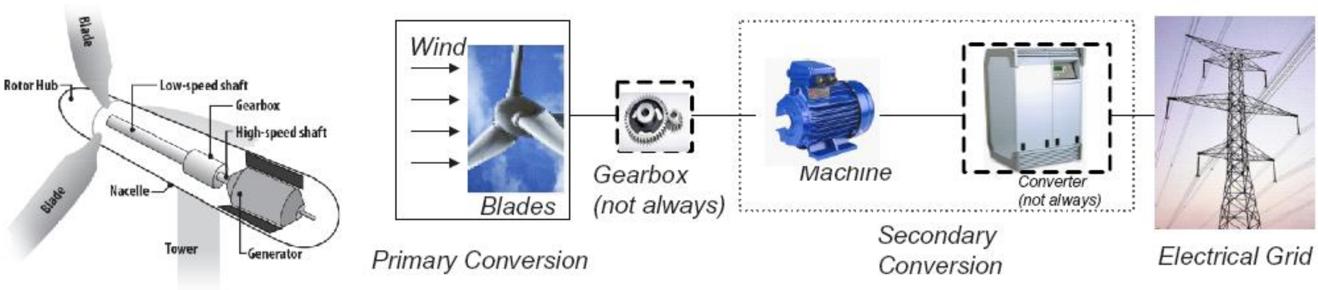

Figure 6. Block diagram of a Wind Energy Conversion Systems

1. The wind blows and pushes against the blades on top of the tower, making them spin.
2. The turbine blades are connected to a low-speed drive shaft. When the blades spin, the shaft turns. The shaft is connected to a gearbox. The gears in the gearbox increase the speed of the spinning motion on a high-speed drive shaft.
3. The high-speed drive shaft is connected to a generator. As the shaft turns inside the generator, it produces electricity.
4. The electricity is sent through a cable down the turbine tower to a transmission line.

The amount of electricity that a turbine produces depends on its size and the speed of the wind. Wind turbines come in many different sizes. A small turbine may power one home. Large wind turbines can produce enough electricity to power up to 1,000 homes. Large turbines are sometimes grouped together to provide power to the electricity grid. The grid is the network of power lines connected together across the entire country.

Modern wind turbines generate electricity at wind speed as low as 2.5 m/s, and for safety reasons the operation of the wind turbine is halted when the wind velocity reaches 25 m/s. In order to have an

economical power generation of electricity, an annual average velocity of the wind of 6 m/s is required.
Due to the friction between wind motion and the ground and the internal viscous forces in the air mass, the wind speed increases with increasing altitude. The wind speed is further influenced by the topography of the land such as roughness of the terrain, presence of natural and artificial impediments etc. In order to view the wind energy in its proper vetrocontext, it is important to have at least an approximate estimate of wind energy's strategic potential. Most estimates use the same basic steps: define the climatic and physical characteristics – average wind speed and areas where turbines can be placed; estimate the space available for development from the results of the previous step and finally using current technology estimate the energy yield which can be derived. The second step has major influence on the final outcome and is most difficult to perform accurately. On the other hand, even minor errors in location choice may have negative effects on the overall cost effectiveness. Small and very small turbines (up to 3 kW approximately) usually use a direct-drive system, which offers the advantage of omitting
the gearbox, and utilizing a generator that can operate at the rotational speed of the rotor. Such products can be utilised for remote communications, electric fences, domestic systems, leisure craft etc. Wind turbines rated at several dozens of kW generate threephase electrical current, and are usually connected to utility grids. Medium size turbines produce electricity of several hundred volts at the frequency of 50/60Hz. By means of transformers the voltage is raised to 10 - 30 kV so that electrical grids may transmit it. Although the wind industry has demonstrated technical and commercial feasibility of units of about 1.5 MW, larger wind turbines have been built but the present generation of megawatt machines may well be close to the economic limit of up-scaling. All of these units are connected to the utility grids. In some land based and offshore applications larger generating units are desirable. The most cost effective use of wind turbines is the so-called wind farm, which comprises a large number of individual units.

CONCLUTION

Wind energy is a rapidly growing sector of renewable energy sources, which are increasingly beginning to discover their true potential, which is recognized by many countries more and more invested in the installation new wind turbines and researching technologies that could improve the exploitation of wind energy. As the popularity of wind energy, reduce the production cost of electricity in wind by wind power is becoming competitive with traditional fossil fuels. All this results in an even stronger orientation towards that individual states to build more wind and try as much as electricity produced from wind energy. In the remote areas, using relatively simple technology small hydro industry can be a catalyst in mobilizing productive resources and creating improved economic prospects for local residents. Small hydro usually provides more local employment in construction of civil works than in case of large-scale projects.

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SESSION 4: Basic operations,machinery and processes

A BIOREFINERY AND FUTURE FUELS

James G. Speight
CD&W Inc., Laramie,
Wyoming 82070, USA
E-mail: jamessp8@aol.com

Abstract: During the next 20 to 30 years, the evolution future of petroleum refining will be primarily on process modification with some new innovations coming on-stream. The industry will move predictably on to (1) deep conversion of heavy feedstocks, (2) higher hydrocracking and hydrotreating capacity, and (3) more efficient processes.
However, there will be a move by high conversion refineries to gasification of feedstocks for the development of alternative fuels as well as to incorporate different feedstocks. A major trend in the refining industry market demand for refined products will be in synthesizing fuels from simple basic reactants (e.g. synthesis gas) when it becomes uneconomical to produce super clean transportation fuels through conventional refining processes. Fischer-Tropsch processes will be more highly integrated into refineries, which will offer the advantage of high quality products (Stanislaus et al., 200).
Key words: Biorefinery, fuels, gasifiers.

INTRODUCTION

During the next 20 to 30 years, the evolution of fuels production will focus primarily on process modification with some new innovations coming on-stream (Penning, 2001; Lerner, 2002; Davis and Patel, 2004; Speight, 2008; Speight, 2011a; 2011b).
However, high conversion refineries will move to gasification of feedstocks for the development of alternative fuels (Speight, 2011a, 2011b). A major trend in the refining industry market demand for refined products will be in incorporation of new feedstocks and the production of fuels from simple basic reactants (e.g. synthesis gas). Fischer-Tropsch processes will be integrated with or even into refineries, which will offer the advantage of high quality products (Stanislaus et al., 200; Speight, 2011a, 2011b).
This paper presents suggestions and opinions of the means by which refinery processes will evolve during the next three-to-five decades.

REFINERY CONFIGURATIONS

Petroleum Refinery

In recent years, the *average quality* of crude oil has become has deteriorated (Swain, 1991, 1993, 1998, 2000; Speight and Ozum, 2002; Hsu and Robinson, 2006; Gary at al., 2007; Speight, 2007) and continues to do so as more heavy oil and tar sand bitumen are being sent to refineries (Speight, 2007, 2008, 2011b) . This has caused the nature of crude oil refining has been changed considerably.
While a refinery can be represented by a general configuration (Figure 1), the actual configuration of refineries may vary from refinery to refinery. Some refineries may be more oriented toward the production of gasoline (large reforming and/or catalytic cracking) whereas the configuration of other refineries may be more oriented towards the production of middle distillates such as jet fuel, and gas oil. At the same time, biorefineries will come on-stream and play a role in the production of gaseous and liquid fuels.

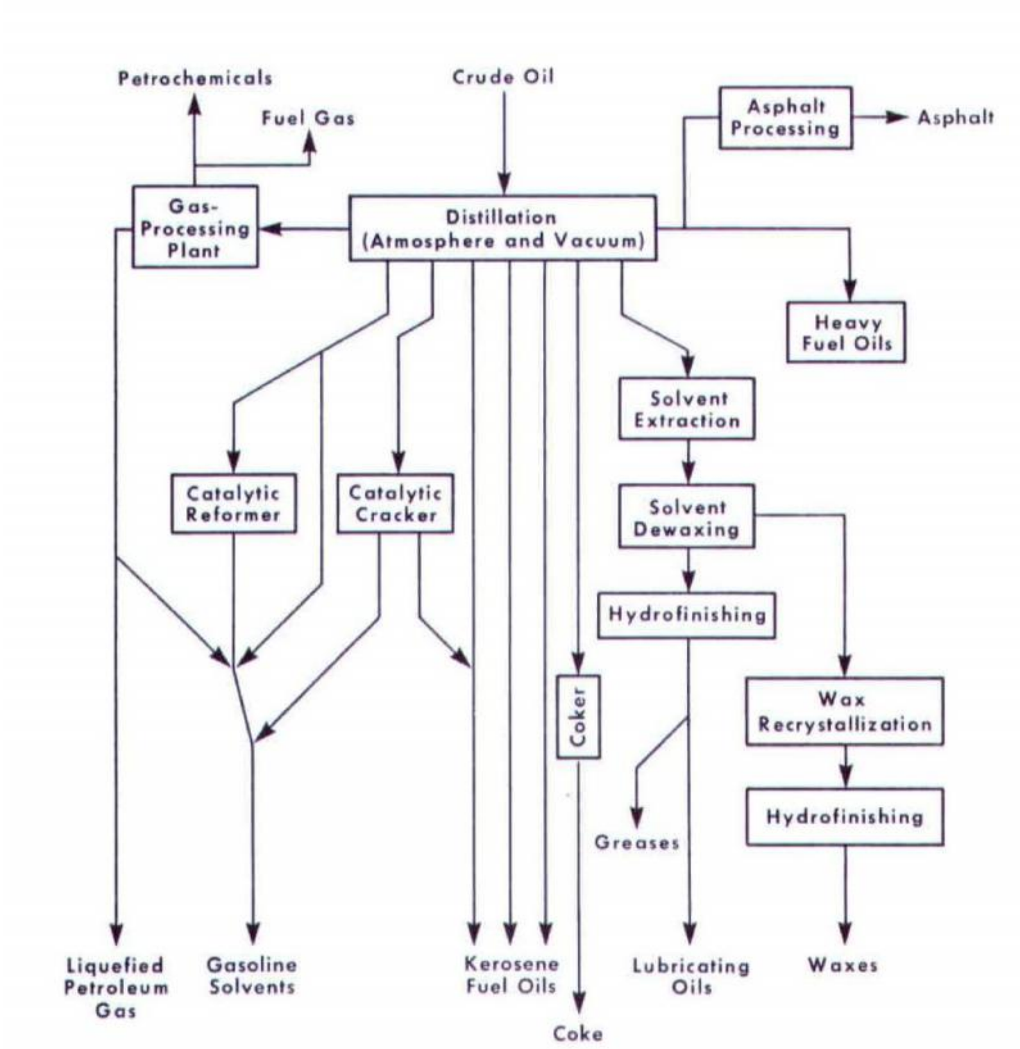

Figure 1. General Layout of a Refinery

Biorefinery

A biorefinery is a facility that integrates biomass conversion processes and equipment to produce fuels, power, and chemicals from biomass (Ruth, 2004). The biorefinery concept is analogous to the petroleum refinery, which produce multiple fuels and products from petroleum.

As a raw material, biomass is a nearly universal feedstock due to its versatility, domestic availability, and renewable character but there are limitations. For example, the energy density of biomass is low and the heat content of biomass, on a dry basis (7000 to 9000 Btu/lb) is at best comparable with that of a low-rank coal or lignite. Most biomass, as received, has a high burden of physically adsorbed moisture, up to 50% by weight and, without substantial drying, the energy content of a biomass feed per unit mass is even less. Nevertheless, biomass can be converted by thermal or biological routes to a wide range of useful forms of energy including process heat, steam, electricity, as well as liquid fuels, chemicals and synthesis gas. These inherent characteristics have focused the development of efficient methods of chemically transforming and upgrading biomass feedstocks in a refinery (Figure 2). The refinery would be based on two *platforms* to promote different product slates.

The different compositional nature of the biomass feedstock, compared to crude oil, will require the application of a variety of process options in the biorefinery. Processing of the individual components will utilize conventional thermochemical operations and state-of-the-art bioprocessing techniques.

While, the biorefinery concept provides a means to produce fuels and chemicals, significant technical challenges remain before the full potential of the biorefinery concept can be realized.

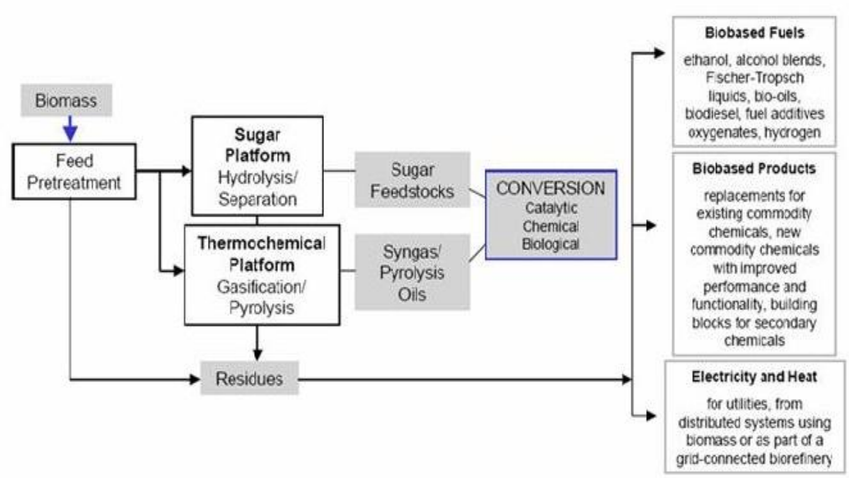

Figure 2. Fuels from Biomass using the Sugar (Biochemical) Platform and the Thermochemical Platform (Source: Office of the Biomass Program-Multiyear Plan 2004 and Beyond, Nov. 2003)

Gasification Refinery

Plant biomass can be gasified to produce synthesis gas; a basic chemical feedstock and also a source of hydrogen for a future hydrogen economy (Speight, 2008; Speight, 2011b). Thus, there is a renewed interest in the utilization of plant based matter (biomass) as a raw material feedstock for the chemicals industry (Marcilly, 2003; Lynd et al., 2005; Huber and Corma, 2007; Lynd et al., 2009).
A gasification refinery would have, as the center piece, gasification technology and would produce synthesis gas (from the carbonaceous feedstock) from which liquid fuels would be manufactured using the Fischer-Tropsch synthesis technology to produce a variety of hydrocarbons (Couvaras, 1997; Speight, 2008; 2011a, 2011b). In fact, biomass gasification is therefore one of the most technically and economically convincing energy possibilities for a potentially carbon neutral economy.

Gasifiers

Four types of gasifier are currently available for commercial use: (1) the counter-current fixed bed, (2) co-current fixed bed, (3) the fluidized bed, and (4) the entrained flow (Speight, 1994, 2008, 2011a, 2011b).
The counter-current fixed bed (up draft) gasifier consists of a fixed bed of carbonaceous fuel (e.g. coal or biomass) through which the gasification agent (steam, oxygen and/or air) flows in counter-current configuration. The ash is either removed dry or as a slag.
The co-current fixed bed (down draft) gasifier is similar to the counter-current type, but the gasification agent gas flows in co-current configuration with the fuel (downwards, hence the name down draft gasifier
In the fluidized bedgasifier, the fuel is fluidized in oxygen (or air) and steam. The temperatures are relatively low in dry ash gasifiers, so the fuel must be highly reactive; low-grade coals are particularly suitable. Fluidized bed gasifiers are most useful for fuels that form highly corrosive ash (such as biomass ash) that would damage the walls of slagging gasifiers.
In the entrained flow gasifier a dry pulverized solid, an atomized liquid fuel or a fuel slurry is gasified with oxygen (much less frequent: air) in co-current flow. The high temperatures and pressures also mean that a higher throughput can be achieved but thermal efficiency is somewhat lower as the gas must be cooled before it can be sent to a gas processing facility.
While there are many alternate uses for the synthesis gas produced by gasification, and a combination of products/utilities can be produced in addition to power. A major benefit of the integrated gasification combined cycle concept is that power can be produced with the lowest sulfur oxide (SOx) and nitrogen oxide (NOx) emissions of any liquid/solid feed power generation technology.

Fischer-Tropsch Synthesis

The synthesis reaction is dependent of a catalyst, mostly an iron or cobalt catalyst where the reaction takes place. There is either a low or high temperature process (LTFT, HTFT), with temperatures ranging between 200 to 240°C for LTFT and 300 to 350°C for HTFT. The HTFT uses an iron catalyst, and the LTFT either an iron or a cobalt catalyst.
The reactors are the multi-tubular fixed bed, the slurry or the fluidized bed (with either fixed or circulating bed) reactor. The fixed bed reactor consists of thousands of small tubes with the catalyst as surface-active agent in the tubes. Water surrounds the tubes and regulates the temperature by settling the pressure of evaporation. The slurry reactor is widely used and consists of fluid and solid elements, where the catalyst has no particularly position, but flows around as small pieces of catalyst together with the reaction components. The slurry and fixed bed reactor are used in LTFT. The fluidized bed reactors are diverse, but characterized by the fluid behavior of the catalyst (Dry (2001).
The high temperature Fischer Tropsch technology uses a fluidized catalyst at 300 to 330°C. Originally circulating fluidized bed units were used (Synthol reactors). Since 1989 a commercial scale classical fluidized bed unit has been implemented and improved upon.
The low temperature Fischer Tropsch technology has originally been used in tubular fixed bed reactors at 200 to 230 °C. This produces a more paraffinic and waxy product spectrum than the high temperature technology. A new type of reactor (the Sasol slurry phase distillate reactor has been developed and is in commercial operation. This reactor uses a slurry phase system rather than a tubular fixed bed configuration and is currently the favored technology for the commercial production of synfuels.

THE FUTURE REFINERY

The precise configuration of the refinery of the future is unknown but it is certain that no two refineries will to adapt in exactly the same way.
However, the evolution of the refinery of the future will not be strictly confined to petroleum processes. The major consequence will be a much more environmentally friendly product quality. These will be solved in refinery of the future, the refinery beyond 2020 with the development of deep conversion processing, such as residue hydrocracking and the inclusion of processes to accommodate other feedstocks.
The refinery of the future will have a gasification section (Figure 3) devoted to the conversion of coal and biomass to Fischer-Tropsch hydrocarbons – perhaps even with rich oil shale added to the gasifier feedstock. Many refineries already have gasification capabilities but the trend will increase to the point (over the next two decades) nearly all refineries feel the need to construct a gasification section to a variety of feedstocks, including biomass.
The biomass refinery will be able to shift output from the production of one chemical to another in response to market demands. Given that biomass will be a part of a refinery of the future, refiners may dictate that biomass receives preliminary upgrading at the biomass site before being shipped to the petroleum refinery.

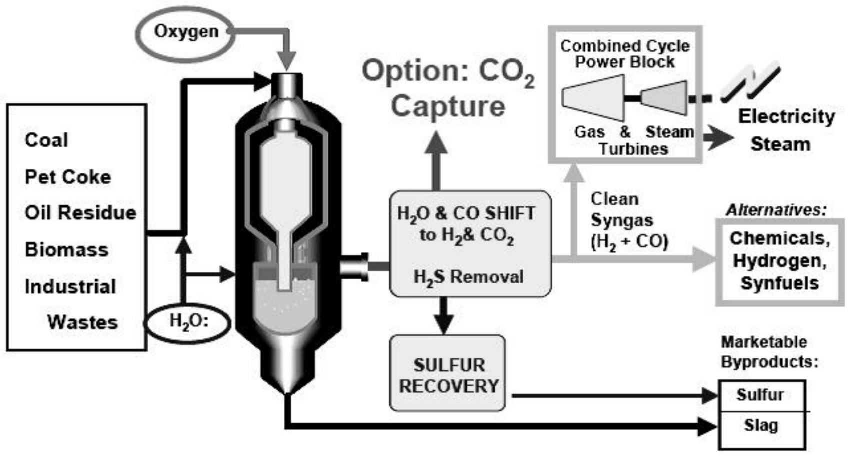

Figure 3: Gasification of Various Feedstocks

This leads to the concept of *alternative energy systems*, which is wider-ranging and more meaningful than *alternative energy sources***,** because it relate to the actual transformation process of the global energy system (Szklo and Schaeffer, 2005). Alternative energy systems integrate petroleum with other energy sources (such as biomass) and pave the way for new systems where *refinery flexibility* will be a key target, especially when related to the increased use of renewable energy sources.

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COMPARISON OF TWO MATHEMATICAL MODELS FOR CONTROL SYSTEM OF LEVEL IN CONDENSER OF TURBINE IN THE THERMAL POWER PLANT

Prodanović, S.[1], Nedić, N.[2], Filipović, V.[2]
[1] University of East Sarajevo, Faculty of Mechanical Engineering, East Sarajevo
[2] University of Kragujevac, Faculty of Mechanical Engineering, Kraljevo
E-mail: elsing123@yahoo.com

Abstract: This paper shows large importance of adequate mathematical modeling of system. Control system of level in condenser of turbine in thermal power plant Gacko is taken into exploration. Here it was presented in two ways, as first-order system and second-order system. Their analysis and comparison were carried out after auto-tuning of PID (proportional-integral-derivative) controller using relay feedback test simulation. Obtained parameters of PID controller were applied into both variations of the system block diagram and its responses have been utilized for giving evaluation of researched models.
Key words:mathematical model, relay feedback test, simulation

INTRODUCTION

All analytical and numerical investigations depend on its appropriate mathematical model. The task is as better as possible presentation of system behavior. In this paper two mathematical model of control system of level in condenser of turbine in thermal power plant Gacko were compared. In first case, condenser was presented as first-order system (using continuity equation) [1] and in second as second-order system (taking into account also transfer function of turbine) [2]. The main aim of this paper was proving better properties of second-order model in order to improve functioning of explored control system. Simulation of auto-tuning of PID controller using relay feedback test was performed in both cases [3]. In the following exposure these two approaches will be shown parallel.

DESCRIPTION OF THE SYSTEM

This system for control level in condenser is one of subsystems in thermal power plant. In order to give closer explanation of the problem, approaches of modeling are presented here.

System structure

Level in condenser depends on the amount of steam which comes from turbine (directly and from heater for regenerative heating), supply of demineralized (DEMI) water, drain condensate and working of vacuum pumps for obtaining vacuum in condenser. Control of level is performing by using two closed-loops, i.e. over valve for condensate drainage from the condenser and valve for demineralized (DEMI) water supply. Accordingly, good dynamic behavior of system and keeping desired level value in steady state is enabled using dumping control method. Schema of this control loops is shown in Fig. 1.

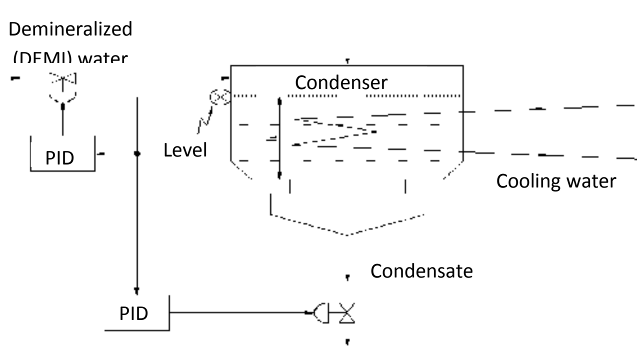


Figure 1. Control system of level in condenser in thermal power plant Gacko [3]

Mathematical model

Mathematical model of all system components leads to its transfer functions and components introduced into structure diagram of system give block diagram [2,4,5,6]. This block diagram is given in Fig. 2.

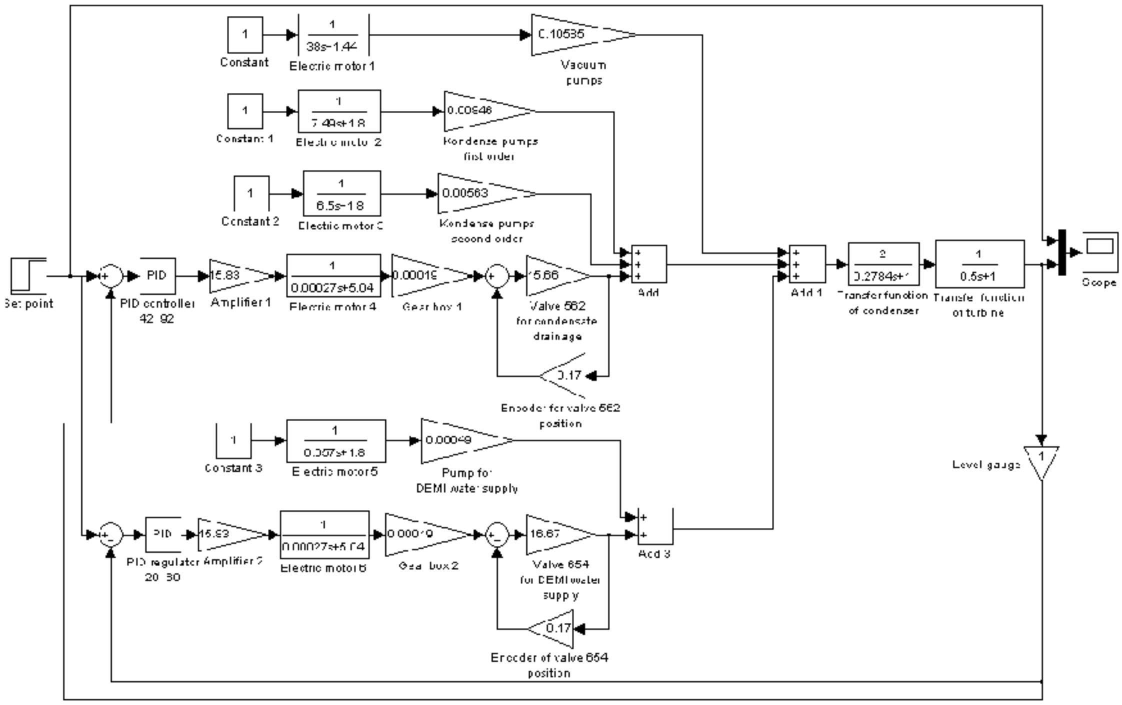


Figure 2. Block diagram of control system of level in condenser in thermal power plant Gacko [2,4,5]

Difference between these two approach is transfer function of process. In the first, transfer function is determined using continuity equation as first-order process (Fig. 2. without transfer function of turbine) [4,5], hence:

$$G_k(s) = \frac{2}{0{,}2784 \cdot s + 1} \tag{1}$$

To improve description of level as function of time, transfer function of turbine was derived, because of vast influence of inlet steam from turbine into condenser [2]. It is given by:

$$G_t(s) = \frac{1}{0{,}5 \cdot s + 1} \tag{2}$$

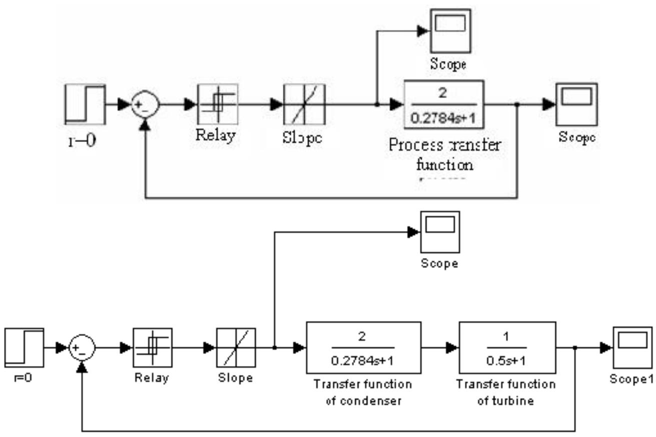
In the second approach, serial connecting of these two transfer function gives second-order process (Fig. 2).

COMPARISON OF SUITABILITY OF MATHEMATICAL MODELS

Usefulness of mathematical models is reflected in good representation of process behavior. A more complete description of the physical principles of the system increases the possibility of more accurate studies of its behavior. Evaluation of these two mathematical models is carried out after finishing two phases: auto-tuning of PID controller and introducing of obtained parameters into block diagram of entire control system of level in condenser. These activities were performed using simulation in the software Matlab.

Auto-tuning of PID controller

Relay feedback test is utilized for auto-tuning of PID controller for both mathematical models of process. Saturation relay is applied instead of ideal relay because of its proved advantages in terms of reducing errors in estimatin ultimate gain (K_u) and ultimate period (T_u). Configuration for saturation relay application into relay feedback test for both explored transfer functions of process is shown in Fig. 3.

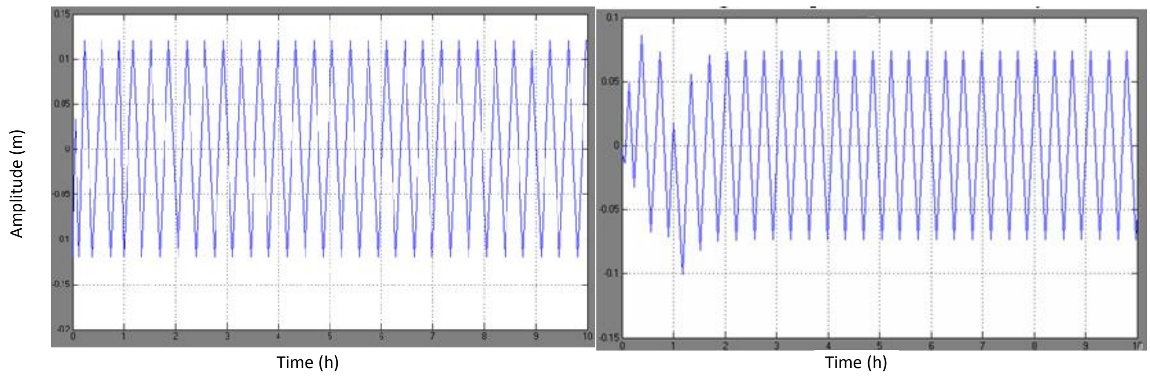


a) b)

Figure 3. Configuration for simulation of relay feedback test using saturation relay: a) without taking into account transfer function of turbine, b) with taking into account transfer function of turbine

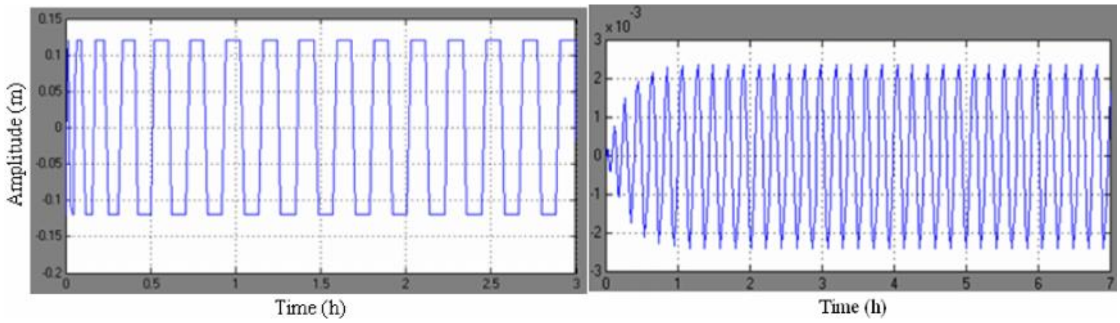
In first case (Fig. 3.a), relevant values are: height of ideal relay$h$=0,12(m), i.e. 10% of set value $h_{\check{z}}$=1,2(m), the previously completed test with ideal relaygives $k_{\min}=4h/\pi a$=2,11, slope of saturation curve$k=1,4k_{\min}$=2,954 [1]. So, simulation gives oscillatory output of saturation relay (Fig. 4.a) and process response (Fig. 4.b).

In second case (Fig. 3.b), relevant values are: height of ideal relay$h$=0,12(m), i.e. 10% of set value $h_{\check{z}}$=1,2(m), the previously completed test with ideal relaygives $k_{\min}=4h/\pi a$=15,44, slope of saturation curve$k=1,4k_{\min}$=21,62 [2]. So, simulation gives oscillatory output of saturation relay (Fig. 5.a) and process response (Fig. 5.b).



a) b)

Figure 4. Graphics forfirst case of proces transfer function: a) output of saturation relay b) oscillatory process response



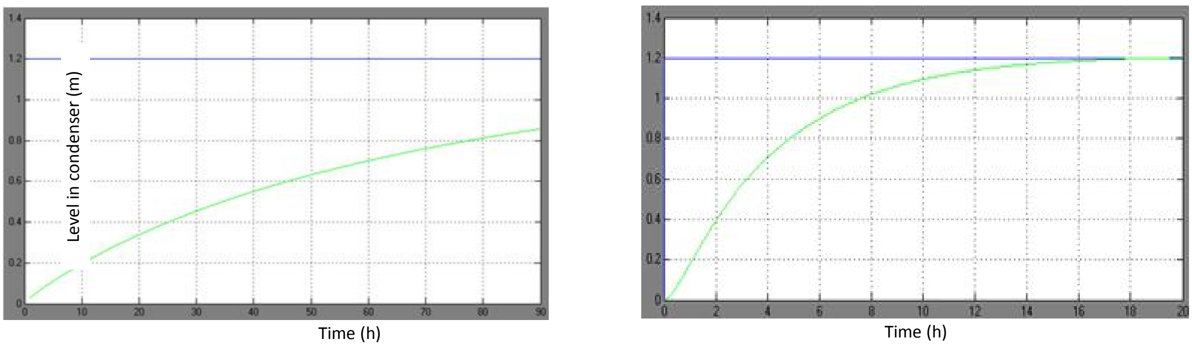
a) b)

Figure 5. Graphs forsecond case of process transfer function: a) output of saturation relay b) oscillatory process response [2]

Parameters of PID controller are calculated according Tyreus-Luyben method in order to enhance system robustness.
According to characteristic values in obtained diagrams (Fig. 4.b) parameters of PID controller (first case of process transfer function) are the following:K_p = 0,89 ; K_i = 1,145 ; K_d = 0,05.
Using values in diagrams (Fig. 5.b) parameters of PID controller (second case of process transfer function) are the following: K_p = 9,83 ; K_i = 20,91 ; K_d = 0,29 [2].
Deviation values of the parameters for PID controller is noticable here.

Evaluation and comparison validity of process response

Difference between parameters in this two cases leads to opinion that transfer function will give different display of system behavior. In order to explore better solution, responses of entire control system of level in condenser are simulated and analyzed. For that purpose, obtained parameters of PID controller are incorporated into appropriate block diagram (Fig. 2.).
Simulated response in Fig. 6.b gives better dynamic behavior of process and it is closer to usual response of level systems. There is no overshoot, output is faster, settling time is shorter, which means corect functioning [2].
Process which was modeled without transfer function of turbine don't reflect appropriate neither dynamic nor static characteristic. Because it doesn't achieve stationary regime in appropriate time, i.e. this is very slow process (Fig. 6.a).
Therefore, lack of information of system causes errors in simulation of auto-tuning of PID controller and bad representation of system behavior.



a) b)

Figure 6. Response of control system of level in condenser with controller`s parameters obtained using saturation relay: a) without taking into account transfer function of turbine, b) with taking into account transfer function of turbine

CONCLUSION

Process which has been modeled as second-order system gives larger possibility for taking information of its behavior. That is concluded after comparison of its responses parameters with parameters of first-order system. It is very important for high-quality analysis and eventual improving of system functioning. Also, auto-tuning of PID controller depends on appropriate derived mathematical model. This means that wrong choice of mathematical model causes errors in simulation of relay feedback test and in display of entire control system.

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USE OF CHEMICALLY CONTAMINATED WATER FOR IRRIGATION

Stikić, R.[1], Blagojević, S.[1], Jovanović, Z.[1], Žarković, B.[1], Surdyk, N.[2], Kloppmann, W.[2], Sandei, L.[3]
[1]University of Belgrade, SerbiaFaculty of Agriculture,
[2]Bureau de Researches Geologique et Minieres (BRGM), Orléans Cedex, France
[3]Stazione Sperimentale Industria Conserve Alimentari (SSICA), Parma, Italy
E-mail: rstikic@agrif.bg.ac.rs

Abstract: Drought is one of the most common environmental stresses that may limit agricultural production worldwide and therefore, irrigation is necessary for achievement of high yield with the good quality. However, the clean freshwater is becoming a limited resource and its use for crop irrigation is in competition with the demand for household or industrial consumption. Another problem is that waters in many countries are seriously contaminated with either inorganic or organic pollutants. Uncontrolled use of contaminated waters (especially contaminated with heavy metals) for irrigation of vegetables, could have serious environmental and health implications. In presented paper results of the use of technologically improved filter for removing heavy metals (HMR device) from water for irrigation of potatoes are shown. The analyses of heavy metals (Cd, Cr, Fe, Ni, Pb and Zn) concentration in the system water/soil/potato tubers confirmed the effectiveness of HMRD in decontamination of water. The presented data are part of the research done during realization of FP6EU project SAFIR.
Key words: contaminated water, irrigation, heavy metal filters, potato

INTRODUCTION

Water is essential for high and stable yield of agricultural plants and in many areas modern farming would be impossible without irrigation. However, only a small proportion of the world cultivated area is equipped for irrigation. According to FAO [7], more than 80% of global agricultural land is rain-fed and in these regions, crop productivity depends solely on sufficient precipitation to meet evaporative demand and associated soil moisture distribution. At the same time that agricultural water demand increased, other sectors of society also increased their demands, notably for the environment. Given the economic and environmental limitations to increase the supply of water to meet the increased demand, the prospects for water scarcity and food safety are increasing in many world regions. Furthermore, most of the climatic scenarios predicted that climate change will have a range of impacts on water resources. A simulation study done by Eitzinger et al. [6] predicted that groundwater recharge will be reduced in Central and Eastern Europe. Therefore, saving of water resources and increasing agricultural productivity per unit of water (“more crop per drop”) are becoming of strategic importance in these regions of Europe as in other worldwide regions, [11].

Current problem together with water scarcity is also contamination of water resources~~.~~ The competition for clean fresh water and sustainable management of water resources are becoming general problem. In the most of European countries water for irrigation is abstracted from surface water. The surface water resources may be recipients of treated wastewater and may be polluted from other anthropogenic activities or natural sources. The problem is very serious because about 10% of crops is irrigated with untreated wastewater, [2] and currently the potential for contamination *via* irrigation water is further increased worldwide.

Water for irrigation could be contaminated microbiologically and/or chemically. The pathogens, organic and inorganic chemical compounds in wastewater, can induce health risks for workers and consumers, exposed *via* the direct or indirect contact with such waters during field work and ingestion of fresh and processed food, [12]. The special problem might be the introduction of hazardous heavy metals into the food chain, [4].

The main sources of heavy metals to agricultural plants are water for irrigation or their growth media (soil, air, nutrient solutions) from which these are taken up by the roots or foliage. Although heavy metals like Fe, Zn, Ni and other trace elements are important for growth and proper functioning of plants their deficiency or excess could lead to a number of disorders. Furthermore, their presence in

food chain could be dangerous as they tend to accumulate in living organisms faster than they are metabolized or excreted, [8].
Heavy metals can enter a water supply through contamination by industrial and urban waste, or even from acidic rain breaking down soil minerals and releasing heavy metals into surface and groundwater. Furthermore, groundwater itself can be geologically polluted especially with arsenic, and the use copper, lead and zinc on buildings surfaces increase the heavy metal load discharged into receiving waters. Also several fertilizers and pesticides contain heavy metals, [3].
The use of low quality water for irrigation may introduce hazardous heavy metals into the food chain, [4], [9]. Heavy metals are dangerous as they tend to accumulate in living organisms faster than they are metabolized or excreted, [8]. However, only a few studies worldwide have studied the long-term impact of irrigation with raw urban waste waters, [5], [10] and concluded on significant accumulation of heavy metals in irrigated soils with the waste water, over several decades (up to 100 years).
There is also a lack of information and advices to grower, especially grower of vegetables, regarding the use of contaminated water for irrigation or possible method to decontaminate water prior to irrigation. Generally, the growers are not aware of the consequences of high build-up of heavy metals in the food chain, hence they continue to grow vegetables on sewage and industrial effluents.
The aim of presented paper was to review some of the results concerning the problem of heavy-metal contamination and to present some of our experimental results obtained during 2007 season where the efficiency of the new devices for removing contaminants (Cd, Cr, Fe, Ni, Pb, Zn) from water for irrigation was tested in potato field. The presented data are part of the research done during realization of FP6EU project SAFIR during 2006, 2007 and 2008 year. More detailed explanation of the experimental design and results obtained in SAFIR are presented in our recently published paper, [16].

MATERIAL AND METHODS

Presented results are from the potato experiment that was carried out during growing season of 2008 in a vegetable commercial farm “Salat Centre”, located 10 km north of the Serbian capital, Belgrade. The experiment was a part of the research of EU FP6 project SAFIR done during 2006, 2007 and 2008 seasons. The potato (*Solanum tuberosum* L.) variety *Liseta* was used for the investigation. The soil of the field site was a silty-clay and it was developed on alluvial deposit. The irrigation was done with the subsurface drip system in the period between May and August. The amount of irrigation water was calculated by evapotranspiration data using Penman–Monteith equation and adjusted by soil water content results measured by Time Domain Reflectometer probe (TDR, TRASE, Soil Moisture Equipment Corp, USA). During the vegetation season plants were treated against weeds and diseases and regularly fertilized.
Water for irrigation was supplied from a canal located 100m away from the experimental field. To increase the amounts of heavy metals in the water for irrigation, the special dosing system (produced by NETAFIM, Israel) that contained stock solution of several metals was applied. This flow of heavy metal solution was proportional to the input water flow, and prepared to reach the following target concentration: 5 µg/l in Cd,100 µg/l in Cr and 100 µg/l in Pb. The stock solution was prepared by adding solid heavy metal salts to tap water. The stock solution was then added to the input water flow using a MixRite injection pump assuring proportional metering, [16].
In the presented analysis, two water types were applied: 1. untreated canal water (C1), and water treated by heavy metal-spiked sand filter connected to heavy metal removal device-HMRD (C2).HMRD is adaptation of a well-known industrial wastewater treatment technology and produced for FP6 SAFIR partner’s experimental fields (in Serbia, Italy, Greece and China). The HMRD device is designed to consist, in the same body that are usually utilized for gravel filters, a high porosity absorber matrix able to reduce inorganic contaminants. The adsorber matrix consisted of ferric hydroxides, which are well known to adsorb heavy metals. Granulated Ferric Hydroxide (GFH), was chosen among the different commercial adsorber matrices due to its high adsorption capacity and fast adsorption kinetics for arsenic and heavy metals usually found in municipal wastewater, [3].
The integrated samples of water from all treatments were collected in the period between July and August 2007. Soil samples were taken three times during investigated season (before the planting, at the end of irrigation and at harvest) and from these sub-samples a composite sample was prepared and

analyzed. Control soil samples were collected from the plots irrigated with canal water (C1) during 2006 season, while during 2007 the samples were taken from C2 treatment.
Potato tuber samples were collected at harvest from the control plots and HMRD plots. The analyses of water and soils samples were done in BRGM (France), while analyses of potato tubers in SSICA (Italy). Measurements of the concentration of Cd, Cr, Ni and Pb were carried out by ICP-MS method, while the concentration of Fe by ICP-AES, [1].
Statistical tests were done by XLSTAT package under EXCEL. The differences between treatments were tested by ANOVA.

RESULTS AND DISCUSSION

The presented experimental results included the analyses of the content of the six heavy metals (Cd, Cr, Fe, Ni, Pb and Zn) in water, soil and tubers.

Heavy metals in water

Analyses of water for selected elements and during 2007 season showed that the device designed for removal of heavy metals was very efficient in removing Cd, Cr and Pb (Table 1). However, zinc increased after the HMRD. According to Battiliani et al. [3] this could be only explained by corrosion of zinc protected filter body components. The results of Zarkovic et al. [18] also showed that HMRD was not very efficient in removing arsenic.

Table 1. Concentration of some selected inorganic elements in canal water (C1) and HM-spiked SF-HMRD treated canal water (C2) used for potato irrigation in 2007 season - modified from Surdyk et al. [16]

Elements	C1	C2
Cd (μg/l)	17.0 ^{a}	5.0 ^{b}
Cr (μg/l)	16.0 ^{a}	2.0^{b}
Fe (mg/l)	0.02	0.02
Ni (μg/l)	10.0	13.0
Pb (μg/l)	14.0 ^{a}	6.0^{b}
Zn (μg/l)	7.0 ^{a}	39.0 ^{b}

Different letters show significant differences at the 95% level for comparison between irrigation treatments.
The presented HMRD system was checked in several field sites including these in Serbia, Italy, Greece and China as a part of EU project SAFIR activity. These results showed that efficiency for heavy metal removal varied from element to element and among experimental sites, [3]. Results for cadmium showed that only 32% was removed in Italy while the efficiency reached 98% in China, with an overall average efficiency of 36%. A similar trend was measured for chromium that was removed at 38% in Italy and at 95% in China, with an overall average of 48%, while lead was removed respectively at 26% in Italy and at 87% in China. The overall removal efficiency average of copper and lead were around 46% and 37%, respectively. The efficiency of removal also depends on the initial water source. The very high removal efficiency measured in Serbia is related to the good quality of the canal water. In all analyzed waters the heavy metal content was below the recommended maximum concentrations in irrigation water, [14].
The efficiency of HMRD in decontamination of water is very important because water filters designed to protect irrigation systems, offers no barriers against heavy metals contamination, except for the fraction of metals bound or trapped into the suspended solids.However, according to Batiliani et al. [3] the HMRD cannot remove steadily the inorganic pollution, mainly at such low concentrations. This might be related to metal-humic complex in influent water. Metal-humic complex prerequisites for adsorption onto Granulated Ferric Hydroxide (GFH) are both a minimum number of carboxyl and hydroxyl functional groups and a molecular size large enough to facilitate the contact on the GFH, rugged surface. Thus, the suggestion of Batiliani et al. [3] is that HMRD can be added after the gravel

filter when the concentration in the water source of one or more of the heavy metals exceed the treatment goal or the thresholds fixed by local regulations of more than 35-40%.

Heavy metals in soil

The results of soil analyses are presented in Table 2. They showed that in both treatments content of chromium, nickel, lead and zinc was higher than the optimal value, while cadmium and iron were in the range of optimal concentration, [13].
Significant treatment differences were found for Cr and Ni and these elements were higher in C2 treatment than in the control for 13% and 47%, respectively. However, these differences could not be attributed to the contaminated water for irrigation because HMRD was efficient in removing these metals, especially Cr from contaminated water (Table 1).

Table 2. Concentration of some selected inorganic elements in soil after harvest in 2007 season. Types of irrigation were: non-treated canal water (C1) and HM-spiked SF-HMRD treated (C2) canal water - modified from Surdyk et al. [16]

Elements	C1	C2
Cd (mg/kg)	2.0	2.0
Cr (mg/kg)	158.0 [a]	178.67 [b]
Fe_2O_3 (%)	4.0	3.70
Ni (mg/kg)	67.0 [a]	98.67 [b]
Pb (mg/kg)	27.0	27.0
Zn (mg/kg)	84.0	78.33

Different letters show significant differences at the 95% level for comparison between irrigation treatments.

Heavy metals in potatoes

Analyses of potato tubers showed no significant impact of irrigation treatments (Table 3). Furthermore, the concentrations of all elements were below the permissible limit for human diet.

Table 3. Concentration of some selected inorganic elements in potato tubers harvested in 2007 season. Types of irrigation were: non-treated canal water (C1) and HM-spiked SF-HMRD treated (C2) canal water - modified from Surdyk et al. [16]

Elements	C1	C2
Cd (mg/kg)	0.07	0.06
Cr (mg/kg)	2.81	2.51
Fe (mg/kg)	4.89	3.82
Ni (mg/kg)	0.45	0.32
Pb (mg/kg)	0.13	0.11
Zn (mg/kg)	5.57	4.55

These results are of special interest because the increased concentration of heavy metal in the food might have significant consequences for human health, [15]. The main concern is related to Pb and the limit concentration of this metal in edible part of plants is according to WHO, [17] standard 0.3 mg/kg. The problem with the Pb is that it can be harmful to plants, although plants usually show ability to accumulate large amounts of this element without visible changes in their habitat. When accumulated more than maximal (100 mg/kg) in addible part of plant, Zn may also cause significant health problems (diarrhea, abdominal pain), mainly because of its interference with Cu metabolism. Acute problems induced by Cd includes pneumonitis, while chronic proteinuria, lung cancer. Cadmium Higher content of Cr in the diet than limited values has been found to induce growth depression, liver and kidney damage or cardio-vascular disease, while the increase of concentration of Ni in the food above limit (2.0 ppm) is very harmful to eyes and also induces dermatitis or myocardidtis. Optimal concentration of Fe is also very important because the excess affects the blood vessels, although the low content in diet reduces the level of hemoglobin in blood and producing anemia, gastro-intestinal and myocardial diseases.

CONCLUSION

The content of heavy metals in tubers irrigated with contaminated water was in the range of permissible limits and tubers were safe for human consumption. Therefore, these results confirmed the efficiency of HMRD for removing the heavy metals from water for irrigation. Furthermore, they pointed to an urgent need to educate farmers to adopt new technology for treating contaminated waters prior to their use for irrigation of vegetables. In this way the health of farm workers and consumers of irrigated produce can be ensured.

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EXPERIMENTAL VERIFICATION OF STRESS STATE IMPACT TO WORKABILITY IN COLD CYLINDER UPSETTING PROCESSES WITH VARIOUS TOOLS

Kraišnik, M., Košarac, A., Petrović, Ž.
University of East Sarajevo
Faculty of Mechanical Engineering
E-mail: milijakraisnik@yahoo.com

Abstract:: In order to establish successful and optimal design for technology of plasticity it is necessary to have information dealing with performance of materials in the working system from the standpoint of achieving the maximum amount of deformation. In that manner, forming limit diagram provides the most opportunities.
Cylinder upsetting processes with flat and hollow plates with and without concentric channels are analyzed in this paper in order to verify the impact of stress state to the size of limit strain and expanding the forming limit diagram in the specific areas of stress state indicators. Research is conducted on cylinder specimens made of 100Cr6steel
Key words: workability, state of stress, upsetting of cylinder, cold forming

INTRODUCTION

Development and commercial application of large number of technological methods for metal forming processes with plastic deformation is tightly connected to achievements and findings in the area of materials performance in various working systems. Starting from that observation, the key concept which establishes the relationship between performance of materials inside the working system, parameters of the process and external factors during metal forming by plastic deformation is workability. In general, workability can be defined as ability to permanently change shape under certain circumstances during forming process without cracks, forming localization or any other unwanted form of surface damage or specimen inside structure damage.
Monotonous forming models are mostly applied for the purpose of preliminary FLD defining, but for the purpose of providing further definition non-monotonous, dominant processes of bulk metal forming have to be applied. According to the available experimental research on workability we can note that models based on cylinder upsetting processes with various tools are intensively and continuously introduced to the existing FLD defining methodologies.
In the paper [1], FLD is defined through the application of three different tests of upsetting hollow cylindrical specimens: flat, hollow and cone plates. Defining the forming limit curve in the specific field of indicators of stress state β, applying the model of upsetting the cylinder with sphere is introduced in the paper [9]. Model of upsetting the cylinder with conic and concave plates [4]. In the paper by Petruška and Janiček [7] are introduced the research results of ductile fracture in compression and cracking notched cylindrical specimens. For the purpose of FLD defining are also used models of cylinder upsetting presented in paper [3].
Research presented in this paper set as a goal experimental verification of impactof generated state of stress to workability (FLD) during upsetting of cylinder samples made of 100Cr6steel with flat or hollow plates with and without concentric channels.

THEORETICAL BASIS OF FLD DEFINING

Results of many theoretical and experimental research like [1-5, 7-10] point out existence of a large number of factors that influence performance of materials in working system. In general workability of materials depends on two groups of factors.
The first group is factors conditioned by the selected material referring to its chemical composition and structural state and their common name is material factors. Variations of these factors are achieved through metallurgical procedures in the production of metals and other different processes of thermal treatments of half-finished products.
In the second group arefactors determined by the working system: temperature, strain rate, stress state, contact friction.

$$W_M\left(\varphi_e^f\right)=\left(H_M, S_M, T_W, \dot{\varphi}, T_\sigma\right) \qquad (1)$$

Nevertheless, if we limit the research of performance of materials to a specific material with previously defined structural state, under cold forming conditions, under conventional forming, we can say that the size of limitstrain as a numerical indicator of workability is dominantly determined by realized stress state in the working zone of the work piece. Under such circumstances implicit record of workability function (1) comes down to the following form (2):

$$W_M\left(\varphi_e^f\right)=f\left(T_\sigma\right) \qquad (2)$$

In the workability analysis stress state is circumstantially followed through the relation between main strains or directly through indicators of stress state. According to the previous statement there are generally two methodologies of FLD defining in the area of bulk forming.
The first methodology relates to the determination of forming limit curve as a function of dependence of larger and smaller main strain in the moment of material destruction, or: $\varepsilon_2 = f(\varepsilon_1)$.
The second approach to the methodology of FLD defining is based on research of direct link between stress state and effective strain. In this case, impact of stress state to the value of limitstrain is taken from the indicators of stress state β. Using the previously mentioned approach, defining FLD is possible exclusively through experimental research and it essentially represents graphical interpretation of functional dependence of effective limit strain from stress state indicators, or: $\varphi_e^f = f(\beta)$.
Monotonous formingmodels for preliminary FLD defining in the bulk forming processes are applied in this paper, where it is relatively easy to determine stress-strain state in the critical zone of working piece forming. In such a way three points of forming limits curve are easily identified: point zero (β = 0, puretorsion) and two points symmetrically placed in relation to ordinate axis (β = +1, axial tension and β = –1, axial upsetting). Experimental verification of this methodology is provided in [8,11], and graphical interpretation on Figure 1.

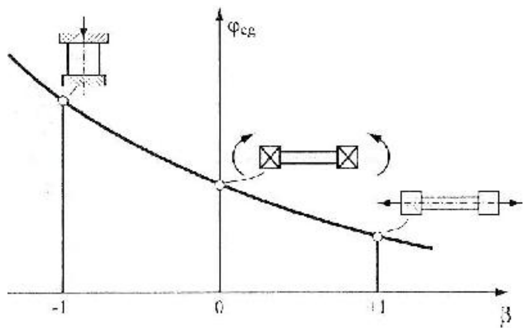

Figure 1. Basic models of forming in FLD [8, 11]

Forming history

Determining the position of base models in FLD is made easier because those are monotonous forming processes. In such cases ß - factor has a constant value during entire period of forming process.
On the other hand, in case of non-monotonous processes we have to consider dependence of effective strain from the indicators of stress state or in other words forming history. For that reason, when wecalculate$ß_{av}$ factor as relevant abscissa coordinate in FLD, we apply Kolmogorov methodology [5]:

$$\beta_{av} = \frac{1}{\varphi_{el}} \int_0^{\varphi_{el}} \beta(\varphi_e) d\varphi_e \tag{3}$$

2.2Identification of stress-strain state in cylinder upsetting processes

In order to define position of models for cylinder upsetting researched in FLD it is necessary to identify stress-strain state in the critical zone of working piece (outer surface and equatorial plane cross-section). In order to solve this problem we applied methodology based on proportionality of stress deviators and strain deviators [8, 11], according to which analytical expressions for determining the stress components are formed (4):

$$\sigma_z = -K\left[1 + \frac{1+2\cdot\alpha}{2+\alpha} + \left(\frac{1+2\cdot\alpha}{2+\alpha}\right)^2\right]^{-\frac{1}{2}} ; \sigma_\theta = \sigma_z\left(\frac{1+2\cdot\alpha}{2+\alpha}\right) \tag{4}$$

where α is a coefficient determined by the relation:

$$\alpha = \frac{d\varphi_\theta}{d\varphi_z} \approx \frac{\varphi_\theta}{\varphi_z} \tag{5}$$

where φ_θ and φ_z are components of logarithm strains in direction of θ and z axis.
Indicator of stress state β and effective strain φ_e on the outer surface of the working piece are determined according to the following expression (6):

$$\beta = \frac{\sigma_r + \sigma_\theta + \sigma_z}{K} = \frac{\sigma_\theta + \sigma_z}{K} \quad ; \quad \varphi_e = \frac{2}{\sqrt{3}} \cdot \sqrt{1+\alpha+\alpha^2} \cdot \varphi_z \tag{6}$$

EXPERIMENTAL RESEARCH

In order to conduct experimental research of influence of stress-strain state to workability of 100Cr6steel in the processes of cold cylinder upsetting, models of cylinder upsetting with flat and hollow plates with and without concentric channels were used. For the practical realization of the experiment were made cylindrical specimens with starting dimensions provided in Table1.

Table 1. Dimensions of specimens

Cylinderupsetting with flat plates			
d_0 [mm]	h_0 [mm]	h_0 / d_0	N_0
20	25	1,25	3 ($FP_{1,2,3}$)
Cylinder upsetting with hollow plates			
d_0 [mm]	h_0 [mm]	h_0 / d_0	N_0
20	35	1,75	3 ($A_{1,2,3}$)
Cylinder upsetting with hollow plates with concentric channels			
d_0 [mm]	h_0 [mm]	h_0 / d_0	N_0
20	35	1,75	3 ($D_{1,2,3}$)

All the cylinder upsetting processes were conducted incrementally, in multiple upsetting phases. Experimental results were processed according to the methodology explained in papers [6, 8, 11], and then entered into the FLD which was previously defined by three basic models. Experimental research was conducted on hydraulic press with tripleaction Sack und Kisseldbach with nominal force 6,3 MN,

installed at the Laboratory for Technology of Plasticity- Institute for Productive Mechanical Engineering Novi Sad, Republic of Serbia.
On Figure 2 is schematic overview of upsetting process, on Figure 3 samples after destruction.

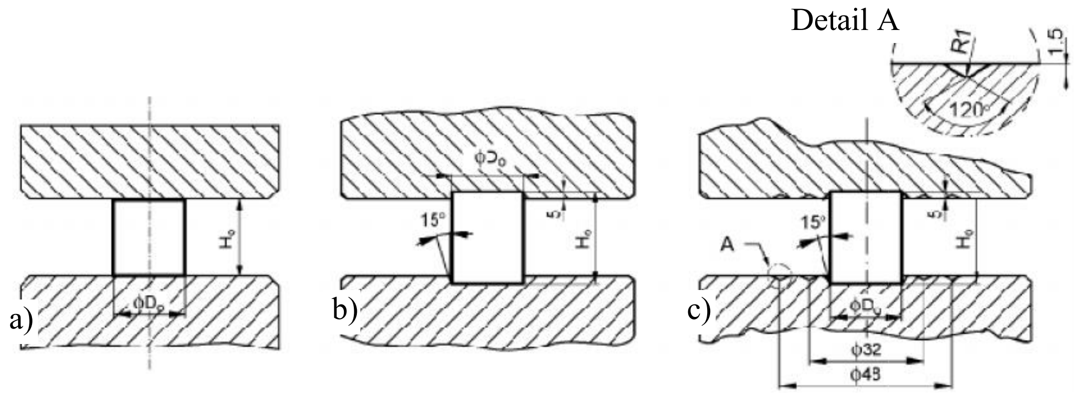

Figure 2.: Schematicoverviewofcylinderupsettingprocess: a) Flat plates, b) Hollow plates, c) Hollow plates with concentric channels

Figure 3. Samples after destruction: a) Flat plates, b) Hollow plates, c) Hollow plates with concentric channels

For the purpose of determining stress-strain state in critical zone, before the upsetting started all the samples were marked with mechanically made thin lines on z_o=4 mm distance on the equatorial plain of free surface. Using the above mentioned expressions (3-6), and based on the measured height of z_i belt and sample diameter d_i in each upsetting phase, it is possible to determine all the elements necessary for construction of FLD [6].
Flow curve is determined by application of Rastegajev methodology and results were approximated with exponential regressive dependence in the following form:

$$K=423,22+657,718\varphi_e^{0,3495}[\text{MPa}] \tag{7}$$

Impact of stress state to workability

Cylinder upsetting processes can be characterized as controlled change in dimensions and shape of work piece that is performed with continuous shift of stress state and working conditions.
Figure 4 shows changes of stress components depending on tool stroke at the place where cracks occur. Impact of stress state to workability is manifested through changes in β-factor in critical forming zone, which actually represents indicator of materials performancein the working system during the process of upsetting the cylinder with different tools.

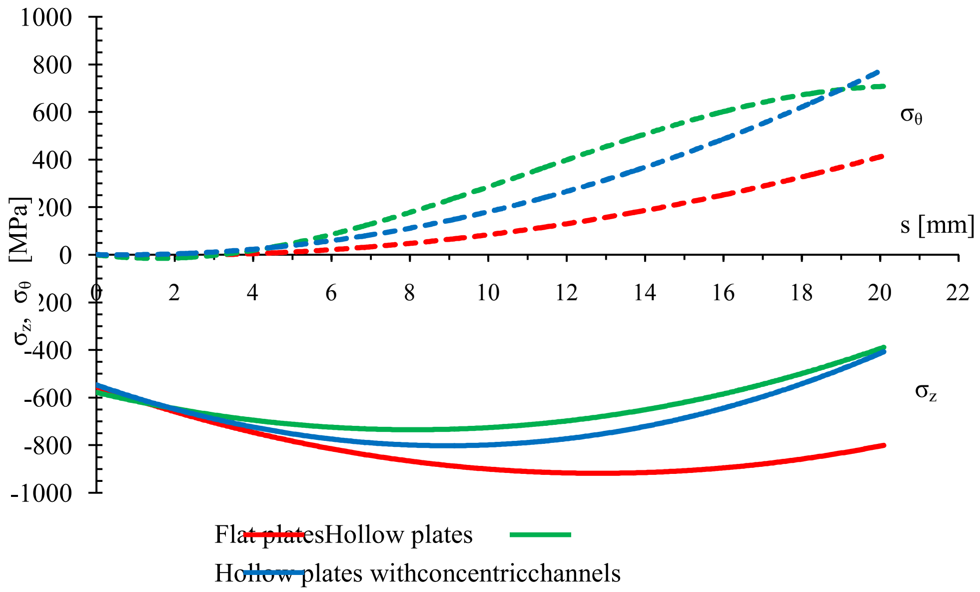

Figure 4. Change in stress components depending on tool stroke

Impact of stress state to workability of materials is experimentally verified for all the models of cylinder upsetting, which had impact on positions of some points in FLD. Results which are presented relate to the set of samples of identical initial dimensions, which eliminates impact of geometry of specimen to stress state in the forming zone.

The highest values of limit strainare achieved with cylinder upsetting with flat plates. Such a result was expected because material flow is opposed only by contact friction.

On the other hand, while upsetting the cylinder with hollow plates, due to indentations on the tool itself, material flow was disrupted in radial direction, which reflected to stress state in the forming zone through enhanced intensity of tension components in the meridian plane of the specimen. Consequence of such stress state is reduced capability of material to form without damage. For that reason valuesfor limits strain are smaller compared to values obtained for cylinder upsetting with flat plates.

The least favorable situation for realized stress state in the forming zone of the specimen from the workability standpoint, and as a result of that the lowest values for limit strain is the one for cylinder upsetting with hollow plates with concentric channels. In the beginning of realization of this process, specimen upsetting realizes identically to the previous case when the specimen in its radial expansion reaches the first out of two existing concentric channels, intensive material flow disruption occurs in the upper and lower plate of the tool. Further specimen forming is somewhat more difficult, additional forming force is needed, and the intensity of tension stress components is enhanced. Final result of such state is worsening of working conditions manifested through reduced workability of materials which is a direct consequence of realized stress state or applied model of cylinder upsetting.

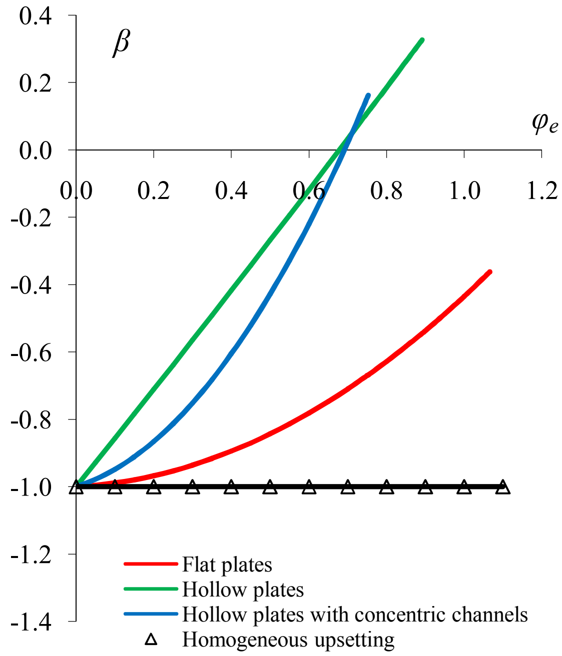

Figure 5. Dependenceβ=f(φ_e)

Findings of the previously conducted analysis fully support changes of indicators of stress stateβ in dependence from effective strain φ_e. Graphical interpretation of this dependence for the used models of cylinder upsetting compared to the process of homogenous upsetting is provided on Figure 5. Results refer to the specimens with the sameinitial dimensions.
Dependence β=f(φ_e) for all the models of cylinder upsetting, except the process of homogenous upsetting, support the general tendency of magnifying β-factors in the course of specimen upsetting. Effects of these changes are the least visible during cylinder upsetting with flat plates, and that resulted in the largest values for limit strain. In other models of cylinder upsetting magnification of indicators of stress state in the course of upsetting is more visible, which influences the value of limit strain.

Forming limit diagram

Starting point for defining the forming limit diagram were basic forming models: free cylinder upsetting, axial tension and pure torsion.
After that mean values of stress state (β_{av}) and limits strain (φ_e^f) were entered into the FLD, and those values were obtained from cylinder upsetting with hollow plates with and without concentric channels. Valuesfrom experimental data for all the forming models which are necessary for FLD construction are provided in Table 2.

Table 2. Limit strains for used forming models

Forming model	Series	β_{av}	φ_e^f
Axial tension	AT Ø10x100 mm	+1,000	0,1290
Pure torsion	PT Ø12x65 mm	0,000	0,4471
Cylinder upsetting with flat plates	FP Ø20x25 mm	-0,7763	1,0658
Cylinder upsetting with hollow plates	A Ø20x35 mm	-0,3448	0,8919
Cylinder upsetting with hollow plates with concentric channels	D Ø20x35 mm	-0,5680	0,7532

Forming history $\beta=f(\varphi_e)$ was determined by regressive analysis, and it has a form of polynomial $\beta=a\varphi_e^2+b\varphi_e+c$ [3]. All the equation couples (β_{av}, φ_e^f) are approximated by exponential regressive dependence in the following form:

$$\varphi_e^f = A \cdot e^{B \cdot \beta} \tag{8}$$

which represents graphical interpretation of dependence of effective limit strain from stress state indicators or FLD on Figure 6. In the above written equation coefficients A and B are determined by method of smallest squares

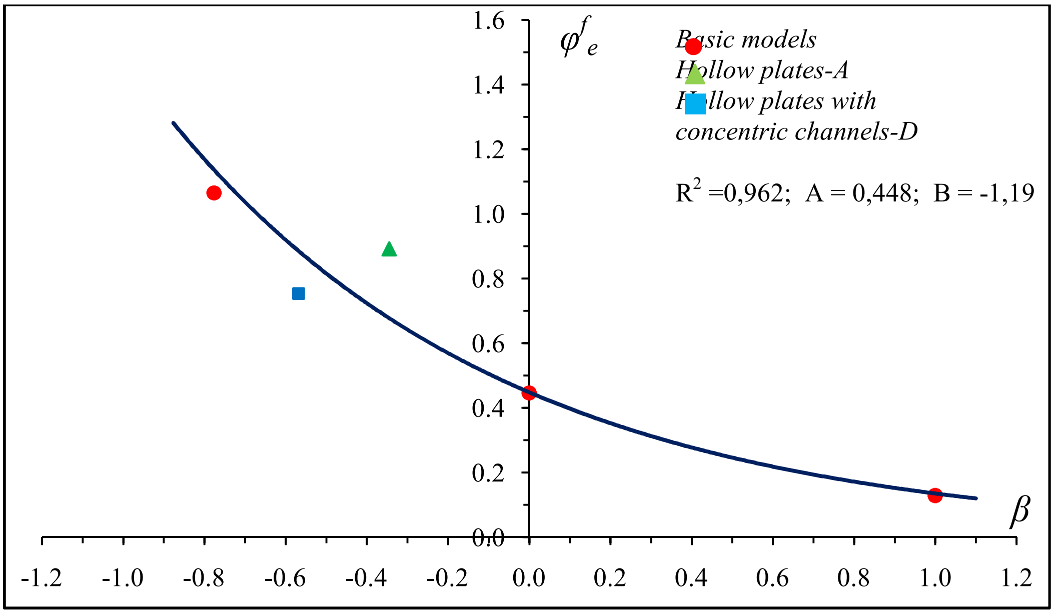

Figure 6. Forming limit diagram for 100Cr6steel

CONCLUSION

Research on material performance in working system from the aspect of achieving maximum amount of limits strain are very significant because they provide starting point for creation of conditions for expansion technology of plasticity which directly influences reduction of material consumption, energy and time which significantly reduces production costs.

Total results of experimental research of 100Cr6steelworkability, obtained through cylinder upsetting with flat and hollow plates with and without concentric channels show high impactof generated stress state in the critical forming zone to the value of limit strain.

In that regard, due to the reduced value of tension component of stress in the forming zone, higher workability was achieved with cylinder upsetting with flat plates (for 16.32%), opposed to cylinder upsetting with hollow plates with concentric channels (for 29.33%).

These results can be used in practice in designing cold forging technologies, for cold extrusion, cold thread rolling and gear rolling, ring rolling and so on.

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CHEMICAL REDUCTION OF CAHs BY DIFFERENT ZEROVALENT IRON PARTICLES

Velimirovic, M.[1,2], Simons, Q.[1], Bastiaens, L.[1]
[1] Flemish Institute for Technological Research (VITO), Mol, Belgium
[2] University of Antwerp, Department of Bio-Engineering, Antwerp, Belgium
E-mail: milica.velimirovic@vito.be

Abstract: This lab-scale study presents the reactivity of different zerovalent iron (ZVI) particles with respect to chlorinated aliphatic hydrocarbons (CAHs) for in-situ remediation applications. Batch experiments were carried out to study degradation rates of CAHs from simulated groundwater. Twenty-five different commercially available and new fine Fe-based materials were tested for their degradation potential towards different chlorinated compounds: perchlorethylene (PCE), trichloroethylene (TCE), cis-dichloroethylene (cDCE) and 1,1,1 trichloroethane (1,1,1 TCA).Tests were comprised nanoscale zero-valent irons (nZVI), microscale zero-valent irons and fine iron-sulfides supplied by different suppliers. FeS were produced at VITO using sulfate reducing bacteria cultures. Granular ZVI was included in the tests as a reference material. Degradation intermediates cDCE, VC, 1,1 DCA were also analyzed. Dechlorination rates of tested irons were also calculated using the pseudo-first order rate equation. After 15 weeks of experiment the results have shown that the fastest reduction rates were by nZVI. Several new produced mZVIs were capable for PCE, TCE, cDCE and 111-TCA removal of > 90%. 2 micro scale irons were showed sorption tendency. Iron sulfides showed slow degradation of PCE and 111-TCA. On the basis of the results from the batch degradation studies, promising reactive materials were selected for a more detailed characterization and evaluation for in-situ remediation applications.
Key words:zerovalent iron, CAHs remediation

INTRODUCTION

Last decades remediation of groundwater polluted with chlorinated aliphatic hydrocarbons (CAHs) has been studied by many research groups in the world. CAHs also represent a class of dense non-aqueous-phase liquid (DNAPL) contaminants in groundwater and soil. DNAPLs are one of the major environmental problem in the industrialized countries because they are difficult to remediate [1]. Chlorinated aliphatic hydrocarbons such as perchlorethylene (PCE), trichloroethylene (TCE), cis-dichloroethylene (cDCE) and 1,1,1 trichloroethane (111-TCA) were mainly used in dry cleaning and metal degreasing processes and represent the most frequently detected groundwater contaminants in industrialized countries [2]. One of the reason why research in this field is very active, is that remediation of a site contaminated by CAHs is a difficult and time consuming process [3].
The use of granular zerovalent iron for in-situ remediation of groundwater contaminated with chlorinated solvents is a proven technology [4, 5, 6]. Chlorinated aliphatic hydrocarbons (CAHs)can be degraded abiotically by reductive dehalogenation in the presence of zerovalent metals:

$$Fe^0 + RCl + H^+ \longrightarrow Fe^{2+} + RH + Cl^- \qquad (1)$$

One of the main side reactions that occur in the ground water is anaerobic corrosion:

$$Fe^0 + 2H_2O \longrightarrow Fe^{2+} + H_2 + 2\,OH^- \qquad (2)$$

The anaerobic corrosion is strongly dependent on the pH. At a high pH the corrosion almost ceases, whereas at a very low pH the corrosion is very rapid.
Up to now, ZVI has been mostly emplaced into the subsurface in granular form to create permeable reactive barriers or funnel and gate systems [6], restricting the application to the plume area. The last years microscale [7] and also nano-sized (< 100 nm) (bi)metallic particles [8] are gaining increasing interest as these materials have been found to be more reactive towards a variety of pollutants including also chlorinated ethenes [9] and chlorinated ethanes [10]. In contrast with granular, micro/nano iron particles are injectable and more mobile in the subsurface [11]. This implies that these fine particles can migrate to some extent in the subsurface along with the groundwater. Up to now, however, it remains difficult to predict and verify the injection radius.

Although applications of injectable zerovalent iron particles are already available on the market, there are still major uncertainties about the application. Most research is focused on nanoparticles because of their extreme reactivity. It concerns mainly laboratory scale tests, although during the last years the number of field applications increased [12, 13]. In comparison with nano-sized particles, micro scale zerovalent iron particles are less expensive, more stable, do have a longer lifetime and pose less risk for human health. Microparticles of iron are used widespread in the food industry, i.e. likely to be less risky. On the other hand micro scale particles are less reactive than well suspended nanoparticles.
The general aim of this study was to find reactive Fe-based microscale particles (100 nm < d < 100 μm) for efficient CAHs degradation and compare their reactivity to the nano-scale zerovalent iron particles (< 100 nm).

MATERIALS AND METHODS

Batch dechlorination tests

The injectable Fe-based materials that are considered in this study are reducing materials, being zero-valent iron and iron sulfides. Based on grain size, specific surface area and the composition of the material 25 different iron materials were selected. The particles considered in the screening tests are:

- mZVI1-mZVI19;
- nZVI1-nZVI2;
- gZVI1;
- FeS1 – FeS3.

To investigate reactivity of original materials towards CAHs mixture lab-scale batch tests were done as is described by Bastiaens et al. [14]. Simulated groundwater for batch tests consisted of MilliQ water containing 0.5 mM $CaCl_2.2H_2O$ and 0.5 mM $MgCl_2.6H_2O$. After deoxygenating by flushing with nitrogen gas 0.5 mM $NaHCO_3$ and 0.5 mM $KHCO_3$ were added. In anaerobic conditions the pH was set at 7.0 and simulated groundwater was spiked with approximately 5 mg/l of PCE, 5 mg/l of TCE, 5 mg/l of cDCE and 5 mg/l of 111-TCA.
Batch tests were prepared in a 160 ml glass vials with butyl/PFTE grey septum containing 5 g of ZVI (0.5 g for nZVI) and 100ml of anaerobic simulated groundwater, leaving a 60 ml headspace. Control conditions were set up following the same procedure but in the absence of ZVI particles.
The experiments were set up under anaerobic conditions and in triplicate, and were incubated (shaking) at groundwater temperature (12 ^{0}C). Remaining concentrations of CAHs, ethane, ethane, acetylene were measured at the start (only blank) and after 14, 28, 49 and 105 days (3, 6, 8 and 22 days for nZVIs).
At each time point mass balances were made on molar basis (PCE + TCE + cDCE + VC + 111-TCA + 1,1 DCA + acetylene + ethene + ethane) to determine whether sorption occurred.
After reactivity tests dechlorination rates of irons were calculated using the pseudo-first order rate equation:

$$C = C_0 \cdot e^{-kt} \tag{3}$$

with C the concentration at any time, C_0 initial concentration, k the first order decay constant (day^{-1}) and t the reaction time (days). Half-lives were calculated as

$$t1/2 = \ln 2/k \tag{4}$$

Chemical analyses

Concentrations of CAHs, ethene, ethane and acetylene were determined via headspace measurements using a Varian GC-FID (CP-3800) equipped with a Rt-U plot column for the detection of ethene, ethane and acethylene or a split-splitless injector followed by a Rt-X column (Restek) and a DB-1 column (J&W Scientific) for analysis of CAHs. At each sampling time point the redox potential (ORP) and pH were measured using a redox/pH meter (Radiometer).

RESULTS AND DISCUSSION

The main idea of batch experiments was to chemically reduce different CAHs concentrations and compare degradation properties of the commercially available ZVIs and newly produced mZVIs. In the first screening test different ZVI particles were applied to remove PCE, TCE, cDCE and 1,1,1 TCA mixture from batch reactors. The degradation efficiency of different irons towards CAHs is given in Table 1.

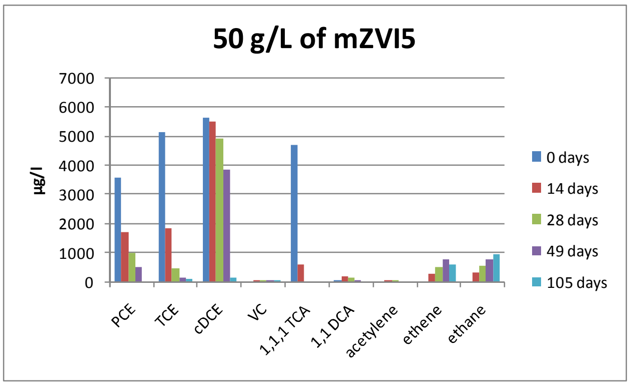
In this study selected different ZVIs showed a wide spectrum of reactivity towards CAHs. The CAHs degradation presented in Table 1 show that 111-TCA was one of the most reactive compounds degraded by the most of examined irons. According to not shown data 111-TCA was rapidly degraded and this can be due to differences in bond strength (sp2 > sp3) [15]. The most of examined irons showed the slowest degradation towards cDCE. This can be explained by β-elimination with minor hydrogenolysis of PCE and TCE and cDCE as by-product [16]. The final degradation products were 1,1-DCA, ethene (reactive intermediate mainly transformed to ethane) and ethane, which is in line with the reported degradation pathways [16]. VC as intermediate product did not increase significantly. During the batch experiments drastic decreases in ORP and elevated pH were observed, as expected. The pH increased from near neutral to approximately pH 10 due to proton consumption by reductive dechlorination and anaerobic corrosion [17].

According to presented data new produced irons mZVI2 and mZVI10 showed not any or a limited reactivity toward PCE, TCE, cDCE and 111-TCA, while the fastest reduction rate was for nZVI1. Further, the reactivity tests results led to the particles capable for PCE, TCE, cDCE and 111-TCA removal of > 90% being: mZVI1, mZVI5, mZVI6, mZVI9, mZVI15 and nZVI1. Figure 1 shows the time course of the CAHs concentrations and breakdown products degraded by mZVI5 and nZVI1. Microscale particles mZVI12 and mZVI13 showed mainly sorption tendency what was concluded from calculated mass balances (results not shown). Interestingly, FeS2 realized a slow degradation of PCE and 111-TCA after 15 weeks. FeS3 was not reactive toward studied CAHs. Commercial FeS is capable for PCE, TCE and 1,1,1 TCA degradation, but not for cDCE degradation.

Table 1. CAH mother products degradation by different ZVI particles after 105 days of experiment (granular, micro-scale particles and FeS) and after 22 days (nZVI)

	% of degradation			
	PCE	TCE	cDCE	111-TCA
Granular particles (50 g/L)				
gZVI1	97	100	42	100
Micro-scale ZVI particles (50 g/L)				
mZVI1	100	100	100	100
mZVI2	31	25	16	19
mZVI3	70	78	52	100
mZVI4	98	98	51	100
mZVI5	100	98	98	100
mZVI6	97	99	90	100
mZVI7	91	99	65	100
mZVI8	96	99	42	100
mZVI9	98	100	100	100
mZVI10	9	5	3	4
mZVI11	88	51	30	46
mZVI12	100	100	100	100
mZVI13	100	99	87	98
mZVI14	95	100	45	100
mZVI15	100	100	99	100
mZVI16	69	8	1	100
mZVI17	79	61	34	100
mZVI18	30	24	21	100

mZVI19	100	100	88	100
FeS (50 g/L)				
FeS1 Commercial FeS	100	98	20	100
FeS2 Biogenic FeS	37	26	16	62
FeS3 Biogenic FeS	25	16	6	28
Nano scale particles (5 g/L)				
nZVI1 (Nanofer25S, NANOIRON)	100	100	100	100
nZVI2 (ANIP, TODA)	97	99	33	100



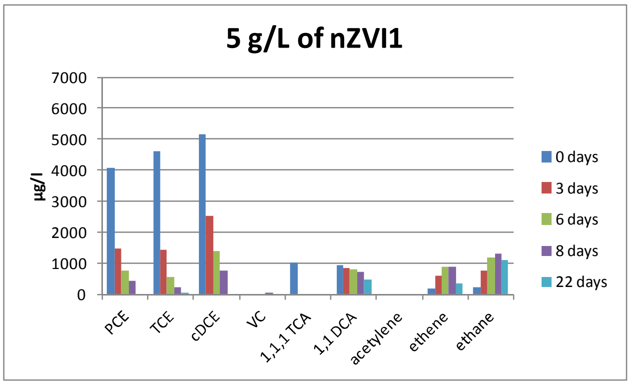


Figure 1. Evaluation of the CAHs concentrations and breakdown products with time (days) for promising materials – batch screening tests

Reactivity tests results were shown that both mZVI and nZVI particles could be used for degradation of CAHs in injection wells. Half-life time of PCE, TCE, cDCE and 111-TCA for ZVIs (data not shown) mostly confirmed iron efficiency data presented in this paper.

CONCLUSION

During the lab-scale study different iron materials with regard to their reactivity towards mixture of CAHs were examined. In this study mZVI and nZVI particles showed different reactivity towards different pollutants. Further, this lab-scale study demonstrated that mZVI in the aspect of reactivity could be used for in situ remediation of CAHs. Comparing to nanoscale iron particles, microscale iron particles are less reactive, but still cheaper, more available, easier to handle and with a longer life time.
On the basis of the batch studies results promising reactive materials being mZVI5, mZVI19 and nZVI1 were selected for a more detailed characterization and evaluation for in-situ remediation applications.

ACKNOWLEDGMENTS

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THE INFLUENCE OF SURFACE COATINGS ON THE WEAR OF POLYAMIDE GEARS

Petrov D. G. [1], Dearn K. D. [2], Walton D. [2], Banks R. [3]
[1]TechnicalUniversity of Sofia - Plovdiv branch, Plovdiv 4000, Bulgaria
Department of Mechanical and Instrument Engineering
[2]School of Mechanical Engineering, University of Birmingham,
BirminghamB15 2TT,United Kingdom
[3]Indestructible Paint Limited,19-25 Pentos Drive, Sparkhill
Birmingham, B11 3TA, United Kingdom
E-mail: dimgog@abv.bg

Abstract: In an attempt to investigate the influence of surface coatings on dry running polymer gear wear a number of gears were coated with what was considered to be suitable candidate materials. All the coated gears were made from nylon (PA 6/6) and the coatings were either MoS_2, graphite, boron nitride or PTFE. Tests were carried on coated/coated gears running against themselves, coated gears running against a steel counterpart and coated gears running against uncoated gears. Weight loss and running (mesh) temperatures were recorded.
All the coated/coated tests showed that the coatings reduced wear, with PTFE coated gears showing very considerable less wear than any of the other coated gears. Mesh temperatures showed that the lower the temperature the less the wear, with the PTFE gears running at almost half the temperature of the uncoated gears. Coated gears running against steel gears showed that again, the best coating was PTFE, although the wear was higher than for coated/coated gears. For two of the coatings (MoS_2 and boron nitride) the wear was higher than for uncoated gears. Temperatures for the PTFE coated gears were around half the temperatures of uncoated, MoS_2 and boron nitride gears with the temperatures of the graphite gears falling between the two. For coated gears running against uncoated gears PTFE gears showed the least wear. All the other coatings showed more or less the same wear which was lower than for uncoated gears. The wear for PTFE/PTFE gears was considerably less than for PTFE running against an uncoated gear. In all but one test instead of wear the teeth fractured. None of the gears failed by a loss of adhesion between the coating and the substrate or the substrate and the base polymer.
Key words: Wear, polymer gears, coatings, MoS_2, graphite, boron nitride, PTFE, temperatures

INTRODUCTION

Polymer gears are used in numerous applications where their low cost (when injection moulded), light weight and resilience are beneficial. A major benefit, over metal gears, is their ability to operate under dry, unlubricated, conditions in such applications as office machines, food mixers and cash point dispensers. In these types of applications the gears are essentially motion devices where the transmissible loads and running speeds are low. Polymer gears were first introduced around forty years ago, but in more recent times developments in materials and gear geometry have enabled designers to use polymer gears in more demanding applications. As an example, dry running polymer gears have been operated at 3.15 kW.
In an attempt to increase the transmissible power levels still higher problems of surface temperatures arise due to the frictional losses between mating gear teeth. This paper examines the influence of surface coatings, designed to reduce friction, and reports on the wear and temperatures of nylon (PA 6/6) gears coated with Molybdenum disulfide (MoS_2), graphite, boron nitride and PTFE and compares the wear with uncoated gears. As polymer gears are frequently run against a steel gear, coated polymer gears running with steel were also tested. The results described below were based on a pilot study of the influence of coatings on gear wear.

POLYMER GEAR FAILURES

Polymer gears may fail in a variety of ways, the most common of which are thermal related tooth failures, tooth root and pitch point fatigue. The most common failure however, is wear which has been extensively reported and even modelled [1-6]. Wear will take place along the whole length of the tooth flank but the wear is not uniform along this length. Figure 1 shows a heavily worn gear made from PA6/6, even in this condition the gears were still operating but to the right hand side of the gear can be seen the thermal failure which eventually terminated the test. Wear is normally plotted against either running time, or, more usually, against the test duration measured in cycles. The curves show that the initial wear is high as the gears bed-in [1-2]. At moderate loads the wear rate becomes more or less linear after the initial wear until eventually the wear rate increases again leading to eventual destruction. At very high loads the wear rate exhibits no gradual, linear wear but increases rapidly, the gears lasting for only a short period. The high wear rate leads to high surface temperatures resulting in the gear flanks melting and rapid failure.

Figure 1. A nylon gear having failed by gross wear and thermal melting

Various authors have investigated different parameters thought to influence wear. Akkurt [7] examined the effect of surface roughness of steel gears running against polymer (acetal) gears and found that the wear rates and the type of wear were influenced by surface roughness of the metal counterface. Friedrich et al [8] looked at the effects of steel counterface roughness on the friction and wear of PEEK and reinforced PEEK. He found that roughness effects were more pronounced in non-reinforced PEEK than in fibre filled versions. The incorporation of carbon fibres proved to be more beneficial than glass fibres with respect to both friction and wear. An increase in testing temperature resulted in higher specific wear rates. The composition with the highest resistance to wear at elevated temperatures was a PEEK version containing 15% (by weight) of PTFE and 15% graphite lubricant. Rao et el [9] using a twin disc rolling-sliding test rig looked at the effect of PTFE as an internal lubricant on the friction and wear of filled and unfilled PA6/6 and polyacetal. The experimental results showed that the friction and wear performance of the PTFE filled polymers was superior to those of the unfilled polymers. In addition the surface cracking that was found in unfilled PA6/6 and was thought to be responsible for premature fracture of components such as gear teeth was suppressed by the PTFE which, by reducing friction, inhibited crack formation.

COATING POLYMERS

Two candidate coating types were proposed for initial evaluation. A 2 part epoxy system and a stoving epoxy system. The candidate coating types are marketed for use in Aerospace applications for use on a variety of metallic and polymeric substrates. The coatings were proposed based on results from R&D evaluations and current commercially available Dry Film Lubricants that utilize these materials as their primary binder. The two candidate systems were evaluated over substrate samples supplied by Birmingham Uni. The test polymers and adhesion results are shown below:

Table 1. A table showing the the test polymers and adhesion results

Polymer type	Coating / drying schedule	Substrate preparation	Result
Nylon 6-6	2pk epoxy / 80C 60 minutes	Solvent degrease	Fail
		Grit Blast	Pass
	Stoving epoxy / 190C one hour	Solvent degrease	Pass
		Grit Blast	Pass

The grit blasting shown in the table uses a 12/220 Aluminium Oxide grit to remove substrate surface contamination leaving a finely abraded surface that helps to promote coating adhesion. No wet cleaning procedures were applied to the samples following blasting; any dust residue was removed by compressed air blow off prior to coating. This process is the default substrate preparation used for coating evaluations at Indestructible Paint.
The substrate preparation used for the initial sample evaluations was adopted for use when preparing and coating the final test specimens.

Solid Particle Dry Film Lubricant (DFL) Selection

The four commercially available solid particle DFL's selected for evaluation are materials that find application in dry film lubricants for Aerospace applications. The four test materials are listed below:

1. Molybdenum Disulphide
2. Graphite Flake
3. Boron Nitride (hexagonal)
4. PTFE powder

Coating Application

All coating application was performed by hand spraying using a conventional air atomizing spray gun at an ambient temperature of 16-18°C. All application was performed in the Indestructible Paint QC laboratory using a filtered air supply compliant with current practices.

Coating Curing Schedule

- 10 minutes flash off at 16-18°C following spraying
- 1 hour @ 190°C, laboratory air circulating oven
- Cool specimens and de-mask prior to visual examination to ensure no contaminants are present in the dry film

Coating Composition

The table 2 shows the density, percentage (%) by weight of DFL and percentage (%) by volume of DFL within the dry film for the four test coatings.

Table 2. Characteristics of DFL

DFL type	Density g/ml	Percentage (%) DFL by weight (g)	Percentage (%) DFL by volume (ml)
Molybdenum Disulphide	1.56	47	11.6
Graphite	1.39	43	22
Boron Nitride	1.38	43	22.7
PTFE	1.39	46.9	25.3

The DFL loading used for each composition was based on coating compositions currently used within Aerospace applications.
The % of dry film lubricant per coating will be a theoretical calculation based on the densities of the raw materials for each coating provided by Indestructible Paints raw material suppliers.

Measured coating thicknesses were, for MoS_2 0.06 mm, for graphite 0.07 mm, for boron nitride 0.1 mm and for PTFE 0.05 mm. These are average thicknesses as the coating layer was not uniform along the flank of the gear teeth, being thicker at the base of the tooth than at the tip.

TEST RIG

Fig. 2 shows the test rig used for all the tests. It is a closed loop rig designed specifically for testing polymer gears and is described in [2]. When using a closed loop system the torque is normally wound-in but for plastic gears wear and tooth deformations would mean that the torque would change (reduce) with time. Using a pivot block and load arm to load the gears ensured that the test gears were subjected to a constant load throughout the test. Temperatures were measured using non-contacting infra-red thermocouples and the data stored on a computer. Three of these thermocouples can be seen in Fig. 2 facing the test gears- the centre probe measured the mesh temperature. Much of the test rig (electric motor, master gearbox and drive shafts to the pivot block) shown in Fig.2 is covered by an acoustic box. The acoustic box was used as the noise of the test gears was recorded for future use.

Figure 2. The closed loop test rig which was used for all the tests.

WEAR AND TEMPERATURE RESULTS

Fig. 3 shows the wear for an uncoated PA6/6 gear pair together with nylon gears (both pinion and wheel) coated with MoS_2, graphite, Boron Nitride and PTFE against the number of running cycles. The wear was measured by measuring the weight loss after a number of cycles. The gears were removed each time the weighing took place. A non-running control gear was mounted on the pivot block assembly (see Fig. 2) and the weight of this gear was measured so that any moisture either absorbed or released from the nylon gears could be added or subtracted from the test gear measurements. Wear is shown by the percentage relative weight loss, ie the original gear weight minus the weight of the worn gear after a number of cycles all divided by the original weight. Note that each point on the graph represents the average of the pinion and wheel weight losses. All the gears tested were to a common benchmark geometry, namely 30 teeth, module 2mm, 200 pressure angle with a face width of 17.4 mm. All the gears tested were loaded to a torque of 7 Nm, running at 1500 revs/min. Note that 1500 revs/min is a relatively high speed for unlubricated polymer gears, but at this speed around 2.5 million cycles could be achieved in a week of continuous running.

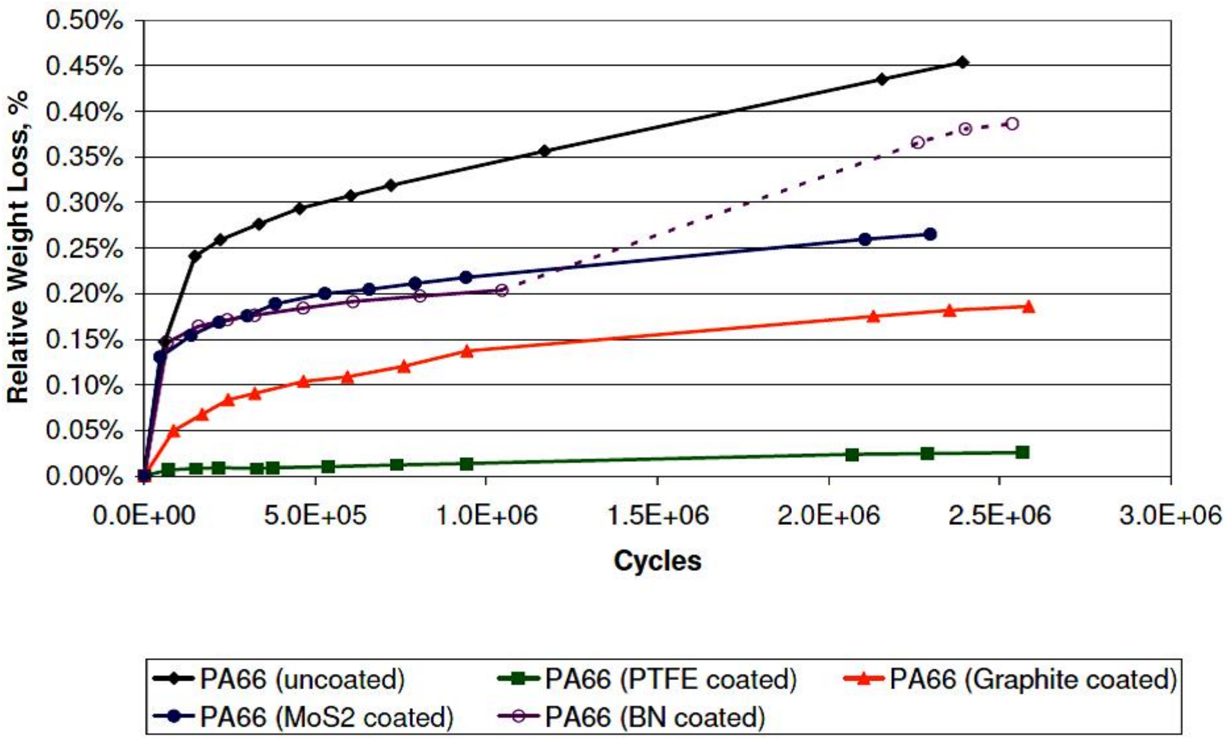

Figure 3. The relative wear of coated or uncoated (both pinion and wheel) gears.

Fig. 4 shows the temperatures of these gears, where the temperatures were measured at the point of mesh.

Fig. 5 shows the relative weight loss for coated and uncoated polymer gears running against a steel gear.

Fig. 6 shows the temperatures of the gears shown in Fig. 5.

Fig. 7 shows the wear of coated gears running against uncoated gears and Fig.8 shows the running temperatures for the gears shown in Fig. 7.

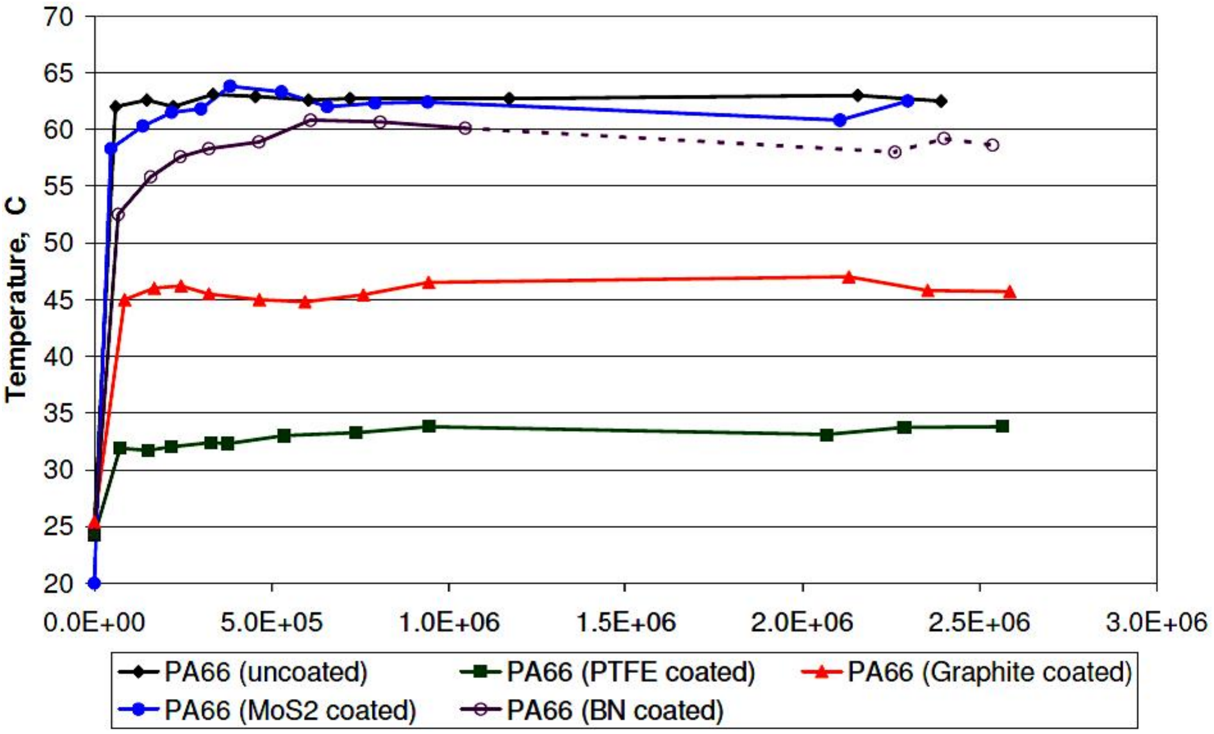

Figure 4. The temperatures at meshing point of the gears shown in Fig. 3

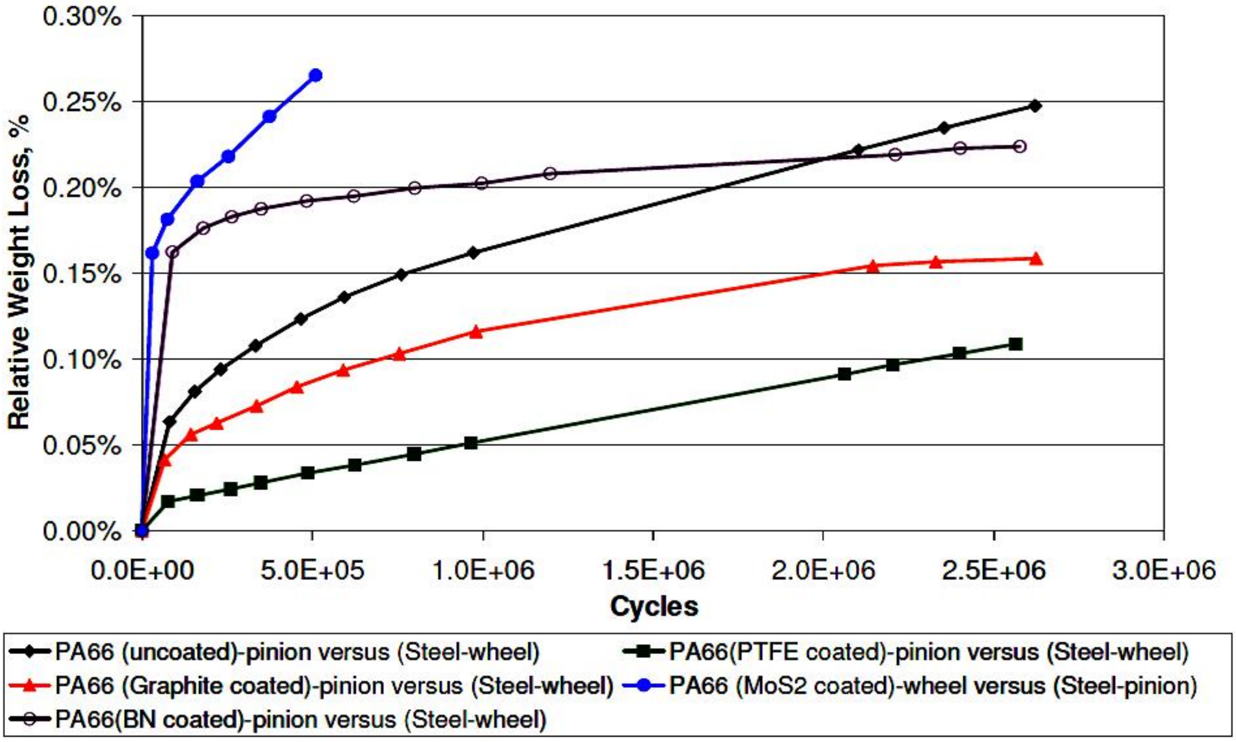

Figure 5. The relative wear for coated and uncoated gears running against a steel gear.

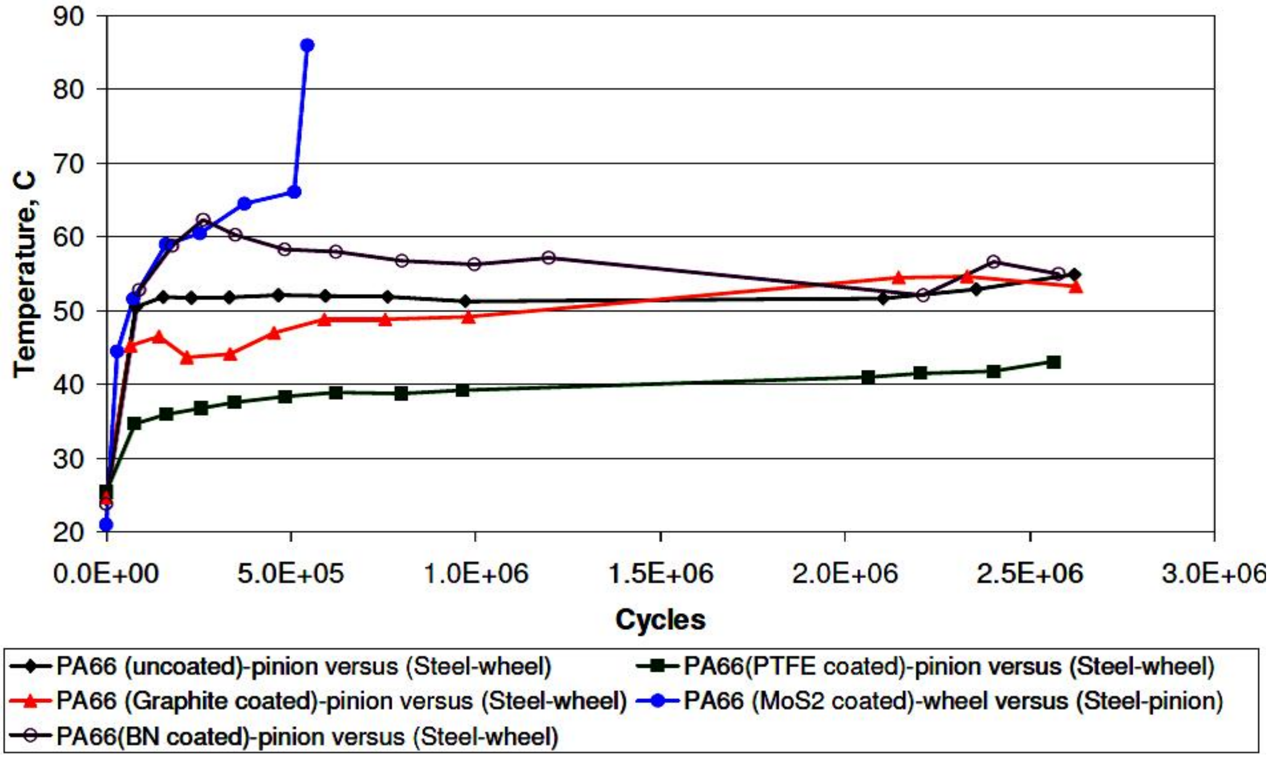

Figure 6. The temperatures for the gears shown in Fig. 5.

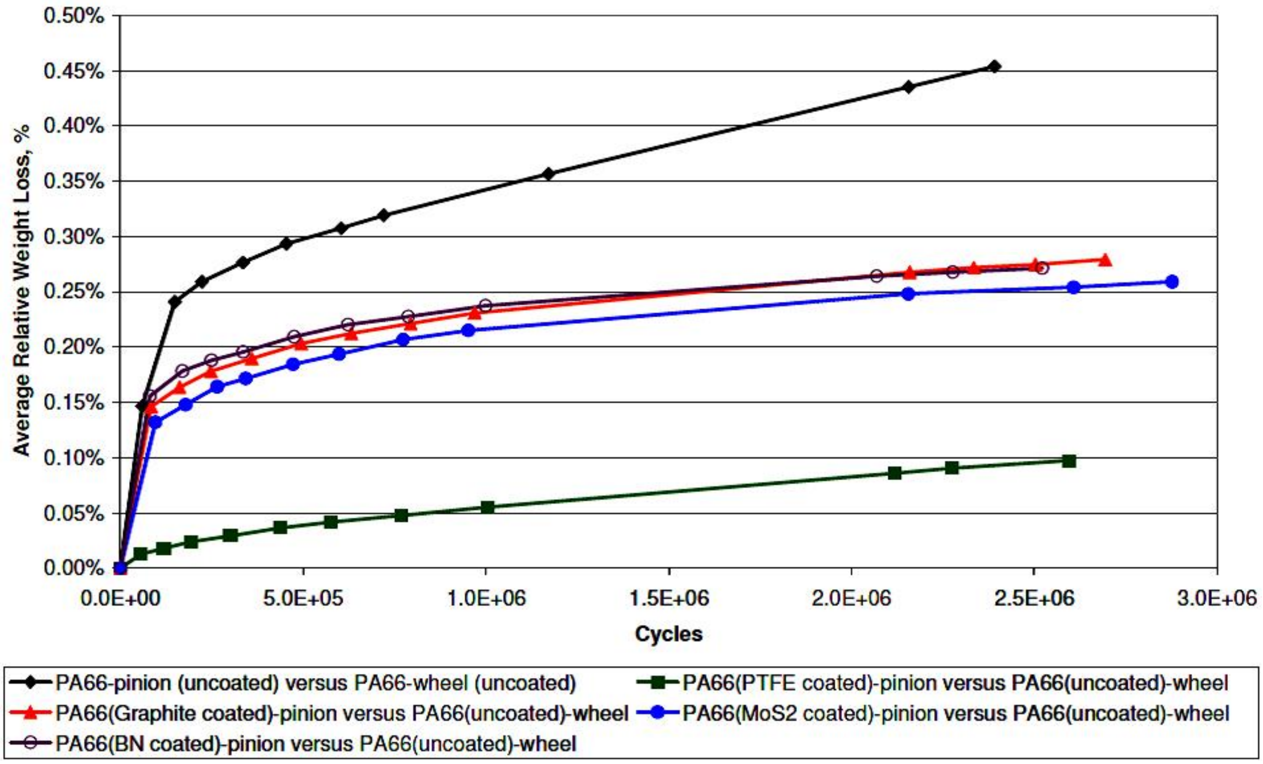

Figure 7.Coated gears running against uncoated gears.

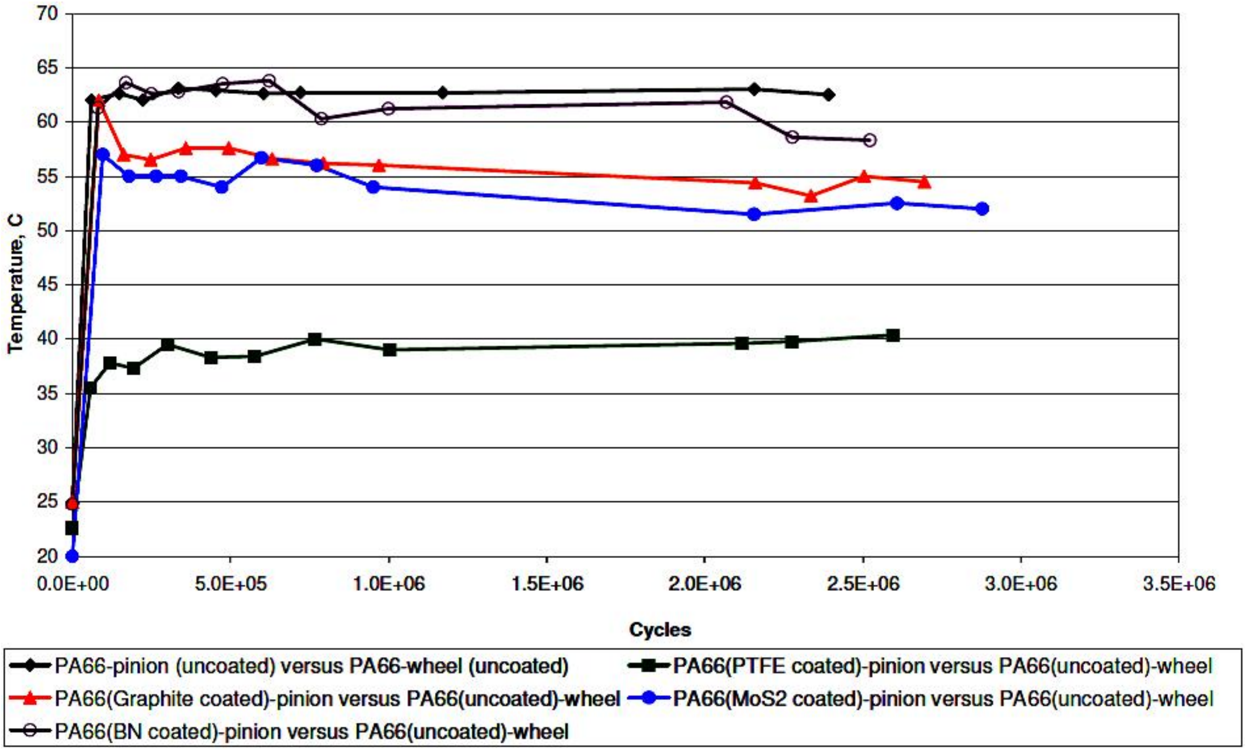

Figure 8. Running temperatures for the gears shown in Fig. 7

DISCUSSION OF RESULTS

The curves shown in Fig. 3 all exhibit the characteristic shape of polymer gear wear, namely a high initial wear rate followed by a period of linear wear. The tests were stopped before the wear rate would again have increased towards the end of the gears' life. All the results for coated gears showed superior performance compared to the uncoated gears. The best performance were for PTFE coated gears, graphite coated gears were the next best, with MoS_2 and boron nitride gears showing more or less similar performances. Part of the curve for the Boron nitride coated gears is discontinuous. This is because on one test the gear teeth failed by fracture. The temperatures of these gears, shown in Fig. 4, show that the lowest temperatures were reached by the PTFE coated gears. Graphite coated gears were running at about 10°C hotter and the MoS_2 and uncoated gears were running at almost equal temperatures but at almost twice the temperature of the PTFE coated gears. These results show the correlation between wear and running temperatures. The frictional looses for coated gears reported here would be less than for uncoated gears.

Fig. 5 shows the wear of coated and uncoated gears running against steel. PTFE coated gears showed the least wear, followed by graphite. The uncoated gear result showed higher wear but lower than for the gears coated with MoS_2 and, in the main, the boron nitride gears. The running temperatures of the PTFE gears were considerably cooler than for any of the other gears. Of interest is that the temperatures, Fig. 6 of all of the other gears, including uncoated gears all more or less converged after around a million cycles. At around half a million cycles the MoS_2 gear temperature rose dramatically. The wear rates for all the steel/polymer combinations showed markedly higher wear rates than for the coated/coated gear tests. Temperatures for the steel/polymer combinations were generally lower than for polymer/polymer combinations, possibly due to the high thermal conductivity of the steel gear.

For the coated gears running against uncoated gears, Fig. 7 the results showed that the PTFE coated gears performed best with all the other coated gear pairs showing much higher wear and with boron nitride, MoS_2 and graphite gears all exhibiting more or less the same wear. The uncoated gears showed the highest wear levels. Temperatures for the PTFE coated gears showed higher levels than for the coated/coated gears, Fig. 8.

CONCLUSION

- The results of the tests showed that coating polymer gears with a material designed to reduce friction resulted in less wear than for uncoated gears.
- Mesh temperatures were seen to relate with wear, the lower the wear the lower the temperature.
- In general the best results were obtained from running similar coatings together, but the benefits of running coated gears against a steel counterpart and running coated against uncoated gears could also be seen.
- In all cases PTFE coated gears performed the best, followed by graphite coated gears.
- All the coated gears survived the tests without the coatings separating from the substrate or the substrate and base polymer.
- All the tests described were carried out at one speed and load. Further work needs to be carried out exploring a range of loads and speeds as well as examining the influence of different base polymers.
- The influence of steel gear surface roughness would need to included in a longer term project.

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JUSTIFICATION OF UTILIZATION OF SOLAR DRYERS AND SELECTING THE RIGHT TECHNOLOGY CHOICES

Topić, R.,[1] Ćuprić, N[2]. Topić, J.[3]
[1]University of Belgrade, Faculty of Mechanical Engineering,
[2]University of Belgrade, Faculty of Forestry,
[3]Certified designer, Energoprojekt, Belgrade,
E-mail: rtopic@mas.bg.ac.rs

Abstract: This paper presents a classification and review of characteristic solar dryer constructions from different aspects: their advantages and disadvantages, comparison with classical convective dryers, selecting the right technology and construction, applied construction materials and knowledge required for an adequate solution.
Key words: Solar dryer, Active and passive dryers, Direct and indirect dryers

INTRODUCTION

It is estimated that 12 % of the total energy used by industry, belongs to drying processes. Reduction of this share could contribute to lower CO_2 emission, which can be obtained by upgrading existing drying technologies and developing and implementing new ones. The mechanical moisture extraction process, vortex drying, impulse drying, usage of heat pumps and overheated steam as a drying agent, could considerably contribute to the reduction of energy needed for the drying process. Usage of overheated steam as a drying agent enables lower energy consumption in the drying process. Steam recompression in the drying process enables reduction of energy usage of the device per 1 kg of evaporated steam.
One possibility is usage of a high temperature drying process and matching drying processes within wider technology processes. Greater implementation of technologies based on the first moisture extraction principle (mechanical, sorption, osmotic, electro osmotic, etc.) would be of significance.
During and after harvesting, most products contain more moisture than is necessary for long term storage, and this is extremely unfavorably as most of microorganisms intensively grow in moisture and warm ambient conditions. Meanwhile products are not dried to an “absolutely dry material” state, because they are hydroscopic, but they are dried in accordance with the drying process static, to a conditional humidity state for given conditions. At the same time, a minimal relative humidity level exists, under which development of harmful microorganisms stop. During a drying process, humidity has to decrease below the minimal level needed for microorganisms’ development.
The drying process makes products more stable for safe long term storage, especially in food production. Safe storage means storage conditions which prevent possibilities for mold and microorganism development.
Possible losses caused by microorganisms are:

- Reduction of seeds germination ability,
- Loss of products color, reducing product value in different applications,
- Development of mold and the other unwanted smells and tastes,
- Unwanted chemical changes which devastate product utilization or suitability for further processing,
- Formation of toxic substances, some of which can be dangerous if they are consumed,
- Total product spoilage (decay) followed by heating, which sometimes can cause spontaneous auto-ignition of stored products.

The working principle of direct or indirect, passive or active solar dryers is heating air by solar radiation, then used as a drying agent, and is brought into contact with the material being dried. Heated air as a drying agent has lower relative humidity, enabling it to accept higher amounts of moisture. The drying agent removes moisture from a dryer, evaporating from a wet drying material.
In determining which type of dryer will be the most appropriate for a given purpose, it is necessary to perform an analysis of relevant factors.

MATERIAL AND METHODS

Classification .of solar dryers

From the aspect of capacity solar dryers are classified as [1]:

- small capacity solar dryers
- medium capacity solar dryers
- large capacity solar dryers

Small capacity solar dryers are devices which can dry up to 150 kg of dried products per month. Large capacity solar dryers can dry up to 4500 kg or more dried products per month. These values of obtained capacity are related to solar drying in temperate climate regions.

Solar dryers are also classified in accordance with the way the drying agent flows:

- Solar dryers with a natural flow – passive dryers, and
- Solar dryers with a forced flow – active dryers.

Passive solar dryers can be further classified as:

- Solar radiation, direct,
- Solar indirect

In direct solar radiation dryers, the drying material is directly exposed to solar radiation.

In indirect passive solar dryers solar radiation does not act directly on the material being dried.

Fig. 1 gives a schematic view of the classification of solar dryers [2].

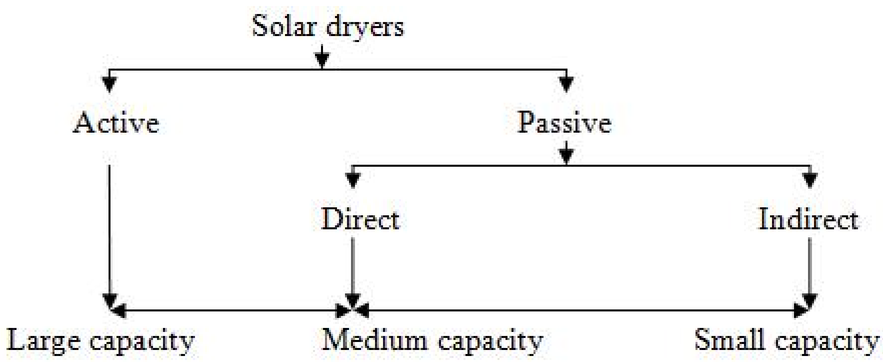

Figure1. Classification of solar dryers

Passive solar dryers only use natural movement of heated air. They can be easily made of cheap and locally available materials. Direct passive dryers are mostly used for drying small amount of products. Indirect solar dryers vary in size between small home units to large commercial ones.

Fig. 2 shows one possible design of a direct and indirect solar passive dryers.

Advantages of solar dryers

The main advantage of solar dryers is usage of free energy from the Sun, an available and unrestricted energy source that does not pollute the environment. In regions with good sun irradiation drying should not be a problem at all. For example, most vegetables can be dried between 2.5 and 4 hours, at temperatures between 43 and 63 ^{o}C, depending on preparation. Fruit needs more time, from 4 to 6 hours, at temperatures between 43 and 66 ^{o}C. During long and sunny summer days it is possible to dry two batches in a day.

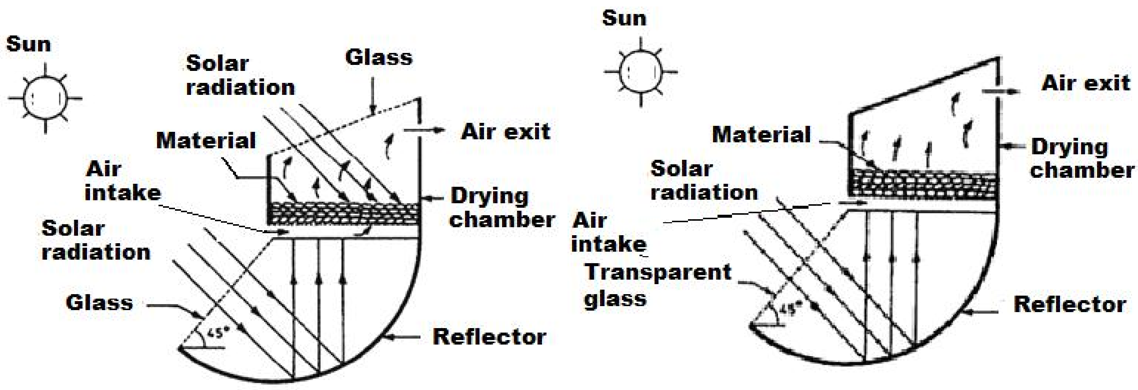

Figure 2. A direct and indirect solar passive dryers.

The main advantages of solar dryers compared to traditional methods of drying in the open are:

- *It is faster*. Wet material can be dried in a shorter time. Solar dryers' influence time shortening in two ways: the first, by allowing sun radiation and heat conduction in the collector at the same time, depending on the collector construction, different covers and different absorption surface, enabling a desired temperature in the drying chamber; and second, the expansion ability of sun energy collection surfaces allows obtaining better concentrations of solar energy.
- *It is more efficient*. As it is possible to dry products in a shorter time, there will be less product spoilage after product picking or harvesting. This is very important for products which require instant drying, such as products with high moisture content. This way it is possible to produce large amounts of consumable products. Also, lesser products would be lost and spoilt by harmful organisms, because more products will be stored.
- *It is safer.* Products are dried under controlled conditions pollution by small harmful organisms is less probable. They can be stored with a lower probability of developing of microorganisms.
- *It is healthier.* Product drying at an optimal temperature and for a shorter time enables sustaining more nutrients, especially vitamin C. This is even better when this is food as it looks better and is tastier that enables better sales.
- *It is cheaper.* Utilization of solar energy instead of conventional fuels for drying or utilization as an auxiliary source with the purpose of reducing conventional fuel consumption results in significant savings. Solar drying reduces drying costs, improves product quality and reduces losses due to rotting.

Disadvantages of solar dryer

Solar dryers also have disadvantages. They are of little use on a cloudy day. They function very well during good weather so overheating in the middle of the day is possible causing damage to the material being dried. Only control – maintenance of the drying regime can prevent this. As temperatures rise (measured with a thermometer or by experience), it is necessary to create a larger air flow, lower shutters must be opened to enable larger air flow through the dryer in order to maintain an adequate temperature.

Comparison with classical convection dryers

Conventional, classical dryers using fuel are the first alternative to solar dryers. They consume fuel for preparation of the drying agent. In some cases direct drying methods mix combustion products with air in order to achieve a desired temperature regime. Though these dryer solutions are mostly used with no obvious problems, low regulation is possible that can lead to excess products in the drying agent that can lead to pollution of the material being dried.

One of the great advantages of classical solutions in relation to solar dryers is that drying can be performed for 24 hours under any weather conditions. Compared to solar dryers, operation of classical dryers does not depend so much on daily and seasonal weather or other climatic conditions. The combustion process in classical dryers is followed by other problems: using wood can contribute to forest devastation, using coal can cause pollution. Fossil fuels have also become more expensive and are not always available.

RESULTS AND DISCUSSION

Selecting the right technology

Analysis of the drying process shows that many factors need to be taken into account before a solar dryer solution is created. Four important questions need to be answered before making the decision to construct a solar dryer. They are:

1. For what materials will the dryer be used? What is the necessary dryer capacity, what amounts of material will be dried?

As an example grains, fruit and vegetables require different drying techniques. Fig. 4 shows an algorithm that can help in defining the project type.

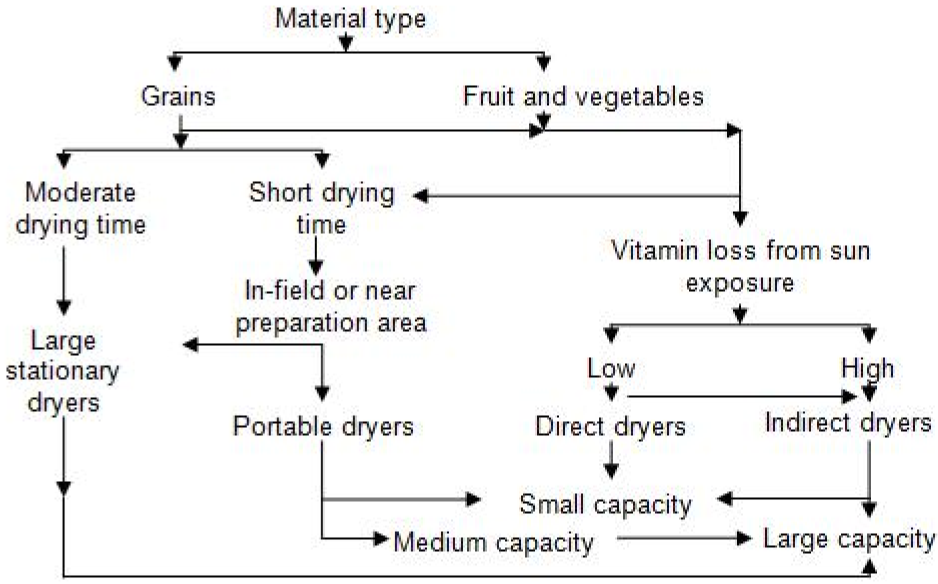

Figure 4 Factors that need to be taken into account when selecting a solar dryer

Safe food storage is of primary importance. Fresh fruit and vegetables need to be prepared (some need to be peeled, cut into pieces or blanched) for the drying process and dried as fast as possible. Grains also have a limited time for drying to enable storage. Rice with a husk, for example starts to germinate in 48 hours if its moisture content is 24%. Grain products need to be dried immediately after harvesting and can require portable dryers that can be installed on the harvesting plot. Stationary dryers should be located close to the location of fruit and vegetable preparation or centrally when grains are considered.
Some materials can lose much of their nutritive values or lose color if drying is performed at a too high temperature or if they are directly exposed to solar rays in direct radiation solar dryers.

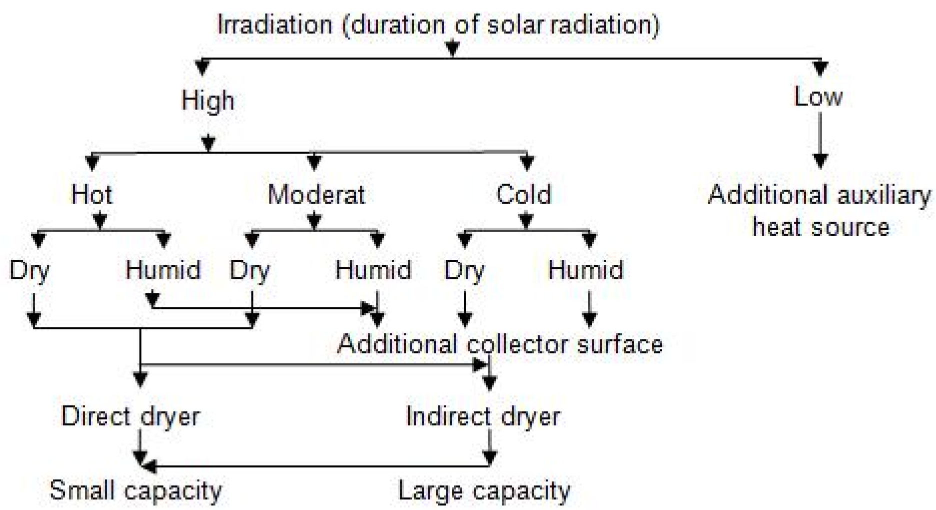

Figure 5. Climate and weather conditions that need to be taken into account when selecting the dryer solution

Finally, the amount of material needed to be dried, dryer capacity and average time needed to dry one charge and the time necessary for drying the products must be taken into account when determining the number (dryer farm) and size of the required dryers.

2. Where is the operating location, what are the climate and weather conditions at the time of harvesting and drying?

Climate and weather conditions (solar radiation intensity, rain, temperature, humidity, wind etc.) need to be taken into account when determining what dryer type suits the given application.

If irradiation is low then introduction of an auxiliary heat source could be useful to enable drying when it is cloudy or even over night. A dry climate with high and moderate temperatures is very suitable for solar dryer operation.

A cold or damp climate is a problem as it is difficult to provide the necessary amount of warm air, as the drying agent, to effectively dry the material before it starts to spoil. Such weather conditions can limit the application of direct dryers to keep only small amounts of food that needs to be dried in a very short time (for one or two days). Indirect dryers have an advantage over direct dryers in that they are capable to concentrating solar energy. Increase of the collector surface and changes of air flow through the collector enables indirect dryers to attain almost optimal conditions in different climate and weather conditions.

Figure 5 shows the factors (climate and weather conditions) that need to be taken into account when selecting the dryer solution.

3. Is the dried material or food stored immediately or is it immediately put on the market for fast consumption?

The answer to this question determines the moisture required in the dried product. The final moisture sets how long a material can be stored and what temperature needs to be maintained in the drying chamber. The time the material spends in the drying chamber needs to be taken into account when determining the number of dryers required for drying the whole harvest.

4. What materials are available for making the dryer solution? Are these materials available locally?

Building can be a good way to construct stationary dryers when the material to be dried is transported to the dryer. If, however, the dryer needs to be transported to the operating location then light materials will be needed to construct transportable and mobile units.

CONCLUSION

It is obvious that regardless to the good sides of solar energy utilization and suitable dryer solutions a thorough analysis of relevant factors is needed to select the best solution from a selection of possible ones.

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ENERGY SAVING IN THE PNEUMATIC SYSTEMS

Stojiljković, M., Blagojević, V.
University of Niš, Faculty of Mechanical Engineering, Niš
E-mail: misa@masfak.ni.ac.rs

Abstract: The need to reduce global energy consumption and make efficient use of energy resources by adopting energy efficient regimes is on the rise, today. Pneumatic systems, as important parts of any branch of industry, are large consumers. It is very important to find a concept that offers a means of saving energy when using and operating pneumatic components from both ecological and economical points of view. The paper presents and describes all main parts of one pneumatic system and ways for reducing the compressed air consumption (energy) separately in each part, as well. A method of restoring energy in execution part of pneumatic system is also presented.
Key words: Pneumatic System, Energy Efficiency, Compressor, Actuator

INTRODUCTION

The effort to increase energy efficiency is a general trend worldwide and it has become an integral element in all international contracts and agreements. The Kyoto Protocol to the United Nations Framework Convention on Climate Change signed in 1997, known under the name of conference against global warming, among other things, determines the reduction of emission of harmful substances in the atmosphere (which is particularly related to the ingredients that may cause greenhouse effect) for each individual country and also a more efficient use of energy sources. The European Union is under obligation to reduce its total emissions of greenhouse gases to at least 8 % below the 1990 level between 2008 and 2012 year. A significant segment of this area is the increase in industrial energy efficiency, whose significant portion belongs to pneumatic and electro pneumatic automation systems. They are under the same obligation to reduce energy consumption by 8 % [1, 2].
Pneumatic systems offer many benefits in terms of small cost; they do not represent polluters and are easy for installation and maintenance, etc. For these and many other reasons they are used in many industries, and in the automotive, semiconductor industry, food processing, wood processing, textile industry, etc. The energy used in pneumatic systems is the energy of air under pressure which comes in special plants that are called compressors. Generally, the cost of electricity used to power air compressor in the production under pressure is around 20% of the cost of electricity for a factory. For these and many other reasons, it is very important to carefully manage expenditure air under pressure.
An extensive survey of the energy consumed by pneumatic systems throughout EU was carried out within the framework of the EU study on “Compressed Air Systems in the European Union”, which contained details of energy saving potential [1].
Good quality and reliability of operation of these systems are accomplished with good system management, which is described in detail in [3, 4, 5, 6]. This enables significant savings of the consumed energy, prolonged component's life cycle, more reliable system operation and lowered system operation costs. There are significant issues that influence the overall increase in energy efficiency of the compressed air systems, which are explained in greater detail in [7, 8, 9, 10, 11, 17, 18, 19, 20].

INCREASE OF ENERGETIC EFFICIENCY PNEUMATIC SYSTEM

Generally, energy savings in pneumatic systems can be divided, as to where the energy is used, into:

- Part of production, where mechanical energy is converted into pneumatic energy, i.e. in the compressors;
- Part of transmission, where the compressed air is transported through the line; and,
- Part of execution, where the potential energy of compressed air is converted into mechanical work, the cylinders and motors (actuators).

The flow of compressed air energy is shown schematically in Fig. 1.

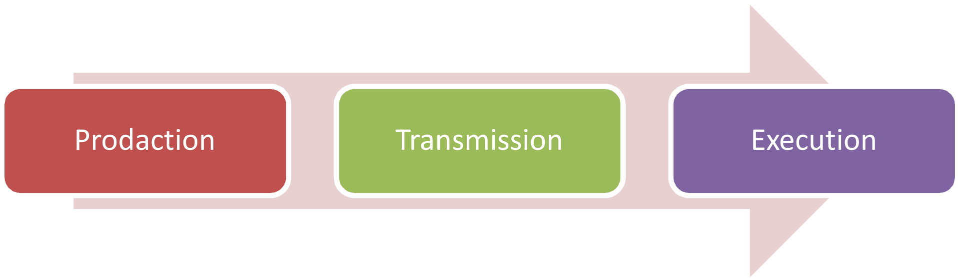

Figure 1. Flow of compressed air energy

PART OF COMPRESSED AIR PRODUCTION

The energy flow diagram for compressed air supply with electric motor, Fig.2, shows, that the part of production uses most of the electrical energy. In the EU study mentioned above, it was discovered that accumulated saving potential in the part of production compressed air amounts to around 16 % and in some cases (some industries) up to 25 % [1].

Usage of high-efficiency power drives in part of production compressed air, increase's energy efficiency. Integration of variable speed drives (VSD) into compressors can lead to energy efficiency improvements with respect to characteristics of the load. Application of high-efficiency drives renders the largest savings to new systems. Integration of speed controllers (frequency inverters) into compressed air systems is a very cost-effective measure, under the conditions of variable demands, and it is estimated that such systems participate in the industry with 25%.

In cases of multi-compressor stations, variable speed drives are integrated into only one machine and are usually coupled with more sophisticated control system for the whole compressor station that powers on and off individual compressors with a constant speed and also varies the speed of one compressor in order to adjust the production of compressed air to instantaneous requirements of consumers.

In order to make an optimal selection of compressor it is necessary to consider the specifics of the user's compressed air system. The choice of compressor can greatly influence the energy efficiency of the system, with respect to compressor performance but also regarding multiple interactions with other elements in the system. The advantages of multi-compressor systems are especially emphasized in production systems with the high workload that operates almost continuously.

A whole array of efforts is directed towards improving the existing compressor lines but also towards the development of new types, which are usually customized to different segments of industry. There are many researches with improving production methods such as applying narrower tolerances in order to reduce the leakage within the compressor.

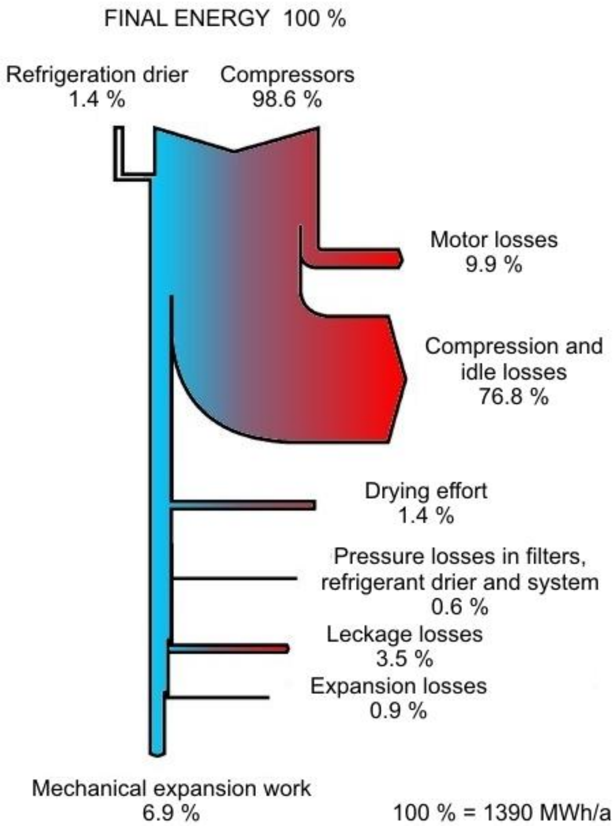

Figure 2. Energy flow diagram of compressed air supply with electric motor

Sophisticated control systems are applied in order to adjust the compressor outlet flow to the consumers' requirements. They save the energy by optimizing the transition between non-loaded working state, loaded working state, and non-operating state of compressor. Sequencers optimize the operation of multi-compressor stations and can be combined with applications of variable speed drives. Predictive control uses fuzzy logic and other algorithms to predict the future behavior of consumers, considering the history of system behavior.

Compressors intrinsically generate heat, which can be, under certain conditions, used for other functions. The recommendations for its usage depend on the presence of those consumers of thermal energy whose characteristics comply with the amounts of generated heat, whose usage is enabled by adequate equipment (heat exchangers, pipelines, regulators etc.) the price of which is favorable in comparison with alternative solutions. The design of the heat regeneration system must provide for appropriate compressor cooling. The heat dissipated by the compressor is in most cases too low in temperature, or too limited by its quality to adequately respond to the needs of industry regarding their main processes or heating. The climate and seasonal changes also influence the ratio between investments and yields. Typical application is heating the space close to the location of compressor, when needed. Possibilities for using the compressor recycled energy are:

- Used in buildings (Water heating and Building Heating),
- Compressed air preparation (Standard dryer regeneration, Integral dryers with compressor),
- In processes (Heating, Drying),
- Boiler preheating (Drinking water, Boilers).

The cost efficiency of heat regeneration depends on available alternative energy sources. It could be very cost-effective, only if it is alternative to electrical energy.

The equipment for drying and filtering causes the pressure to drop while dryers often consume electrical energy or partially use compressed air for their operation and regeneration. Because of that, the optimization of compressed air preparation as a function of the user needs is one of the main sources of energy savings. There are some possible measures for rising energy efficiency of this system [12, 13, 14, 15, 16].

PART OF COMPRESSED AIR TRANSMISION

The saving potential in the transmission part of a compressed air system is estimated about 18 % by the EU study [1]. The greatest saving potential is clearly evident in the reduction of pressure loses due to pipeline friction and leakage losses and these are quoted as being the most important energy saving measure overall.

Pressure loses in compressed air distribution network depend on several factors: topology (ring or network, etc.), geometry (pipeline diameter, curvature radius), materials used, etc.

The proper designing and realization of distribution network can optimize the friction loses. Long, narrow lines should be avoided wherever possible as the associated friction losses are higher. Modern energy management systems permit the deactivation of system branches when they are not needed.

Reduction of air leakage is probably a single most important measure for obtaining energy savings that are applicable to most systems. In typically well-maintained plants, leakages range between 2 and 10% of total capacity, but can amount up to 40% in the plants that are not maintained properly. It is considered that leakage can be tolerated while being less than 10% of total production. An active approach that involves permanent leakage detection and appropriate maintenance work can reduce the leakage to this level [16].

Costs of compressed air leakages and air losses through hole in pipeline, Fig 3, can serve as a guide in evaluating the scope of loses that arise due to leakage (through hole). In this example [16], it is assumed that the price of electrical energy is 0.1 €/kWh (costs of industrial electrical energy in EU) and that system is operated at 8 000 hours/year, while the price of 600 kPa compressed air supply preparation is 0,02 €/m³.

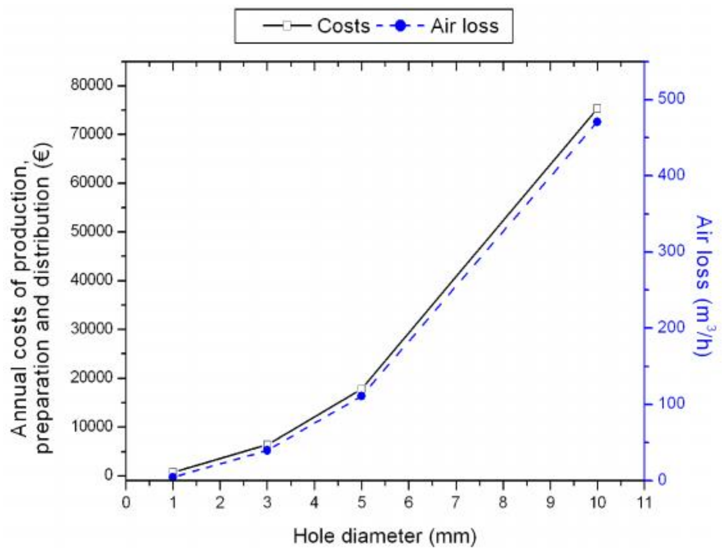

Figure 3. Costs of compressed air leakages and air losses

Removing leakage sources is based on detecting and repairing locations of leakage and removing the root causes that generated leakage within the system. Proper maintenance is of essential importance when fighting leakages and a good program for leakage detection can prevent unexpected failures from happening and reduce downtimes and loses.

PART OF EXECUTION

According to the EU study, part of execution of compressed air system, offers the least saving potential. The potential savings of a specific unit or some execution system may be considerably higher. A distinction can basically be made between design engineering and control engineering measures to reduce energy consumption. It is also well known, that the control engineering measures for their part may exert an influence on the design [19].

It is very important to notice, that keeping compressed air leakage in execution elements and units to minimum and proper maintenance have a significant influence on energy consumption of the system. Also, the drive task should be defined to reduce compressed air consumption, for example, that the mass to be moved should be kept to a minimum or the movement should take place with a minimum of friction, etc.

Compressed air is extensively misused for applications in which it is not energy efficient, for which better solutions exist or, its implementation is incorrect in the places where its usage is justified. So, it is very important to use pneumatic systems only for suitable applications. Some of unsuitable applications are: Control cabinet cooling, Vacuum production by Ventouri pipe, Cleaning of parts and processing residuals removal, Removal of parts from the moving production line by nozzles, Blower guns, Powdered materials transport (pneumatic transport), etc.

Many devices that consume compressed air can be used in a more energy efficient manner. The optimization of devices that consume compressed air is one aspect of systemic approach to designing a compressed air system. The optimization can be achieved by: replacing the existing components with more energy efficient ones, installing additional elements, or, better use of the existing components.

For example, in the case of applying a vacuum generator, the savings in the compressed air are realized by using more energy efficient components, that possess an installed vacuum switch whose function is to save air (example is Air saving circuit – Festo). If the value of vacuum drops under a specified limit, the vacuum sensing switch sends a signal to vacuum generation and distribution components. In case the value of vacuum is within the designed range, the vacuum is not generated.

A reduction of dead volume offers reducing compressed air consumption. This is because there are no benefits directly associated with the necessary pressure build-up in the dead volume. Apart from the energy consumption factor, a large dead volume exerts a negative effect on the pressure build-up rate and therefore on the positioning time. Where the dead volume is made up of long pipes or hoses, for example, this increases the line resistance and with it the pipe friction losses. In practice, the simple design rule for minimization of dead volume is frequently ignored, particularly in cases where meters of hose are fitted downstream of valve terminals.

Also, there are some energy-saving potential in the operation of the actuators, more preciously in recycling of used compressed air (restoring energy). It is a well known fact that the pressure of compressed air in the working volume of pneumatic actuator increases and reaches the final value equal to the supply pressure of compressed air, just after the actuator rod or shaft reaches the end of the stroke of pneumatic actuator. When the direction of the actuator piston or shaft motion is reversed, all the compressed air contained within a working volume is released into the atmosphere. This represents a significant loss of the compressed air that possesses enough potential energy to perform some other kind of work [18, 19, 20].

Restoring energy

The basic principle of restoring energy is shown in the following Fig. 4. This figure shows the advantage of pneumatic system with restoring energy because the compressed air consumption is less than in a system without restoring energy.

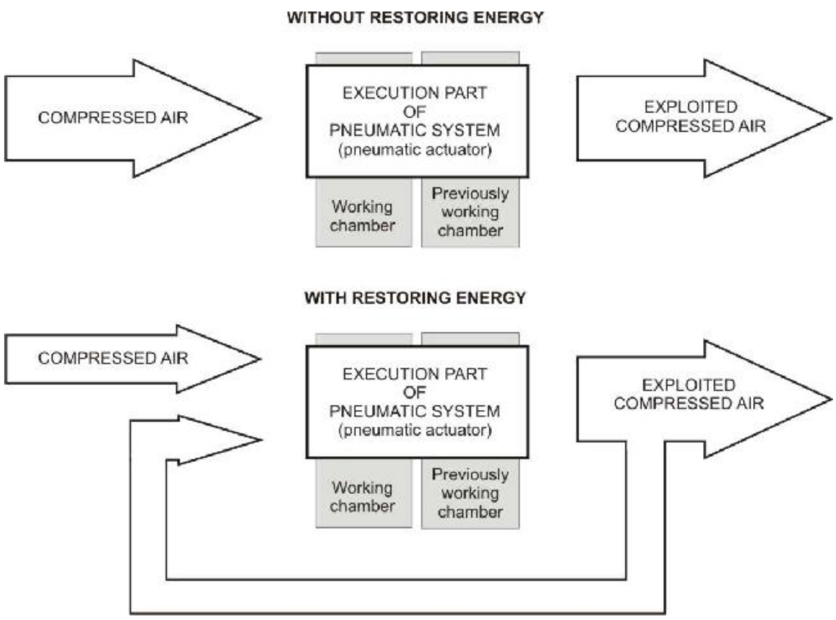

Figure 4. Basic principle of restoring energy in the execution part of pneumatic system

This ensures that almost completely the use of compressed air from the previously working chamber can be used in two ways:
1st way: Compressed air from the previous working volume is used in the other volume in the actuator so that it generates sufficient force to move actuator's piston or shaft in the opposite direction.
2nd way: Compressed air from the previous working volume is used in the other volume in the actuator where there is no enough force for back-stroke, but it reduces the need for a new amount of compressed air. That is, you only need to bring in a smaller amount of air in order to pressure in the mentioned volume grown enough to enable the process of movement in the opposite direction.
To demonstrate energy efficiency of pneumatic system with restoring energy, experimental measurements with different load were performed. Load force was acting to extand cylinder's rod and each test was repeated 10 times. Cylinder was DNC-50-200-PPV (FESTO). Air box unit (FESTO) was used for measuring the compressed air consumption. After 10 measurements with 10 cycles in each measurement with 600 kPa pressure supply and 500 N load, compressed air consumption of pneumatic system with restoring energy was 24.2 l in average, and it was less than in system without restoring energy with average consumption of 43.06 l. So, net saving was 43.8%. Measurements were also performed with different load (50 N and 100 N) and supply pressure (200 - 600 kPa) at 10 working cycles. Under these conditions, compressed air savings of pneumatic system with restoring energy was 33.3 - 44.3 %. These values of energy saving are very important for taking in consideration when execution part of pneumatic system is design. According to the prices of FESTO components, the return of investments periods of proposed pneumatic system with restoring energy are average 2-2.5 years.

CONCLUSION

Compressed air systems represent a significant segment of production and service systems. Therefore, it is necessary to pay attention to their energy efficient operation. The application of the measures for an energy efficiency increase in compressed air systems enables prolongation of the components' life cycle and the reduction of total operation costs that in turn increases the economic quality of working process. The procedure that was presented and explained in detail, for all parts of pneumatic system (production, transmission and execution) can significantly increase the energy efficiency of compressed air systems.

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ON THE DETACHMENT OF A CAPILLARY BODY

Mitrovic, J.
University of Paderborn, Thermal Process Engineering, Germany,
University in East Sarajevo, Faculty of Production and Management Trebinje,
Republic of Srpska, Bosnia and Herzegovina
E-mail: mitrovic@tebam.de

Abstract: Visual observations of gas bubbles emerging from a submerged orifice prove that bubble detachment occurs by a necking process on bubble foot. The detachment inception is formulated in this paper on the basis of the interfacial condition in the neck region. This condition is also used to deduce approximate equations for the velocity and duration of bubble detachment. These quantities are shown to decisively depend on the physical properties of the system, particularly on surface tension and viscosity. The results obtained apply likewise to liquid drops under similar conditions. In case of drops, the final detachment step, the rupture of the liquid thread, is governed by the tensile strength of the liquid.
Keywords: Necking, Detachment inception, Detachment velocity, Capillary body.

INTRODUCTION

Several fundamental works on the detachment of capillary bodies, appeared in the last decades, provide excellent high speed photographs which are important for understanding the detachment process; see e.g. the review paper of Thoroddsen et al. [1]. They confirm qualitatively the model proposed in [2,3] for a vapour bubble. By this model, the bubble detachment occurs via constriction of bubble neck, formed near the bubble foot, and the detachment process is completed when the neck radius vanishes.
Despite the considerable research progress, some detachment details of a capillary body are still not fully resolved. In analytical treatments, the last detachment step runs through a singularity, which prevents a close solution of the issue. The nature, however, manages this problem. The present contribution provides an idea of how to circumvent this singularity. It starts with a brief description of a simple apparatus devised some three decades ago for watching the bubble detachment by naked aye. The detachment of a bubble in a water-diluted shower gel is documented by photographs. The detachment inception of a capillary body is formulated basing on the interface jump condition. The final detachment step is considered as rupture of the interior phase that is controlled by the tensile strength of the liquid.

EXPERIMENTAL

Bubble Apparatus

The apparatus used for watching the bubble detachment is shown in Figure 1. It consists of a plexiglass box (250 mm high, horizontal cross section 130 mm x 50 mm); a plexiglass plate having three identical orifices (mouth diameter 2mm) divides the box in two equal compartments. To make the apparatus ready for experiments, a liquid is to be filled in and the box connection sealed (bottom and top on the left). In steady-state, the liquid occupies the lower compartment (not completely). One starts an experiment by turning the box. One orifice generates bubbles, while the other two orifices regulate the liquid outflow. Air bubbles pearl up through the liquid in the upper compartment while liquid drops form on the underside of the dividing plate at the same volume flow rate.

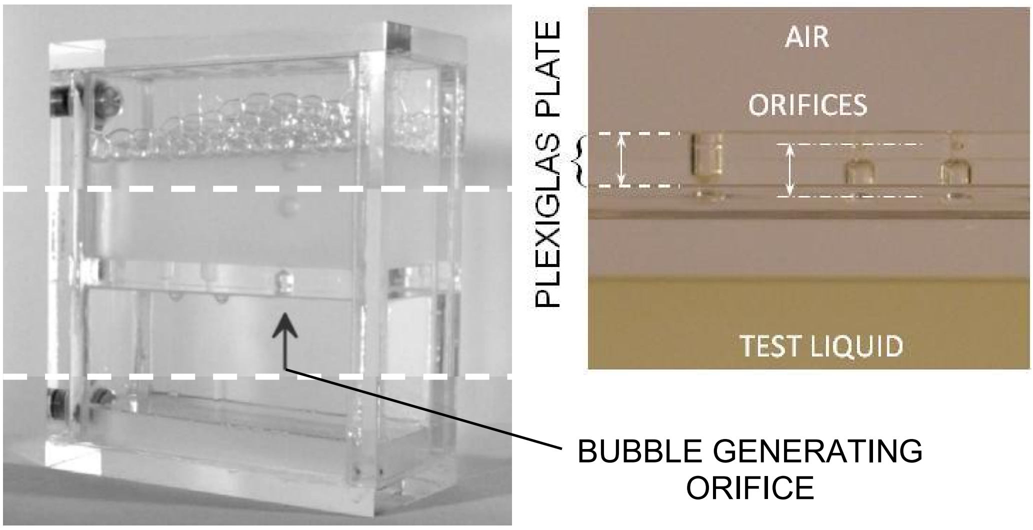

Figure 1. Two-compartments bubble apparatus. Gas (air) bubbles were generated in the upper (liquid) compartment. The dividing plate is provided with three identical orifices; the orifice mouth diameter is 2 mm

In order to observe the bubble detachment with naked eye, slow bubble kinetics was realized by using a liquid of high viscosity and low surface tension. Slowly detaching bubbles were generated with a water-diluted shower gel. Because of the quantitative interest in the detachment process, the physical properties of the system used have not been quantified.

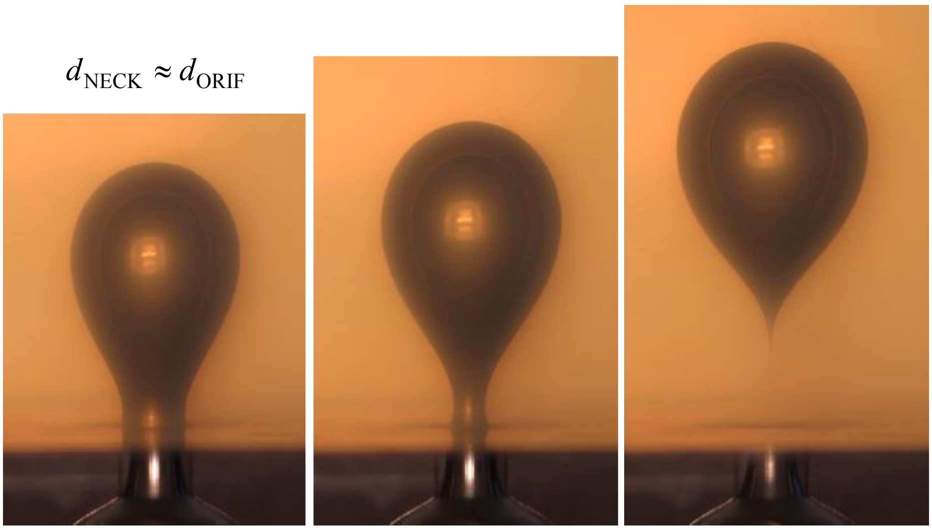

Figure 2. Air bubble formed on the submerged orifice (mouth diameter 2 mm) in a water-diluted shower gel solution, gravity field. The bubble neck constriction (from left to right) precedes the bubble detachment

Photographs of bubble shape are reproduced as example in Figure 2. The maximum horizontal bubble diameter is about 7 mm. The bubble detachment occurs via necking, at a continuous neckconstriction. The ascending bubble (on the right) drags a gas tail, which is connected to the gas in the compartment. After a certain period of time, the gas filament breaks, and the detachment process is completed.

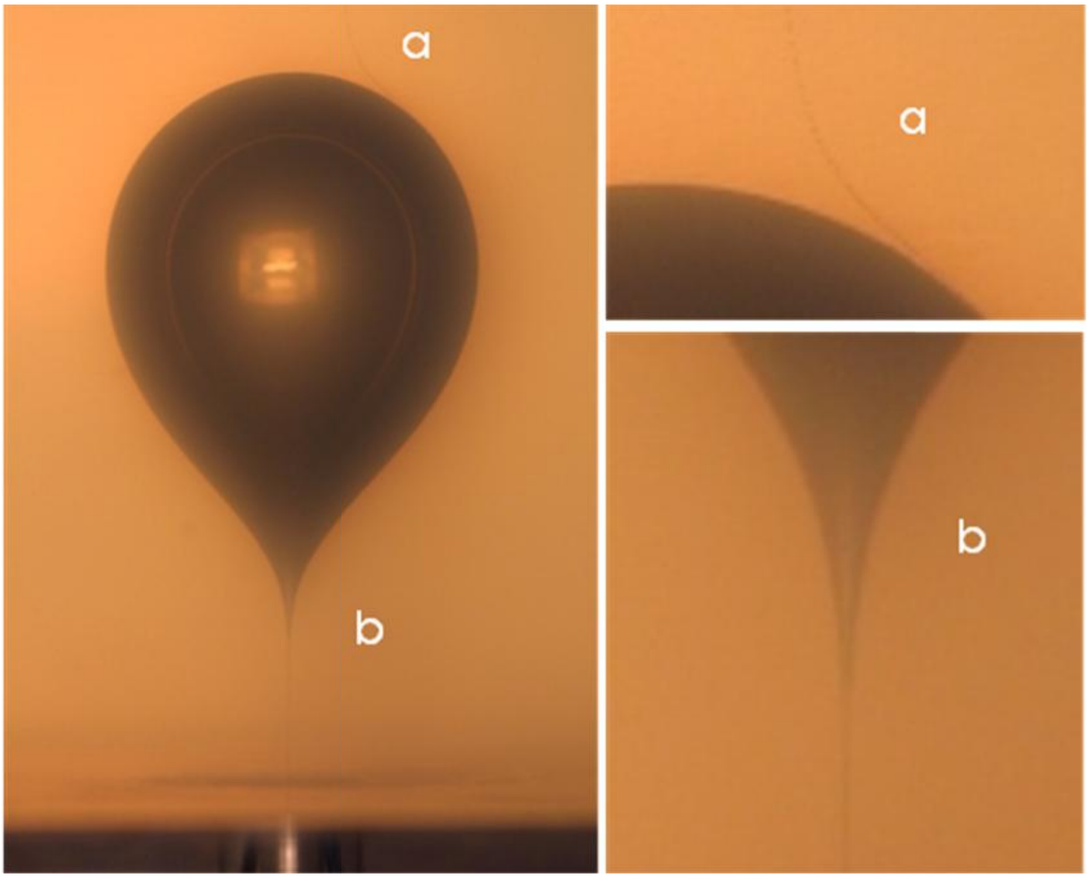

Figure 3. Micro-bubbles formed by disintegration of gas thread of the previous bubble (region a); the gas thread of the actual bubble is connected with the container gas (region b)

Some further details of the bubble in Figure 2 are displayed on Figure 3. In the bubble top region (a), micro-sized bubbles are visible; they are formed by disintegration of the gas thread of the preceding bubble. The considered bubble is connected to the gas in the compartment, enlarged region b).

Brief comparison with literature

The bubble necking is not limited to particular systems. Bubble detachment via neck constriction, as first described by the present author in the early 1970's, has meanwhile been observed in several systems. In 1990 Peregrine et al. [4] published photographs that clearly demonstrate the necking and detachment of liquid droplets and of air bubbles in water. The detachment phenomena do not change when instead of gas a liquid is used that is immiscible with the exterior phase, see e.g. Marschall [5]. The high speed photographs provided in recent publications underpin the detachment universality of capillary bodies; the reader may be referred to the papers by Doshi et al. [6], Burton et al. [7], Bolaños-Jiménez [8], and Keim [9] for details and further references.

The interest in detachment of capillary bodies has a long history. In the *Theoria,* published in 1763, Boscovich [10] described remarkably precise the detachment of a hanging droplet (§434):

"..., *in the case of drops of water hanging suspended; here, as soon as they have increased up to a point where the weight of the whole drop becomes greater than the mutual attractive force of its parts, any greater part is not torn away as a whole, but by degrees, though in a time that is **exceedingly short**, the drop is attenuated at its upper part, until **the neck**, which has by now become exceedingly narrow, is **finally broken altogether**. There were, say, initially, a thousand particles in the surface connecting the hanging drop to the upper part of the water which is left adhering to the body from which the drop was suspended; these a little afterwards become 900, then 800, then 700, & so on, their number being gradually diminished **as the sides of the neck approach one another**, & its figure is narrowed*." (Bold is mine).

SOME DETACHMENT CHARACTERISTICS

Inception of detachment

The inception of the detachment of capillary bodies is a typical example of stability of fluid interfaces; Savart [11], Plateau [12], and Rayleigh [13] pioneered the investigations in this field. For a review of recent analytical models dealing with the dynamics of fluid interfaces, the reader is referred to Eggers and Fontelos [14].
In the following, the interfacial (orthogonal) jump conditions for the linear momentum are used to gain some insight into the detachment phenomena:

$$\left(\rho u\left(u-u_{\mathrm{I}}\right)-\tau_{\mathrm{rr}}\right)\Big|_{\mathrm{L}}^{\mathrm{G}}=\sigma\kappa\,, \tag{1}$$

$$\tau_{\mathrm{rr}}=-p+2\mu\left(\frac{\partial u}{\partial r}\right)_{\mathrm{I}}. \tag{2}$$

Here u is the radial fluid and u_{I} the interface velocity, p is the pressure, μ is the dynamic viscosity; σ is the surface tension, and κ the interface curvature.
In case of no phase transition, $u=u_{\mathrm{I}}$, and Eqs.(1) and (2) give

$$\left(-p+2\mu\left(\frac{\partial u}{\partial r}\right)\right)_{\mathrm{LI}}-\left(-p+2\mu\left(\frac{\partial u}{\partial r}\right)\right)_{\mathrm{GI}}=\sigma\kappa\,, \tag{3}$$

where the indices G, L and I refer to the gas, the liquid, and the interface, respectively.
Neglecting the dynamic terms, Eq.(3) reduces to the classical equation of capillarity,

$$p_{\mathrm{GI}}-p_{\mathrm{LI}}=\sigma\kappa\,. \tag{4}$$

The pressure difference $p_{\mathrm{GI}}-p_{\mathrm{LI}}$ is illustrated in terms of hydrostatic pressures by the straight lines in Fig. 4. As far as the pressure inside the capillary body is larger than the outside pressure, $p_{\mathrm{GI}}>p_{\mathrm{LI}}$ (for bubbles) and $p_{\mathrm{GI}}<p_{\mathrm{LI}}$ (for drops), the interface is expected to be stable. At the intersection point, Eq.(4) reduces to

$$\kappa=0\,. \tag{5}$$

This equation demands a concave-convex interface of same principal radii. Below the intersection point (for bubble) and above (for droplet), no stable states are possible, and the disappearance of the average curvature κ fixes the inception of body detachment [3].

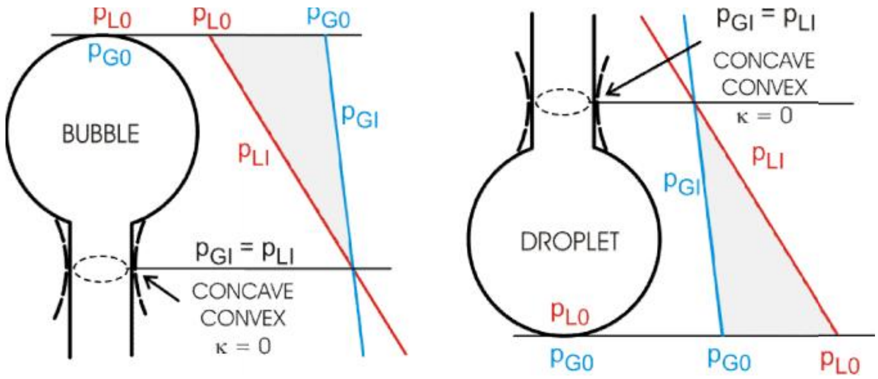

Figure 4. Illustration of detachment inception for a bubble (left) and a droplet (right) in gravity field.

The case of a system following Eq.(3) may be reduced to that of static system. Considering that, for detachment inception, the interface reverses the direction of its movement from radial outwards to radial inwards, the interface velocity goes through zero: $u=u_{\mathrm{I}}=0$, for impermeable interface. If the reversal of this movement occurs asymptotically, the velocity derivatives in Eq.(3) may be set equal to zero, so that $\partial u/\partial r\rightarrow 0$, when $u_{\mathrm{I}}\rightarrow 0$. This leads to Eqs. (4) and (5).

Velocity and duration of the detachment process

The interfacial conditions, Eqs (1), respectively Eq.(3), are satisfied at any time; their content becomes fully evident only in numerical treatments of the detachment process, see e.g. Eggers and Fontelos [14]. However, we will use these equations to estimate order of magnitude of some bubble/drop detachment quantities, assuming the interface velocity to be a function of the neck radius such that $\partial u_{\mathrm{I}}/\partial r$ may be replaced by u_{I}/r. Then, eq.(3) becomes

$$p_{\mathrm{GI}} - p_{\mathrm{LI}} + 2(\mu_{\mathrm{L}} - \mu_{\mathrm{G}})\frac{u_{\mathrm{I}}}{r} \approx \sigma\kappa . \tag{6}$$

Regarding the singularity at $r \to 0$, we may note that the range of extremely small radii are excluded by the continuity requirements.

Taking the bubble neck as a cylindrical surface and neglecting the pressures difference term on the left, $p_{\mathrm{GI}} - p_{\mathrm{LI}} \approx 0$, Eq.(6) gives

$$(\mu_{\mathrm{L}} - \mu_{\mathrm{G}})u_{\mathrm{I}} \propto \sigma , \tag{7}$$

$$u_{\mathrm{I}} \propto \frac{\sigma}{\mu_{\mathrm{L}}} , \text{ for } \mu_{\mathrm{L}} >> \mu_{\mathrm{G}} . \tag{8}$$

The detachment velocity is governed by surface tension and liquid viscosity.

Within the same simplifications, the time span τ of bubble detachment becomes

$$\tau \propto \frac{r}{u_{\mathrm{I}}} \propto \frac{\mu_{\mathrm{L}} r}{\sigma} . \tag{9}$$

This equation is in agreement with the conclusion Doshi et al. [6] arrived at on the basis of numerical simulations of drop break-off.

For water at 100°C ($\sigma \approx 60\cdot10^{-3}\,\mathrm{N/m}$, $\mu_{\mathrm{L}} \approx 2800\cdot10^{-7}\,\mathrm{Ns/m^2}$), $u_{\mathrm{I}} \propto \sigma/\mu_{\mathrm{L}} \approx 214\,\mathrm{m/s}$ (at 20°C, u_{I} is about $70\,\mathrm{m/s}$), is obtained from Eq.(8). The bubble/drop detachment may be assumed to start at a neck radius equal to the orifice radius, say, r = 1mm. Then, $\tau \propto r/u_{\mathrm{I}} \approx 5\,\mu\mathrm{s}$ (15μs at 20 °C), from Eq.(9).

Regarding the calculated time span τ, the impression Rayleigh [15] obtained while experimenting with bubbles and drops are of particular interest. His attempts to detect the detachment instant of single drops from liquid jets remained unsuccessful, noting: "*At certain point it breaks (jet) into drops, but you cannot see them because of their rapidity*."

CONCLUDING CONSIDERATIONS

The macroscopic force balance, as usually encountered in literature, is not useful for pursuing the detachment of capillary bodies. This may be illustrated by considering a hanging droplet, Figure 5 left. The droplet is taken as detached, when the liquid is ruptured and the detached mass is moved down a distance δz such that the interaction between this part and the remaining liquid vanishes; δz is comparable with the spatial interaction range of liquid molecules. To perform the liquid rupture, the applied force has to overcome the liquid ***cohesion***. Dividing this force by the area of the interface area created by the rupture, one obtains the ***tensile strength*** of the liquid.

The tensile strength of a liquid is the maximum tension (or negative pressure) sustainable before a cavity is formed in the liquid. It depends on several parameters and lies for most liquids at room temperature within 200 bar and 300 bar, see e.g. Skripov [16]; for our purpose, we will adopt 200 bar ($2\cdot10^{7}\,\mathrm{N/m^2}$). With this value and the neck radius at the inception of drop detachment of, say, r = 0.7mm, the cohesion force of $F \approx 10\pi$ N is obtained. For the detachment caused by gravity, this gives a mass of the drop $m_L = F/g = \pi\,\text{kg} \approx 3\,\text{kg}$ (!). Note that in macroscopic force balance, the drop is usually cut at a radius equal to the orifice radius, the shape of the drop is frozen, and the cohesion force is disregarded.

By this example, the notion of a frozen neck shape during detachment is untenable. On the contrary, when reaching the detachment inception, the neck radius decrease as far as the cohesion force is larger than the weight of the drop. In the state of equal forces, no further neck narrowing is needed and the liquid may rupture. Following this line of reasoning, we can calculate the neck radius *r* that may break due to weight of the drop:

$$r = \left(\frac{4}{3} R^3 \frac{g\rho_L}{\wp}\right)^{1/2}, \tag{10}$$

where *R* denotes the drop radius and $\wp$ the tensile strength of the liquid.

For illustration, we choose: $R = 2\cdot10^{-3}\,\text{m}$, $\wp = 2\cdot10^{7}\,\text{N/m}^2$, $\rho_L = 1000\,\text{kg/m}^3$; Eq.(10) then delivers $r \approx 2.3\cdot10^{-6}\,\text{m}$.

As envisaged for the first time by Boscovich [10], the narrowing of the neck occurs by los of liquid molecules in its horizontal plane. The detachment process via necking sketched above, including Eq.(10), is thus identified as **Boscovich's model**.

The numerical illustration of Eq.(10) is in qualitative agreement with many high speed observations of drop detachment. In low viscosity systems, the liquid thread sharply constricts immediately behind the drop, prior to break-off, see e.g. Shi et al. [17] and Eggers [18]. The neck constriction is governed by inertial and capillary effects, capillary pressure $\sigma(\kappa_N - \kappa_D)$, in the neck and the drop region. With high viscosity liquids, the viscous stress prevents a sharp constriction of the liquid thread that now smoothly narrows and reaches its minimum at larger distance to the drop. The picture is analogous to the photograph of the gas thread in Figure 3.

Experiments by Kowalewski [19] show that the rupture radius of liquid micro-thread is independent of the system properties, and an average value of $r \approx 0.5\cdot10^{-6}\,\text{m}$ is obtained with different liquids. This finding confirms the structure of Eq.(10), because the tensile strength is practically independent of liquid kind. Note that the above evaluation of Eq.(10) represents an example, without reference to Kowalewski's experiments in which the acceleration was different from *g*.

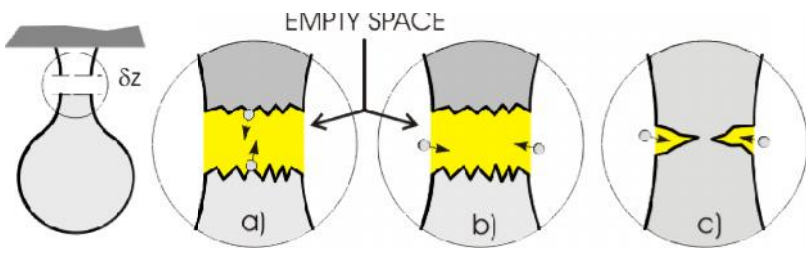

Figure 5. Homogeneous rupture of liquid (drop) neck followed by formation of empty space (yellow colour) that successively becomes filled by evaporation of liquid molecules a) and inflow of gas molecules b). More realistic is non-homogeneous rupture by formation of cracks along the neck circumference, c)

If the liquid thread breaks homogeneously on the whole neck area, an empty space forms between the separated parts, yellow area in Figure 5. As the fresh formed interfaces recede from each other, the emptiness thus increasing is expected to be filled with evaporating molecules of the liquid phase and/or by radial inflow of gas molecules, Figure 5a) and b). In case of a non-homogeneous thread break-off, wedge like cracks along the neck circumference form, which progress toward the thread axis, Figure 5c).

In context with the rupture notion, experiments by Burton et al. [7] are of particular interest. The break-off of a bubble neck (Ø25μm, τ = 10μs) resulted in a diffuse interface. Excluding experimental uncertainty, this picture may be explained on the basis of Figure 5c). Assuming cracks (liquid wedges) developing in the bubble neck, not in the same plane, but in different planes, one above the other, the gas confined between the liquid lamellas forms a secondary bubble.

NOMENCLATURE

d	-	diameter
F	-	force
g	-	acceleration due to gravity
m	-	mass
p	-	pressure
$\wp$	-	tensile strength of liquid
R, r	-	radius
u	-	velocity
ρ	-	density
σ	-	surface tension
τ	-	time, stress
μ	-	dynamic viscosity
κ	-	curvature

Indices

G	-	gas (vapour)
D	-	drop
I	-	interface
L	-	liquid

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ANALYSIS OF EFFECTIVENESS DISTRICT HEATING AND DISTRICT COOLING (DISTRICT COOLING SYSTEM)

Bajmak, Š.[1], Anđelković D.[1], Šarevski, V.[2]
[1]Univerzitet u Prištini, Fakultet tehničkih nauka, Kosovska Mitrovica
[2]Univerzitet "Sveti Kiril i Metodij" vo Skopje, Mašinski fakultet, Skopje
E-mail: bajmak@yahoo.com

Abstract: With the development of air conditioning systems and district cooling residential, commercial and manufacturing facilities, which are located in warmer regions, the central task of supplying cooling energy becomes an integral part of engineering practice that is projecting and performers of district heating and cooling. When comparing different energy structures, which produce cooling, heat and electricity, it is important to assess or evaluate the quantity of fuel consumed and also the size of investment and maintenance costs. The paper will consider the three power structures that give consumers the same amount of external power, cooling and thermal energy for heating air conditioning and hot water.
Key words: efficiency, heating, district cooling, systems

INTRODUCTION REMARKS

System A, cooling energy is produced in compressor cooling machine that uses electric power $W_0(KWh)$ of condensate power plant KTEC, which simultaneously produces electricity for external consumers $W_{sp}(KWh)$. Thermal energy $Q_{cg}(KWh), Q_{stv}(KWh)$ is produced in the boiler room area. One component of heat from the compressor cooling machine (the condenser) $Q_{rkgr}(KWh)$, is used for sanitary hot water.

System B, cooling energy is produced in absorption cooling station, that uses thermal energy from area boiler room $Q_{rkh}(KWh)$, with dispatching the heat from absorber and condenser $Q_{AK}(KWh)$ to the system of sanitary preparation of hot water. Condensing thermo central KEC provides at the same time producing electricity for external consumers $W_{sp}(KWh)$. Required amount of thermal energy for heating and sanitary hot water is provided by the area boiler room $Q_{rkgr}(KWh)$.

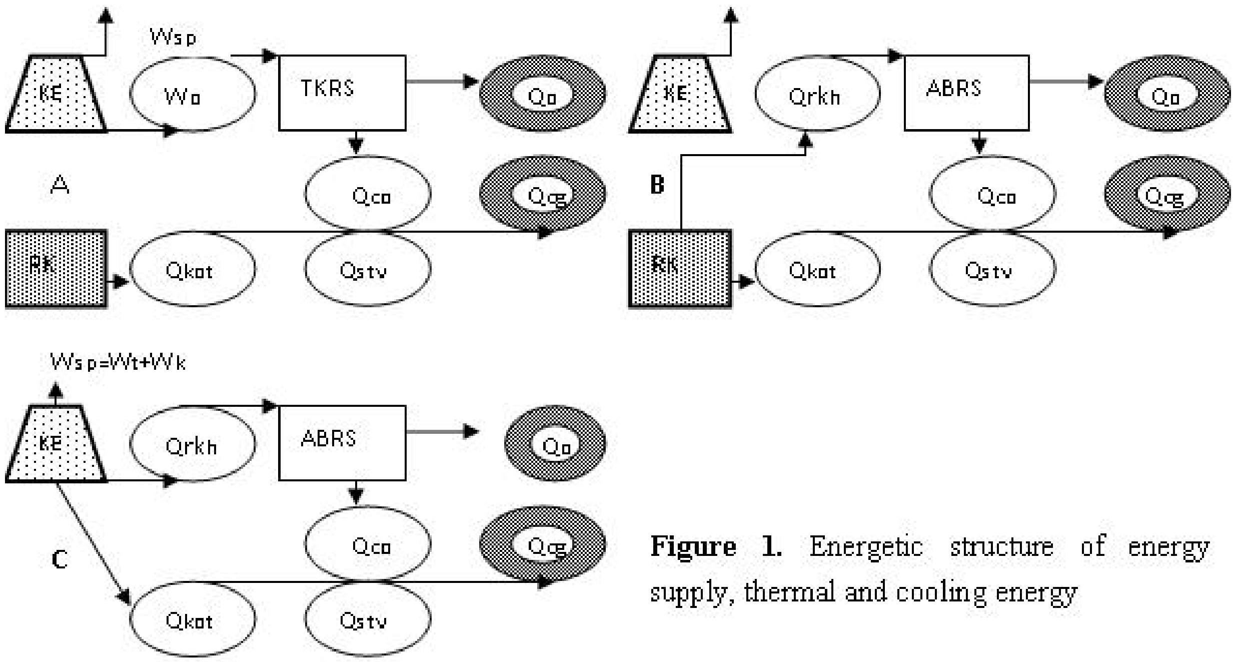

Figure 1. Energetic structure of energy supply, thermal and cooling energy

System C, cooling energy is produced in absorption cooling machine, using thermal energy $Q_{TECh}(KWh)$ that has been reduced from some level of district heating turbine in TEC, with dispatching of thermal energy from absorber and condenser $Q_{AK}(KWh)$ for the needs of sanitary hot water. TEC at the same time generating electricity for external consumers $W_{sp}(KWh)$ in that amount, by the district heating cycle $W_{top}(KWh)$ as well as condensation cycle $W_{kon}(KWh)$. Based on these three energetic structure (system) optimal structure of energy supply has been determined, figure 1.

FUEL CONSUMPTION ANALYSIS OF SOME SYSTEMS

Analyse of fuel consumption of system A

Based on the analysis of the system turbo compressing cooling stations, specific fuel consumption without the use of condenser heat is given by the formula:

$$\overline{B}_1^{BK} = 10^{-3} \cdot \left(\frac{W_{sp}}{Q_0} \cdot b_{KEC} + \frac{b_{KEC}}{\varepsilon} + \frac{\alpha + \chi}{H_d \cdot \eta_k \cdot \eta_{cs}} \right) \tag{1}$$

For values of conditional fuel $H_{dug} = 29.300(KJ/kg) = 8{,}204(KWh/kg)$, and for $\eta_k = 0{,}80$, $\eta_{cs} = 0{,}95$ we have:

$$\overline{B}_1^{BK} = 0{,}28 \cdot \left(\frac{W_{sp}}{Q_0} \cdot b_{KEC} \right) + 10^{-3} \left[\frac{b_{KEC}}{\varepsilon} + 0{,}1604 \cdot (\alpha + \chi) \right] (tug/GJ) \tag{2}$$

According to system analyse of turbo compressing cooling stations, specific fuel consumption with the use of condenser heat is given by the formula:

$$\overline{B}_1^{SK} = 10^{-3} \left[\frac{W_{sp}}{Q_0} \cdot b_{KEC} + \frac{b_{KEC}}{\varepsilon_{TK}} + \frac{1}{H_d \cdot \eta_k \cdot \eta_{cs}} \left(\alpha + \chi - \beta - \frac{\beta}{\varepsilon_{TK}} \right) \right] \tag{3}$$

For values of conditional fuel $H_{dug} = 29.300(KJ/kg) = 8{,}204(KWh/kg)$, and for $\eta_k = 0{,}80$, $\eta_{cs} = 0{,}95$ and $b_{KEC} = 0{,}4(tug/KWh)$; formula (3) becomes:

$$\overline{B}_1^{SK} = 0{,}28 \cdot \frac{W_{sp}}{Q_0} \cdot b_{KEC} + 0{,}28 \left[\frac{0{,}4}{\varepsilon_{TK}} + 0{,}1604 \cdot \left(\alpha + \chi - \beta - \frac{\beta}{\varepsilon_{TK}} \right) \right] (tug/GJ) \tag{4}$$

Therefore, based on the use of heat given by the condenser of turbo compressing cooling machines can be saved in the fuel, which is:

$$\overline{\Delta B_1} = \overline{B}_1^{BK} - \overline{B}_1^{SK} = 0{,}045 \cdot \beta \cdot \left(1 + \frac{1}{\varepsilon_{TK}} \right) (tug/GJ) \tag{5}$$

Analyse of fuel consumption of system B

Based on the analysis of the system turbo compressing cooling stations, specific fuel consumption without the use of condenser heat is given by the formula:

$$\overline{B}_2^{BK} = 10^{-3} \left[\frac{W_{sp}}{Q_0} b_{KEC} \right] + \frac{10^{-3}}{H_d \cdot \eta_k \cdot \eta_m} \left(\alpha + \chi + \frac{1}{\xi_{AB}} \right) \tag{6}$$

For values of conditional fuel $H_{dug} = 29.300(KJ/kg) = 8{,}204(KWh/kg)$, and for $\eta_k = 0{,}80$, $\eta_{cs} = 0{,}95$ we have:

$$\overline{B}_2^{BK} = 0{,}28 \cdot \left[\frac{W_{sp}}{Q_0} b_{KEC} \right] + 10^{-3} \cdot 0{,}1604 \cdot \left(\alpha + \chi + \frac{1}{\xi_{AB}} \right) (tug/GJ) \tag{7}$$

According to system analyse of turbo compressing cooling stations, specific fuel consumption with the use of condenser heat is given by the formula:

$$B_2^{SK} = W_{sp} \cdot b_{KEC} + \frac{Q_{rkh} + Q_{stv} + Q_{cg} - Q_{ABM}}{H_d \cdot \eta_k \cdot \eta_m}$$
$$= \frac{W_{sp}}{Q_0} \cdot b_{KEC} + \frac{1}{H_d \cdot \eta_k \cdot \eta_{mr}} \left(\frac{1}{\xi_{AB}} + \alpha + \chi - \frac{1 + \xi_{AB}}{\xi_{AB}} \cdot \beta \right) \tag{8}$$

For values of conditional fuel $H_{dug} = 29.300 (KJ/kg) = 8{,}204 (KWh/kg)$, and for $\eta_k = 0{,}80$, $\eta_{cs} = 0{,}95$ we have:

$$\overline{B}_2^{SK} = 0{,}28 \cdot \frac{W_{sp}}{Q_0} \cdot b_{KEC} + 0{,}0449 \cdot \left(\alpha + \chi + \frac{1}{\xi_{AB}} - \frac{1 + \xi_{AB}}{\xi_{AB}} \cdot \beta \right) (tug/GJ) \tag{9}$$

Therefore, based on the use of heat given by the condenser of turbo compressing cooling machines can be saved in the fuel, which is:

$$\overline{\Delta B}_2 = \overline{B}_2^{BK} - \overline{B}_2^{SK} = 0{,}045 \cdot \beta \cdot \left(\frac{1 + \xi_{AB}}{\xi_{AB}} \right) (tug/GJ) \tag{10}$$

Analyse of fuel consumption of system C

Fuel consumption in TEC, which at the same time produce electric and thermal energy, is given by formula:

$$B_3^{BK} = W_{top} \cdot b_{TOP} + W_{kon} \cdot b_{KON} + Q_{top} \cdot b_{KOT} \tag{11}$$

Based on the analysis of the system turbo compressing cooling stations, specific fuel consumption without the use of condenser heat is given by the formula:

$$\overline{B}_3^{BK} = \frac{W_{sp}}{Q_0} \cdot b_{KON} + \left(\alpha + \chi - \frac{1}{\xi_{AB}} \right) \cdot \left[\overline{W}_{top} \cdot (b_{TOP} - b_{KON}) + b_{KOT} \right] \tag{12}$$

Dependence of the specific production of electricity by the district heating regime of temperature of the heat carrier t_{nte} for anti pressure turbine is given by:

$$\overline{W}_{top} = \frac{11428}{t_{nte}} (KWh_{ee}/GJ) = \frac{41{,}2}{t_{nte}} (KWh_{ee}/KWh_{te}) \tag{13}$$

For values $b_T = 0{,}179 (kgug/KWh); b_{KON} = 0{,}4 (kgug/KWh); b_{KOT} = 0{,}154 (kgug/KWh)$ formula (12) becomes:

$$\overline{B}_3^{BK} = 0{,}28 \cdot \left[\frac{W_{sp}}{Q_0} b_{KON} \right] + 0{,}28 \cdot \left[\alpha + \chi - \frac{1}{\xi_{AB}} \right] \cdot \left(0{,}154 - \frac{9{,}111}{t_{nt}} \right) (tug/GJ) \tag{14}$$

The amount of heat that is released from the condenser and absorber of absorber cooling machine is:

$$Q_{ABM} = Q_0 \cdot \beta \cdot \frac{1 + \xi}{\xi} \tag{15}$$

Based on an analysis of the absorber cooling stations system, specific fuel consumption with the use of condensers and heat absorber is given by the formula:

$$\overline{B}_3^{SK} = 10^{-3} \cdot \left[\frac{W_{sp}}{Q_0} \cdot b_{KON} + \left(\alpha + \chi + \frac{1}{\xi_{AB}} - \beta \cdot \frac{1 + \xi_{AB}}{\xi_{AB}} \right) \cdot \left[\overline{W}_{top} (b_{TOP} - b_{KON}) + b_{KOT} \right] \right] \tag{16}$$

For values $b_T = 0{,}179 (kgug/KWh); b_{KON} = 0{,}4 (kgug/KWh); b_{KOT} = 0{,}154 (kgug/KWh)$ formula (14) becomes:

$$\overline{B}_3^{SK} = 0{,}28 \cdot \frac{W_{sp}}{Q_0} b_{KON} + 0{,}28 \cdot \left(\alpha + \chi + \frac{1}{\xi_{AB}} - \beta \cdot \frac{1 + \xi_{AB}}{\xi_{AB}} \right) \cdot \left(0{,}154 - \frac{9{,}111}{t_{nt}} \right) (tug/GJ) \qquad (17)$$

Therefore, in the name of heat use divulged from the condenser and absorber absorption refrigeration machine can be saved in the fuel, which is:

$$\overline{\Delta B}_3 = \overline{B}_3^{BK} - \overline{B}_3^{SK} = 0{,}28 \cdot \frac{1 + \xi_{AB}}{\xi_{AB}} \cdot \beta \cdot \left(0{,}154 - \frac{9{,}11}{t_{nt}} \right) (tug/GJ) \qquad (18)$$

Based on the analyse of formulas (4), (9) and (17) we see that each contain one and the same addition $W_{sp} \cdot b_{KON} / Q_o$. For further analyse this addition will be consider as constant.

Figure 2, shows specific consumption of conditional fuel for production $Q_o = 1GJ$ of cooling energy for different types of energetic systems depend on amount of specific burden for supplying with sanitary water α for different values of efficiency level of the heat β from condenser of turbo compressing cooling machine and from condenser and absorber of absorbing cooling machine.

Maximum possible value of efficiency level of divulged heat β with relatively small specific burden of sanitary water α. For value $\alpha = 0$ it's obvious that is $\beta = 0$. Value for $\beta = 1$ will be achieved in the system with compressing cooling machine only with:

$$\alpha \geq \alpha' = \frac{\varepsilon_{TK} + 1}{\varepsilon_{TK}} \cdot \frac{t_{stv} - t_{poc}}{t'_{co} - t_{poc}}; \quad \frac{Q_{stv}}{Q_o} \geq \frac{\varepsilon_{TK} + 1}{\varepsilon_{TK}} \cdot \frac{t_{stv} - t_{poc}}{t'_{con} - t_{poc}} \qquad (19)$$

Analogously for lithium bromide absorption refrigeration machine, the value of $\beta = 1$ is accomplished in the system only when:

$$\alpha \geq \alpha' = \frac{\xi_{AB} + 1}{\xi_{AB}} \cdot \frac{t_{stv} - t_{poc}}{t'_{ak} - t_{poc}}; \quad \frac{Q_{stv}}{Q_o} \geq \frac{\xi_{AB} + 1}{\xi_{AB}} \cdot \frac{t_{stv} - t_{poc}}{t'_{ak} - t_{poc}} \qquad (20)$$

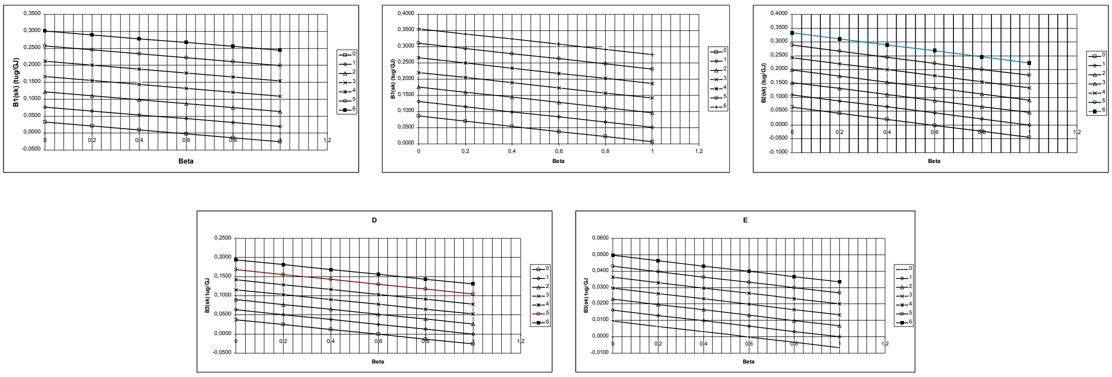

Figure 2: Diagram of conditional fuel consumption comparison for different energy systems
1) diagram for system A with condensing temperature $t_{kon} = 35^0 C$; 2) diagram for system A with condensing temperature $t_{kon} = 50^0 C$; 3) diagram for system B with temperature of thermal heat carrier $t_{nte} = 150^0 C$ and condensing temperature $t_{kon} = 50^0 C$; 4) diagram for system C with temperature of thermal heat carrier $t_{nte} = 150^0 C$ and condensing temperature $t_{kon} = 50^0 C$; 5) diagram for system C with temperature of thermal heat carrier $t_{nte} = 70^0 C$ and condensing temperature $t_{kon} = 35^0 C$;

ANALYSIS OF EFFECTIVENESS BY SPECIFIC COST

Analyse of effectiveness of district heating and cooling systems by the fuel consumptions, cannot be used as a base for system selection, but as a criteria for evaluating economic effectiveness of systems where specific costs were applied $\left((E/god)/(GJ/h)\right)$:

$$\overline{T}_{SIS} = r \cdot \overline{T}_{in} + \overline{T}_{ek} \tag{21}$$

Specific investment costs of the system are equal to:

$$\overline{T}_{SIS} = r\overline{T}_{in} + \overline{T}_{ek} = r\left(\overline{T}_{in}^{RS} + \overline{T}_{in}^{KEC} + \overline{T}_{in}^{KOT}\right) + \overline{T}_{ek} = r\left(\overline{T}_{in}^{RS} + \overline{T}_{in}^{RK} + \overline{T}_{in}^{MR} + \overline{T}_{in}^{KOT} + \overline{T}_{in}^{KEC}\right) +$$
$$+ \overline{T}_{ek}^{RS} + \overline{T}_{ek}^{KEC} = r\left(\overline{T}_{in}^{RS} + \overline{T}_{in}^{RK} + \overline{T}_{in}^{MR} + \overline{T}_{in}^{KOT} + \overline{T}_{in}^{KEC}\right) + \overline{T}_{ele} + \overline{T}_{am} + \overline{T}_{ld} + \overline{T}_{w} + \overline{T}_{tr} + \overline{T}_{gor} =$$
$$= r\left(\overline{T}_{in}^{TK} + \overline{T}_{in}^{RK} + \overline{T}_{in}^{RM} + \overline{T}_{in}^{KOT} + \overline{T}_{in}^{KEC}\frac{280}{\varepsilon_{pr}}\right) + \left(\overline{N}_{RS} + \overline{N}_{RK} + \overline{N}_{PP}\right)\tau_{rop}\eta_{irop}C_{ele} +$$
$$+ \left(0{,}2 + p_1^{'}p_3^{'} + p_2^{'}p_4^{'}\right)\overline{T}_{in}^{RS} + \frac{LD_{rad}^{RS}m_{rs}}{q_0} + \frac{\dot{V}_w C_w}{q_0} + \overline{B}_{gor}C_{gor}\tau_{rop}\eta_{irop} + LD_{rad}^{KEC}n_{rad}^{KEC} \cdot \frac{280}{\varepsilon_{pr}}$$

The cost of heat generator (boiler room-heating) for the needs of lithium bromide absorption refrigeration machine will not been taken into the budget, as we assume, use of heat in summer, on behalf thermal heating is calculated and thrust applications during cooling period.

For turbo compressing and absorbing cooling machine cooling capacity of each machine will be calculated by the formulas:

$$q_o^{TK} = \frac{q_o^{nom} \cdot \varepsilon_{pr}}{\varepsilon_{nom}}; \quad q_o^{AB} = 0{,}147 \cdot (t_h - 49)(GJ/h) = 40{,}6 \cdot (t_h - 49)(KW) \tag{22}$$

Specific investment costs $\overline{T}_{KEC}$ for condensing thermo central KEC that produces electric energy for the needs of cooling compressing station are as follows:

$$\overline{T}_{KEC} = \overline{\overline{T}}_{sp}^{KEC} \cdot \frac{280}{\varepsilon_{pr}}(Euro/GJ/h) \tag{23}$$

For the variant, when absorption cooling machine has been used, amount $\overline{T}_{KEC}^{'}$ is not taken into account, because cooling energy is produced in district heating regime (in the absorption cooling machine). Figures 3a and 3b shows the results of calculations based on follows adopted values of variables:

$r = 0{,}12(1/god)$; $\overline{T}_{TK} = 23000(Eu/GJ/h)$; $\overline{T}_{RK} = 7200(Eu/GJ/h)$; $\overline{T}_{RK} = 8400(Eu/GJ/h)$;
$\overline{T}_{KOT} = 300(Eu/GJ/h)$; $\overline{\overline{T}}_{KEC} = 200(Eu/KW)$; $\overline{N}_{TK} = 70(KWee/GJ/h)$ $\overline{N}_{AB} = 1{,}1(KWee/GJ/h)$
$\overline{N}_{RK} = 2{,}1(KWee/GJ/h)$; $\overline{N}_{PP} = 4{,}5(KWee/GJ/h)$; $p_1^{'} = 0{,}04$; $p_2^{'} = 0{,}10$; $p_3^{'} = 0{,}2$; $p_4^{'} = 0{,}80$;
$LD_{rad}^{RS} = LD_{rad}^{KEC} = 6000(Eura/god)$; $\tau_{rop} = 2101(h/god)$; $\eta_{irop} = 0{,}75$; $\varepsilon_{nom} = 3{,}5$; $\varepsilon_{pr} = 3{,}5$;
$\dot{V}_w = 10000(m^3/god)$; $C_w = 0{,}2(Eura/m^3)$; $LD_{rad}^{RS} = LD_{rad}^{KEC} = 6000(Euro/god)$;
$m_{RS} = 5(rad/mas)$; $n_{rad}^{KEC} = 0{,}0004(rad/MW)$;

CONCLUSION

Following systems has been included: **A1)** System **A** with condensing temperature $t_{kon} = 35^0 C$; **A2)** System **A** with condensing temperature $t_{kon} = 50^0 C$; **B3)** System **B** with thermal energy carrier temperature $t_{nte} = 150^0 C$ and condensing temperature $t_{kon} = 50^0 C$; **C4)** System **C** with thermal energy carrier temperature $t_{nte} = 150^0 C$ and condensing temperature $t_{kon} = 50^0 C$; **C5)** System **C** with thermal energy carrier temperature $t_{nte} = 70^0 C$ and condensing temperature $t_{kon} = 35^0 C$;

Based on analyse and showed results on figures 3a and 3b, stems, system with compressing cooling machine and high condensing temperature of A2 system $\left(t_k = 50^0 C\right)$ and absorption cooling machines, system C5 that supply with temperature carrier $t_{nte} = 70^0 C$ that has been characterized with highest specific costs.

Lowest value of specific costs are characterized by the system B3 and C4, actually, system with absorption cooling machine, during which absorption cooling machine work with use the heat from TEC has better economic indicators, than when cooling energy has been produced in turbo compressing cooling machine.

In all systems, with an increasing ratio between heat load and sanitary cooling load consumption α decrease, and with increasing of β efficiency coefficient of divulged heat from turbo compressing condenser specific costs are increasing.

Comparison of the specific costs of different systems of centralized heat supply and cooling energy taking into account the complex economic conditions gives us the ability to perceive the advantage of some systems. In any case, absorption cooling machines have high energy and economic advantage in the system of energy supplying and urban production plants.

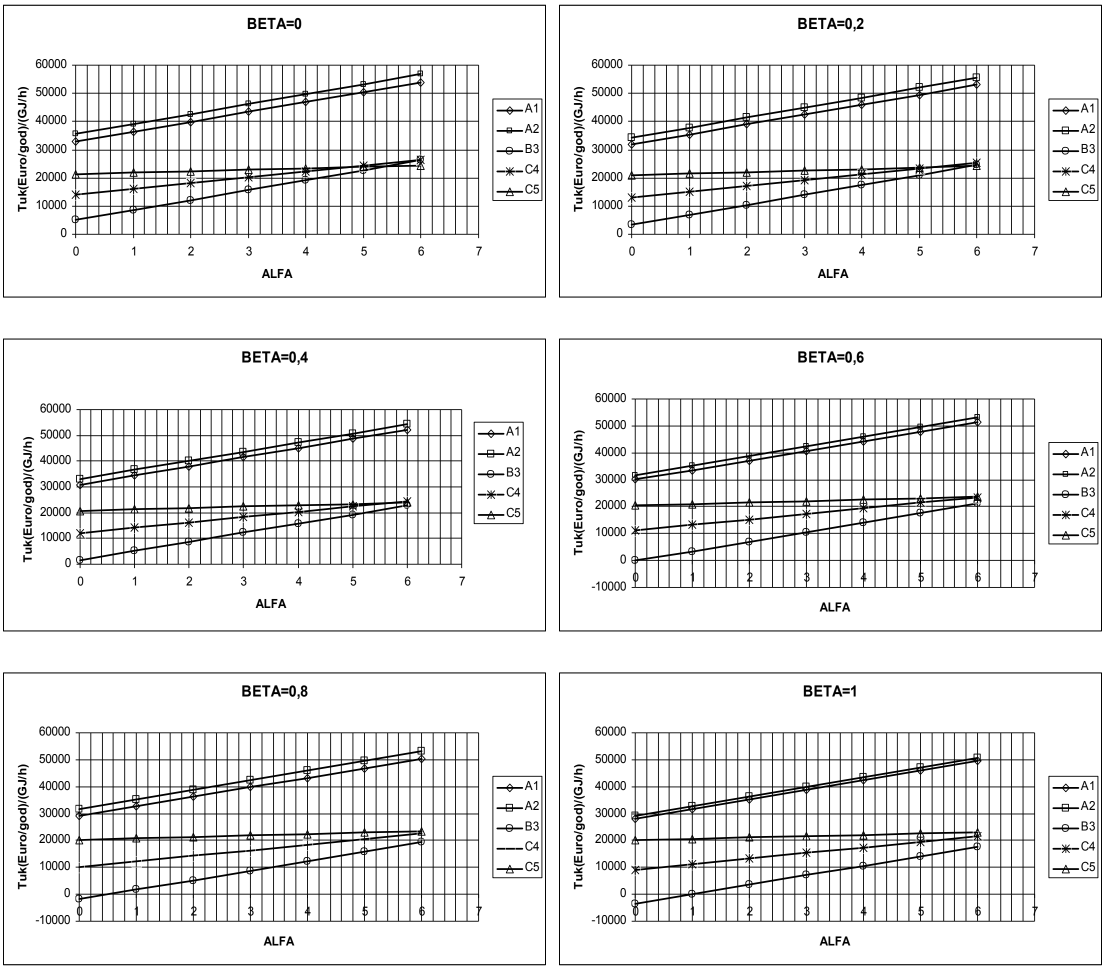

Figure 3a. Diagram of specific changes in annual costs, depending on the relationship α and β

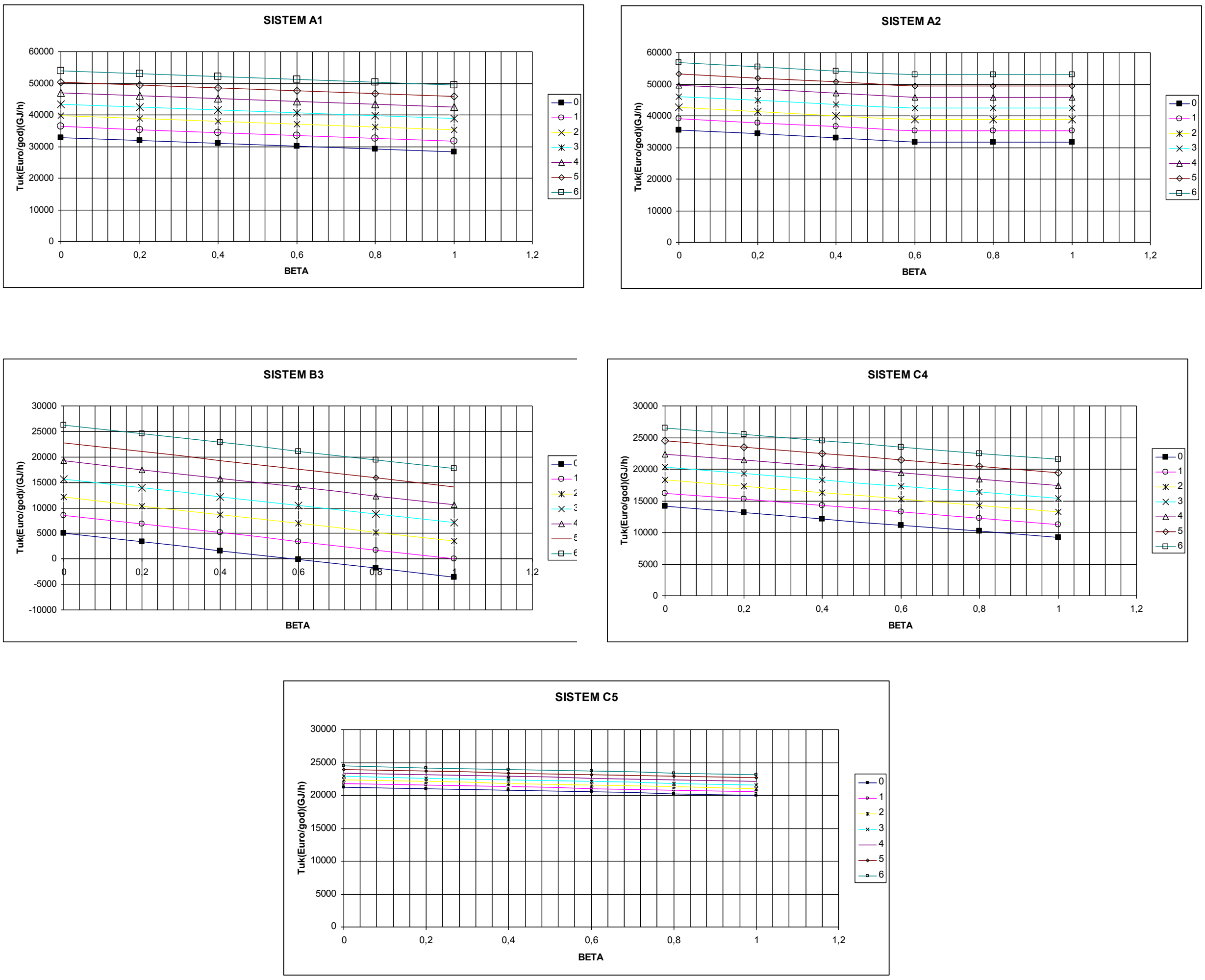

Figure 3b. Diagram of specific system changes in annual costs A1, A2, B3, C4 and C5, depending on the relationship α and β

MARKINGS

$\overline{T}_{in}$ - specific investment costs of district cooling and district heating system elements of the system, depending on the type of cooling machines and their operation mode, $Eura/GJ/h$; r-factor of capital return, $1/god$; $\overline{T}_{ek}$ - specific exploitation costs of district cooling and district heating elements, depending on the type of cooling machines and their operation mode, $Eura/GJ/h$; t_{stv} - temperature of sanitary water in the pipe system of supplying, ^0C; $t^{'}_{con}$-water temperature boiled in condenser, ^0C; t_{poc} - initial temperature of water, ^0C; $t^{'}_{con}$ - water temperature boiled in absorber and condenser, ^0C; $\alpha = Q_{stv}/Q_0$ - relationship between sanitary heating load and cooling load consumption; $\chi = Q_{cg}/Q_o$ - relationship between the heat load of heating and cooling consumption thrust applications; β - coefficient of utilization of heat removed from the turbo compressor condenser of cooling machines; ε_{TK} - coefficient of cooling of the turbo compressor; ξ_{AB} - thermal coefficient of absorption of cooling machines; ε_{pr} - coefficient in the cooling project mode; ε_{nom} - cooling coefficient in the nominal regime mode; q_{nom} - nominally specific load, GJ/h; t_h - temperature of the thermal energy carrier , C

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RESULTS OF EXPERIMENTAL RESEARCH IN CONVECTIVE HEAT TRANSFER DRYING

Blagojević, Z.[1], Tolmač, D.[2], Prvulović, S[2].
[1]JP. Toplifikacija, Požarevac, Serbia.
[2]University of Novi Sad, Technical faculty "Mihajlo Pupin", Zrenjanin – Serbia.
E-mail: zvonko@toplifikacija.rs

Abstract: This paper presents the results of research which can be useful in designing and construction of such dryers in the food industry. It refers to the technological and technical characteristics of the dryer, energetic balances, coefficients of heat transfer and kinetic drying. Accomplishment of the heat transfer in these systems is based on the principle of direct contact of dried material and warm air. Then an intensive transfer of heat and mass is accomplished. Experimental and theoretic research was conducted and the results were implemented in a real industrial environment on convection dryer with pneumatic transport of material. The numeric values are given for optimum parameters of drying, energetic characteristics and balances as well as the models of heat transfer.
Key words: Heat transfer, convection dryer, numerical data.

INTRODUCTION

Heat transfer systems of such of kind and likewise are introduced in literature [1] [4] [7] [9] [12, 13] [15] [17] [19].
Application of the convection pneumatic dryers is represented especially in food industry in plants for industrial processing of grains (wet milling processing of wheat and corn).Generally, such dryers can be used for drying of meal-like and fine-kernel materials. Simple construction and a relatively low consumption of energy have enabled successful application of such dryers in the above stated industrial branches. The construction of the convection dryer enables simultaneous pneumatic transport of wet material and its drying.
The specific consumption of energy is usually (3900-5040) kJ kg^{-1}, of evaporable water. Efficiency of such dryers is evaluated according to the thermal degree of utilization which is within the limits of (66-75) %, depending of the drying system (indirect or direct drying). The drying time in these dryers is very short, only several seconds, therefore they can be used for drying of the materials susceptible to high temperatures in a short drying period of time.

EXPERIMENTAL PLANT

Experimental research is made in the convection pneumatic dryer, Fig. 1. Drying agents are heated with the gas burner (1). Drying is performed in the direct contact of warm gases with the moist material. The principle of direct drying is represented here. The drying material is corn bran.

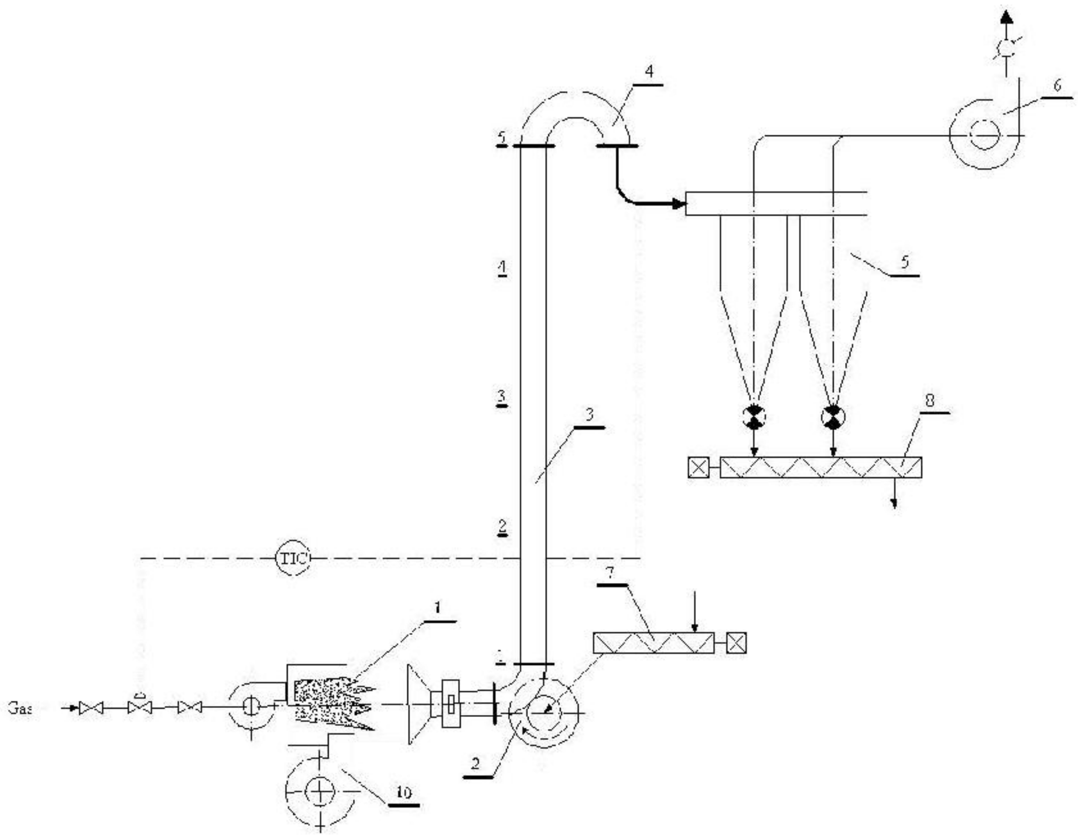

Figure 1. Scheme of experimental drying equipment: 1 – gas burner, 2 – rotation dozer of moist material, 3 – dryer pipe, 4 – dryer head, 5 – cyclones, 6 – centrifugal ventilator, 7 – auger for bringing of moist material, 8 – auger conveyer, 9- pneumatic transport, 10- ventilator

Dosing of moist material to the dryer is performed through the rotation dozer (2) with the capacity of m_l = 9925 kg h^{-1}, through the auger conveying system, as given in the scheme of experimental equipment in Figure 1. Auger conveyers (7), have a role of mixing the moist material. In such a way, a homogenous moist material is obtained at the dryer inlet. In the (Table 1), the characteristics of convection pneumatic dryer are given.

Table 1. Characteristics of convection pneumatic dryer

No.	Pos.	Name of equipment and characteristics
1	1	Gas burner type: Saacke SG, heat power Q= 3,40 MW
2	2	Rotating dozer N = 18,5 kW, n = 660 min^{-1}.
3	3	Dryer pipe, diameter d=625 mm, height h=25 m
4	4	Dryer head
5	5	Cyclone separator, diameter Dc=1.350 mm
6	6	Centrifugal ventilator V = 26.000 m_n^3/h, Δp = 3.500 Pa, N = 75 kW.

Moist material is transported via hot air – the drying agent through the dryer pneumatic pipe (3), it passes through the dryer head (4) and goes to the cyclone separators (5) for separation of dried material, and the hot gases are expelled by a ventilator (6), into the atmosphere. The dried material is transported from the cyclone via auger conveyors (8). During drying, the determined fuel - gas consumption is B = 290 m^3h^{-1}.
Table 2, contains average values of the results of measuring the air temperature – the drying agent and moisture of dried material. Experimental measuring is being made in the approximate stationary conditions of the dryer operation. The stationary conditions mean the stationary conditions during a longer period of the dryer operation and greater number of measuring (where non-stationary conditions of the process are excluded during the realistic conditions of the dryer operation).

Table 2. Average values of the results of measuring the drying temperature and the material moisture

Measuring place, according to the figure 1	1-1	2-2	3-3	4-4	5-5
Temperature of the hot air, t ˚C	425	342	222	155	110
Moisture of the dried materijal, w %	30	22	16	14	12

In the drying process, the total invested energy is spent on: water evaporation, heating of drying material and heat losses. Energetic balances show appropriate relations between the total invested energy, utilized energy and heat losses during the drying process. The energetic balances can be useful when showing the dryer condition diagnosis.

RESULTS AND DISCUSION

Experimental research on the convection pneumatic dryer, Fig. 1, was aimed at determining the energetic balance, specific consumption of energy, thermal degree of utilization and other relevant parameters of drying. The results of the energetic balance are given in the Table 3.

Table 3. Energy balance of convection pneumatic dryer

No.	Energy drying parameter	Sign and measure unit	Energy value parameter
1	Air temperature at the inlet of dryer	T_1 ˚C	425
2	Quantity of evaporable water	W kg h^{-1}	2.030
3	Total heat quantity	Q_u kJ h^{-1}	7.956.000
4	Drying heat power	Q_d kW	2.210
5	Energy specific use	q kJ kg^{-1}	3.920
6	Quantity of drying air and brids	V_L $m_n^3h^{-1}$	19.500
7	Specific quantity of evaporable water	kg $m^{-2}h^{-1}$	41,3
8	Quantity of drying air	V_T $m_n^3h^{-1}$	14.430
9	Air temperature at the outlet of the dryer	T_2 ˚C	110
10	Thermal degree of utilization	η_T %	74

Based on the research, the total heat force of drying of Q = 2210 kW, is being acquired as well as the specific consumption of energy q = 3920 kJ kg^{-1}, of evaporable water. According to the literature Heβ

[2], Tolmac [17], a specific consumption of energy in convection drying amounts (3650 – 5040) kJ kg $^{-1}$, of evaporable water. According to the data from literature Islam [6], specific consumption of energy amounts q = (3640 – 5280) kJ kg $^{-1}$, of evaporable water. On the basis of the results of energetic balance and results of the drying parameters measuring, according to the literature Prvulovic [14], the total coefficient of the heat transfer during convection drying is h_u = 340 Wm^{-2}K^{-1}, Table 4. On the basis of the research results, the mass air flow amounts 0,169 kg s^{-1}m^{-2}, the drying capacity is 1640 kg h^{-1}, and the air temperature at the dryer inlet is 425 °C. According to the literature Lin [11], the mass air flow is 0,289 kg s^{-1}m^{-2}, the drying capacity is 1152 kg h^{-1}, at the drying temperature of 90 °C.

Table 4. Total coefficient of heat transfer (h_u)

Total quantity heat (heat power)	Volume of pipe drying place	Drying surface∗	Middle log. difference of temperature	Total heat transfer coefficient
Qu	Vk	A	ΔT_m	h_u
kW	m^3	m^2	^oC	Wm^{-2}K^{-1}
2.210	6,44	41,20	158	340

∗ According to [2, 10, 14, 17] drying surface is equal to interior surface of drying pipe (A=d π h ; d=0,625 m - pipe diameter ; h=21 m - pipe height).

According to the research Prvulovic [16], on the convection pneumatic dryer, the value of the total coefficient of heat transfer in the process of drying corn starch is 308 Wm^{-2}K^{-1} , and in drying of potato starch the coefficient of heat transfer is 320 Wm^{-2}K^{-1}. The coefficient of heat transfer under the dynamic conditions of the dryer operation (non-equal dosing of material to be dried, oscillations in the initial moisture content, temperature of drying, heat flux, etc.) depends on the greater number of different values which characterize the heat transfer. The objective of this part of research is to determine the character of heat transfer in such complex dynamic model, considering that the heat transfer comprises a phenomenon of heat transfer by convection, conduction and radiation. Based on the results of research, the value of the coefficient of heat transfer by convection has been determined, Table 5.

Table 5. Coefficient of heat transfer by convection (h_c)

Heat power for water evaporation	Heat power for material heating	Heat power of heat transfer by convection	Surface drying	Mean logarithmic difference of temperature	Coefficient of convection heat transfer
Q_w	Q_s	Q_{conv}	A	ΔT_m	h_c
kW	kW	kW	m^2	^0C	Wm^{-2}K^{-1}
1	2	3	4	5	6
1.500	68	1.568	41,2	158	240

It is according to the research Tolmac [19]. On the basis of the results of research acquired in the Table 4, the total coefficient of the heat transfer h_u = 340 Wm^{-2}K^{-1} . The coefficient of the heat transfer by convection h_c = 240 Wm^{-2}K^{-1} is given in Table 5. The largest quantity of heat during drying is consumed for heating of the material to be dried and water evaporation. Coefficient of heat transfer by convection h_c = 240 Wm^{-2}K^{-1} in the complex conditions of the dryer operation depends on the various values which characterize the heat transfer. It is according to the research Prvulovic [17].

These values are the heat flux, the area of drying, the temperature differences, etc. In order to determine the effects of the heat transfer during convection drying, the topic of heat losses is reviewed as well. On the basis of that, as a separate value, the coefficient of the heat transfer has been determined h_u-h_c =100 $Wm^{-2}K^{-1}$ which shows the share of the heat losses through the air outflow from the dryer and the losses due to conduction and radiation through the dryer pipe.
For flowing agens drying (heat air) through pneumatic pipe of dryer V_T = 14.430 $m_n^3h^{-1}$, and diameter of pipe dryer d = 625 mm, the quick rate transport is v_n = 13 ms^{-1}. Taking lenght (height) into a consideration, pneumatic pipe drying is h = 21 m, and time for drying is t = 1,616 s.

CONCLUSION

This work presents the experimental and theoretic research of relevant parameters of drying on the convection pneumatic dryer in the food industry. Based on the analysis of energetic balance, the heat force of drying has been determined Q_u = 2.210 kW, specific consumption of energy q = 3.920 kJ kg^{-1} of evaporable water, as well as the thermal degree of utilization η_T = 0,74. Energy balance of the dryer can serve in evaluation of power condition of the dryer as well as in reviewing of the possibility of rational consumption of energy.
A significant share of the energy during drying is forwarded to transfer of heat to the material, necessary for evaporation of moisture and heat for the breaking of connection forces of moisture with the basis of the material to be dried. Specific consumption of energy and quality of dried material are basic data which characterize the results of drying on the convection dryer. By following and control of these parameters in the drying process, the optimum consumption of energy is provided as well as the quality of dried material.
On the basis of the results of research of energetic balance and the results of measuring the temperature of the drying agent, the total coefficient of the heat transfer is being determined in the convection dryer in the amount of h_u = 340 $Wm^{-2}K^{-1}$, and the coefficient of the heat transfer by convection h_c = 240 $Wm^{-2}K^{-1}$. The effects of the heat losses during drying are expressed through the separate value h_u – h_c = 100 $Wm^{-2}K^{-1}$, so called coefficient of the heat transfer for the heat losses together with the outlet air and the heat transfer by conduction and radiation through the dryer pipe. In such a way the effects of the heat transfer are determined as well as the basic parameters of the heat transfer.
The acquired results of research are based on the experimental data from the industrial dryer. Based on that, the results of research have a value of use, i.e. they are useful to the designers, manufacturers and beneficiaries of these and similar drying systems as well as for the educational purposes. The results of research can also be used for: determination of dependence and parameters of the heat transfer during convection drying, as well as in designing and development of convection dryers.

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SESSION 5: Reengineering and project management

COMPETITIVENESS AMONG MACEDONIAN COMPANIES

Mitreva, E.[1], Prodanovska, V.[2]
[1]Goce Delcev University,Faculty of Tourism and Business Logistics, , Shtip
[2]Faculty of Philology Stip, GoceDelcevUniversity, Shtip
E-mail: elizabeta.mitreva@ugd.edu.mk

Abstract: Demanding high quality of products/ services impose not only supplying new equipment but investing in education and training of employees, reengineering of business processes as well as permanent improvement of the quality system. Strong competition can be survived only by those companies that are well organized, have a qualified working capital, and the ones that invest into improvement of business processes, education, and training as well as in organization's innovative attitude. Modern market conditions, besides responding on customers' desires and needs, also impose an analysis of the position of the completion into their strategy.
This paper presents a completed analysis of the condition of Macedonian companies through one of the criteria for gaining a European quality award: measuring of contentment of purchasers/buyers as well as the manner of receiving information of their desires and needs.
The condition of Macedonian companies is different from those worldwide that are based on TQM (Total Quality Management) principles. But, the positive fact is that (as of the confirmed research) the attitude towards quality is changing. During the recent years, as of the beginning of the introduction of the market reforms, the tendency to include Macedonia into the European association is being largely emphasized; therefore the attitude of the top managers willing to achieve top quality is changing as well.
Key words: Enrichment of assortment and quality of products and services, competitive prices, existing and new markets, cooperation with foreign partners.

INTRODUCTION

Perceiving the desires and needs of the customers and the attempt of the companies to fulfill those, will increase the contentment of the users and will allow a competitive advantage to the companies. In order to gain successful information regarding the standing position and the position of its products on the market, it is necessary for the management to collect and adequately value the data from the customers for the products, their experiences and expectations and their level of contentment.
As for that purpose, a quality perception research is implemented through: questionnaires, association tests and other indirect testing and techniques for examination of users. Throughout the process of collecting of original primary data, their adequate processing, their estimation and effective interpretation, a mobilization of valuable entering information that help the development of own product concept is enabled. Through those measures according to Zairi [9], the management could follow the realization of its aims and especially the measurable operative goals for product/ service quality. More precisely, the management compares the perception of its own product of the customers in terms of perception of the best competitive product.
Turning marketing information [4] into measurable indicators and standards is necessary; in order to fulfill the demands of the buyers it is also necessary to provide a platform for understanding and cooperation with the other sectors and departments within the organization so that those demands would be fulfilled. In this way the development of these indicators and standards allows measurement and following of the quality accomplishment, reaching as acceptable level of quality to each sector, removal of defects and disposal. Therefore there is no need of a special control to each working position and there is also a reduction of the costs for that purpose.
Gathering data regarding the consumers' contentment for the quality products/ services is to show which measures should be taken from the companies in order to improve their contentment. The sources of measuring could be objecting, reclamations, questionnaires, debates, participating in the design etc.

Those statements open up dilemmas:

- are Macedonian companies prepared to come out at the global market?
- what's the condition to create values and build business culture as a respond to the development of competition and fast adaptation of needs and desires of consumers/ buyers?
- is there a system built to measure the contentment by setting measurable dynamic standards?
- are they ready to accept the TQM philosophy?

MATERIAL AND METHODS

This paper provides an analysis of the condition of Macedonian companies through one of the criteria to gain a European quality award [3]: measuring the contentment of buyers/ consumers as well as the manner of getting information regarding their necessities and desires.
Analyzing this paper is only a segment of the general research and the constant condition within Macedonian companies [4] in the domain of projecting and implementation of the quality system, analyzed through four polls of the house of quality at which highest position is the top management and the bases are measuring, estimating, analyzing and comparison of high and low quality. The house of quality is held by 4 subsystems: internal standardization, methods and techniques for flawless working, education and motivation, and analyzing the quality costs.
The constant situation was analyzed through the criteria for gaining European quality award: leadership, policy and strategy, employee's management, resources, processes, contentment of buyers/ purchasers, contentment of employees, influence towards the society and business results. Those were the criteria upon which Macedonian companies were evaluated in case they compete for the European quality award.
A special attention is given to the gathering of the entering data within the research. These researches have been done through a questionnaire and personal aspect of the current condition of Macedonian companies. The analysis of the findings is done through an algorithm for evaluating and determining the "age" i.e. the development stage of the Macedonian companies according the polls in the house of quality (beginning from an undeveloped system to a more developed and vice versa) and the reckoning of the deviations of the subsystems that are part of TQM system, through the symptoms of the "shape" the system has. Pareto analysis has been used as well as an analysis for a percentage of the participation to individual responses.
The research was accomplished by testing 151 companies from different business areas and in order to make it more representable, the size, the settlement and the business field was taken into record as well.

RESULTS AND DISCUSSION

One of the criteria for gaining an EQA (European quality award) is: how far has the company reached according to the plan to accomplish contentment to all those that experience a financial interest of it. The measurements of the performances need to be financial and additional. ***As for the question what are the issues during the appearance on the market (domestic and foreign), here are the received information***:
The results of the analysis show that the most serious issues are:

- 53 from the examined or 35%, - d*isloyal competitiveness;*
- 44 of them or 29%, - *high prices;*
- 29 of them or 19%, - *strong competition*
- and 17 of them or 11%, *listed " other".*

By "other" they have listed: illiquidity of firms, inexistence of distribution networks, and frozen rate of the euro currency, uncontrolled and illegal import, fake brands etc. Many of the constructing companies have announced the protective attitude of the government towards the public supplies that results with a bad distribution of capital and concentration of capital at certain structures only, reducing of the customs formality, as well as the electronic approval of licenses and permits. None of the companies have announced the bad quality of its products/ services as an issue that is faced with at the placement at the domestic and foreign market.

As for the question whether the competition is a threat for them and how do they see the advantages of the competition, here is the data:

- 76% *of them claimed that the competition is a threat;*
- 24% *do not see the competition as a threat;*

86% had listed the reasons:

- 34 of them or 26%, *see the competition in better quality of their product/ services*;
- 34 or them or 26%, *claimed that low prices are a huge advantage of the competition;*
- 27 of them or 21%, *take as an advantage the well-developed distribution network of the competition;*
- 16 of them or 12%, *take as an advantage the importance of quality of the entering raw materials;*
- 12 of them or 5%, *have claimed that the design of the products is a key to success;*
- 2 of them or 10% claimed *"other"*.

The business subjects that deal with agriculture, forestry and fishing see the advantage in the contract manufacturing (a manufacturing with a known purchaser) within the processing industry. As well as adjusting the assortments, meaning updating with new sorts of vegetables and fruit that give increased profit and which sorts are more resistant to the outer influences. The cooperation with the research organizations counts here as well.

Macedonian is well known by the brand of the red paprika, cabbage, peaches and tomatoes and not much for the cereals that bring far lower profit in the neighboring countries. The agricultural companies ought to renew the cooperation with the processing industry and deal with some supplying of fresh fruits and vegetables for canning because the processed food is actually a competitive advantage of Macedonian economy.

*Claimed **as "other"** by the companies that deal with production of food was given the export at the foreign market by the quality system and the food safety such as* ISO 9001:2008 and HACCP. They also need to have an export registry number. It refers to the diary companies mostly. Besides the producer itself, those international standards need to be followed by the cooperative companies that apply for the export registry number. This means that the company needs to demand from the responsible institutions (such as the state department of food safety, and the Food Institute) and to perform checkups over the working of their cooperative partners as a quality guarantee to the final product. Macedonia has only three diary companies that own an export registry number.

The companies dealing with production of machines and appliances such as MZT Pumpi see the advantage into servicing the pumps, which means that they need to provide a servicing after the sale of the product.

10% of the researched companies see the advantage in "lovebrand". Purchasers need to love the brand in Macedonian companies. Creating Macedonian brands that will be identified through the Macedonian identity is a necessity. For ex. if a Macedonian wine is promoted that means participation to each wine festival and getting a reward for it, of course. Then, people will say that Macedonian wine had beaten the German one and everyone will be proud of it.

Macedonian population is the most sensitive on pride, identity and nationality, therefore this should be used. The fact that Macedonian citizens avoid Macedonian products doesn't mean that there is a bad quality but only refers to the necessity to stabilize the brand. There are Macedonian products that cause a sense of pride such as "skopsko", because everyone would say it's the best, everyone buys it and present it to the foreign visitors claiming that it's the best that cannot be replaced by any other. "Tikves" winery as one of the largest wine cellar on the Balkans has its "T'ga za jug" wine as a symbol of Macedonian beauty and love towards the country and it is an actual "lovebrand".

Measuring the business results the trend of performance and results as well as a comparison with the competitive side are a key areas of business. Self-evaluation of the company, comparing own practice with the best practice using benchmarking strategy is supposed to help the organization to stimulate the internal creation [1].

Our researches have shown that 68% of the researched companies do a constant comparison with the competitive sides and the best ones; they also are taking measures to improve the business processes and products. Measuring would not stimulate imitating, direct copying of the competitive side, which is one of the most massive trend in Macedonia, but also a manner of manipulation of the buyers/ users[1].
Based on the measurements it is seen which are the competitive advantages of the competitive side, but as of the results it is shown that 26% of them claimed that the advantage lays in the better quality of their products/ services. In this way the benchmark is a useful method within the quality management, especially reckoning the continuous measuring of the gap between internal (own) practice and the best external practice, by setting measurable dynamic standards. Based on those measurements the policy and strategy of the organization is being built.
Our researches have shown that 68% of the researched companies do a constant comparison with the competitive sides and the best ones; they also are taking measures to improve the business processes and the products. Measuring would not stimulate imitating, direct copying of the competitive side, which is one of the most massive trend in Macedonia, but also a manner of manipulation of the buyers/ users.
Gathering data for contentment of the purchasers regarding the quality of the products/ services needs to present which measures should be undertaken for improvement of their contentment. The sources of measures could be in a form of objections, reclamations, questionnaires, debates etc.
As for the question "what do buyers/users search for" here is the data:

- 90 of them or 60%, *get informed through an analysis of the profit/ offers;*
- 30 of them or 20%, make it through a questionnaire;
- 5 of them or 3%, *do not bother at all;*
- 26 of them or 17%, Claimed "*other"* (direct contact with the users/ buyers and finding a mutual optimal and acceptable solutions).

The fact that brings a concern is that there is a weak interaction between the buyers/ users and the producers, which refers to a bad function of the marketing services. The nonexistence or not well-developed marketing services to Macedonian companies eliminates them from the knowledge and providing the necessities on the market as well as their adjustment towards the contentment of those needs.***As to the question whether there are some requests from the buyers/ users that cannot be fulfilled, here are the results:***

- 59% of them totally respond to the needs of the buyers/ users;
- 41% of them are not able to do that.

The reasons refer to the lack of the technological abilities, unrealistic demands of the buyers/ consumers as well as demands within the deadline that is shorter than the optimal etc.
Macedonian companies do not use questionnaires much on order to measure the level of purchaser contentment of products, **because the question: what's the manner that they get informed whether the products/ services fulfill the expectations of the users, here are the results:**

- 54 of them or 35,7%, claim that the bad quality of the products/ services is revealed through reclamations;
- 36 of them or 23,8%, through the realized sale (whether increased or reduced);
- 26 of them or 16,7%, through an analysis of a conducted questionnaire to the consumers;
- 21 of them or 14%, from the reports given from the quality control service;
- 7 of them or 4,7%, by tracking the competitive side and
- 7 of them or 4,7%, claimed " other" (finding *direct contacts with users as a tremendous help).*

In order to improve the products/ services it is essential for the company to interpret well and correct the well-purposed objections and reclamations and to practice a continuous following of their contentment that would give a priceless source of information regarding the business analysis as well as their handling. In order to receive the information of the position of its products on the market successfully, it is necessary to collect and adequately value the data and the parameters of the users in terms of the product, about their experiences and expectations, as well as their level of contentment.

As to the question whether there are some new improvement of the business processes and changes that have significantly influenced towards the business results to their companies, here are the results:

- 52 of them or 34,3%, *have introduced new technology;*
- 47 of them or 31,4%, *included new products/ services;*
- 26 of them 17,1%, *have realized an improvement of the marketing concepts and strategies;*
- 21 of them or 14,3%, made some significant improvements of the business processes or the organizational methods;
- 5 of them or 2, 8%, Claimed that the step that significantly influenced over their business results was their proactive reaction of the company's working.

Technical and technological equipment of Macedonian companies is nearly up to a satisfactory level and at some point it fulfills the current requests of the buyers/ users. The problems mainly come from a weak marketing approach (only 17% of them have realized an improvement of the marketing concepts and strategies), bad organized business processes or the organizational method) and the inability to fulfill the requested quality standard. This same technology when applied in Macedonia gives out bad results. The reasons are not only in lacking in modern technology but a weaker abilities of the managers, qualifications and the fulfillment of the employees and quality of leading the business processes.

The demanding for high quality of products/ services impose not only a need to supply equipment but investing into education and training of the employees, reengineering of business processes as well as a permanent improvement of the quality system. Strong competition can be survived only by those that are well organized, own a qualified working capital and ones that definitely invest into the organization innovativeness.
Modern market condition imposes an analysis of the position of the competitive sides and their strategy, besides the desires and needs of the purchasers. The marketing activities at those companies need to focus on enrichment of assortment and quality of products/ services, determining constant markets and achieving new and richer cooperation with the foreign partners.
As to the question what is the pricing quality of the new companies, here are the results:

- 97 of the examined or 64%, determine the prices according the costs and their own policy;
- 36 of them or 24%, do it through comparison with the competitive sides;
- 12 of them or 8%, according to demand/ offer;
- 6 of them or4%, *upon the influence of foreign partners.*

According to the given aspects it is shown that during the process of price determining there is a huge influence from the detailed analysis of the competition as well as the market potential.
Building policy and strategy in comparison with the best, using benchmarking strategy should not be turned into imitating, direct copying of the competition i.e. a direct support of the competitive products which appears as one of the massive phenomena and trends in Macedonia; it is also done through manipulation of the purchasers. All of the abovementioned leads to an uninventive approach, breakage of own creativity, crashing own working standards etc. Successful firms use the benchmarking as a possibility for creation and not imitating [2].
As to the question which companies are compared while creating the policy, here are the results:

- 103 of the examined or 68%,claimed that they make a constant comparison of their own abilities in regard to the competition from the same branch and undertake measures for quality improvement;
- 38 of them or 25%, *compare with the best companies worldwide;*
- 5 of them or 3,5%, *make comparison with the competitive sides from the same field and do not take any improvement measures;*
- 5 of them or 3,5%, *do not compare with any other.*

In order to improve the competitive of our products the innovators should be stimulated, new technologies and innovation need to me conducted, some research centers should be developed and some of the world achievements should be followed (by purchasing licenses and other rights and by establishing a cooperation with foreign partners).

The competitiveness can be improved by practicing training on regular basis and achieving an additional knowledge among the employees in order to raise their qualification potential.

How does the company formulate, develop and question its policy and how does it switch into plans and actions? The question what is the key to their competitiveness on the market, here are the results:

The companies in Macedonia are aware of the necessity to provide quality of products/ services as one of the condition to become competitive on the market. Through an analysis of data, the question what is competitiveness for them, here are the received results:

- *quality of products/ service;*
- *quality confidence of the products/ services;*
- *long-term tradition/ established reputation;*
- *achieved image;*
- *organization innovativeness;*
- *low prices;*
- *other.*

Under *"other"* the examined have listed:

- *adjustment to the needs of the market;*
- *business;*
- *fast problem solutions;*
- *kindness and cordiality of the employees;*
- *modern technology;*
- *marketing and knowledge about the promotion of its products and services;*
- *specialized expertise or specialized products;*
- *knowledge about foreign markets.*

As with the Pareto analysis, it could be concluded that 108 (71, 5%), of the examiners claimed the quality of products/ services as a key factor of the competitiveness of their products/ services on the market.

The rest of them claimed the following:

- 15 of them or 9,9%, for confidence;
- 10 of them or 6,6%, *long-term tradition and only;*
- 5 of them or 3,3%, for organization innovativeness.

The company's innovativeness is in a very small percentage. This is a consequence of the inadequate attitude of the top management towards the innovativeness (not being respected for the employees, not being rewarded and not investing into innovativeness, research and development). As of all the researches worldwide [2] the innovativeness is placed on the second or the third place as a key factor of competitiveness.

As to all production companies the order of the key factors for competitiveness is the following: products quality, confidence, long-term tradition, image, exception is the food processing industry to which the innovativeness comes on the second position.

This refers to those companies that sell knowledge and the ones owning monopoly among the Balkan countries and so on such as Mikrosan, MZT pumps, MZT Hepos etv.

The key for competitiveness of Macedonian banks is the following: regardless sounding absurd, the non-development of Macedonian banking system is the best protection during this global crisis. Macedonian banks are conservative and focused mainly to collect deposits and give credits, while the investment banking is still unknown for many of them. None of them has compound financial instruments and disposal to risky markets within its portfolio.

CONCLUSION

The practice that Macedonian companies apply indicates that they do not pay much of an attention to the quality costs analysis as a result of ignorance and as a result of not being competitive enough on the market. *What those companies need to do is striving to minimize the costs meaning that they shouldn't use more than the necessary resources*. As an outcome*, it will arouse as a larger profit* because there is a huge difference between the price within the production and the selling price from minimal costs. *As from a lack of statistical approach for data processing, the evaluation of quality and transfer of information, there are many huge issues that Macedonian companies deal with through their placement on the domestic and foreign market.*

The condition that Macedonian companies have is significantly different that the ones worldwide, which generally based on TQM principles. But, the positive fact is (as confirmed with the research) that the attitude towards quality is changing in Macedonia. In the recent years as of the introduction of the market reforms, the tendency towards including Macedonia into the European associations is largely emphasized. Therefore the attitude of the managers itself that are prepared to achieve a top quality changes as well.

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APPLICATION OF MULTICRITERIA DECISION IN ENTREPRENEURSHIP

Subota, D.
Wirtschaft Universität Wien, Austria
E-mail: subota.j.damir@hotmail.com

Abstract: This paper has several criteria analysis of short-term business plans considering small entrepreneur attempts with help of PROMETHEE-GAIA methodology and the choice for the most optimal solution. Due to offered business plans referring different activities and approximately same financial investment and with the appliance of PROMETHEE-GAIA method, the future entrepreneur should choose the alternative (entrepreneur attempt) which is going to be the best for his needs.
Keywords: entrepreneur, business plan, multi criteria analysis, PROMETHEE-GAIA method

INTRODUCTION

The great number of entrepreneurs has many difficulties to make the decision about creating new business. Even when such decision is made there is a question which activity to choose if there are a number of alternatives, or, simply which business to choose. In recent years, new methods of assessing a firm's risk were developed, which thanks to the advancements of computer and information science. [17]
Rating is also needed when the decision is made which alternative to choose. In some cases such ranking will be spontaneous, based on knowledge and experience of the decision maker, while in some other cases such ranking has to be based on ranked in different ways at a given time depending on the person performing the ranking . These diferences are based on using different criterions of business efficiency and diffrent methods. Efficiency is a complex and multidimensional concept whose contents depend upon decisions within an economic system and upon the features of the current economic policy. [2]
This work will perform ranking of business plans based on determine criterions using the method of multicriteria decision-making. We shall use the PROMETHEE-GAIA method for final ranking.

METERIAL AND METHOD

The relatively large amount of data generated in a practical research made it difficult to compare the sites and important particle sizes using univariate analysis only. This problem was overcome by using multivariate approaches in order to explore and understand relationships between the objects and the variables. [13] The selected particle size ranges and sites were ranked with the help of multi criteria decision making methods (MCDM). [10]
Like all outranking methods, PROMETHEE proceeds to a pair of wise comparison of alternatives in each single criterion in order to determine partial binary relations denoting the strength of preference of an alternative
precise evaluations and application of various methods. The very same set of enterprises can be a over alternative b.[5] The evaluation table is the starting point of the PROMETHEE method. In this table, the alternatives are evaluated on the different criteria. These evaluations involve mainly quantitative data. The implementation of PROMETHEE requires two additional types of information, namely:

- the information on the relative importance that is the weights of the criteria considered and
- the information on the DM preference function, which he/she uses when comparing the contribution of the alternatives in terms of each separate criterion . [14,12]

Weights. The weights coefficients can be determined according to various methods. [15] In the present paper, weight factors reflecting the DMs previous experience and their insights are adopted.
Preference function. The preference function (Pj) translates the difference between the evaluations obtained by two alternatives (a and b) in terms of a particular criterion, into a preference degree ranging from 0 to 1. Let

$$Pj(a,b) = Gj[dj(a,b)] \forall a,b \in A, \tag{1}$$

$$dj(a,b) = fj(a) - fj(b), \tag{2}$$

$$0 \leq Pj(a,b) \leq 1 \tag{3}$$

be the preference function associated to the criterion, fj(i) where Gj is a no decreasing function of the observed deviation (d) between fj(a) and fj(b). In order to facilitate the selection of a specific preference function, six basic types have been proposed: usual function, U-shape function, V-shape function, level function, linear function and Gaussian function [8,16] .

Individual group analysis. PROMETHEE permits the computation of the following quantities for each alternative (a) and (b):

$$\pi_r(a,b) = \sum_{j=1}^{k} Pj(a,b) w_{r,j}; \tag{4}$$

$$\varphi^+(\alpha) = \sum_{x=A} \pi_r(x,a); \tag{5}$$

$$\varphi^-(\alpha) = \sum_{x=A} \pi_r(a,x); \tag{6}$$

$$\varphi(\alpha) = \varphi^+(\alpha) - \varphi^-(\alpha); \tag{7}$$

For each alternative (a), belonging to the set A of alternatives, π(a,b) is an overall preference index of (a) over (b), taking into account all the criteria, φ+(α) and φ−(α). φ (α) represent a value function, whereby a higher value reflects a higher attractiveness of alternative (a) and is called net flow. [9,8]

- m - indifference threshold;
- n - strict preference threshold;
- σ - middle value between m and n.

The two main PROMETHEE tools can be used to analyze the evaluation problem:

- the PROMETHEE I partial ranking,
- the PROMETHEE II complete ranking.

The PROMETHEE I partial ranking provides a ranking of alternatives. In some cases, this ranking may be incomplete. This means that some alternatives cannot be compared and, therefore, cannot be included in a complete ranking. This occurs when the first alternative obtains high scores on particular criteria for which the second alternative obtains low scores and the opposite occurs for other criteria. The use of PROMETHEE I, then, suggests that the DM should engage in additional evaluation efforts.

PROMETHEE II provides a complete ranking of the alternatives from the best to the worst one. [16] Here, the net flow is used to rank the alternatives.

Additional tools, such as the ‘walking weights’, can be used to further analyze the sensitivity of the results in function of weight changes.

GAIA, on the other hand, is a descriptive complement to the PROMETHEE methods, which makes use of the principles of principal component analysis (PCA). The GAIA plane corresponds to the projection of PROMETHEE II results on the first two orthogonal principal components. [8,9,11] Criteria or variables are then represented by axes or vectors, whose orientation and length illustrate the importance of the variables. Axes oriented in similar directions correspond to variables that are in general agreement and the length of the variable vector shows the amount of important deviations observed. Thus, a variable with a larger deviation will have a longer axis than a variable with a small deviation. Further information on how to use PROMETHEE and GAIA as well as the algorithms for these procedures has been documented elsewhere. [5,6,18].

Multi criteria analysis of small enterprises

Considering the facts that in Serbia as well as in the whole world in the last few years there is a great importance of independent entrepreneur development and there is a great number of people who have lost their jobs in the period of transition, people are constrained to think about starting their own business and opening their own companies. Therefore, many institutions have been founded to give advice to future entrepreneurs, to make business plans and to help clarifying anything that is ambiguous in that process.

This paper presents one possibility of future business. The future entrepreneur has ten business plans to choose from and they all satisfy his financial and other personal needs. He has to select the right one which will give the best results by any criteria. All business plans are harmonized with current prices of products or services in Serbia, with the price of workforce in that field, with the costs in the similar companies and with taxes set by law in Serbia. So, it is about short-term business plans which refer on period of time for five years.Given options are referred to present market production and service needs of local community.The characteristics of the alternatives have been following describes the 10 possible solutions used in the evaluation (Table 2): (A1 - Catering service; A2 - Beauty salon; A3 - Production of wedding-dress; A4 - Balloon production; A5 - Honey production; A6 - Gaming establishment for children; A7 - Internet club; A8 - Pizza restaurant; A9 - Chicken farm; A10 - Flower shop (Selling of fresh flowers)). The future entrepreneur has chosen nine criteria based on the economic indicators, which he thinks are the most important for choosing own business, and has given them proper weights (Table 2): (K1-Number of employee; K2-Revenues; K3-Competitors; K4-Material cost; K5-Gross earnings; K6- Nonmaterial cost; K7-Income tax; K8-Internal Rate of Return; K9-Investments).

Therefore he has given every criterion one of the six types of function of preferences, which are shown in the Table 2. Quantity values are given, with the help of the scale from 1 to 10, to those criteria that are descriptively (quality), shown in the Table 1.

Table 1. Linear scale used to quantify the quality attributes

0	1	2	3	4	5	6	7	8	9	10
Extremely low			Low		Middle		High		Extremely high	

Table 2. Evaluation table

	Criteria								
	K1	K2	K3	K4	K5	K6	K7	K8	K9
Min/max	min	max	min	min	min	min	min	min	min
	V-shape	Linear	V-Shape	Level	Level	V-Shape	Linear	U-Shape	V-Shape
Indiference threshold	-	1	-	1	1	-	0,250	1	-
Preference threshold	1	3	1,5	2	2	0,5	0,5	-	1,5
A1	3	144000	21157	9550	95700	4500	1309,3	1,36	5
A2	5	280100	8000	39500	165300	10000	5730	0,12	7
A3	6	182250	6900	24900	90000	2125	5832,5	1	3
A4	2	118000	16434	34000	42000	5500	2006,6	3	3
A5	3	120000	21255	27500	47250	5500	1849,5	4	5
A6	2	120000	17734	22500	42000	7500	3026,6	2,6	1
A7	2	129600	20691	32500	42000	5500	2890,9	3	5
A8	2	140000	12007	27500	42000	11250	4724,3	1,2	5
A9	4	371520	26400	96288	72000	6000	17083,2	1,4	3
A10	2	130000	16543	28500	42000	5000	3795,7	1,9	5
Weights	0,05	0,2	0,2	0,08	0,05	0,04	0,04	0,14	0,2

Different types of software can be used to help this decision making process. [11] In further research, methods referred to as PROMETHEE and GAIA were used with the aid of DecisionLab software.
PROMETHEE I ensure partial ranking with positive and negative preference flows, while PROMETHEE II is enabling complete ranking, which balance these two preferences flows (positive-input and negative-output) and seek the best compromise. [6,7,8,9]
Decision problem is presented graphically by GAIA analysis which ensures complete examination overview of conflicts between criteria, action characteristics and weight measured parameters. In Decision – Lab this method is used together with 3D so it could help the decision makers to identify the best compromise decisions. Its orientation is a compromise which matches ranking by PROMETHEE II method. For making decisions GAIA plane ensures, as it is shown on Figure 1**,** easier and more content view. Criteria in plain are shown with green squares, so if we look at orientated axis, we can quickly identify conflicts between criteria. Alternatives are shown with blue triangles, so their position in plain enables identification of strong and slack properties of alternatives. Decision Pi axis presents weight of measured parameters. It is a compromised illustration which matches weights parameters. If we change weight criterion parameters, we can see in GAIA plane how the decision axis is moving.
One of the advantages of using PROMETHEE and GAIA in this work was that PROMETHEE ranked the each alternative for given criterions while the GAIA plane is a useful analytical tool that some remarks can be detected from the alternatives. [1] Another advantage of these MCDM is that GAIA incorporates a decision axis, pi, which complements the decision from the PROMETHEE ranking. When pi is long, the most preferred objects are oriented in its direction and furthest from the point of interception of the principal component 1 and principal component 2 axes. With the “minimized” modeling option, variables which are associated with particular objects were displayed opposite those objects. Quadratic shapes represent the variables in the GAIA-analysis (number of employee, revenues, competitors, material cost, gross earnings, nonmaterial cost, income tax, internal rate of return, investments), while the size fractions of each site are represented by rectangle shapes.
In this case based on the positions of criterions in GAIA plane it is obvious that all criterions are very conflict among each other (different axis directions). Also some alternatives are very good for specific criterion (directed in place of the certain criterion). For example, alternative A9 is good for criterion, K2; alternative A2 is good for criterion K8, etc., also some alternatives are good for several criterions. According to the positions of alternative A3 and directions of decision axis, pi, we can also conclude that this option is the best solution since it is directed in orientation of decision axis.

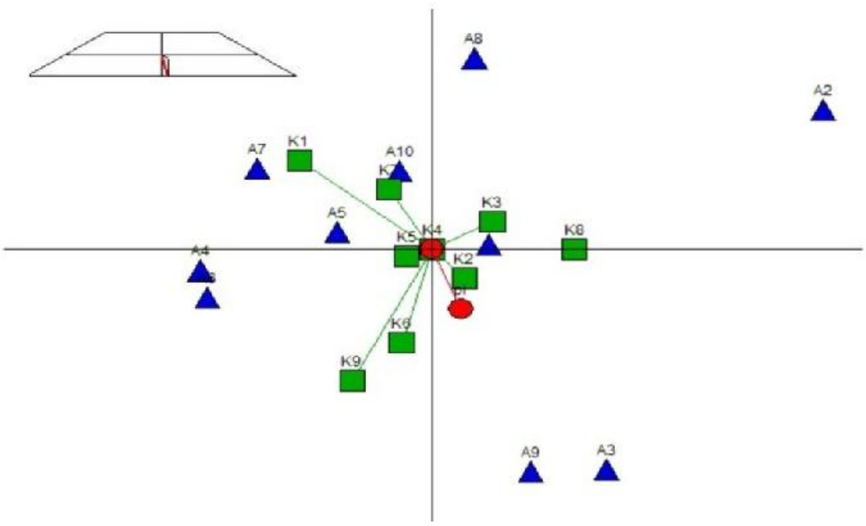

Figure 1. GAIA plane with decision stick

CONCLUSION

This paper introduced multi criteria decision making approach based on the PROMETHEE-GAIA method, applying it in hypothetical selection of the final solution of multi-objective optimization problem. The MCDM process has been used to define the most optimal business plan concerning on future business. On the basis PROMETHEE I, PROMETHEE II and PROMETHEE-GAIA analysis we can conclude that the most optimal solution to decision maker is alternative A3, then also are acceptable and alternatives A6 and A9 while the worst solutions are A1, A7 and A5. If decision maker chooses alternative A3 he will gain enterprise that is the most convenient to his financial possibilities and criterions of maximal incomes and minimal losses what is the main goal for every entrepreneur.

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PROCESS OF DECISION MAKING REGARDING SELECTION OF MANAGERS

Stanković, M.[1], Živković, M.[2], Cincar Škrinjarić, S.[3], Atanasković, P.[4], Z.[5], Sajfert
[1]Business – Tehnical Faculty in Diboj, Bosnia and Herzegovina
[2]Astra Plan, Brčko, Bosnia and Herzegovina
[3]Univerzity of Osijek, Medicinal Faculty, Hrvatska
[4]Univerzity of Novi Sad, Fakulty Tehnical sciencie Novi Sad
[5]Univerzity of Novi Sad, Tehnical Faculty "Mihajlo Pupin", Zrenjanin
E-mail: z.sajfert@sbb.rs

Abstract: This paper exemplifies the possibility of applying fuzzy logic into the process of decision making regarding the selection of executive managers. The decision making process related to the selection of executive managers has been conceived in such a way that human resource (HR) departments assess candidates with application of a grade system. Candidates can be assessed against defined mangers' goals. Research concerning managers' general goals has been used for this paper and the goals which research has proved to be of the greatest relative weight have been selected. The application of fuzzy logic, along with a multi-criteria analysis, is very convenient for decision making (selection of candidates, optimization of processes, choice of the optimal variant, etc) when there is vagueness, uncertainty and a great number of candidates. This paper discusses the process of making an optimal - preferential decision (choice of an optimal manager for leading positions in a company) by application of fuzzy logic and a fuzzy system.
Key words: Manager, fuzzy logic, fuzzy systems, manager's goals, optimization, selection.

INTRODUCTION

Selection of an optimal manager for a leading position in a company is a very important strategic decision for a human resource (HR) department in a company. The role of the HR department is to screen a number of received applications and select an optimal candidate among those who are applying for the position of an executive manager. Recruitment and selection of the optimal candidate can be carried out in many ways – through individual assessment of candidates, testing of candidates, requesting formal qualifications, specific work experience or achieved results, application of a multi-criteria analysis, etc. The selection of an optimal candidate can also be conducted by taking into consideration a number of candidates from the perspective of their personal goals in the role of a manager.

Those responsible for making decisions regarding an optimal candidate for a manager's position in a company are rarely faced with a situation that only one candidate has responded to the job advertisement. Almost always, a great number of candidates apply for the job so that the candidates should be ranked and a conclusion drawn as to which of them may be an optimal choice for the company.

The process of making a decision with respect to an optimal candidate for an executive manager by application of fuzzy logic, in accordance with criteria describing manager's defined and relevant goals, will be explained in this paper.

MANAGER'S GOALS

According to Weihrich and Koontz (Weihrich, Koontz, 1993) the goal of every manager is to create added value (this means profit in business organizations). Clear and measurable goals facilitate measuring of that extra value, successfulness and effectiveness of manager's activities. They (Weihrich, Koontz, 1993) argue that manager's goals express the final results and the totality of goals should be supported by objectives of lower ranks. Moreover, organizations and managers have multiple goals that sometimes may be mutually compatible, so that they do not lead to arising of conflicts in organizations or within a group or even individuals. Managers at different organizational levels are concerned with different types of goals.

According to Rensis (Likert Rensis, 1967), some of manager's goals can be clustered around the factors (motives) such as leadership, professionalism, prestige, creativity, solidarity, wealth, independence, love, safety, sense of duty and satisfaction.

In the process of research into managers' goals in a number of companies 442 managers occupying leading positions (who run companies, lead a part of a company or its sector) were surveyed. Each manager had at least ten employees in their work environment doing different work and tasks. The research objective was to establish, based on the survey, the most important manager's goals. 11 manager's goals were investigated in that survey. The results were statistically processed and statistical estimation of the relative weight (ώ) derived.

As this paper aims at presenting a possible approach to the selection of an optimal manager by application of fuzzy logic, the four most important manager's goals with the corresponding resulting relative weights are presented in the following table.

The relative importance of criteria $\tilde{W}_k,\ k=1,\ldots,K$, has been obtained through defuzzification and normalization of fuzzy weights in the following way:

$$w_i' = \left[\prod_{j=1}^{n} \lambda_j w_{ki}\right]^{1/n} \longrightarrow \tilde{w}_{ki} = \frac{\lambda_j \cdot \tilde{w}'_{k_i}}{\sum_{j=1}^{K} \lambda_j \cdot \tilde{w}'_{k_i}} = \left[\prod_{j=1}^{n} \lambda_j w_{ki}\right]^{1/n} \cdot \left\{\sum_{i=1}^{n}\left[\left[\prod_{j=1}^{n} \lambda_j w_{ki}\right]^{1/n}\right]\right\}^{-1} \qquad (1)$$

$$\sum_{j=1}^{K} \tilde{w}_k = 1,\ \tilde{w}_k\ \grave{o}\left[0,1\right],\ \lambda \in \left[0,1\right] \qquad (2)$$

where λ_j stands for the decision maker's preference, i.e. degree of confidence.

Table 1 presents the relative importance of criteria $\tilde{w}_k\ ,k=1,\ldots,K\ \left(K=5\right),\ k=1,\ldots,K\left(K=5\right)$ and the degree of influence on the choice of the manager.

According to the conducted survey, the most important manager's goals are:

Table 1. Manager's Goals with Relative Weights (ώ)

Goal	Manager's goal	Resulting relative weight ώ
K1	Wealth	0,20
K2	Prestige	0,22
K3	Professionalism	0,28
K4	Leadership	0,30

The stated goals will represent the relevant criteria (Ki), based on which an optimal choice of the manager through application of fuzzy logic and fuzzy systems can be made in the selection process for an executive position.

BASIC CONCEPTS OF FUZZY LOGIC AND FUZZY SETS

The basis of this field was formed by Professor Lotfi Zadeh in 1965. Professor Lofti Zadeh is considered the founder of fuzzy logic. According to Professor Zadeh, fuzzy logic has two different meanings. In the narrow sense, fuzzy logic is a logic system that is an extension of classical logic. In a broader sense, fuzzy logic is mostly a synonym with the fuzzy set theory – the theory that refers to the class of objects with unclear borders, whose membership is measured in specific degrees. It is of great importance to recognize that fuzzy logic is different from traditional logic systems.

Fuzzy logic is very close to human perception. In its essence, fuzzy logic is many-valued logic that admits some medium values between traditional statements: yes/no, true/false, white/black.

Fuzzy logic draws on the experience of experts in the form of linguistic if-then rules. In our example, it will be used to demonstrate the impact of input criteria (K1-K4) on preferences in making the decision on the choice of the optimal manager.

Optimization of choice by application of fuzzy logic in practice has been applied many times: Belman and Zadeh (1970) – in management projects; Kabbara (1981), Tanaka and Asai (1984) - particularly structural design; Blockely (1980) - optimal choice of contractor; Teodorovic and Kikuchi (1991) – resolving problems in traffic and transport; Pamučar (2009) – organizational structure design; Božanić and Pamučar (2010), Pamučar et al (2011) – application of fuzzy logic in decision making processes in the armed forces.

The first task in fuzzy set design is to define the membership function: This function shows to what degree $x \in A$ meets the condition of membership to set A. In classical logic there are clearly established rules that define the boundaries of membership of a certain element to a set and set apart those elements that are not included in the set. We can say that in this case there are two possibilities – either the given elements is included or not included in the specific set.

That given element x is included in set A can be mathematically described by means of membership function $\mu_A(x)$ in the following way:

$$\mu_A(x) = \begin{cases} 1; & x \in A \\ 0; & x \notin A \end{cases} \tag{3}$$

Formally, a fuzzy set is defined as a set of ordered pairs:

$$A = \{x, \mu_A(x) \mid x \in X\} \tag{4}$$

Where $\mu_A(x)$ is a degree of membership of element x to set A.

In fuzzy theory, choice of membership function and the range of discourse are usually made on the basis of subjective assessment or experience. Membership functions may take different shapes. Fuzzy numbers with membership functions: triangular, trapezoid, Gauss curve...are most often used.

Figure 1 shows the fuzzy set membership function which is most frequently used in work.

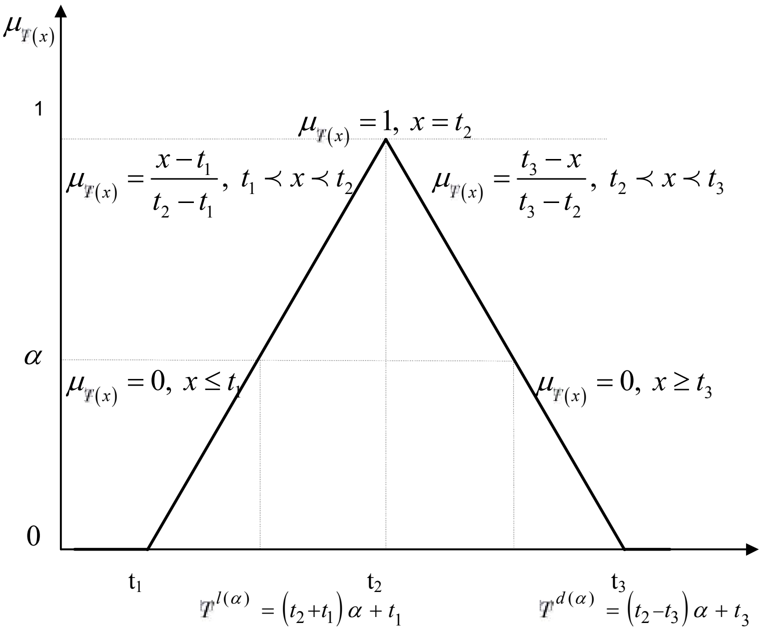

Figure 1. Fuzzy Set Membership Function

As shown in Figure 1, the membership function for the given fuzzy set is defined as:

$$\mu_T(x) = \begin{Bmatrix} 0, & 0 < x < t_1 \\ (x - t_1)/(t_2 - t_1), & t_1 \le x \le t_2 \\ (t_3 - x)/(t_3 - t_2), & t_2 \le x \le t_3 \\ 0, & x > t_3 \end{Bmatrix} \tag{5}$$

MODELLING OF FUZZY SYSTEMS FOR EVALUATION OF CRITERIA RELATED TO CHOICE OF OPTIMAL MANAGER

The main parts of each fuzzy logic system are: fuzzification, rules, conclusion and defuzzification. The notion of fuzzification implies the representation of input values in such a way that they can be applicable in fuzzy logic. In other words, fuzzification is used for mapping numeric input values onto a fuzzy set:

$$F \quad : \; X \rightarrow X^{FUZ} \tag{6}$$

where all fuzzy sets which can be defined on domain x are marked as X^{FUZ}

The following part is rules or as some name it rule base. The problem posed to a fuzzy system is how to transfer expert linguistic knowledge into it. This means that the way how input values are mapped onto output values is to be found.
The basic way to achieve this goal is a list of so called IF-THEN statements which are named rules. The set of these rules is called the rule base. Their order is not important since they are executed in parallel. Rules are executed through the mechanism of approximate reasoning. Approximate reasoning is a form of fuzzy logic which contains a set of rules for reasoning whose premises are fuzzy propositions. Each rule contains an assumption (if part) and a consequence (then part). Each assumption may have many parts, depending on the number of input values. The rules are interconnected by expression „else“(or). The operations of union, intersection and complement have their equivalents in fuzzy logic represented by conjunctions "and", "or" and "not". By combining them, complex rules can be constructed. The maximum number of rules is limited by the number of input values, as well as by the number of linguistic variables they can take. If there are A input values, and each of them take B linguistic variables, the maximum number of rules which can be generated is b^a.

The rules using „if-then” format can be generally presented as follows:

- If A is small and B is small, then C is small
- If A is small and B is medium, then C is medium

In reality, the most frequent input values are represented by numbers, in which case the output value is also obtained in a numerical form. In a fuzzy system, on the other hand, the given system is described verbally (qualitatively) through production rules. For that reason, numerical values are converted (fuzzified) first by application of fuzzy logical operations, and then they are processed by the mechanism of approximate reasoning in the fuzzy system through the phases of aggregation, activation and accumulation (Pamučar, 2009). The numerical output value is obtained by defuzzification process. Figure 2 presents the process of approximate reasoning.

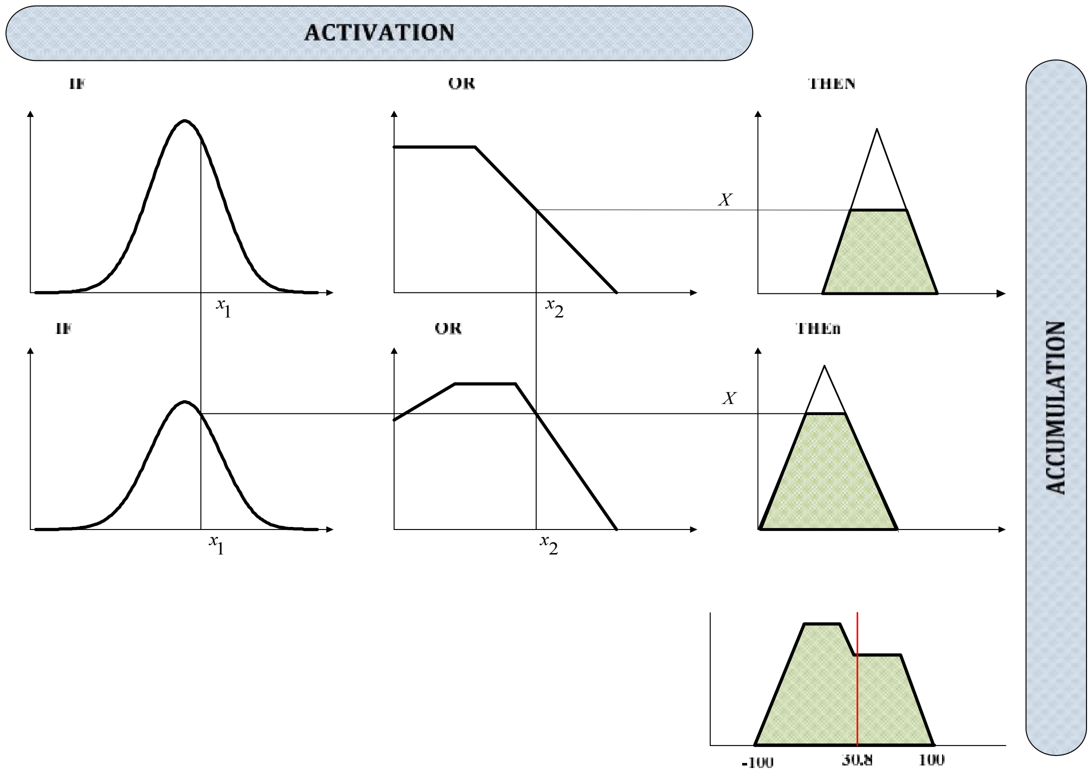

Figure 2. Graphical representation of the process of approximate reasoning

The criteria for the selection of an optimal manager (decision preference) are in fact the goals which that manager has to attain. Each manager can be assessed in a different way by the HR department in accordance with the assessors' estimation.

The candidates are assessed against the following criteria (goals):

K1 – wealth

K2 - prestige

K3 –professionalism

K4 - leadership

The values of input criteria are represented by numbers. The universes of discourse range within a numerical interval of [0,10], given the assumption that the HR department will use a marking scheme with grades 1 – 10 for each candidate.
The value of output variable *decision preference* for choice of an optimal manager will fall within the interval of [0,1].
Each criterion in the fuzzy model has three linguistic values, and they are:

- wealth (poor, good, excellent)
- prestige (poor, good, excellent)
- professionalism (poor, good, excellent)
- leadership (poor, good, excellent)

Output variable *decision preference* has values: poor, good, very good, excellent.

Based on the written concept of the model, conditions are created for the given system to be modelled as a complex fuzzy system, Figure 2.

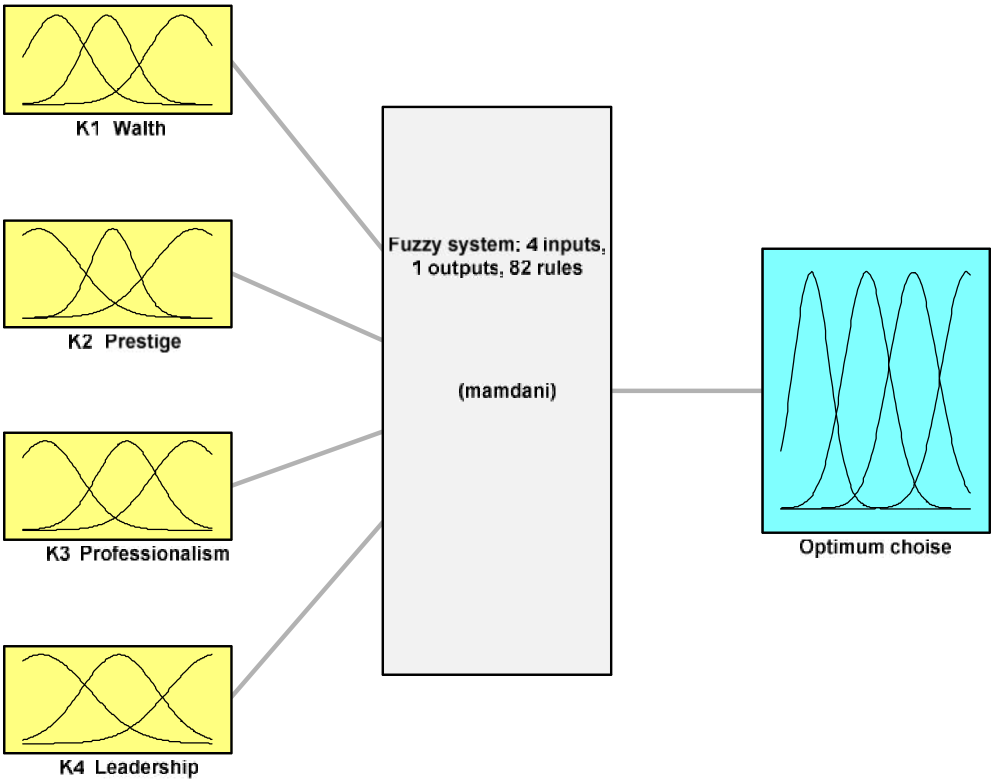

Figure 3. An Overview of General model of a fuzzy system

For the specified criteria based on which an optimal manager will be chosen by application of fuzzy logic against the goals (assessment against criteria), the membership function of input and output linguistic variables are specified. The choice of the shape of the membership function and universe of discourse is a very important phase in fuzzy set modelling. The membership function of the Gauss curve has been selected for this fuzzy system.

Linguistic variable – *criterion wealth* has Gaussian shapes of membership functions of linguistic values with the following parameters: poor rating (2.1 1.53), good rating (1.8 4) and excellent rating (1.36 9.39). It should be noted that the linguistic evaluation, the value for good rating, is defined on the basis of the comparative relation between the relative weight of this criteria and the table, in relation to the marking scheme 1-10.

Linguistic variable – *criterion prestige* has Gaussian shapes of membership functions of linguistic values with the following parameters: poor rating (2.37 0.95), good rating (1.167 4.83) and excellent rating (2.23 9.55). It should be noted that the linguistic evaluation, the value for good rating, is defined on the basis of the comparative relation between the relative weight of this criteria and the table, in relation to the marking scheme 1-10.

Linguistic variable – *criterion professionalism* has Gaussian shapes of membership functions of linguistic values with the following parameters: poor rating (2.187 1.75), good rating (1.6 5.5) and excellent rating (2 8.83). It should be noted that the linguistic evaluation, the value for good rating, is defined on the basis of the comparative relation between the relative weight of this criteria and the table, in relation to the marking scheme 1-10

Linguistic variable – *criterion leadership* has Gaussian shapes of membership function of linguistic values with the following parameters: poor rating (2.54 0.9), good rating (2 7) and excellent rating (2.4 9). It should be noted that the linguistic evaluation, the value for good rating, is defined on the basis of the comparative relation between the relative weight of this criteria and the table, in relation to the marking scheme 1-10

The following figures (4, 5, 6, and 7) show the input membership functions.

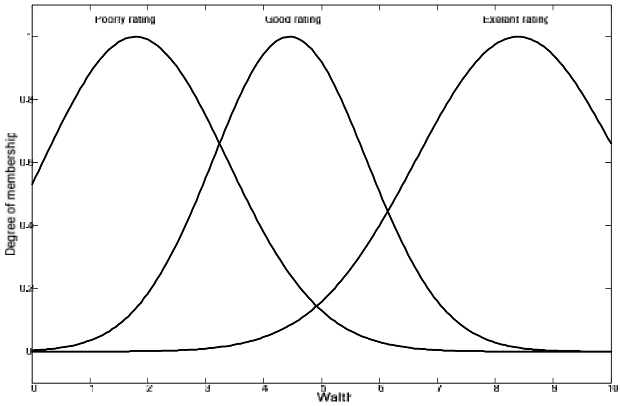

Figure 4. Input Membership Function for Criterion *Wealth*

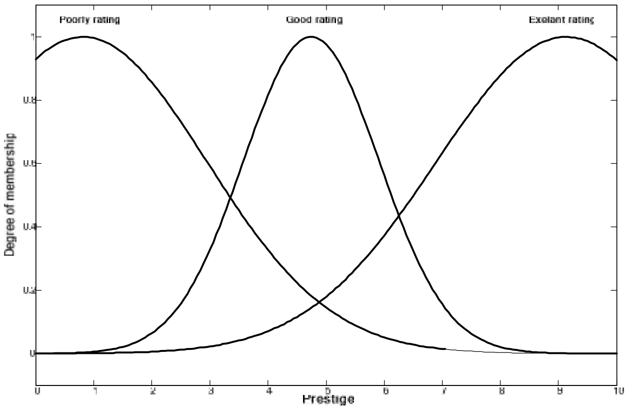

Figure 5. Input Membership Function for Criterion *Prestige*

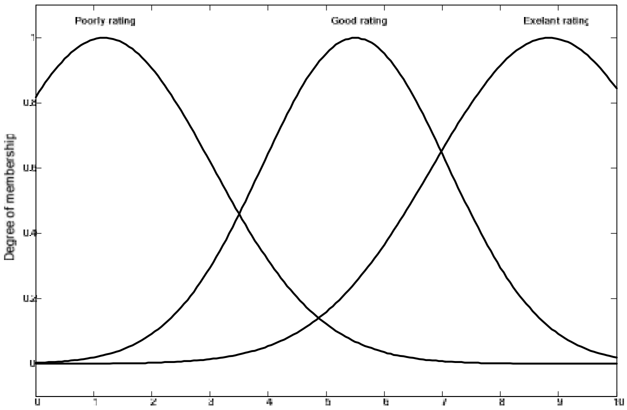

Figure 6. Input Membership Function for Criterion *Professionalism*

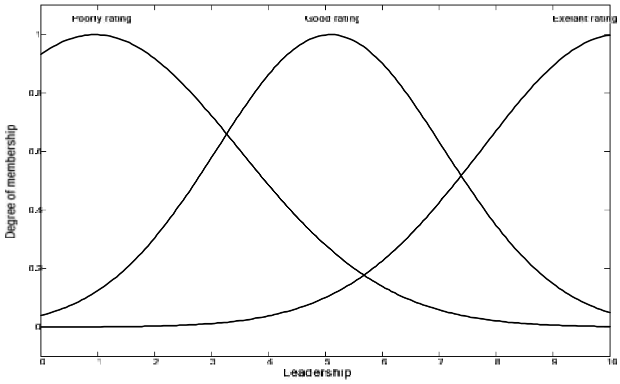

Figure 7. Input Membership Function for Criterion *Leadership*

The output linguistic variable – decision preference or optimal choice (Figure 8) also has the shape of the Gaussian membership function of linguistic values with the following parameters: poor rating (0.19 0.1608), good rating (0.15 0.425), very good rating (0.14 0.7) and excellent rating (0.144 0.98). The following figure shows the output membership function – *decision preference*.

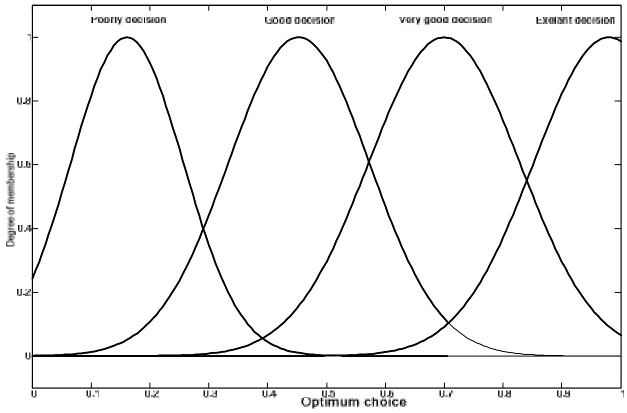

Figure 8. Output Membership Function – *Decision Preference*

Linguistic rules have to be created as a link between the input and the output of the fuzzy system. The purpose of all the rules to be created is to „assess and optimize"the output results. In this paper, considering the presence of four linguistic variables A (criteria) with three linguistic values B each, the number of rules is 3^4= 81 rules.
One of the created rules reads:
Rules no. 9: IF K1(poor rating) AND K2(poor rating) AND K3(excellent rating) AND K4(excellent rating) THEN (output variable optimal choice is a good decision).
Rule no. 78: IF K1(poor rating) AND K2(poor rating) AND K3(excellent rating) AND K4(excellent (excellent rating) THEN (output variable optimal choice is a good decision).

Figure 9 shows the base of the sets of the created rules.

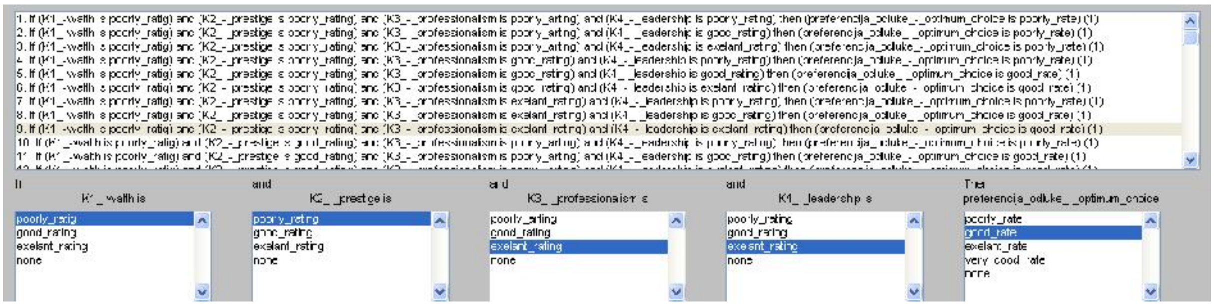

Figure 9. Base of Fuzzy Logic System Rules

The Centorid model was used for defuzzification of the system. The following formula was applied:

$$a = \frac{\sum_{i=1}^{K} p_i \int_u \mu_B(u)du}{\sum_{i=1}^{K} \int_u \mu_B(u)du} \tag{7}$$

where K stands for the number of rules, p_i for the centre of plane μ_B (the membership function of set B), which is the consequence of *i*-rule.

The following graphs depict sets of possible solutions (three dimensional fuzzy system transfer function).

The relation between criterion K-1 Wealth and criterion K-2 Prestige is shown in Figure 10.

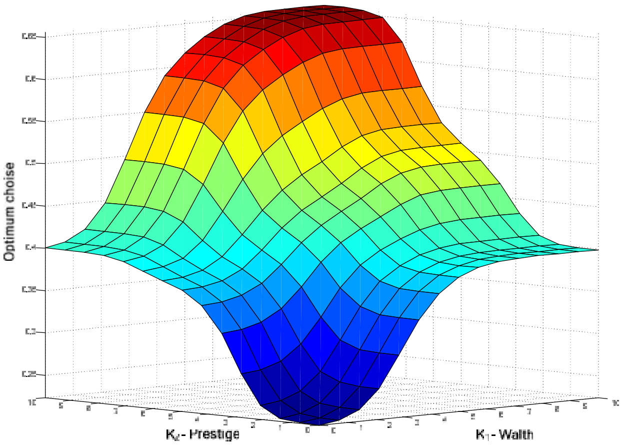

Figure 10. The Relation between Criteria K1and K2

The relation between criterion K-2 Prestige and criterion K-4 Leadership is shown in Figure 10.

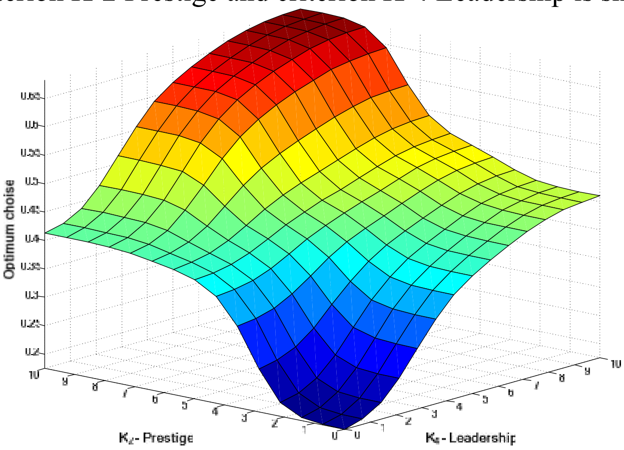

Figure 11. The Relation between Criteria K2 and K4

The relation between criterion K-3 Professionalism and criterion K-4 Leadership is shown in Figure 12.

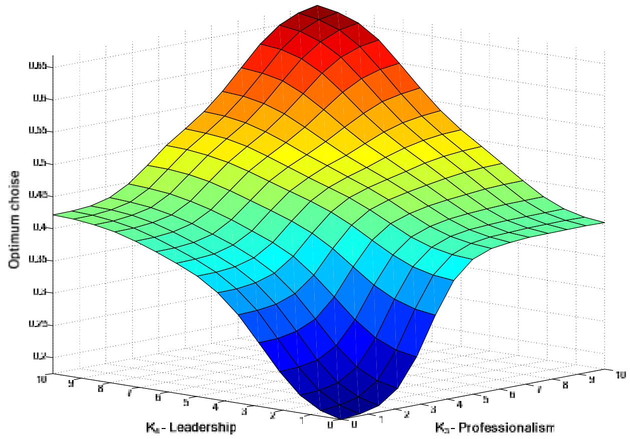

Figure 12. The Relation between Criteria K3 and K4

The relation between criterion K-1 Wealth and criterion K-3 Professionalism is shown in Figure 13.

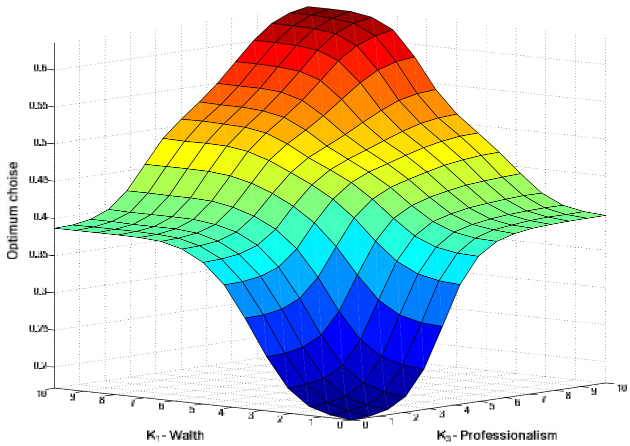

Figure 13. The Relationship between Criteria K1 and K3

TESTING OF FUZZY SYSTEM ON THE CHOICE OF OPTIMAL MANAGER AGAINST GOALS

Practical application of a model is a logical concluding phase of the subject research. The suggested model, based on fuzzy logic, can be applied in the cases where an adequate manager for an executive position in a company should be selected, and among many candidates only one has to be chosen. The Human Resource Department is responsible for selection. They assess and evaluate candidates for the manager's position based on qualifications and competences, but also against the candidate's goals (criteria K1-K4 in this case). The HR Department evaluate each individual candidate applying 1 to 10 grading scheme for each suggested criterion, and take the arithmetic mean grade Xisr for the evaluated value.
An example with five candidates applying for the same job who have been assessed against the manager's goals is shown in the following table (Table 2). The average grades are shown as the arithmetic mean grade (X*isr*) awarded to the candidate by the evaluating department.

Table 2. Mean Values of Candidates' Grades against Criteria

Candidate	Criterion K1 Wealth (grade)	Criterion K2 Prestige (grade)	Criterion K3 Professionalism (grade)	Criterion K4 Leadership (grade)
A1	6.4	5.6	7.0	8.0
A2	7.0	4.5	6.5	7.0
A3	8.0	6.5	4.5	8.0
A4	5.0	7.0	8.0	4.0
A5	5.5	3.0	9.0	9.0
A6	4.5	8.0	9.0	8.3

After applying the formed model, the following results have been obtained.

Table 3. Decision preference by application of fuzzy model

Candidate	Preferential decision Optimal decision
A1	0.540
A2	0.552
A3	0.617
A4	0.420
A5	0.460
A6	0.529

According to the given results, the most suitable candidate for an executive manager, by applying the model of fuzzy logic against the manager's goals (the observed criteria), is candidate A3, considering the highest degree of preference obtained as the output through the application of the created fuzzy model.

CONCLUSION

In most cases, decision making process comes down to experiential knowledge of the person who makes decisions. As there is the possibility that evaluators or decision makers may take a subjective approach to a candidate in decision making process, there is an objective possibility that a wrong choice can be made.

This paper has demonstrated that candidates for top positions in a company may be selected through application of advanced models based on fuzzy logic in accordance with the chosen criteria. The manager's goals relevant to this research and example are: wealth, professionalism, leadership and prestige. Undoubtedly, there are more criteria – manager's goals based on which a candidate can be assessed, but the objective we pursued in this paper was to present the application of fuzzy logic in making a choice and reaching a preferential solution.

Having analyzed the output results, we may conclude that a developed fuzzy system can be successfully used for assessing candidates against their goals and for creation of a decision making strategy in choosing the candidate.

In some of the papers to come, neuron networks can be used for the same purposes to upgrade this research.

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MINIMUM CRITERIA TO BE TAKEN INTO ACCOUNT BY MEMBERSTATES FOR THE NOTIFICATION OF BODIES

Đerić, A. [1], **Nikolić, J.** [1], **Petrović, A.,** [2]
[1] Univerzitet u Beogradu, Inovacioni centar Mašinskog fakulteta,
[2] Univerzitet u Beogradu, Mašinski fakultet
E-mail: adjeric@mas.bg.ac.rs

Abstract: This paper shows the definition for notified conformity assessment body and short procedure for obtaining notification to provide services for conformity assessment. It also shows comparison of minimum criteria that must been taken in consideration for notification of conformity assessment bodies, for a number of rulebooks. These rulebooks, created from the directives, are currently implemented in Republic of Serbia legislation. Modules of the conformity assessment are also shortly explained.
Keywords: designated body, conformity assessment, guidebooks, modules

INTRODUCTION

By the Decree on designation and notification of conformity assessment bodies ("Official Gazette of RS", No.98/2009) is defining the manner of designation and notification of conformity assessment bodies. Conformity assessment body is a body that performs conformity assessment activities including calibration, testing, certification and inspection. These activities are performed by laboratories, control and certification bodies.
Designation of a conformity assessment body for performing conformity assessment of products with requirements from particular technical regulation shall be performed upon request for designation, which is submitted by the conformity assessment body. The request shall be submitted to the Ministry responsible for drafting and adoption of the relevant technical regulation upon which the designation is requested. Fulfillment of the request for designation in accordance with the technical regulation shall be confirmed by the Commission competent for one or more technical regulations, appointed by the relevant Minister. The Commission shall comprise of minimum three members: at least one of which shall be a representative of the competent Ministry, a representative of the Accreditation Board of Serbia who has not been involved in the accreditation procedure and a representative of the Institute for Standardization of Serbia.
When Applicant proves its competence for performing conformity assessment in regards to particular technical regulation with accreditation certificate, the Commission evaluates the scope of activities for conformity assessment which is subject of the request for designation, in regards to the scope of activities for which the Applicant has already been accredited.
If the Commission establishes that the applicant fulfills the requirements for designation, it shall submit a proposal for designation to the competent Minister, or propose rejection of the submitted request, if it is established that the applicant does not fulfill requirements for designation. On the basis of the proposal, the competent Minister shall issue a decision on designation or decision on rejection of the request.
The competent Ministry shall submit the decision on designation to the Ministry responsible for maintaining the Registry of notified or authorized conformity assessment bodies, which shall register the notified body to the European Commission, in accordance with ratified international agreements where the Republic of Serbia is one of signatories.
Here are compared the minimum criteria that must been fulfilled for notification of conformity assessment bodies, for a number of rulebooks (created from the directives, and currently implemented in Republic of Serbia legislation):
- Rulebook on Machinery Safety ("Official Gazette of RS", No.13/2010);
- Rulebook on Electrical Equipment Designed for Use within Certain Voltage Limits ("Official Gazette of RS", No.13/2010);
- Rulebook on Electromagnetic Compatibility ("Official Gazette of RS", br. 13/2010);
- Rulebook on Lift Safety ("Official Gazette of RS", No.101/2010);
- Draft of Rulebook on Pressure Equipment;

- Draft of Rulebook on Testing and Examination of Pressure Equipment;
- Draft of Rulebook on Simple pressure vessels.

COMPARATION OF CRITERIA THAT MUST BEEN FULFILLED FOR NOTIFICATION OF CONFORMITY ASSESSMENT BODIES

In further text were analyzed the Rulebooks that were listed in the introduction.
Rulebook on Machinery Safety applies to the following products: machinery, interchangeable equipment, safety components, lifting accessories, chains, ropes and webbing, removable mechanical transmission devices and partly completed machinery. Products, to which this regulation does not apply, were defined under Article 3. Annex 11, of this Rulebook, contains criteria that must been fulfilled for notification of conformity assessment bodies:
1. The body, its director and the staff responsible for carrying out the verification tests shall not be the designer, manufacturer, supplier or installer of machines which they inspect, nor the authorized representative of any of these parties. They shall not become involved, either directly or as authorized representatives, in the design, construction, marketing or maintenance of the machines. This does not preclude the possibility of exchanges of technical information between the manufacturer and the body.
2. The body and its staff shall carry out the verification tests with the highest degree of professional integrity and technical competence and shall be free from all pressures and inducements, particularly financial, which might influence their judgment or the results of the inspection, especially from persons or groups of persons with an interest in the result of verifications.
3. For each category of machinery for which it is notified, the body must possess personnel with technical knowledge and sufficient and appropriate experience to perform a conformity assessment. The staff responsible for inspection shall have:
1) Relevant work experience and relevant authorization for carrying out conformity assessment;
2) The ability and confidence in the preparation of reports related to completed evaluation and the testing specified in this rulebook.
4. Conformity assessment body must have test equipment according to the requirements contained in the Serbian standards and machine types whose conformity is assessing according to relevant demands.
5. The impartiality of inspection staff shall be guaranteed. Their remuneration shall not depend on the number of tests carried out or on the results of such tests.
6. Conformity assessment body must have the appropriate general act which regulates the basic procedures for carrying out of conformity assessment, including the procedure for making complaints to the work and decisions of this body.
7. Conformity assessment body must have liability insurance.
8. The staff of the body shall be bound to observe professional secrecy with regard to all information obtained in carrying out its tasks under this Rulebook or any other regulation.
Modules for the conformity assessment procedures are modules B and H.
Rulebook on Electrical Equipment Designed for Use within Certain Voltage Limits applies to equipment designed for use with a voltage rating of between 50 and 1 000 V for alternating current and between 75 and 1500 V for direct current. Electrical equipment to which this regulation does not apply, is defined under Article 4. Annex 5, of this Rulebook, contains criteria for notification of conformity assessment bodies and they are same like criteria in Rulebook on Machinery Safety.
Module for the conformity assessment procedures is module A.
Rulebook on Electromagnetic Compatibility applies to equipment which may cause electromagnetic disturbance and/or to equipment to which working characteristics these disturbances can affect. Equipment and products, to which this regulation does not apply, are defined under Article 3. Annex 6, of this Rulebook, contains criteria for notification of conformity assessment bodies and they are same like criteria in Rulebook on Machinery Safety.
Module for the conformity assessment procedures is module A.

Rulebook on Lift Safety applies to lifts permanently serving buildings and constructions. It shall also apply to the safety components for use in such lifts listed in Annex 4 of this Rulebook. Lifts and products, to which this regulation does not apply, are defined under Article 3. Annex 14, of this Rulebook contains criteria for notification of conformity assessment bodies and in comparison with criteria from Rulebook on Machinery Safety (which is given as an example) there have been identified following differences:
- Rulebook on Lift Safety is not defining test equipment and appropriate general act which regulates the basic procedures for carrying out of conformity assessment,
- Rulebook on Lift Safety is not defining that personnel must have relevant authorization for carrying out conformity assessment, but defines it as follows:

1. The body must have at its disposal the necessary staff and possess the necessary facilities to enable it to perform properly the technical and administrative tasks connected with inspection or supervision; it must also have access to the equipment required for special verification.
2. The staff responsible for inspection must have:
- appropriate technical and professional training,
- satisfactory knowledge of the requirements for the tests they carry out and adequate experience of such tests,
- the ability to draw up the certificates, records and reports required to authenticate the performance of the tests.

Notified body for lift examination must fulfill minimum criteria, which are defined in Article 26, to obtain notification. To become a notified body, except requirements from Annex 14 from this Rulebook, it must fulfill requirements from Serbian standard SRPS ISO IEC 17020, and it must have at least one:
1. graduated electrical engineer (M.Sc.) or mechanical engineer, with minimum 5 years of experience in inspection and testing of elevators, to manage operations of review and /or testing of lifts,
2. graduated electrical engineer (M.Sc.) or mechanical engineer, with minimum 3 years of experience or graduated electrical engineer (M.Sc.) or mechanical engineer, with minimum 5 years of experience in inspection and/or testing of elevators,
3. one person with degree in vocational education like electrical or mechanical technician with minimum 5 years of experience in inspection and testing of elevators.

The Lift Safety Directive is not defining notification body for lift examination and criteria for notification of this body.
Module for the conformity assessment procedures is module B, E, H, G, C, and E.
Draft of Rulebook on Pressure Equipment applies to the design, manufacture and conformity assessment of pressure equipment and assemblies with a maximum allowable pressure PS greater than 0,5 bar. Equipment, to which this regulation does not apply, is defined under Article 3. Annex IV, of this Rulebook contains criteria for notification of conformity assessment bodies and in comparison with criteria from Rulebook on Machinery Safety (which is given as an example) there have been identified following differences:
- Rulebook on Pressure Equipment is not defining test equipment and appropriate general act which regulates the basic procedures for carrying out of conformity assessment,
- Rulebook on Pressure Equipment is not defining that personnel must have relevant authorization for carrying out conformity assessment, but defines it as follows:

1. The body must have at its disposal the necessary staff and possess the necessary facilities to enable it to perform properly the technical and administrative tasks connected with inspection or supervision; it must also have access to the equipment required for special verification.
2. The staff responsible for inspection must have:
- appropriate technical and professional education,
- satisfactory knowledge of the requirements for the inspection they carry out and adequate experience of such inspection,

- ability to draw up the certificates, records and reports required to authenticate the performance of the inspection.

Module for the conformity assessment procedures is module A, A1, B, B1, C1, D, D1, E, E1, F, G and H.

Draft of Rulebook on Testing and Examination of Pressure Equipment provides procedures for pressure equipment and simple pressure vessels placing at the place of use and procedures and deadlines for inspection and testing of pressure equipment being used. Draft of Rulebook on Testing and Examination of Pressure Equipment is defining minimum criteria for notified body for testing and examination of pressure equipment, notified body for the classification of pressure equipment and notified body for inspection, settings and testing of safety devices. Draft of Rulebook on Testing and Examination of Pressure Equipment is not resulting from the Directive.

Notified body for testing and examination of pressure equipment must fulfill minimum criteria, which are defined in Annex II of Draft of Rulebook on Testing and Examination of Pressure Equipment, which are in comparison with criteria from Rulebook on Machinery Safety (which is given as an example), different in:

- Rulebook on Testing and Examination of Pressure Equipment is not defining that the body and its staff shall carry out the verification tests with the highest degree of professional integrity and technical competence and shall be free from all pressures and inducements;
- Rulebook on Testing and Examination of Pressure Equipment is defining:

1. Notified body must have minimum three graduated mechanical engineers (M.Sc.), with minimum 5 years of experience in the design (the construction), manufacturing, testing and conformity assessment of pressure equipment, as follows:
   - at least two, with license for chief designer responsible for the thermotechnics, thermoenergetics, process and gas technology (330);
   - at least two with diploma for European welding engineer or international welding engineer;
   - at least two with certificates from the course for visual examination.

   In addition to the above, notified body must have employed personnel with relevant profile or external associates under contract.
2. Notified body must prove competence (e.g. by the act of accreditation by standard ISO IEC 17020, or otherwise).
3. Notified body must demonstrate a positive financial performance and must show the proof of paying taxes and other contributions.

Notified body for the classification of pressure equipment must fulfill minimum criteria, which are defined in Annex II of Draft of Rulebook on Testing and Examination of Pressure Equipment, which are, in comparison with criteria from Rulebook on Machinery Safety (which is given as an example), different in:

- Rulebook on Testing and Examination of Pressure Equipment is not defining next:
  - with what kind of jobs notified body, its director and members of the management can not deal with,
  - conformity assessment body and its staff shall carry out conformity assessment with the highest degree of professional integrity and technical competence and shall be free from all pressures and inducements,
  - conformity assessment body must have the appropriate general act which regulates the basic procedures for carrying out of conformity assessment.
- Rulebook on Testing and Examination of Pressure Equipment is defining next:

1. Notified body must prove competence with professional results;
2. Notified body must have minimum one graduated mechanical engineer (M.Sc.), with license for chief designer responsible for the thermotechnics, thermoenergetics, process and gas technology (330) and minimum 5 years of experience in the design (the construction), manufacturing, testing and conformity assessment of pressure equipment;
3. The notified body must demonstrate a positive financial performance and must show the proof of paying taxes and other contributions.

Notified body for inspection, settings and testing of safety devices must fulfill minimum criteria, which are defined in Annex II of Draft of Rulebook on Testing and Examination of Pressure Equipment, which are, in comparison with criteria from Rulebook on Machinery Safety (which is given as an example), different in:

- Rulebook on Testing and Examination of Pressure Equipment is not defining next:
  - conformity assessment body and its staff shall carry out conformity assessment with the highest degree of professional integrity and technical competence and shall be free from all pressures and inducements.
- Rulebook on Testing and Examination of Pressure Equipment is defining next:
  1. Notified body must prove competence (by the act of accreditation or otherwise);
  2. Notified body must have minimum one graduated mechanical engineer (M.Sc.) with minimum 5 years of experience in the design (the construction), manufacturing, testing and conformity assessment of pressure equipment safety devices and at least one examiner with at least IV degree in mechanical engineering;

     In addition to the above, notified body must have employed personnel with relevant profile or external associates under contract;
  3. The notified body must demonstrate a positive financial performance and must show the proof of paying taxes and other contributions.

<u>Draft of Rulebook on Simple pressure vessels</u> applies to simple pressure vessels manufactured in series. Equipment, to which this regulation does not apply, is defined under Article 2. Annex III, of this Rulebook contains criteria for notification of conformity assessment bodies and in comparison with criteria from Rulebook on Machinery Safety (which is given as an example) there have been identified following differences:

- Rulebook on Simple pressure vessels is not defining that the body must have appropriate general act which regulates the basic procedures for carrying out of conformity assessment,
- Rulebook on Simple pressure vessels is defining that personnel must have:
  - appropriate technical and professional education;
  - satisfactory knowledge of the requirements for the inspection they carry out and adequate experience of such inspection;
  - ability to draw up the certificates, records and reports required to authenticate the performance of the inspection.

CONFORMITY ASSESSMENT AND MODULES

Structure of the rulebooks, which creating is based on European Directives, is such that conformity assessment is based on modules. The conformity assessment is divided in modules, which includes a limited number of different procedures that apply to the widest group of products. According to modules, conformity assessment procedures are carried out by the manufacturer (First Party) or by the means of a notified conformity assessment body (Third Party/ Notified Body). The conformity assessment activities are relevant to the product design phase or manufacturing phase or both. The conformity assessment activities are confined in a specific number of modules; 8 Basic (A, B, C, D, E, F, G, H).

In Table 1 is shown which kind of accreditations must have the body that proves its competence by accreditation.

Table 1. Accreditations necessary for use of modules

MODUL A1	EN ISO/IEC 17025(+ability to decide on conformity), or EN ISO/IEC 17020 (EN ISO/IEC 17025 to be taken into account for testing required), or EN 45011 (EN ISO/IEC 17025 to be taken into account for testing required)
MODUL B	EN ISO/IEC 17020 (EN ISO/IEC 17025 to be taken into account for testing required), or EN 45011 (EN ISO/IEC 17025 to be taken into account for testing required)

MODUL C1	EN ISO/IEC 17025(+ability to decide on conformity), or EN ISO/IEC 17020 (EN ISO/IEC 17025 to be taken into account for testing required), or EN 45011 (EN ISO/IEC 17025 to be taken into account for testing required)
MODUL D	EN ISO /IEC 17021 (+product related knowledge)
MODUL D1	EN ISO /IEC 17021 (+product related knowledge)
MODUL E	EN ISO /IEC 17021 (+product related knowledge)
MODUL E1	EN ISO /IEC 17021 (+product related knowledge)
MODUL F	EN ISO/IEC 17025(+ability to decide on conformity), or EN ISO/IEC 17020 (EN ISO/IEC 17025 to be taken into account for testing required), or EN 45011 (EN ISO/IEC 17025 to be taken into account for testing required)
MODUL G	EN ISO/IEC 17020 (EN ISO/IEC 17025 to be taken into account for testing required), or EN 45011 (EN ISO/IEC 17025 to be taken into account for testing required)
MODUL H	EN ISO /IEC 17021 (+product related knowledge)
MODUL H1	EN ISO /IEC 17021 (+product related knowledge) + EN ISO/IEC 17020 (EN ISO/IEC 17025 to be taken into account for testing required), or EN ISO/IEC 17021 (+product related knowledge) + EN ISO/IEC 45011 (EN ISO/IEC 17025 to be taken into account for testing required)

CONCLUSION

All differences that occurred by comparing the requirements which body must fulfill to become notified conformity assessment body, are shown in Article 2. Draft of Rulebook on Testing and Examination of Pressure Equipment is defining minimum criteria for notified body for testing and examination of pressure equipment, notified body for the classification of pressure equipment and notified body for inspection, settings and testing of safety devices. It was noted that Rulebook on Lift Safety in addition to the requirements for criteria for notification of conformity assessment bodies, includes minimum criteria that notified body for lift examination must fulfill. Draft of Rulebook on Testing and Examination of Pressure Equipment is not resulting from the Directive. Some of the rulebooks are defining that the competence is proving by act of accreditation, while this is not defined like that in other rulebooks. Also is noted that this rulebooks are defining conformity assessment using the modules.

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REVIEW OF IMPLEMENTATION OF PROJECTS IN PROCESS COMPANY

Knežević, D.
Public CompanySports Center "New Belgrade", Serbia
E-mail: dakne.bg@gmail.com

Abstract: The paper deals with the problems of planning the time, of project realisation as well as of planning the resources and expenses, of structuring the project, its following up and the control of its realisation.
Key words: Development project, investment, planning.

INTRODUCTION

For too long the construction of facilities investment leads to long delays in terms of facilities and completion of commissioning. With time delays appear in the increasing cost of building an investment property.
More efficient investment construction is inevitable in the future development of the economy. It is possible if done in an organized manner, and if we coordinate and manage the process of building an investment property. Thus increasing the effectiveness of investments, which as a whole is the sum of economic, social and other impacts that accompany the investment activity.

DEFINING THE OBJECTIVES OF THE PROJECT

Planning the implementation of investment projects based on project definition and structuring, in order to avoid major problems - delays in relation to the plan and exceeded the planned cost of investment. Therefore the aim of management of investment projects providing the necessary conditions to complete the facilities on schedule with planned expenditures and the realization of investment projects must provide for monitoring and management of the project through three basic elements - time, resources and costs, to increase the overall effectiveness of investment. Structuring the project shows the division into several sub-projects, which can be implemented independently, according to the method of structuring the technological organization in the WBS technique called literature (The Breakdown Structure). This technique is widely used by managing the development of new products, managing the implementation of large projects to manage the production of complex products, etc..

PROJECT ORGANIZATION

Establishing plans for construction planning is the key events across the network to create a Gantt chart of global weather and operational plans and plans network of key events from the point of time, personnel and costs.
Network planning provides a systematic approach to solving problems, and provides control of the project with daily monitoring of progress.
The time factor in the process of investing is often neglected.
Tests industry shows that the] 2 [performed the Institute of Economics maturation period of investment typically longer and more than doubled from the originally specified time. It is therefore necessary planning and time management through the global project plan, a network plan, operational plan, Gantt chart of key events and the different phases of the project. By this time from a computer analysis to get information It is necessary for the project.
Gantogramski plans are needed for planning and resource allocation and planning of the required quantities and types of materials, often because of material costs accounted for 50% of the total project investment, manpower needs, etc.
Specification of the required materials and components shall be based on investment-Technical file, determining the required amount of material and its quality, grouping by type, by technological units. Cost estimates shall be made on the basis of the information and experience to conduct the procurement of materials and parts.

The connection time and cost of the project creates the need for cost analysis of certain parts of the project and the project as a whole and finding the most appropriate relationship between time and cost of the project.
When planning the total cost of the project must be taken into account and some contingencies women cases, any changes in the project and the impact of inflation.
Dependence of the time and cost tends to be time or during certain activities of the project as a whole is shortened as much as possible with as little cost or heavier than the optimal time and cost. Shortening can be made eg. in the construction of the building, installation and assembly of mechanical and technological equipment.
In the project design should take account of environmental and energy issues, without neglecting the performance of the project cost.

CONTROL PROJECT

For the successful implementation of the project is to create a unique portebno Management Information System project, where the main contractor project team with Project Manager. Monitoring and control of the project is achieved by an efficient system of reports with real data about the timelines, resources spent, the cost of the project, the proposals of concrete measures for improving and regulating the resulting deviations or so. control reports that are distributed their management.
The monitoring and control of the state of works and costs in relation to planned and anticipated, measures are provided to complete the project on schedule with planned expenditures.

REALIZATION OF INVESTMENT PROJECTS IN THE PRODUCTION PROCESS

As part of this paper discussed the realization of investment projects in the company AD. "IPOK" - corn products industry, Zrenjanin.
Building a corn processing plant, later called the starch industry, was approved by the Ministry of Industry 1946th whatever. With the test run began 1954th whatever. After a series of organizational changes, since 1976. whatever. until recently operated as a public company.
The organizational structure consists of six plants of technological and organizational units:

1. corn processing plant,
2. plant native and modified starches,
3. plant hydrolysates,
4. plant maintenance
5. commercial business sector,
6. sector joint ventures.

The main activity is the production of starch and starch products from corn. Since November, the 1975th whatever. "IPOK" has concluded a joint venture with the American company "CPC" - Corn Product Company, one of the world's largest processors of corn.
The aim of the joint venture was:
- Eliminating bottlenecks in the primary processing plants and final production,
- Increasing the range of products, particularly products of a higher degree of completion,
- Increase production capacity and utilization of dry matter with 95% corn,
- Improving product quality and increase output.

In the period from 1978 to 1988 yr. in "IPOK-in" was planned and carried out a series of successful investment projects as follows:

- Construction of plants modified starches,
- Construction of silos for starch,
- Reconstruction of production lines syrup and dextrose,
- Increase capacity fermentorske station
- Stabilization of corn processing at 280 tonnes / day,
- Construction of kilns for starch and modified starch production line extruder,
- Construction of silo capacity of 20.000 tons of corn,
- Construction of transfer stations for the syrup,
- Construction of mechanized storage pomace, with capacity of 800 tons,
- Construction of silos for gluten, a capacity of 150 tons,
- Construction of transformer station III and the expansion of substations,
- Construction of new plants for the production capacity of 15.000 tons of dextrose / year
- Construction (reconstruction) three-way otparke syrup and dextrose,
- Acquisition of basic and standard equipment and so on.

This expansion of knowledge of human resources and technology, including cooperation with the "CPC", produced noteworthy results:
- Mastery of production technology at the highest international level,
- Increased utilization of corn grain dry matter at 95% and decrease in dry matter gibitaka to 5%,
- Increased production capacity, product range, removing bottlenecks, improving product quality and the like.

This investment activity has enabled the flexibility to output the final line of production, productivity and survival of plants in the difficult period of economic blockade of the country.

CONCLUSION

Planning the implementation of the investment project is the initial phase of implementation of the project management process, which allows a unitary implementation of the project within the stipulated time and with the projected costs. Based on what we could say the following: "who does not invest in the present that does not benefit in the future".

The presented example of realization of investment projects in a specific production company, is a useful tool: the development engineers, development managers in the service of companies and all personnel who deal with these issues.

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METHOD FOR EVALUATION OF RISKS IN THE WORKPLACE AND WORKING ENVIRONMENT HIGH EDUCATION SCHOOL OF PROFESSIONAL STUDIES IN NOVI SAD

Gemović, B.
Higher Education School of Professional Studies, Novi Sad, SERBIA
E-mail: gemovic@vtsns.edu.rs

Abstract: The aim of this work is to show, with due respect to the existing methodologies, the implementation of an original method of risk assessment at workplace and working environment. The example represented here is based on implementation of this method in a section of a factory where mechanical processing of metal is performed. The risk assessment procedure is conducted through implementation of our own method. It is ensured that the project is conducted thoroughly, from the defining of technological process – system, to implementation of measures for control of ("emergency") risk.
The method is of quantitative character with possibility to determine and compare all risks, at every workplace and including all participants who take part in working environment on every basis.
Key words: risk, safety, metod of risk assessment

INTRODUCTION

Risk assessment is based on systematic record keeping and tracking of all factors, vulnerability and hazards in a working process. Therefore, it is crucial to recognize organization of work, working process, means of work, material and raw material used in working process, means and equipment for personal protection and other relevant elements. A precondition to this has to be the recognition of existent facts. This is a basic and starting point and it is also required by the Code of Practice (1), made in compliance with Directives of the European Union. Apparently, the true answer and primary task of any method is: to determine risk arising at any workplace and regarding any worker, to determine all risks and to allocate the risks to individuals, working space and working environment.
Risk assessment methodology has to be clear and unambiguous in order to enable a complete analysis of risk assessment to be conducted. A methodological way of risk analysis, according to the method of High School from Novi Sad is the following:
Defining of system – defining assessment levels (company, facilities, floors, premises, work-rooms, workplace, work activity etc.) – identifying hazards and vulnerability – evaluation of risk – measures for elimination, prevention and reduction of risk – re-evaluation of risk – conclusion on risk – measures for maintenance of risk control.

THE STUDY

Input data. Technological setting

In our example, an engine hall and working process of metal processing are used as a model. In this section of a factory, steel material is processed through grinding, perforating, milling, welding etc. It is a standard section of a factory with typical and recognizable hazards.
There are N workplaces in this factory section where it is likely that hazards and vulnerability for workers at those workplaces may occur. The workers in the engine hall are exposed to shared hazards and vulnerability arising from workplaces in the environment all the time during their working hours. The workers whose workplace is not the engine hall, but who are frequently present there during their working hours (such as section managers, maintenance workers, controllers and alike) are also exposed to the same hazards. Also, all those who every now and then enter the hall are exposed to the same hazards (directors, trainees etc.). Naturally, risks relating to each of these categories of employees are different because of their different frequency of exposure to hazards and vulnerability.

About the method
The method of the School is formed to meet the following requirements:

- to include all workplaces by making a selection of them out of technological process together with important hazards and vulnerability and to determine risks for each of them
- to determine risks at all levels (the engine hall);
- By meeting the given requirements it is ensured that risks for each of the workers are determined, i.e. for all those who are present in the company (the engine hall)

- the method for all risk parameters is based on numerical, quantitative values, independent of a level at which the risk is determined, thus enabling presentation of all risks together and their uniform observation
- the measures for elimination, reduction and prevention of risks are clearly defined, as well as the measures for maintenance of risk control level. The represented system of risk management makes way to implementation of quality systems in health and safety at workplace.

Characteristics of the method:

a) Risk calculation of a workplace based on a table determination of all risk parameters; likelihood of accidents, damage size, frequency and number of people exposed to hazards and vulnerability

$$R_i = V*F*S_i*N$$

$R_{i,}$ S_i – risks and damage size for different categories of employees, depending on the frequency of their exposure to hazards and vulnerability.

b) risk assessment of working environment based on determining likelihood of accident occurrence which is based on values of safety conditions in the working environment and accordingly developed mathematical equation

$$R_i = f(x)*F*S_i*N$$

$$\text{where } f(x) = 16.46\ x^{2.7}$$

$$x = n/N,$$

n – is the number of negative values of safety conditions

N – is the total number of evaluated values of safety conditions

The evaluated values of safety conditions have to be in compliance with legislation and technical regulations.

Output data

There are several key points in the risk assessment procedure, of which every represents an interest evaluated from various points of view. One of them is a table of remaining risk for all workplaces, working environment and for each of the workers. The significance of this table is to the advantage of an employer and, naturally, to the advantage of an employee. According to the results of this work, the table has to determine the following risks for each of the workplaces:

- the risk of a workplace
- the risk of the engine hall
- the “somebody else’s” risk

The “somebody else’s risk” relates to the activities of some other workplace, which a worker sometimes has to perform. The example is a job of a driver, a work which we sometimes have to do. The risk is considerably lower compared to a driver’s risk, since the frequency of exposure to hazards and vulnerability is also lower, but positively this risk exists.

Only a risk assessment conducted in such a way can provide answers regarding size and types of risks which a worker is exposed to during the working hours.

Table 1. Risk table

	WORKPLACE		QUANTITATIVE ASSESSSMENT OF REMAINING RISK							QUALITATIVE RISK ASSESSMENT
			Primary risk					Secondary risk		
	Occupation (job)	Code number	Company, facility	facility part, plant	Plant, working room	workplace	source	value	Source (activity, workplace, ...)	
1.	Counselor	112	0	0,3	0,05		Company Headquarters			
2.	Technical secretary		0	0,5	0,32		Company Headquarters			
3.	Operational engineering						Company Headquarters			
4.	Qualified worker						Company Headquarters			
5.	Coordinator						Centre for ambrosia suppression			
6.	Section manager		2,7	0,52	0,36		Plantation			
7.	Assistant		2,7	0,52	0,36		Plantation			
8.	Non-qualified worker						Plantation			
9.	Driver					37,5	Form 4/23 Company Headquarters			

ANALISES, DISCUSION, INTERPRETATIONS

The example for mechanical processing on a lathe:

IDENTIFICATION OF HAZARDS AND VULNERABILITY

1 No	2 Code of hazards and vulneradility	3 The descriptive analysis of hazards and vulnerability including data regarding easier and more precise determination of likelihood, frequency and damage size
1	05	When grinding fragile material with low speed of cutting or with particular geometry of cutting tools, there occur torn parings whose temperature might go even up to 800^0C, and which are likely to hit a worker in the eye thus causing a severe injury. As a worker does this type of work during a whole working day, it is possible that a worker sustains eye injuries often and it is more than likely that injuries occur every day

QUANTITATIVE RISK ASSESSMENT

4 Likelihood lavel	**5** Frequency	**6** Damage size	**7** No. of peple – coeff.	**8** Risk	**9** Risk lavel
5	**4**	**2**	**1**	**40**	Low but present

THE MEASURES FOR REDUCTION, PREVENTION AND ELIMINATION OF RISK

10 Safetyain	**11** Organizacioal	**12** Constructive	**13** Safety	**14** Personal safety means	**15** Other
Protection of eyes				Protective spectacles	

ADDITIONAL RISK ASSESSMENT

16 Likelihood lavel	**17** Frequency	**18** Damage size	**19** No. of peple – coeff.	**20** Risk	**21** Risk level
0,033	**4**	**2**	**1**	**0,264**	Negligible

RISK MANAGEMENT

22 Who implements	**23** Time frame for implementation measures	**24** Procedure within quality systems	**25** Conslusion	**26** Measures for control of the remaining risk
Safety officer	Immediately	IQ2.f...	Rislk is low and tolerated	Drawing up and strict implementation of code of personal means of protection

The example of working environment risk assessment

According to the Code of general measures for buildings whose purpose is to be used for working or subsidiary premises and Code of keeping records, values that characterize the safety conditions of the engine hall can be determined. Those values are:

- Clear height of the work-room
- Clear area of the work-room per worker
- Clear volume of the work-room per worker
- floor of the work-room
- inner surface of ceiling and walls
- opening of windows of the work-room
- door of the work-room
- lighting of the work-room
- corridors, availability of staircase
- passages and access
- protective fence
- handy warehouse
- rotating and mobile parts
- free movement of parts
- indoor transport
- exposure to being blocked (shut), covered by something and alike
- hazardous surfaces
- work at height and depth
- cramped, limited
- hazardous space
- wet and slippery surfaces
- physical instability of the work-room
- inappropriate and not adapted working methods
- contact of elements at voltage
- indirect contact
- thunderbolt
- thermal effect of electrical source
- work in low/ high pressure atmosphere
- electrostatic charge
- work in the open air
- radiation
- work with animals water surfaces
- use of hazardous material

In comparison with the procedure for the workplace, we determined hazards and vulnerability in this way (columns 1, 2 and 3); other columns are identical to risk assessment of a workplace .

CONCLUSION

In compliance with the set aims of the work, the conclusions have completely met and justified the expectations. Basically, the conclusions are:
the established methodology and formed method of risk assessment make risk analysis simple
the method implemented in engine hall for metal processing gives completely precise answers to all arising risks two risk levels are distinctive: the level of engine hall and the level of workplace, evaluation within these two levels gives all information;
quantitative nature of the method enables comparison of all obtained values; the method presented in this work can be completely applied to any engine hall that is basically used for mechanical processing; the same method, but with a change to values evaluating safety conditions, can be used for any working environment, which can differ.

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TOURISM INFLUENCE ON THE PRESERVED DEVELOPMENT

Djurovic, I.[1], Randjic, D.[2], Bagaric, I.[3]
[1] The University in Novi Pazar, Department of Pancevo
[2] The Belgrade Business School
[3] The Singidunum University, The Faculty of management
E-mail: ivona_zenovic@yahoo.com

Abstract: Tourism is an important element of social and economical life . It maintains a legitimate man's desire to visit new places and get to know various cultures as well as to take the advantage of his activities or vacation far away from his home or work. Tourism presents a good example of essential link that exists between development and living environment with all its benefits , problems and potential conflicts. Our planet's development requires preservation and respect of the space capacity. In which way to reconcile the requirements and create such development as to influence , via tourism, the preservation and prosperity of the development of destinations at the global level? In order to realize this plan it is vital that tourism respects elements of preserved development and to impact operations of tourism economy and making of a milieu for the preserved development via tourism. Also, tourism economy must have in mind: visitors expectations, making products that will draw the attention of visitors, use of natural cultural resources , requirements for economic operations.
Key words:tourism, tourism development and sustainable development

INTRODUCTION

The impact of tourism on the environment greatly depends on the type of tourism, tourist behavior and quality of tourist services. The greatest pressure on the environment comes from the mass tourism in coastal and mountainous regions, which will likely increase significantly in the following decades. In this way, you will need to develop national and regional plans for coastal and mountain zones.
The elements in these strategies, which directly depend on the interaction of tourism and the environment are: control of land use; establishing strict rules for new buildings and to prevent unlawful construction, control and limit traffic in tourist regions, expanding tourism, strict application of environmental standards for noise , drinking water, bathing water, waste water and gases (including the industrial zone of tourist regions), creating safety zones around sensitive regions; professional training of appropriate personnel.

ECONOMIC DEVELOPMENT DIMENSION OF TOURISM

Tourism is an activity that affects many other sectors such as transport, construction, banking, rent and many other sectors that are involved in the creation of a comprehensive tourism product. The importance of tourism for economic growth and development on a global scale shows and launch new pilot projects within the European Union.
The European Commission in 2006 launched the first pilot project: great destinations across Europe. This project is aimed at:
- to draw attention to the value, diversity and shared characteristics of European tourist destinations and to promote destinations that reach their economic growth by providing social, cultural and environmental sustainability of tourism. Besides this project, and set specific objectives:
- to increase the visibility of European tourist destinations,
- to create awareness of European diversity and quality,
– to promote all European countries and areas,
- to help eliminate overcrowding, seasonal battle, are balanced flows to non-traditional tourist destinations.

At the beginning of the project, the backbone of the continental areas were under the slogan
"The best destinations in rural development".
In this way they evaluate local tourism initiatives, something that Serbia lacks. If we know that the first 9 states that have joined this project, Austria, Belgium, Cyprus, Greece, Hungary, Ireland, Italy,

Lithuania and Malta, plus the candidate country Croatia, it is obvious that these are just the developed countries tourism.
The European Commission in 2007 launched the second phase of this project with a new theme: tourism and local intangible heritage. This time 18 countries participated and thus made the pilot project becomes a real backbone of the tourism development of individual countries of the European Union. Any country which wants to develop tourism is to create a tourism policy in order to help its development and to overcome many challenges advancing global competitiveness. These challenges include extensive research and quality assessment of tourism demand and its basic characteristics. This advanced development policy aims to create more employment and jobs that will help the development of tourism.

SOCIAL DIMENSION OF TOURISM

Tourism can be a force for conservation and threat to natural and cultural resources and heritage of local communities. The mutual dependence that exists between tourism and cultural heritage is obvious. While cultural heritage forms the basis for tourism development, tourism has the power to stimulating effect on the preservation of these resources. Cultural heritage is necessary to show and display, because this way it has its purpose and achieves its goal. Tourism is the very activity that makes it happen. With the growing interest in culture and community, eventually becoming recognized tourism as an activity that can develop the rural areas, create jobs for local people and help preserve local culture and customs. This means that tourism offers not only improve the lives of those who provide services, but also those who use these services. It is therefore extremely important that all those who participate in the creation of tourist activities take place right balance in order to check the viability of development. On the other hand, the tourist destinations where the condition of natural and anthropogenic resources deteriorate, the economy will be in a risky position because tourists are directed to competing destinations.

DIMENSIONS OF THE ENVIRONMENT THROUGH THE DEVELOPMENT OF TOURISM

Seventeen years ago the Earth Summit held in Rio de Janeiro, where the question of the impact of industry on the environment, was one of the main topics of consideration. Spreading tourist movements eighties caused great concern among activists for environmental protection. Therefore, the adopted Agenda 21 for the travel and tourism industry, which is aimed at increasing tourism to the global responses to global demand for environmental protection through the adoption and implementation of protection programs. In addition, there was an increased number of conferences and congresses dealing with these issues. At these conferences were particularly emphasized the responsibility of private and public sectors to protect natural and cultural heritage and emphasized the importance of environmental sustainability. It was stressed that if tourism does not develop in a planned and carefully regulate the negative elements of its development can overcome attractive elements that are the main driving factors for many tourists. Examples of the expansion of tourism, which ignored its negative elements are numerous. Ignoring the realization that tourism can be negative for the development of certain regions, local communities rather than sustainable development led to the emergence of a number of issues that are impacting the lives population in certain areas. Mention a few examples:
- construction of tourist facilities on the land without their permission native (Aboriginal, Indian tribes, tribes in Africa),
- construction of golf courses in the area where there is a problem with water (use of scarce local resources and causing drought)
- construction of infrastructure on private land without consent owner, or looking at their needs;
- construction of ski trails on the grounds of protected areas and ecological destruction of the ecosystem without consulting organization for the protection of the environment;
- building houses for vacation and tourism facilities in localities where it is not allowed to build.

Massification of tourism trends and development of tourism leads to adverse effects on natural and cultural environment. Without desire to adversely affect the environment, mass tourism affects the destruction of sensitive ecosystems, coastal areas, mountain areas of destruction, denial of the local culture and consumption of natural and cultural resources. However, not all that bad, because tourism is basically positive activities, which are experiencing significant revenues raised by local communities affected by the possibility of protecting and preserving biodiversity and become forces for the protection of the environment particularly in developing countries. The creation of amusement parks and nature reserves is one of the examples of how tourism can impact positively on profitability and development of certain areas.

A new concept of nature tourism experience much higher growth than the usual development of tourism. In the twenty-first century, its growth is about 20% per year as opposed to tourism growth rate of 7% per year. There are also indications that travel consumers are beginning to influence the direction of travel business. Tourists are aware of choices available to them affect the rapid growth of niche eco-tourists. However, the eco-tourism can be the answer to the need for greater attention to environmental protection.

HOW TO AFFECT TOURISM SUSTAINABLE DEVELOPMENT

Effective use of the tourism industry can be a stimulus for positive growth and economic success of developed countries and developing countries. Tourism market has the potential through the provision of various services, choice, innovation and competition improve the lifestyle of the population. Tourism opportunities through increased exports, multiplier effect, increasing capital investment, increase in gross domestic product, job growth and a large number of economic and non-economic effects, makes this the most desirable activities for development at the global level. If we look at the impact of tourism on the rise in the number of jobs, it is obvious that this activity not only produce jobs in organizations that are involved in tourism but also in many other industries such as retail, construction, information technology. It is expected that tourism in 2010, affects about 10% of all employment in the world. It is particularly important that this activity increases youth employment, and national minorities.

How small and medium enterprises in the tourism sector is dominated by it and expressed the possibility of employment, especially for seasonal work, low-skilled workforce and specific occupations. Therefore, it is extremely important and effective human resources management is reflected in additional education and specialized training programs for the tourism industry with the aim of providing quality services. Considering that the aim of the tourism industry sustainable economic development it has to work to reduce social, economic, and cultural barriers. The biggest barrier to this development was undoubtedly the lack of infrastructure, environmental degradation and vulnerability, which reduces tourism potential of a combination of countries. One way of removing these barriers is establishing a partnership of public and private sector investment in tourism coordination. Joint planning between the two sectors and is an essential component of creating sustainable employment and sustainable development in the tourism industry.

The lack of uniform data and inability to record and measure the impact of tourism on economic development negative effect on the global assessment of the economic effects of tourism. By creating a TSA methodology (Tourism Satellite Accounting) by WTTC and UNWTO has led to an overall look at the impact of tourism on the economy. This research has indicated that the impact of tourism on the whole economy is far greater than the size of the industry. Multiplier effect of tourism in many countries is much greater than the total tourist spending. In the UK, to 17 billion U.S. dollars spent by foreign tourists, the economy has earned an additional 36 billion dollars. Looking at the example of the Balearic Islands, which are the 1950th year was the poorest province of Spain, after half a century, 2000. he became the richest, thanks to tourism. Hotel industry has significant potential for growth in those countries and regions that are just beginning to develop their economies. A particularly important influence on the development are investments in infrastructure and employment of local staff, as well as the multiplier effect of money that visitors spend in the hotel and catering facilities.

THE CONCEPT OF SUSTAINABLE DEVELOPMENT

Achieving sustainable and equitable economic development is the biggest challenge facing the human race ... Without adequate environmental development will be undermined without the development environment will be unsuccessful.

World Bank, World Development Report, 1992.

The concept of sustainable development has emerged the 1980th when the International Association for the Protection of Nature and Natural Resources developed a protection strategy that had the main task of *"achieving sustainable development through the protection of living resources"*.

The concept was then taken over by the World Commission on Environment and Development, and widely used in its final report in 1987. , popularly called the Brundtland Report, which is given the following definition:

"Sustainable development is one that provides a satisfying present needs without compromising the ability of future generations to meet their needs" .

Thus defined sustainable development has a very broad general meaning. As such, it can be a major landmark of national and global politics. Sustainable development is connected with the concept of optimal growth. It aims to establish a balance between economic growth and environmental degradation. It is known that the concept of sustainable development and the concept of optimal growth, there are differences. The first, consists in the fact that the concept of sustainable development include, among others, and social impacts such as poverty, social disorder and other problems of social and political stability.

It includes also the degradation and environmental pollution and depletion of natural resources. Sustainable development seeks to prevent the negative economic growth, especially today, which may increase future costs. We know that the less-developed countries and developing countries are particularly vulnerable to restrictions placed their economic development and rapid population growth, lack of resources, most of technology and capital. Many poor countries are facing serious shortages of water, food, land and energy. The rapid development of the population threatens to further exacerbate these conditions. Eliminating poverty and inequality at the national and global international level is a key factor for sustainable development.

The concept of sustainability was also understood in different ways, which complicate the operational concept. Sustainability is often seen as a solution the problem of inequality and poverty in a way that will affect the environment by reducing the future prospects of mankind. Similarly, the worn-out claims that it is unfair and wrong to use limited resources to acquire the current used in a way that impoverishes future generations. These statements can be understood as a concern for equality among regions and parts of the region, and between countries and between parts of the country. As a result, some scientists warned that sustainable development can not be accepted as an absolute goal.

In contrast to developed countries, developing countries are trying to adjust to the economic development of rapid population growth, increasing environmental pollution and resource depletion. A larger population necessarily increases the demand for goods and services.

The impact on the environment	=	**Income per capita**	+	**The impact on the environment**	+	**The number of inhabitants per unit of income**

Figure 1. Model Environmental Impact

Given the close link between tourism, environment and climate, we can say that tourism is an economic sector that is sensitive to climate changes such as agriculture, energy, transport ...

CONCLUSION

Caring for the tourist environment, whether the nature or manmade, is associated with the concept of sustainable development. In order to establish a balance of sustainable development and economic growth through tourism in the country future, it is necessary to develop dialogue and cooperation with all parties (stakeholders) within the sector, and promote a broader understanding of the role that tourism has on a global scale. To make that happen, you need to:
- promote the competitiveness and sustainability of tourism,
- improve the control of space tourism, increase the level of knowledge and quality of employees in tourism;
- understand the role and importance of tourism to other economic and non-economic activities through its multiplier effect,
- understand the role and the importance of tourism to other economic and non-export activities through the invisible,
- high-quality design and support the promotion of tourist destinations.

The concept of sustainable tourism imposes the need for a strategic approach to management. Sustainable tourism means that the effects of the economic, social and ecological point of satisfaction over a long period of time. You need to pay special attention to education, training and awareness to learn about the most important goals and objectives of sustainable tourism.
Information about tourism and its impacts on natural and socio-cultural environment should be available to the general public. Particular attention should be paid to informing the local population, to include in the planning and development decision-making. Therefore should be made applicable, and interest among participants who advocate strict protection of the environment, tourism industry and government bodies, to improve the quality of life of local communities.

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SELECTION OF PSE OPTIMAL CHARACTERISTICS USING AHP - METHODS

Vujičin, K.[1], Pavlović, N.[2], Bagljaš, A[3].
[1]TF „Mihajlo Pupin“, Zrenjanin
[2]VPŠSS, Novi Sad
[3]Thermo Solar, Žiar, Slovakia
E-mail: kristijan@gmail.com

Abstract: In practise, problem in selection of PSE (Receiver of Solar Energy) most optimal caracteristics is quite often. Choise is often subjective sensivity of bearer decision which is not always the best.To avoid that, in this case is created a model for selection of PSE most optimal caracteristics. Physical, structural and economical parametars are analysed. On basics of finished analyse, criteriums are established, and using of Expert Choise software, selection of solar collector of most optimal characteristics are done.
Key words: receiver of solar energy, optimal characteristics, AHP-metod

INTRODUCTION

In practise, selection of PSE remits for personal judgement of in engineer, D esigner. That choice is often inadequate. With tendency to gratify a demands if investitor,quite often PSE with lower price elects. Criteria like overall area, absorb area, absorb of Sun radiation, price, mass, and waranty affects on priority of alternatives.By making a decision most objective, it is possibly to do appliance of Analytical Hierarchy Process (AHP) method and Expert Choice software tool.

Analytical Hierarchy Process (AHP) method

AHP is systematic method for selection of objectives or alternatives. When it's using in engineering, AHP method represents a powerful tool for election of alternative concepts. AHP method represents very useful tool in analysing of determination, created to afford help to bearer of decisions in resolving of complex problems in determination, in which a larger number of bearers of decision participates, larger number of criteriums, but can be aplly in multiple periods of time. Area of application is multicriterion determining, where on the basis defined set of criteria and value of atributs for every alternative are doing selection for most acceptable, or displayed total disposition of alternative importance in model. Progam packet Expert Chioce 11.5 (EC11.5) was usen for making most optimal RSE.

Expert Choice

Program Expert Choice enabels structuring of hierarchyc model of problem in determining on more ways, and also a combination in couples on few ways. Number of criteria and subcriteria is practickly unlimited. Softwareupholdsexaminationing of coexistation, so that in proces of exemination can be observing his value, and on need, it can be done a corection of evaluation in pair so that indecks of coexistent is pit on value below 0.1. Also, it is posible that bearer of decision update hos opinion and changeing individual eveluation in pare during the work, whitch software automaticly dealt with. Special quality of softwares giving different odds, between whitch is very significant posibility for transaction of sensibility analisis

RESULTS AND DISCUSSION

The analysis included five collectors from different manufacturers, different characteristics. To make it easier opted for a particular type of solar collector is applied AHP method of multi selection mode. The criteria by which to determine the final alternative of targets are given in Table 1.
Using the software tool EC11.5 it is enable to solve problems of multi-making choose when choosing a PSE with optimal characteristics with priority sorting and evaluating alternatives. In selecting is particulary helpful visualization of the sensitivity analysis, is based on a simple interactive mode of changes weight the criteria and alternatives.

Table 1. The criteria that determine the final alternative target

Manufacturer Criteria	Total surface (m^2)	Absorbing surface (m^2)	Absorption of solar radiation (%)	Mass (kg)	Price (€)	Guarantee (year)
Manufacturer 1	2.14	2	95	36	290	2
Manufacturer 2	1.79	1.62	95	34	255	2
Manufacturer 3	1.86	2	95	49	250	25
Manufacturer 4	2.17	1.94	94	45	330	2
Manufacturer 5	2.03	1.76	95	37	360	12

SENSITIVITY ANALYSIS PERFORMANCE

Results of analysis sensitivity performance show the importance of action according to each criterion separately and importance of action by all criteria together. With this analysis can be seen all Intermediate and final results. Graphical display of performance sensitivity analysis (picture 1.) shows the effects of certain criteria to the current and total comparison. Currently comparison of alternatives is a change in priorities of alternatives, influenced by the weight of one criterion. Total comparison of alternatives is a comparison of the same weight under the influence of the criteria taken into the analysis. Completed analysis shows that the alternative to the *Manufacturer's* 3 which is priorities, that positively influence the masses and especially the criteria guarantee. Criteria prices and absorption of solar radiation negatively affect the alternative *Manufacturer's* 3.

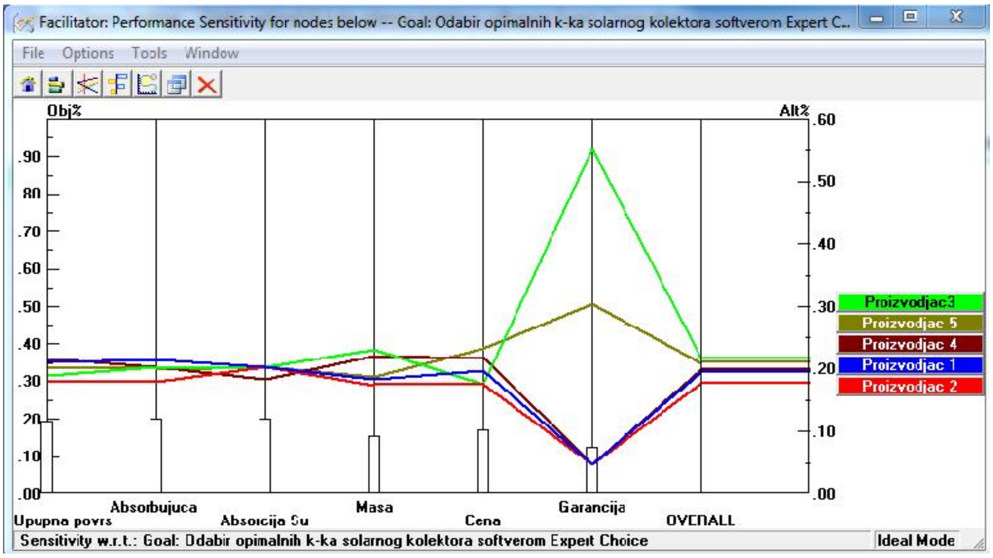

Figure 1. Graphical representation of sensitivity analysis performance

DYNAMIC SENSITIVITY ANALYSIS

Dynamic sensitivity analysis shows how a change in importance (weight) one of a criteria priorities affect the action. By changing the weight of one criterion, automatically is changing the weight and other criteria. In the basic view is the original solution without correction (picture 2.). Dynamic analysis results show that dynamically change the priorities of alternatives at different weight of individual criteria. This view allows look at the overall share of the weight of individual criteria in the overall priority of alternatives. If we change the weight of one criterion, other weight change proportional to the initial weight criteria. Criteria: absorbing surfaces and absorption of solar radiation has a share of 19.3% - which means that these two criteria are priority.

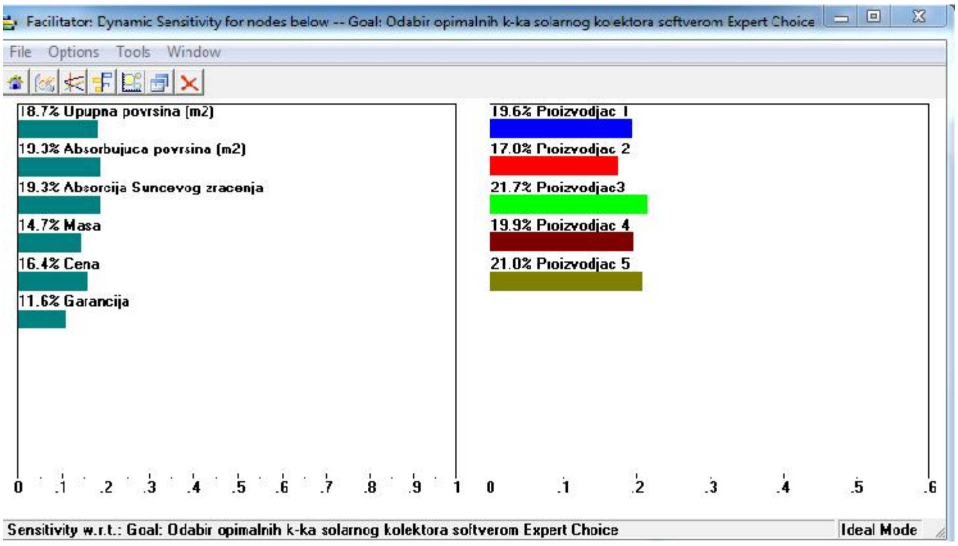

Figure 2. Graphic representation of the dynamic sensitivity analysis

GRADIENT SENSITIVITY ANALYSIS

Gradient sensitivity analysis is presented in a graphical representation of the dynamic sensitivity analysis for each criteria (picture 3.). On the coordinate axis shows the observed weight criteria, and on the ordinate actions are priorities depending on the weight of criteria. The line L1 represents the ranks of Action for the observed weight observed criteria.

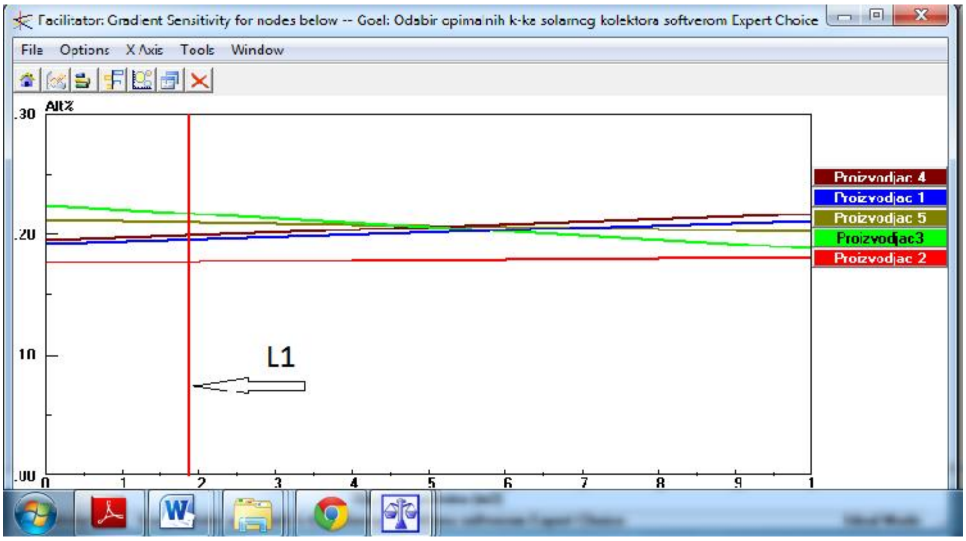

Figure 3. Graphic representation of gradient sensitivity analysis

COMPARATIVE ANALYSIS (HEAD TO HEAD)

Comparative analysis (head to head) shows the comparative presented alternatives. In view of default criteria different alternatives affect on the final result of the sensitivity. Presented alternatives (picture 4.) P1 i P2. Mutual qualitative relationship between two alternatives is shown in bar chart histogram. If one alternative is better than the other, then the surface of the bar chart illustrated to show how this alternative is better. Information about which alternative is better represented by the spatial position of the bar chart. If the bar chart on the left side shows an alternative P1, then the alternative P1 is better than P2 alternatives with regard to certain criteria. In that way, alternative P1 compared to P2 a better alternative on the criterion of total area, as indicated by the blue area. Like the other criteria are also sympathetic to the alternative P1, so that both the bar chart are displayed on the left side.

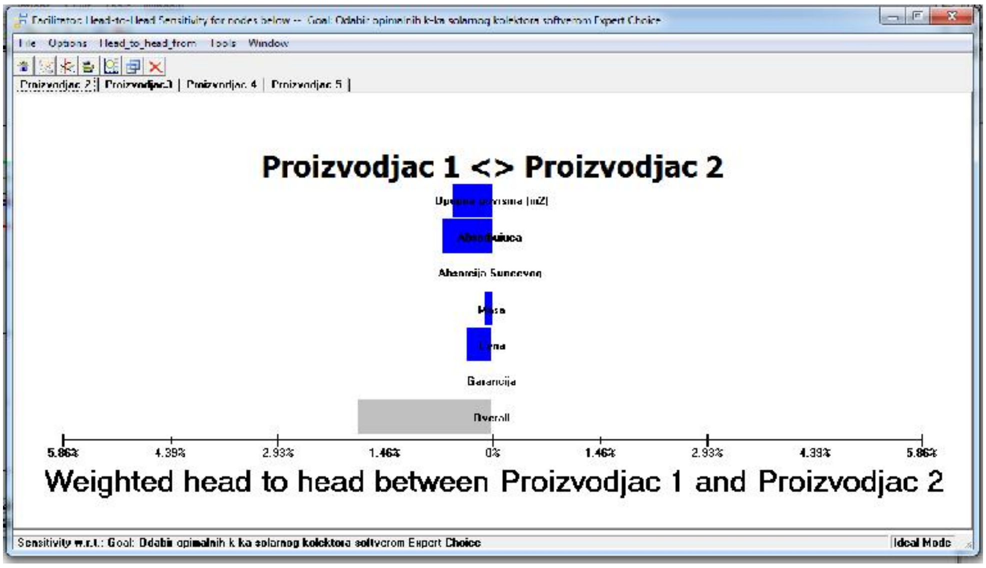

Figure 4. Graphic representation of comparative analysis (head to head

CONCLUSION

Completed od AHP analysis shows, that, taking into account the criteria set stands as best manufacturer of "Manufacturer 3". Choosing the best features of PSE is very important. The result of selecting the most optimal characteristics of PSE as a positive result, for example higher energy efficiency of the entire solar system. Select a type of PSE in this manner may, for example, can influence on the price of the solar system, but these higher energy efficiency investment quickly pays off. Failure od this method is a subjective method of selection criteria for this analysis if the person is not competent to do so. Further research will be developed in order to increase the number of criteria, based on expert analysis of the parameters relevant to enhancing energy efficiency as the final target.

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THE VIABLE WASTE MANAGEMENT IN THE WEST BACKA REGION WITH THE TRANSFER STATION IN ODZACI

Tasic, I.[1], Tasić, J.[2]
[1]Novi Sad University, Technical Faculty "Mihajlo Pupin", Zrenjanin
[2]Informatics teacher, Primary School "Mihajlo Pupin" ,Veternik
E-mail: tasici@tfzr.uns.ac.rs

Summary: How to leave off communal and industrial waste without any impact on the environment, is one of the main problems that faces modern society. Some villages and residents' communities on account of resources limitation, have not the means to provide independently all the services they should, concerning managing communal waste and other projects of public significance. One of the strategies developed by municipalities with the aim of increasing services providing, is division on regions.
By the viable waste management in the West Bačka region would be proved feasible and viable technical capabilities for establishing the regional system of waste management that would cater the population of this region.
Keywords: waste, management, transfer station

INTRODUCTION

The West Bačka Region is located in the outermost northwest part of the Republic of Serbia. It covers 2,74% of the surface of the Republic of Serbia, that is 11,25% of the surface of the Autonomous Province of Vojvodina.According to the covered surface the largest municipality is Sombor (1178 km²). The other municipalities are substantially smaller and their surfaces are in the boundaries from 350 to 481 km². The smallest municipality according to its surface is Apatin (350 km²), then isBač (365 km²), Odžaci (411 km²) and Kula (481 km²). The investigated region has the total surface of 2,785 km². There are 43 settlements in the Region: the average surface of the settlement is cca 65 km². Theadministrative, economicalandculturalseatoftheRegionisSomborwhichisamongfourlargesttownsinVojvodina. The municipality of Odžaciis situated in the south part of West Bačka.It is bordered on the municipalities ofSombor, Apatin, Kula, БačkaPalankaand Bač, and along the Danube, it is bordered onCroatia.
The municipality of Odžaci consists of nine settlements: Ožaci, Bogojevo, Deronje, Srpski Miletić, Lalić, Karavukovo, Bački Brestovac, Bački GračacandRatkovo. The municipality center is the built - up area Odžaci, while the other settlements are of village character.

DEMOGRAPHIC CHARACTERISTICS OF THE AREA

The region for the communal waste management comprises the municipalities of Apatin, Kula, Somborand Odžaciin the South – Bačka county.
At the census from 2002. year, at this area were 230.279 inhabitants. The largest number of inhabitants are in the town of Sombor (97.263). it is the cultural and economical center of the Region. The smallest municipality is Bač (16.268). After it are Apatin (32.813), Odžaci (35.582) and Kula (48.353). Taking into account the total surface, the average population density was 88,4 inhabitants/km² in the West Bačka county and 44,6 inhabitants/ km² in the municipality of Bač, that is 82,7 inhabitants/ km² on average for the Region. The population density in this region is a little lower against the average population density in Vojvodina (94,5 inhabitants/ km²) and Serbia (111,2 inhabitants/ km²).

Table1. Basic data about municipalities and population by lists

	Western Backa district					**South Backa district**	**Total**
	Apatin	**Kula**	**Odzaci**	**Sombor**	**Total**	**Bac**	
Area (km²)	350	481	411	1.178	2.420	365	2.785
Number of settlements	5	7	9	16	37	6	43
The average size of settlements m^2	70,0	68,7	45,7	73,6	65,4	60,8	64,8
Population by list							
Year 1971	34.279	48.727	39.585	98.080	220.671	19.348	240.019
Year 1981	33.843	49.898	37.967	99.168	220.876	18.243	239.119
Year 1991	31.850	48.559	36.189	94.081	210.679	16.559	227.238
Year 2002	32.813	48.353	35.582	97.263	214.011	16.268	230.279
Working age in 2002	22.230	32.787	23.802	65.910	144.729	10.760	155.489
Share of working age in 2002	67,75%	67,81%	66,89%	67,76%	67,63%	66,14%	67,52%
Growth rate 2002/1991 (per thousand)	2,7	-0,4	-1,5	3,0	1,4	-1,6	

Comparing the results of the census of the previous years, one can ascertain that in the period till 1981. year was recorded the growth of population. After the year 1981. was noted a small fall, and in the last inter - census the regrowth, but in full it can be said that the population in Vojvodina stagnates already several decades backwards. The stated phenomenon is named demographic transition.
The demographic transition had at first spread in the developed European countries and later spread out as well as on the less developed countries. With the idea of demographic transition one implies decreasing of birth – rate and mortality- rate, and the process of growing old of population. The process of demographic transition surely should be connected as well with the process of industrialization, deagrarianism, abandonment of villages and urbanization.
In the period after the year 1981,the number of municipalities has been increased as well as reducing of population in Serbia. So, it is difficult to expect that so bad demographic situation could be improved in so short time.
On the basis of the shown details of the surface and number of inhabitants in the region, it can be ascertained that this region fulfils one of basic criteria for the formation of the region for the management of the communal solid waste. According to it with the view of cutting down expenses per ton of the left waste, that is rational investment of resources into construction and exploitation of a waste area, the region should comprise at least 200.000 inhabitants.
Also in order to succeed in making up municipalities as a functional body concerning refuse collection, transport and putting it side, the criterion that the municipalities in the region are in their traffic well connected is as well fullfiled. Also is fulfiled the criterion that the biggest length of transport from the most distant transfer station in the region to the regional refuse tip should not be over 80 km.
According to the number of inhabitants in the region prevail smaller municipalities with cca 15-50.000 inhabitants, besides the municipality of Sombor with 97.263 inhabitants in the year 2002. Because of that, as an advantageous and vantage location for the regional waste area would be adopted the existing location of the waste area in Sombor.

THE MUNICIPALITY OF ODŽACI

Odžaci is the municipality canter where, according to the census from the year 2002. live 35.582 inhabitants. From the year 1991 the number of inhabitants is reduced from 36.189 according to the annual rate of -1.5‰.
According to the details of the census from the year 2002, the largest number of inhabitants gravitated in village settlements, with 25.642 inhabitants, while in the very town live altogether 9.940 inhabitants. The latest census shoved that the municipality of Odžaci is ethnically characteristically versatile, since there are registered even 22 nationalities.
From the total number of inhabitants the work contingent numbers 23.802 inhabitants, that is 66,89%. 7.823 of them are employed, or 231 on 1.000 inhabitants. Out of the total number of inhabitants female inhabitants are 18.251 and male ones are 17.331. In the municipality of Odžaci were in the year 2005. liveborn 262 children. The number of the died inhabitants were 623 inhabitants. The natural increment (in population) is negative, and the rate of natural increase is -10,7 $^{0}/_{00}$. The natural motion of inhabitants according to the above given details is unfavourable. It is characterized by the low rate of births (liveborn ones), i.e. 7,8 $^{0}/_{00}$ and high rate of general mortality (died ones) 18,4 $^{0}/_{00}$.
According to the statistic data from the year 2002, in the municipality of Odžaci were 12.443 households with the average of 2,86 members. The largest number of hausehold is with 2 members. The number of the marriages was 172, and the divorced ones 43.

Table 2. Memeber number by households in Odzaci Municipality

Member number	Household number
With 1 member	2647
With 2 members	3311
With 3 members	2226
With 4 members	2599
With 5 members	974
With 6 members	513
With 7 members	121
With 8 members	33
With 9 members	17
With 10 members and more	2

THE NEW CONCEPT FOR WASTE MANAGEMENT

On the basis of the analysis of the instantaneous state in the management of the communal waste, it is indispensably to make a plan for the viable waste management for a longer time period which would organize the management of the solid communal waste on the territory of the West Bačka region from its origin till its final providing for. The basic purpose should be establishing one integrated system of the waste management in accordance with the National strategy and the existing European standards and requests.
The aims of the integral waste management will be to a greater extent:

- Reducing the generated quantity of waste;
- Reducing the quantities of waste put off at waste areas applying the primary extraction of useful waste;
- Reducing the portion of bio – degradable waste in the dumped communal waste;
- Decreasing the negative impact of the dumped waste on the environment and human health;
- Management of the generated waste on the principle of the viable development;
- Waste exploitation for energy production;

Itisnecessarytoprojectthetransferstations.
Theywillprovidetemporarykeepinginstoragewasteatcertainsettlements. After that the waste would be trash compacted at greater density in containers transported from the transfer stations to the regional waste area at the location of Rančevo (Sombor municipality).

The whole waste transported to the location of the regional waste area from a transfer station would be at first pass through the plant for waste treatment. At this plant waste would be undergone to the mechanical and biological treatment depending on the composition of the treated waste. After the secondary operation of waste because of the extraction of useful recyclable materials as plastics, metals, glass and paper, they can be sold at the market as secondary raw materials. The waste remnants that are in the greatest quantity bio – degradable waste would be susceptible of the biological treatment in order to obtain valuable products as biogas and compost (vegetable mould) that have their market value. The second capability of the communal trash treating would be its incineration and production of electrical energy or water vapour that could further find their market.
In order to satisfy the goals defined by the National strategy for waste management it is necessary to establish an absolutely new system of the waste management in the Region which includes the municipalities of Sombor, Apatin, Kula, Ožaci and Bač. It implies a new organization, construction new plants, and an absolutely new concept of gathering and transport.
The new concept of the communal waste management proposes the formation of the inter – municipal committee for waste management constituted of the representatives of the municipalities of the Region. It would initiate an action to solve the problem of the waste in the Region.
At the suggestion of the Inter – municipal committee, should be formed the Regional enterprise for waste management which would be based exclusively at commercial bases. The essential activities of this enterprise should be:

- Construction and work of a new regional sanitary waste area,
- Construction and work of transfer stations,
- Collecting and transport of the generated waste to the regional waste area or a transfer station,
- Waste transport from transfer stations to the regional waste area,
- Construction of the plants for the biological – mechanical treatment.

THE TRANSFER STATION IN ODŽACI

The final aim of the implementation of the plan for the management of communal waste in practice, as well as the commitment defined by the Natural strategy for the waste management, would be the coverage of all territories in the Region municipalities (both urban and rural) through gathering and collecting of the solid communal garbage to the regional sanitary waste area. In order to reduce the transport expenses, because of the remoteness of some municipal centers from the location of the sanitary waste area (as well as on account of great remoteness of some rural districts from municipal centers), it will be necessary to form in some municipalities local points for temporary (provisional) disposal of the gathered waste (as well as sorting out, that is separating of some kinds of garbage). These points would present reloading transfer stations.
The transfer stations are the locations where the waste out of local vehicles for waste gathering temporarily keeps in storage and reloads into larger vehicles to be transported to the sanitary waste area.
The location and capacity of the transfer station depends on the waste quantity it would receive, its composition, remoteness from the regional waste area and the kind of settlement (villages or towns). It is impossible to classify the standards that would be adequate for all transfer stations, because their role varies depending on the legal acts that will cover this field of activity.
The number of inhabitants that are oriented to a transfer station can vary in a very wide range from 5000 to 500000.With quantity and structure of the waste it makes, population influences on the capacity and technology of a transfer station, while the other quoted factors influence on location.

- The principle of the station work includes several phases:

1. The vehicle for gathering conveys waste to transfer station and unloads it onto the plateau or into reception container, directly.
2. Bybulldozermanipulationorbyhand (dependingonwastequantityandstationtype) wasteis "pushed" through container (or basket) into a special compactor where waste is compacted through multi – stage phases.

3. On the other compactor side is placed a container with a pressure plate, and into it is “pushed“ the compacted waste.
4. When a container is full, its plate is being lifted. Then comes a traction vehicle and transports the container directly to the waste area.

Because all of waste, by the closed system “puts“ in the container, virtually there are no wasted waters (all water enters the container together with garbage) neither bad small shedding. The best option is to transport all of waste daily to the waste area, i.e. after the ending of the working day, there are no waste at the transfer station. It can be achieved only by optimal frequency of waste gathering and collecting.

The transfer stations contribute to the protection of environment and, people’s health, on many bases:

- Air pollution and fuel consumption are being reduced in view of the increased efficiency in gathering and collecting waste which reduces energy consumption.
- Construction of transfer stations provides the capability that the Regional waste areas can be situated in more secure zones concerning population. They can be also far from the place of gathering, as well as at more favourable locations.
- Construction of the transfer stations reduces transport loading at the regional waste areas.

The transfer station consists of a concrete plateau with adequately fixed communication lines. On the plateau is usually placed a smaller compactor unit for waste compacting and certain number of containers. The designs of transfer stations can be very different among themselves. In the range of simple surfaces with solid groundwork (base) where waste is disposed (dumped) and pushed directly into large containers or lorries, to complex treatment plants where waste is being compacted in special plants, i.e. compactors and containers. In fittings (equipment) can be included as well the presses for waste compaction.

Dimensioning (design) of transfer stations includes the next elements, necessary for optimal functioning:

- Space for manipulation of the transport vehicles which convey waste,
- Space for vehicles unloading,
- Bridge balance (scales)
- Space for compactor unit for waste compacting,
- Space manipulation of the reloading vehicle,
- Space for parking and vehicle washing,
- Administrative building for the management,
- Traffic infrastructure, car parks for reloading and transport vehicles (cleanandfilthy), car-parksmanipulativetrafficarteriesformanipulationandvehiclesmovements at reloading.
- Indispensable infrastructure: plumbing and sewer(age) network, electrical energy for feeding plants, lighting, hydrant net for plateau washing and for firefighting water
- Fence and gate.

At the station for transfer must be space enough so that waste can be piled up till one month, in excess sitnations. Such waste storage will be more than sufficient to compensate possible unexpected breakdowns in vehicles because of which waste can not be transported to the regional sanitary waste areas.

The positioning of transfer stations includes such choice of location that can accept transport vehicles that convey collected waste and reloading larger vehicles into which waste is reloaded in order to be transported to the regional waste area.

Aiming at the rationalization of expenses, it is useful to build transfer stations in the places where already exist some capabilities for adaptation of an existing building or location of a closed waste area. Taking into account that such stations are located as near as possible to a settlement, it is necessary to select such technology of transfer i.e. reloading to which will be consent the surrounding population and instance. Also have to be minimized stench arising originating of waste waters, traffic increasing and the like.

The locations of transfer stations have to be easy accessible to traffic, on the steady ground that can endure higher vehicles loading, and locations are assigned on the basis of:

– Transport remoteness of some local centers from the municipal center,

– Municipality location as well its local centers in regard to the regional waste area,
– State of traffic net and
– Communal installations and implements and situations of the existing municipal waste areas.

- Number and dimensioning of necessary transfer stations in the region for waste management will depend on:
  - Largeness of areas and distances among settlements,
  - Remoteness of the regional waste area,
  - Quantity of waste material and
  - Makes of transport vehicles being used in the primary transport (collecting-station).

On the basis of the Contract of the formation of the region for the management of communal waste, signed by the town-ships chairmen (mayors) of the municipalities of Odžaci, Kula, Sombor, Apatin and Bač, the building of the three transfer stations is stipulated at the locations in the municipalities of Kula, Odžaci and Bač.

The transfer station in Odžaci is more complex section with direct reloading, where waste is being compacted in compactors. Such a kind of transfer station would be positioned on the plateau that is sufficiently large for the construetion of the building for transfer, (reloading) and the driveaway for the qarbage collector vehicles and the driveaway for transfer. The transfer station indispensably ought to have erough space for vehicles manipulation and for setting up sufficent number of containers. The building for transfer enables to the Comunal refuse and it stems the possibility of rainwater gathering in the refuse for transfer. Besides the part for the transfer point, in the building can be situated the offices and other necessary premises for the employees.

At such sort of transfer station, the communal refuse is at first being thrown into a garbage chute positioned directly above the stationary compactor. The drive away for the refuse collector vehicles ought to be inclined, taking into consideration that the garbage chute is positioned at the fixed height in relation to the container for transfer. The compatible container transfer is connected to the stationary compactor in which the hydraulic press compresses the garbage into container. The transfer containers ought to be strengthened so that they could withstand compression pressure. The filled container is transported to the transfer station, and on its place is being placed an empty one. The refuse transport to the regional waste area would be carried out at least twice daily, depending on the quantity of refuse.

The imperfections of this system is the shortage of space for receiving the increased quantity of refuse at the time of high loading during on the refuse selection is not possible.

The principle of refuse transport from all transfer stations can be organized as the system of containers exchange. Here is implied that at the beginning of the workdays are being brought empty containers to the starting location. They would be left there and the full containers would be taken over and transported to the waste area. Here they would be unloaded and the empty containers would be conveyed to the transfer station, where the empty containers are exchanged by the full ones.

CONCLUSION

When the space resources are confined as well as the financial resources are limited, as is the situation in Serbia, the essential task would be the priority to make a system of waste management which would be established exclusively on the formation of the Region for the management of the solid communal refuse. It would cover the space with at least 200.000 inhabitants.

The construction of the regional waste area in the West Bačka county and implementation of the system of the advanced and promoted regional waste management substantially would contribute to the following:

- Improvement of the quality of life and the environment;
- Viable management of resources;
- Application of the legal regulations of EU related to the waste management;
- Greater interest of the investor in the region;
- Fulfillment of the development objectives for the region;

- Development of the communal infrastructure and communal services;
- Increasing of the number of households included in the pattern of structure for rural settlements
- Increasing of the participation of the general public in the development of the system for the waste management;
- Development of the market for the materials from waste and formation of small and middling size businesses in the department of the waste management;
- Restitution and development of public-private partnership in the communal services.

At the conclusion, one should have in mind that waste management is the indispensable factor of the viable development of every municipality, and that cannot be neither development nor prosperity without regular, integral recognizing and settlement i.e. solving of this problem.

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LEGAL PROTECTION FOR SOFTWARE IN EUROPEAN UNION AND SERBIAN LAW

Ljubojev, N.
University of Novi Sad, Technical Faculty "Mihajlo Pupin", Zrenjanin, Serbia
E-mail: nadezdaljubojev@gmail.com

Abstrakt: The need for the appropriate legal norms of software is one of the imperatives not only for our, but also for the globally observed modern society. However, there are still many doubts concerning the legal framework where the legal protection is possible. In the legal practice, at the moment, currently are accepted a copyright and a patent way of protection. Therefore, in this work the author has tried to define the concept of software, through the analysis of the relevant sources of our laws and stating the source from the European Union laws, as there is a tendency for belonging to the European concept of software protection, and highlight the current situation regarding the legal in the our law and European Union law . In the last part of the paper, the author will briefly explain the relation between copyright and patent protection of software co-existing in practice.
Key words:software, copyright protection, patent protection.

INTRODUCTION

Software companies, gained a large profit even in the first years of the designing of software. As the legal protection of software was not provided, one of the main goals was to establish adequate legal framework for the exploitation of software whose market value was very high. It became a worldwide problem so the debate between the advocates of patent law and those of copyright law was lively in the realm of intellectual property law. Although numerous legal acts were passed nationally and internationally, there seemed to be no uniformity of legal protection.

The complexity of software issue caused the debate about the appropriate legal protection of this good to drag out for decades. Since the growing significance of electronic commerce and information technology on society based on the Internet indicates that the real expansion of software designing and use is to come, the problem of the adequate legal protection on European continent is still regarded as unsettled. Moreover, the economic impact of software industry of the United States of America and its considerable effort that software should have the legal protection as a patent have raised to some extents the doubts about the effectiveness of the concept of copyright protection.

There is a need for precise definition of the term of software as the object of legal protection that the work will deal with in the following parts. The term "software" denotes "computer program and procedures, associated documentation and data relating to the functioning of the computer system."[1] We have to distinguish this term from the other closely resembling term-computer program- since their meanings are not identical. We will indicate what it means since it is a narrower term. A computer program includes "an arranged sequence of instructions that are attached to the material carrier and with the help of a computer performs a specific function or achieves a particular result."[2] Yet, in legal literature the usage of both terms are equally justified for computer programs are often marketed in the form of software. In practice, however, the term software is prevailing, which has influenced us to choose this term in our work even though there are the cases of solely computer programs. Although we have opted for language consistency, we will necessarily use the term computer program as well in order not to reduce the credibility of an information source.

Otherwise, according to its implementation software is frequently divided into two groups: system and application software but in terms of legal protection, this division has no special significance. Existing differences between them may affect the certain issues in the legal transactions. For example, system software includes a translation program (from programming language into machine one). utility program (including services, help) as well as a protocol and managing program (drivers) [3]. An operating system is the part of system software and it consists of programs that are the basis of application software for it coordinates the work of different operating units: processors, printers, keyboards, and other related devices [4].In fact, an operating system is a combination of hardware, on the one hand, and a user and application software, on the other hand.

On the market the most significant application software is intended for end users "to solve business, scientific and industrial problems,"[3]and whose performance depends on the operating system and utility program.
There are numerous works which seriously deal with the dilemma between copyright and patent protection both in our and foreign literature. They all provide the starting point for a comprehensive analysis of the problem but in our work we will present only the current normative acts in our law, noting what is the legal protection of software in the European Union, primarily, due to the aspirations of our country towards the European and global integration, and the commitment to the European concept of software protection. Regarding all aspects, we feel it necessary to depict EU and our legislation as *de lege lata* and *de lege ferenda*.
In the last part of the paper, we will briefly explain the relation between copyright and patent protection of software co-existing in practice.

LEGAL PROTECTION FOR SOFTWARE IN EUROPEAN UNION LAW

According to the provisions of the European Communities Council Directive on the legal protection of computer programs (Directive 91/250)[5] which is the primary act regulating the issue of protection of computer programs in the EU, member states protect computer programs as literary works by copyright within the meaning of Berne Convention for the Protection of Literary and Artistic Works. It is important to note that the term "computer program" according to the Directive "shall include their preparatory design material". The protection applies to the expression in any form of a computer program. Ideas and principles which underlie any element of a computer program, including ideas and principles which underlie its interfaces, are not subject of copyright protection.(Art. 1 (1) and Art.(2) Directive 91/250.) [6] In fact, the form of software includes source code (when expressed in some of the programming languages), objective code (in the form of binary numbers, i.e. In machine language) and executable code (electronic digital readout on the physical medium: magnetic tape, a chip, CD). [7]
However, neither judicial nor administrative practice in European Union member states and the European Patent Office ignores the current trends of American precedents when making decisions. It has been proven by the data which show that the national authorities in the European Patent Office has granted thousands of patents applicable to computer inventions. [8]
According to the European Patent Convention (Convention on the Grant of European Patents), which was ratified in 1996, computer programs "as they are" were excluded from the patent protection (Art. 52 (1) of the European Patent Convention). However, taking into account the specified provisions of the Convention, the patent protection can be granted only if the patent application relates to a computer program "as it is", which does not mean that it can not be granted. [9] Based on this, below, we answer the question which computer software is patentable.
Specifically, the Appeals Chamber of the European Patent Office has the opinion that all inventions must have the technical character. The Agreement on the Trade Related Aspects of the Property Rights TRIPS predicts the possibility to issue a patent to all technical - technological inventions that meet the general requirements for a patent. (Art. 27 (1) TRIPS) [6]. That means that the Appeals Chamber of the European Patent Office takes the computer application as a patent invention in case it has a technical character or when it belongs to the field of technology. (Computer program product I & II, T 1173/97 July 1998, OJ EPO 1999(609) and T 0935/ 97 February 1999, (1999) RPC 861[10]
With this in mind, there is still the question of whether copyright and patent protection exist in a parallel way or complement each other.

LEGAL PROTECTION FOR SOFTWARE IN SERBIAN LAW

In our legal system, the basic form of protection for software is copyright. The software was firstly recognized copyright protection by the Law on Amendments and Supplements to Copyright of 1990. Copyright and Related Rights Act of 1998 that followed took the same concept explicitly adding software to the list of works of authorship. (Art. 2 (2) (10) . (Copyright and Related Rights Act in1998, Official journal n. 24/ 98.)

Act of 2004 did not make any substantial changes, but seeking to formally comply with international regulations, the software was classified as a written work. (Art. 2 (2) (1). Copyright and Related Rights Act in 2004 Official journal SCG, n. 61/ 2004) It provides for the existing Law on Copyright and Related Rights. (Copyright and Related Rights Act in 2004 Official journal RS br. 104/09.) However, given the specificity of software as intellectual property, consistent application of the provisions of the copyright in works of literature is not justified. Therefore, our law as well as international legislation has provided a number of provisions, which recognize the need for special regulation of the software, which we will deal with in particular.
According to the current Law on Copyright and Related Rights, the author of the computer program has the exclusive right to permit or prohibit the rental of copies of his work. The term 'rental` means making a copy available for use to the other by a public institutions without direct or indirect commercial advantage(Art.24.Copyriht and Related Rights Act.) This legal provision was not the part of Law on Copyright and Related Rights of 1988. In accordance with Article 40 of existing Law on Copyright and Related Rights which has been taken along with the previous Article 24 of the Directive on rental and serve, in the case of the serve of copies of works of authorship by a person whose business is registered, the author has the right to claim compensation. [5] The different legal treatment in terms of this power stems from the highly technical characteristics of software, which makes its reproduction very simple procedure. Therefore, the legislator considered it necessary to provide the author with the exclusive authority to be able to achieve the higher degree of control over the use of his work.
The software copyright suspension is strictly regulated. The legislator has provided that a person who has lawfully obtained a copy of a computer program may, for their own use of the usual special-purpose programs: accommodate a program in computer memory and run it, remove bugs and make other necessary changes to itwhich are consistent with its purpose, unless otherwise agreed, make a backup copy of the program on a tangible carrier, made compilation of the program exclusively in order to obtain the necessary information to achieve interoperability of the program with other independently created software or specific hardware, if that information is not available in any other way and the decompilation of the program is done in only a portion of which is necessary to achieve interoperability. (Art. 47 (1). Copyright and Related Rights Act.)
Program storage in computer memory and its running are, in fact, acts of reproduction which are exclusively within the power of the author. (Art. 20 (4). Copyright and Related Rights Act) However, these actions are necessary to the person who has legally obtained a copy of the software, to use it. Therefore, it was necessary to suspend the specified powers of the author.
The technical nature of software means that the design and use of software requires the use of machines (computers), so software bugs often occur. Any unauthorized intervention would represent a treatment of the work, and thus a violation of the exclusive non-proprietary rights to make changes. First of all, because of the undisturbed use of the program, the legislature has given the holder the legal authority to remove bugs and to make other necessary changes to the program. However, by the agreement between him and the right holder the application of this provision may be excluded. The similar purpose has legal authority of the holder of the copy of the software to make copies of the software on a durable physical medium, since the working copy during the use can be damaged or destroyed. [7]
Given the extraordinary economic importance of software, the legislature has provided specific provisions in the Law of Treaties, and for the copyright work created in employment, which may be waived only if it is provided in the contract. If the subject matter is the order of the software, the customer acquires the publishing rights and all proprietary rights, which are consistent with the purpose of concluding such an agreement. Finally, it must be emphasized that the employer is the permanent holder of all exclusive proprietary powers to the software employed.

THE COEXISTENCE OF COPYRIGHT AND PATENT LAW

As stated above, according to Directive 91/250, TRIPS and the WIPO Copyright Treaty, software along with its source code and object code is protected as literary work in terms of the Berne Convention. (Art. 1 (1) i (2) Directive 91 / 250 i 10 (1) TRIPS-a) [11] Given the legal significance of these acts, the legislation of European countries is, in this regard, largely harmonized. However, the field of the application of software in the information era spreads and covers those areas that are traditionally protected by industrial property rights, i.e. by patent law. This fact causes differences in software protection.

In this regard, and by the analysis of current legal practice, it can be concluded that the software under certain conditions, may be subject to patent protection. Interpreting the relevant provisions of the European Patent Convention, the standpoint of the European Patent Office is that software, when you start or store it in a computer, produces or has the ability to produce a further technical effect which goes beyond the normal physical interaction between software and computers (hardware) by which the program is run.

This means that the software can be patentable. The basic requirement for the patentability of software is to make a technical contribution. The similar determination of patentability exists in the legal system of the United States, because a patent can be assigned for the procedure, device or product that are new and useful. [12] Patent protection can be given to the promotion of procedures, devices and products, provided that such promotion satisfies required conditions.

We can conclude that the uneven level of the protection for software, in those situations when it can be considered an invention in terms of patent law, brings a different view of patentability. Given the above facts that the United States recognizes inventions patent protection under somewhat different conditions than it is the case in the European Union and most national legislations in Europe, it is possible that certain software is protected under Patent Law in the United States, but under Copyright Law on European continent. In this way, however, it does not call the primacy of the worldwide concept of copyright law into question.

Doubtlessly, some legal and economic uncertainty on the market of software brings software in some cases, depending on the territory of a country, under the protection of both patented invention and the work of authorship. In this regard, it is not unlikely that in the same country, under certain conditions, software as a work of authorship may also meet the requirements of patentability.

THE RELATIONSHIP BETWEEN COPYRIGHT AND PATENT LAW

Based on previous exposure it is evident that in practice copyright and patent protection of software co- exist. Given this fact, we will present briefly what is their relationship.

On the one hand, the patent provides protection for an invention within the patent claims. [7] On this basis, the legal owner of the patent for computer applicable invention has the right to prohibit any third party the use of a patented invention, within the limits specified in the patent application. [13]

On the other hand, copyright protects the software expressed in any form. Ideas and principles which underlie any element of software, including ideas and principles which underlie its interfaces, are not covered by the protection of copyright. (Art.1 (2) Directive 91 / 250) Therefore, the software will enjoy copyright protection only if it is genuine, if it is the author's own intellectual creation. (Art. 1 (3) Directive 91 / 250) Thus, copyright protects the right holder against direct copying of source and object code, but this protection does not extend to those cases that represent different ways of expressing the same ideas or principles.

The theory states, however, that the right holders can refer to the patent infringement even when the computer applicable invention, whose source or object code are different, has the same effect, although according to copyright law that created independent program also was the object of protection.

Based on this we can conclude that these two types of protection can complement each other so that copyright protects the **form** in which the software expresses, and the patent protects the **idea** on which it is based, provided it meets the requirements of patentability.

CONCLUSION

If we bear in mind that the basic form of the protection for software is copyright, we should not ignore the fact that copyright protection for software, which has already been widely accepted, includes any form of expression, that is, both source and object code. On the other hand, considering the cases of recognition of patents for software, one of the key issues which has been raised is whether the copyright and patent protection coexist in a parallel way or complement each other. The answer to this question is the subject of the consideration in this section.

As stated above, according to Directive 91/250, TRIPS and the WIPO Copyright Treaty , software along with its source code and object code is protected as literary work in terms of the Berne Convention. Given the legal significance of these acts, the legislation of European countries is, in this regard, largely harmonized. However, the field of the application of software in the information era spreads and covers those areas that are traditionally protected by industrial property rights, i.e. by patent law. This fact causes differences in software protection.

In this regard, and by the analysis of current legal practice, it can be concluded that the software under certain conditions, may be subject to patent protection. Interpreting the relevant provisions of the European Patent Convention, the standpoint of the European Patent Office is that software, when you start or store it in a computer, produces or has the ability to produce a further technical effect which goes beyond the normal physical interaction between software and computers (hardware) by which the program is run.

This means that the software can be patentable. The basic requirement for the patentability of software is to make a technical contribution.

Doubtlessly, some legal and economic uncertainty on the market of software brings software in some cases, depending on the territory of a country, under the protection of both patented invention and the work of authorship. In this regard, it is not unlikely that in the same country, under certain conditions, software as a work of authorship may also meet the requirements of patentability.

In our legal system, the software was firstly recognized copyright protection by the Law on Amendments and Supplements to Copyright of 1990. Copyright and Related Rights Act of 1998 that followed took the same concept explicitly adding software to the list of works of authorship.

Act of 2004 did not make any substantial changes, but seeking to formally comply with international regulations, the software was classified as a written work. It provides for the existing Law on Copyright and Related Rights. However, given the specificity of software as intellectual property, consistent application of the provisions of the copyright in works of literature is not justified. Therefore, our law as well as international legislation has provided a number of provisions, which recognize the need for special regulation of the software, which we will deal with in particular.

Based on previous exposure it is evident that in practice copyright and patent protection of software co- exist.

Based on this we can conclude that these two types of protection can complement each other so that copyright protects the **form** in which the software expresses, and the patent protects the **idea** on which it is based, provided it meets the requirements of patentability.

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XML BASED SIMULATION OF SMS SERVICE IN BANKING INFORMATION SYSTEMS EDUCATION

Kazi, Lj.[1], Petrovic S [1], Markoski B [1], Ivkovic M [1], Ivankovic Z[1], Bhatt M. [2]
[1]University of Novi Sad,Technical Faculty "Mihajlo Pupin", Zrenjanin
[1]University of Mumbai,R.D. National College, India
E-mail: leremic@tfzr.uns.ac.rs

Abstract: In this paper we present basic framework for banking information systems education applied at Technical faculty “Mihajlo Pupin” Zrenjanin, University of Novi Sad. This framework is based on banking business processes, elements of information systems technology and adjusted to existing commercially available total banking solutions. This way we formulate concept of banking information systems education at classess and learning by students’ work on projects. One of students’ projects deals with XML based simulation of SMS service in banking information system. We present concept and results of this project.
Key words:banking information system, education, XML, SMS service, simulation

INTRODUCTION

Banking information systems are professionally developed upon the needs of the business processes in banks. Generally speaking, there are three segments each business organization business processes: basic processes (realizing the existence goals of a company), supporting processes (enabling resources needed for basic processes) and management processes (defining rules, monitoring results of basic and supporting processes and initiating activities according to analytics of state of quality of results monitored). In the case of bank, basic processes are related to services directed to citizens, companies and other banks. Banks for each of clients have accounts opened and process transactions for money transfer to these accounts. Each of these accounts in any moment of time has temporary state, which is of interest to client to be informed of.
Information systems technology is based on applying technology for functional segments of data updating, storing, manipulation, transport and exchange, display, query, analytics and printing documents. This functionality is supported at client/server architecture within a bank,as Internet applications for e-banking services, as well as other technologies such as ATM/POS terminal support and mobile applications. SMS messaging is one of technologies that are supported in banks that enable communication of bank's information system with clients mobile phones.
At Technical faculty "Mihajlo Pupin" Zrenjanin, Serbia banking information systems education is established as a subject within education of students at business informatics course, at final year of study. Banking information system education at Technical faculty "Mihajlo Pupin" Zrenjanin, Serbia is based on general banking business process, modern information systems technology, as well as commercially available solutions. One of these solutions are provided by SAGA as Total banking IT solution (TBS) [1], that provide a complex infomation system for all business segments of banking. The concept of the education process in previous years was designed as classess lectures (having Microsoft Excel lessons and MS Visual Studio NET programming lessons) and evaluation of students knowledge and skills (by partial laboratory exams and student projects).
In this paper we present one of banking information system topic. It is XML based simulation of banking SMS service directed to citizens' mobile phones, regarding state of their accounts.

SIMULATION IN EDUCATIONAL SOFTWARE

According to Nadrljanski [2], there are two mayor approaches for simulation software in education:
1. Creating model for simulation building - student has data and need to create model for simulation by identifying parameters and relationships among variables. After creating model, student has to use data to verify the model.
2. Simulation of behaviour - within this approach, students get the model and they can test it with changing parameters.

Within the second approach, there are three types of simulation software:

1. Dynamic simulation - student can change parameters in software based on an internally implemented model that is based on scientific laws that present part of reality or natural laws.
2. Methodology simulation - this software enables comparison of simulation outcome data and real experiments outcome data and verifying simulation model, i.e. verifying theory that is basis for that model
3. Operative simulation - this type of software presents simulation of experiment, tool or process in aim to identify relations between depending variables. This type of simulation software is usually used for smaller educational topics.

Figure 1. presents basic activities in creating a simulation, i.e. creating model, getting testing data and testing simulation model,that verifies the model and theory that is basis for model.

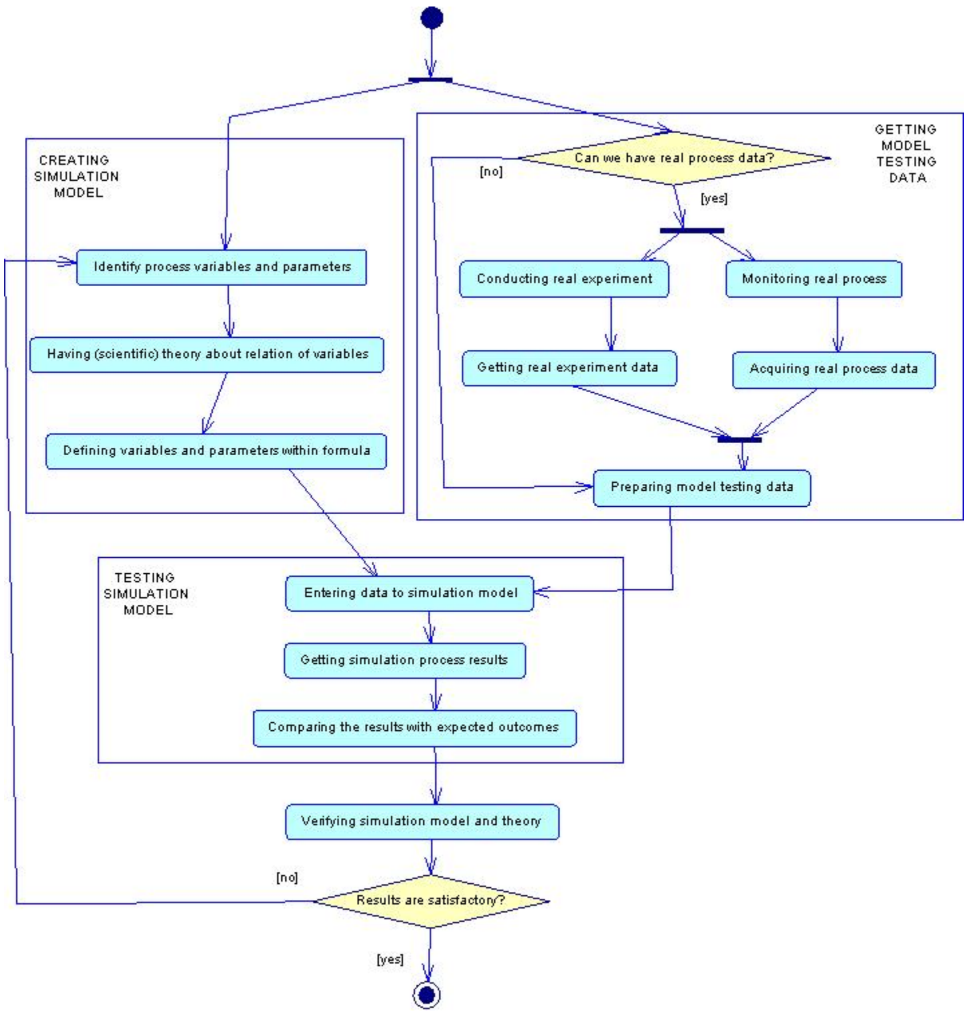

Figure 1. The process of creating a simulation **[3]**

XML SIMULATION OF BANKING SMS MESSAGING

Main parts of solution designed during consultations regarding student project and developed by student's partial exam requirement [4] are presented in this section. Database is developed as MS Access database with structure presented at Figure 2.

Windows forms are developed for account registration (Figure 3.) and updating data regarding account money transactions (Figure 4).

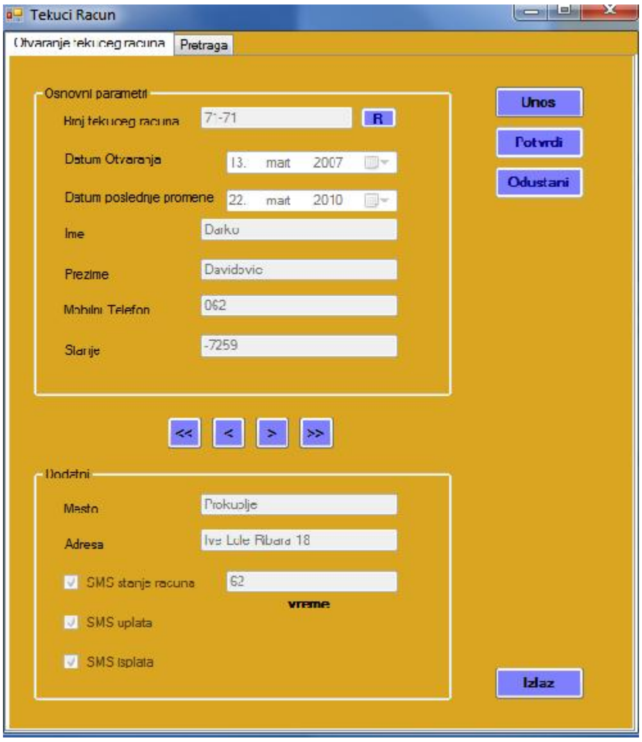

Figure 3. Account registration

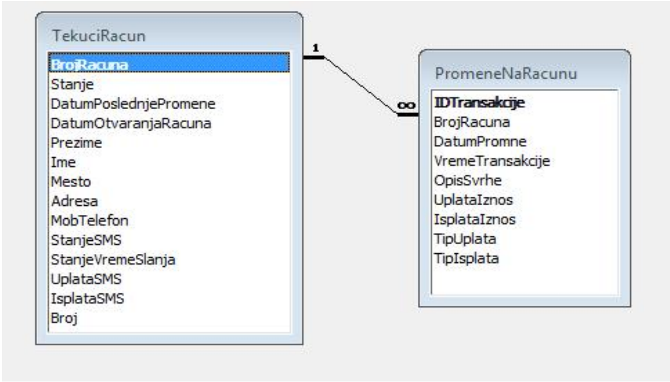

Figure 2. Database structure [4]

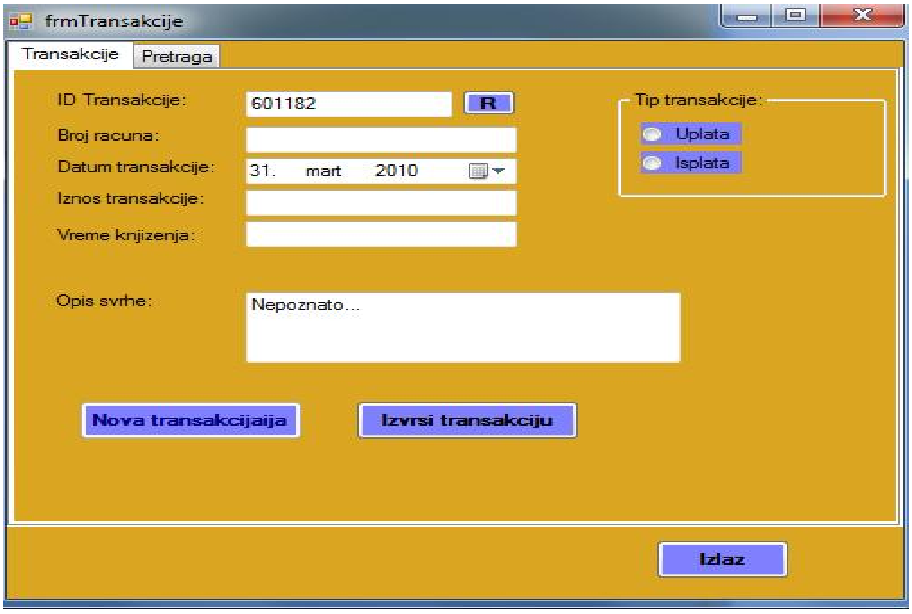

Figure 4. Money transactions at account

Figure 5. Windows form simulating bank client's mobile phone

Finally, if user of this software choose, upon client request, to enable SMS messaging (at account registration), then after each transaction upon account, XML file is generated that present an SMS message. This message will appear at Windows form (Figure 5) presenting mobile phone, after opening. This form read XML file and present content at user interface of this form.

Key Visual Studio NET code (C#) that read XML that simulates SMS is presented as follows. Stream reader reads path of XML where it has been stored, data set reads XML by ReadXML and List box show content from data set.

```
string fullpath = Globalna.promenjiva;
try
        {
StreamReader sr = newStreamReader(fullpath);
            dsPoruka.ReadXml(fullpath);
            listBox1.DataSource = dsPoruka.Tables[0].Rows[i].ItemArray;
            sr.Close();
        }
```

CONCLUSION

In this paper, we show basic concept of banking information systems education at Technical faculty "Mihajlo Pupin" in Zrenjanin. This concept of education is based on banking business processes, information systems technology and available commercial solutions.
We particularly presented a general concept of using simulation in education, i.e. creating simulation software in education. We described student's project that demonstrate how XML could be used for simulation of SMS messaging regarding bank account information, i.e. information regarding transactions at citizens' accounts.
XML as a technology is taught at Technical faculty "Mihajlo Pupin" in Zrenjanin within classes of banking information systems with business informatics students at final year of study. This way we show that XML could be used in simulation software, specially in banking SMS messaging simulation software.

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IMPLEMENTATION OF QUALITY MANAGEMENT SYSTEM – EFFECTS IN SERBIAN ECONOMY

Ćoćkalo, D., Đorđević, D., Stanisavljev S.
University of Novi Sad
Technical Faculty "Mihajlo Pupin", Zrenjanin
E-mail: cole@tfzr.uns.ac.rs

Abstract:A part of bigger research is presented in this paper [1]; one of the secondary objectives was to examine the reasons for certification QMS, difficulties and effects in its application, as well as (though a great response of companies and experts wasn't expected) the reasons against certification according to ISO 9000. Surveying available companies and experts was carried out by e-mail interview. For the sake of the survey it was created a methodologically adjusted questionnary which, among other things, included the questions related to the reasons for certification QMS, difficulties and effects in its application. The communicative principle was: one qustionnary – one company/expert.About 600 organizations (micro, small, medium size and big companies) and about 100 experts were included in the survey.The obtained results point at the significance of internally motivated organization for improving business processes. In such cases, certification results in improving performances and market position of a company.The call for participation in the survey accepted 84 companies (which was, at that time, between 4,5 and 5,5% of all certified companies in the Republic of Serbia) and 37 experts from the field of interest. The response was modest – only 14% of companies and 37% of experts accepted the call.
Key words: ISO 9000, benefits, certification, QMS.

INTRODUCTION

The quality of business implies a management approach, which means quality management of a company's business identified through respecting international quality standards. The quality of products and services represents a starting point in applying this concept but it also represents the result of improving business quality.

Aseriesofinternationalstandardsis, firstofall, orientedtowardssatisfyingcustomers' requirements whose objective is improving competitive advantage as one of the basic pre-conditions of permanent improving in business quality.The best proof for successful application of ISO 9000 standard is the growing number of the world's companies that implemented this concept. By the end of 2007 there were 951486 companies in 175 countries with certificated quality management system according to the requirements of the series of international standards ISO 9000. Only during 2007 there were 54557 companies (+ 6 % in comparison to 2006) that implemented quality management system. Europe with its 431479 companies represents the region which has the greatest number of companies with the implemented quality management system according to the series of standards ISO 9000. China leads in the number of newly certificated companies (210773) followed by Italy (115359) and Japan (73176). According to the total number of certificated companies in the region, Serbia takes the fifth position (1987) after Hungary (based on insufficient data 10473), Romania (9633), Bulgaria (4663) and Croatia (2073). According to the increase of certificates in comparison to 2006, Serbia takes the second place (+436) after Bulgaria (+1566) and before Bosnia and Herzegovina (+410) [2].

The advantages of implemented quality management concept can be internal and external. The following advantages are internal: improvement of documents, consumers' expectations and the process, development of products' quality, reduce of reject, increase of efficiency, improvement of business and the motivation of employees.Theexternaladvantagesare: improvementofproducts, developmentofmarketingimage, salerise, satisfactionofconsumers' requirements, developmentinrelationshipwithsuppliers, increaseofcompetitiveness and sale at international markets, profit rise and reduce of consumers' complaints.[3]

PREVIOUS RESEARCHES IN THE WORLD

The number of advantages is significant for the organization which implements the quality management system.Generally, theresearchesshow that such organizations have better management and productivity as well as the reduction of reject.The experiences of foreign companies which implemented the quality system point at the following advantages: business costs are reduced up to 50%,productivity is increased, as a rule, up to 50%,profit is increased from 30-50%. [3]

TheSwedishstudy[4] onexpectationsandactual (realized) conditioninthefieldofcertificationaccordingtoISO 9000 waspublishedin 1993 and it examined data collected from 23 multinational companies working in Sweden. Two factors are emphasized: improvement of market position and motivation of employees. The data tell us that the most expected results are those which are the least actual – market share is expected in 17 companies but it is realized in only 9, which makes the only disproportion. Concerning the factors such as smaller quality costs and better organization effectiveness greater realized benefit than expected one is noticed; concerning the factor “better relations with customers” the benefit is equal (11:11). Concerning the factor “improved motivation of employees” the actual benefit is doubled in comparison to the expected (20:10). Similarly, concerning the improvment realized through certification, the relations among the ranks “exeptional improvement”, “some improvements” and “without improvements” is at market position – 3:6:14 and at motivation of employees – 11:9:3. The factor “relations with customers” is equally badly presented, as well as “market position” – 3:8:12.

During the year 1995 ManchesterBusinessSchoolcarried out the research [4] by using the advantages of SGS Yarsley in order to find out the reasons for acquiring ISO 9000 certificate, the influence (of benefits) on business, as well as the common problems with certification, which will be shown in the tables 1,2,3. It was completed 1190 questionnaries from the companies certified according to ISO 9000 (any model from the series from 1994) dealing with production, building and services. Market and marketing reasons were dominant among all the reasons. The interviewed most frequently identified “the requirements of the future consumers for ISO 9000” – 78%; between 60-70% were the reasons: maintaining/improving market position and improving quality of services; between 50-60% were the reasons: pressure from consumers, ISO 9000is a “good tool for promotion”, increasing the efficiency of operations and improving products quality. The least important reason was “reduction of costs” – 22%.

Comparative review of the results is presented in the following tables [5].Inthecaseswherealltheintervieweddidnotanswerthequestion the number and percentage of participation (relative frequency) of the companies/experts who answered the questions are marked.This information is relevant for absolute and relative frequencies of the answers.

Concerning the benefits from certification according to ISO 9000 a dominant position took the management – more efficient management (78%) and improving consciousness about procedure problems (77%) – these were the most frequently identified factors of benefits. The factor “improved market position” was the least identified one as a real benefit from certification (at 47% interviewed) which linked this study with the previously mentioned one.

Concerningthemostcommonproblemswithcertificationitshouldbenoticedthattherewasrelativelysmallpercentage of the companies which noticed those problems at all - maximum 31%. Speaking about the time necessary for writing the procedure the interviewed emphasized: a great quantity of paper (27%), high price of implementation (25%) and the time necessary for implemetation (24%).

Table 1. Reasons for acquiring ISO 9001 certificate

	Offered answer	The interviewed who selected the answer (companies)	The interviewed who selected the answer (experts)
(a)	Requirements of the future consumers for ISO 9000	30 (12,6%)	20 (20,2%)
(b)	Maintaining/improving market position	57 (23,9%)	21 (21,2%)
(c)	Improving the quality of services	49 (20,7%)	21 (21,2%)

(d)	Pressure from consumers	11 (4,6%)	8 (8,1%)
(e)	ISO 9000is good as a “tool for promotion”	2 (0,8%)	6 (6%)
(f)	Increasing efficiency of operations	36 (15,1%)	5 (5,1%)
(g)	Improving quality of products	34 (14,3%)	10 (10,1%)
(h)	Test forTotal Quality Management	4 (1,7%)	3 (3%)
(i)	Reducing of costs	13 (5,5%)	5 (5,1%)
(j)	Other	2 (0,8%)	-

Table2. Benefits from certification according toISO 9001

Offered answer		The interviewed who selected the answer (companies)	The interviewed who selected the answer (experts)
(a)	Better management control	28 (11,7%)	11 (10,6%)
(b)	Improving consciousness on procedure problems	18 (7,5%)	5 (4,8%)
(c)	Use of standards as promotion tool	11 (4,6%)	5 (4,8%)
(d)	Improving relations with customers	18 (7,5%)	18 (17,3%)
(e)	Relief in eliminating of procedure problems	12 (5%)	2 (1,9%)
(f)	Increasing efficiency	36 (15,1%)	16 (15,5%)
(g)	Improving quality of products/services	31 (13%)	18 (17,3%)
(h)	Retained present customers	3 (1,3%)	2 (1,9%)
(i)	Increasing customers satisfaction	38 (15,9%)	12 (11,5%)
(j)	Reduction of costs	5 (2,1%)	-
(k)	Improved market position	30 (12,6%)	11 (10,6%)
(l)	Help at introducing new employees	8 (3,3%)	4 (3,8%)
(m)	Continual improvements	1 (0,4%)	-

Inthesecondstudycarriedoutin1995 byManchester Business School 140 companies of different sizes participated in identification of the reasons against certification according to ISO 9000. The results emphasized the following reasons: the volume of documentation (“paper”) – 82%, the implementation costs – 77%, the time spent on implementation – 75%, or making documentation – 71%,as well as the costs for system maintenance – 68%.
Theresearchersreportedthatmanyorganizationsfromthesphereofservicesthought that ISO 9000 wasn’t relevant for them and the companies with fewer that 25 employees were especially worried about implementation costs [4].

Table 3.Common problems at certification according to ISO 9001 (80(95,2%) companies)

Offered answer		**The interviewed who selected the answer (companies)**	**The interviewed who selected the answer (experts)**
(a)	Time necessary for writing procedures	47 (24,9%)	20 (21,3%)
(b)	A great quantity of “paper”	32 (16,9%)	14 (14,9%)
(c)	High price for implementation	15 (7,9%)	6 (6,3%)
(d)	Time necessary for implementation	36 (19%)	24 (25,5%)
(e)	High costs for maintenance	8 (4,2%)	3 (3,2%)
(f)	Lack of solidity among evaluators	6 (3,2%)	7 (7,4%)
(g)	Time spent on checking “papers” in pre-checking period	10 (5,3%)	2 (2,1%)

(h)	Ambiguity in standards	8 (4,2%)	4 (4,3%)
(i)	Problems at standard interpretation	21 (11,1%)	11 (11,7%)
(j)	Other	6 (3%)	3 (3,3%)

In 1998 theresearchersfromSloveniacollected the answers from 117 out of 355 Slovenian organizations certificated according toISO 9001orISO 9002[4].The objective of the study was to determine parameters for improvements that could be attributed toISO 9000. Likert-like scale, consisted of seven points for evaluation of the situation,[2] was used in the study. The results followed paralelly the relation of the aproximate mark of the companies which didn't follow the parametres in %. The best marks were given to: process efficiency (5,82 – 6%), quality of products and services (5,65 – 3%), productivity (5,60 – 24%), the results of business (5,58 – 32%), customers' satisfaction (5,49 – 11%), planning the business (5,48 – 10%), after-sale services (5,48 – 38%), managing the material (5,43 – 32%), quality management (5,38 – 35%). The worst marks were given to the following parametres: innovations of products and/or services (4,92 – 23%), innovations in the business process (4,89 – 27%) and satisfaction of employees (4,84 – 23%). These results could have been expected.
The performance of organizations and the relationship with certification on the ISO 9000 series is a theme of the research which was realise by Singels, RueÈl and van de Water (2001)[6] using KKNN (the foundation of Quality Circles North Netherland). About 950 mail questionnaires were sent to organizations throughout the North of Holland: approximately 300 to organizations with more than 50 employees and 650 to organizations with less than 50 employees. A total of 192 organizations filled in the questionnaire (response rate of 20%). It is often claimed that ISO certification generates an improvement in the performance of organizations. This research aims to find out if ISO certification indeed results in better performance outcomes for organizations. This is of importance, for example, for those organizations that seek ISO certification in order to improve their performances. To test the hypothesis, an instrument is developed to measure the performance. The performance of organizations is operationalized through five performance indicators: production process, company result, customer satisfaction, personnel motivation, and investment on means. Besides this main research interest the question is posed if other factors can explain for the performance.
Chow-Chua, Goh and Boon Wan (2002.)[7] examines the issue of ISO 9000 certification and its perceived benefits for Singapore based companies. Using an empirical approach, the research seeks to ascertain if certification has indeed improved the performance for listed (such firms are listed on either the main board or the secondary board of the Singapore Stock Exchange) and non-listed companies.The results from a survey of 146 firms suggest that while certification leads to better overall financial performance, non-listed certified firms experience better documentation procedures, higher perceived quality of products or services, and more effective communication among employees than listed certified firms. Some problems encountered in certification include the failures to establish adequate monitoring programs, to follow set procedures and to carry out appropriate management reviews of the new system as well as unclear authorisation.
The purpose of the study by Lagrosen and Lagrosen (2003.)[8] has been to identify and describe the differences between organisations of different configurations (Mintzberg's five different organisational configurations) to determine the way that quality management is used and the effects that are produced. The research population comprised the members of the Swedish Association for Quality. The following key positive effects are given: Improvements regarding the processes (46.8%), Increased participation (12.8%), Improved climate, including increased understanding for quality and a more holistic view (12.5%) and Improvements regarding the customers such as customer satisfaction, market share, etc. (12.1%). Even 57.4% companies stated that they didn't have negative effects and when they had them the most frequently mentioned are: Increased bureaucracy (15.1%),

[2] 1. the situation goes wrong significantly, 2. the situation goes wrong, 3. there is minimum decline, 4. the situation is unchanged, 5. there are minimum improvements, 6. the situation is improved, 7. the situation is exceptionally improved.

Increased workload (19.1%). Difficulties which are most frequently mentioned are: Inadequate leadership (29.9%), Lack of commitment amongst the employees (28.6%), Lack of commitment amongst the employees (28.6%) and Lack of time (14.5%).
To analyze the changes in the perceived benefits of ISO 9000 with the passage of time, is purpose of the research by Casadesus and Karapetrovic (2005.)[9] conducted in 2002 in Catalonia (region of Spain) on the sample of 399 companies. The studuy indicates that ISO 9001: 2000 registered organizations report benefits to a lesser extent than their ISO 9001/2/3: 1994 registered counterparts across all studied benefit categories. Considering that the new standard is supposed to be a much improved version of the old one, these findings are then contrasted with the results of an almost identical survey performed in 1998. The discussion demonstrates that the perceived benefits of the ISO 9001/2/3: 1994 implementation have also decreased over time.
To assess the relative value of the 2000 version of the ISO 9000 series of quality management system standards in comparison with the 1994 version, is purpose research van der Wiele, van Iwaarden and Williams (2005.)[10].
The main goal of the research presented by Ivanovic and Majstorovic (2006.)[11] is the investigation of quality management (QM) practices in the West Balkan countries and their advancement according to the models in developed countries. The investigation was carried out on the sample of 59 certified organizations amounting to about 5% of the total number of QMS certificates issued in Macedonia, Serbia and Montenegro and Bosnia and Herzegovina.

SIMILAR PREVIOUS RESEARCHES IN SERBIA

In the research[12]carried out at the Institute for small and medium size companies in Belgrade in March 2000, 143 companies out of 245 were ready for cooperation. 81 companies were certified according to ISO 9001 quality system and 62 according to the model ISO 9002 from the territory of Serbia and Montenegro. According to the surveyed companies, the most important reasons for implementation of the quality system were customers' satisfaction (25,8%) and higher level of quality (25,8%). Less important reasons were: better competitiveness (17,87%), lower costs (13,65%) and higher profit (9,68%). Higher level of quality was the best ranked[3] advantage from the implementation of quality system. (34,53:9,49:10,29%). Documentation (15,11:18,25:19,12%) and working process (10,07:24,09:16,91%) followed and the least important reasons were reduced costs (6,47:10,22:11,03%) and image (9,35:10,95:7,35%).
Small and medium size companies and QMS were the subject of the research "The Analyses of atitudes and opinions of firms on implementation of QMS in SME" [13] , carried out on the territories of Republic of Serbia, Republic of Montenegro and Republic of Srpska from 1st December 2005 to 25th March 2006. On the sample of 56 surveyed owners and leaders of SME, 95,92% thought that the implementation of QMS inSMEwas necessary and the most common reasons for validity of this claim were: efficient management of the organization (24,64%), improving quality of the organization (22,46%) and better business performance (15,22%). A greater number of the surveyed experts, 78,72%, wasn't satisfied by the implementation of QMS inSME.
According to the research results [14] carried out among certified organizations in Serbia, primarily focused on the general model of quality management and its implementation, the main effects of QMS stand out:improving relationship with customers (44,2%), improving quality climate (22,4%), improving the process (19,1%) and increasing participation of employees (12,5%). Themainnegativeeffects are:increasing bureaucracy (26,7%) and prolonging working processes (19,8%). Previously mentioned indicators clearly speak on behalf of the necessity for implementation of the quality management concept according to ISO 9000 series of standards in domestic companies, in order to improve competitive advantages of domestic companies on the international market.
Theresearchofcorporativeenterpriseconceptanditsimplementation [15] wascarriedoutfromMay 2007 tillOctober 2007 ontheterritoryofRepublicofSerbia. The objective of this research was to collect opinions of companies' leaders, among other issues, about the factors which improve business

[3]Ranks 1:2:3 in % - were given according to the declining level of importance for the company

process. This research was based on the analyses of company leaders' attitudes and the sample size was 50 units. By analysing the answers obtained in the survey (there were mainly medium size and big companies) the researchers came to the basic assumptions which creatively influence the processes in modern economy and management. The leaders emphasized the following main factors in improving the business process: improving the quality of business – 22,5%, increasing productivity – 20,3%, enterprise behaviour – 16,54%, training of employees – 15%, improving technological bases of the business process – 8,27%, increasing knowledge productivity, 7,5%, development of integrated management systems – 7,5%, internationalization of Serbian companies – 2,34%.

METHODOLOGY

Primary objective of this research was to assert:the facts, attitudes and opinions in relation to implementation and providing QMS in the economy and services; needs and specific demands of Republic of Serbia economy concerning modeling the process of measuring and monitoring customers' requirements, as well as the specific demands of experts in the sphere of quality concerning the same issue. [1]

One of the secondary objectives was to research the reasons for certification QMS, difficulties and effects in its application, as well as (though great response from companies and experts was not expected) the reasons against certification according to ISO 9000.

The target groups of the research were:

- companies (manifacturing and/or services) which were, according to the primary objective, certified according to the standards of QMS (ISO 9000 series of standards) and which perform business and are located on the territory of Republic of Serbia, in other words quality managers, owners or employees in general who are in charge for application of QMS (EMS, OHSAS, HACCP etc.) in their companies, as a primary group,
- experts in the sphere of quality, as a control group.

Surveying of the available companies and experts was carried out by e-mail (e-mail survey).Thereasonsforthiskindofsurveywerequickresponse and costs having in mind the main characteristics and difficulties. [16]

A methodologically adjusted questionnary was created for the sake of the survey. Introductory part of the qustionnary consisted of, apart general information, the questions related to the reasons for certification QMS and difficulties and effects present in its application. The communicative principal was: one qustionnary – one company/expert.

The survey included about 600 organizations and about 100 experts. Totally 84 companies (between 4,5 and 5,5% from all certified companies in Republic of Serbia) [2,17] and 37 experts from the sphere of interst accepted the call for the survey. That means that the response for the companies was about 14% and for the experts was about 37%. The structure of the surveyed companies was: **35 (41,7%)**from the territory of Vojvodina, **18 (21,4%)**from the territory of the City of Belgradeand**31 (36,9%)**companies from central Serbia; according to the size: micro **6(7,2%),**small **8(9,5%), medium size38(45,2%), big32(38,1%).** The structure of the surveyed experts was: **13 (41,9%)**over 50 years of age, **11 (35,5%)**between 30 and 40 and **7 (22,6%)** between 40 and 50 (average length of service is about 15 years); according to the level of qualification: PhD (**15 (40,6%)**), masters and university degree (**10 (27%)**) and **2 (5,4%)**of the experts were with college diploma; according to the occupation (answered **22 (59,5%)**of the interviewed): university professors/college teachers (**11**), 5experts employed as consultants, **2** expert assistants and 2 technologists, 1 top manager, 1 head engineer and 1 programmer.

DISCUSSION AND CONCLUSIONS

As this research shows (the majority of the experts and the companies agreed), the most common reasons for receiving ISO 9001 certificate are: maintaining/improving market position, improving quality of services/products, increasing efficiency of operations, requirements of the future customers forISO 9000. These results correspond to the previous researches in the world and in Serbia and they confirm that domestic businessmen, in most cases, knew what the application of ISO 9000 standard should have brought to them. Certification itself doesn't authomatically result in improving performances and better market position, as some previous expectations were and some researches rejected [6] but it was considered as an appropriate “tool” in achieving this objective. This corresponds to the received answers about the benefits from certification. The most frequently mentioned benefits correspond to the reasons, and they are: increasing customers' satisfaction, increasing efficiency, improving quality of products/services, better position on the market and better control of management. Here, again, a consensus of the experts and the interviewed from companies exists.

The most common problems at certification according to ISO 9001 and the reasons against certification according to ISO 9000 are not essential, but procedural-administrative and economical. They relate to: the time necessary for writing the procedure (time necessary for making documentation, the “reason against”), time necessary for implementation, a great quantity of “paper” (too much documentation, the “reason against”), difficulties at standard interpretation, high costs of implementation, as well as high costs for maintenance. Bad response of companies, in the case “reason against”of the experts as well, as it was expected in the beginning, seems to indicate that more attention is paid to the benefits from certification and that the “problems” are considered as normal and side phenomenon. Sometimes, they are not treated as problems at all.

As a possible general conclusion of the presented part of the research it is imposed the significance of internally motivated organization for improving organizational processes. In this case, certification results in improving performances and market position of companies.

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SESSION 6: Process management

THE ANALYSIS OF ENERGY ISSUES BY USING SOLAR COLLECTORS USED FOR IRRIGATION OF PLANTS IN THE GREENHOUSE

Kurpaska, S.
University of Agriculture in Krakow
Institute of Agricultural Engineering and Informatics
E-mail: rtkurpas@cyf-kr.edu.pl

Abstract: The paper presents the results associated with the estimate of collector area used for irrigation of crops grown in the greenhouse. On the basis of experiments and determined the efficiency of conversion of solar radiation into heat was calculated surface of solar collectors (flat and vacuum). For arbitrarily adopted collector surface, was also analyzed monthly demand for fossil fuel (coal). Also defined ecological effects of using collectors for preparation of process water.
Key words: flat solar collectors, vacuum solar collectors, irrigation of plants, coal

INTRODUCTION

The global increase in energy demand caused by rapid economic growth, rising prices of fossil fuels and the threat of depletion, and excessive environmental pollution in recent years have caused great interest in devices that enable the production of energy from renewable sources, including from the sun. The most popular and cheapest for active device of solar energy conversion are solar collectors, including flat collectors and vacuum. The amount of heat that is extracted from solar radiation and vacuum of flat solar collectors in the world is diverse. The current global development of the sector that uses solar energy to heat water is at a level which allows to produce approximately 128 GWh of heat [8]. Most of the heat is obtained in China and Taiwan (80.8 GWth), Europe (15.9 GWth) and Japan (4.9 GWth) the remaining potential is distributed to the rest of the economy which use energy from solar radiation [10] .Among the many potential opportunities, heat from the solar collectors are also used in agricultural production, mainly as a complementary reheating objects under cover [2], [10], [4], supplementary or main floor heating in foil tunnels in order to accelerate yielding, preparation of process water for watering plants, preparing seedlings for transplanting, heat treatment needs in postharvest fruits and vegetables and thermal against soil pathogens [1], [7]. The profitability of the solar collectors depends on their energy efficiency: the ratio of energy obtained to energy supplied by solar radiation. exerts its influence not only the construction of the collector (the aim is to minimize heat loss), but also the operating parameters (flow rate of the working medium, the angle of the collector in both planes) and the configuration of the system (eg capacity storage tank with heated water so that the amount of accumulated water demand covered during cloudy days). The issue of conversion of radiation for various equipment configurations and system conversion was a problem of intensive research in various scientific centers. Sabatellli et al [9] analyzed in accordance with the applicable standard (ISO 9801 / 1) the efficiency of flat plate collectors. To describe the efficiency was used equation containing three parameters endearing: parameters of the circulating medium, global solar radiation and ambient temperature. Also conducted analysis of the sensitivity of used method associated with errors of measurement. Luna et al [6] studied the effects of work flat solar collector based on the linearization of the equations of conservation of energy. The method was analyzed in terms of sensitivity to the value of this parameter, considering its suitability for the stage of construction analyzed collectors. Herrero-Martin et al [3] analyzed the possibility of increasing the thermal efficiency of a liquid solar collector by increasing the heat exchange process. Theoretical analysis was conducted using TRNSYS simulation model. Thermal efficiency identified in accordance with the applicable standard. They found the optimum value of the circulating medium flowing stream (water, aqueous propylene) and found that the use of the optimum value of flow stream increases by nearly 5% conversion efficiency of solar radiation into heat. Kurpaska and Latała [5] studied the efficiency of conversion of radiation in flat and vacuum collectors. Also been developed a multiple regression model endearing dependency of efficiency on the parameters of the surrounding climate.

In conclusion, the results of research can be concluded that the efficiency of the collectors was largely considered mainly in laboratory conditions and its value depends on the parameters of the surrounding climate and stream of factor flow.

Hence the aim of this study is to determine the efficiency of converting solar radiation into heat in a flat and vacuum collectors. On the basis of the obtained results will be defined energy effects of using such collectors to irrigation of greenhouse tomatoes.

MATERIAL AND METHODS

Experiment set- up

The study was conducted on a laboratory located in facilities of University of Agriculture in Krakow, whose diagram is shown in Figure 1. This position consists of a flat and vacuum solar collectors with an effective area respectively 7,8 m^2 (flat) and 4,3 m^2 (vacuum tube solar collectors) and a heated storage tank for liquids. Heat removal from the tank (1) followed by heat pump (2), in which the bottom source was an additional heat exchanger placed in the buffer tank. From the buffer tank (3) heat was supplied to the heating system foil tunnel(4).

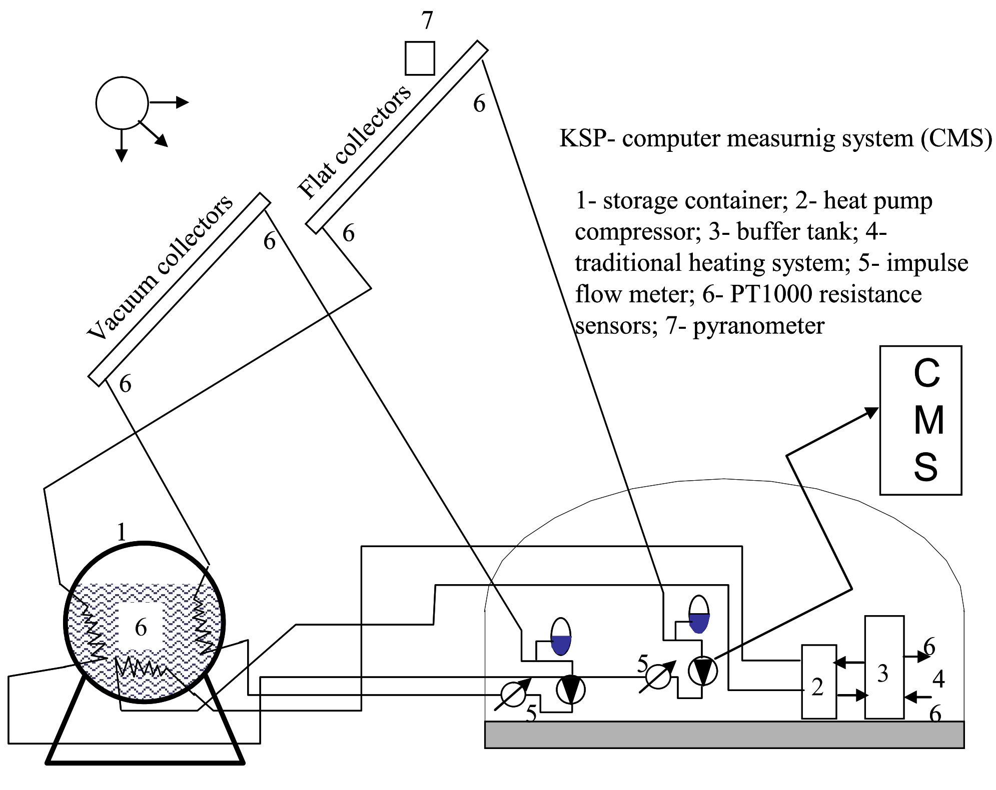

Figure 1. Scheme of the laboratory stand

During the tests, to measure the size of the analyzed were used: the liquid stream flowing through the impulse flow meter (5), water (inside container, circulating liquid) and air temperature measured with the use of copper-constantan thermocouples (6), and solar irradiation by pyranometer (7).
All volumes were monitored and archived with the time sampling every 30 seconds using a computerized measuring system (CMS).

Analysis

Conversion efficiency of heat radiation (η) was calculated from the following formula:

$$\eta = \frac{m \cdot c_c \cdot \left(T_z - T_p\right)}{\sum_{i=1}^{n} R_{zew,i}} \quad [-] \tag{1}$$

Daily water demand for irrigation of tomatoes was determined on the basis of Zwarta researches [12]. Diurnal course of the demand for water is shown in Figure 2.

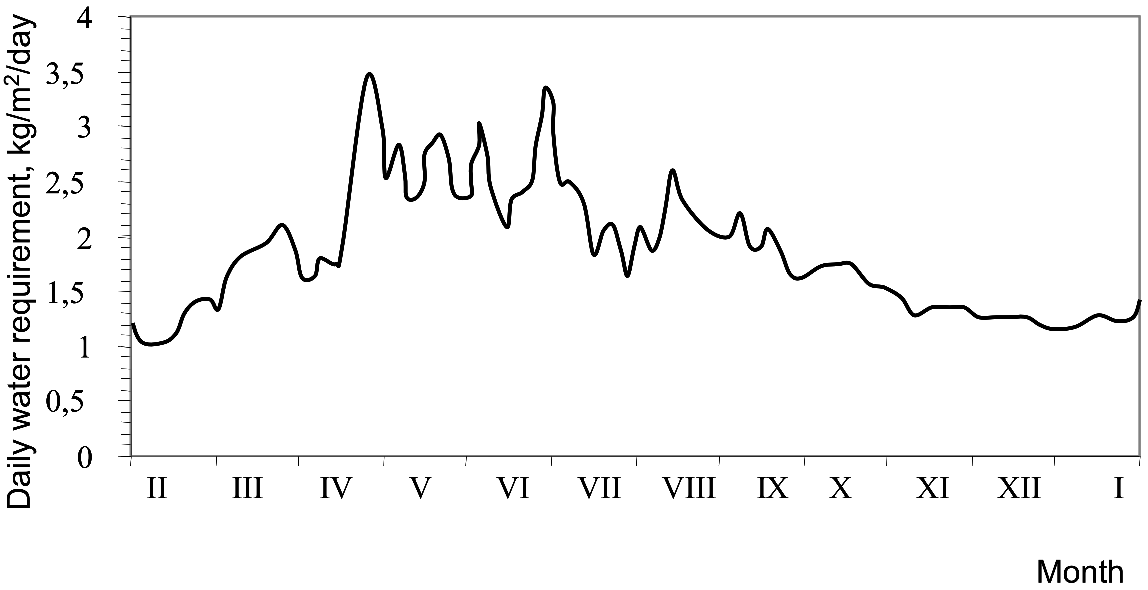

Figure 2. Changing demand for water by greenhouse tomatoes

From the presented on chart mean values were read the water demand and on the basis of these values determined the average monthly demand for energy needed to heat water for irrigation. For further analysis of the assumed average values of solar radiation (H). With these values calculated the necessary collector area by the formula:

$$A_k = \frac{Q_u}{H_r \cdot \eta} = \frac{m_w \cdot c_w \cdot \left(T_k - T_0\right)}{H_r \cdot \eta} \quad [m^2] \tag{2}$$

The mass of fossil fuel was determined from the formula:

$$m_{pal} = \frac{Q_u}{W_u \cdot \eta_k} \text{ [kg/day]} \tag{3}$$

Where:
m - mass flow of circulating factor [kg / s]

c_c, c_w, - specific heat of the circulating factor (c_c) and water (c_w) [J / kg • K]

Tz, Tp-temperature of circulating factor (power Tz) and return (Tp) [° C]

m_w-mass of water needed for irrigation of plants [kg / day]

T_0, T_k-initial (T_0) and final (T_k) water temperature for irrigation [° C]

Q_u - the demand for heat [J / day]

W_u- the calorific value of fuel [J / kg],

η-efficiency of boiler, [-]

RESULTS AND DISCUSSION

For the analysis was adopted greenhouses with an area of 0.5 ha, with coal-fired boiler with a calorific value 20 MJ / kg, and the average annual mileage of solar radiation is illustrated graphically in Figure 3.

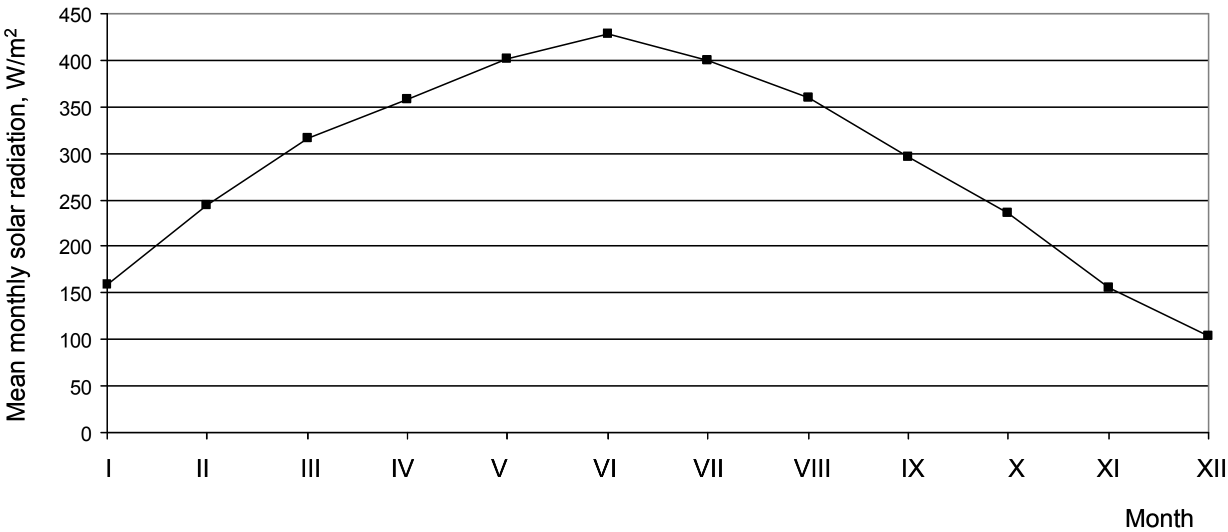

Figure 3. Mean monthly solar radiation for Poland

Following the performance of a series of tests, a dependence was found between to determine the efficiency of the collectors. A dependence between independent variables (liquid volume in the tank - V_{zb}, surrounding temperature - t_{ot} and the sum of solar radiation energy $\sum R_{sl}$) is defined, for vacuum collectors, by the following dependence [5]:

$$\eta = -0{,}5 \cdot V_{zb} + 1{,}24 \cdot t_{ot}^{0,023} + 3{,}85 \cdot 10^{-5} \cdot \sum R_{sl}^{1,19} ; \qquad R^2 = 0{,}87$$

for the scope of application: $1{,}25 \le V_{zb} \le 1{,}78\ m^3$; $-4 \le t_{ot} \le 37{,}5^oC$; 1,78; $0{,}15 \le$ □$R_{sl} \le 7{,}525$ kWh

In turn, for flat collectors this connection is expressed as follows::

$$\eta = -0{,}22 \cdot V_{zb} + 0{,}52 \cdot t_{ot}^{0,162} + 0{,}0168 \cdot \sum R_{sl}^{0,448} ; \qquad R^2 = 0{,}82$$

for the scope of application: $2{,}25 \le V_{zb} \le 3{,}22\ m^3$; $-4 \le t_{ot} \le 37{,}5^oC$; 1,78; $0{,}15 \le$ □$R_{sl} \le 7{,}5$ kWh

Table 1 shows the adopted for the analysis of data related to: the average monthly value of the usable solar radiation (H_r), the average ambient temperature, collectors efficiency (flat η_p) and vacuum (η_v) and daily water demand for irrigation of plants (m_w). For the analysis adopted capacity of the tank liquid of 1,5 m^3.

Table 1. Monthly value adopted for the analysis of parameters

Specification	**Month**											
	I	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	**IX**	**X**	**XI**	**XII**
H_r, kWh/day	1,43	3,17	4,73	5,37	6,2	7,26	6,8	6,1	3,84	3,06	1,72	0,93
t_{ot}, ^oC	-3,3	1,6	2,5	7,9	13,2	16,2	17,6	17,1	13,1	8,4	3,3	-0,9
η_p, [-]	0,32	0,26	0,3	0,43	0,5	0,52	0,53	0,53	0,49	0,43	0,32	0,2
η_v, [-]	0,52	0,5	0,51	0,53	0,56	0,54	0,56	0,56	0,56	0,55	0,52	0,48
m_w, kg/day	1,25	1,4	1,7	1,8	2,5	2,6	2,3	2,2	1,9	1,7	1,4	1,2

Using the formula (2) for the values adopted for the analysis ($Hr,\ \eta_p,\ \eta_v,\ t_{ot}$) on the Figure 4 is shown the required area of solar collectors in each month of the year.

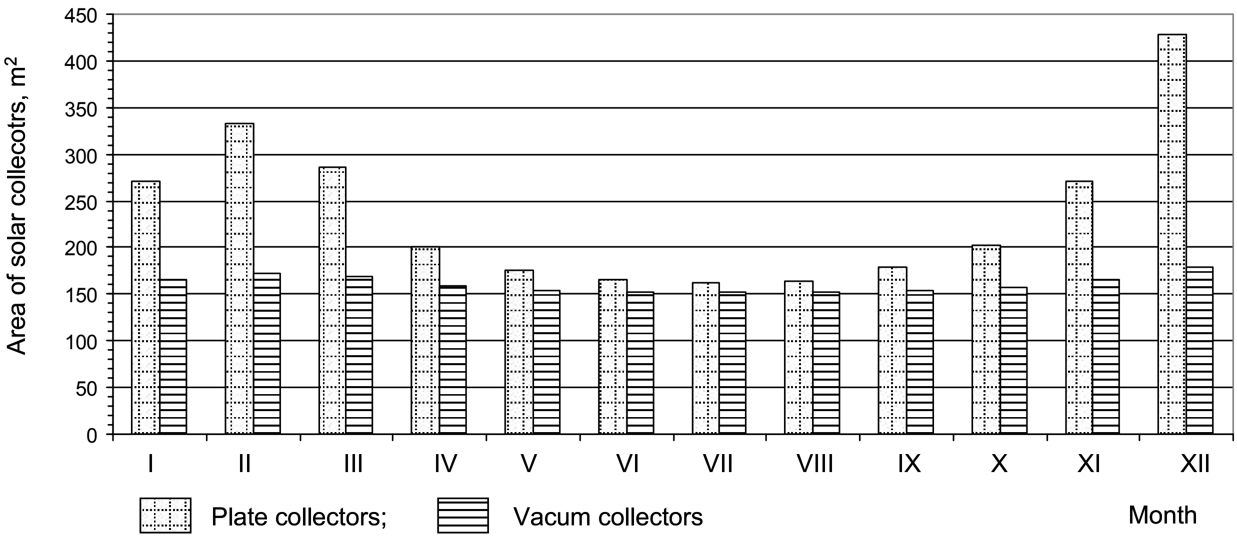

Figure 4. The required area of solar collectors used to heat water for tomatoes grown in greenhouse

The presented calculations show that the required collector area, depending on the individual months is changing for flat collectors from 162 m^2 (in July) to nearly 430m^2 (in December). On the other hand, for vacuum collectors the surface is not as varied and is within the limits of 152 m^2 (July) to 178 m^2 (in December).

Analyzing these data can be unequivocally stated that in such a system of using solar collectors, required due to smaller area and a smaller range of changes are recommended vacuum collectors. However, the experiments conducted at the University of Agriculture in Krakow, the decision to invest should be considered greater failure rate of work of these collectors.

Based on calculations derived, on Figure 5 is shown the required fuel mass for adopted average values of collectors. Calculations were performed for accepted collector surface, under which the quasi-total coverage of heat demand (162m^2 - flat collectors) and 160m^2 – vacuum collectors.

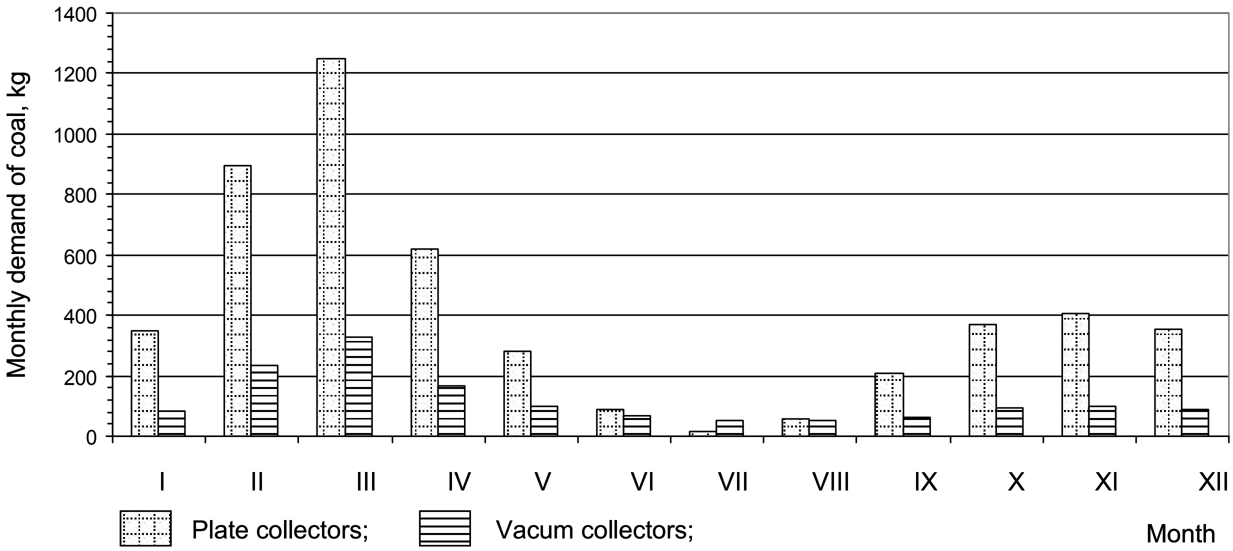

Figure 5. Monthly demand of coal for heating of irrigation systems

As you can see the mass of fuel needed throughout the year is as follows: for flat collectors 4,89t, and for vacuum collectors 1,43t. Providing this amount of energy without solar collectors (only with coal-fired boiler) requires the use of nearly 30,7 tons of coal.

Using publicly available data on harmful emissions into the atmosphere, in Table 2 shows the calculations associated with limitation of this emission.

Table 2. Emission of harmful substances into the atmosphere for the analyzed cases

Specification	Annual emissions of harmful substances into the atmosphere, kg/year				
	CO_2	CO	SO_2	NO_x	Dust
Without collectors	57251	729	277	58	369
Flat collectors	9111	116	44	9,3	59
Vacuum collectors	2664	34	13	2,7	17

It may be noted that due to the use of collectors, the annual emissions of harmful substances into the atmosphere is 5 (vacuum collectors) to 16% (flat collectors) of emissions, in which the heat supply will only be from working with coal-fired boiler.

CONLUSIONS

Required surface collectors, depending on the individual months is changing for flat collectors from 162 m^2 to nearly 430m^2 , and from 152 m^2 to 178 m^2 (vacuum collectors).
When installing the collector surface overlying a quasi-total heat demand in summer months, the annual needed mass of fuel is: for flat collectors 4,89t, and 1,43t for vacuum collectors.

As a result of using the collectors the annual emissions of harmful substances into the atmosphere is 5 (vacuum collectors) to 16% (flat collectors) boiler only runs on coal.

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VISBREAKING: A TECHNOLOGY OF THE FUTURE

Radovanović, Lj. [1], **Speight, J., G.** [2]
University of Novi Sad, Serbia, Technical Faculty "Mihajlo Pupin", Zrenjanin,
CD&W Inc., Laramie, Wyoming 82070, USA
E-mail: ljiljap@tfzr.uns.ac.rs

Abstract: Because of the relative simplicity of design and straightforward thermal approach, visbreaking processes will not be ignored or absent from the refinery of the future. However, new and improved approaches are important for production of petroleum products. These will include advances in current methods, the minimization of process energy losses, and improved conversion efficiency. In addition, the use of the visbreaking process to co-process typical petroleum-based feedstocks and biomass could become a reality in future refineries. Depending upon the relative amounts of hydrocarbon feedstock and biomass, disposal of the process sediment can be achieved by a choice of methods.

INTRODUCTION

Balancing product yield and market demand, without the manufacture of large quantities of fractions having low commercial value, has long required processes for the conversion of hydrocarbons of one molecular weight range and/or structure into some other molecular weight range and/or structure. Basic processes for this are *cracking processes* in which high boiling constituents of petroleum are cracked (thermally decomposed) into lower molecular weight, lower boiling molecules, although reforming, alkylation, polymerization, and hydrogen-refining processes have wide applications in producing premium-quality products (Speight and Ozum, 2002; Hsu and Robinson, 2006; Gary et al., 2007; Speight, 2007).
Visbreaking (*viscosity reduction*, *viscosity breaking*) is one of several cracking methods used in the petroleum industry to process crude oil and other petroleum products for commercial use (Speight and Ozum 2002; Hsu and Robinson, 2006; Gary et al., 2007; Speight, 2007). The major process variables are (1) feedstock type, (2) temperature, (3) pressure, and residence time, which need to be considered to control the extent of cracking.

THE VISBREAKING PROCESS

Visbreaking, a mild form of thermal cracking insofar as the thermal reactions are not allowed to proceed to completion and are interrupted by quenching, was developed in the late 1930s to produce more desirable and valuable products (Visbreaking is a relatively *mild* thermal cracking operation. The process is used to reduce the viscosity of residua to produce fuel oil that meets specifications (Ballard et al., 1992; Dominici and Sieli, 1997; Speight and Ozum, 2002; Hsu and Robinson, 2006; Gary et al., 2007; Speight, 2007; Joshi et al., 2008).
Visbreaking conditions range from 455 to 510°C (850 to 950°F) at a short residence time and from 50 to 300 psi at the heating coil outlet. It is the short residence time that brings to visbreaking the concept of being a mild thermal reaction in contrast to, for example, the delayed coking process where residence times are much longer and the thermal reactions are allowed to proceed to completion. Liquid-phase cracking takes place under these low-severity conditions to produce some naphtha, as well as material in the kerosene and gas oil boiling range. The gas oil may be used as additional feed for catalytic cracking units, or as heating oil.
In the process, the feedstock (usually residuum) is passed through a furnace where it is heated to a temperature of 480°C (895°F) under an outlet pressure of about 100 psi. The cracked products are then passed into a flash-distillation chamber. The overhead material from this chamber is then fractionated to produce naphtha and light gas oil. The liquid products from the flash chamber are cooled with a gas oil flux and then sent to a vacuum fractionator. This yields a heavy gas oil distillate and a residuum of reduced viscosity (Speight, 2007, 2011). A 5 to 10% conversion of residuum to naphtha is usually sufficient to afford at least an approximate five-fold reduction in viscosity. Reduction in viscosity is also accompanied by a reduction in the pour point. An alternative option is to use lower

furnace temperatures and longer times, achieved by installing a soaking drum between the furnace and the fractionator. The disadvantage of this approach is the need to remove coke the soaking drum.
Mild cracking conditions (low feedstock conversion per cycle) favor a high yield of naphtha with low gas production and decreased coke production. With limited conversion per cycle, the higher boiling residues must be recycled. However, the recycled oils become increasingly refractory with each pass through the thermal zone and if such oils are not required as a fuel oil stock they may be subjected to a coking operation to increase gasoline yield or refined by means of a hydrogen process.
The process is a relatively low-cost and low severity approach to improving the viscosity characteristics of the residue without attempting significant conversion to distillates. Low residence times are required to avoid coke formation, although additives can help to suppress coke deposits on the tubes of the furnace. By reducing the viscosity of the non-volatile fraction, visbreaking reduces the amount of the more valuable distillate heating oil that is required for blending to meet the fuel oil specifications. The process is also used to reduce the pour point of a waxy residue.
Two visbreaking processes are commercially available: the *soaker visbreaker* and the *coil visbreaker*.
The *soaker visbreaking process* (a low-temperature- high-residence-time process) (Speight and Ozum, 2002; Hsu and Robinson, 2006; Gary et al., 2007; Speight, 2007) achieves a minor degree of conversion within the heater but the majority of the conversion occurs in a reaction vessel (soaker) that holds the two-phase effluent at an elevated temperature for a predetermined length of time to allow cracking to occur before being quenched. The oil then passes to a fractionator. Lower temperatures are used in soaker visbreaker than in coil visbreaking. The comparatively long duration of the cracking reaction is used instead is used to achieve the desired results.
Product quality and yields from the coil and soaker drum design are essentially the same at a specified severity being independent of visbreaker configuration. By providing the residence time required for achieving the desired reaction, the soaker drum design allows the heater to operate at a lower outlet temperature (thereby saving fuel) but there are disadvantages.
The main disadvantage of the soaker visbreaking process is the decoking operation of the heater and soaker drum and, although decoking requirements of the soaker drum design is not as frequent as those of the coil-type visbreaker; the soaker design requires more equipment for coke removal and handling. The customary practice of removing coke from a drum is to cut it out with high-pressure water thereby producing a significant amount of coke-laden water that needs to be handled, filtered, and then recycled for use again.
• The *coil visbreaking process* (high-temperature-short-residence-time process) (Speight and Ozum, 2002; Hsu and Robinson, 2006; Gary et al., 2007; Speight, 2007) differs from soaker visbreaking insofar as the coil process achieves conversion by high-temperature cracking within a dedicated soaking coil in the furnace. Products exiting the furnace are quenched to halt the cracking reactions – this is frequently achieved by heat exchange with the virgin material being fed to the furnace or a stream of cold oil (usually gas oil) is used to the same effect and the gas oil is recovered and re-used. The extent of the cracking reaction is controlled by regulation of the speed of flow of the feedstock through the furnace tubes. The quenched oil then passes to a fractionator where the products of the cracking (gas, LPG, gasoline, gas oil and tar) are separated and recovered.
• The main advantage of the coil-type design is the two-zone fired heater that provides better control of the material being heated and, with the coil-type design, decoking of the heater tubes is accomplished more easily by the use of steam-air decoking.
The higher heater outlet temperature specified for a coil visbreaker is an important advantage of coil visbreaking. The higher heater outlet temperature is used to recover significantly higher quantities of heavy visbroken gas oil. This capability cannot be achieved with a soaker visbreaker without the addition of a vacuum flasher.
In terms of product yield, there is little difference between the two options (soaker visbreaker compared to coil visbreaker) approaches. However, each offers significant advantages in particular situations. For example, the cracking reaction forms coke as a byproduct. In coil visbreaking, this deposits in the tubes of the furnace and will eventually lead to fouling or blocking of the tubes.
However, a recurring issue with the soaker visbreaker is the need to periodically de-coke the soaker drum and the inability of the soaker process to easily adjust to changes in feedstock quality because of

the need to fine tune two process variables, temperature and residence time. Recent combination of the visbreaking technology and the addition of new coil visbreaker design features have provided the coil process with a competitive advantage over the traditional soaker visbreaker process. Limitations in heater run length are no longer a problem for the coil visbreaker. Advances in visbreaker coil heater design now allow for the isolation of one or more passes through the heater for decoking, eliminating the need to shut the entire visbreaker down for furnace decoking.

Overall, the main limitation of the visbreaking process, and for that matter all thermal processes, is that the products can be unstable due to the presence of unsaturated products. For example, thermal cracking at low pressure produces olefins (and di-olefins) particularly in the naphtha fraction. These olefins give a very unstable product, which tends to undergo secondary reactions to form gum and intractable non-volatile tar.

The reduction in viscosity of distillation residua tends to reach a limiting value with conversion, although the total product viscosity can continue to decrease. The minimum viscosity of the unconverted residue can lie outside the range of allowable conversion if sediment begins to form. When shipment of the visbreaker product by pipeline is the process objective, addition of a diluent such as gas condensate can be used to achieve a further reduction in viscosity.

In spite of the various limitation outlines above, visbreaking has much potential and, in fact, remains an important, relatively inexpensive bottom-of-the-barrel upgrading process in many areas of the world.

OPTIONS FOR HEAVY FEEDSTOCKS AND BIOMASS

Refinery evolution (to accommodate the more complex difficult-to-convert heavy oil and residua) has seen the introduction of a variety of heavy feedstock cracking processes (Speight and Ozum, 2002; Hsu and Robinson, 2006; Gary et al., 2007; Speight, 2007).

Visbreaking may the most under-estimated and/or under-valued process in a refinery, although the process is not seen as making major comeback in US refineries (Marano, 2003) but this opinion may require some re-evaluation (Speight, 2011).

For example, visbreaking (or even hydrovisbreaking – i.e., visbreaking in an atmosphere of hydrogen or in the presence of a hydrogen donor material) the long ignored step-child of the refining industry may see a surge in use as a pretreatment process. Management of the process to produce a liquid product that has been freed of the high potential for coke deposition (by taking the process parameters into the region where sediment forms) either in the absence or presence of (for example) a metal oxide scavenger could be valuable ally to catalyst cracking or hydrocracking units.

Because of the relative simplicity of design and straightforward thermal approach, visbreaking processes will not be ignored or absent from the refinery of the future (Speight, 2011). These processes should not be ignored because they have the ability to adapt, by virtue of their relative simplicity, to the changing markets of heavy feedstock processing, and tar sand bitumen processing.

However, new and improved approaches are important for production of petroleum products. These will include advances in current methods, the minimization of process energy losses, and improved conversion efficiency – in particular (1) mitigation of fouling in heat exchangers, and (2) improved conversion efficiency.

As a feedstock to a visbreaker intermixed with the petroleum-based feedstock, biomass can be converted to a wide range of useful forms of energy.

The most effective method of converting biomass into fuel is to subject it to high temperatures and high pressure to produce gaseous and liquid products. Mixtures of biomass material and heavy oil will improve biomass decomposition. This improvement might be the result of higher heat and mass transfer rates, due to the liquid phase that is more present in the reactor. Experimental conditions will influence product yields and the extent of the decomposition. An increase of the reaction time will cause an increase in the alkane and alkene content of the gas fraction, at the expense of a decrease in the carbon monoxide and carbon dioxide content.

An increase in the reaction temperature will, however, lead to a decrease of the liquid fraction and an increase in the amount of with a corresponding increase of the gas and char products. At lower temperatures, the formation of carbon monoxide and carbon dioxide from the biomass will be favored.

An issue driver in the use of biomass in a visbreaker will be the disposal of waste material from the decomposition of the biomass. The waste residues will contain significant amounts of pollutants such as heavy metals and carbonaceous organic material. However, this will be offset by the need for sustainable development in terms of safely biomass (and biomass waste) resulting in the transformation of biomass to valuable materials and energy.

The integration of refining and biomass conversion processes, new technologies based on the traditional visbreaking and hydrovisbreaking processes will be of increased interests to refiners because of their potential to meet the increasing demand for hydrocarbon fuels.

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USING BPMN AND INTOUCH HMI 10.0. SOFTWARE PACKAGE FOR MODELING FLOW MEASUREMENT SYSTEM FOR CRUDE OIL AND PETROLEUM PRODUCTS

Obradović, J.[1], Linić, S.[1], Ristić, M.[1] Ilic, O.[1], Milovanović, M.[2]
[1]Institute Goša, 35 , Milana Rakića str., Belgrade, Serbia,
[2]Union University, Faculty of real estate management, 62, Cara Dušana str., Belgrade
E-mail:jasmina.obradovic@institutgosa.rs

Abstrakt: The goal of this paper is modelingof flow measurement system for crude oil and petroleum products in refineries. In order to get better process explanation in term of modeling and implementation of concrete software, BPMN (Business Process Modeling Notation) is used as standardized notation for business process modeling and software package InTouch HMI 10.0 (Wonderware company) which has special importance for business processes because it enables process supervision, control and optimization. The first part represents brief description of BPMN graphical tools. Second part is dedicated for modeling of „Transaction supervision and control" subprocess which represents very important part of entire process and therefore it's separately modeledl is showed.
Key words: BPMN, InTouch HMI 10.0., flow measurement of crude oil and petroleum derivates in refineries, transaction supervision and control.

INTRODUCTION

The purpose of modeling to represent the structure of objects, system or concept, using graphical presentations. Graphical presentations are used in order to make the modeling process brighter. Over time, new languages and standards for process modeling, and new tools also for their implementation, are developing. One of them is BPMN, standardized modeling notation developed by the Business Process Management Initiative (BPMI) group, together with the Object Management Group (OMG) group. BPMN represents intuitive notation, which is easily adopted and implemented. For creating BPMN diagrams, for business process modeling of flow measurement system for crude oil and petroleum derivates, Microsoft Visio is used . One of the software that uses mentioned standards by which is possible to control and optimize processes is InTouch HMI version 10.0. Flow measurent of crude oil and petroleum derivates must be performed in accordance with „Law of planning and construction" ("Official Gazette of RS, NO. 47/2003 and 34/2006, „Law on security and health at work in RS" and „Fire protection and prevention Act ". Also, it is necessary to get an approval from the „Direction for measures and rare materials". This work represents the modeling of „*Transaction supervision and control*"subprocess which represents very important part of entire process.

MATERIAL AND METHODS

BPMN graphical concepts

Business Process Modeling Notation has emerged as an important open standard graphic notation for drawing and modeling business processes (Figure 1.), [1], [5]. Its design goals include being readily understandable by all business users, from the business analysts that create the initial drafts of processes, to IT architects and developers that implement and deploy processes, and to business and IT users that manage and monitor those processes.
Microsoft Visio is software that enables creating diagrams by the BPMN specification, including set of patterns, which can be imported into it. ***Business process diagram (BPD)*** is made by importing BPMN graphical tools into Visio workspace. When the modeling of business process is complete, diagram can be saved in various formats: JPEG, XML drawing, AutoCAD drawing, Web page, Windows Bitmap and other.

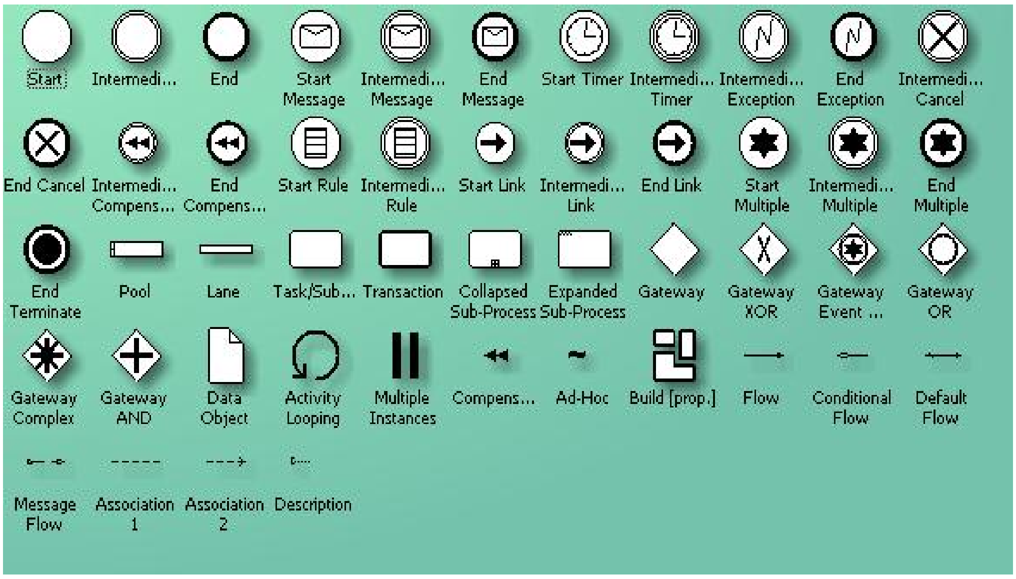

Figure 1. Graphical representation of BPMN concepts using MS VISIO tool

A Business Process Model is a network of graphical objects, which consists of activities and the flow controls that define their order of performance. In BPMN a process is depicted as a graph of flow objects, which are a set of other activities and the controls that sequence them. A BPD is made up of a set of graphical elements. These elements enable the easy development of simple diagrams that will look familiar to most business analysts. The four basic categories of graphical elements are: ***Flow objects, Connecting objects, Swimlanes, Artifact.***
Events, Activities and Gateways are ***Flow objects***.
Eventsare used to show that something "happens" during the course of a business process. Events are circular shape. There are three types of Events based on time when they affect the flow: ***Start Event, Intermediate Event and End Event*** (Figure 1.). Start Event indicates at the beginning of the process, while End Event indicates at the end of the process. An Intermediate Event which affects the process flow can be inserted between them within an activity or a subprocess. That event usually has a cause and effect, ie. "trigger" and result. Start and intermediate events are connected with activities by normal sequence flows, while triggered start and intermediate events are attached to the edge of the activity and they occurs in the case of exception related to the activity.
An activity is work that is performed within a business process. An activity has rectangular shape. The types of activities are: ***Process, Sub-Process***, and ***Task*** (Figure 1.). The ***process*** is a set of graphical objects. A***sub-process*** is a graphical object within a process flow, but it also can be "opened up" to show another process. A sub-process can be in a collapsed view that hides its details or can be in an expanded view that shows its details within the view of the process in which it is contained. A ***task*** is an atomic activity that is included within a process.
Gatewayscan define all the types of business process sequence flow behavior Decisions/branching (***exclusive-XOR, inclusive-OR, parallel – AND, and complex***). BPMN extends the behavior of the diamonds to reflect any type of sequence flow control. Gateways have rhomb shape. Each type of Gateway will have an internal indicator or marker to show the type of Gateway that is being used (Figure 1.).
Connecting objects define the graphical objects used to connect two objects together and how the flow progresses through a process. Types of connecting objects are: ***Sequence flow***, ***Message flow*** and ***Association*** (Figure 1.). A ***sequence flow*** is used to show the order that activities will be performed in a process. Types of sequence flow are: normal, conditional and default. A***message flow*** is used to show the flow of messages between two entities that are prepared to send and receive them. Two separate Pools will represent the two entities. An***association*** is used to associate information and

Artifacts with Flow objects. Types of association are: an Association of text annotation and a directional Association.
Swimlanes use to organize the similar types of activities. Swimlanes are: ***Pools*** and ***Lanes*** (Figure 1.). A ***pool***represents a participant in the process and may be shown as a “White Box,” with all details exposed or as a “Black Box,” with all details hidden.***Lanes*** represent a sub-partition within a Pool and will extend the entire length of the Pool. Lanes are used to organize and categorize activities within a Pool.
Artifactshows additional information about a process that is not directly related to the sequence flow or message flow of the process. The types of Artifacts are: ***Data object, Group and Text Annotation***(Figure 1.).***Data Objects*** provide information about what the process does and generally will be associated with Flow Objects. ***Groups*** are artifacts that are used to highlight certain sections of a diagram without adding additional constraints for performance. ***Text Annotations*** use to provide additional information for the business analysts of a BPD.

BUSINESS PROCESS MODELING OF FLOW METERING SYSTEM FOR CRUDE OIL AND PETROLEUM DERIVATES IN REFINERIES USING BPMN AND INTOUCH HMI 10.0. SOFTWARE PACKAGES

Business process of flow measurement system for crude oil and petroleum derivates is carried out by three independent participants: customer/supplier, refinery and laboratory. The entire business process is taking place in five locations:

1. **Jetty** associated with customer/supplier
2. **Measuring place** in refinery associated with manipulating and maintenance workers
3. **Control room** associated with operator and responsible person who verifies the entire business process
4. **Pump station** associated with the employee who is responsible for pumps control.
5. **Laboratory** associated with specialists who are responsible for product analysis.

Speaking BPMN language, business participants represent Pools. Jetty represents first pool, the second one is Refinery, which has three lanes within it (measurement place, control room and pump station) and third one is Laboratory. Subprocess „*Transaction supervision and control*“ takes place in control room and operator is responsible for it.

Suboprocess *Transaction supervision and control*

The complex subprocess „***Transaction supervision and control***“ consists of two main activities which are repeating during the process executing. They are:

TRANSACTION SUPERVISION

Activity „*Transaction supervision*“is the repeating one. Repeating activity is characterized by circular arrow directed from right to left in the bottom. This activity has one message type intermediate event (when the end of transaction is close) and two triggered events in cases of the exeptions, related to this activity (if the transaction is paused or when some of the alarm occured). Hence, there are three variations of activity „*Transaction supervisionl*“ flow:

Normal flow

If there is no problem during this activity, a message will appear on the screen that transaction is near to an end, ie. that current value of elapsed volume is 99.5% of requested volume. This situation (using InTouch HMI software) is given in Figure 3. In order to reduce flow rate and make it easier to determine moment when the transaction is complete, SET-STOP valve is closing to 50% and operator continues to monitor transaction. The main function of SET-STOP valve is flow regulation. It can be totally opened, 50% opened and closed. Furthermore, another intermediate event (rule type) is used –

when the elapsed and requested volume are equal, operator sends request for closing SET-STOP valve. That is the moment when activity „*Transaction supervision*" is finished.

Exception flow (Error type)

Exception flow (Error type) – occurs when transaction is paused. This activity is performed by operator. On the edge of „*Transaction supervision*" activity an error triggered intermediate event is attached and it leads to the end of this activity.

Exception flow (Message type)

Exception flow (message type) – occurs in case when some of alarms is activated.. On the edge of „*Transaction supervision*" activity a message triggered intermediate event is attached as an information about alarm. It is followed with „*Alarm aknowledgement*" activity and checking which category this alarm belongs to.
1.3.1. If alarm belongs to category that demands momentally transaction stopping (for example, there is a problem with equipment that can not be removed and therefore transaction must be stopped), then the transaction will be finished with end event (error type).
1.3.2. If alarm doesn't belong to category that demands momentally stopping of transaction (for example, there is a problem with pressure measuremnet, and average value in last hour can be used instead real one, then the subprocess will be moved back to the „*Transaction supervision*" activity and entire procedere will be repeated.

Sampling supervision and control

Activity „*sampling supervision and control*" is also the repeating one. It has one message intermediate event, in case that the transaction is completed, and has three triggered events, exception in the cases related to the activity „*sampling supervision and control* " (if the sampling cell is full, if the transaction is paused, and if some of the alarms for sampling process occured).
Sampler is device for taking representative sample during transaction.
There are four variations of activity „*sampling supervision and control* ":

Normal flow

If there isn't any problem during this activity, a message wil appear that transaction is successfully completed.

Exception flow (Message type)

Exception flow (message type) – occurs in case the operator receive a message that the sampling cell is full. In the edge of „*sampling supervision and control* " activity a message triggered intermediate event is attached and it leads to the end of this activity.

Exception flow (Error type)

Exception flow (Error type) – occurs when transaction is stopped. In the edge of „*sampling supervision and control*" activity, an error triggered intermediate event is attached and it leads to the end of this activity.

Exception flow (Message type)

In case that some of the alarms for sampling process appeared, a message type exception flow occurs. In the edge of „*sampling supervision and control*" activity a message triggered intermediate event is attached. There are following activities:

When operator receive information that some of the alarms for sampling process appeared, he sends command „*Stand By*“ using coresponding button on the screen – that means, that there is still flow through the pipeline, but it is not possible to continue sampling.

When the problem with sampler is removed, operator sends command „*Alarm reset*“.

Then operator sends command „*Pre Flight Check OK*“ and reads results about several key parameters, sach as overall condition, gross cell weight, max sampling frequency...

After that, operator checks if everything is ok.

checking if there is any alarm still active:

If the problem isn't overcome, the sampling process will be finished (error type end event).

If there isn't any alarm that is still active, operator will send command „End Stand by“ and the entire procedure will be repeated.

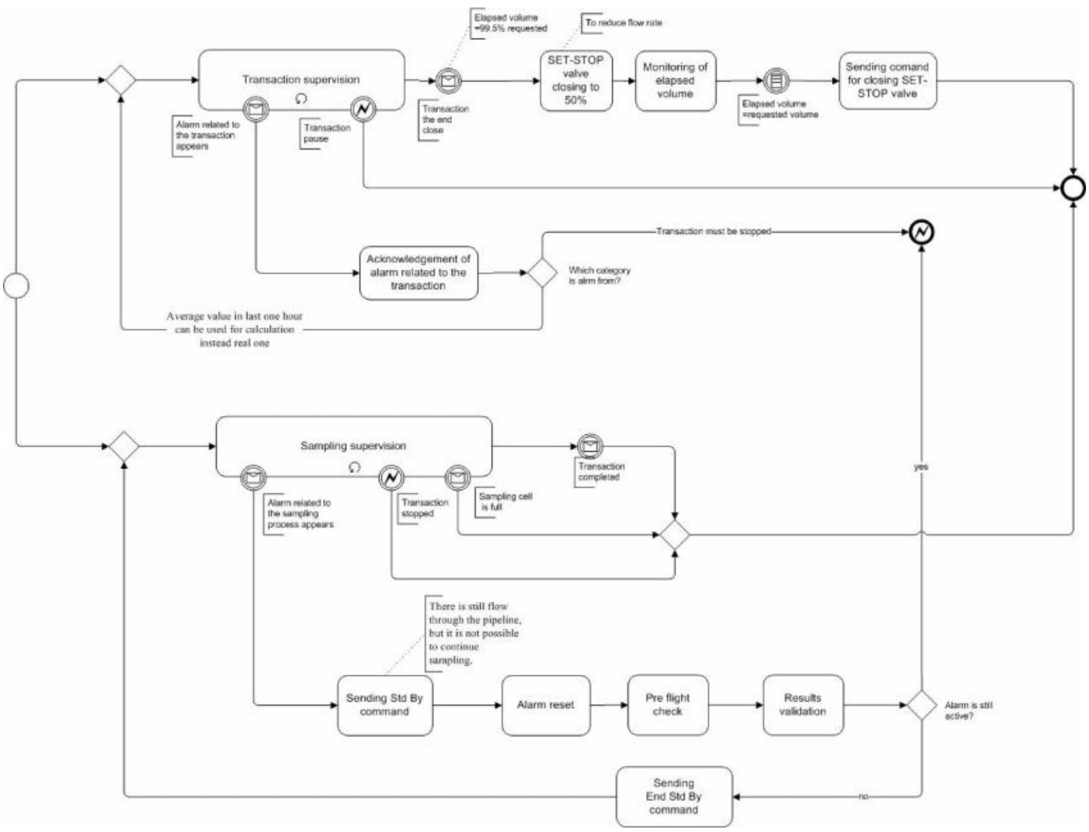

Figure 2. BPMN diagram of „*sampling supervision and control* “subprocess

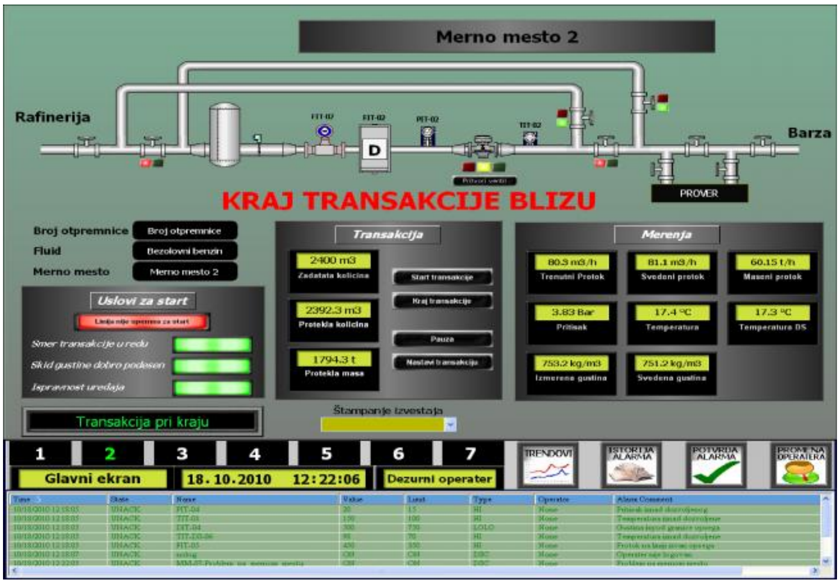

Figure 3. Screen look for measuring place number 2 (transaction the end is close)

Figure 3. shows screen form of InTouch 10.0. application for one of the measuring places with: shipping number, product name, number of measuring place and indications related to SET-STOP and hand valves positions. It is seen that requested volume is 2400 m^3 and elapsed one is 2392.3 m^3.

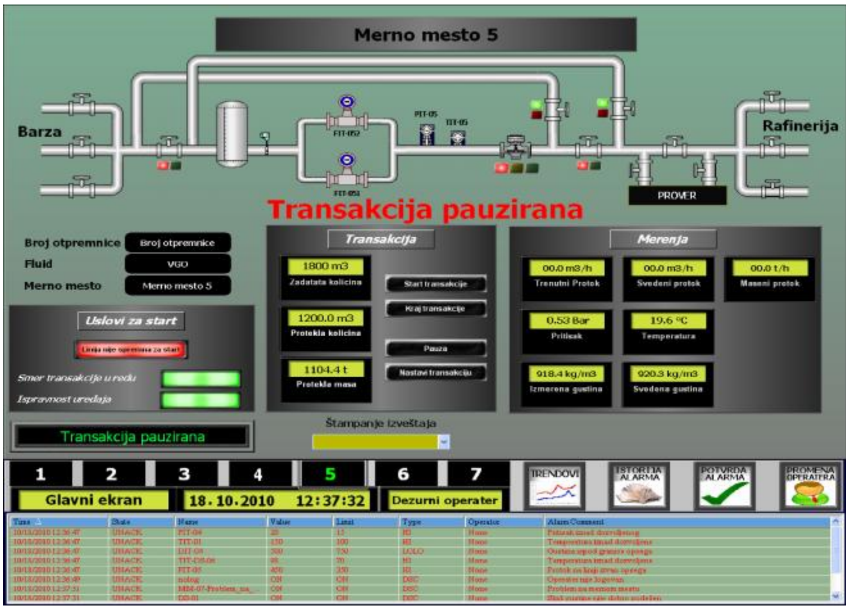

Figure 4. Screen look for measuring place number 5 (transaction is paused)

Figure 4. shows screen form of InTouch 10.0. application for one of the measuring places with: shipping number, product name, number of measuring place and indications related to SET-STOP and hand valves positions. It is seen that the transaction is paused and can not be continued because start conditions are not met.

CONCLUSION

The field of business process modeling is very complex and different. The benefits of modeling by BPMN notation are simplicity, clear visualization and visibility of business process. Software support represents a great contribution to the process precision. There are a lot of attempts to formalize semantic for modeling real life situations completely. This work has the same goal also. Modeling business process of flow metering system for crude oil and petroleum derivates is a huge challange. This process consists of many subprocesses, which need additional modeling in the future works. In this paper it is represented the modeling of complex „ *Transaction supervision*“ subprocess, while in the future could be illustrated some other subprocesses, such as measuring place setup, sampler setup, data entry for SCADA application and others.

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PROCESS MANAGEMENT OF GAS DISTRIBUTION FROM THE ASPECT OF REDUCING LOSSES

Brković, M.[1], Radovanović, Lj.[2], Desnica, E.[2], Pekez, J.[2], Adamović, Ž.[2]
[1]Public Enterprise for Communal - Housing Jobs „Komunalac", Novi Becej
[2] University of Novi Sad, Technical faculty "Mihajlo Pupin", Department of Mechanical Engineering, Zrenjanin, Serbia
E-mail: marijabrkovic71@gmail.com

Abstract: This paper describes application of natural gas and development of natural gas and gas pipeline system. There are also present losses in transportation and distribution of natural gas for the region of the Autonomous Province of Vojvodina (Serbia). Effects of natural gas loss reduction during transportation and distribution are analyzed on the example of one distributor after implementation of appropriate measures.
Key words: process management, distribution, natural gas, losses

INTRODUCTION

Natural gas, a gaseous hydrocarbon mixture with methane being its principal component, is an extraordinary valuable energy and chemical raw material which possesses significant technological-economic and ecological advantages in comparison with conventional fuels. Natural gas is almost an ideal fuel which is easily mixed with air, which has high smokeless combustion speed, leaving no soot or solid residue, so it does not pollute the environment. Experience of the countries with a long tradition of gas consumption shows that natural gas is also one of the safest energy-generating products. Gaseous fuels cover a wide range of uses: from laboratories, households, agricultural and manufacturing facilities to its use as a basic raw material in petrochemical industry [1].
The most available forms of energy/energy generating products are used in urban areas today. These are electrical energy, natural gas, coal, wood and oil derivatives.All previously mentioned energy raw materials and energy generating products are used in the territory of Serbia. There are certain deviations in the consumption structure of particular energy generating products depending on the area. In northern parts (the region of AP of Vojvodina) electrical energy, natural gas, oil derivatives are used to a larger extent while at the same time coal and wood are less used. In central parts, wood is used as fuel in households to a significant extent[2].
The global market for natural gas is much smaller than that for oil because gas transport is difficult and costly, due to relatively low energy content in relation to volume. Pipeline transportation is not always feasible because of the growing geographic distance between gas reserves and markets. Also, since potential political instabilities may affect long pipeline routes, importing countries may wish to diversify supply sources. While natural gas can be piped in a gaseous state, it needs to be liquefied in order that sufficient energy is packaged to be economically transported by ship. A full liquefied natural gas chain consists of a liquefaction plant; low temperature, pressurized, transport ships; and a regasification terminal. World liquefied natural gas trade is currently about 60 million metric tons per year, some 65% of which is imported by Japan [3].
A critical aspect of risk management in energy systems is minimizing pipeline incidents that can potentially affect life, property and economic well-being. Risk measures and scenarios are developed in paper in order to better understand how consequences of pipeline failures are linked to causes and other incident characteristics. An important risk measure for decision-makers in this field is the association between incident cause and cost consequences [4].

APPLICATION OF NATURAL GAS AND DEVELOPMENT OF GAS PIPELINE SYSTEM

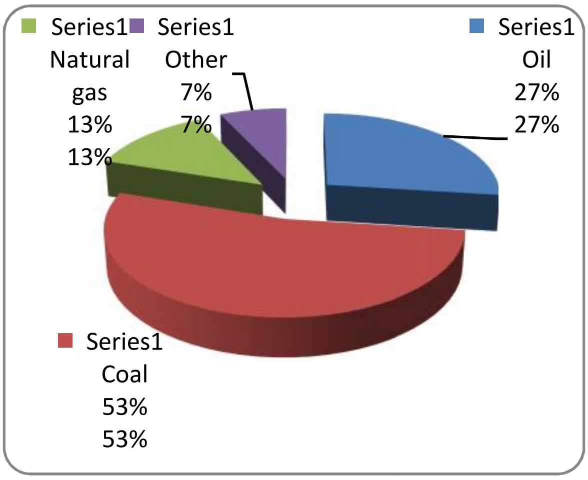
Households, for space heating, water heating and cooking, mainly used, wood, coal, fuel, electricity, gas and solar energy.
Electricity certainly has a number of well-known advantages over other energy ns. Price policy will be increasingly discouraged Disadvantages and advantages of wood, coal and fuel oil, the most

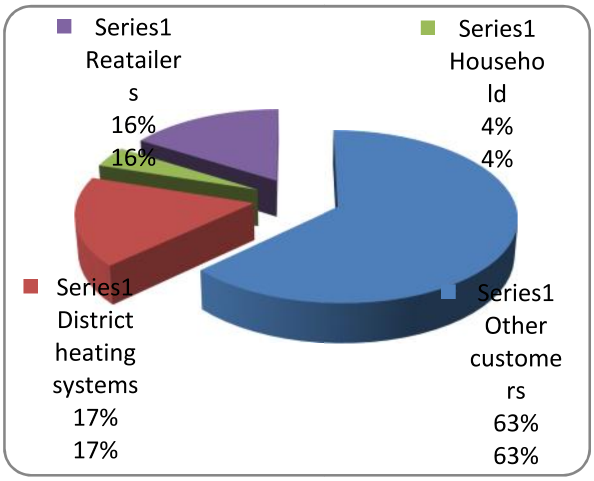
common uses of energy in our country, are well known to our citizens. Solar energy has mass application and is mainly used for heating water.
Today's trends on the world market of energy generating products indicate a growing role and significance of natural gas. The reserves of natural gas are estimated as sufficient for the next 100 years (table 1). The balanced development of three „E" (energy, economy, environment) provides natural gas with an advantage over other conventional fuels. Hence, gas is considered an energy generating product in expansion, i.e. an energy generating product of the 21st century.

Table 1. Estimated gas consumption in Serbia in billions of cubic meters [5]

Year	1995	2000	2005	2010	2015	2020
Consumption	1,7	2,7-3,0	3,4-4,0	4,5-5,0	5,5-6,0	6,5-7,0

Natural gas with coal and other solid fuels, only the primary form of energy that can be directly used. All other forms of energy (crude oil, water power, nuclear fuel and the like.) they must be transformed into more convenient forms (oil products, electricity, steam or hot water). It requires the construction of energy transformation, with some losses and large investment. It is reasonably trying to get as much natural gas is used directly.
Direct use of natural gas in households can meet 80-85% of energy requirements (space heating, cooking, hot water). The use of gas in boilers for heating individual, you get more efficient than using hot water and heating boiler. Compared with central hot water systems, distributing natural gas distribution network has other benefits: less investment, because they do not require construction of toplanai boiler, gas network is less expensive than hot water, which must be thermally insulated and must have a heat pipe. Using natural gas, among other things, has the advantage that it is minimally polluting. Natural gas does not contain pollutants, so it gets its combustion only carbon dioxide and water vapor.
Strategy of long-term development of energy industry in Serbia for the period until 2020 with the vision until 2050 underlines natural gas as an energy source of the 21st century and ecologically the most acceptable conventional fuel.
The planned production of natural gas in 2010 in AP of Vojvodina is 198.7 million m^3. The planned import of natural gas for the needs of Vojvodina is 1.461 million m^3, so the total quantity of natural gas for the needs of Vojvodina in 2010 is 1.660 million m^3.
The graphs on figure 1 shows the share of gas in primary energy in Serbia and the structure of gas consumpti.





a) b)

Figure 1. a) The share of gas in primary energy in Serbia and
b) the structure of gas consumption [5]

The graph on figure 1b show the dominance of other customers (industrial consumers and budget) with 63% in the overall structure of consumption. For natural gas consumption in Serbia is characterized by seasonal fluctuations caused by the increasing needs of customers (primarily district heating systems and household) during the heating season (first and last quarter of calendar year). Natural gas consumption in Serbia is about three times higher in winter months compared to consumption in the summer months. This fact is reflected in the physical volume of business of all energy activities.

Environmental protection

The modern business principles impose a highly developed environmental awareness. Analysis of the impact on the environment, aimed at preventive action, and affect the maximum reduction of environmental accidents are a common part of the projects within their enterprise activities.
The activities of internal inspection and maintenance of gas installations gas distributor shall at least annually. Distributor shall immediately cease the supply of gas if it doubts the validity of established internal gas installations, ie. If there is an imminent danger to life people and the environment.
In the natural gas industry, greenhouse gases are emitted as a result of: processing and compression of the gas, fugitive emissions (unintended losses of gas during transportation and distribution), blowdowns (the deliberate release of gas during maintenance operations), and combustion of natural gas during day-to-day operations (i.e., for vehicle use, heating). Once natural gas is delivered to end users, greenhouse gas emissions are created during combustion [6].

LOSSES IN TRANSPORTATION AND DISTRIBUTION OF NATURAL GAS

Transportation and distribution of natural gas in the whole territory of Serbia is carried out by Public Enterprises (PE) „Serbia gas“, while distribution in the territory of Vojvodina is carried out by other 24 gas distribution companies as well. Natural gas is distributed to end-users – households and companies in 37 municipalities in Vojvodina and in about 30 municipalities of the central Serbia. Out of total of 750 thousand households in the region of Vojvodina, about 200 thousand households use natural gas – an energy generating product which is the most convenient conventional energy source regarding environmental protection. Construction of the gas pipeline towards the south part of the country is also expected to result in increased number of connections to gas pipeline network in these parts of Serbia as well [5].
The age of gas pipeline system in Serbia ranges between 25 and 40 years, which means that considerable funds are needed to invest in maintenance and reconstruction of the system. The aim of these activities is safe transportation and distribution of natural gas, as well as reduction in potential risks which can negatively affect the transport. The following activities are necessary: gas pipeline inspection using modern inspection tools; replacement of the oldest gas pipelines with the new ones; reconstruction of the existing measurement and regulation stations; upgrading of existing remote control and management systems and systems for measurement of distributed quantities of energy. The estimated value of this investment is about 30 million Euros.
Transportation, manipulation and use of gas necessary result in gas losses. Quantitative values of gas losses depend upon many factors: type and manner of transportation, quality of transportation systems, quality of gaseous fuel, quality and adjustment of metering devices, level of training of operators, etc.
The experience has shown that gas losses range from 1% to 2% in the process of pipeline transportation of gaseous hydrocarbons. They are a result of uncontrolled and controlled discharge and difference in quantity measuring. Differences in quantity measuring are a result of incompatibility and imperfection of flow meters.
In distribution system, in the sector of general consumption residential, the real losses amount to 6% of the total delivered quantities. The have the same origin as those that occur in transportation and are increased due to: greater dissection and specific number of connections by running unit of gas pipeline, but also greater and actual unauthorized use by end-users. Review of losses in the area of transportation and distribution of natural gas in Vojvodina is shown in figure 2 [7].

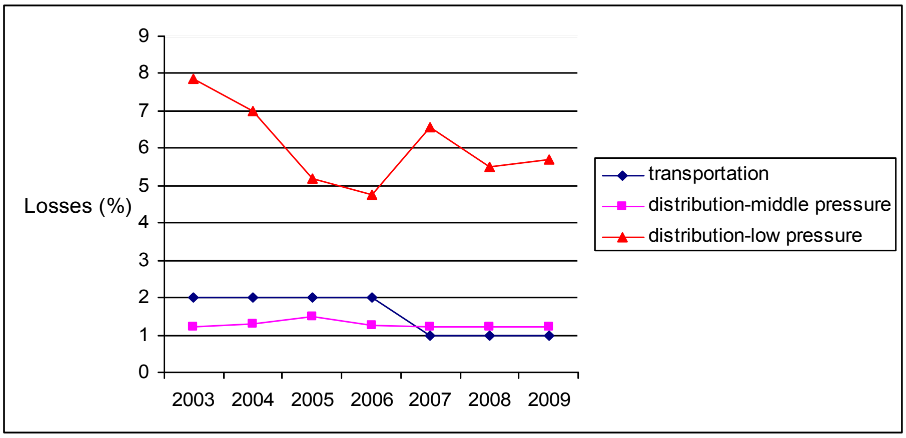


Figure 2. Losses in transportation and distribution of natural gas in AP of Vojvodina

Causes and measures to reduce of natural gas losses

The structure of natural gas losses in distribution has not been precisely determined and the causes of losses in the system are as follows:

- error in measurement of natural gas consumption;
- error in calculation of natural gas consumption with metering devices having no temperature compensation;
- impossibility of simultaneous gas quantity sensing at entry and exit points;
- uncontrolled gas discharge ("leakage") which occurs due to gas network damage and due to leakage at joints of elements which constitute gas system; In the paper [8] is present study leakage from the UK natural gas distribution system;
- unauthorized gas consumption ("theft");
- connecting new consumers to distributive gas network made from steel pipes.

Measures which natural gas transportation and distribution companies have to undertake as planned measures to reduce losses are:

- Natural gas transportation-high pressure: replacement of a part of existing metering devices;
- Natural gas distribution-middle pressure: gas pipeline reconstruction; calibration of metering devices; replacement of metering devices; more intensive control of gas pipeline, the main measurement and regulation stations and measurement and regulation stations;
- Natural gas distribution-low pressure: gas pipeline reconstruction; calibration of metering devices; replacement of metering devices and embedding of metering devices with temperature compensation; control and replacement of regulators; more intensive control of measurement and regulation stations, distribution gas network, household measuring-regulating sets and indoor gas installations; control of cut-off consumers (to identify unauthorized gas consumption); implementation of preventive measures (preventive gas pipeline maintenance, embedding quality metering and safety equipment, quality gas detectors purchase, regular training of operators).

ANALYSIS OF LOSSES REDUCTION ON THE EXAMPLE OF ONE DISTRIBUTOR [2]

A representative distributor in the region of Vojvodina was used as an example to analyze losses reduction. Losses which occur as difference between overtaken and delivered quantities of natural gas were analyzed. Losses occurred due to: defectiveness of elements in measuring-regulating sets; uncalibrated metering devices which causes irregular metering; damage; age of pipelines; unauthorized gas consumption. Tables 2 and 3 show data about losses in 2009 and 2010. Energy Agency of the Republic of Serbia requests data about losses from distributors every three months.

Table 2. Difference between overtaken and delivered natural gas quantities in 2009

Months	1. Total overtaken in distribution system	2. Total delivered from distribution system	3. Difference between overtaken and delivered natural gas quantities (1-2)	
			m^3/month	%
I	523.656	506.693	16.963	3.23
II	412.341	398.336	14.005	3.39
III	344.880	333.242	11.638	3.37
IV	99.570	93.916	5.654	5.67
V	25.318	24.254	1.064	4.2
VI	30.673	29.104	1.569	5.11
VII	28.564	27.975	0.589	2.06
VIII	38.995	35.726	3.269	8.38
IX	75.074	71.998	3.076	4.1
X	140.138	135.528	4.610	3.3
XI	257.544	247.334	10.210	3.96
XII	387.775	372.700	15.075	3.89
Σ	**2.364.528**	**2.276.806**	**87.722**	**3.71**

Table 3. Difference between overtaken and delivered natural gas quantities in 2010

Months	1. Total overtaken in distribution system	2. Total delivered from distribution system	3. Difference between overtaken and delivered natural gas quantities (1-2)	
			m^3/month	%
I	464.128	448.006	16.122	3.47
II	423.776	417.661	6.115	1.44
III	370.771	366.233	4.538	1.22
IV	195.229	194.333	0.896	0.44
V	133.338	131.719	1.619	1.21
VI	98.552	97.791	0.761	0.77
VII	94.950	93.369	1.581	1.67
VIII	88.228	87.548	0.68	0.77
IX	78.033	76.721	1.312	1.68
X	144.563	142.973	1.590	1.1
XI	273.321	271.976	1.345	0.49
XII	456.778	454.881	1.897	0.415
Σ	**2.821.667**	**2.783.211**	**38.456**	**1.362**

Analysis of Tables 2 and 3 shows reduction in losses from 3.71% to 1.362%. In this case, the measures which were undertaken for this purpose are as follows: more intensive and regular control of measurement and regulation stations, distributive gas network, household measuring-regulating sets and indoor gas installations; quality gas detectors purchase which assured timely leakage detection and repair of the smallest gas quantities; control and replacement of regulators; control of cut-off consumers (due to identification of unauthorized gas consumption); gas pipeline reconstruction; metering devices calibration; metering devices replacement and embedding of metering devices with temperature compensation.

Preventive measures: preventive gas pipeline maintenance; embedding quality metering and safety equipment, regular training of operators; investing in replacement of the oldest gas pipelines with the new ones and reconstruction of existing measuring-regulating stations.

CONCLUSION

The process of losses reduction in natural gas distribution is very important since it affects better safety and supply regularity and price reduction of natural gas for end-users. Within its range of activities the Energy Agency of the Republic of Serbia also monitors losses which occur in transportation and distribution and requests from energy companies which operate in this area to forward plans for their reduction. We believe that common action of Provincial Secretary for Energy and Mineral Resources and the Energy Agency of the Republic of Serbia is necessary to provide conditions for losses reduction in natural gas distribution.
Solutions which will assure quality and economical supply with necessary energy must be found for energy situation in our country. Therefore, precise long-term policy for energy development in every town and city must be defined, which is only possible if long-term energy appraisal is carried out based on available resources and technologies, new and more rational energy technologies, better efficiency of energy transformation and its transport, ecology-friendly systems, scientific-professional bases, optimized models and other. Long-term planning and balancing will assure strategic planning of substitution of imported fuels with local and reachable energy sources. This would need optimization of necessary investments, development plans and environmental protection.

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ENERGY CONSUMPTION AND POTENTIAL ENERGY SAVINGS IN SCHOOL BUILDINGS

Dragićević, S.[1], Stojković, S.[1], Radojković, N.[2]
[1]University of KragujevacTechnical Faculty, Čačak,
[2] Primary school "Ivan Milutinovic" Belgrade
E-mail: snezad@tfc.kg.ac.rs

Abstract: Energy efficiency is the topic that has seen major expansion during the several past years. Therefore, it is necessary to put a great effort in order to have everyone together approach, in a rational manner, the use of poor source of energy resources in the future. With appropriate computerised engineering tools, we would be able to evaluate various energy saving options before deciding on implementation. In this paper we used the RETScreen software, which assists users in identifying and assessing potential energy projects, to support the deployment of renewable energy and energy efficient technologies. The software evaluates project savings, life-cycle costs and emission reductions to determine the viability of clean energy projects. This paper presents an analysis of the energy consumption and potential energy savings in primary school "Vuk Karadzic" in Cacak. Obtained results show a possibility measures to improve the energy efficiency of the analyzed school building.
Keywords: energy efficiency, energy savings, RETScreen software, school

INTRODUCTION

The effects of energy use are global. All sectors of society have important roles to play in ensuring that energy is managed more efficiently. As school buildings usually have great potential for improving energy efficiency and school children can benefit from increased knowledge of how to use energy efficiently, schools are a promising location for addressing energy savings. The average annual energy consumption in residential buildings in Serbia is over 150 kWh/m^2. In buildings constructed before 1945 installed capacities of heating systems was on average 200 W/m^2, in those constructed after 1960 about 145 W/m^2, which means that average heat energy consumption in buildings is 200-300 kWh/m^2. In reality, having in mind the real statuses of buildings, maintenance, insulation, and sealing of buildings, average consumption in buildings connected to district heating systems is as high as 420 kWh/m^2. In the European countries with similar climate conditions, buildings are today constructed with annual consumption of energy for heating, hot water, air conditioning, and lighting lower than 100 kWh/m^2. Specific energy consumption in buildings in Serbia is larger 3-4 times, and that in this subsector exist a large possibility for increase of energy efficiency [1].

Schools usually have a high level of energy consumption due to their considerable heating requirements and high electricity usage for lighting and equipment [2,3]. Investment in building and technology, as well as more conscious user behaviour, can lead to considerable energy savings. This paper will analyze usage of RETScreen software for estimation of the energy efficiency measures for building primary school "Vuk Karadzic" in Cacak. The selected object has a total area 4,236 m^2, external surfaces of the facade is 2,700 m^2 and the facade window area the 487 m^2 [4]. Following the adoption of the input data for the selected school building, RETScreen software will give an analysis of the current energy consumption in the school, consumption of hot water and electricity, and analysis of proposed measures to increase energy efficiency.

ATERIAL AND METHODS

The RETScreen Clean Energy Project Analysis Software is the world's leading clean energy decision-making software. It is provided completely free-of-charge by the Government of Canada as part of Canada's recognition of the need to take an integrated approach in addressing climate change and reducing pollution. RETScreen is a proven enabler of clean energy projects worldwide to monitor, analyse, and report key energy performance data to facility operators, managers and senior decision-makers.The RETScreen Software is a unique decision support tool developed with the contribution of numerous experts from government, industry, and academia. The softwarecan be used to evaluate the

energy production and savings, costs, emission reductions, financial viability and risk for various types of renewableenergy and energyefficient technologies. The software (available in multiple languages) also includes product, project, hydrology and climate databases, a detailed user manual, and a case study based college/university-level training course, including an engineering e-textbook.
The model used for analysis in this paper is the school building. School buildings in Serbia were mostly built in mid last century and most buildings have poor insulation, outdated heating system and wood joinery. Most school buildings do not meet energy efficiency standards that are represented in all developed countries [5,6]. The heating system, hot water system, lighting, and the building envelope will be included in the RETScreen analysis. Nevertheless, schools as objects with large surface areas require installation of a large number of lighting with large electrical energy consumption. By installing energy saving light bulbs that are significantly less power with the same effect as conventional, it could be extent to make significant energy savings, which will also be included in the RETScreen software analysis.
Types of heating and lighting systems that could be used to achieve energy savings is choose in performed analysis of energy savings. Electricity heating is adopted in the base case heating. For the proposed heating cases, there is a choice of different types of fuels such as coal, biomass, oil and heating mode defined by the user. Ordinary light bulb (so-called white light) is adopted in the lighting base case. For the proposed case compact fluorescent lighting and halogen bulbs is adopted.

RESULTS AND DISCUSSION

Scenario 1: electric vs. coal heating

The first analysis will cover the heating system whether it is possible to choose two parallel types of fuel, then the percentage of seasonal efficiency, the additional initial costs and additional savings. Figure 1 shows a comparison of selected data for electricity heating and coal heating. Heating efficiencies for electricity of 100 % and for coal heating system of 55% were adopted. In addition to these parameters, there is the possibility of defining the initial costs which are the sum of costs for design, purchase, construction and installation of all elements of the energy system. In the selected case sum of these costs is 3,000 €.

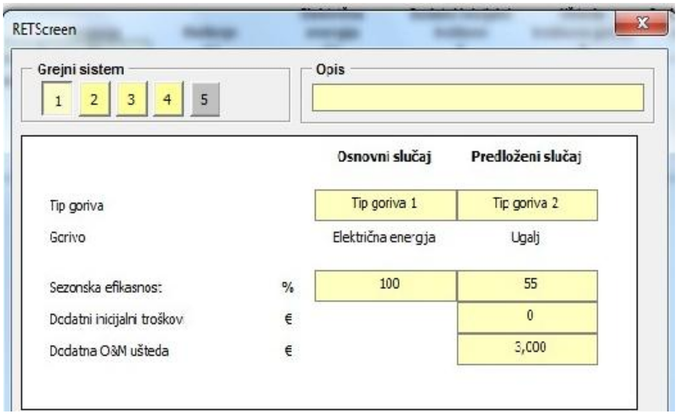

Figure 1. Defining the type of fuel in Scenario 1: electric vs. coal heating

The base case is the current state, while the proposed case is case whit greater energy efficiency. Building cover of elementary school "Vuk Karadzic" is 2,700 m² where each side of the school has a different surface area. In order to achieve greater energy efficiency implementation of building insulation and replacement of old windows by windows with better thermal characteristics is proposed (Fig. 2). The costs of proposed measures in this case range between € 45,000 and 48,000 €.

		Osnovni slučaj	Predloženi slučaj	
Građevina sever	°		0	☑ Osnovni slučaj = predloženi slučaj
Raspored		Raspored 1	Raspored 2	
Opis		24/7	24/7	

Omotač građevine		Osnovni slučaj Sever	Istok	Jug	Zapad	Predloženi slučaj Sever	Istok	Jug	Zapad		Dodatni inicijalni troškovi
Zidovi						☐ Osnovni slučaj = predloženi slučaj					
Površina	m²	900	750	650	400	900	750	650	400		
R-vrednost	m² - ºC/W	0.745	0.745	0.745	0.745	0.6	0.6	0.6	0.6	€	45,000
☑ Prozor						☐ Osnovni slučaj = predloženi slučaj					
Površina	m²	220	100	100	67	220	100	100	67		
R-vrednost	m² - ºC/W	0.36	0.36	0.36	0.36	0.22	0.22	0.22	0.22	€	48,600
Koeficijent dobitka solarnog grejanja											

Figure 2. Defining the parameters of the school building cover

The next part of the analysis relates to the lighting, where first selection is the type of space (Fir. 3). The program automatically suggests the classroom brightness level of 500 lux. The level of illumination in the base case is 450 lux, while in the proposed case illumination is 300 lux. Type of lamps for the existing case are an ordinary light bulb or the so-called white light, and the proposed lamps are compact fluorescent lighting. It should be noted that the power load from 100 W to 40 W is reduced, and also the number of working hours will be reduced from 12 to 9 hours.

		Osnovni slučaj	Predloženi slučaj
☑ Tip prostora		Učionica	
Nivo osvetljenosti - predloženo	Lux	500	
Nivo osvetljenosti	Lux	450	300
Svetlosni i fiksni tip		Belo-usijanje	Kompaktni fluorescent - za zavrtanje
Efikasnost svetala i instalacija	lm/W	14.7	56.7
Opterećenje električne energije	W	100	40
Broj popravki - predloženo			3
Broj popravki		8	16
Nivo osvetljenosti - promenljivo	%		362.9
Radnih sati	h/d	12	9
Dodatni inicijalni troškovi	€		300
Dodatna O&M ušteda	€		150
Broj jedinica		4	6
Električna energija	MWh	14	13

Figure 3. Defining the parameters of lightning in Scenario 1

Reducing of hot water consumptioncan greatly contribute to saving energy resources, and thus reduce costs for consumed water and electricity. Daily use of water is actually a number of liters consumed per day, which in turn depends on the number of students. There are 1,200 students in the selected school. Daily use of hot water is defined by the program and is 690 l/d. In the base case hot water flow is 4 l/s, whereas in the proposed case this value is 2l/s. The program provides the opportunity to define the temperature and it is assumed 32 °C in base case, ie. 28 °C in the proposed case (Fig. 4). In the basic case hot water is used 12 hours during the day,and 9 hours in the proposed cases. According to the selected data in this section, hot water energy consumption in the basecase is 1,534 MWh,ie.372 MWh in the proposed case. Applying selected energy efficiency measures energy savings for water heating of 76% can be achived.

		Osnovni slučaj	Predloženi slučaj	
☑ Tip opterećenja		Škola		
Broj jedinica	Student	1,200		
Vrednost zauzeća	%	25		
Dnevno korišćenje tople vode - procena	L/d	690.00		
Korišćenje tople vode	L/s	4	2	
Temperatura	°C	32	28	
Metod dopune temperature		Formula		
Temperatura vode - minimalana	°C	7		
Temperatura vode - maksimalna	°C	15		
Radnih sati	h/d	12	9	
Efikasnost oporavka grejanja	%	0	20	
Dodatni inicijalni troškovi	€			
Dodatna O&M ušteda	€			
Grejni sistem		Grejni sistem 1	Grejni sistem 1	
Opis grejnog sistema				
Grejanje	MWh	1,534	372	75.8%

Figure 4. Defining the parameters of hot water consumption

After entering all parameters, the program provides an overview of all data entered for selected segments of analysis for base and proposed case. Figure 5 shows that the energy consumption in the proposed case is reduced more than twice. The total energy consumption for heating and lighting is decreased from 11.421 GJ to 7.816 GJ. Energy savings for heating is 49.8%, while electrical energy saving is 10%. Results of the entire school energy analysis show that the maximum energy savings that can be achieved is 31.6%.

Pregled ☑ Prikaz podataka

	Gorivo		Osnovni slučaj		Predloženi slučaj		Ušteda troškova goriva	
Tip goriva	Potrošnja goriva - jedinica	Protok goriva	Potrošnja goriva	Troškovi goriva	Potrošnja goriva	Troškovi goriva	Goriva sačuvano	Ušteda troškova goriva
Električna energija	MWh	€ -	2 185.6	€ -	1 103.3	€ -	1 082.3	€ -

Verifikacija projekta Tip goriva	Potrošnja goriva - jedinica	Potrošnja goriva - istorijski	Potrošnja goriva Osnovni slučaj	Potrošnja goriva - promenljivo
Električna energija	MWh		2 185.6	

Energija	Grejanje GJ	Hlađenje GJ	Električna energija GJ	Ukupno GJ
Energija - osnovni slučaj	7,818	3,553	50	11,421
Energija - predloženi slučaj	3,926	3,844	45	7,816
Sačuvana energija	3,891	-291	5	3,606
Sačuvana energija - %	49.8%	-8.2%	10.0%	31.6%

Figure 5. Summary data after entering all the parameters in Scenario 1

Scenario 2: electric vs. biomass heating

An analysis of proposed energy efficiency measures in Scenario 2 is case of using biomass as heating fuel. Price of 150 €/tone is adopted, including its transportation. Installation of biomass heating system will cost 4,000 € which will create conditions for maintenance costs savings of 1,000 €.

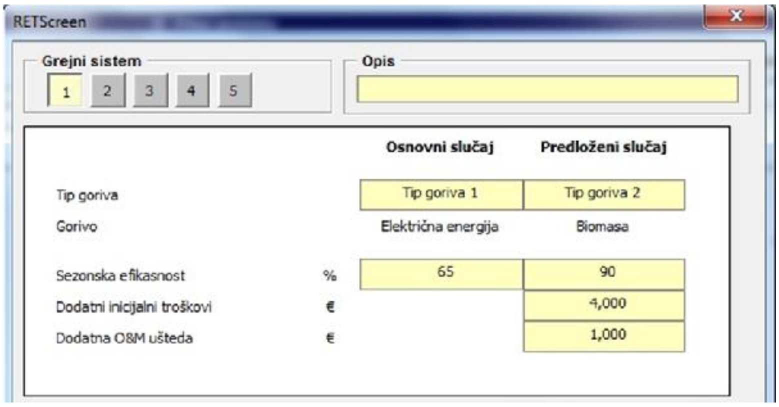

Figure 6. Defining the type of fuel in Scenario 2: electrical vs biomass heating

For lighting in the Scenario 2, instead of the standard white light bulbs halogen bulbs are proposed, whose efficiency is slightly lower than that of white light bulbs. In this case the brightness level is reduced by 30%. Installation cost of this type of bulb is 2000€ and thus annual savings of 700 € could be achieved. Proposed type of lamp will have not an impact on heating and cooling load calculations, while these lamps use up to 65% less electricity (Fig. 7).

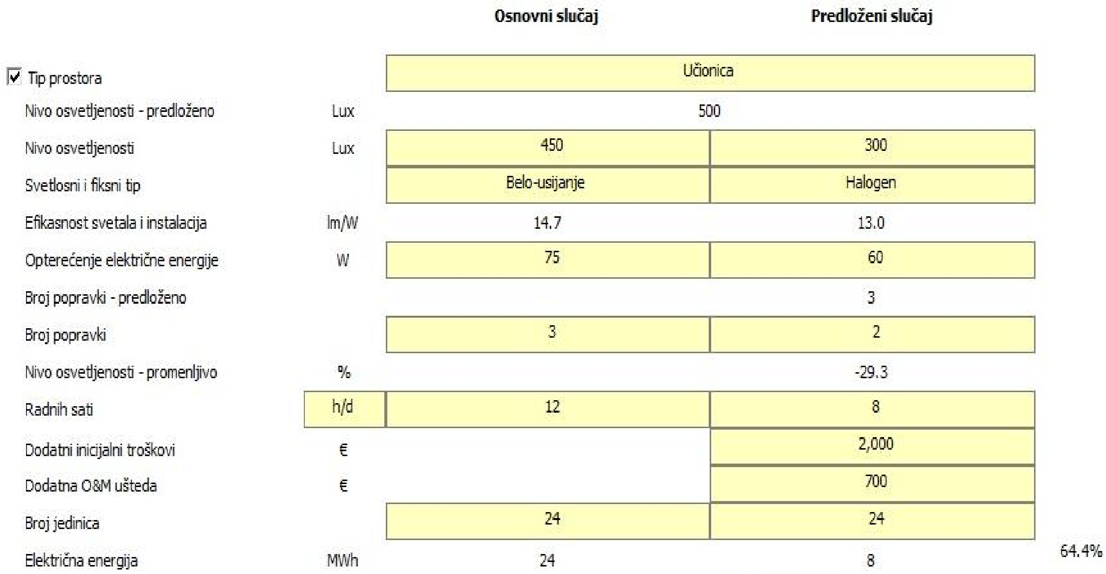

Figure 7. Defining the parameters of lightning in Scenario 1

The amount of greenhouse gas emissions of 8421 t_{CO2}/MWh is calculated (Fig. 8) in this case. Annual bruto emission is 128.4 t_{CO2}, but with the use of fees for GHG credits, this amount is 124.5 t_{CO2}. Reduction of greenhouse gas emissions, compared to the base case, is equivalent to 42.9 tons of recycled waste.

☑ Analiza Emisije

Osnovni slučaj elektro energetskog sistema (polazna linija)		staklene bašte faktor (bez Prenosa i	Prenos i distribucija gubici	Emisija gasova staklene bašte faktor
Zemlja - region	Tip goriva	tCO2/MWh	%	tCO2/MWh
Srbija	Drugi	8.000	5.0%	8.421

Emisija gasova staklene bašte					
Osnovni slučaj	tCO2	199.2			
Predloženi slučaj	tCO2	70.8			
Bruto godišnje smanjenje emisije gasova staklene bašte (GHG)	tCO2	128.4			
GHG kredit transakciona naknada	%	3.0%			
Neto godišnje smanjenje emisije gasova staklene bašte	tCO2	124.5	jednak je	42.9	Tona recikliranog otpada
Prihod od smanjenja gasova staklene bašte					
Iznos kredita emisije gasova staklene bašte	€/tCO2				

Figure 8. Analysis of greenhouse gas emissions in Scenario 2

The proposed energy efficiency measures in Scenario 2 include replacement of lighting (MR16 halogen bulb, 60W, 220V) and installation of the biogas boiler (TIG-S, 100kW, 4 bars, 30 kg). Economic analysis of this case shows that in case of using biomass as a fuel return on capital will be available for 1.4 years.

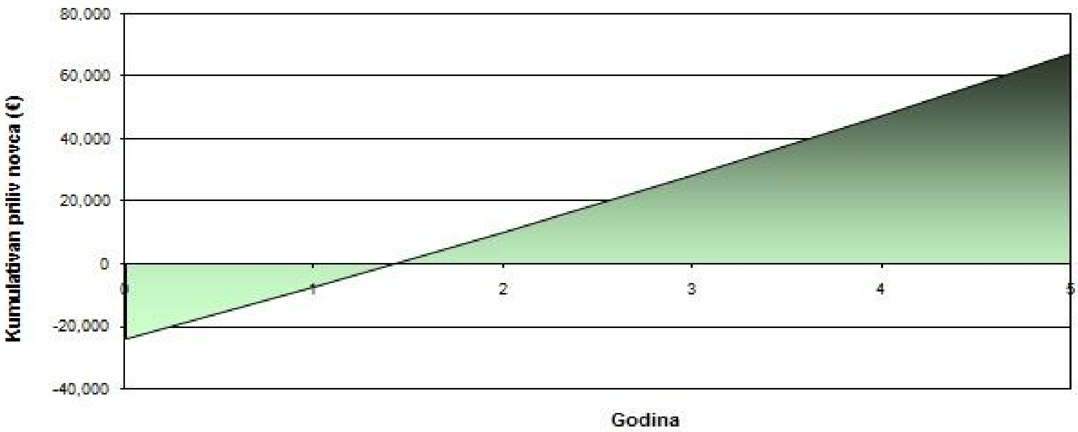

Figure 9. The Cumulative Cash Flow Diagram

CONCLUSION

This paper presentsan analysis of energy consumption and energy saving measures to achieve greater energy efficiency for the selected school building. The analyses were performed using the data of the primary school building "Vuk Karadzic" in Cacak, using the RETScreen software. We investigate improved insulation, better windows, lighting, the heating system, building cover, and hot water system of the school. From the obtained results it can be concluded that the investment in energy efficiency measures, such as replacement of heating and lighting system and improving the thermal characteristics of building cover, can pay off in less than 2 years.

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SESSION 7: Students papers

EFFICIENCY OF CORRECTIVE MAINTENANCE - DIFFERENCES IN THEORY AND PRACTICE

Mojsin, M.
University of Novi Sad
Technical Faculty "Mihajlo Pupin", Zrenjanin
E-mail: sinzr@open.telekom.rs

Abstrakt: The aim of this work is to show the difference in theory and practice in the performance of corrective maintenance or corrective maintenance problem in practical applications. We analyzed the problem of the purchase speed of a new fan for the cooling device that cools water, which further cools the presses gear oil in operation of pressing sunflower oil. It was concluded that there is a need to respond quickly with purchasing, because the daily delay only increases production costs.
Key words: Corrective maintenance, purchase.

INTRODUCTION

When we talk about maintenance in general, the best possible solution is that it is given preventively or by using other methods (such as preventive periodic reviews, technical diagnostics, preventative substitute equipment, preventive and general periodic repairs) pre eliminate possible irregularities in the work of technical system. However, as failures of technical systems are of highly stochastic nature (it is not possible to accurately determine the moment of failure occurrence), there is a need for corrective maintenance, apropos maintenance after the failure occurrence.
In modern business where most of the production goes on quantity rather than on quality, such failures are more frequent. Technical systems are increasingly exploited, soit is required to maximize utility with minimal investments in them. General repairs are shorter now bacause of the over-production orders, so it is impossible to do them well. As product of this,corrective maintenance is becoming more frequent, and therefore the time it is becoming shorter.

CORRECTIVE MAINTENANCE

Corrective maintenance can be defined as the maintenance which is required when technical system has failed or worn out, to bring it back to work order.
That can be done in two possible ways as follows:

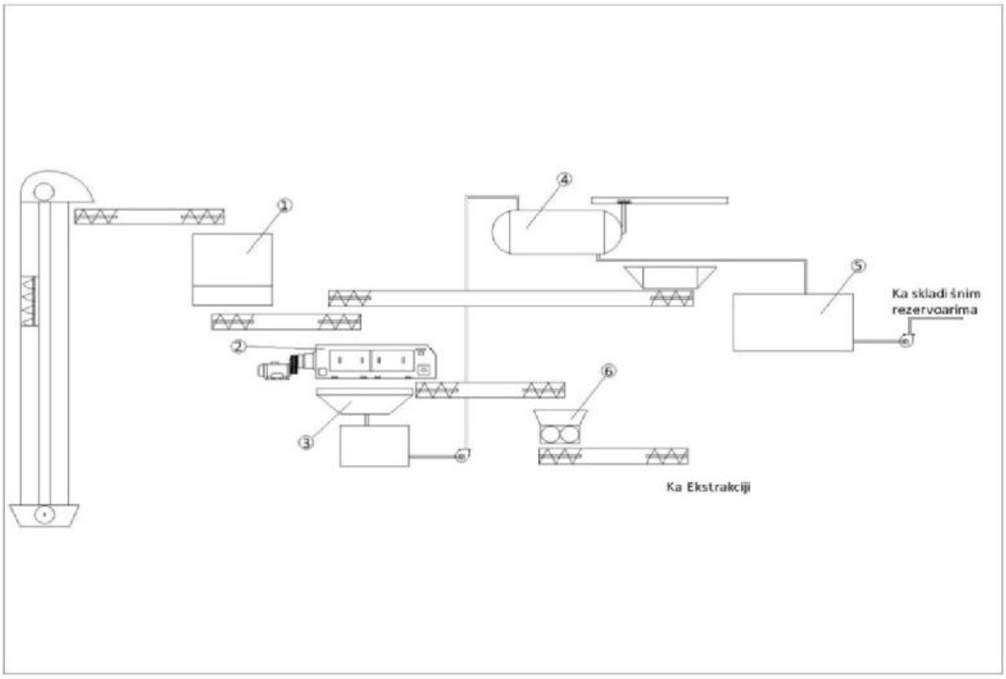
- by repair services, in which the dismissals are removed while the system is off . This includes work on the technical system without removing the part of the engine to be repaired or waiting for the engine part that is taken away for repair or overhaul.
- the Replacement of the engine part , when we replaces them with a new or remanufactured one.

In addition to these two concepts, there is a process that is inherented in this region, which is a bypass of defective units, so that the system can work until they are purchased or repaired.
Since the quantity is the only important thing for the company, no one questiones whether this procedure is a rational one from economic point of view. Apparently, the system may do as well as a new one, but with that increasesthe costs of its exploitation and whether it was reasonable to use it, still remains unsolved.
If the company decides to follow these concepts, it would be good to analyze the system in order to see whether the costs have increased and, if they had, as soon as possible to repair the bypassed units or replace them.

EXPERIMENTAL FACILITY

A department called „Presaona" was taken as an experimental plant where the raw material from the sunflower treated previously, is now pressed in order to get oil.

The material first passes through the conditioner (1) from which it enters the press (2). Gained oil must be purified first of coarse particles in the sump(3) and then filtrated (4). After the filtration, the oil is pumped furhter over tanks for crude oil (5) to the storage. Coarse sediment is returned back for pressing. The resulting cake from this pressing is crumbled(6) and then routted to the extraction. The building of the Presaone is given in Figure 1.

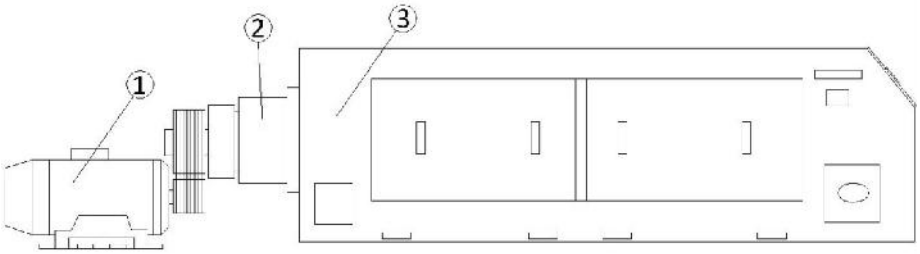


LEGEND:1-Conditioner; 2-Press, 3- Oil Sump, 4-Filter, 5-Tank for crude oil; 6-Breakers

Figure 1. The Presaona building

DESCRIPTION OF PRESS AND CHILLER

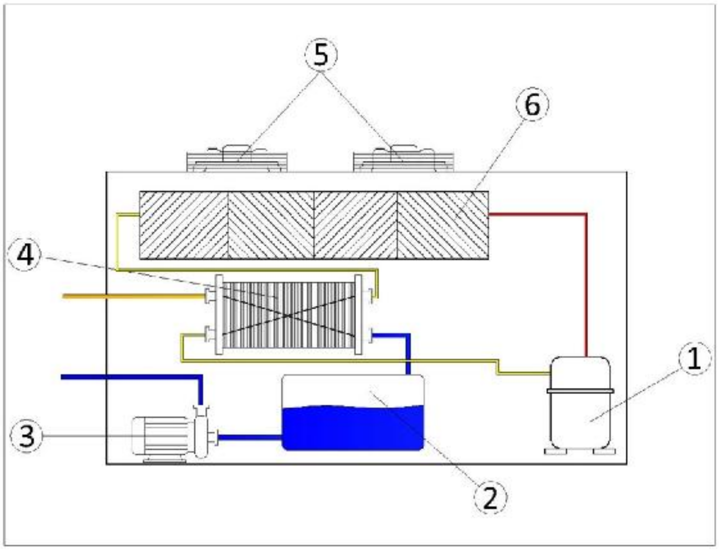
In the plant , there are two presses (3) and each of them is powered by electric motor of 630kW power (1), which , through the planetary gear (2), provides a torque on the press shaft of 110000Nm. Because oil heats in the gear when the press is working, it is necessary to achieved its cooling by using a cooling system - chillers. The sheme of press is given in Figure 2.



LEGEND:1-Motor, 2-Planetary gear, 3-Presses

Figure 2. Appearance of the Presses

A Chiller is a device which serves for cooling water. It consists of a compressor (1), the water tank (2), pumps (3), heat exchanger (4), fan (5) and a condenser (6).
During its work, the compressor pushes the freon into the condenser. Freon is compressed here and slowly turned into a liquid state. During this compression it gives off the heat accumulated inside into the outer space.
Then, freon (still liquid) passes through a heat exchanger where it cools thewater.
At the end of the exchanger, freon is in gaseous state. Being like that, it is sucked into the compressor and the process repeats. The appearance of chillers is given in Figure 3



LEGEND: 1-Compressor, 2-Water tank, 3-Pump, 4-Heat exchanger, 5-Fans; 6-Condensers

Figure 3. Chiller

Water controller for cooling the planetary gear, is necessary to set in that way that a temperature sensor turns on water cooling only if the temperature oil gear exceeds over 50°C. The schematic connection between presses and chillers is given in Figure 4.

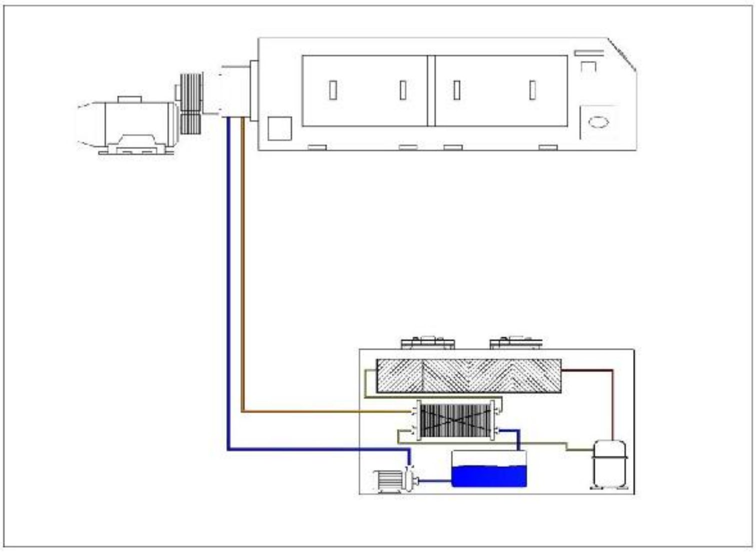


Figure 4. The connection between the Presses and the Chillers

The Gearbox of the presses in the Presaona can be cooled with city water. This is done as an alternative solution in case of chiller failure because if we turned off the chiller for the repair work, we would have to stop the whole Presaona and four other plants alongside.

RESEARCH PROBLEM

During the presses operation, the increasing of the oil temperature of gearbox wasnoticed after which the pressstopped in order to detect the problem.
There was a failure of the chiller, after which the drive had to switch to an alternative solution, cooling gearbox oil with a city water.
Electrical maintenance found a defective fan on chiller condenser. The fan was dismantled and all required data were sent to the supply service to order another one**.**

RESULTS AND DISCUSSION

After the cooling was done with the city water, tempering of oil in gear could not be done, but for its work it was important not to let the temperature rise.
The Press can work without the chiller longer without any problems. The drive works without consequences, but the delay of the repairs would significantly increase thecosts of thePresaona work.
The pipeline diameter for city water in Presaone is 1" and if we assume that the velocity of water is 2m/s and if we neglect the losses in the pipeline, the flow of water would be $Q = 5{,}324\, {m^3}/{h}$.

$$Q = A \cdot v$$

$$A = \frac{d^2 \cdot \pi}{4}\ [m^2]$$

The inner pipe diameter for 1" is d = 30.7 mm

$$Q = \frac{d^2 \cdot \pi}{4} \cdot v$$

$$Q = \frac{0{,}0307^2 \cdot 3{,}14}{4} \cdot 2 = 1{,}479 \cdot 10^{-3}\ {m^3}/{s} = 5{,}324\ {m^3}/{h}$$

The new fans came after 35 days and during that time it was spent472.1 m^3 of city water having the price of 104din per cubic meter.
The Cost of water amounted to 465,098.4 dinars, and the new fan cost 31,000 dinars.
Figure 5. gives the cost-price of daily water consumption and prices of new fans.

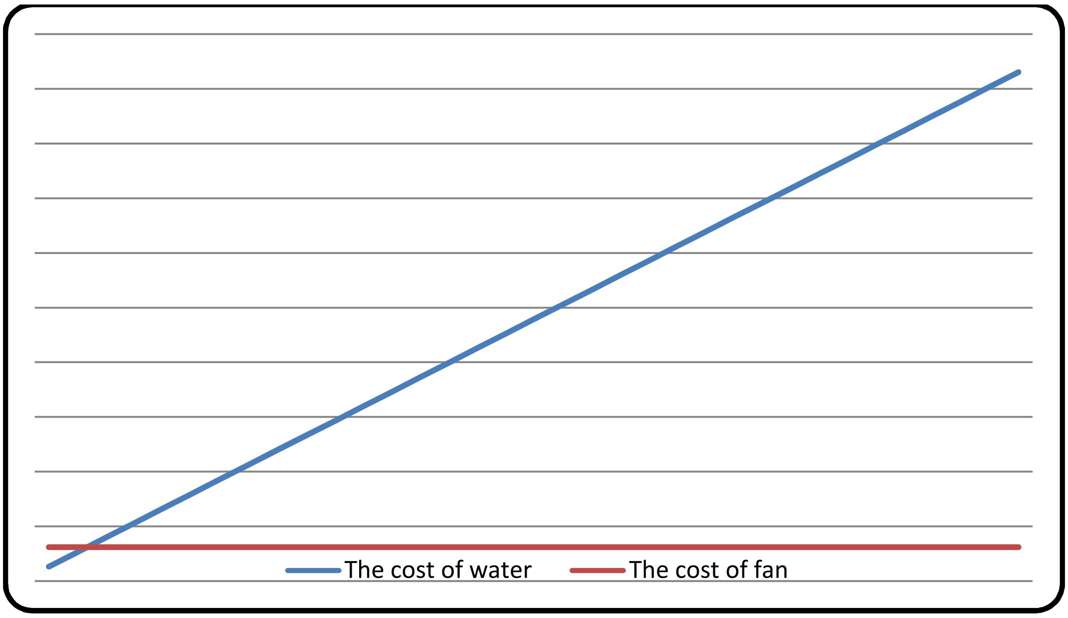


Figure 5. The ratio between the cost of Water and a Fan

CONCLUSION

As we can see from the enclosed research, labor costs of the press without a chiller has already exceeded the cost of the fan after two and a half days.

In such situations, it is important to react as quickly as possible, whether a mechanical intervention should be done or whether we talk about purchasing a new part.

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OCEAN WAVES AS A SUSTAINABLE ENERGY RESOURCE

Ramić, E.
University of Novi Sad, Technical Faculty "Mihajlo Pupin", Zrenjanin
E-mail: enaramic@hotmail.com

Abstract: This paper presents a description of sea and ocean waves´ potential to be a sustainable energy resource, as well as overwiev and analysis of current technologies for extracting energy from waves. Document also contains a brief review of achievements on this field up to now, and challenges that stand in front of future development.
Keywords: wave, production, energy, electric, ocean

INTRODUCTION

You only have to look at waves pounding a beach, inexorably wearing cliffs into rubble and pounding stones into sand, to appreciate the power of the ocean. As soaring oil prices and concern over climate change give added urgency to the search for new, renewable sources of energy, the sea is an obvious place to look. [1] Wave energy technologies are designed to extract energy from the energy contained in the movement of waves. [2] The first serious study of wave energy took place in the 1970s and early 1980s when several governments undertook national R&D programmes as a response to the emerging oil crises. In many countries this research was greatly curtailed or stopped altogether throughout most of the 1980s and 1990s. Over the past decade a number of small companies have tried to develop and commercialise a range of different wave energy technologies as a non-polluting source of energy. In some countries, these initiatives have been accompanied by government-funded activities, as well as developments in international organisations such as the European Commission and the International Energy Agency. [3]

WAVES AS AN ENERGY RESOURCE

Coasts with exposure to the prevailing wind direction and long fetches tend to have the most energetic wave climates, such as the western coasts of the Americas, Europe, Southern Africa and Australia/New Zealand as shown in *Figure 1*. The global wave power resource in deep water (i.e. 100 m or more) is estimated to be ~ 8 000–80 000 TWh compared to global electricity production of 19855TWh in 2007 (IEA, 2009). The economically exploitable resource varies from 140-750 TWh/yr. for current designs of devices when fully mature (Wavenet, 2003) and could rise as high as 2 000 TWh/yr. (Thorpe, 1999), if all the potential improvements to existing devices are realised.[3] Some confirmation of these values can be derived from the more recent wave power maps from Cornett (2008).[5] These indicate a value for the exploitable resource (i.e. with wave power levels ≥ 20 kW/m) of approximately 800 GW corresponding to ~ 2 000 TWh/yr. [3

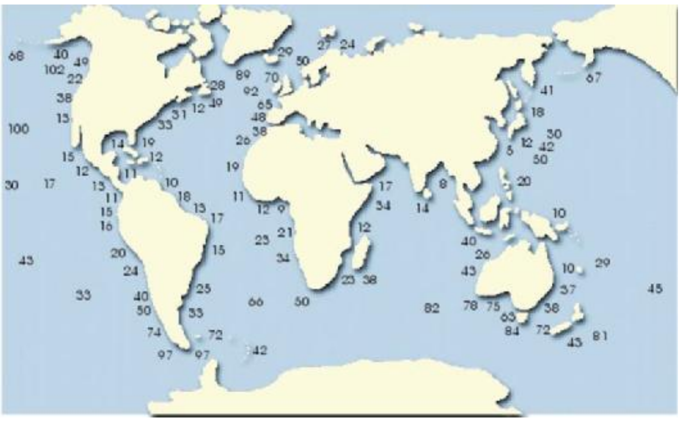

Figure 1. Average annual wave power levels as kW/m of wave front

TECHNOLOGIES

Through time several concepts to extraction of energy from waves have been invented and developed. More than 100 concepts are globally in varying levels of development and several are in demonstration phases. Many designs are being pursued by developers to harness the power of the waves. They can be categorized according to the location and depth in which they are designed to function: shoreline, near-shore, offshore, or by the method used to extract the energy from the waves.[2] Methodological approach is the most common, so it will be used here to categorize devices. There are 5 types of wave energy extractors by this categorization:

1. Oscillating water column (OWC)
2. Point absorber
3. Surge device
4. Attenuator or linear absorber (also: Contouring device)
5. Overtopping device

Oscillating Water Column (OWC)

An OWC comprises a partially submerged structure forming an air chamber, with an underwater aperture. This chamber encloses a volume of air, which is compressed as the incident wave makes the free surface of the water rise inside the chamber. The compressed air can escape through an aperture above the water column which leads to a turbine and generator. As the water inside falls, the air pressure is reduced and air is drawn back through the turbine. Both conventional (i.e. unidirectional) and self-rectifying air turbines have been proposed. OWC devices have several benefits: they have been extensively researched; they have been deployed in their hundreds (as small navigational buoys); they have effectively one moving part thereby increasing reliability; their mechanical and electrical (M&E) plant can be easily accessed in service, because they are shore-based or the M&E equipment lies well above the waves. Even with this commonality of operating principles, the examples of oscillating water column actually deployed vary considerably, e.g.

- Wavegen deployed a single, bottom-standing, shoreline-based concrete device in Scotland, which has functioned with great reliability since 2002;
- A multiple unit, floating offshore steel device to be deployed by Oceanlinx in Australia following proof of concept with their near-shore 400 kW device;
- A floating single unit OWC where the mouth of the OWC points away from the waves towards the shore (thereby significantly reducing mooring loads) to be built in Ireland by OceanEnergy;
- An OWC to be tunneled into a cliff in the Faeroe Islands by SeWave;
- An increasingly popular option is to build a number of OWCs into new breakwaters, thereby defraying their high structural costs, either as a few large OWCs (as with the 3 x 250 kW OWCs in the breakwater at the mouth of Douro river in Portugal) or as multiples of smaller OWCs (such as Wavegen's 16 x 18.5 kW OWCs in Mutriku, Spain).

Point Absorber

This is a buoy that is small in size compared to the length of the waves, which floats at or near the surface. It can usually absorb energy in all directions by following the movements of water at or near the sea surface (like a float) or, for subsea devices, move up and down under the influence of the variations in subsea pressure as a wave moves by. Energy is generated by reacting these movements against some kind of resistance, which can take a number of forms, depending on the configuration of resistance, the power take-off (PTO) and the type of device-to-shore transmission, for instance:

- Ocean Power Technologies' PowerBuoy is a vertical float that uses a heave plate attached to connecting spar as resistance (its large surface area reduces the heave plate movement through water). The relative motion between the float and the heave plate drives a hydraulic and mechanical PTO that generates electricity on the device. The output from up to 10 PowerBuoys is linked via an Underwater Substation Pod (USP)[4], where it is transformed to a higher voltage for transmission to shore. Several 20-40 kW demonstration buoys have been deployed and a larger 150 kW system awaits deployment in 2010 in the USA and Scotland.
- Carnegie Wave Energy's CETO uses an underwater buoyant float attached via a flexible mooring line to a simple pump, which is fixed on the seabed via a gravity anchor or steel pile. The movement of float with respect to the pump is used to pressurize seawater and the output from an array of these devices is collected for onward transmission to the shore where it drives a Pelton turbine to produce electricity. The first buoy in a 5 MW scheme will be deployed in early 2010 in Western Australia.
- Seabased's Linear Generator has a buoyant surface float attached via a flexible connector to a unit on the sea bed. The movement of the float is converted directly into electricity using a linear generator (such a generator has been used in other devices, such as the most powerful device yet deployed, AWS Ocean Energy's Waveswing). A pilot project of up to 10 x 10 kW devices has been under way in Sweden since 2002.
- Other developments have occurred regarding point absorbers, such as:

- Encapsulated Devices, which have all the PTO within the body of the float so as to avoid equipment coming into contact with seawater. Some of these devices follow the inspiration of Professor Stephen Salter, the father of wave energy, by using internal gyroscopes to provide the resistance to movement (e.g. devices from Oceantec Energies Marinas and Kobe University);

- Multi-unit Platforms comprising a number of point absorbers on an offshore platform in an attempt to simplify installation and allow easier access for repair and maintenance (e.g. devices from Hidroflot and Floating PowerPlant).

Surge Device

These extract energy from the horizontal to-and-fro movements of water particles within waves. They are situated in shallower water close to shore, because it is only in shallow water that the circular movement of water particles in deep water then becomes elongated into horizontal ellipses (surge). These devices usually take the form of wide flaps that are pivoted about a rotor. Again, despite the same operating principle, the examples of surge devices actually deployed vary considerably, e.g.:

- Aquamarine Power's Oyster is a large (2.4MW), single-flap device whose movements activate hydraulic rams to pressurize seawater, which is then pumped ashore to drive a turbine and generate electricity. A demonstration 315 kW prototype device was installed in Scotland in 2009;
- AW-Energy's Wave Roller is a device with several flaps mounted on a single sea-bed platform, where the movements of each flap activate piston pumps that drive an on-board hydraulic motor and generator. A 13 kW prototype was deployed in Portugal in2007 and 2008;

[4]An underwater substation pod (USP) adapted to collect and process the electrical outputs of an array of offshore power generating devices includes a voltage boosting transformer for combining and transmitting with increased efficiency an amplified version of the collected electrical outputs to an on shore facility. Combining the outputs and transmitting at a higher voltage reduces transmission losses and the number of cables required to transmit the electrical outputs. The USP is mounted on the seabed but operated at atmospheric pressure to accommodate standard components. The pod may be designed to include remotely controlled operation and to have a long service life since few, if any, moving parts are used. Also, the equipment may be designed to have a high degree of redundancy to provide greater reliability.[6]

- Other devices have been designed to have flaps mounted on floating platforms, e.g. Cwave and Langlee Wave Power, whilst one other imitates the motions of subsea flora (Biopower Systems).

Attenuator/Contouring Devices

These are elongated floating devices that extend parallel to the wave direction and so effectively ‘ride’ the waves. As the incoming wave passes along the device, it generates movements within the device that are used to produce energy. The types of device under development are very varied, e.g.:

- Pelamis Wave Power’s Pelamis is a series of floating cylindrical hollow steel segments that are connected to each other by hinged joints. As waves run down the length of the device, the segments move with respect to each other and actuate hydraulic cylinders incorporated in the joints between sections to pump oil to drive a hydraulic motor/generator via an energy smoothing system. A 750 kW prototype device was deployed in Scotland in 2004, followed by a prototype production device and a three-device wave farm in Portugal in 2008.
- Wave Star Energy’s Wave Star has a series of floats either side of a long connecting structure. As the wave passes down the length of the structure, it raises and lowers the independent floats, each driving a hydraulic pump that is connected to a common hydraulic motor and generator. A 1/10th scale system has been running in Denmark since 2006 and the first section of the 500 kW device was installed in September 2009.
- Checkmate Seaenergy’s Anaconda comprises a distensible rubber tube, filled with sea water. It is anchored to a mooring post and floats just beneath the surface, head to sea. Passing sea waves produce a succession of bulges in the tube, which travel down its length, producing pressure fluctuations ahead of the bulge. These are smoothed out in an accumulator at the end of the tube and used to drive a hydraulic turbine and generator in the stern of the device.

Overtopping Device

These rely on using a ramp on the device to elevate part of the incoming waves above their natural height in order to fill a raised reservoir, from which the seawater is allowed to return to the sea via low-head turbines:

- The Wave Dragon is a floating device using a pair of large curved reflectors to gather waves into the central portion where they flow up a ramp and over the top into a raised reservoir on the device, from which the water is allowed to return to the sea via a large number of low-head turbines. A quarter-scale, 20 kW prototype was deployed in a Danish inlet in 2003.Activities are under way for installation of full-scale devices in Denmark (1.5 MW in 2011) and Wales (7 MW in 2012). Wave Energy AS has plans for a 300 kW multi-reservoir, shoreline device in Denmark during 2011;

- Wave Energy has developed a multiple-stage overtopping device that can be used as a breakwater or as a floating or fixed offshore island. It utilizes a total of three reservoirs placed on top of each other, in which the potential energy of the incoming wave can be stored, until it is allowed to run through their multi-stage turbine. Using multiple reservoirs is hoped to increase the overall efficiency compared to single overtopping devices. [2][3]

BENEFITS

Offshore wave energy has the potential to be one of the most environmentally benign forms of electricity generation. The wave energy around the British Isles has been estimated to be equivalent to three times current UK electricity demand, with the potential to convert a sizeable fraction of this wave energy to electricity. Many other areas of the world also present possible opportunities for wave power conversion. [7] In addition to the large size of the resource and the lack of associated greenhouse gas emissions, wave energy has several important advantages:

• outside the tropics, storms are usually more intense and frequent during winter, which results in wave power levels being higher in that season. Therefore, wave energy provides good seasonal load-following for those regions where peak electricity demand is produced by winter heating and lighting requirements (e.g., northern Europe, western Canada and northwest USA);
• wave energy is predictable for one to two days ahead, because satellites can measure waves out in the ocean that will later impact on devices around the coast. This predictability will allow for less spinning reserve that is often required to support more intermittent renewable energy sources;
• most studies on the environmental aspects of wave energy (e.g. Wavenet, 2003) concluded that the environmental impacts are likely to be low, provided developers show sensitivity when selecting sites for deployment and key stakeholders are consulted;
• several wave energy developers are seeking to use their technology for producing potable water by reverse osmosis (RO), thereby helping to address a major environmental crisis – the lack of clean drinking water for many millions of people. The fact that the vast majority of the world's population lives within 30 km of the coast makes wave energy a suitable technology for providing water close to where it will be consumed.

CHALLENGES

A successful wave energy device faces a number of design challenges:

5.1 Design waves.[5] To operate its mechanical and electrical plant efficiently, a wave energy device must be rated for wave power levels that occur much of the time (e.g. in the UK this would be 30-70 kW/m). However, the device also has to withstand extreme waves that occur only rarely and these could have power levels in excess of 2 000 kW/m. This poses a significant challenge because it is the lower power levels of the commonly occurring waves that produce the normal output of the device (and hence the revenue) while the capital cost[6] is driven by the civil structure that is designed to withstand the high power levels of the extreme waves –unless the device designer is cunning.
5.2 Variability of wave power levels. Waves vary in height and period from one wave to the next and also from storm to calm conditions. The average wave power levels can be predicted in advance by using satellites to observe the waves far out to sea, which will arrive near to the shore in the next 24-48 hours. However, the short term variation (over periods of minutes) has to be converted to a smooth electrical output if it is to be accepted by the local electrical utility. This usually necessitates some form of energy storage or smoothing.
5.3 Variability in wave direction. Normally, offshore waves travel towards a wave energy device from a range of directions, so it has to be able to cope with this variability either by having compliant moorings (which allow the device to point into the waves) or by being symmetrical. Another approach is to place the wave energy device close to the shore, because waves are diffracted as they approach a coastline, so that most end up travelling at right angles to the shoreline.
5.4 Wave movement. To produce useful electricity, the relatively slow oscillation of waves (typically at ~0.1 Hz) has to be transformed into a unidirectional output that can turn electrical generators at hundreds of rpm, which requires a gearing mechanism or the use of an intermediate energy transfer medium.
5.5 Reliability. As has been found in the offshore wind industry, maintenance and repair at sea is an expensive undertaking. In addition, many devices cannot be repaired at sea, necessitating return to harbour. This entails considerable expense and loss of production, in part because the ships used are those employed by the offshore oil and gas industry, which can command high costs. This leads some developers to consider deploying a purpose-built vessel, thus ameliorating the situation. Nevertheless, to be successful, wave energy devices will have to achieve high levels of reliability.[3] The single

[5]Design Current Speed: The design current speed is the maximum velocity of the water expected to occur at the site. [8]

[6] The capital cost of marine renewables technologies can be broken down into: the cost of the generation device itself (materials, components and labour in manufacturing and fabrication processes); the costs associated with installing it (deployment); the costs of keeping it on station (foundations or moorings); and the costs of connecting it to the grid (electrical cables and switchgear).As the rated velocity of the device increases, so do power train costs. Since the velocity distribution tails off at higher velocities, the capital cost for equipment to extract incrementally more flow power at high velocities may not be "paid back" by the additional power generated.[8]

most important challenge for wave energy technology is to develop survivability in full scale ocean environments. This has to be possible at a reasonable cost of investment to indicate a future economy in the cost of energy production. For a wave energy device to survive in the chosen wave environment several issues have to be solved, including anchoring or position control to allow a stable grid connection, storm protection and in general a strength of construction to withstand the three dimensional forces of the ocean.

Another challenge is to find funding for the needed large-scale demonstration projects. Favourable feed-in tariffs[7] for wave energy that is fed into the transmission grid; values from 20-25 c€/kWh may be necessary in the demonstration phase and are provided in some countries, such as Ireland, Portugal, and the UK. Other countries provide values from more than 9 c€/kWh, such as Germany, France, and Spain. The cost of energy production during the lifetime of the installation is also a challenge. The device needs to have a mass production potential and a forecast of materials costs, installation and maintenance expenses. For now, a good projection will be sufficient to allow a project to go forward, but this projection has to include the cost of grid connection and bringing the electricity onshore. [2]

5.6 Environmental issues. Conversion of wave energy to electrical or other usable forms of energy is generally anticipated to have limited environmental impacts. However, as with any emerging technology, the nature and extent of environmental considerations remain uncertain.Noise pollution, for example, could have negative impact if not monitored, although the noise and visible impact of each design varies greatly.[10]Visual impact is often cited as one of the reasons that many communities have opposed plans to develop power projects.[13] Other biophysical impacts (flora and fauna, sediment regimes and water column structure and flows) of scaling up the technology are being studied.[11] In terms of socio-economic challenges, wave farms can result in the displacement of commercial and recreational fishermen from productive fishing grounds, can change the pattern of beach sand nourishment, and may represent hazards to safe navigation.[12]

CONCLUSIONS

The resource is, in principle, unlimited and exists in all world regions, but it is exploitable in practice only at sites that are close to demand centres and where, at the same time, damage to local ecosystems can be contained.[14] Wave energy technologies are the least developed of the renewable energy technologies. Of the various wave energy devices mentioned, many will remain uneconomic and some will not work reliably. Hence, over the next few years there will be some spectacular failures as the false promise of a number of devices will be laid bare. Similar to wind turbines and solar arrays, no single wave energy converter produces enough energy to match a conventional fossil fuel-burning power plant. A single Pelamis device, for example, generates enough electricity to power approximately 500 homes, compared to a medium-sized coal-fueled power plant, which can power tens of thousands. Future wave farms, then, will most probably be relatively small-scale ventures pumping electricity to nearby grids supplying coastal towns and cities.[15] As it seems,this field is still waiting for a device that is cheap, reliable, and effective enough to give unifying direction for future research. However, for this to happen, it is first needed to have trials and failures.

[7]Feed-in tariff (FIT) – A governmentpolicy mechanism designed to accelerate investment in renewable energy technologies. It achieves this by offering long-term contracts to renewable energy producers, typically based on the cost of generation of each different technology.Under a feed-in tariff, eligible renewable electricity generators (which can include homeowners, business owners, farmers, as well as private investors) are paid a cost-based price for the renewable electricity they produce. Feed-in tariff policies have been enacted in many European countries, including Serbia. Current FIT levels in Serbia are 23€c/KWh for solar power, 7.8-7.9 €c/KWh for minor hydro-electric plants, 11.4-13.6 €c/KWh for biomass-derived power, 12-16 €c/KWh for biogas, and 9.5 €c/KWh for wind power. [9]

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DETERMINATION OF RESISTANCE TO WEAR OF BORONIZING LAYER USING TESTS METHOD IN TRIBOLOGY

Stojanović, Ž., Topličević, M., Ristić, S., Rus D.
University of Novi Sad, Technical faculty "Mihajlo Pupin" in Zrenjanin
E-mail: zeljkoelemir@gmail.com

Abstract: This paper presents the research of resistance to abrasive wear mechanism previously boronized carbon and low alloy steel, 1020, 1045, 4140 and the 4340. Test on abrasion performed using the aparatus „dry sand-rubber wheel" (accordant with ASTM-G65 standard), and the force between wheel and the sample was 130 [N]. As a result, boronized steel 1020 showed the highest resistance to abrasive wear. In another case, examined the effect of boronizing on wear N80 tube pipes. Testing on the wear was conducted on tribometer „pin-on-disc" under conditions of dry sliding at room temperature of 25 [°C]. Measured the friction force and wear parameters of the application tribometer „pin-on-disc", and part results of this research is presented in this paper.
Keywords: boronizing, „dry sand-rubber wheel", tribometer, tribomaterials, wear, friction

INTRODUCTION

Boron gas diffusion coating or boronizing is a high temperature chemical vapor deposition process whereby boron atoms diffuse into the base metal of the component to form new metallurgical alloys at the surface. The alloys are thus an integral part of the base metal. They possess very distinct properties and the new surface alloys attain very high hardness. It is this enhanced surface that has resulted in dramatic improvements to the service life of the component. The depth obtained boronized layer is determined by temperature, duration of treatment and material. Boronizing layer depth ranges from several teens [μm], up to 0,3 [mm]. Boronized coating-layer can be used very effectively when parts need to withstand abrasive wear.

Compounds of the element boron will vaporize and react with steel and other alloys to convert a diffused layer at the surface of parts to an extremely hard compound, which has superior wear resistance. Parts are borided by heating them in a furnace in an atmosphere containing these boron compounds. The parts, heated to temperatures in the 1800 [°F] (982,2 [°C]) range for several hours, can be used directly after the boriding treatment in applications requiring extreme wear resistance. Dramatic increase wear resistance is based on the creation of iron borides in the surface layer of steel.

It is a diffusion process whereby a single phase Fe_2B or a double inter-metallic phase (Fe_2B, FeB) is obtained by diffusing boron atoms into the surface of metallic materials. The boronized metal surface is of high hardness, good wear resistance, excellent corrosion resistance and ideal oxidation resistance. [6] However, the main disadvantage of boronizing is the embrittlement of boronized layers. One of the methods to overcome this shortcoming is forming single phase Fe_2B on the metal surface through choosing boroning processes. The low-grade boron Fe_2B phase with low embrittlement is especially desirable for industrial application. There are several boronizing methods that can form ideal single Fe_2B phase in boride layer [6].

The technique is labor intensive making the method less cost effective than other thermochemical surface hardening processes. [11]

The purpose of this paper is to analyze and determine how much boronizing contributes to improving the efficiency of protection surface of the concrete mechanisms and conditions wear, that is, provides antiwear protection of the treated material changing test conditions in relation to each other as in relation to the untreated working parts.

EXPERIMENTAL DETERMINATION OF RESISTANCE TO ABRASIVE WEAR

In the design phase devices and machines in today's technology it is essential to understading influence types of materials , and proceduress to improve the abrasion resistance contact layers, and roughness of contact surfaces on the intensity of wear and friction coeficient in purposes choice optimal of the material elements of tribo mechanical system. It is very important to the design and construction elements tribo mechanical system approach to the tribological aspect, because errors in the design and production can not be to repair not perfect maintenance. Identification and measurment of tribological characteristics of materials elements of the tribo mechanical system reduced to the identification process of friction in the contact zone and wear process each element especially.
Tribological problems can be solving in many ways. The way to reduction friction and wear navigate, primarily, across choice of material elements in contact and choice optimal processing conditions contact surfacess. At choice materials for making the solid elements of the tribo mechanical system, it is necessary, barring knowledge of material properties such as tensile strength, toughness, resistance to high temperatures, anti-corrosive properties and the like, to know their tribological properties, above all, their wear resistance in possible conditions of contact.
Abrasive wear is displacement of materials induced by hard particles or hard protuberances. [1] About 50 [%] of all cases wear goes to abrasion. The characteristics of this type wear is presence of hard abrasive particles mainly of mineral origin so is sometimes called mineral wear. The relative motion can be described as a slip. Exist the next lavel danger of some mechanism wear: abrasion-very high, fatique surface-low and tribo corrosion-lowest. [1]

Choice of materials resistant to abrasive wear

At chose materials, apropos protective layer should be taken in to attention the hardness of abrasives. Since materials with high proportion of hard phase mainly brittle, the request for toughness (work in stroke) and technological adequancy (processing of cutting) are in fact contradictory request for resistance on abrasive wear. This contradictions is often exceeds the application procedures for the protection surface of wear. In the case of abrasive wear are suitable boronizing, vanadizing and hard facing.

Laboratory examinations

Flat samples with a 25 [mm] diameter and a thickness of 5 [mm] were prepared from the steels listed in Table 1. The microhardness of the as-received steels is given in Table 2. Before boriding, the samples were polished to a mirror-like finish and cleaned with acetone. Boronizing was performed by putting the study samples and the chemical agents (Table 3) into a sealed steel crucible, whichwas then heated in an electrical resistance furnace. The treatment temperature was in the 1000 [°C] range and the duration was 8 [h]. The abrasion tests were performed by using a rubber-wheel apparatus, in accordance with the ASTM-G65 standard (one of the metods of experimental determination of resistance to abrasive wear), operating at a peripheral wheel speed of 2-2.5 [m/s] and with a force against the samples of 130 [N]. Quartz sand (200 [μm]) was used as the abrasive agent. The samples mass loss was measured each 60 [s].

Table 1. Nominal compositions (wt. [%]) of tested steels [4]

Steel	*C*	*Mn*	*Cr*	*Mo*	*Ni*	*Si*	*Fe*
1020	0,20	0,45	-	-	-	0,2	Ostatak
1045	0,45	0,75	-	-	-	0,2	Ostatak
4140	0,4	0,65	1,0	0,2	-	0,2	Ostatak
4340	0,4	0,7	0,8	0,25	1,8	0,2	Ostatak

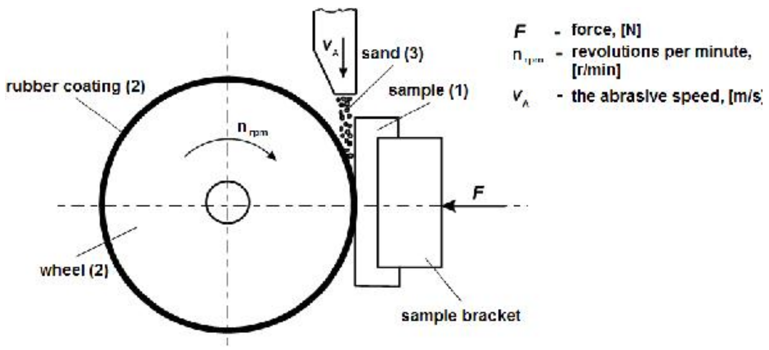
Table 2. Microhardness ($HV_{0.1}$) of as-received steels [4]

Steel	Microhardness
1020	250
1045	260
4140	370
4340	330

Table 3. Compositions (wt. [%]) of boronizing mixtures [4]

Borax	*SiC*	NH_4Cl	*NaCl*
73,26	24,06	1,22	1,46

The test consist abrade sample (1) standard rounded quartz sand (3), (see Fig. 1). Test tube rest on wheel (2) veneered rubber hardness about 60 *Shore A*, and burdened by the weight over the knee lever. The force *F* is 130 [N] or 45 [N] depending from variant procedure, and unsteady and total of revolutions wheel which register counter.



(a)

(b)

Figure 1. a) Sketch of the device „dry sand-rubber wheel“ and (b) a „dry sand-rubber wheel“ [1]

Weighing the samples before and after tests determined the mass loss which is converted into a loss volume. This method enable relative rating of resistance to abrasive wear different materials if the ascendant mechanism of wear abrasion.

By boronizing steel at 1000 [°C] for 8 [h], the boride layer thickness attained a value greater than 200 [μm] (see Fig. 2). With the increasing of carbon (1045 steel), the layer thickness decreased (see Fig. 3). This decrease is attributed to the low solubility of carbon in the boride layer. Consequently, carbon is forced to move inwards, accumulating below the boride layer and forming a polyphase zone rich in carbides and borocarbides. In 4140 steel (not shown in this paper) although *B* has a higher affinity for *Cr* than for *Fe*, the boride layer thickness was similar to that of 1045 steel. Carbon content is probably the factor that limits the layer thickness for these two steels. In the case of the 4340 steel (see Fig. 4), as this steel also contains *Ni*, and *B* has a higher affinity for *Fe* than for *Ni* [4], *C* and *Ni* are forced to move inwards, resulting in a relatively thin boride layer.

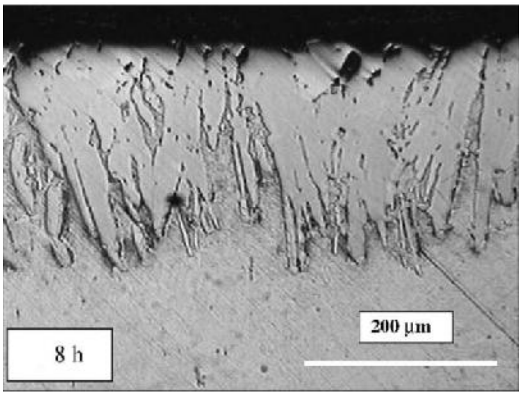


Figure 2. Optical micrograph of 1020 steel boronized at 1000 [°C] during 8 [h] [4]

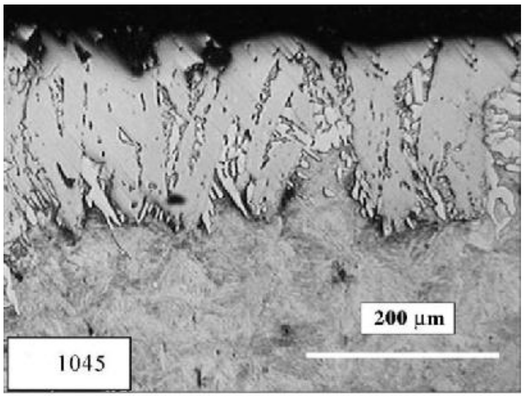


Figure 3. Optical micrograph of 1045 steel boronized at 1000 [°C] during 8 [h] [4]

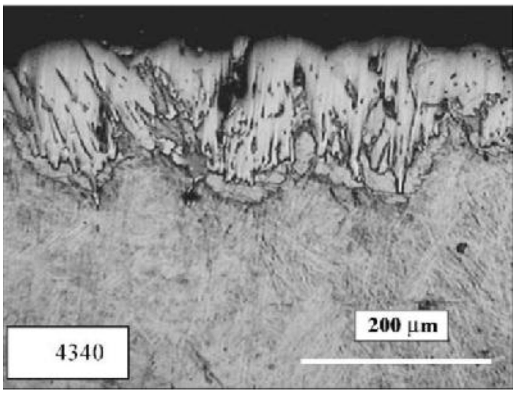


Figure 4. Optical micrograph of 4340 steel boronized at 1000 [°C] during 8 [h] [4]

The maximum microhardness values of the boride layer of samples, measured at 25 and 50 [µm] depth. They show that in all boronized steels, the maximum surface microhardness could be slightly over 2000 $HV_{0.1}$. At 1000 [°C], the maximum microhardness in the boride layer of the 1020 steel was about 1500 $HV_{0.1}$, while the maximum microhardness in the other steels was greater.
Mass loss values, as a function of sliding distance, for boronized steels are shown in Fig. 5. Mass loss of samples treated at 1000 [°C] during 8 [h] was relatively low (see Fig. 5). Although at those boronizing conditions 1020 steel presented the lowest hardness its mass loss was the lowest among all steels considered (see Fig. 5).

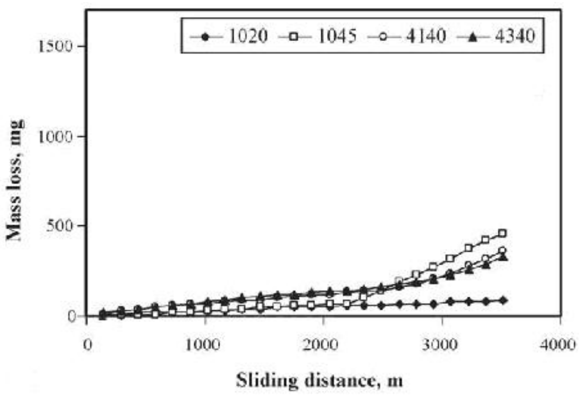


Figure 5. Mass loss of boronized samples as a function of sliding distance, at the conditions boronizing on 1000 [°C] during 8 [h] [4]

This apparently contradictory behaviour would be explained by both (referring to the 1020 and 4340 steels) a greater boride layer thickness (see Figs. 2 and 4) and a lower brittleness of this layer, in comparison with the other steels. The lower brittleness would be confirmed by the cracks observed on the surface of the boronized 1045, 4140 and 4340 steels after they were abrasion tested (see Fig. 6).
As shown in Fig. 5, the initial dependency of mass loss with sliding distance was linear for all steels treated at 1000 [°C] during 8 [h]. For 1020 steel, the linear dependencywas up to 3500 [m], presenting within that range a wear rate of 25 [μg/m]. Instead, for the other steels considered linear dependency was only maintained up to 2200-2500 [m], after which the mass loss rate increased.
It must be noted that such a mass loss rate increase does not necessarily mean that the boride layer was completely worn out. Rather, that change must be related to the formation, by localized wear, of grooves at zones where the corresponding boride layer was thinner, as shown in Fig. 6.

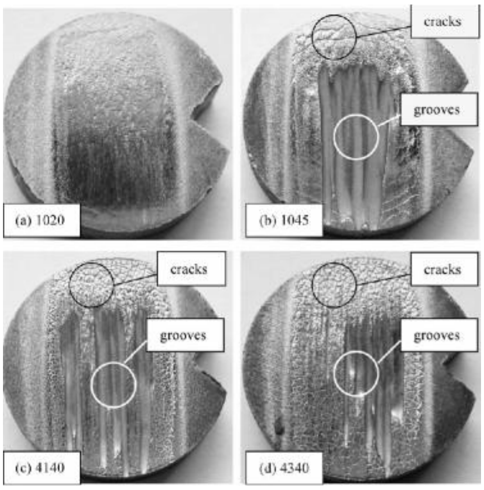


Figure 6. Surfaces of samples boronized at 1000 [°C] during 8 [h], after abrasive test [4]

EXPERIMENTAL DETERMINATION OF COMPATIBILITY BORONIZED LAYER FOR AT SLIDING PAIR

To the size of the friction force, and therefore on the tribological characteristics elements of tribo mechanical system in general, from the energetic aspect, affect primarily [8]:

- types of material solid elements in contact and their thermal treatment,
- type and quality of lubricants, as at third element basic tribo mechanical system,
- micro geometry of contact surfaces and
- conditions of contact.

To determine, for example, the influence of the type thermal processing of materials from which the made one element basic of the tribo mechanical system, to the size of the friction force is necessary, before designing the experimental program, determine conditions under which, the appropriate tribo mechanical system perform in practice. [8]
By analyzing the conditions under which the contact between the elements of the tribo mechanical system be effectuated in practice is determined by: [8]

- types and mechanical characteristics materials second solid materials in contact,
- types and physical-chemical characteristics of lubricant as the third element of the system,
- micro geometry contact surfaces of both solid elements tribo mechanical system,
- type and speed of relative motion,
- size of the external load zone of contact,
- temperature under which the contact is realized in tribo mechanical system.

Nowadays, measurement of the friction force it is possible thanks to the development and productions of large number of tribometers. For them, it is possible to simulate the contact in one point per line and surface whit element different geometries. [8]
Modern tribometers enable us to measure the contact at all types of movement (sliding, rolling, touch etc.) and in different conditions (external load, relative speed and lubrication). [8]
Some of the researchers have reported the effects of conventional heat treatment and boronizing applied to SAE 1010 and SAE 1040 structural steels, D2 tool steel, ductile iron, 304 stainless steel and 5115 steel. In their investigation, carburization, nitriding, transformation hardening and boronizing applied to the specimens were examined in terms of layer thickness, corrosion and wear resistance. [12] Boronized steels consistently outperform nitrided and carburized steels, because the iron boride formed at the surface exhibited substantially higher hardness (HV 1200-2000) as compared to carburized or nitrided steels (HV 650-900). In particular, boronized steels exhibited excellent resistance to a variety of tribological wear mechanisms. In addition, the resistance of boronized steels against the attack by non-oxidizing dilute acids, alkalis and molten metals was also outstanding. [12]
To improve the wear and corrosion properties of tube, various surface techniques have been employed including nitriding, electroless *Ni-P* coatings and hard *Cr* coatings. Martini *et al.* reported the wear behavior of the boride coating thermochemically grown on an iron and a medium carbon steel by pack boronizing, in comparison with other surface modifications, such as nitriding, hard chromium coatings and *WC-Co* coatings. The wear resistance of boride coating was intermediate between nitrided steel surface and *WC-Co* coating, and comparable to the hard chromium coating.

Laboratory examinations

Boronizing process was carried out at 860 [°C] for 5 [h] with a powder mixture consisted of B_4C (5 wt [%]), KBF_4 (5 wt [%]), a reducing agent (*Mn-Fe*, 10 wt [%]) and *SiC* (balance) in an electrical resistance furnace.
Wear testing was conducted with a pin-on-disc type machine (one of the experimental method of determining the compatibility of materials for at sliding pair) under dry sliding condition at a room temperature of 25 [°C] using specimens of 5 [mm] diameter × 12 [mm] length, machined from pipe wall and then boronized separately at 860 [°C] for 5 [h] and cooled in center of boriding agent within the annealing pipe. The tests were carried out in a load range of 50-150 [N] at a sliding speed of 0.785 [ms^{-1}]. Specimens were weighed on a single pan electrical balance that gave readings to an accuracy of 0.1 [mg], before and after the wear test. The difference in weight of three test pins before and after the experiment gave the average weight loss from a sliding distance of 754.56 [m], from which the average wear rate was calculated. The disc was 70 [mm] in diameter and made of high carbon chromium steel hardened to a hardness of 57 HRC, the surface of which was ground to a constant surface finish of about 0.4 [µm] *Ra*.
The coefficient of friction and wear rate as a function of applied load are shown in Figs. 7 (a) and (b). The coefficient of friction for both materials decreases with increasing the applied load, and boronized steel exhibits lower value than the non-boronized one though there is not too much difference between them. Friction coefficient ranges from 0.45 to 0.63 for the boronized, and 0.49-0.70 for the non-boronized N80 steels, respectively. It is evident that the friction coefficient depends systematically on applied load. However, as the load was increased to 150 [N], the sudden rise in friction coefficient was observed for the boronized N80 steel and this is due to localized spalling of the boride layer on worn surface, which could be confirmed in the observation of the worn surface. The boronized samples exhibited effective wear resistance compared with the untreated ones. The wear rate of non-boronized steel dramatically rose as applied load exceeded 100 [N] because of surface softening caused by substantial friction heat, whereas the boronized steel maintained a low and steady wear process under given conditions due to the presence of boride layer. The boride layer can remain almost intact under rather high load; this can be confirmed from SEM examination of worn surfaces.

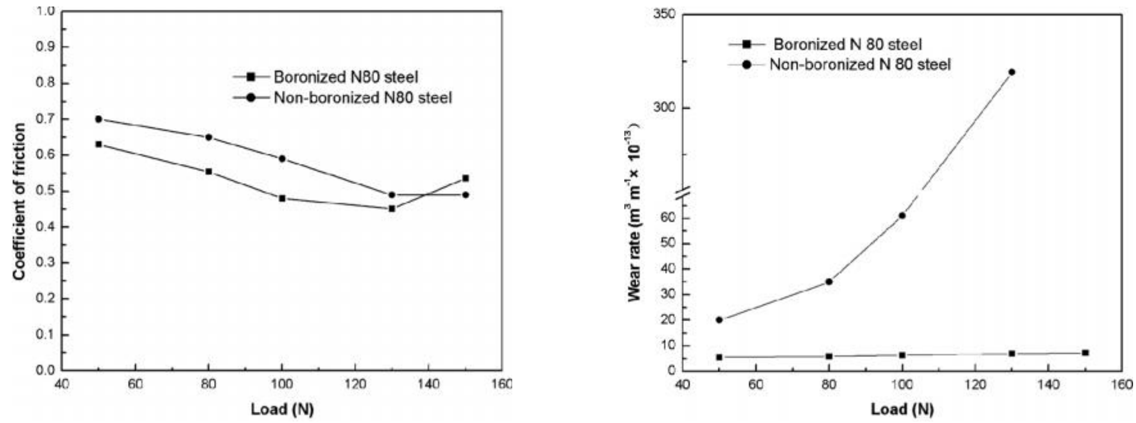
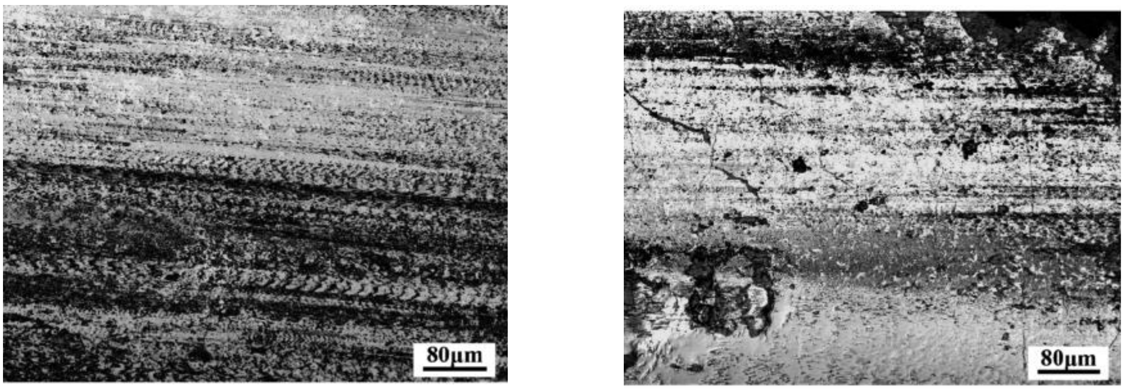


Figure 7. The variation in coefficient of friction (a) and wear rate (b) for non-boronized and boronized N80 steels subjected to annealing [12]

It was seen that after sliding a distance of 754.56 [m], as the load was at 130 [N], the boride layer remained almost intact except a few grooves on the worn surface as shown in Fig. 8 (a), indicating an abrasive wear mechanism. Previous studies by *Hungar* and *Trute* have shown that the boronized steels are extremely resistant to abrasion and adhesion on account of their great hardness and the boride layers have low welding tendency. This property is of great consequence for adhesive wear and explain why boronized samples show higher wear resistance. As the load was increased up to 150 [N] (see Fig. 8 (b)), boride layer still covered most of the worn surface though a few cracks occurred at localized area. Once the boride layers cracked and flaked off on a large scale under heavy load, the protection of boride layer, restricting metal-to-metal contact between pin and disc, would lose, consequently the wear rate is expected to increase much faster.



(a) (b)

Figure 8. Worn surface morphology of boronized N80 steel subjected to annealing at different applied load: (a) 130 [N] and (b) 150 [N], showing localized cracks on the worn surface [12]

FINAL CONSIDERATIONS

For metals and alloys which do not set conditions of high toughness and impact loads, but required special surface properties such as abrasion and corrosion resistance, fireproof as increase surface hardness, can be applied thermodiffusion surface heat treatment process-boronizing. [7]

Though it is a procedure which does not require large investmens, they have not found wide application in practice. [10]

Boronizing is the process thermal-chamical processing of steel on which affects a large number of different factors. Among the most influential factors in the process boronizing include: boronizing temperature, holding time at temperature boronizing and types of steel apropose its chemical composition. How to boronizing steel achieved on the surface of the workpiece boride layers which

have hardness 5 or more times higer than the hardness of steel himself, to be in cases abrasive wear mechanism certainly be justified to apply this process in purpose extend life workpiece duration. [3]
Identification of tribological characteristics of the material elements tribomechanical system, when it comes to wear, can be done measuring one or several wear parameters.
This paper was had the task to objectively demonstrate the advantages and disadvantages of introducing non-metalic chemical element boron in the surface of treated parts. All in all, it was concluded that the advantages of the introduction of boron exceed its shortcomings. Also is shown the justification for selection this type of solutions for the problems of abnormal wear parts in contact whith the surrounding aggresive environment.
At the end of this analysis, it can be concluded that the experimental research established by linear depending on the resistance to abrasive wear from mechanical properties of steel.
As is evident from the earlier exposures, based on some mechanical properties, especially hardness, can be predict the behavior of boronized steel to abrasive wear. The depth of penetration of foreign particles is inversely proportional to the hardness of the surface layers. However, the wear resistance of boride layer the same or similar hardness may be defferent depending on the temperature, duration of the process, chemical composition and structur of the compaund.
It is can be sean if we observe the case of steel 1020, where a combination of lower hardness and larger depths of boride layer resulting lower loss of weight in relation to all other treated samples. This means that in addition to the hardness on the abrasive wear affects the depth and brittleness boride component.
Based on the obtained values for the coefficients of friction boronized and unboronized steel N80 and sliding distance of 754.56 meters, boronized N80 steel exposed to abrasive wear mechanism shows a higher wear resistance under given sliding conditions due to high hardness and integrity boride layer. Boride layer provides excellent wear resistance in the range loads from 50-130 [N] at a sliding speed of 0,785 [ms^{-1}]. The results can provide useful references for extension of the application thermal-diffusion procedure boronizing, especially in the oil industry.

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ANALYSIS OF SOLAR POTENTIAL IN REPUBLIC OF SERBIA

Jonaš, D. , Đurđev, M.
University of Novi Sad, Technical Faculty "Mihajlo Pupin", Zrenjanin
E-mail: darjanjonas@gmail.com

Abstract: The paper gives a summary of the application of solar energy in Serbia, as well as significantly greater potential that Serbia has in relation to the countries of Western Europe that are leading in the application of solar energy. Emphasizes the necessity to rationalize the use and conserve energy in our country due to serious deficiencies, with which will Serbia, and also many countries in the world next to her, face in the near future.
Key words: potential, rationalization, solar energy, solar radiation

INTRODUCTION

Global potential of solar energy

The energy of the sun rays coming to Earth's surface that is potentially usable radiation of the sun, is about 1.9 x 10^8 TWh (190 million terawatt hours) per year. This is the energy approximately 170 times greater than the total energy of coal reserves in the world and when compared to the energy needs of humanity, which amount to 1.3 x 10^5 TWh (130 thousand terawatt hours) per year, we obtain information that the solar energy that reaches the Earth's surface during only 6 hours sufficient to meet all the needs of the world annually. In order to get a better insight into these data the average household in some of the most developed countries spends about 10.000 kWh of electricity a year and it would take about 100.000 years to spend a TWh . About 37% of global energy demand is met by the production of electric energy which in 2008 amounted to 17.000 TWh. If the energy was generated by the photovoltaic (FN) systems (systems that convert solar energy into electric) with modest annual power output of 100 kWh per square meter, this would require an area of 150 x 150 km^2 for the accumulation of solar energy. A large part of the absorption surface could be placed on the roofs and walls of buildings, and would not require additional area on the ground [11].
Although it is the largest and completely clean energy source that is available to man, the energy of solar radiation, in the last twenty years , become the only guaranteed opportunity to meet the energy needs for the upcoming long term, due to the risk of impact on climate change and reduce fossil fuel reserves.
Average solar radiation in Serbia is about 40% higher than the European average, but still use solar energy for electricity production lags far behind other EU countries. Creating conditions for sustainable development and function of the market of photovoltaic systems is of great importance for the economy and environmental protection in Serbia.
Serbia, as a waster of electricity, has a chance, just by saving, rational consumption and increase in overall energy efficiency, to attain excess energy without construction of new power generating capacity. On the basis of this attitude we come to conclusion that the new power plants should be built and that almost all new amount of energy will be available for export. The application of solar energy is only a healthy way to make reduction in energy consumption wherever possible. This means that no matter that the cost of investment in solar energy is quite large, of about 3.000 Euros for 1kW of installed power, it pays to invest in a certain market. If that price also includes everything that follows well conceived and organized work such as research, development, production, marketing, creating professional scientific and production staff, new technologies, export of much of production, employment in primary and related activities, then this price is significantly lower and the full effect is achieved. Then the price of installing 1 kW thermal collectors for the state may be negligible [5].
There are four main reasons why Serbia should engage all available forces to significantly increase the use of solar energy now, in a very short period of time, which is very important to us. These are:

- Over 55% of the total energy is consumed in households in Serbia in the form of electricity, with much energy spent on the sanitary water heating.

- Reduction in costs for heating sanitary water of about 60 to 70% is achieved in one year, resulting in the relief of the home budget.
- Increased employment in the research, production, installation and servicing solar equipment.
- With the significant application of solar power we are getting closer to the recommendations of the European Union on the use of renewable energy sources, which include the sun to a large extent.

MATERIAL AND METHODS

On most of the Serbian territory number of sunny days is significantly higher than in many European countries (between 1500 and 2200 hours per year). The potential of solar energy in Serbia amounts to 0.64 million toe (tons of oil equivalent) per year or about 16.7% of the total exploitable potential of renewable energy sources in Serbia. The energy potential of solar radiation is about 30% higher in Serbia than in Central Europe and the intensity of solar radiation is among the largest in Europe. The greatest potential for using solar energy are cities in the southern part of Serbia - Niš, Vranje and Kuršumlija.

The average daily global radiation energy on a flat surface during the winter period is between 1.1 kWh/m^2 in the north and 1.7 kWh/m^2 in the south, and during the summer period between 5.4 kWh/m^2 in the north and 6.9 kWh/m^2 in the south. For the purpose of comparison, the average value is of global radiation for the territory of Germany is about 1000 kWh/m^2, while in Serbia that value is about 1400 kWh/m^2. The most favorable areas in Serbia has a large number of sunny hours, and the annual ratio of the actual radiation and total radiation can be approximately 50%. The average daily energy of global radiation on horizontal surface in Serbia is presented in figure 1 [7].

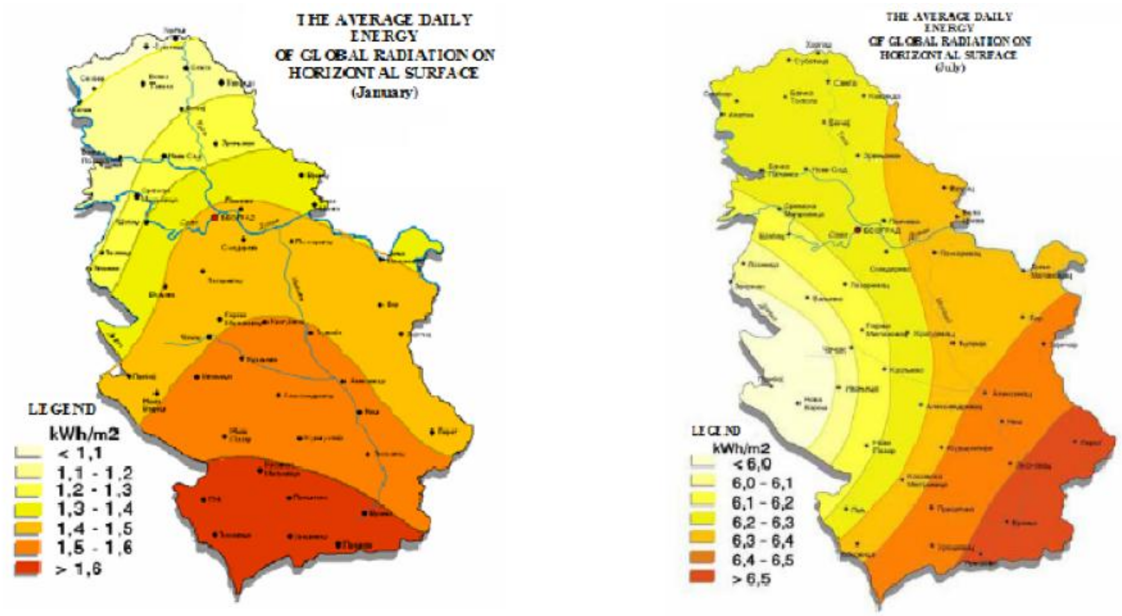

Figure 1. The average daily energy of global radiation on horizontal surface in january and july in Serbia

The highest annual income of energy is obtained if the surface is oriented towards the south and has a slope of 30 degrees, the orientation and slope are optimal for the period March-April and August-September. Estimate of the total potential for savings in Serbia has 2.65 million housing units. If there are 4 m^2 solar collectors set on each dwelling unita year would save about 7420 GWh of electricity worth about 370 million euros.

Taking advantage of the total potential of solar energy for water heating would reduce carbon dioxide emissions - by 6.5 million tons per year.

Table 1 presents the average daily sums of global solar radiation energy on a horizontal surface in some places in Serbia. It may be noted that the annual amounts of solar radiation are greatest in Kuršumlija, Niš and Vranje.

All these data clearly indicate that Serbia has the resources of solar radiation well above the European average with a very favorable seasonal schedule and that its efficient and long-term use is necessary to design in the shortest period of time, including for compliance with European measures and plans regarding renewable energy sources.

Solar energy potential on the whole territory of Serbia satisfies all standards for efficient use of thermal solar energy. In the past this aspect of energy consumption was not adequately made use of due to the lack of stimulation and advertising of its benefical economic and environmental effects. With the awareness of energy shortage present in the whole world, and with the increase of domestic electric energy price in order to level off with the prices in the European Union, a simple economic analysis will lead to the use of this most rational source of energy. Even in comparison with the photovoltaic electrical energy or with the electric energy obtained from the windpowered generators use of solar collectors is at present the most economical and offers the possibility of its widest use [12].

Table 1. Average daily sums of global solar radiation energy on a horizontal surface in kWh/m^2, for some places in Serbia [7]

Place	Month												Total annual	Average
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII		
Beograd	1,40	2,20	3,35	4,85	6,00	6,45	6,75	6,00	4,65	3,05	1,60	1,15	1446,80	3,96
Novi Sad	1,45	2,35	3,20	4,65	5,80	6,20	6,35	5,75	4,40	2,90	1,45	1,20	1392,64	3,82
Zrenjanin	1,30	2,15	3,45	4,90	6,05	6,35	6,55	5,90	4,45	2,95	1,45	1,05	1419,45	3,89
Kikinda	1,00	2,05	3,55	5,10	6,40	6,55	6,85	5,95	4,45	3,00	1,05	1,05	1456,50	3,99
Niš	1,75	2,60	3,45	5,00	6,10	6,35	6,70	6,15	5,35	3,45	1,85	1,50	1530,40	4,20
Kuršumlija	2,15	3,00	3,60	5,05	5,85	6,05	6,55	6,10	5,30	3,50	2,00	1,75	1550,50	4,25
Vranje	1,70	2,70	3,65	5,15	6,15	6,40	6,50	6,35	5,25	3,45	1,85	1,50	1543,40	4,23
Kragujevac	1,50	2,40	3,35	4,80	5,85	6,10	6,45	5,90	4,85	3,30	1,70	1,30	1447,85	3,97
Vrbas	1,45	2,35	3,45	4,80	5,90	6,15	6,40	5,70	4,35	2,95	1,45	1,20	1406,85	3,85
Loznica	1,50	2,30	3,05	4,35	5,30	5,75	6,15	5,60	4,30	2,80	1,45	1,20	1333,50	3,65

Sombor	1,35	2,15	3,35	4,85	5,95	6,30	6,15	5,65	4,20	2,80	1,35	1,40	1387,35	3,80
Smederevo	1,45	2,25	3,40	4,80	5,70	6,30	6,50	5,95	4,75	3,15	1,65	1,10	1432,75	3,93
Negotin	1,35	2,05	3,25	4,85	6,05	6,60	6,95	6,25	4,75	2,90	1,45	1,20	1453,35	3,98

RESULTS AND DISCUSSION

Compared with the plans of the European Union about using of solar energy for space heating, we are not doing anything in Serbia, for now. Certain improvements are achieved in the field of energy efficiency, primarily individual desire to improve the thermal insulation to reduce future costs for heating.

Unlike wind energy or hydropower to use solar energy for heating sanitary water or drying of agricultural products, no permissions or consents are needed. It means that there are no administrative or technical barriers to use solar energy, but there are other reasons that influence the current situation in Serbia [5]:

- Ignorance about the use of renewable energy sources, about the situation and plans in Europe, about our future obligations and any beneficial aspects arising from their application in decision-making circles.
- Uninformed people about the possibilities of solar energy use, cost of equipment, energy and financial effects.
- The living standard of the population of Serbia is at a very low level compared to the price of the equipment that is the same as in the European Union.
- Low electricity price automatically leads to electricity not being consumed rationally. Compared to other energy sources, for consumers heating was best with electricity. It also showed this winter when the record consumption of over 150 million kWh per day was recorded.
- Production of domestic equipment is expensive because of import dependence in the procurement of materials and the small unformed market. Only one serious producer, due to low sales (80 collectors per year), cannot invest in manufacturing capacity equipment and become even more cost competitive compared to imported equipment.

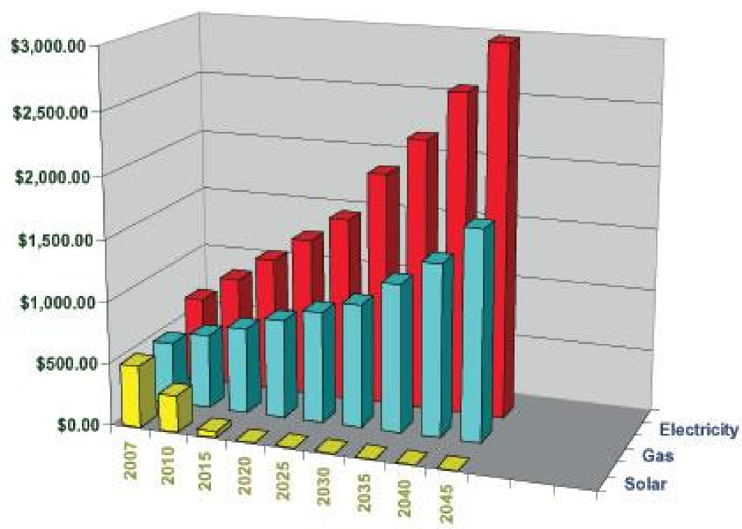

Figure 2. Estimated value price for electricity, gas and solar energy in the future [9]

The figure 2 presents a graphical view of the situation of prices three basic sources of energy in the world for the estimated period of the near future. The results indicate an increase in electricity and gas for each period, which will cause that Serbia, as well as many other countries, seek to significantly increase use of solar and other renewable energy sources in the future whose the total value decreases year by year .

CONCLUSION

Since Serbia is in the group of countries whose energy consumption, particularly electricity, is not too rational, it is necessary to increase interest in renewable energy sources and allow educating people about the importance and benefits of energy efficiency and using solar energy. We should emphasize the economic aspect, but also the impact on the preservation of the natural environment. Programs of this type could be organized and coordinated at the national level, but also by the relevant academic institutions, as well as by nonprofit and other organizations.

In order to intensify the use of solar power in Serbia it is necessary to create a favorable business climate for the development of domestic industries of solar equipment on the basis of its own research and development. Under current conditions it is possible to even in small series obtain equipment of suitable quality and at lower prices than imported equipment. Certification of domestic equipment remains one of the currently biggest unsolved problems in this regard [5].

It is also important the legislation on rational energy consumption, as well as amendments to energy law in order to adapt it to European requirements and standards.

It is necessary to set the goal that all needs to heat water to 80 ° C in the residential venues and industrial processes are met by using solar energy. This would encourage the construction industry to be seriously engaged in renewable energy.

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PUBLIC RELATIONS IN FUNCTION OF CREATING A POSITIVE COMPANY IMAGE

Terek, E., Nikolić,M., Istrat, V.
[1]University of Novi Sad
Technical Faculty "Mihajlo Pupin", Zrenjanin
E-mail: terekedita@gmail.com

Abstract: Some of the main goals of public relations are to create, maintain, and protect the organization's reputation, enhance its prestige, and present a favorable image. Studies have shown that consumers often base their purchase decisions on a company's reputation, so public relations can have a definite impact on sales and revenue. Public relations can be an effective part of a company's overall marketing strategy. In the case of a for-profit company, public relations and marketing should be coordinated to be sure they are working to achieve the same objectives. This work represents how public relations is important in creating a positive image of a company.
Key words: public relations, international relations, image building

INTRODUCTION

Public relations (PR-public relations) involve a multitude of programs designed to promote or protect the company's image, as well as its individual products. Public relations activity is focused on building good relationships with various public, on the basis of publicity, building good corporate image and solving problems arising from unfavorable stories, rumors and events.[5]
As defined by the Institute of Public Relations, public relations are a "versatile, planned effort to achieve and maintain a successful understanding between the organization and audience."
PR can be observed and interpreted as a profession, process, communication with the general public and practice.[1]
It is commonly considered that the activity of public relations developed from publicity. Public relations are much broader concept that includes publicity, and many other activities. Publicity is a form of communication with the public enterprises and also an important tool in realizing goals of public relations companies.
Public relations are conducted through the most massive media (agent)-TV, radio, newspapers, trade fairs, exhibition, advertizing. In our PR does not yet have emphasized the role and significance in economic activity, while the outside of the economy is still in its infancy, because it has long been equated with propaganda and other means and forms of promotion.
Public relations are a business that is focused on establishing and developing understanding with the public divided by segment. The main instruments of public relations including: press relations, product publicity, corporate communications, lobbying and extension.[4]
The development of PR is particularly important in companies operating in transition. On the Serbian market PR, as a business activity, is still in the early stages of establishing itself. In neighbouring countries such as: Croatia, Bosnia and Herzegovina, Hungary, Romania, and Bulgaria a more favourable situation is present. [8] In these countries, PR activity has been developing more intensively over the past 15 years. In Serbia, such trends started later, and more intensively only after 2000.
In Serbia there are good potentials in the PR profession. There is a tendency in improving its importance and reputation, which is proved by the research in the reference.[7]

MARKETING PUBLIC RELATIONS

To assist the promotion of companies or products, many companies are turning to marketing public relations (MPR-marketing public relations)

The old name for MPR was publicity. Marketing public relations does not mean just creating publicity, they have an important role in the following tasks:

• Assistance at the launch of new products. An incredible commercial success toys such as Teenage Mutant Ninja Turtles, Pokemon, etc. can be largely attributed to shrewd publicity.

• Assist in repositioning a mature product. New York had a very poor rating in the 1970's, until he came to the launch of the campaign "I Love New York".

• Building of interest for a particular product category. Companies and business associations MPR used to re-build and run regular interest in products that were on the decline.

• The impact of specific target groups. McDonald's company-sponsored special events at sites inhabited by Latin Americans.

• The defense products that are facing problems in public. Experts in the field of public relations must be skilled in dealing crisis.

• Building a corporate image that will positively represent companies. The Speeches and books that where written by Bill Gates helped create the innovative image of Microsoft.[6]

Instruments of marketing public relations:

• Events (the company can draw attention to new products or activities of the company by organizing special events: seminars, tours, press conferences, competitions and tenders, trade fairs, by which to reach the target audience.

• Sponsorships (companies can promote their brands and corporate name by the sponsoring sporting and cultural events as well as various campaign and with the aim of the common good)

• Publications (the company is heavily reliant on printed materials such as articles, annual reports, brochures, informants, magazines, companies and other audiovisual materials)

• Press (company directors increasingly have to respond to media inquiries and to speak at meetings of business associations or sales meetings. The image of the company can build such impressions)

• News (One of the main tasks of professionals in the field of public relations is to find or create the positive news regarding the company, its products and its people, also specify the media to attend press conferences and take print)

• Presentation of the identity (a company must have a visual identity that the public would immediately recognize. The visual identities are: company logos, signs, forms, buildings, uniforms, business cards, brochures)

• Activities related to public services (companies can build a reputation by the time and money given to the objectives of the common good)

A Manager of Marketing Public Relations has to identify or develop interesting stories about products. An example: A smaller college wants to become visible. Expert in MPR will search for appropriate stories, such as whether holding a strange and new courses? If some employees work at Faculty building on some unusual projects? In the event that there is an interesting story, experts should propose appropriate events that would have to sponsor college. The most important thing is to create something new. Inviting experts and celebrities, organizing press conferences are some of the ideas. The best practitioners of public relations, marketing know how to find or create a story, even for a completely ordinary or obsolete products.

INTERNATIONAL RELATIONS

The positive significance of public relations is much greater in international than in domestic marketing purposes. An Internationally oriented company must seek to establish constructive relationships with a number of stakeholders and for specific business entities, with the affirmation of mutual benefit. Good public relations are more efficient communication and require appropriate professional conduct by companies in different areas. In international relations three principles are the most important: a company must act legally under the laws of the host country, a company that behaves ethically correct in accordance with the postulates of the local culture, a company that behaves externally friendly and attentive.

The biggest problems stem from the fact that one finds large differences in the perception and interpretation of the legality and ethical correctness friendly kindness. The company must continuously nurture, develop and coordinate internal and external communication with interested parties and the public. International companies have to translate their promotional materials into different languages and to create a series of audio-visual resources. International marketing is complex and interact with segments of the public entities involved in the business arrangement with the company and who may significantly affect its positioning in a foreign environment. This group include government, media, industry and business associations, citizens, local communities, consumer associations. An internationally oriented company has to investigate and evaluate the business significance of each.

In international marketing the company more often chooses to hire a professional agency for public relations or to engage special advisors and consultants. In the framework of international public relations is often used the form of unpaid publicity as mass communication through foreign media. This is achieved by holding a press conference on the occasion of some concrete action, introducing a new product, presentations of achieved business results, obtained community and business awards as well as giving interviews, publishing business stories and reports in the media, public seminars, art exhibitions.

The strategy of public relations and publicity direction must be created on a case by case basis from country to country. Mainly individual approach is recommended.

The least desirable consequences and effects that can happen to a company is an echo of negative publicity. The disastrous consequences of the negative publicity felt the company Caridbe Union after the tragic accident at its plant in India, where thousands of people were killed or wounded. Imports of Italian wine in America has declined dramatically after the news that Italian wines contaminated methyl alcohol. Although the news were not true, sales of Italian wines in the U.S. declined by 30%.[2]

Regardless of the level of significance of PR in relation to other marketing activities and PR target is conceptually speaking one of the most important marketing activities long-term oriented and aimed at creating a corporate identity and image. Even, if only narrowly holding on marketing to increase sales of products and services, and then must conclude that there is a modern and successful sales without taking account of the mission of the company and corporate identity.

IMAGE BUILDING

Management has unwritten rules concerning the company's public image. Admittedly, there are wide variations in corporate practice on image building, but certain common denominators appear and reappear - with regularity:

Public image is an image for selected small groups within the total public:

Suppliers and state and federal agencies, as well as customers, are key small groups to keep in mind for selected personal opinion conditioning; Employees are a key small group to keep in mind; Future employees - executives, scientists, and high skill people - are a key group to think about - to make them easier to hire.

Public Image can be controlled regionally - Distinctly different images can be presented in varying geographical locations. Such variations can be desirable if plant locations or state regulations or competitive patterns hold different problems and/or opportunities.

Public image must be a flexible thing - Flexibility is important to a company image in order to adjust rapidly to social changes, political changes, and economic changes.

The responsibility of top management today, as never before, is to guide all image activities against the company long-term planning - as well as in implementation of its short-term objectives. The old days, when a top executive could call in an outside public relations firm and say: "Build me a program," are gone. Today's top management has the exclusive ultimate responsibility for being the central policy maker on all aspects of company imagery. In fact, because top management is alone in its possession of background information on its long-term strategic decisions, and because much of such information must remain confidential - only top management can call the shots on the direction of the image desired, and the best way to accomplish the desired image.

Employees are one of the most important audiences a company has, and an ongoing public relations program is necessary to maintain employee good will as well as to uphold the company's image and reputation among its employees. The essence of a good employee relations program is keeping employees informed and providing them with channels of communication to upper levels of management. Bechtel Group, a privately held complex of operating companies, published an annual report for its employees to keep them informed about the company's operations. The company used surveys to determine what information employees considered useful. A range of other communication devices were used, including a monthly tabloid and magazine, a quarterly video magazine, local newsletters, bulletin boards, a call-in telephone service, and "brown bag" lunches where live presentations were made about the company. Suggestion systems are another effective way to improve employee-management communications.

A comprehensive, ongoing community relations program can help virtually any organization achieve visibility as a good community citizen and gain the good will of the community in which it operates. Banks, utilities, radio and television stations, and major retailers are some of the types of organizations most likely to have ongoing programs that might include supporting urban renewal, performing arts programs, social and educational programs, children's programs, community organizations, and construction projects. On a more limited scale, small businesses may achieve community visibility by sponsoring local sports teams or other events. Support may be financial or take the form of employee participation.

Organizations attempt to generate good will and position themselves as responsible citizens through a variety of programs conducted in the public interest. Some examples are environmental programs (including water and energy conservation) and antipollution programs. Health and medical programs are sponsored by a wide range of nonprofit organizations, healthcare providers, and other businesses and industries.

The company's image and reputation vis-a-vis its various stakeholders will influence their willingness to provide or withhold support. Thus, if its customers develop a negative perception of the company or its products, its sales and profits assuredly will decline. Consider the recent travails of the Nissan Motor Company. In the 1980s it enjoyed the image of a customer-oriented, trendsetting automobile manufacturer with an excellent reputation for automotive engineering. By the mid-1990s, however, as a result of a series of poor decisions, its image as a cutting-edge producer, along with sales and profits, had declined precipitously. It is now perceived by customers as well as other stakeholders as a conservative maker of stodgy, boxy cars with its engineering reputation compromised. [3]

CONCLUSION

Public relations describes the various methods a company uses to disseminate messages about its products, services, or overall image to its customers, employees, stockholders, suppliers, or other interested members of the community. The point of public relations is to make the public think favorably about the company and its offerings.

While communication is the essence of public relations, an effective public relations campaign is based on action as well as words. Whether it is practiced formally or informally, public relations is an essential function for the survival of any organization.

Effective public relations requires a knowledge, based on analysis and understanding, of all the factors that influence public attitudes toward the organization.

The attitudes of the public toward the company are formed on the basis of what it does and says. The importance of a positive image for the company is related to all the segments with which it interacts and comes into contact. Positive image of the company among its employees affects the productivity.

In modern society the image of the company is the main argument of competitiveness, prestige and success and is therefore now more important to sell the brand or company image rather than a specific product.

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MAINTENANCE OF BELT CONVEYORS IN THE INDUSTRY OF BRICK

Asimi, M.
University of Novi Sad, Technical Faculty "Mihajlo Pupin", Zrenjanin
E-mail: masimi25@gmail.com

Abstract: The paper presents problems of maintaining belt conveyors in the industry of brick. Belt conveyors deliver clay to the vacuum press and in case of delays in transport, will stop production, leading to increased costs. The most sensitive element of the conveyor, and the most common cause of delay is the accumulation of clay on the elements of transport. By applying the latest tapes and tape cleaners provides greater reliability of belt conveyors.
Key words: belt conveyor, tape, maintenance, reliability.

INTRODUCTION

The transport clay from the landfill to the vacuum press is made by belt conveyors.For continuous production it is necessary to ensure reliable operation of the conveyor. However, due to specific properties of clay, it often lead to delays in transport. Above all, clay buildup on critical areas makes transport equipment difficult to work, and also shortens the life of the machine or its parts.

MATERIAL AND METODS

General characteristics

Belt conveyor is a universal tool of continuously transport witch, using an endless tape, transferrs between two points of the unit or bulk. They are adaptable to a wide range of applications from light specific pharmaceutical products through boxes and packages in the food and drinks, to transport bulk materials in heavy industry. They are used in manufacturing and process industries, automated systems, distribution centers, flexible assembly lines, foundries, airports, post offices and others.
In these carriers, belt represents towing and carrying element.
Because of its extremely favorable technical and economic characteristics they are the most widespread devices of continuous transport in the operation.
Normal capacity: from 50 to 25,000 t/h (the plant with the capacity to 50,000 t/h are realized) [1].
Conveyor Speed: 0.8 to 8 m/s (in special circumstances up to 15 m/s).
Conveyor length: from a few meters to 15 kilometers, with the possibility of unlimited continuing.
Scheme of belt conveyor equipment and components:

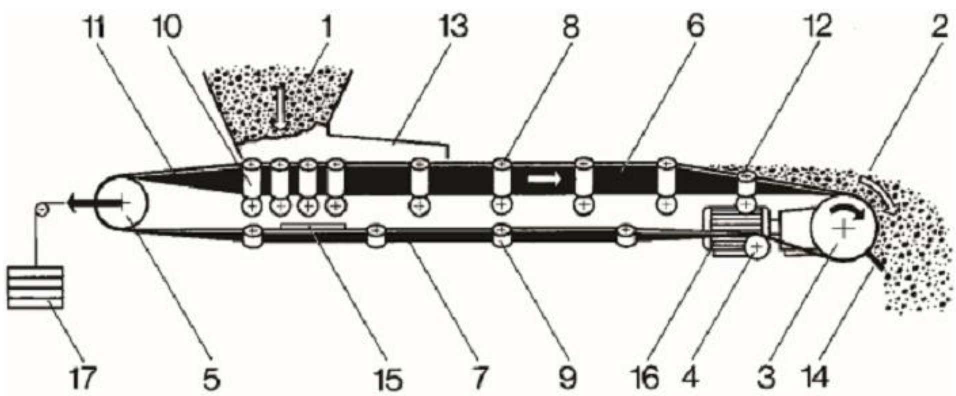

Figure 1. Scheme of belt conveyor: 1. receipt of material, 2. delivery of material, 3. transmission drum, 4. i 5. turnabout drum, 6. i 7. belt, 8. troughing idler, 9. below flet idler, 10. amerzation idler, 11. formation of bed strips, 12. correction tape, 13. extension of receiving basket, 14. spring cleanser, 15. nonleaded cleanser, 16. drive system, 17. weight tensioning drum

A typical belt conveyor maintenance plan

- Inspection / lubrication of all joints, connections, drum.
- Checking the level of wear parts wear.
- Check your chain and sprockets (wear, centricity, lubricants).
- Check tension of belts, wear of strips, joints, alignment.
- Check scraper and brush of strips.
- Check drive unit, el. engine, gearbox leak.
- Control of all system conditions.
- Launching of the transportation after inspection.
- Report with recommendations and a list of parts to be replaced or repaired[2].

The tape is the most important element of belt conveyor, which simultaneously achieves two functions: supporting and towing. The tape is the most valuable part of the transporter and its share price in the entire conveyor is 25% to 35%.
The tape should have a high longitudinal strength, high elasticity, dimensional stability, a little stretching, resistance to chemical, mechanical and biological effects, little own weight, high abrasion resistance ...
The core band is the most important factor because it provides towing capacity of tape. It is determined by tensile strength and it defines with the **N** per **mm** width.
Because of the relatively high cost of tape, it is important to provide quality maintenance service life as long conveyor belt.
Reliability of tape depends on the quality of the joint where the tape is made up (continued) [3]. Hot process provides the highest quality (vulcanization) at 130 ˚ **C** and a pressure of 5 **bar**.

Arrangements for the conduct and management of tape

Conveyor belt moves on rollers witch through the ball bearings rotate around the fixed pin. Rollers are an important part of the carrier, because the resistance movement of tape and its durability depend on their work.
Frequently, in order to increase capacity, the working side of strips relies on a three-roll bars provide gutter-like profile of tape, while the reverse side strips relies on a reel[1]. Rollers on working side (who make up one set of mounting elements) can be arranged in one plane, or the middle roller can be derived from the plane of the lateral rollers, which significantly facilitates the lubrication of bearings. In this case it is possible to ensure that the tape along its width lies on rollers, which increases its durability.
Rollers are arranged along the conveyor belt in a relatively short distance and because of their large number thay have a significant impact on investment and running costs. Their participation in investment costs is up to 25%. Technical lifetime is 36,000 hours reels, and depends on the working conditions and ranges from 4 to 6 years.

INCREASE THE RELIABILITY OF BELT CONVEYORS

Unlike the existing ring-roll rubber distance feedback rolls that are always placed on the conveyor belt at certain points, new SRC return rolls, overlapping the entire width of the strip, thus eliminating the possibility of grooving and wear strips lengthwise.

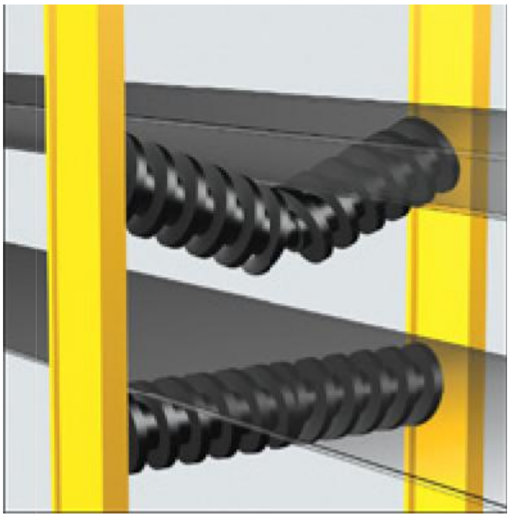

Figure 2. Router - cleaners - shock absorbers

In rough conditions of transporters, apart from protection of the metal cylinder, provides three basic functions:
Router - cleaners - shock absorber and thus protects the conveyor belt and extends its life.
SRC is mounted to the carrier as well as the feedback rolls and requires no special facility for used motor effect and the direction of the conveyor belt.
Spiral router and Cleaner (DOUBLE SRC) is used to cleaning and straight running conveyor belt on the conveyor where is only one roll mounted on the bracket and return part of the conveyor belt.
The outer surface of rolls is profiled with rings with a certain step. For the roller core is used steel metal roller with bearings that are put as the cover with a special device with hydraulic and pneumatic cylinder in the minus tolerance. Between metal and rubber parts it ensure a solid connection without additional bonding or mounting of insurance wedge.

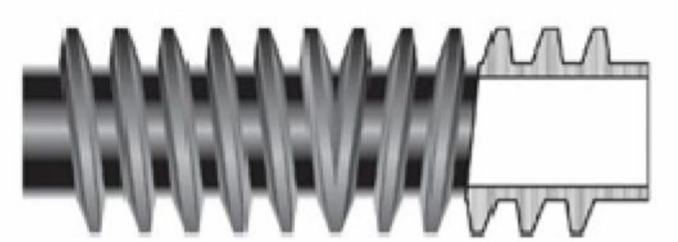

Figure 3. Spiral router and Cleaner (DOUBLE SRC)

Installation of new SRC spiral rubber rolls, extended service life of conveyor belts to 40% on average, depending on the conditions of exploitation, the distance at which material is transported and the type of transported material[7].
Installation of new roller SRC facilitated the holding of the whole transport system and control the movement of tape, thereby reducing the need for a workforce of about 50%.
Also, the pop-tape delays, and delays due to the pasting material elements of the transport system, are minimized.

DISCUSSION

By applying new SRC rubber rollersin operation of transport systems, must be carried out significant production and financial effects.
There are two types of effects that will be in service delivery system with spiral SRC rubber rollers, namely:

- measurable effects that can be quantified and expressed in value and
- immeasurable that can not be quantified, but merely a descriptive explanation.

The first group called "measurable" effects can be classified based on the effects of increased life cycle of conveyor belts, reduced the cost of providing rubber rollers and conveyor belts, and reducing the amount of bulk material.
In the second group of so-called "immeasurable" effects can be given effect under the impact of increased transport due to reduced downtime, reduced labor involvement in the maintenance and elimination of delays in the transport system and so on.

CONCLUSION

By applying the latest technical and technological novelty is achieved by linear movement of the conveyor belt and the return on the bracket part, effectively cleaning conveyor belts in the return area, as well as depreciation and prevent damage to the conveyor belt at the add-on material on the bracket part of the tape.

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PREVIOUS DEVELOPMENT OF BIO-ENERGY IN SERBIA

Mulic R.[1],. Djuric A.[2], Tornjanski O.[1]
[1] "Bioprimat" d.o.o, Novo Milosevo
[2] Tehnical faculty "Mihajlo Pupin", Zrenjanin
E-mail: r.mulic@gmail.com

Abstract: This work represents the potential of bioenergy in Serbia. This work has been done summary of the history of development of biomass utilization for energy purposes as well as potency to develop in the future. The analysis done for the potential of solid biomass and its use in the form of briquettes, pellets and chips, bio-alcohol, biodiesel and bio-gas. Especially taken to ensure the work described the situation in the past, and reasons for their failures as well as resources that can be developed in the future.
Key words: Solid biowaste, Bioalkohol, biodiesel, biogas, Biofuels

INTRODUCTION

Biofuels are energy past a man. The Industrial Revolution led to radical changes in production and consumption of energy. Biofuels are unjustly neglected. Monopolies are promoting fossil and nuclear fuels and the production founded by them, transport, consumer assets, which led to the ecological crisis, energy inefficiency and economic irrationality.
The consequences are well known. Biomass accumulates as waste burdening the villages and towns. Gradually becomes degraded. Rotting of the land and underground. Burned the fields and landfills. Contrary to the laws of nature and society, destroyed. The atmosphere is polluted by harmful gases. The ozone layer is damaged. The country remains without flora and fauna, without the precious topsoil. The water is poisoned. Finally, a centralized energy strategy monopoly gives room for expansion of decentralized, autonomous bio-energy systems, which appear as a marketing imperative
Opting for European Integration, Republic of Serbia signed a Memorandum of integration with the EU energy market. Joined the International Renewable Energy Agency, but that's not enough for success. Bioenergetic model for the development of powerful countries can not be applied in the impoverished Serbia. Although, that is not enaugh, the successful development of bioenergetics last decades of the second millennium ended, almost at the very beginning. The discontinuity is caused great damage to bioenergetics. [1]
Developmental delay Serbian bioenergetics can be compensated by relying on natural resources and the wealth created by the work (technological know-how, manufacturing experience ... the energy system of the country), the use of comparative advantages. And they are not small. Estimates of the yield of biomass energy in Serbia reached 115,000 TJ per year. Of these 65 000 TJ per year lies in the agricultural biomass residues that are destroyed every year criminal burning of the fields, throwing in the landfill. Somewhat smaller are the remains of the forest, about 50,000 TJ annually. In other words, the only Serbian agriculture produces around 13 million tonnes of biomass per year, which is 2.68 million tons of oil equivalent [2] .The primacy of biomass in renewable energy sources Serbia should not be controversial. To tell the facts (Table 1.)

Table 1. The energy potential of renewable energy sources (EPOIE) in the Republic of Serbia

Renewable source	Milion tons of oil equivalent per year	Percent
Biomass	2.7	63 %
Hydro potential (untapped)	0.6	14 %
Solar Energy	0.6	14 %
Wind Power	0.2	4,5%
Geothermal energy	0.2	4,5%
Totall	4.3	100%

SOLID BIOMASS - BRIQUETTES, PELLETS, CIPS

The first and the only energy source for a long time man was solid biomass. Today is a respectable source. The problem is in the rational collection of solid residues from agriculture and forestry, the ready-made, storage, conversion and consumption of these energy sources.
However, there are modern techniques and appropriate technology to produce bales, briquettes, pellets, chips ... Unfortunately, in this area is evident discontinuity. In the last quarter of the last century it was built about thirty plants for processing of biomass[5].
Briquette plant were made in Karadjordjevo, Mladenovo, Novo Milosevo, Zrenjanin, Debeljača, Ilandža, Stara Moravica, Veliko Gradiste, Vrnjacka banja, Banatsko Karadjordjevo, Novi Sad, Subotica, Old Zednik, Padej, Backi vinogradi , Backa Topola Tornjoš, Lovćenac, Sombor, Curug, Samos, Vrsac, Doroslovo. For pellet production plants were built in Kovačica, Vajskoj, Backi Jarak, Selenca.
Unfortunately, out of service is 17 plants. Sold five. And the function is less than ten plants. The largest number of plants intended for briquetting straw, cornstalks and sawdust. Are worth mentioning briquetting plants sunflower husks, sugar beet pulp, vine and forest waste [2]. Summary technical capacity is 72500 tons of biomass per year [4]. Of these, the paper plants with a production capacity of 17000 tons per year. Most power plants are represented by the combustion of solid biomass. There are more than 1400, with an installed capacity of 140 megawatts. Energetic significance of briquetting, pelleting, baling solid waste biomass is known. More importantly, their economic, in particular ecological significance. Special attention must be paid to baling, briquetting, pelleting feed [6]... The construction of plants for processing of biomass, there are natural limits. Waste biomass is needed, primarily as a fertilizer to maintain soil quality, the quality of the expanded reproduction of soil humus. In this context, the greatest threat to soil quality, the greatest damage to the economy is the burning of straw, cornstalks, etc.. in the fields, wood waste in forests, biowaste by meadows, gardens, vineyards, orchards ... the roads.

BIO-ALCOHOL

Is a centuries old tradition of craft, a decades-long practice of industrial ethanol production in Serbia. Craft, better home production is widely represented in the manufacture of beverages.
It was originally present as a by-product residues fodder had primacy in the industrial production of bioethanol. The quality of the by-products as animal feed provided a much higher gain in the fattening of cattle from grain [9].A received from the biomass that contained a large percentage of sugar (molasses, sugar beet roots, grains damaged ...). [9]
More lies from the application of carbon dioxide and ethanol production in the food industry as carbonated beverages, and in the mechanical industry for metal processing (cutting, welding, casting ...)
The present production of bioethanol has much more scattered and all applications.
The importance of ethanol production in Serbia, says 11 factory built (Beograd, Crvenka 1 and 2,

Kovin, Osecina, Novi Sad, Pec, Zrenjanin, Srbobran, Coka, Takovo.), In the last century, with a production capacity of 39,260 thousand hectoliters [10] ...
Over time, the demand residues, and especially alcohol in the country covered by the transition is reduced. Technical capacity of the factory is less used. More factory is now out of service. Some are dismantled. After more than centuries of production, rather than the technical museum, were sent to waste (Čoka. ..).No new capacity. However, there is talk of building a modern plant to produce ethanol and animal feed in the "Elan" from Srbobran and mega ethanol plants to get in Zrenjanin. All in all, the production and consumption of ethanol in Serbia are radically reduced. And the world is the opposite trend.
Bioenergy in the world conjuncture includes ethanol. Over the past three decades, the production of bioethanol is several times enlarged. Reached a value of 60 million cubic meters per year, with the tendency of doubling every four or five years. The leaders are Brazil with 37%, USA with 33% share in world production of bioethanol. It is evident that the increase in ethanol production and consumption in the European Union during 2004 - 2007 years from 528 to 1771 million liters. [7]
The explosive growth of bio-ethanol production in the world is caused by a proportional increase in consumption of bioethanol as a fuel. In 2010 the distribution of ethanol consumption was: 65 000 000 liters of fuel, 5,000,000 liters of industrial needs, and 9,000,000 gallons of obtaining alcoholic beverages.
In natural and labor resources and the needs created by the same trend of increasing production and consumption of ethanol could be in Serbia. The traditional need for ethanol in Serbia (beverage production, industrial and pharmaceutical consumption ...) exceed 50,000 tons per year, which is 2.5 times the current production of ethanol, 2.3 times more than existing technical capacity in the country. Increasing ethanol production in the country assumed its application in the production etiltercijalnog butylether (ETBE), in blending with gasoline, the fuel production biooto. Meet EU standards on the substitution of fossil fuels was in Serbia requires the production of 130,000 tons of ethanol a year [8].
Meet EU standards on the substitution of fossil fuels was in Serbia requires the production of 130,000 tons of ethanol a year.
Mixture of gasoline and ethanol, gasoline and ethyl tertiary butylether in the world is increasingly used in internal combustion engines. Ethanol refining gasoline [9]. Ethyl Tertiary butiletar is even better. Improve the fossil fuel energy and environmental characteristics.
First of all, are important in their Anti-knock properties. Bio-ethanol has an octane number of is 109.5 and ethyl tertiary butiletar is 115. Polluting alternative to carcinogenic benzene and lead anti-detonators.
Ecological significance of mixtures of gasoline and ethanol is indisputable. Oxygen from the combustion of ethanol fuel is more completely disproportionate. Carbon monoxide is reduced more than 25%. Carbon balance is improving. The share of ethanol in the mixture of 10% reduces greenhouse gas emissions by 12 - 19%. Solid particles are radically reduced. Sulfur compounds as well.
The country does not have experience of producing bio-benzine, mixtures of alcohol and gasoline. Significant scientific and technological research are not sufficient for marketing operationalization of the new fuel. However, illegally, at the time of the embargo, methanol was thrown into the gasoline. Experience in obtaining and applying in this way, made the mixture of methanol and gasoline are not professionally processed.
In addition to existing resources, achievement of desired goals presupposes systematic agro-ecological, technical and technological research, marketing to increase the involvement of existing planting areas and innovative culture, the promotion of new crops, the use of comparative advantages in the selection of raw materials, skillfully collecting waste materials, the optimal production and application of bio-ethanol, residues, carbon dioxide ...

BIODISEL

Oleo-chemical production in Serbia has a long tradition. It is based on a home and handicraft of oils and fats ... soaps and lubricants. The peak was reached in the production of oil and meat and the processing industry, the industrial processing of waste fat. Implementation of the project **"Alkamin"** (1975 -1990) in Novi Becej was supposed to lead to chemical and energetic valorization of waste Oleo-chemical, to the production of raw materials, particularly surfactants (about 20,000 tons) and fatty acid methylester, that biodiesel (3000 tons per year). Unfortunately, it projected in Serbia, probably, the first producer of biodiesel in Europe is built.

Soon after, followed by the right marketing campaign production of biodiesel in the country. Amid the energy crisis - the embargo on oil and petroleum products, 1994 -1995. years, created the optimal conditions for the production of more than 50,000 tons of biodiesel per year. Serbia, according to plans and technical capacity built, one of the biggest producers of biodiesel in the world [11].

As soon as possible, chemical plants have been reconstructed. Adapted to the needs of biodiesel production plant in Baric 1 and Baric 2, Vrsac, Sid, Novi Sad, Zrenjanin, Pancevo. At the same time and are built for a small biodiesel plant in Ada, Coka, Uzice, New Milosevo, Belgrade ... The embargo has passed. Constructed facilities are not used. Will the mighty big undertaking failed. After ten years, Sid has built the "first", the most modern producer of biodiesel in Serbia, the Balkans, with a capacity of 100,000 tons per year methyl-ester fatty acids. Huge funds have not yielded results. Lack of raw vegetable oil, ie. unsecured marketing logistics prevented the successful implementation of a major project. It is and should be an alarm of danger for all professional not designed, raw unsecured, logistically disadvantaged bioenergy projects [16].

Fifteen-year continuity in the production of biodiesel in Serbia achieved minor processing of waste vegetable oil in the New Milosevo. In the meantime, were built in small workshops to obtain biodiesel from waste vegetable oil in Subotica, Belgrade, Backa Topola, Sombor, Sid, Vrbas, Alibunar, Banatski Karlovac, Paracin, Smederevo, Pećinci ... Rather, each year to build and put out several small biodiesel production facility.

Environmental project of collecting and processing waste vegetable oil in Serbia, and after 15 years of efforts, not far odmakao.Od estimated production of 5,000 tons of waste vegetable oil annually collects about ten percent.From 25 years of experience comes the conclusion: ``Without macro project expanded reproduction in agriculture, bioenergy - the production of oilseeds, oils and animal feed, biodiesel, glycerine (non-toxic antifreeze,anti- sparkling, energy concentrates and drugs for ruminants ...) and methyl ester product (insecticides, pesticides , surfactants ...) is not possible optimal biodiesel economy ..``

BIOGAS

Biogas production was, and is increasingly becoming the most important ecological and economic energy project in Serbia. It is the only option for solving the environmental problem of waste biomass, to obtain the ecological solid and liquid organic fertilizers, the consumption of the poisoner most dangerous atmosphere (methane, carbon dioxide ...) in order to get heat and electricity needed in the production of organic food.

Thirty years ago, in Serbia there were ten industrial biogas plants. In PKB, was Vizelj (1987) built and put into drive then most modern plant for manure for biogas and organic fertilizer, electricity and heat. On a large pig farm in Jakovo a long time the plant was to produce biogas and organic fertilizer, as well as thermal energy. In Sombor for plant effluent water utility, to produce biogas, heat. The Santee has been built and put into operation bio-gas plant for processing industrial waste water from sugar factories and yeast, which is a reconstruction, upgrading facilities for cogeneration [13].

In Čelarevo has built a processing plant waste water from breweries, production of biogas or thermal energy. In Kragujevac and Apatin worked as biogas plants processing municipal waste. Nineties has been arranged, purchased processing equipment for the construction of several biogas plants, for known reasons, are not installed (Sečanj. ..).

New investment surge is underway. Biogas plants in Senta and Kragujevac were reconstructed, and restored. In Subotica is built modern facility. In Dragacica, near Guca built biogas plant, with 200 KW. Preparation of the test run. In Vrbas began building a new plant. In Cuprija, too. Precision in

Belgrade, Padej, Becej Čurug ... tenders, contract purchasing techniques, technology and engineering, develop an investment program for the construction of biogas plants. The Dairy, Blace, cows on the farm biogas into the program [15].

Unlike the first generation biogas plants, which are mainly restricted to the production of ecological fertilizer and biogas or thermal energy, modern facilities are more or less advanced bioenergy play based on the raw waste mix multiple substrates and raw materials, aimed at producing large quantities of many and carbon dioxide biogas, quality solid and liquid fertilizers, more electrical, heating and cooling energy for different purposes [16](Figure 1.)

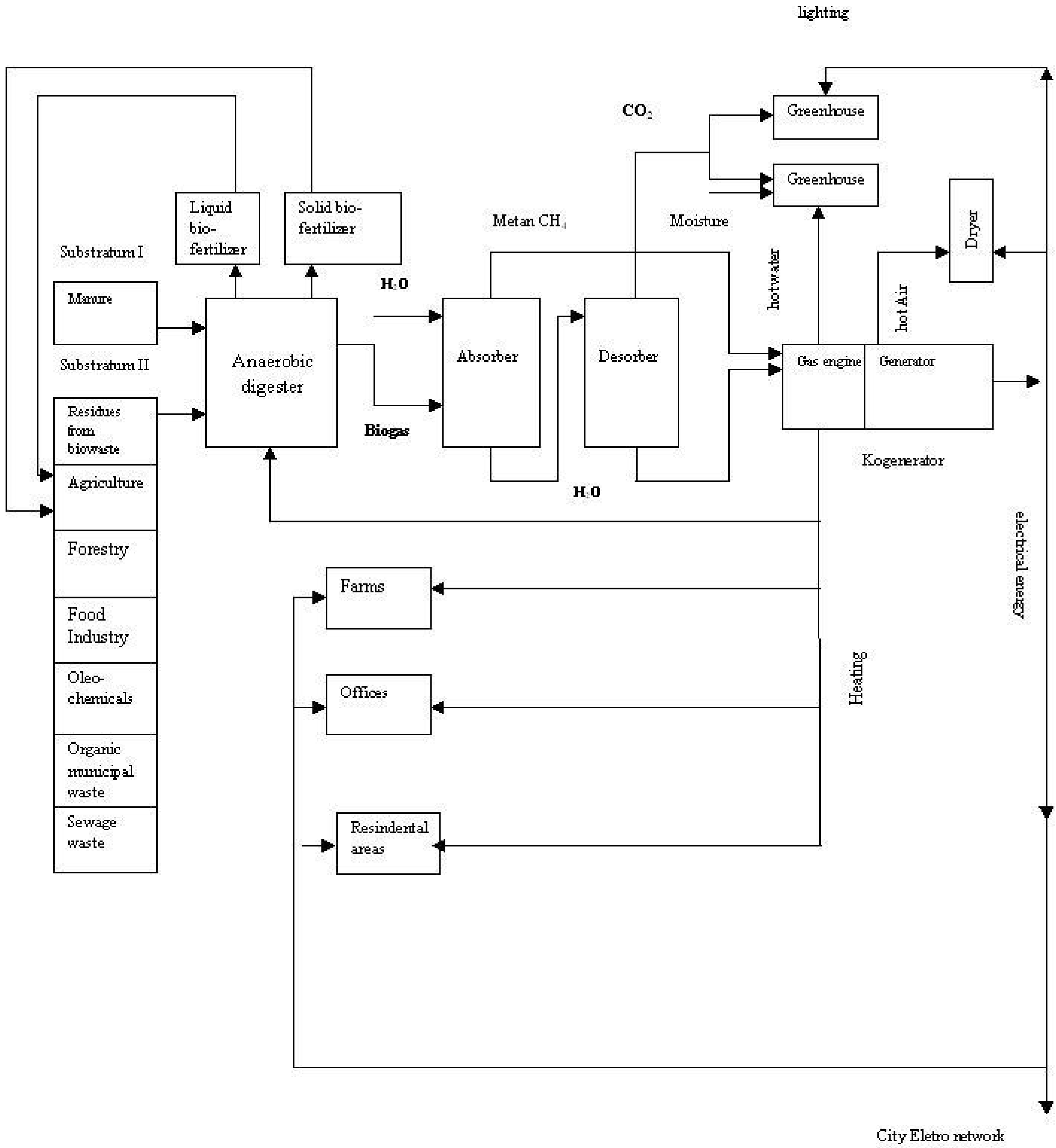

Figure 1. Bio-energy reproduction from farm

Processing only one type of manure is doomed to low productivity, the costly production without a significant profit. On the other hand, the establishment of biogas production, green electricity for silage maize and so on. can have good economic results, but also adverse effects on crop rotation, the

system of prices of corn and oil products. Specifically, bioenergy production must be systematically planned. It must not break balance model of economic policy and agriculture, food production ...
The new bioenergy strategy opens up better opportunities for the processing of increasing amounts of biowaste from landfills nebrojanih. Processing of biomass, the removal of harmful and dangerous substances, pathogens, odors is the ecological imperative.
A production of biogas is a contribution to the development of heat and electricity companies, such as the production of ecological organic fertilizer essential contribution to the advancement of organic agriculture, getting healthy food [17].. Conversely, removal of hazardous pollutants earth, water and air in order to obtain clean energy and irreplaceable ecological fertilizer requirements are for a healthy economy
Besides the undisputed primary ecological importance of processing certain types of waste in the production of biogas as a raw material available include high-yield eco-balast (eg glycerol waste, biogenic waste fat) and particularly biogenic grown culture (sorghum, Jerusalem artichoke, algae.).
In other words, in addition to environmental and energy criteria, the assessment of biogas production of primary importance and should have an objective, the actual profitability [18]. State intervention measures (subsidies, relief ...) are, by nature, temporary incentive motives. Their goal must be the alienation of capital from underdeveloped parts of Serbia.
In this case, repeat the horrific practice of discontinuity in the development of bioenergetics. He must be stopped forever. An example of bioenergy should be rational bio-ekonomic, such as China, Germany ,Vietnam, Netherland (Table 2.)

Table 2. Biogas plants in representative countries

Year / Countrie	1995	2003.	2005.	2010.	2020.
China		11.000.000	20.000.000	50.000.000	
Nepal			18.000	145.00	
Vietnam			18.000	150.000	
Germany	850		3.500	5.905	43.000
Austria	35		350	450	

CONCLUSION

A disturbing trend of environmental destruction, which consists in the destruction of biomass, the destruction of essential value of land, pollution of the environment, the creation of countless landfills - the source of infection of wildlife, springs wicked poison the atmosphere must be stopped. Effective development strategy realizaijom bioenergetics in Serbia, as a whole and in individual segments, which should be directed to adequate measures of state intervention.
Second Demand processing plants must be based on sound knowledge of technology, technology, engineering, manufacturing experience in the desired production. Without knowledge of the required technology in a world without market research techniques is not possible optimal transfer. Are unacceptable plants buying overpriced because the dangerous burden of investment costs. Even less acceptable insufficient quality technology. In this case, would be burdened with production costs. Inferior plants are based on monocultures of raw materials. Such a decision denying the possibility of choice at a time most appropriate technology and energy resources, the largest sources of profit. Purchase plants from us without references and personal experiences (hunters subsidies) in order to obtain non-profit and can not be justified pre-marketing are doomed to failure.
The high-risk investment ventures in which the biogas industry based on monocultures in the field of traditional raw food. (Eg corn silage). Food as a raw material may not be a substitute for biowaste. And the thought of food is reduced to the biowaste is absurd in a world where billions of people starving, millions are dying of hunger.And this practice is economically insane. Because the explosive consumption of food in bioenergetics (vegetable oil, cereals ...) whether spontaneous or orchestrated monopoly - ignorant forced, as a rule leads to disruption of supply and demand, the crisis in agriculture and food industry, the discontinuity in the development of bioenergetics.

Great demand for silage and grain corn (for the production of biogas and alcohol) leads to an increase in feed prices. The increase in food prices for fattening pigs and cattle meat will cause price increases, that is. reduction in demand and sales of meat products, which will, like a boomerang, return biogas industry. Farms will be closed. Manure will not be ...
The right path is the inclusion of neglected land (Parlog), forgotten crops (rapeseed, castor oil ... sorghum, Jerusalem artichoke) in the expanded reproduction of bioenergy. Such an approach is not only desirable but also necessary. Due to this increase in productivity and profitability of agriculture and bio-energy.The Primary was uncontested, ecological importance of biowaste processing.
However, it refines the energy and economic involvement in the energy high yield eco-burden, such as biogenic waste fat, crude glycerol, crude rapeseed noodles, molasses, oil sludge, biowaste cooking, confectionery waste, old bread and pastries ... at all greasy and sweet biowaste from the food industry.

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RISK MANAGEMENT

Kek, U[1], Grujic, D.[2] , Lackov, P.[2], Nikolic, J.[3]
[1]University of Maribor, The Faculty of Logistics
[2]University of Novi Sad,Technical Faculty "Mihajlo Pupin", Zrenjanin
[3]University of Belgrade, Faculty of Mechanical Engineering
E-mail: lackov.p@gmail.com

Abstract: This work represents a review of risk management. Risk management is very important part of everyday production and business; in this work are shown main steps and activities of RM, how to develop Risk Management Plan, and also principles of risk management according to International Organization for Standardization (ISO). Applying of these steps and rules improve production processes, minimizes costs…

INTRODUCTION

This section explains why risks exist and highlights the purpose and importance of the risk management plan. It provides a general description of why risk management is essential to effectively managing a project and describes what is needed before risk management can begin.

As organizations begin new projects they begin operating in an area of uncertainty that comes along with developing new and unique products or services. By doing so, these organizations take chances which results in risk playing a significant part in any project. The purpose of the risk management plan is to establish the framework in which the project team will identify risks and develop strategies to mitigate or avoid those risks.

METOD

However, before risks can be identified and managed, there are preliminary project elements which must be completed. These elements are outlined in the risk management approach.

This project is considered a medium risk project as it has an overall risk score of 24 on a scale from 0 to 100. The project risk score is the average of the risk scores of the most significant risks to this project. A risk score below 16 is low risk project, a score between 16 and 45 is a medium risk project and a score above 45 is a high risk project.

Before risk management begins it is imperative that a foundation is established for providing structured project information, thus, the following project elements were completed and defined prior to developing this Risk Management Plan:

• Define work scope, schedule, resources, and cost elements

    o Develop project WBS/WBS dictionary
    o Develop master schedule and detailed schedules
    o Estimate project cost and finalize budget
    o Identify required and available resources
    o Establish performance measurement metrics

• Define minimum and maximum baseline thresholds
    o Schedule
    o Resources
    o Cost

• Baseline reporting requirements
    o Format
    o Frequency of distribution
    o Distribution list

• Define Risk Management Roles and Responsibilities o Project Manager chairs the risk assessment meetings

o Project team participates in risk assessment meetings and members serve as meeting recorder and timekeeper

o Key stakeholders participate in risk assessment meetings

Project Risk Management

A risk is something that may happen and if it does, will have an adverse impact on the project. A few points here. "that may happen" implies a probability of less then 100%. If it has a probability of 100% - in other words it will happen - it is an issue. An issue is managed differently to a risk and we will handle issue management in a later white paper. A risk must also have a probability something above 0%. It must be a chance to happen or it is not a risk. The second thing to consider from the definition is "will have an adverse impact". If it will not have an adverse impact, it is not a risk. Suppose we said a risk was that we would find the project less complicated than we thought, and could finish early. Unless finishing early has an adverse effect on the project, it is not a risk.

Risk Management Plan

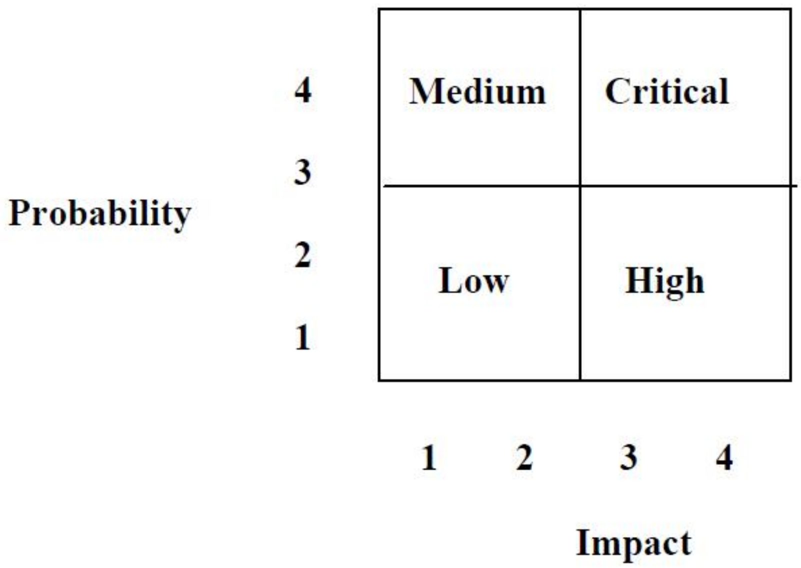
There are four stages to risk management.
They are:
• Risk Identification
• Risks Quantification
• Risk Response
• Risk Monitoring and Control

Risk Identification

In this stage, we identify and name the risks. The best approach is a workshop with business and IT people to carry out the identification. Use a combination of brainstorming and reviewing of standard risk lists. There are different sorts of risks and we need to decide on a project by project basis what to do about each type. Business risks are ongoing risks that are best handled by the business. An example is that if the project cannot meet end of financial year deadline, the business area may need to retain their existing accounting system for another year. The response is likely to be a contingency plan developed by the business, to use the existing system for another year. Generic riks are risks to all projects. For example the risk that business users might not be available and requirements may be incomplete. Each organisation will develop standard responses to generic risks.
Risks should be defined in two parts. The first is the cause of the situation (Vendor not meeting deadline, Business users not available, etc.). The second part is the impact (Budget will be exceeded, Milestones not achieved, etc.). Hence a risk might be defined as "The vendor not meeting deadline will mean that budget will be exceeded". If this format is used, it is easy to remove duplicates, and understand the risk.

Risk Quantification

Risk need to be quantified in two dimensions. The impact of the risk needs to be assessed. The probability of the risk occurring needs to be assessed. For simplicity, rate each on a 1 to 4 scale. The larger the number, the larger the impact or probability.
By using a matrix, a priority can be established.



Note that if probability is high, and impact is low, it is a Medium risk. On the other hand if impact is high, and probability low, it is High priority. A remote chance of a catastrophe warrants more attention than a high chance of a hiccup.

Risk Response

There are four things you can do about a risk. The strategies are:
• Avoid the risk. Do something to remove it. Use another supplier for example.
• Transfer the risk. Make someone else responsible. Perhaps a Vendor can be made responsible for a particularly risky part of the project.
• Mitigate the risk. Take actions to lessen the impact or chance of the risk occurring. If the risk relates to availability of resources, draw up an agreement and get sign-off for the resource to be available.
• Accept the risk. The risk might be so small the effort to do anything is not worth while.

A risk response plan should include the strategy and action items to address the strategy. The actions should include what needs to be done, who is doing it, and when it should be completed.

Risk Control

The final step is to continually monitor risks to identify any change in the status, or if they turn into an issue. It is best to hold regular risk reviews to identify actions

Summary

Risk management is not a complex task. If you follow the four steps, you can put together a risk management plan for a project in a short space of time. Without a plan, the success of the project, and your reputation as a Project Manager, are on the line. Follow these steps and you will increase your chances of success.

Principles of risk management

The International Organization for Standardization (ISO) identifies the following principles of risk management:

Risk management should:

- create value - resources expended to mitigate risk should generally exceed the consequence of inaction, or (as in value engineering), the gain should exceed the pain
- be an integral part of organizational processes
- be part of decision making
- explicitly address uncertainty and assumptions
- be systematic and structured
- be based on the best available information
- be tailorable
- take into account human factors
- be transparent and inclusive
- be dynamic, iterative and responsive to change
- be capable of continual improvement and enhancement
- be continually or periodically re-assessed

Rules of Project Risk Management

The benefits of risk management in projects are huge. You can gain a lot of money if you deal with uncertain project events in a proactive manner. The result will be that you minimise the impact of project threats and seize the opportunities that occur. This allows you to deliver your project on time, on budget and with the quality results your project sponsor demands. Also your team members will be much happier if they do not enter a "fire fighting" mode needed to repair the failures that could have been prevented.
This article gives you the 10 golden rules to apply risk management successfully in your project.

Make Risk Management Part of Your Project

The first rule is essential to the success of project risk management. If you don't truly embed risk management in your project, you can not reap the full benefits of this approach. You can encounter a number of faulty approaches in companies. Some projects use no approach whatsoever to risk management. They are either ignorant, running their first project or they are somehow confident that no risks will occur in their project (which of course will happen). Some people blindly trust the project manager, especially if he (usually it is a man) looks like a battered army veteran who has been in the trenches for the last two decades. Professional companies make risk management part of their day to day operations and include it in project meetings and the training of staff.

Identify Risks Early in Your Project

The first step in project risk management is to identify the risks that are present in your project. This requires an open mind set that focuses on future scenarios that may occur. Two main sources exist to identify risks, people and paper. People are your team members that each bring along their personal experiences and expertise. Other people to talk to are experts outside your project that have a track record with the type of project or work you are facing. They can reveal some booby traps you will encounter or some golden opportunities that may not have crossed your mind. Interviews and team sessions (risk brainstorming) are the common methods to discover the risks people know. Paper is a different story. Projects tend to generate a significant number of (electronic) documents that contain project risks. They may not always have that name, but someone who reads carefully (between the lines) will find them. The project plan, business case and resource planning are good starters. Another categories are old project plans, your company Intranet and specialised websites.
Are you able to identify all project risks before they occur? Probably not. However if you combine a number of different identification methods, you are likely to find the large majority. If you deal with them properly, you have enough time left for the unexpected risks that take place.

Communicate About Risks

Failed projects show that project managers in such projects were frequently unaware of the big hammer that was about to hit them. The frightening finding was that frequently someone of the project organisation actually did see that hammer, but didn't inform the project manager of its existence. If you don't want this to happen in your project, you better pay attention to risk communication.

A good approach is to consistently include risk communication in the tasks you carry out. If you have a team meeting, make project risks part of the default agenda (and not the final item on the list!). This shows risks are important to the project manager and gives team members a "natural moment" to discuss them and report new ones.

Another important line of communication is that of the project manager and project sponsor or principal. Focus your communication efforts on the big risks here and make sure you don't surprise the boss or the customer! Also take care that the sponsor makes decisions on the top risks, because usually some of them exceed the mandate of the project manager.

Consider Both Threats and Opportunities

Project risks have a negative connotation: they are the "bad guys" that can harm your project. However modern risk approaches also focus on positive risks, the project opportunities. These are the uncertain events that beneficial to your project and organisation. These "good guys" make your project faster, better and more profitable.

Unfortunately, lots of project teams struggle to cross the finish line, being overloaded with work that needs to be done quickly. This creates project dynamics where only negative risks matter (if the team considers any risks at all). Make sure you create some time to deal with the opportunities in your project, even if it is only half an hour. Chances are that you see a couple of opportunities with a high pay-off that don't require a big investment in time or resources.

Clarify Ownership Issues

Some project managers think they are done once they have created a list with risks. However this is only a starting point. The next step is to make clear who is responsible for what risk! Someone has to feel the heat if a risk is not taken care of properly. The trick is simple: assign a risk owner for each risk that you have found. The risk owner is the person in your team that has the responsibility to optimise this risk for the project. The effects are really positive. At first people usually feel uncomfortable that they are actually responsible for certain risks, but as time passes they will act and carry out tasks to decrease threats and enhance opportunities.

Ownership also exists on another level. If a project threat occurs, someone has to pay the bill. This sounds logical, but it is an issue you have to address before a risk occurs. Especially if different business units, departments and suppliers are involved in your project, it becomes important who bears the consequences and has to empty his wallet. An important side effect of clarifying the ownership of risk effects, is that line managers start to pay attention to a project, especially when a lot of money is at stake. The ownership issue is equally important with project opportunities. Fights over (unexpected) revenues can become a long-term pastime of management.

Prioritise Risks

A project manager once told me "I treat all risks equally." This makes project life really simple. However, it doesn't deliver the best results possible. Some risks have a higher impact than others. Therefore, you better spend your time on the risks that can cause the biggest losses and gains. Check if you have any showstoppers in your project that could derail your project. If so, these are your number 1 priority. The other risks can be prioritised on gut feeling or, more objectively, on a set of criteria. The criteria most project teams use is to consider the effects of a risk and the likelihood that it will occur. Whatever prioritisation measure you use, use it consistently and focus on the big risks.

Analyse Risks

Understanding the nature of a risk is a precondition for a good response. Therefore take some time to have a closer look at individual risks and don't jump to conclusions without knowing what a risk is about.
Risk analysis occurs at different levels. If you want to understand a risk at an individual level it is most fruitful to think about the effects that it has and the causes that can make it happen. Looking at the effects, you can describe what effects take place immediately after a risk occurs and what effects happen as a result of the primary effects or because time elapses. A more detailed analysis may show the order of magnitude effect in a certain effect category like costs, lead time or product quality. Another angle to look at risks, is to focus on the events that precede a risk occurrence, the risk causes. List the different causes and the circumstances that decrease or increase the likelihood.
Another level of risk analysis is investigate the entire project. Each project manager needs to answer the usual questions about the total budget needed or the date the project will finish. If you take risks into account, you can do a simulation to show your project sponsor how likely it is that you finish on a given date or within a certain time frame. A similar exercise can be done for project costs.
The information you gather in a risk analysis will provide valuable insights in your project and the necessary input to find effective responses to optimise the risks.

Plan and Implement Risk Responses

Implementing a risk response is the activity that actually adds value to your project. You prevent a threat occurring or minimise negative effects. Execution is key here. The other rules have helped you to map, prioritise and understand risks. This will help you to make a sound risk response plan that focuses on the big wins.
If you deal with threats you basically have three options, risk avoidance, risk minimisation and risk acceptance. Avoiding risks means you organise your project in such a way that you don't encounter a risk anymore. This could mean changing supplier or adopting a different technology or, if you deal with a fatal risk, terminating a project. Spending more money on a doomed project is a bad investment.
The biggest category of responses are the ones to minimise risks. You can try to prevent a risk occurring by influencing the causes or decreasing the negative effects that could result. If you have carried out rule 7 properly (risk analysis) you will have plenty of opportunities to influence it. A final response is to accept a risk. This is a good choice if the effects on the project are minimal or the possibilities to influence it prove to be very difficult, time consuming or relatively expensive. Just make sure that it is a conscious choice to accept a certain risk.
Responses for risk opportunities are the reverse of the ones for threats. They will focus on seeking risks, maximising them or ignoring them (if opportunities prove to be too small).

Register Project Risks

This rule is about bookkeeping (however don't stop reading). Maintaining a risk log enables you to view progress and make sure that you won't forget a risk or two. It is also a perfect communication tool that informs your team members and stakeholders what is going on (rule 3).
A good risk log contains risks descriptions, clarifies ownership issues (rule 5) and enables you to carry our some basic analyses with regard to causes and effects (rule 7). Most project managers aren't really fond of administrative tasks, but doing your bookkeeping with regards to risks pays off, especially if the number of risks is large. Some project managers don't want to record risks, because they feel this makes it easier to blame them in case things go wrong. However the reverse is true. If you record project risks and the effective responses you have implemented, you create a track record that no one can deny. Even if a risk happens that derails the project. Doing projects is taking risks.

Track Risks and Associated Tasks

The risk register you have created as a result of rule 9, will help you to track risks and their associated tasks. Tracking tasks is a day-to-day job for each project manager. Integrating risk tasks into that daily routine is the easiest solution. Risk tasks may be carried out to identify or analyse risks or to generate, select and implement responses.

Tracking risks differs from tracking tasks. It focuses on the current situation of risks. Which risks are more likely to happen? Has the relative importance of risks changed? Answering this questions will help to pay attention to the risks that matter most for your project value.

The 10 golden risk rules above give you guidelines on how to implement risk management successfully in your project. However, keep in mind that you can always improve. Therefore rule number 11 would be to use the Japanese Kaizen approach: measure the effects of your risk management efforts and continuously implement improvements to make it even better.

RESULTS AND DISCUSSION

In this project we have presented some of the most important aspects of risk management. In today's industry and production sector it is very important to minimalise costs and production time, by enlarging efficiency. In that case, if risk management is applied, there are no reason for any undesirable or unexpected case to go on. Beside production goals, risk management also benefits employees.

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