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HIGH PRODUCTIVITY INSTALLATION FOR THE RECOVERY OF WASTE BY BRIQUETTING OF POWDER

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ABSTRACT:
This briquetting method is for obtained spherical, oval or rectangular pieces of ore from dust. Operations of pressing are made on specialized equipment, followed by a drying - roasting process in order to increase their mechanical characteristics. This method is characterized by high productivity and appropriate mechanical characteristic briquette. In other words, paper presents a way for the recovery and reinstates the economic cycle of this pulverous waste.
KEYWORDS:
Pulverous wastes, briquette, pressure, hydraulic press

1. INTRODUCTION

For obtaing of briquette, the raw material can be finely crushed if is necessarily. Milling operation is usually done in ball or bars mills similar to those described in the ores preparation. In the intimate mixture between binder additions and ore are used different types of machines such as scraper mixer with one or two axes.

Regarding of briquetting methods, they can be divided into two categories:

- briquetting without binder additions;
- additions briquetting with binders.

Depending on the made pressures in order to obtain, for both briquetting metod, they can be obtained by:

- low pressure briquetting (50 - 150 kg/cm^2)
- medium pressure briquetting (150-750 kg/cm^2)
- briquetting under high pressure (over 750 kg/cm^2).

For briquetting, also can be used several types of machines, some with limited productivity and other with high productivity. For high productivity and low pressures are required for certain types of briquette are use roller press.

Most often, for obtaining the briquette with higher work pressure, but also with considerable productivity is used the ring presses, consisting of an outer ring supported on rollers and a serrated inner cylinder, placed eccentric. Rotation of inner cylinder inside ring presses the dust and results the briquette.

So, in Hunedoara area are greater quantities of this type of wastes, most of them are stored in pounds, but also stored in special places designed for this purpose. In figure 1 is presented these places from a satellite map.

2. THE STUDY

Waste results from the gas treatment plants and industrial wastewater discharged from various steel processes. It is therefore a source of ferrous waste generated by the action of preventing environmental pollution, air and water.

Ring presses can achieve pressures up to 3000 daN/cm^2, with productivity up to 9 t/h. For drying briquette and their heat treatment are used tunnel furnaces with 35m lengths, 1.2 m wide and 1.8 to 1.9 m high, equipped with track for truck where briquette are drying.

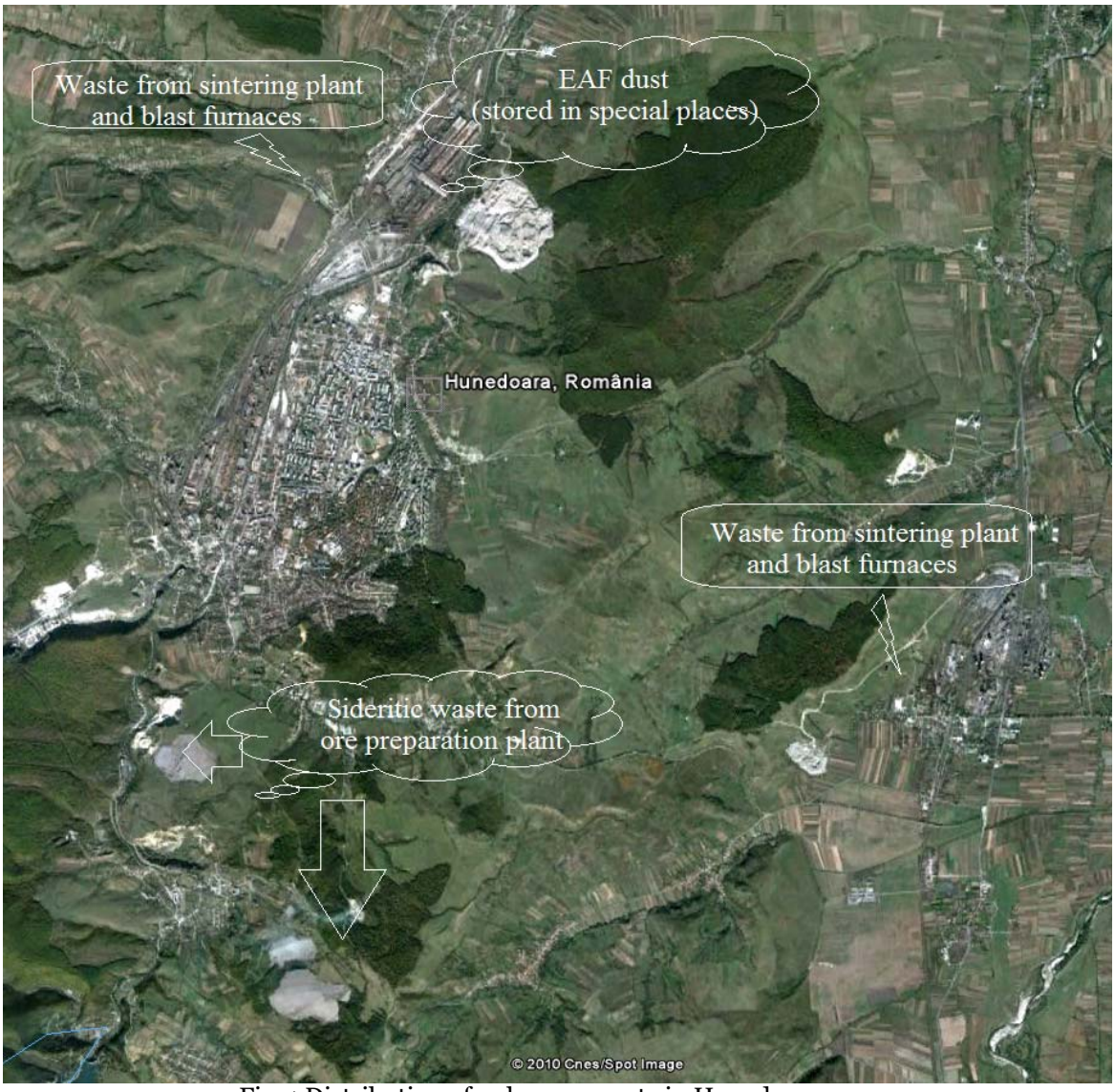

Fig. 1 Distribution of pulverous waste in Hunedoara area

Taking into account sources that generates ferrous waste can be established the following classification of them:

- ferrous waste from the steel industry
- iron waste from industrial activities or processes that use steel products
- ferrous waste from disposal of fixed assets and collected from the population (in households and downgraded objects containing steel or iron).[1,2,4]

Need for a highly productive presses in the briquetting process occurred because of the possibility of processing a large quantity of waste, especially in the area that these types of waste are present in large amounts.

To design this type of press, experimental tests were conducted to determine the optimal compress forces of waste so not destroy the briquette when is extracting from the form.

In figure 1 is presented the experimental test made for obtains the optimal press force.

Fig.2 Experimental briquette made with hydraulic press and manual installation

Figure 2 presents experiments carried out to obtain briquette. Attempts have been made in two versions:

- pressing the waste at high pressure using a hydraulic press that can develop a maximum pressing force of 41 kN;
- pressing at low pressures by pressing waste manual with different compression forces 100N, 150N and respectively 300N.

Where are compaction of waste using hydraulic press, the mechanical strength of resulting briquette was large enough to reach up to 450 N/briquette, depending on the of waste recipes mixture pressed at high specific pressures (25 N/mm² for ∅45 mm punch, respectively 84 N/mm² for ∅25 mm punch).

In case of manual pressing, the forces are much smaller, so for ∅45 mm punch specific pressures are small, up to 0.188 N/mm² and due to greater height of mold and lower pressing forces the compactness are smaller on height of briquette.

In variant of use ∅25 mm punch, the results are satisfactory as it was considered that the maximum specific pressure is approximately 0.611 N/mm².

The mechanical strength of briquette is increased, either by chemical hardening (using a binder to do this as bentonite or cement) or by thermal hardening (burning, eventually sintering the briquette in furnace with electric resistors or flame).

Briquette strength was measured in raw state and after burning. In raw state it was used three methods to measure mechanical resistance, as follows:

- empirical approximate method, when compressive strength of briquette was determined by static progress loading (using the weights) until is observed the cracking of briquette;
- 2nd method using a specialized mechanical-hydraulic installation to determine the compressive strength of briquette [4].
- Mechanical resistances are influenced by several factors such as:
- the quality of the binder and its quantity - the mechanical strength increases with increasing of binder quantity.
- water content of the mixture - the mechanical strength increases with increasing of water quantity. If it exceeds a certain percentage of, intergranular water shell becomes much thicker, interaction forces between the dipoles of water molecules and crystal lattice forces become weaker and leading to a decrease strength of the mixture
- the degree of tamping - mechanical strength increases with increasing of tamping degree. A tamping too strong can cause cracking of the briquette;
- grain size and shape of powdered material – change of the granulation conduct to increasing of mechanical strength. Strength of briquette made from less grain waste will be higher than the mechanical strength of briquettes from more grain waste. Higher mechanical strength values are obtained when are uses a non-uniform waste granulation (large and small granules).

According to the literature are considered best values of compressive strength between 1.2 ... 4.1 N/mm² for raw state and shear resistance between 0.8 ... 2 N/mm² . In case of hand pressing resistance to compression are presented in table 1.

Table 1. Compressive strength for raw briquette in case of hand pressing

Compression forces		Specific pressures	Compressive strength (raw briquette)
	kN	N/mm²	N/mm²
Punch ∅25 mm	0.1	0.203	11
	0.15	0.407	17
	0.3	0.611	21
Punch ∅45 mm	0.1	0.063	inconsistente briquette
	0.2	0.126	inconsistente briquette
	0.3	0.188	inconsistente briquette

where specific pressures are : $p_{sp} = \frac{F_{press}}{S_{transverse\ punch}}$

3. DISCUSSIONS

Based of these experiments, can be used two models in construction of this ring press, depending on the pressing force:

- first version, when made of briquette is based on compressing the mixture of waste by roller pressing, due to its own weight;
- the second option involves a higher clamping force, resulting mainly due to the constructive way (fixing the pressure cylinder in bearing, which allows the development of high clamping forces up to 300N/mm² especially for industrial facilities). [3]

3.1.First constructive version

For this alternative design, when the specific pressures and also the pressure forces are small, for get good briquette the mold from clamping cylinder is small. Pressure cylinder moves freely within the compression ring, being guided left-right, as is presented in figure 3. [3]

In terms of computing elements and design is necessary to determine the weight of entire pressing cylinder. So the design of surfaces where is made compacting the pulverous waste (mold) will be consistent figure 4, where dimension are:
D=25 mm – width; L=50 mm – length.

Outer surfaces are:

$$S_{ext.} = \frac{\pi \cdot D \cdot L}{2};$$

$$S_{ext.} = \frac{3.14 \cdot 50 \cdot 50}{2} = 3925\ mm^2$$

Necessary compacting forces:

$$F = p_{sp} \cdot S_{ext.} \qquad F = 0.4 \cdot 3925 = 1570\ N$$

where: p_{sp}=0.4 N/mm²

Mass of compacting element:

$$m = \frac{F}{g}\ ;\ m = \frac{1570}{9.81} = 160.04\ kg$$

The volume of compacting element, in case of this is made from manganese steel or white cast iron ($\rho_{steel\text{-}iron}$=7.8 – 7.6 kg/dm³):

$$V = \frac{m}{\rho_{steel-iron}};\ V = \frac{160,04}{7.8} = 20.52\ dm^3$$

Diameter of compacting element, if case of g=50 mm are thickness of compacting element:

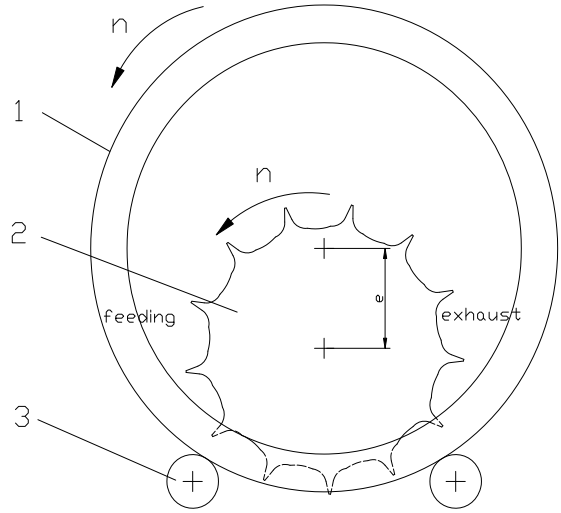

Fig. 3 Design scheme of the ring press, first constructive variant

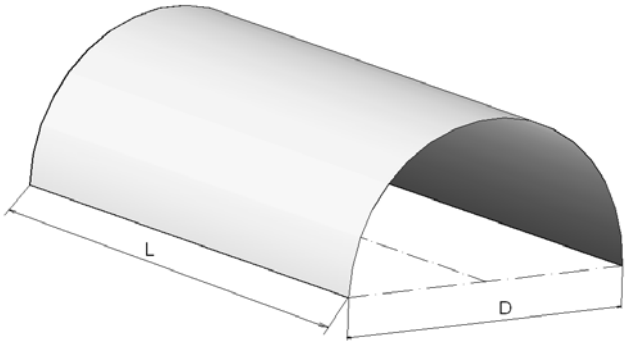

Fig.4. Dimension of mold

$$D_{cp} = \sqrt{\frac{4 \cdot V}{\pi \cdot g}} = \sqrt{\frac{4 \cdot m}{\rho_{fonta} \cdot \pi \cdot h}}\ ; \qquad D_{cp} = \sqrt{\frac{4 \cdot 160,04}{7.8 \cdot 3.14 \cdot 0.5}} = 7.23 \rightarrow dm = 723\ mm$$

Because is necessary a greater compacting forces, this constructive variant lead to a large diameter of cylinder for pressing the raw material in ring. In order to assure a better stability as it reinforces through a spacer element such two tooth pressure cylinder, design of machinery is similar with the roller press.

3.2.Second constructive version.

This constructive variant allows the development of compression forces much higher and increased stability in the functioning of the press.

The difference with the first possibility is that the design of tooth pressure roller is mounted on bearing and pressing force is developed by the eccentric mounting of the cylinder to the outer ring gear (drums).

The wear both of pressing ring and the tooth compress cylinder is lower than the previous version because these two machine parts do not come into direct contact with each other.

In both cases, to prevent mutual slippage between the ring gear and the pressure cylinder , the peripheral speed of the two components must have the same value.

In fig.5.a the tooth cylinder is fitted with eccentric gear after the two axes of the coordinate system inside the pressure ring, which leads to an appearance of overturning moment of the ring by pressing the roller support. This moment must be balanced by a force, applied through a roller press-balancing 1.

In fig.5.b the tooth pressure cylinder is only fitted with eccentricity of OY the axis of coordinate system, roll 1 may be absent from the construction of press ring, because the press force acting on the ring pressing, keeping it in contact with support rollers 5 . [3]

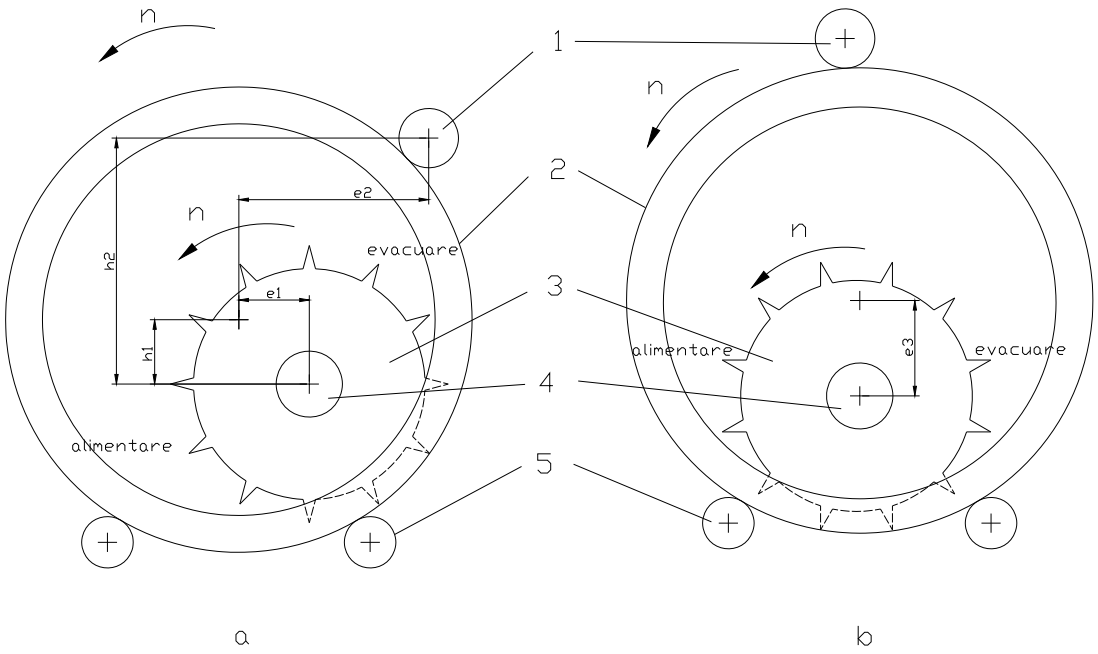

Fig. 5. Ring press
1- press-balancing roll; 2-pressing ring; 3-tooth press cylinder;
4 - axle; 5 – support roll.

Because construction from fig. 5.a. complicates the ring press, although it increased the space through which granular material is introduced into the pressing zone, the preferred construction is on fig.5.b By design, is established the specific pressure at the value of 8 N/mm².

Is determined the pressure area formed by summation of the three areas of empty space (mold) between two consecutive teeth of the tooth pressing cylinder, presented in fig.6 , where: b=60 mm – width of tooth cylinder; h=31 mm – length of inclined part of the tooth; l_R=62 mm – length of circular segment with radius R=150 mm between two consecutive tooth flanks.

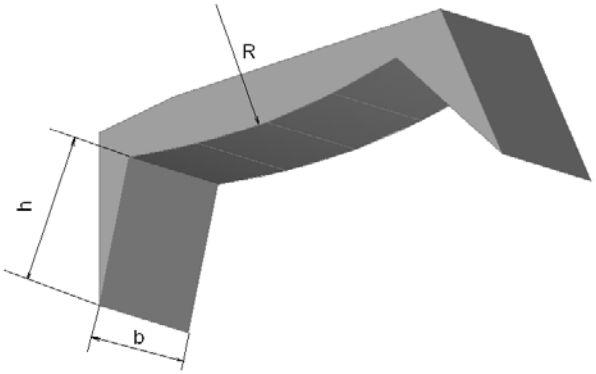

Fig.6. Part of tooth cylinder (mold)

Maximum compacting forces, when this force is distributed evenly throughout the interior surface of mold:

$$F_{\max} = S_p \cdot p_{sp}, \quad N \ ;$$

$$F_{\max} = 7440 \cdot 8 = 59520 \ N$$

Calculate starting at the specific pressure the thickness of material will be briquetting and which will be deposited uniform before the compression cylinder. This calculation will be based on an analogy with the tamping pressure of mixtures with medium pressure.

Degree of tamping:

$$\rho = 1 + C \cdot p_{sp}^{\ 0,25}, \ g/cm^3 \ ; \ \rho = 1 + 0.45 \cdot 8^{\ 0,25} = 2.19, \ g/cm^3$$

where: C=0.4...0.5 – coefficient by pressure tamping

Total height of layer a submitted to tamping from at tamping degree of ρ_o=1g/cm³ to at tamping degree ρ=2.19 g/cm³ are:

$$H_t = H \cdot \frac{\rho}{\rho_o}, \quad mm \ , \ H_t = 30 \cdot \frac{2.19}{1} = 65.88 \, mm$$

Driving is done separately for the outer ring, respectively toothed cylinder. Kinematic scheme is shown in fig.7 for drive of tooth pressing cylinder. Mechanical movement is done using an AC electric motor, worm gear (gear-motor) and an external gear.

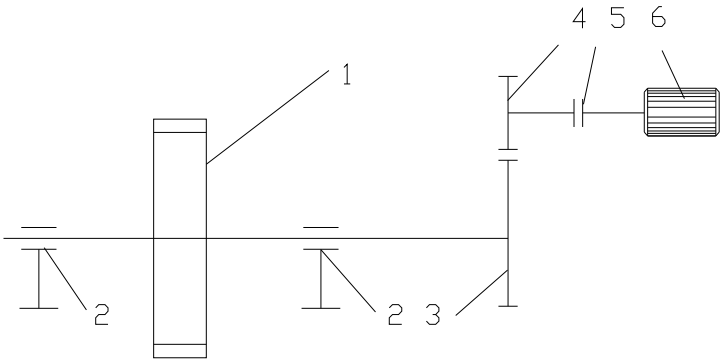

Fig.7. Kinematic scheme of action for tooth press cylinder
1-tooth cylinder; 2-bearing; 3,4-gears; 5-clutch gear; 6 gear-motor

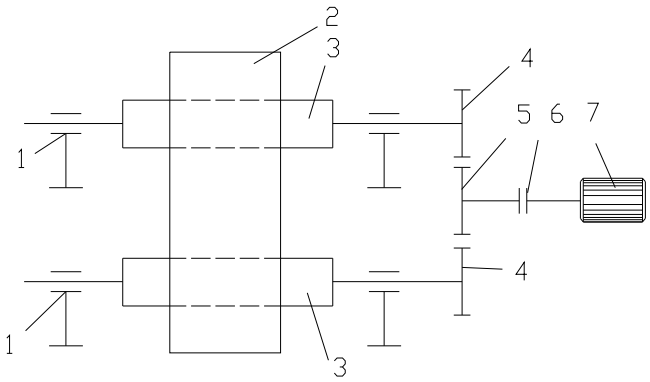

Fig.8. Kinematic scheme of action for pres s ring
1-bearings; 2-press ring; 3-suport roll; 4, 5-gears; 6-clutch geari; 7- gear-motor

In fig.8 is presented a schematic diagram of the ring press drive. The ring 2 is pressed through three support rollers, and driving of this is make trough worm gear motor and outdoor gear.

4. CONCLUSIONS

Briquetting, pelletising and agglomeration represents a viable alternatives technology is if you want to reuse small and powdery waste. This type of installation can be used for recovery the large quantities of waste, in industrial equipment. Can reuse the waste stored in ponds and dumps, but can be adapted in steelworks technological flow chart for recovery of electrofilter dust from EAF furnaces.

For this briqueting equipment is characteristic a higher productivity. Also is selected the second constructive variant because the compacting forces not depends of tooth cylinder weight, and this force value resulting from design of press and is determinated in laboratory experiments. This constructive variant allows the development of compression forces much higher and increased stability in the functioning of the press. In conclusions, using of this press is adequate for recovery of large amounts of waste existing in the Hunedoara area.

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DIFFRACTOMETRIC ANALYSE OF STEEL SLAGS VIEWING THEIR USE FOR ROAD CONSTRUCTION

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ABSTRACT:
The development of steel industry must provide solutions for environmental protection issues and using of production wastes, thus, aiming mineral resources and energy savings. The slag is the main waste type resulting from metal making and represents a valuable raw material for many industries. Steel slag is a product of much importance for road construction, successfully substituting natural materials. The X-ray diffraction analysis carried out in this paper gives a deeper insight in the mineralogical constitution and behavior of such slags when used for road construction purposes.
KEYWORDS:
steel slag, recycling, road construction

1. INTRODUCTION

The steel slag shows good technical and ecological properties, thus being used for the manufacturing of aggregates required by road construction. The reuse steel making slags for road construction must comply with an essential requirement, namely their volumetric stability. This is a condition to be met especially by steel slag, its composition having free calcium and magnesium oxides. The hydration of these oxides increases its volume, possibly causing important damages [1]. Therefore, these slags need a so-called "ageing" time (6 to 12 months) in order to be reused without creating any problems. The increasing use of the converter slag in application fields which demand high qualities is possible by improving the volumetric stability. Insufficient volumetric stability results from the presence of free CaO and occasionally, MgO in the slag.

2. QUANTITATIVE EVALUATION ON SHORT AND AVERAGE TERM OF STEEL SLAGS FROM ROMANIA

In order to perform a quantitative evaluation of slags from Romania, the following presumptions were made:

- Converter and electric steel production in 2015 (average term): 5% increase for converter steel production and 10% increase for electric steel production means 9,173 mil. t/year;
- Steel treated by secondary metallurgy LF type: 7,5 mil. t in 2008 and 8 mil. t in 2015;
- There is no forecast concerning any progress within the specific slag share in steel industry.

Table 1. Quantitative evaluation of steel slags from Romania [2]

Slag type	2006		2008		2015	
	Production, (steel) mil. t/year	Generated slag mil. t/year	Production, (steel) mil. t/year	Generated slag mil. t/year	Production, (steel) mil. t/year	Generated slag mil. t/year
Converter slag	5,5	0,660	5,745	0,689	6,032	0,724
Electric furnace slag	1,65	0,240	2,855	0,414	3,141	0,455
Secondary metallurgy slag (LF)	5,25	0,150	6,000	0,156	8,000	0,208
Total	Total	1,250	Total	1,759	Total	1,987

Under conditions presented above, Table 1 and Fig.1 present the quantitative evaluation of steel slags.

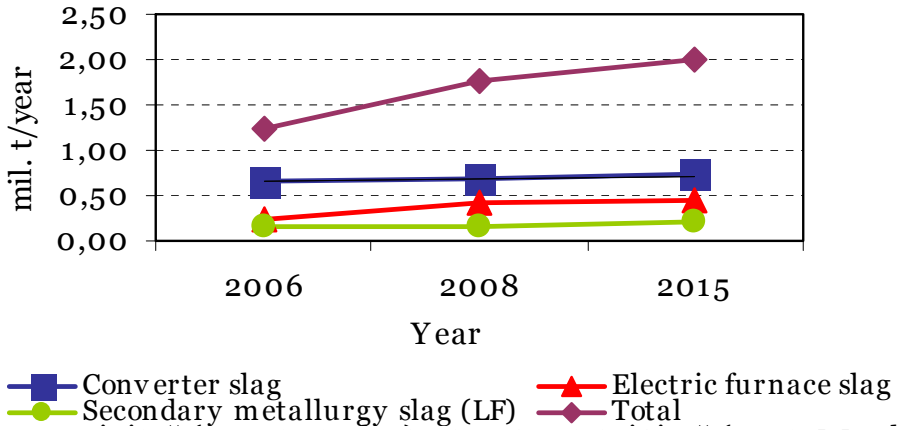

Fig. 1. Quantitative evaluation of steel slag from Romania [2].

Based on the presented evaluation, one considers that on short term the generated total slag amount will increase up to approximately 1,75 mil. t and on average term even to 1,9 mil. t.

2. STEEL SLAG CHARACTERIZATION

The chemical compositions and main performances of analyzed slags as compared with those of crushed stone and pit ballast products most frequently used for road construction are shown in Table 2 and 3.

Steel slag is a dense rock having a raw density > 3,2 g/cm^3. Thus, steel slag is successfully used for road construction (e.g. for portant layers or asphalt layers submitted to high loads). Steel slags are resistant to erosion. By providing a granulation distribution determined by technical regulations, one can observe that the manufactured mineral materials mixtures have to resist to repeated frost-defrost cycles.

Table 2. Chemical compositions for steel slag

Constituent %	Converter slag	Secondary metallurgy slag (LF)	Electric furnace slag – EAF (average)
CaO	40,10	49,56	40,78
SiO_2	17,80	14,73	17,81
FeO	12,92	0,44	9,25
Fe_2O_3	6,58	0,22	3,97
Fe_{tot}	21,18	0,68	12,51
Fe_{met}	6,55	0,17	2,56
MnO	6,52	0,39	9,79
MgO	6.32	7,88	8,53
P_2O_5	1.13	0,20	0,74
S	0,46	0,80	0,30
Cr_2O_3	0,00	0,00	1,42
Al_2O_3	2,04	25,55	4,23
C	0,45	0,07	0,64
CaO_{liber}	3.90		

Steel slags contains pores, which provide a durable adherence if they are used as mineral material for wear resistant layers. Thus, steel slags are recommended to be used in wear resistant asphalt layers as chippings. The high values of polishing strength are tied to the low shock attrition value (less than 18% of the weight), which is concomitantly the precondition of manufacturing asphalt layers having the capability to reduce the level of traffic noise.

Due to the metallurgical technology, steel slags contain only low amounts of CaO not chemically bound and/or free magnesium oxides. Because these mineral constituents retain water by increasing their volume, for road construction one must check the volumetric constancy [3].

Table 3. Main characteristics of steel slags

Characteristics	Slags	Crushed aggregates	Pit ballast aggregates
Apparent density, kg/m^3	3300-3500	2500-2700	2600
Water absorption, mass %	0,7-1,0	<0,5	<0,5
Grain shape – shape factor, %	<10	<10	<10
Crushing degree, mass%	13-17	17	21
Los Angeles test machine, wear %	18-22	12	21
Compression strength, N/mm^2	320-350	260	250
Frost-thaw resistance, mass% - frost cleftness factor	<0,5	<0,5	<1
Bitum adhesivity, %	>90	>80	>80
Polising factor (PSV), %	58-61	48	45

The portant capacity values required by standards for the manufacturing of frost-resistant layers and portant layers consisting in ballast were easily reached and frequently, outstripped due to the 100% crushed stone content, the compact shape of the grains and the harsh surface of steel slag.

These favorable properties give a high deformation resistance to portant asphalt, asphalt binder and wear resistant asphalt layers after placing and compacting.

Due to its chemical and mineralogical composition, the slag desintegrates in free atmosphere (in stockpiles) under the action of atmospheric factors, reaching a quasistatic state after cca. 6 months [4]. This duration can be diminished by watering the fresh slag, the temperature of water ranging from 40 to 50°C. The slag further desintegrated/attrited under the influence of atmospheric factors cause its decay due to the carbonation of the hydrated lime.

3. DIFFRACTOMETRIC ANALYSIS

In order to identify the structural constituents in slags, we have performed phase-analyses on diffractometer DRON 2.0. The working parameters used were:

- 30 kV tension; anodic current 34 mA;
- radiation used CoKα;
- angular frequency ω=1/2° min.

The phases identified from the viewpoint of qualitative and quantitative estimation and their specific diffraction parameters (diffraction angles, interplanar distances, Miller indices of crystallographic planes) are presented in Table 4.

Table 4. Phases identified in iron and steel slags

Test code	Identified phases	Proportion of phase [%]	Miller index of planes crystallographic (hkl)	Crystallographic system
OLD	$2CaO{\cdot}Al_2O_3{\cdot}SiO_2$ gehlenite	28,3	(111); (201); (211); (220); (311); (400); (323);	T
	Fe_2O_3	39,0	(101); (112); (101); (102); (202); (123); (103); (224); (134); (204); (235);	R
	CaO	22,5	(111); (200); (220); (222); (331); (400);(420);	C.F.C
	FeO	10,2	(111); (200); (220); (311); (222);	C.F.C
LF	$\beta CaO{\cdot}SiO_2$ wollastonite	38,0	(400); (310); (501); (203); (710); (313); (631); (322); (314); (223); (205);	Tr
	$CaO{\cdot}Al_2O_3{\cdot}2SiO_2$ anorthite	36,1	(220); (004); (204); (132); (130); (111);	Tr
	CaS	11,3	(111); (200); (220);	C.C.
	αAl_2O_3	14,6	(112); (102); (202); (123); (234); (202); (131); (134); (225);	H
TC	$2CaO{\cdot}Al_2O_3{\cdot}SiO_2$ gehlenite	14,7	(111); (211); (212); (400); (410); (600);	T
	$\gamma\ Ca_2SiO_4$	33,9	(020); (103); (113); (121); (104); (311);	O
	αAl_2O_3	19,0	(112); (102); (202); (134); (231); (204);	H
	CaO	9,4	(200); (220); (332); (222); (400);	C.F.C
	$Al_2O_3{\cdot}SiO_2$	23,0	(122); (230); (042);	O
OE	MnO_2	8,0	(111); (200); (301);	T
	MnO	13,9	(111); (200); (220);	C.F.C.
	Fe_2SiO_4	52,5	(002); (130); (022); (112); (230); (150); (113); (241); (152); (311); (321); (224); (400); (314); (174);	O
	Fe_7SiO_{10}	25,6	(311); (411); (112); (312); (131); (114); (121); (604);	M

Four slag specimens sampled from different zones of the integrated process line and a specimen from the electric furnace process line have been examined. The samples have been codified as follows:

- Code OLD – slag removed after LD converter steelmaking process;
- Code LF – slag resulting from treatment on LF installation;
- Code TC – slag resulting after stirring in the casting ladle;
- Code OE – slag removed after electric furnace steelmaking process.

After analyzing the results obtained, one can state following:

- Slag code OLD contains iron oxides as FeO (10,2% quantitative ratio), but also Fe_2O_3 in a higher proportion, 39%;

- Slag code TC, besides CaO, Al_2O_3 and simple or complex calcium and aluminum silicates *does not contain iron oxides;*
- Slag code OE contains manganese oxides MnO_2, MnO and iron silicates of Fe_2SiO_4, Fe_7SiO_{10} types;
- Slag code LF contains Ca, Si and Al oxides.

The graphic of diffractogramemms is emphasized in Figures 2-5.

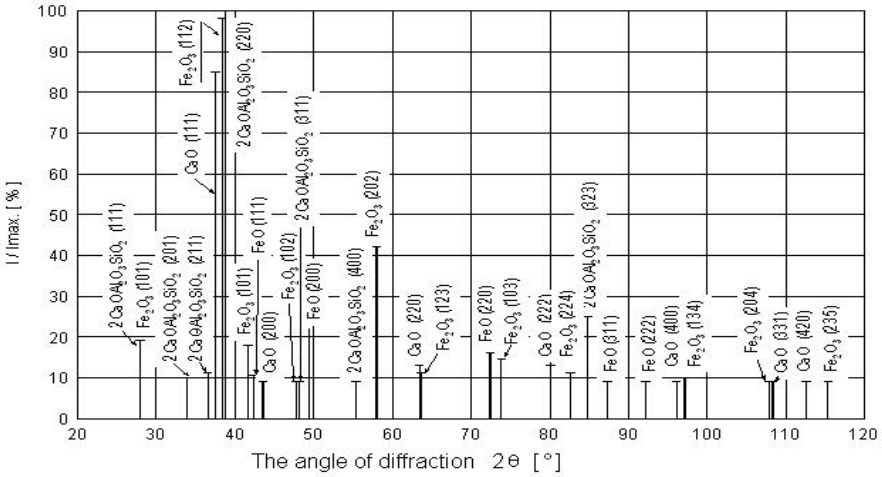

Fig. 2. Relative intensity of the diffraction lines function of the diffraction angle for sample code OLD.

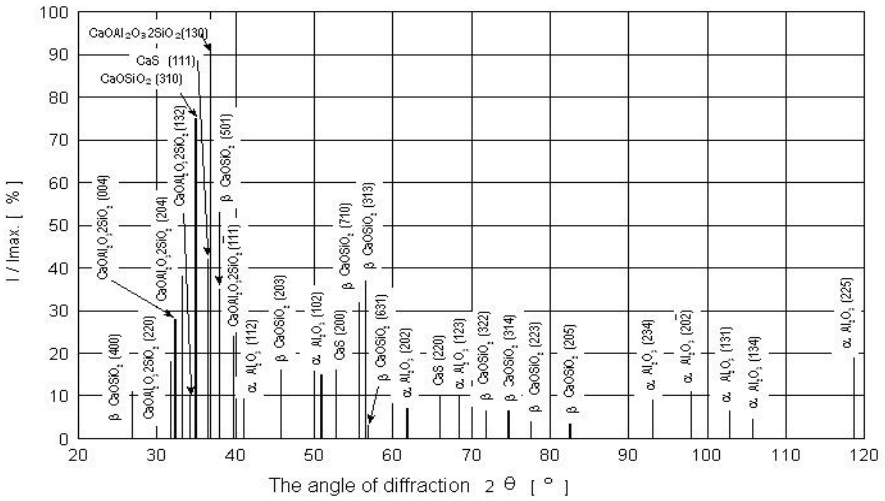

Fig. 3. Relative intensity of the diffraction lines function of the diffraction angle for sample code LF.

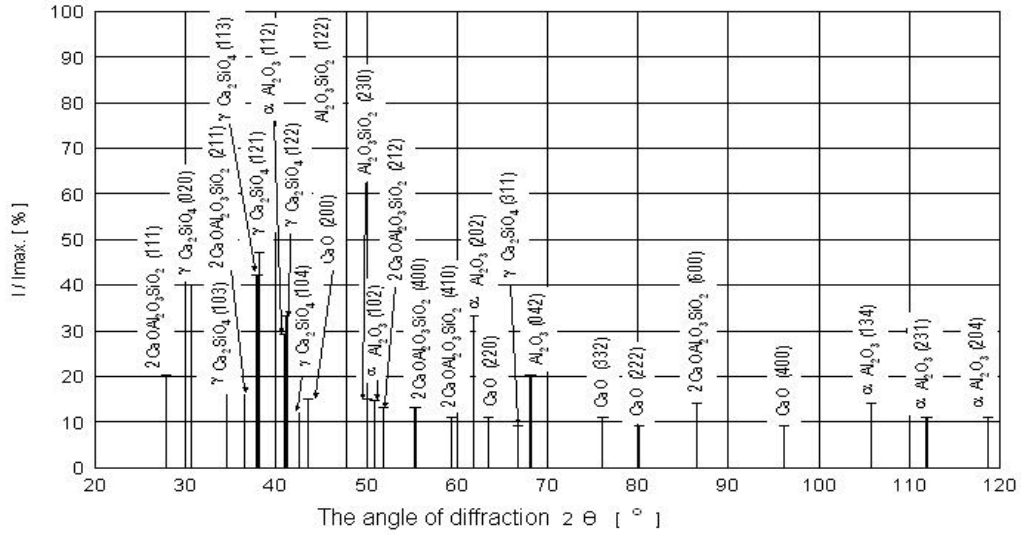

Fig. 4. Relative intensity of the diffraction lines function of the diffraction angle for sample code TC.

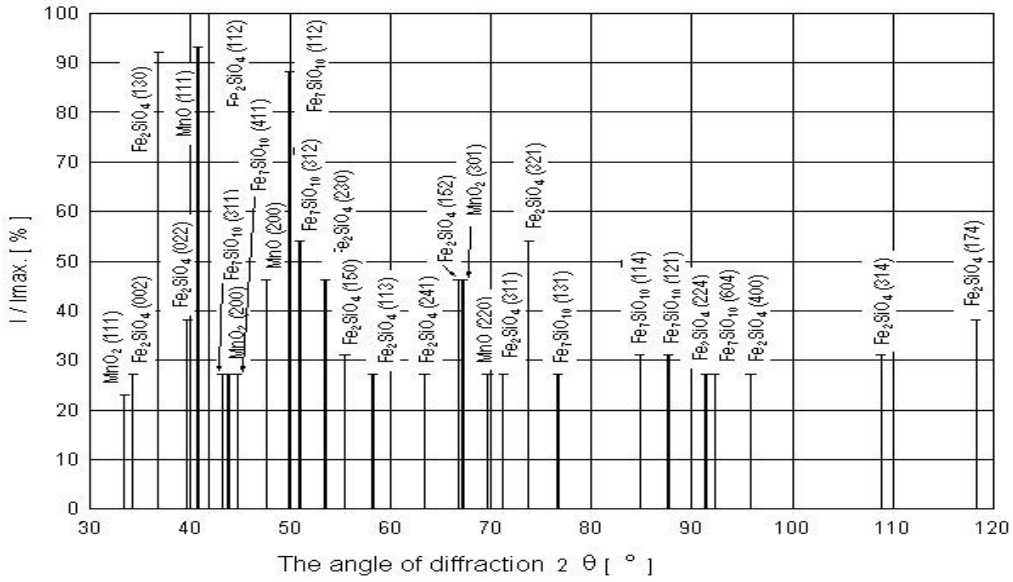

Fig. 5. Relative intensity of the diffraction lines function of the diffraction angle for sample code OE.

4. DISCUSSION

The LF slag comprises mainly CaO. During the cooling process, can be emphasized a beta-gamma structural transformation of dicalcic silicate. Furthermore, it results a pulverized material by the reaction of calcium oxide with carbon dioxide, in the presence of atmospheric humidity (CaO – 50-60%, MgO – 5%, SiO_2 – 5-10% and Al_2O_3 – 5-10%).

After analyzing the converter slag in the $CaO\text{-}FeO_n\text{–}SiO_2$ system one can understand how it is possible to avoid this phenomenon (Figure7).

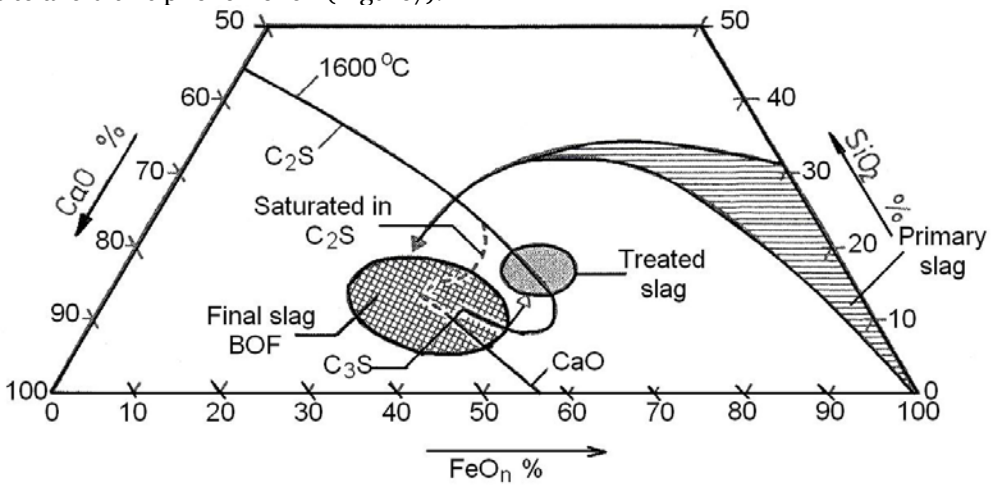

Fig.7. Converter slag location in the system $CaO\text{-}FeO_n\text{-}SiO_2$.

Similarly, the converter slag is deficiently as concerns its volumetric stability. The volumetric stability is influenced especially by the free CaO content. During the free air deposition, over time, due to the atmospheric humidity and rain, the major part of free lime is transformed into calcium hidroxide. This reaction is accompanied by a volume increase of almost 100% and an attrition of the slag aggregate structure. This is disadvantageous because of the amount of dust generated that creates dysfunctions.

The primary converter slag belongs rather to the $FeO_n\text{–}SiO_2$ system. The higher is the lime amount, the closer to the final slag, which can be observed in the saturation zone in $2CaOSiO_2$, $3CaOSiO_2$ and CaO. Therefore, the converter slag contains important amounts of free CaO, which influence the volumetric stability of the solid slag through hydration phenomena. In order to avoid this phenomenon, after the final slag has fulfilled its function in the converter, it is preferred to treat it and to let it migrate into the unsaturated slag zone in CaO and C_2S (eventually by increasing SiO_2 amount).

5. CONCLUSIONS

Due to its raw density, the steel slag is considered a dense rock successfully used in road construction for portant layers or asphalt layers submitted to high loads.

During the cooling of the LF slag, besides the beta-gamma structural transformation of dicalcic silicate, the calcium oxide reacts with carbon dioxide and in humid atmosphere one can obtain a pulverous material (CaO – 50-60%, MgO – 5%, SiO_2 – 5-10% and Al_2O_3 – 5-10%).

The converter slag is volumetrically instable, being influenced by the free CaO content, thus, requiring a free air deposition and due to the atmospheric humidity, the major part of the free lime is transformed into calcium hydroxide.

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ATMOSPHERIC POLLUTION IN AREA CAREER GARLA

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ABSTRACT:
In this paper it is shown activity carried out within the career streams, as the main source of atmospheric pollution, identify all on-site air emissions. Were monitored emissions from combustion processes and direct emissions from processes. Determinations were made in particulate matter sedimentation after puberty comparing them with the permissible limit values, realizing the risk assessment matrix.
KEYWORDS: air emissions, processes, quarrying, mining, pollutants

1. GENERAL CONSIDERATIONS

Garla mining perimeter is located in the county territory Drăguţeşti municipalities, and city Bilteni Rovinari and is in operation since 1969 through extensive mining days. Activity in the area of operation is the extraction and processing brown coal and lignite NACE code: 1020. From the administrative point of view is part of career Garla Rovinari Energy Complex - EMC ROVINARI.. The mine is located near the city perimeter and Rovinari. Identificate all will be on-site air emissions. This identification should include all aspects of:

- emissions from combustion processes;
- processes and direct emissions;
- emissions of air purification installations, air conditioning systems up to (if any);
- details on prevailing wind direction.

The amount and nature of air emissions will be detailed as the conditions imposed by permits, analyzing compliance. It will detail the general nature of the emissions data, including data on particulate matter (smoke), toxic emissions, odors, etc.. In the workplace emissions will be monitored according to business rules developed to ensure the accomplishment of work safety and hygiene. This is important for personnel working in confined spaces. Also presented will be examined and air conditioning systems and cooling agent used for them. It should be mentioned any Legionella pneumophilae record, found the system of observation.

2. AIR EMISSIONS. RISK ASSESSMENT

Air emissions on site are two ways **:**

- emissions from combustion processes
- direct emissions from processes
- emissions from combustion processes have two sources:
- mobile sources
- stationary sources for equipment

To own equipment and transport their yearly consumption is known, in this case the emissions into the air by exhaust gases and particles mainly driven on the roads of land in the dumps career and estimated CORINAIR program

- Fuel (consumption) Car > 3,5 tonnes : 230 686
- Diesel (consumption) 193776 kg / 6 months Content : 0.035%

To produce the heat necessary for heating and sanitary hot water, is used as fuel, lignite career with PCI = 1600 kcal / kg, coal that is burned in boilers PAC15-TubalBuc type, installed thermal electric power boiler is 0 15 Gcal = 174 kW (t) and the installed electrical power boiler (pumps and fans) = 20 kW.

Table 1. Emissions

	Emission factors	M.U.	Emission (kg)
SO_2		kg/month	135,643
SOx	15,9	kg/ month	3081,042
dust	3,35	kg/ month	455,375
heavy metals Cd	0,01	kg/ month	1,938

Table 2. Emissions - coal CT November 2007

lignite (fuel quantity)	79	t/month		
Hi. (internal heating-power)	1815	kcal/kg	7599 kJ/kg	7,599 MJ/kg
content S (anhydrous, maf)	0,01			
As (S retention in ashes)	0,6			
ash content (anhydrous , maf)	0.3	kg/kg	600,3243 GJ	
ash content (wet basis)	30	%		

Table 3. Pollutant

Pollutant	Emission factors	UM	Emission (t)
SO	1053	g/Gj	0,632
NO_x	100	g/Gj	0,062
nmvoc	15	g/Gj	0,009
CO	121	g/Gj	0,073
CH_4	0,7	g/Gj	0,000
CO_2	100,2	Kg/Gj	60,2
N_2O	0,8	g/Gj	0,000
dust	51	Kg/t	4,029
dust	5145,39	g/GJ	3,1

After firing, a process resulting ash (wet basis) 30%, which is stored in a special place near the power station, after which it is discharged to the dump and which, by blending with it is not polluting area. The main components of ash and sulfur coal are silicates, whose concentration is below acceptable limits, according to Order 592/25 June 2002.Gases resulting from combustion of lignite process are discharged into the atmosphere through the chimney, whose height of 15 m, well above the heights of buildings in the area, allowing a good dispersion of pollutants in the atmosphere under normal conditions and safety, without dangerous work area. For thermal power plants the emissions in the atmosphere have been estimated CORINAIR program considering the amount of coal consumed per month.

A potential source of toxic gases is the auto-ignition of coal deposits or strata which outcrop. Because of the incomplete combustion of carbon monoxide emitted into the air and in smaller quantities oxide and sulfur dioxide, light hydrocarbons, toxic substances at concentrations which did not reach to exceed limits.

At career Garla to prevent auto-ignition of coal layers that outcrop, coal is not leaving out fully covered by a sterile layer of approx. 5-10 cm. Measures to prevent auto-ignition of coal in deposits. Proceed to:

- regular water sprinkling of coal, and coal
- loosen periodic continuous movement of stocks during the delivery.

Monitoring of air emissions sources was made in the methodological norms approved by Order no. 592 of 25 June 2002 the Ministry of Waters and Environmental Protection for approval of the standard setting the limit values, threshold values and evaluation criteria and methods of sulfur dioxide, nitrogen dioxide and nitrogen oxides, particulate matter (PM10 and PM2, 5), lead, benzene, carbon monoxide and ozone in ambient air.

Determinations were made:

- particulate matter (PM10) with aerodynamic diameter 10μm, the tree through a hole selection by size, with a yield of 50% off
- dust settled

Particulate matter sampling stations aimed at protecting human health were located near equipment distribution of type MAN from:

- inside career Tismana I
- inside career Tismana II

So as to provide data on air quality in the area where the greatest concentrations occur in the population may be exposed, directly or indirectly, on a 24 hour averaging period of the value (s) limit.

- same machines, the same type, there are careers Garla and results analysis of particulate matter can be considered as having the same values.
- measurement point at 65 m from the node distribution inside the quarry near Tismana I (there certainly could leave for 24 hours to pump suction sampling) value measured = 195.91 mg / m^3
- limit value allowed = 50 mg / m^3 - Order 592 / 25 June 2002

Measurement point at 65 m from the node distribution inside next career Tismana II (if it could safely leave for 24 hours to pump suction sampling)

- Measured value = 185, 49 mg / m^3

- limit value allowed = 50 mg / m^3 - Order 592 / 25 June 2002
- the same machines, same type of construction, there are career Garla and particulate matter analysis results can be considered as having the same values for the same distance. It is necessary to protect personnel serving these plants by watering around the sources of dust

a. Depositing powders were made by placing containers in the field laboratory in the sampling point more representative of polluted eel on period of 15 days.

Sedimentary points for dust measurements were as follows:

- limit Carbesti inhabited village (career Garla)
- limit Carbesti inhabited village (career Garla) measured value = 7, 45 g / m^2 / month according to STAS 12574/87 permissible limit value = 17 g / m^2/ month

b. Pollutant emission tests for cars and lorries weighing> 3.5 t

We measured emissions (kg) of SO2, NOx, particulates and heavy metals. The amount of gaseous emissions from heating the coal career Garla is calculated based on the calorific value of lignite used, its sulfur content, ash retention, and ash content.

To own equipment and transport their yearly consumption is known, in this case the emissions into the air by exhaust gases and particles mainly driven on the roads of land in the dumps career and estimated CORINAIR program

3. CONCLUSIONS

The activity in the career of Garla lignite surface mining, the main source of air pollution particles in suspension. Find loose rocks excavated mostly with low mechanical resistance, plus low humidity, especially in hot weather, leading to the formation of dust. Air quality is affected mainly by the process of career dump coal deposit, the growth in certain points of the perimeter of the mine, the concentration of dust, gas, turn result from vehicles and combustion processes.

Note that these values are very small, very local effect within the quarry, where there are no provisions of Order no. 592 of 25 June 2002 for approval of the standard setting the limit values, threshold values and evaluation criteria and methods of sulfur dioxide, nitrogen dioxide and nitrogen oxides, particulate matter (PM10 and PM2, 5), lead, benzene, carbon monoxide and ozone in ambient air and the impact of emissions from vehicles in the quarry is negligible on the atmosphere of populated areas surrounding career, from the actual business impact of their career.

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ELEMENTS OF METALLURGICAL ECONOLOGY

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ABSTRACT:
A new branch of science called *econology* is being defined and shortly characterized as studying the *economics-ecology-energy* associations (3E or E^3 associations). In the future, the ternary must be transformed into *tehnology(T)-economy- energy-ecology*, so that the symbol of the econology shall be TE^3.
A new classification of the indexes is put up for approval:
→ Indexes, I_e, regarding the *extensive character* of the econological events; these indicators may be characterized as passive-meditative-observing, (e*xtensive* and *extensity* – antonym for *intensive* and *intensity*);
→ Indexes, I_i, regarding the *intensive character* of the econological events; these indicators may be characterized as dynamic-operative-active.
There are defined and characterised the following simple indexes:
❖ energetic extensity and energetic intensity of the gross domestic product;
❖ energetic extensity and energetic intensity of productivity (hourly production);
❖ extensity and intensity of material consumptions;
❖ extensity and intensity of pollutant emittance:
  ☐ in metallurgical engineering;
  ☐ in car area.
There are defined and characterised econological-aggregate indexes of 2E and TE levels.
There are defined and characterised an aggregate index of 3E level (economy-energy-ecology).
Special characteristics are assigned to the metallurgical industry.
KEYWORDS:
metallurgical econology, extensity indexes, intensity indexes, econological-aggregate index

1. INTRODUCTION

The approach of the sustainable development concept can be based on two knowledge methodologies.

On one side, especially in the engineering area, specialization plays an important part. This in the reason why, for example, in metallurgy, the environment engineering is based more and more on a new subbranch of science called *ecometallurgy*. Its objective is the theoretical foundation of the knowledge and application of the technologies and techniquies of improvement in the metallic material industry in agreement with the objectives of the durable development concept. Under the same terms, some other branches of knowledge can be brought forward: *environment economics* and *environment energetics*.

On the other side, in agreement with the globalization tendency, the inter (trans) disciplinary knowledge becomes more and more a necessity. This instrument allows the analysis of the *metallurgical process – industrial ecology – environment economics* associations as integralist-type modern methodology (*Nicolae A., ş.a., 2009*).

The above-mentioned have tunder lately into concern to explore (by study and research) the interdisciplinary area related to the *economics – ecology association* under optimization terms of *energetic requirements*. It is the area of the 3 E or, to underline the significance further, the area of

E^3. This new field of scientific knowledge has been called *econology*. In the future, this ternary must be transformată into the *tehnology(T)-economy- energy-ecology* associations, so that the symbol of econology shall be TE^3. No special arguments are required to accept that econology deals, in particular cases, also with type 2E (or E^2) associations: economics – ecology, economics – energetics or ecology – energetics.

Econology came into being at the end of the XXth century. The etymology of the word is the resultat of a combination between the prefix *econo* (from *economics*) and the suffix *logy* (from *ecology*).

Considering the above, it is difficult to briefly, but wholly define econology. The authors of the present article mean, by econology, the scientific branch of research - development – innovation and the discipline of study regarding the optimization of the pollution prevention and control strategies and of the natural resource consumption strategies under economic effectiveness and energetic requirement minimization terms. If econology approaches a certain sector of industrial activities, it may get specific forms as *metallurgical econology*. Considering the importance of the environmental conditions to the durable development of the society, for the metallurgical engineer, econology means knowledge with reference to associations in the field of environment economics – ecometallurgy – environment energetics – technological processes.

In the metallurgical econology, the 3E correlations have to be studied as interdependences among the following functions:

- **Energetic performance;** it measures the minimization degree of the energetic consumptions;
- **Ecological performance;** it refers to the pollution level;
- **Economic performance;** it is a mixture of:
  - *financial performance* (minimisation of the fabrication costs of the product);
  - *production and productivity performance* (maximization of production, maximization of labour & facility productivity);
  - *quality performance* (social utility degree, whereby the product acquires competitiveness conditions).

From the metallurgical point of view, for the analysis and evaluation of the 3E correlations, it is required to define and use specific ecological indexes and indicators. We propose to classify them into two groups:

- *Extensity indexes* of the events (processes); there are indexes that refer to the size of the energetic consumptions or to the quantity of exhausted pollutants; because they can be derived by measurements or by calculations, they have a *passive* character *(of finding);* in this paper, they are denoted with I_e;
- *Intensity indexes* of the events (processes); there are indexes that refer to the economic performance; for the engineer that works in the industry of metallic materials, the performance of production and productivity has a special importance; because these indexes highlight the modalities of increasing the production and productivity in terms of decreased costs and increased quality, we consider they have a *dynamic* character *(of reforming, of intensification);* in this paper, they are denoted with I_i.

One of the basic principles of the metallurgical econology is: *the ecologic performance doesn't have to affect the economic performance.* In other words, the concerns regarding the minimisation of costs and increase of quality, production and productivity have priority. Therefore, we conclude that the econologic indexes must be predominantly from the category of intensity indexes.

2. DEFINITION AND CHARACTERISATION OF SOME SIMPLY INDEXES

Hereinafter, we are going to present some econologic indexes and indicators applicable in the industry of metallic materials.

The extensity and intensity of specific material consumptions

Currently, the specific consumption index is defined by the quantity of materials [tons of materials] consumed to produce one unit of metallurgical product [1 ton of metallic products]. Because it primarily refers to the quantity of consumed materials and not to the production of metallurgical goods (pig iron or steel), it should be the extensity index:

$$I_{e.m.c} = \left[\frac{\text{tons of materials}}{\text{1 ton of steel}} \right] \quad (1)$$

We propose to replace it with the index that measures the quantity of steel [tons of steel], produced when consuming one unit of materials. Because it primarily refers to the steel production under conditions of restricting the material consumption, it should be the intensity index:

$$I_{i.m.c} = \left[\frac{\text{tons of steel}}{1 \text{ ton of materials}} \right] \quad (2)$$

The energetic extensity and intensity of the *C* production and *p* productivity

Currently, the index that characterises the energy consumptions is defined by the *P* electric power [Mw] of the facility used to realise the *C* production [tons of steel] with the *p* productivity [tons of steel/h]. Because it refers to the energy consumptions (power) and not to the productivity or production, it should be the extensity index:

$$I_{e.e.p} = \left[\frac{\text{h} \cdot \text{MW}}{1 \text{ ton of steel}} \right] \quad (3)$$

We propose to replace it with the index that measures the productivity we can get for one unit of power. Because it primarily shows the importance of the productivity, should be the intensity index:

$$I_{e.i.p} = \left[\frac{\text{tons of steel}}{\text{h} \cdot \text{MW}} \right] \quad (4)$$

The analysis of the above mentioned indexes shows that I_{ee} represents, in fact, the specific consumption of electric energy, in [MW·h/t. steel]. This means that the usually-used index called *specific consumption of energy* is an extensity index that has to be waived. It should be replaced with the intensity index $I_{i.e}$ [tons of steel/MW·h], which indicates the production to be obtained when consuming 1 MW·h.

The extensity and intensity of the pollutant emissivity of the metallurgical facilities

Currently, the index of the pollutant emissivity is defined by the quantity of pollutants [kg; m_N^3 pollutants] exhausted when producing one unit of metallurgical products [1 ton of steel]. Because it primarily refers to the quantity of pollutants and not to the metallurgical production, it should be the extensity index:

$$I_{e.e.p.m} = \left[\frac{kg; m_N^3 \text{ pollutant}}{1 \text{ ton of steel}} \right] \quad (5)$$

We propose to replace it with the index that measures the steel quantity that can be produced when restricting the pollutants to 1 kg; m_N^3. Because this index highlights the role of the steel production, it should be the intensity index:

$$I_{i.e.p.m} = \left[\frac{\text{tons of steel}}{1 \text{ kg; } m_N^3 \text{ pollutant}} \right] \quad (6)$$

The extensity and intensity of the pollutant emissions of the vehicles used in metallurgy

Currently, the index is defined by the quantity of CO_2 exhausted when running 1 km distance. Because it refers to the quantity of pollutant without any information regarding the dynamic factor (number of kilometres), it should be the extensity index:

$$I_{e.e.p.v} = \left[\frac{g\, CO_2}{1 \text{ km}} \right] \quad (7)$$

We propose to replace it with the index that measures the number of kilometres afferent to an imposed quantity of CO_2. In this case, we refer to the intensity index:

$$I_{i.e.p.v} = \left[\frac{\text{number of kilometres}}{100 \text{ g } CO_2} \right] \quad (8)$$

The above information can be interpreted, for example, as follows:

- The furnace producing 0.8 tons of steel is more efficient than the furnace producing 0.7 tons, when the same quantity of materials (1 ton) is consumed;
- The vehicle that exhausts 100 g of CO_2 when running 1.2 km is more efficient than the vehicle that exhausts the same amount of CO_2 when running 0.9 km.

Extensity and intensity of the energetic evaluation of the gross domestic product (GDP). Currently, the energetic value of GDP is calculated by using an indicator that measures the energy consumption [GJ] required to obtain 1 unit of GDP:

$$\text{The current indicator used for the energetic evaluation of PIB} = \frac{[GJ]}{1 unity\, GDP} \quad (9)$$

Defined by this formula, it is an extensity indicator, because it refers to the consumed quantity of energy and not to the PIB to be realised. We propose to replace it with the intensity indicator:

$$I_{i.e.GDP} = \frac{[GDP\ \ units]}{1GJ} \tag{10}$$

which measures the value of the PIB produced in a country by consuming an energy unit.

Based on the above-mentioned things, the rankings of countries, according to the national energetic consumptions, are as follows (Table 1):

Table 1. Evaluation of the national energetic consumptions (Badea A., 2003)

Sr. no.	Country	Current situation		Proposed situation	
		Extensity index [GJ/1000USD]	Place in the rankings	Intensity index [USD/1 GJ]	Place in the rankings
1.	Austria	5.278	9	189.5	2
2.	France	7.076	6	142.0	5
3.	Italy	5.000	10	200.0	1
4.	Germany	6.700	7	149.0	4
5.	Spain	5.770	8	173.0	3
6.	Hungary	16.000	5	62.5	6
7.	Poland	18.450	4	54.2	7
8.	Czech Republic	23.000	3	43.5	8
9.	Romania	31.260	2	32.0	9
10.	Bulgaria	46.800	1	21.37	10

The information about the econologic undexes is summarized in the table 2.

Tabelul 2. Sistematizarea informaţiilor

Target	Defining relations	
	Extensity indexes (current solution)	Intensity indexes (proposed solution)
Specific consumption of materials	$\frac{\text{tons of materials}}{\text{1 ton of steel}}$	$\frac{\text{tons of steel}}{\text{1 ton of materials}}$
Energetic characterisation of the productivity	$\frac{\text{h}\cdot\text{MW}}{\text{1 ton of steel}}$	$\frac{\text{tons of steel}}{\text{h}\cdot\text{MW}}$
The pollutant emissivity of the metallurgical facilities	$\frac{\text{kg; } m_N^3 \text{ pollutant}}{\text{1 ton of steel}}$	$\frac{\text{tons of steel}}{\text{1 kg; } m_N^3 \text{ pollutant}}$
The pollutant emissions of the vehicles	$\frac{\text{g}CO_2}{\text{1 km}}$	$\frac{\text{number of kilometres}}{\text{100 g } CO_2}$
The energetic characterisation of the gross domestic product	$\frac{\text{GJ}}{\text{1 unity GDP}}$	$\frac{PIB\ \ units}{\text{1 GDP}}$

3. AGGREGATE INDEXES OF 2E AND TE LEVELS

a) The ecological-energetic index, $I_{ecl.en.}$. It is a *2E level index*, which highlights the ecological-energetic correlation. In this paper, it is defined as the ratio between the required energy quantity, as input measure, and the CO_2 quantity emitted in the technological processes:

$$I_{ecl.en.} = \frac{[GJ]}{[1\,ton\,CO_2]} \tag{11}$$

The maximisation of this index implies, at the same energy requirement, the minimisation of the energy quantities (heat) obtained by burning materials that contain carbon substances. In this respect, we recommend to act as follows:

- ❖ to use the enthalpy of the secondary energetic resources;
- ❖ to extend the energy making processes (heat) based on hydrogen;
- ❖ to increase the share of the energy supplied by hydro and nuclear stations;
- ❖ to use renewable energy sources.

b) The technological-ecological index, $I_{th.ecl.}$. It is an index used to analyse the influence of the technological factors on CO_2 constants. The $I_{th.ecl.}$ index is a *TE level index*. It is used to analyse the interdependence between the technological factors and the CO_2 conditions. For example, we can define two such indexes:

$$m_{CO_2} = f([\%Si]) \tag{12}$$

$$m_{CO_2} = f(Pg) \tag{13}$$

In the above expressions, [%Si] is the silicon percentage in the pig-iron made in the blast furnace, and Pg is the pressure at the loading aperture.

c) The degree of coke replacement by powdery coal, η_{PC}. This index characterises the coke quantity that can be replaced by powdery coal (PC) at making iron in blast furnaces. It is measured in [t.coke/t.coal]. It is also a TE level index (technology-ecology), which characterises the technological role of the coke replacement by powdery coal in the modification of CO_2 quantities. It is also an intensity index, because it firstly refers to the *coke performance*, and secondly to the *coal performance*.

The ecological evaluation of the substitutes for coke and especially of the powdery coal (PC), can be realised by taking into account the comparision of the chemical reactions of the CO_2 emissions. Appealing to the concept of equivalent carbon, the CO_2 emission can be written as follows:

For coke:

$$C_k E_{c_k} + O_2 \rightarrow CO_2 \tag{15}$$

For PC and coke:

$$\left[C_{Pc} E_{C_{CP}} + \left(C_k - \frac{C_{PC}}{\eta_{PC}} \right) E_{C_k} \right] + O_2 \rightarrow CO_2 \tag{16}$$

In the above relations, C_k is the specific consumption of coke, in [t·coke/t·pig iron], C_{PC} is the specific consumption of coal [t·coal/t·pig iron], E_{C_k} is the equivalent in carbon of the coke [t·carbon/t·cocs], $E_{C_{PC}}$ is the equivalent in carbon of the PC [t·carbon/t·coal], and η_{PC} is the degree of substitution [t·coke/t·coal].

In making the coal replacement advantageous in terms of CO_2 emission, the following inequality should be satisfied:

$$C_{PC} E_{C_{CP}} + (C_k - \eta_{PC} \cdot C_{PC}) E_{C_k} < C_k \cdot E_{C_k} \tag{17}$$

When solving the inequality, we obtain the *maximum allowable value* of the substitution degree, in terms of CO_2 emission:

$$\eta_{PC} > \frac{E_{C_{PC}}}{E_{C_K}} \tag{18}$$

For instance, to replace the coke with 0.85 C with coal with 0.60% C, the process is allowed in terms of CO_2 emission if $\eta_{PC} > 0.70$.

d) The financial-ecological index $I_{f.ecl.}$. It is a *2E level index*, which analyses the link between the savings to be realised through various technological processes and the quantity of CO_2. It can be expressed as follows:

$$I_{f.ecl.} = \frac{E_c}{1t.CO_2}, \qquad \left[\frac{\frac{Euro}{t \cdot (pig\ iron)}}{1t \cdot CO_2} = \frac{Euro}{t(pig\ iron) \cdot t_{CO_2}} \right] \tag{19}$$

where $E_c = (CF_1 - CF_2)$ is the saving [Euro] realised due to the difference between the production costs recorded in two different situations.

4. AGGREGATE INDEX OF 3E LEVEL, FOR ECONOLOGICAL ANALYSES

The evaluation of the efficiency of the econological measures in the *ecology-economy-energy system* requires recourse to specific indexes of *3E level*.

The authors couldn't find this kind of indexes in the iron-steel industry. To define the indexes to be used in the engineering field, we should start from the information found in the economic literature (*Purica I., 2005*). So, for large scale systems (country, geographical area), there are defined indexes resulted from the multiplication of simpler indexes. For example, such index is recommendable:

$$I = \frac{1}{\frac{Energy}{PIB}} \cdot \frac{PIB}{Population} \cdot \frac{1}{CO_2\ emission}; \qquad \left[\frac{PIB^2}{Energy \cdot Population \cdot CO_2\ emission} \right]$$

Analysing the above things, we found that the index trend was:

- inversely proportional to energy consumption;
- directly proportional to PIB;
- inversely proportional to the CO_2 emission.

Starting from this idea, we can define for the ecology-economy-energy correlation (e.e.e) an econological index whose trend is:

- inversely proportional to material price, p_{mat};
- directly proportional to calorific power, H_i;
- inversely proportional to carbon equivalent, E_c.

Therefore, we propose the following econological index:

$$I_{e.e.e} = \frac{1}{p_{mat}} \cdot H_i \cdot \frac{1}{E_c} \left[\frac{1}{\frac{Euro}{kg.mat.}} \cdot \frac{MJ}{kg.mat.} \cdot \frac{1}{\frac{kg.carbon}{kg.mat.}} = \frac{kg.mat.MJ}{Euro \cdot kg.carbon} \right] \quad (20)$$

Applying the above mentioned things when replacing the coke with powdery coal at blast furnaces, and using the *estimative values used in Romania,* we obtain the results presented in Table 3.

Table 3. The values of the $I_{e.e.e}$ index

Material	Price [Euro/kg]	H_i MJ/kg	E_c [kg,carbon/kg]	$I_{e.e.e.}\left[\frac{(kg.mat.)\cdot(MJ)}{(kg.carbon)\cdot(Euro)}\right]$
Coke	0.18	31.5	0.85	206.0
Natural gas (98% CH_4)	0.20	34.0	0.52	327.0
Fuel oil	0.22	42.0	0.87	220.0
Powdery coal	0.10	22.0	0.60	366.0

5. SOME CONCLUSIONS

- The metallurgical econology (application of the industrial econology) is a new field of knowledge to be researched and operationalised at the real conditions of the metallic materials industry.
- We propose and demonstrate the possibility to use the intensity indicators and indexes of events instead of the current ones, which characterise the extensity of events.
- Regarding the replacement of coke with powdery coal at blast furnaces, we can affirm that, from the econological point of view, all the materials proposed as coke replacements have a higher econological index.
- The recommended replacement materials are (in descending order):
  - powdery coal;
  - natural gas;
  - fuel oil.
- From E_c, combined with the other two parameters, we can deduce that, from the point of view of CO_2 emission, the partly replacement with PC is superior to the other two solutions.
- The above findings are supported by the results of other research areas. So, to improve the thermal performances of the blast furnace, we recommend the following materials (in descending order of importance): low-volatile coal, high-volatile coal, liquid fuel (fuel oil) and natural gases (*Peters K. H., 1995*).

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BIOLOGICAL AND CHEMICAL OXYGEN DEMAND AS INDICATORS OF ORGANIC POLLUTION OF LEACHATE AND PIEZOMETRIC WATER FROM SEMI CONTROLLED, NON SANITARY LANDFILL IN NOVI SAD, SERBIA

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ABSTRACT:
Landfill leachate is one of the most serious problems of municipal solid waste landfills. Leachate is generated as a result of the percolation of water and other liquid through any waste and the squeezing of the waste due to its weight. Since all natural waterways contain bacteria and nutrient, almost any waste compounds introduced into such waterways will initiate biochemical reactions. In August and September of 2008. Research was conducted to determine composition and quantity of waste that is disposed at semi controlled, non sanitary, municipal waste landfill in Novi Sad. The leachate samples and samples from piezometers were collected from collecting channel and 6 piezometers in municipal solid waste landfill in Novi Sad in January and May of 2010.
KEYWORDS:
BOD_5, COD, landfill, leachate, waste

1. INTRODUCTION

Landfill leachate is one of the most complex problems of municipal solid waste landfills. is generated as a result of the percolation of water through landfill body and the squeezing of the waste due to its weight, and it is contaminated with dissolved and suspended organic and inorganic compounds with different characteristics. Any oxidizable material present in a natural waterway or in an industrial wastewater will be oxidized both by biochemical (enzymatic) or chemical processes. The result is that the oxygen content of the water will be decreased. Basically, the reaction for biochemical oxidation may be written as:

Oxidizable material + enzymes + nutrient + O_2 ➔CO_2 + H_2O + oxidized inorganics such as NO_3^-, SO_4^{2-} and other residues

Oxygen consumption by reducing chemicals such as sulphides and nitrites is typified as follows:

$$S^{2-}{}_{(aq)} + 2\,O_2 \rightarrow SO_4{}^{2-}{}_{(aq)} \quad (1)$$

$$NO_2{}^-{}_{(aq)} + \frac{1}{2}O_2 \rightarrow NO_3{}^-{}_{(aq)} \quad (2)$$

Since all natural waterways contain nutrients and bacteria, their enzymes will initiate biochemical reactions of almost any waste compounds that are introduced into such waterways. Oxidizable chemicals (such as reducing chemicals) introduced into a natural water will similarly initiate chemical reactions. Both the BOD and COD tests are a measure of the relative oxygen-depletion effect of a waste contaminant.

Non sanitary, semi controlled municipal solid waste landfill in Novi Sad, Serbia was opened in 1964., but systematic land filling with reasonable amount of waste begin in 1980. Landfill size is

56 acres, from which landfill body occupies 22 acres. At the landfill, there is about 2000000 m^3 of waste. Landfill is divided into 3 main fields (Figure 1): I, II and III field (III field is divided into two parts: *a* and *b*). Height of waste at some parts of landfill body is in range from 2.5 to 14 meters.

Figure 1. Landfill in Novi Sad

2. METHODOLOGY

In August and September of 2008 research campaign was conducted to determine composition and quantity of waste that is disposed at landfill in Novi Sad. Figure 2 shows composition of municipal solid waste in Novi Sad.

The biggest part of waste from households and commercial sector is biodegradable, organic waste that is decomposed by microbiological and chemical mechanisms in landfill body (Figure 3). Biodegradable waste consists of:

- **Garden waste**: grass, old dirt, flowers, branches, leaves,
- **Waste from food**: bread, meat, fruit, vegetables,
- **Paper**: old newspaper, journals, books, notebooks, letters, receipts...
- **Cardboard**: cardboard boxes, flat cardboard, packages for juices, yoghurt, milk, etc....
- **Textile**: nature fabrics (cotton, wool, ...)

The biggest percentage of waste is biodegradable organic matter (Figure 2).

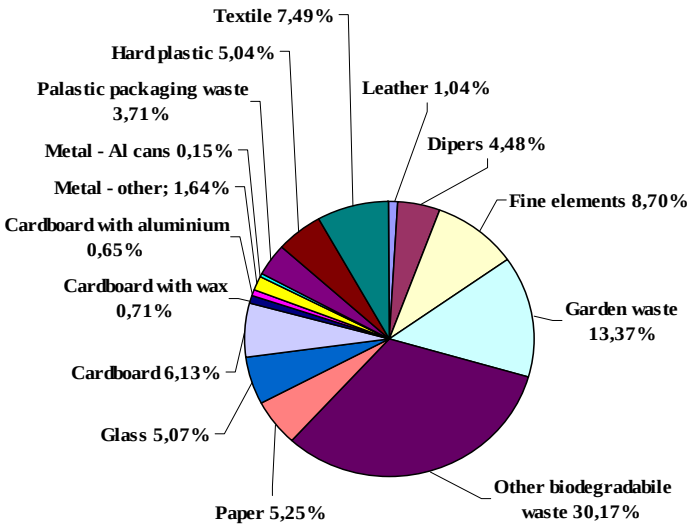

Figure 2. Composition of municipal solid waste in Novi Sad

3. FINAL RESULTS

The leachate samples and samples from piezometers were collected from collecting channel and 6 piezometers in municipal solid waste landfill in Novi Sad (Figure 4) in January and May of 2010. The samples were transported to the laboratory and analyzed immediately.

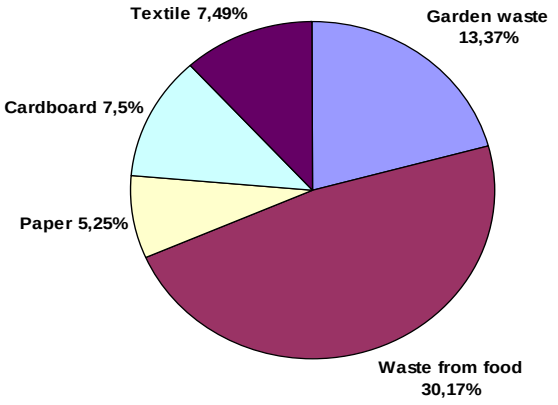

Figure 3. Waste composition of municipal solid waste in Novi Sad

Biological oxygen demand (BOD_5) was determined using HACH BOD TRAK device. The sample is kept in a sealed container fitted with a pressure sensor. According to manufacturer specifications, lithium hydroxide is added in the container above the sample level as a substance

which absorbs carbon dioxide. Oxygen is consumed and, as ammonia oxidation is inhibited, carbon dioxide is released. The total amount of gas, and thus the pressure, decreases because carbon dioxide is absorbed. From the drop of pressure, the sensor electronics computes and displays the consumed quantity of oxygen.

Figure 4. Sampling sites at landfill in Novi Sad

Chemical oxygen demand was determined using reagent test tubes in HACH DR5000 UV visible spectrophotometer. To perform the test, simply pipette water sample to a cuvette and leave it in a heater for 2 hours at 148°C. At the end of this period the intensity of colour in the solution is directly related to the COD value in the sample, and can be measured quickly, accuratly and easily.

The results for COD and BOD of the water samples are presented in Table 1.

Table 1. Results for COD and BOD of the water samples

No.	Parameter	Unit	Piezometers						Collecting channel		
			Pz1	Pz2	Pz3	Pz4	Pz5	Pz6	1	2	3
1.	Water temperature	°C	8	12	9	10	8	12	3	3	3
2.	Ambiental air temperature	°C	-1	0	0	-1	-1	-1	0	0	0
3.	BOD_5	mg/l	8	90	22	80	26	14	86	66	144
4.	COD	mg/l	21.3	443	44.9	88.1	60.2	34.6	429	593	714
Date of analysis: 25.01.2010.											
No.	Parameter	Unit	Piezometers						Collecting channel		
			Pz1	Pz2	Pz3	Pz4	Pz5	Pz6	1	2	3
1.	Water temperature	°C	11	14	12	12	15	12.5	16	16	16
2.	Ambiental air temperature	°C	20	20	20	20	20	19	20	20	20
3.	BOD_5	mg/l	8	85	23	21	15	9	102	90	120
4.	COD	mg/l	10.2	156	27.1	60.3	42.6	12.9	164	163	155
Date of analysis: 07.05.2010.											

Non sanitary, semi controlled municipal solid waste landfill in Novi Sad doesn't have impermeable barrier so contaminated leachate is leaking into the soil and could cause pollution of soil and groundwater. From Figure 5 and Figure 6 it can be seen that most contaminated piezometer is P2 with BOD values from 85 – 90 mg/l, and COD values from 156 – 443 mg/l. This piezometer is located downstream from landfill body and suffers most of the contamination (Figure 4). Also there is noticeable difference in BOD and COD values obtained in January and May.

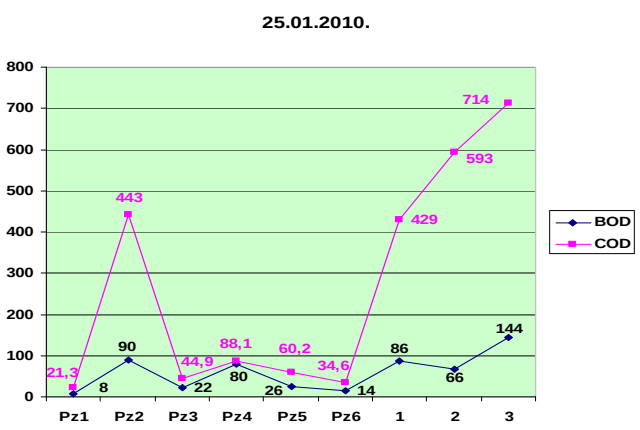

Figure 5. Values for BOD and COD from January 2010

The values for BOD and COD are lower in May than in January. This can be explained as the consequence of seasonal temperature and precipitation variations and hydrological characteristics. Rain and snow melting are causing dilution of leachate and lower BOD and COD values. Also, because there were lot of rain in this period the groundwater level is much higher than in January 2010.

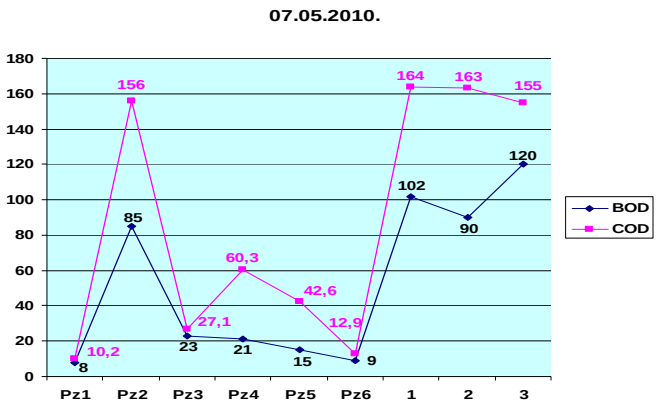

Figure 6. Values for BOD and COD from May 2010

COD values for collecting channels were in range from 155 – 714 mg/l. The collecting channels are located downstream of landfill body and they are collecting leachate water from landfill but also they collect atmospheric water (rain, snow) and groundwater. Having this in mind, the real values for COD and BOD of leachate is much higher than measured values.

BOD values for collecting channels were in range from 66 – 144 mg/l. These high values of BOD show great organic pollution of leachate water with biodegradable organic matter.

4. CONCLUSION

Landfilling is still one of the most used methods for waste disposal. One of the biggest problems with landfills is highly contaminated leachate that is produced in landfill body. In Vojvodina region (northern part of Serbia), there is only one sanitary landfill that has impermeable bottom membrane and leachate collection system (landfill in Kikinda). From obtained results of BOD_5 and COD it can be concluded that the leachate from landfill in Novi Sad is contaminating soil and groundwater *in continuus*. The most contaminated piezometer is P2 that is located downstream from landfill body and suffers most of the contamination. The groundwater level in this part of landfill is very high so there is justified concern for spreading of contamination. Because leachate is very toxic (high content of heavy metals, organic matter and pathogenic microorganisms) it is necessary for landfill to be sanitary (impermeable bottom liner, leachate collection system, on-site wastewater treatment facility...) for prevention of further soil, groundwater and contamination of surrounding environment.

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ANALYSIS OF COLOUR CHARACTERISTICS OF PAPRIKA POWDER WITH DIFFERENT OIL CONTENT

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ABSTRACT:
We investigated the several quality Hungarian paprika powders. The oil contents of paprika powders were increased by 1%, 2%, 3%, and 4% relative to the initial sample. The colour, determined by using the CIE L^*, a^*, b^* colour system, was measured with a Minolta CR-300 tristimulus colorimeter. The colour coordinates were evaluated by using variance analysis of one factor. The colour differences (ΔE^*_{ab}) and hue differences (ΔH^*_{ab}) of the initial samples and the samples with various added oil contents were calculated to determine the changes in colour. The lightness coordinate L* and yellowness coordinate b* were found to decrease significantly. The redness coordinate a* did not change significantly. A significant and perceptible change relative to the initial samples is observed at an added oil content of 3%. The changes in the colour characteristics in response to oil content increase can be observed visually, the powder becoming darker and redder.
KEYWORDS: Hungarian paprika powders, quality, colour characteristics, investigations

1. INTRODUCTION

The use of natural food colours is preferred to that of artificial dyestuffs for modern alimentary purposes. Paprika is a spice plant grown and consumed in considerable quantities worldwide, and also used as a natural food colour. Hungarian paprika powder is still regarded as a "Hungaricum" today. Paprika is cultivated in areas of the world such as Spain, South Africa and South America, where the weather is favourable for the growth of this plant and for the development of its red colouring agents. The large number of hours of sunshine allows the paprika to ripen on its stock, so that the basic material reaching the processing mills has high dyestuff content. Hungarian paprika has a unique aroma and a specific smell, but the production of powder with a good red colour is a considerable problem. The colour of paprika powder is very important, because the consumer concludes its colouring powerful based on its colour, although the relation isn't unequivocal between them (H.Horváth, 2005). The colouring powerful is determined by quality and quantity of colouring agent of paprika squarely, but the colour of the powder is influenced by many factors besides the colouring agent content. Various investigations have been made of the connection between the colouring agent content of the powder and the colour characteristics measured by different techniques (Navarro et al., 1993, Nieto- Sandoval et al., 1999). Such investigations have yielded partial results, but there is no formula that describes the correlation between the colouring agent content and the colour characteristics. Since the 1970s a number of papers have been published on measurements of the colour of paprika powders (Horváth&Kaffka, 1973, Drdak et al., 1980, Huszka et al., 1984, Drdak et al., 1989). Measurements have been performed relating to the changes in the colour stimulus components X, Y and Z of powders during mixing (Huszka et al., 1984) and to the correlation between visual sensing and the instrumentally measured colour characteristics (Huszka et al., 1985). The effects of ionizing irradiation on the colour of paprika powder were investigated by Fekete-Halász et al. (1996). Minguez et al. (1997) analysed how the colour of the powder is changed by the ratio of the yellow and red pigments within the total colouring agent content. Chen et al. (1999) investigated the effects of particle size in Korean cultivars and established that the lightness coordinate of the powder was influenced by the particle size. Applying a Hungarian milling technique, Horváth&Halász-Fekete (2005) demonstrated that the particle size exerts a significant influence on

all three colouring characteristics of powders made from Hungarian, South African and South American paprika. Kispéter et al. (2003) investigated the influence exerted on the colour by saturated steam used for germ reduction. In the case of Korean cultivars, no significant change in colour characteristics was detected when the moisture content varied between 10% and 15% (Chen et al., 1999). H.Horváth&Hodúr (2007a) investigated Hungarian paprika powders and depicted, that the colour of the powder was observed to turn into darker and deeper red with increasing moisture content.

The influence of physical and chemical properties of Hungarian paprika powder on its colour was investigated in course of our work. In this paper is presented, how the colour characteristics of Hungarian paprika powders change following increase of the oil content.

2. THE STUDY

2.1. COLOUR MEASUREMENT

Colour measurements were performed with a Minolta CR-300 tristimulus colour measuring instrument. The CIELab colour system was used for colour characterization. In this colour space the colour points are characterized by three colour coordinates. L^* is the lightness coordinate ranging from no reflection for black (L^*=0) to perfect diffuse reflection for white (L^*=100). The a^* is the redness coordinate ranging from negative values for green to positive values for red. The b^* is the yellowness coordinate ranging from negative values for blue and positive values for yellow.

The total colour change is given by the colour difference (ΔE^*_{ab}), in terms of the spatial distance between two colour points interpreted in the colour space: (Hunter, 1987)

$$\Delta E^*_{ab} = \left[\left(L^*_1 - L^*_2\right)^2 + \left(a^*_1 - a^*_2\right)^2 + \left(b^*_1 - b^*_2\right) \right]^{1/2}. \quad (1)$$

If ΔE^*_{ab} >1.5, then the color difference between two paprika grists can be visually distinguished (H.Horváth, 2007b). The chroma $\left(C^*_{ab}\right)$ the hue difference were used to determine the change of color.

$$C^*_{ab} = \left(\left(a^*\right)^2 + \left(b^*\right)^2 \right)^{\frac{1}{2}} \quad (2)$$

The chroma represents colour saturation which varies dull at low chroma values to vivid colour at high chroma values (Hunter,1987). The equations used to describe the hue difference (ΔH^*_{ab}) between two colour points are as follows:

$$\Delta H^*_{ab} = \text{sign}\left(a^*_1 \cdot b^*_2 - a^*_2 \cdot b^*_1\right) \cdot \left(\left(\Delta E^*_{ab}\right)^2 - \left(\Delta L^*\right)^2 - \left(\Delta C^*_{ab}\right)^2 \right)^{\frac{1}{2}} \quad (3)$$

2.2. PREPARATION AND MEASUREMENT OF THE SAMPLES WITH INCREASED OIL CONTENT

Ten paprika powder samples were prepared from different Hungarian paprika varieties. The oil content of each of the samples was increased by 1%, 2%, 3% and 4% relative to the initial sample. The samples of 10 g of powder were weighed with four-digit accuracy on an analytical balance, after the 0.1 g, 0.2 g , 0.3g and 0.4g of oil was added to samples. After homogenisation the colour coordinates of these samples were measured in 3 parallel measurements. The data were evaluated by using variance analysis of one factor.

3. ANALISES, DISCUSIONS, APPROACHES AND INTERPRETATIONS

Tables 1-3. present the variance analysis results.

Table 1 Variance table for lightness coordinate L*

Source of variation	SQ	DF	MQ	F-ratio	p
Between groups	20.96	4	5.24	2.871	0.0335
Within groups	82.14	45	1.82		
Total	103.10	49			

Table 2 Variance table for redness coordinate a*

Source of variation	SQ	DF	MQ	F-ratio	p
Between groups	17.31	4	4.32	1.681	0.1700
Within groups	115.82	45	2.57		
Total	133.13	49			

Table 3 Variance table for yellowness coordinate b*

Source of variation	SQ	DF	MQ	F-ratio	p
Between groups	48.13	4	12.03	2.22	0.0811
Within groups	243.14	45	5.40		
Total	291.27	49			

The data in Tables 1-3 demonstrate the lightness and yellowness coordinates were significantly influenced by increasing oil content (significant level was p=0.0335 and p=0.0811), whereas there was no influence on the redness coordinate. As concerns the detailed analysis, the average values of the colour coordinates are presented in Figs 1-3, differences being taken as significant at a level p = 0.05.

It can be seen that the lightness coordinate L^* progressively decreased with increasing oil content. An added 3% oil content caused a significant and well-perceptible change. Further added oil did not induce any additional perceptible decrease. The average value of redness coordinate a^* similarly decreased with increasing oil content, as compared with the initial sample, the difference was 1 unit at an added oil content of 4 %. The yellowness coordinate b^* changed more strongly. With increasing oil content, the average values of b^* decreased significantly, 2.1 units at added oil contents of 3%.

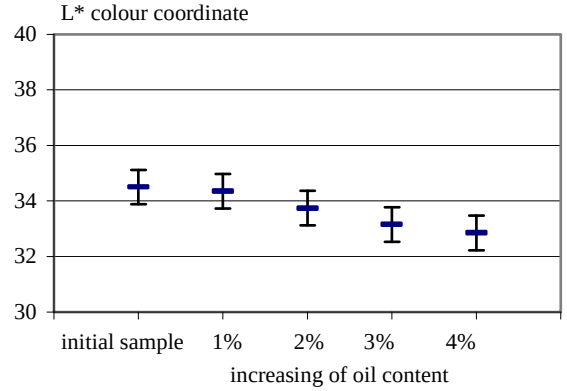

Fig. 1. Result of variance analysis of lightness coordinate (average±$SD_{0.05}$)

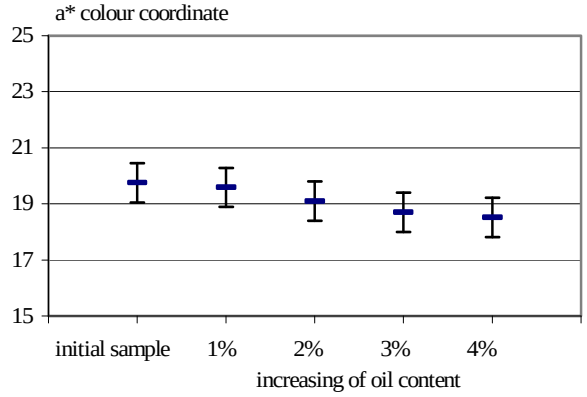

Fig. 2. Result of variance analysis of redness coordinate (average±$SD_{0.05}$)

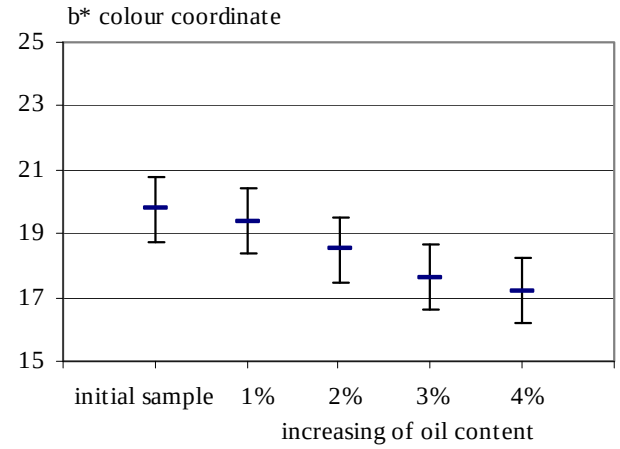

Fig. 3. Result of variance analysis of yellowness coordinate (average±$SD_{0.05}$)

The colour (ΔE^*_{ab}) and hue (ΔH^*_{ab}) differences of the initial samples and the samples with various added oil contents were calculated to determine the changes in colour. The values are shown in Table 4.

We can see, that the value of ΔE^*_{ab}>1.5 for all samples at an added oil content of 3%, therefore an added 3% oil content caused a significant and perceptible change.

The hue difference was negative for all samples at an added oil content of 3%, too. This indicates that the paprika powders became redder.

Table 4.The colour (ΔE^*_{ab}) and hue (ΔH^*_{ab}) differences of the initial samples and the samples with various added oil contents

Sample	Increasing of oil content							
	1 %		2 %		3 %		4 %	
	ΔE^*_{ab}	ΔH^*_{ab}	ΔE^*_{ab}	ΔH^*_{ab}	ΔE^*_{ab}	ΔH^*_{ab}	ΔE^*_{ab}	ΔH^*_{ab}
P1	0,69	-0,36	1,57	-0,15	2,43	-0,82	4,09	-1,08
P2	0,93	0,48	1,09	-0,34	2,44	-0,80	3,42	-1,09
P3	1,10	0,43	2,09	-1,15	1,53	-0,52	2,23	-0,62
P4	1,09	-0,43	3,43	-1,40	3,58	-0,93	4,35	-0,72
P5	0,70	0,03	1,48	0,05	3,10	-0,91	3,70	-1,23
P6	0,33	0,11	1,31	-0,04	2,93	-0,41	3,28	-0,49
P7	0,49	-0,14	2,75	-1,43	3,35	-1,53	3,14	-0,71
P8	2,91	-1,41	2,78	-1,24	4,84	-1,68	5,56	-1,37
P9	0,57	-0,43	2,49	-1,28	1,79	-0,37	2,38	-0,39
P10	1,13	-0,42	1,05	0,01	2,65	-0,71	3,62	-0,72

4. CONCLUSIONS

- ✓ The oil content influenced the lightness coordinate L^* significantly, it decreases with increasing added oil content.
- ✓ The oil content influenced yellowness coordinate b^* significantly , too, gradually decreases with increasing added oil content.
- ✓ The redness coordinate a^* did not change significantly.
- ✓ A perceptible change relative to the initial samples is observed at an added oil content of 3%.
- ✓ The changes in the colour characteristics as the added oil content is increased can be observed visually: the powders became darker and redder.

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OPTIMISATION OF SELECTIVE WASTE COLLECTION ROUTES ON THE BASIS OF GEOGRAPHICAL INFORMATION SYSTEM (GIS)

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ABSTRACT:
The advantages of GIS systems are extended from determining positions into complex route optimisation software. A specialized type of these solutions are applied for elaborating the functions of advanced selective waste collection systems to handle the effects of variable – in some cases non-deterministic – boundary conditions. The aim of this paper is to represent the research activities according to the development of methods towards on one hand the above mentioned application and on the other hand to harmonize them for the sake of economic operation of the collection systems.
KEYWORDS:
optimisation software, waste collection systems, GIS systems

1. INTRODUCTION

Countrywide spreading of selective waste collection systems extends the demand for services which enable the cost -effective operation of these systems. These services are important as the marketing activities regarding the positive environmental effects of the selective collection enhance the amount of waste fractions which became secondary raw material in this way. Accordingly the time period between the unloading procedures of the collection islands have to be shortened to avoid the consumers facing overloaded and contaminated containers. There are several other factors which have influence on the waste amount which is carried to the selective islands (during the periods between the unloading service days) besides this emerging trend. One of these factors is the emerged amount of PET bottles in summer time or another one is the less amount of paper in case of the school organized paper collection actions.

2. THE STUDY

Keeping the regular service level while emerging waste amounts means the continuous revision of the collecting vehicle routes and continuous monitoring of the waste amounts gathered in the collection islands. Collection Service Operators (CSOs) are interested in economic operation accordingly they seek combined collection possibilities of the different waste fractions which ensure the maximal utilization of the collection capacities. My research deals with the effects of various collection conditions and seasonal differences of the waste generation on the vehicle routes. It is possible to answer the following practical questions regarding the operation of collection systems in the base of the research activities:

- What effects the varying gathered waste amount has
  - on the route of the collection vehicles and on the collection time,
  - and on the number of collecting vehicles and other resources?
- What influence the varying velocities of the collection vehicles have on the collection time and length of the routes?
- What kinds of savings are realized (if any) by combined collection?

- Which recycling facilities have to be chosen in a specific situation?
- How collection parameters are influenced by relocating the collection islands or by modifying the configuration of the waste fraction containers on the islands?

The only way of answering these questions is to carry out simulation examinations regarding on one hand the different alternatives of measure of the waste generation and on the other hand the alternatives of collection system operation. The broader aims of the examinations are to determine the optimal service method which is in strict correlation with the decision about the mutual or separated collection of the waste fractions, after these the necessary number of routes has to be determined. Spatial modelling the road network of the service area with the island locations and receivable types and container number of waste fractions in each collection islands are preconditions for accomplishing the examinations.

A sample examination on a route optimization for an urban area selective waste collection system will be presented in the followings. The examined system contains 130 collection islands and covers 3 types of waste fractions: paper, plastic (mainly PET) and glass bottles.

The examinations are carried out by simulation activities on the ground of the following thoughts:

- adequately parameterized (regarding e.g. the fraction types, service locations, vehicle container capacities, vehicle speed, fuel) collection vehicle goes from island to island
- shifts the waste fractions from the waste bins of the collection islands to the vehicle container (The amounts of the waste quantities are taken into account by average load volumes of the waste bins in the case of every fraction. These averages are applied on every island)
- searching the treatment facility in case of reaching the vehicle container capacity
- continuing collection route after bulk unloading at the facility

3. ANALYSES, DISCUSSIONS, APPROACHES AND INTERPRETATIONS

These simulation steps in iteration cycles are continuing until all island containers serviced and minimal collection route length found. The primary topic of this paper is not the calculation of the minimal route length but the interpretation of the effects of the above listed condition changes (e.g. the quantitative change of the waste on the islands between the unloading services) on the routes.

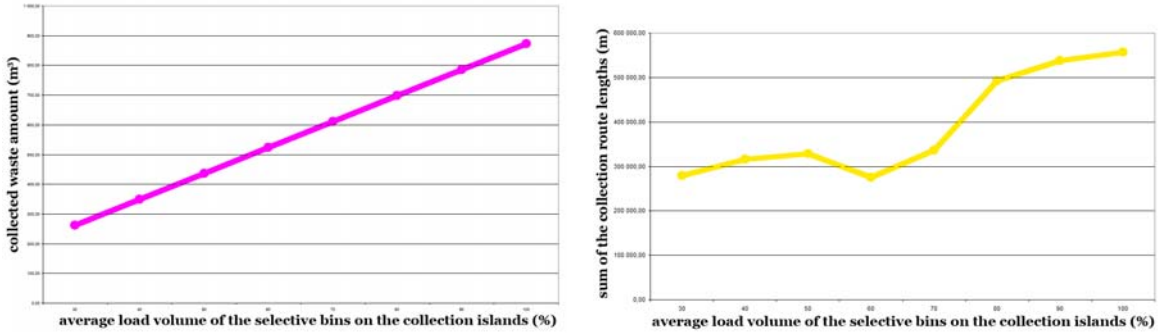

Fig.1.: Collected waste amount and sum of the collection route lengths against the average load volume of the selective bins on the collection islands

Left side of the 1st figure presents the achievement of the examination which regards to the collected waste amount against the average load volume of the selective bins on the collection islands. It shows that the collected waste amount is emerging proportionally with emerging of the average load volumes.

Right side of the 1st figure presents the achievement of the examination which regards to the sum of the collection route lengths against the average load volume of the selective bins on the collection islands. The result shows that the change of the summarized collection length is not proportional with the change of the average load volume. Accordingly higher load volumes of the selective bins will not mean longer collection routes in every case.

This graph shows that higher loads mean shorter routes in some cases. The potential causes to be taken into account for accepting this result are the following:

- the utilization of the vehicle container capacity (tons/km) is better if the load volumes of the selective bins are higher,
- the rate of the filling of the vehicle container is different in the cases of the different average load volumes of the selective bins. It means that treatment facility is visited from the different collection islands in these cases.

Since these visits mean different itineraries and in some cases the shorter route lengths for the collection of higher waste amounts are documented in the course of the route optimization processes.

It is necessary to answer the questions regarding the required number of collection vehicles. On one hand this number is an output parameter of the route optimization process and on the other hand this number has similar correlation to the load volumes of the selective bins such as the previous presented parameter (the sum length of collection routes) had. By the side of the collection service providers it is important to determine the increment of the load volumes of the selective bins which requires involvement a new vehicle to the collection fleet.

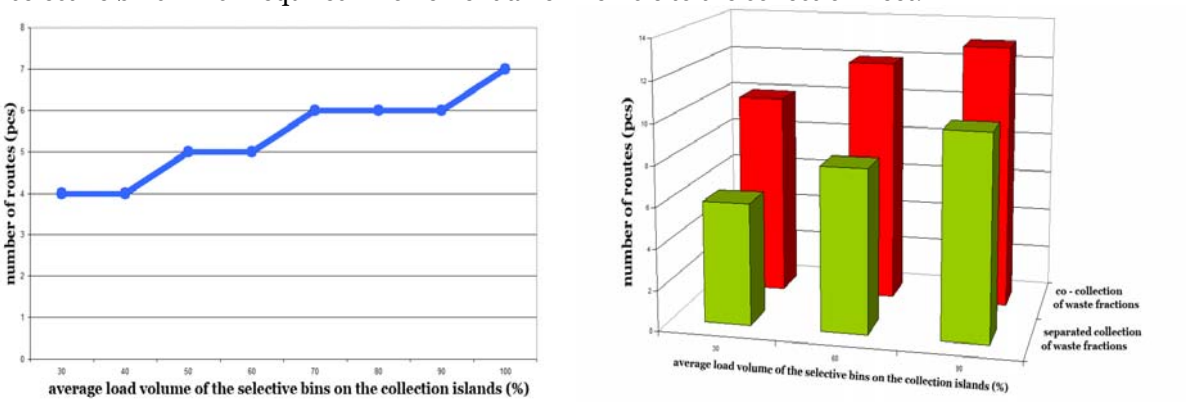

Fig.2.: The number of collection routes against the average load volume of the selective bins on the collection islands and the effects of the different collection methods on the collection routes

Left side of the 2nd figure presents the achievement of the examination which regards the number of collection routes against the average load volume of the selective bins on the collection islands. An important achievement of the examination is that the rising rate of the route numbers is lower than the rising rate of the average load volumes. By means of the previous achievement the reserves of the applied collection fleet are quantifiable by the service providers. E.g. the number of routes which set up for service of waste bins with 70 percent average load volume is able to service waste bins with 90 percent average load volume too.

The right side of the 2nd figure shows that the necessary number of routes in the case of combined collection (when waste collected into separated collection container sections of the same vehicle) is higher than this number of routes in case of separated collection of the waste fractions. The reason is the different loading rate of the vehicle container sections in correlation with the different rate of disposition of the waste fractions on the selective islands.

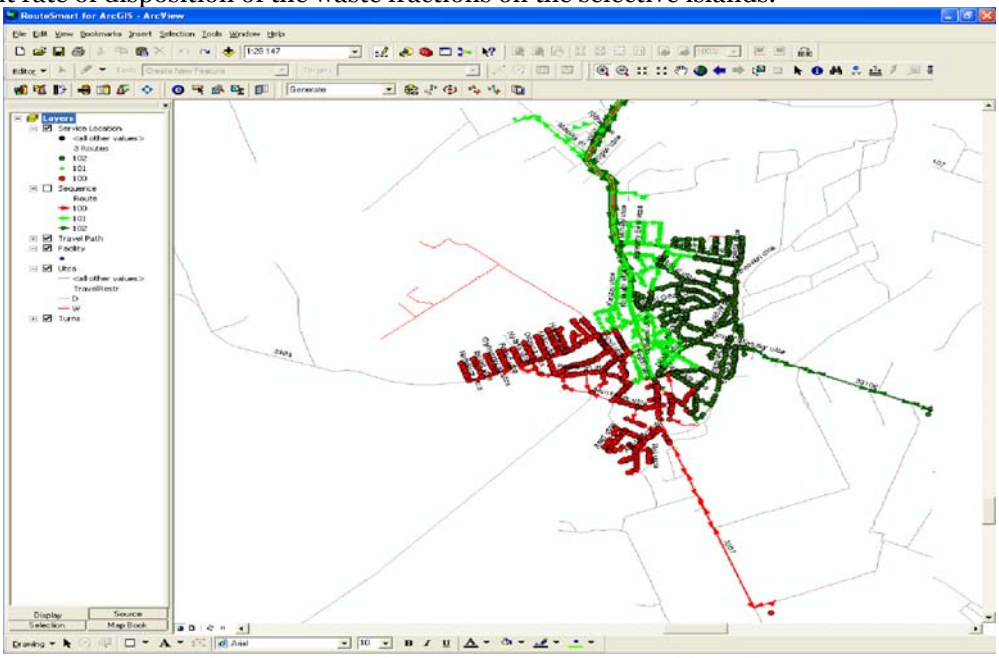

Fig.3.: Service area and collection routes (presented in different colours) in RouteSmart for ARCGIS

The volume of the separated sections are smaller than the volume of the whole vehicle container capacity therefore each of them are filled faster along the collection way. The section of the infrequent waste fraction is filled relatively slower than the section of the other fraction accordingly there will be unused capacity every time after the other section is filled. The collection vehicle visits the treatment facility more often because of this faster filling rate hence the collection route length is emerging.

4. CONCLUSIONS

These statements depend on the examined area however, their application is generalized. Location of the selective collection islands correlated to each other and to the traffic infrastructures and the classification of the actual service area by settlement type (e.g. building estates or bungalow zone) have influence on the quantity of the selective waste fractions to be collected.

An important achievement of these examinations is that the interpretation of a routing system (even the evaluated one) as constantly valid set-up for collective vehicle operation is faulty.

Accordingly the routing system has to be revised and actualised periodically and during these revisions the boundary conditions, economic operation and keeping the desired service level have to be taken into account.

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AIR POLLUTION IN THE AREA OF COAL DEPOSITS OF SE ROVINARI. RISK ASSESSMENT

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ABSTRACT:
This paper is analyzed the work carried out on site is Rovinari generators of pollution. It analyzes the level of pollution, making a quantitative and qualitative risk assessment. Qualitative risk assessment aims to identify factors: source, path, receiver location analysis. Quantitative assessment is made based on a classification system of probability and severity.
KEYWORDS: risk assessment, coal deposits, air pollution

1. GENERAL CONSIDERATIONS

Rovinari Central is located approximately 16 km west of the city of Targu-Jiu, in a hilly area at an altitude of 150 m. Central Rovinari works in: - precincts Rovinari CTE - Rosia coal chamber.

CTE Rovinari - is located on the right side of the river Jiu, near the main road connecting the city of Targu-Jiu Filiasi. Rovinari CTE enclosure includes two coal deposits (and deposit Rogojelu crushed) in the extreme western limit Rogojelu the village.

Rosia coal chamber - (Rosia notbreaking coal deposit) is located in the south-east precinct at about 1500 CTE Rovinari I also mention that it also includes CTE Rosia conveyor between CTE and coal deposit, Rosia 1.5 km in length.

SE Rovinari activity covers the production of electricity and heat. This is accomplished by having produced a total of six boilers that are fueled by coal, with an hourly consumption of about 2300t / h, plus secondary fuel oil and natural gas. lignite power plant supply of household coal is the employer or directly from the pits through conveyor belts.

Household coal supply is designed and flow necessary to continue the six steam boilers, running on fuel from the main pit lignite coal basin Oltenia, located nearby. Lignite supply plant on conveyor belts is high capacity buses (type TMC) that collects the coal from the several quarries: Rosia de Jiu Tismana I Tismana II, streams and Rovinari East.

To compensate for variations of supplies of coal no rhythm (higher in warm seasons and lower in winter) and required power generation plant (higher summer and lower in winter) have constructed deposits of coal (raw and crushed) designed to ensure a match between supply and consumption possibilities.

Sources of coal dust in coal deposits are: - conveyor systems - machines and deposit taking bucket wheel - grinding stations

Emissions of coal dust deposits from the raw coal open pits Rovinari ,Tismana Garla and Rosia, equipment that comes into the production process flow of dust emissions during operation. These emissions occur in the formation of coal deposits for cars with combined KSS1; KSS2; M5a, M6a and acquisition of raw coal deposits of cups impeller discharge conveyor belt.

They also place the discharge of dust emissions on cars combined coal belt conveyors leading to the sorting station for sorting, crushing stations was provided an indoor facility for dusting which reduces emissions of dust in these buildings.

Emissions of coal dust in the form of particulate matter are driven by wind to nearby residential areas and ecosystems. Determinations were made of emissions of particulate matter in open areas immediately surrounding the coal deposits, Rogojelu village, Rosia Rovinari and neighborhood blocks. The results highlight determinations exceeding the maximum permissible concentration of protected areas (according to STAS 12574/87 between 1.2 to 2.4 times)

It should be noted that assessment of the deposit was influenced by the synergistic action due to power plant emissions of pollutants, namely particulate emitted by chimneys, dust from the transport, etc..

2. QUALITATIVE RISK ASSESSMENT

Air pollutants, the potential of respiratory disease are dust (or sediment in suspension). In small and medium concentrations, these pollutants can cause pathological changes of the respiratory system by overloading the respiratory defense mechanisms.

Particulate matter with a diameter greater than 10 mm (sediment) are retained in the rate of 90% in supraglottic extrapulmonary airways, their removal is relatively faster. Powders with a diameter less than 10μm (suspended) in percentage retention extrapulmonary airways is inversely proportional to their size, ranging from 80-90% for close to 10 mm in diameter, until a little more than 5% for those with a diameter of 1μm.

Particles with diameter less than 3μm intrapulmonary enter the airways where they propose retained in 1-2%. When particle sizes are very small (less than 0.001 mm) retention processes are similar to those of gas.

The mechanism of action on the lung tissue is to stimulate the production of mucus and impaired movements of cilia vibrations pulmonary macrophage function, bronchial hyper activity, stimulation of fibrogenesis. The effect depends on both the nature and concentration of pollutant agent or combination with other risk factors.

TABLE 1. Relationship analysis matrix for source-path-receiver

Nr. crt.	Pollutant	Danger	Source	Way	Receptors	Achieving the target path of the source	The importance of risk (quantitative risk assessment, MXP)	The need for remedial works
1.	Suspended powders	Pneuxnoconiogen	Transport System	air	Human (people living in the area analyzed)	Yes	6 average	Yes
			Submission and answer machines					Yes
2.	Sediment particles	Changing natural environment	Transport System	air	ground	Yes	3 average	Yes
					wells	Yes	3 average	
			Submission and answer machines		vegetation	Yes	3 average	Yes
					material goods	Yes	3 average	
3.	Noise	Effect on body additive and other diseases	Transport System	Airborne acoustic wave	Human (people living in the area analyzed)	Yes	6 average	Yes
			Submission and answer machines					Yes

Risk calculation is based on a classification system where the probability and severity of an event is classified Top randomly assigning them a score.

Classification probabilities: 3 = high probability 2 = average 1 = low

Classification of severity: 3= major 2 = average 1 = slight

The risk factor is calculated by multiplying the probability of gravity, thus obtaining a comparative figure, it will allow for comparisons between different risks. As the result is greater, the greater will be the priority will be given to controlling risk.

R=PxG

R :risk of an unpredictable element

P :probability

G:hazard severity

Slacking

Suspended dust

P=3 ; G=2 R=3x2=6

sediment particles

P=3 ; G=1

R=3x1=3

Noise
p=3 ;G=2
R=3x2=6
Risk assessment can be presented as a matrix.

3. CONCLUSIONS

As a result of risk assessment matrix is presented above suggest the following measures (Measures to reduce dust-generating sources):

- To reduce dust aerosol spray is proposed to apply water at the point of discharge / charge carriers or components from loading / unloading conveyors.
- To reduce dust is proposed to apply the dusting installation to the designed parameters, that the designed system components from the crusher. Measures to limit coal dust deposit
- To reduce dust aerosol spray is proposed to apply water at the point of discharge components from loading / unloading conveyors
- Measures to limit dust in inhabited areas in order to reduce dust and sediment suspension in private residential areas shall apply dust control measures at the source. Making screensavers (plantations - where Rosia village church and between deposit and adjoining blocks Rovinari the city).
- Monitoring and surveillance measures to limit dust requires periodic monitoring of concentrations of suspended dust at source and deposit receptors and receptors for tracking the dust settled the efficiency measures implemented.

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[1.]Imre DÉKÁNY

TITANIUM DIOXIDE AND GOLD NANOPARICLES FOR ENVIRONMENTAL AND BIOLOGICAL APPLICATION

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ABSTRACT:
In the work presented here we wished to study the role of clay minerals as environmentally friendly supports of the photocatalyst P 25 TiO_2 in detail. The reason for our interest is that layer silicates are outstandingly efficient adsorbents for organic pollutants, since organic molecules are adsorbed on the surface of clay minerals, which, so to say, accumulate environmentally harmful substances [5,6]. We wish to point out that the layer silicate component has a significant influence on the rate of catalytic degradation and, therefore, TiO_2/montmorillonite nanocomposites are eminently suitable for practical applications such as air and water purification technologies.
In the second part of this work reproducibly size-controlled gold nanoparticles reduced and stabilized by citrate were synthesized in aqueous dispersions. Gold nanorods were grown on functionalized gold surface and the kinetics of growth was studied. The surface of Au nanoparticles was modified by thiol-containing compounds, namely cysteine and glutathione, and the effect of pH and increasing cysteine concentrations on the dispersions was investigated by UV-Vis spectrometry.
KEYWORDS:
Nanocomposites, nanoparticles, gold, application

1. INTRODUCTION

The heterogeneous photocatalysis one of the most dynamically developing fields of high-efficiency oxidative procedures. This method based on irradiation of metal oxide semiconductor nanoparticles using visible light. These procedures show high significance because environmentally hazardous materials can be efficiently degraded by conversion of solar energy into chemical energy [1-3]. Degradation of these toxic substances by photocatalysis in aqueous medium could be the basis of a novel waste treatment method [4-6]. Volatile organic components are widely applied not only in industrial procedures but also in households, which leads to water and air pollution. In the presence of water vapor, the intermediate and final products accumulate on the catalyst surface, causing its deactivation.

In the work presented here we wished to study the role of clay minerals as environmentally friendly supports of the photocatalyst P 25 TiO_2 in detail. The reason for our interest is that layer silicates are outstandingly efficient adsorbents for organic pollutants, since organic molecules are adsorbed on the surface of clay minerals, which, so to say, accumulate environmentally harmful substances [5,6]. We wish to point out that the layer silicate component has a significant influence on the rate of catalytic degradation and, therefore, TiO_2/montmorillonite nanocomposites are eminently suitable for practical applications such as air and water purification technologies.

The preparation and biological applicability of gold nanoparticles are available in the special literature. Reduction of transition metal ions to colloids in aqueous or organic media in the presence of stabilizing agents was first published by M. Faraday in 1857 [7]. The first reproducible method was presented by Turkevich, who synthesized Au nanoparticles with a diameter of 20 nm via reduction of $HAuCl_4$ by trisodium citrate, while boiling and continuously stirring the reaction mixture [8]. In general, particles of different geometries are obtained depending on the quality of the precursor used [9], whereas the size of the particles obtained depends on the

precursor/reductant ratio.; the plasmon resonance peaks of the gold nanodispersions were between 520 and 530 nm. The color of the Au nanodispersion ranged from reddish orange (520 nm) to reddish purple (530 nm) depending on particle size [10].

The work of Liz-Marzán *et al.* is of fundamental importance in the preparation of nanoparticles of various shapes (spherical and anisometric [rod-like and prism-shaped]) [11, 12]. These authors summarize basic procedures and protocols for the preparation of Au, Ag and Cu nanoparticles and explain their optical properties in the journal Materials Today [13]. The resonance wavelength of anisometric particles such as nanorods depends on the orientation of the electric field. Two types of oscillation are possible, namely longitudinal and transverse. The longitudinal and transverse plasmon modes are both found to blue-shift, and the shift is larger for rods with larger aspect ratios. The color changes are visible to the eye for rods with aspect ratios around 2-3 [14].

Zhong *et al.* showed that gold nanoparticles reduced and stabilized by citrate have a negative surface charge and preferentially bind to thiol, amine, cyanide or diphenylphosphine functional groups [15]. They also showed that the reactivity of the amine group of amino acids is pH-dependent. Binding via α-amino groups is preferential at low pH and is suppressed at neutral and high pH, due to electrostatic repulsion between the surface of gold and the charged carboxyl groups.

In the second part of this work reproducibly size-controlled gold nanoparticles reduced and stabilized by citrate were synthesized in aqueous dispersions. Gold nanorods were grown on functionalized gold surface and the kinetics of growth was studied. The surface of Au nanoparticles was modified by thiol-containing compounds, namely cysteine and glutathione, and the effect of pH and increasing cysteine concentrations on the dispersions was investigated by UV-Vis spectrometry.

2. EXPERIMENTAL SECTION

Materials and Methods

Degussa P25 TiO_2 photocatalyst was used (a^s_{BET}=50 m^2/g), Ca-montmorillonite(Süd-Chemie AG, Germany, a^s_{BET}=72.95 m^2/g) and their mixtures with TiO_2 contents of 25%, 50%, 65% and 80%.

Phenol used for degradation was 99% purity (Aldrich). Anhydrous ethanol used in vapor phase degradations was 99.8% (Molar Chemicals Ltd, Hungary), and toluene was 99.94% (Molar Chemicals Ltd, Hungary).

Preparation of the photocatalyst

In each case, 10% suspensions made of Degussa P25 TiO_2 and Ca-montmorillonie were ground in an agate vibration mill (type GIF 3600, Hungary) with agate balls for 30 min. Suspensions were next dried at 110°C and, in order to ensure identical particle size in each experiment, sieved on a 90 μm sieve.

Preparation of gold nanoparticles

Materials used for the preparation of Au nanoparticles were: $HAuCl_4$*$3H_2O$ (Sigma-Aldrich), tri-Na-citrate (Reanal) which served the dual role of a reductant and stabilizer and MQ water. The $HAuCl_4$ was dissolved in deionized water and the result a faintly yellowish solution. It heated until in boils and continued the heating, and while stirring vigorously, was added the sodium citrate solution and kept stirring for the next 30 minutes. The colour of the solution would changed from faint yellowish to clear to grey to purple to deep purple, until setting on wine-red. Added water to the solution was necessary to bring the volume back up to the original volume (to account for evaporation). The identification of prepared gold nanoparticles was performed by their plasmon resonance maximum value.

The formation of Au nanoparticles was followed by Ocean Optics Chem 2000-UV-Vis spectrophotometer at wavelength 200-800 nm. During the preparation, the absorbance spectrum was recorded.

Preparation of gold nanorods

Materials used for the preparation of Au nanorods were: 3-mercaptopropyl-trimethoxysilane (MPTMS, Aldrich), $HAuCl_4$*$3H_2O$ (Sigma-Aldrich), cetyl-trimethyl-ammonium-bromide (CTABr, Reanal), L+ ascorbic acid (Reanal) and MQ water.

For the preparation of nanorods were treated the glass substrates with MPTMS and then with citrate stabilized gold nanoparticle seeds at different concentrations and growth solution which containing cetyl-trimethyl-ammonium- bromide, ascorbic acid and gold ions.

Transmission electron micrographs (TEM) were performed in Philips CM-10 transmission electron microscope with an accelerating voltage of 100 kV. The microscope was equipped with a Megaview II digital camera. TEM grids were prepared by placing one drop of undiluted sols on a

Formwar foil covered copper grid. The size distribution of the particles was determined by using UTHSCSA Image Tool 2.00 software.

The growth of Au nanorodes was also monitored by a Nanoscope III Multimode Atomic Force Microscope (AFM Digital Instruments) using a piezo scanner. Particle size and size distribution was measured by dynamics light scattering (DLS) with a Zetasizer Nano ZS ZEN 4003 (Malvern Instrument, UK).

Degradation of phenol in aqueous TiO_2/ Ca-montmorillonite suspensions

An aqueous solution containing 0.5 mM/L phenol was degraded in a thermostatically controllable reactor (t=25±0.1°C) with a submerged lamp (a high-pressure mercury vapor lamp, 150 W, Heraeus TQ 150). The lamp emits predominantly in the range of 250-440 and 540-590 nm. The lamp was surrounded by a quartz shield in order to be able to also utilize high-energy photons (□ < 310 nm) of the lamp's UV light. A 280 ml stirred 0.1% TiO_2/Ca-clay suspension was filled into the reactor and flushed with air, ensuring a constant concentration of dissolved oxygen. 30 min adsorption time was allowed before the start of photooxidation reactions. For analysis of 2 ml samples were withdrawn from the illuminated suspensions at 20-min intervals and their total organic carbon (TOC) contents were measured in a Euroglas TOC 1200 (The Netherlands) apparatus. The total carbon contents of the suspensions were measured directly, injecting 100 µl aliquots.

If the adsorption equilibrium of solute is obtain, the original solution concentration c_o is reduced to c_o'. In the course of the subsequent photooxidation, phenol concentration decreases to various extents depending on irradiation time, making possible the determination of the concentration vs. t function (Fig. 1).

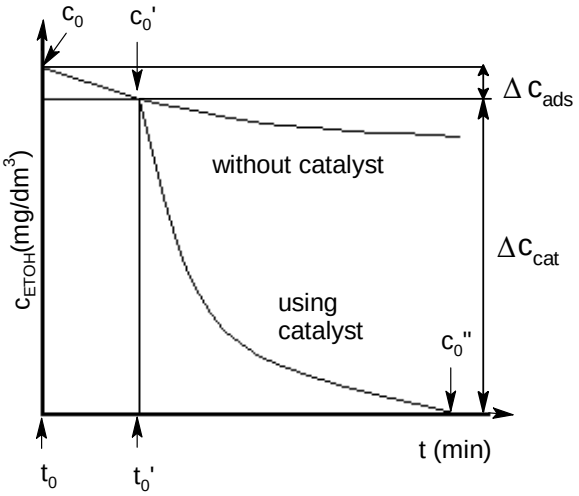


Figure 1. Schematic curve of photooxidation: t_o' is the switching of the light source.
The time difference $t_o - t_o'$ is the adsorption time

3. RESULTS AND DISCUSSION

Phenol degradation in aqueous TiO_2/Ca-clay suspensions

Studies on the structure of TiO_2/ Ca-montmorillonite nanocomposites clearly show that Bragg-reflexions characteristic of TiO_2 and montmorillonite are both present. In other words, no intercalation takes place during the grinding step, since the diameter of the TiO_2 nanoparticles is ca. 50 nm. Particles of such copious size would only be induced by surface charges to interact with the negatively charged lamellae of the clay mineral and to form a heterocoagulation structure.

Photocatalytic degradation of the aromatic phenol molecule was performed in 0.1% aqueous suspensions made of Ca-montmorillonite composites containing 0, 25, 50, 65, 80 or 100% Degussa P25 TiO_2 in a reactor with a submerged lamp, using 2-hour irradiations. The c/c_o values calculated from the data measured after irradiating the samples, represented as a function of catalyst mixture composition are shown in Fig. 2.

Ca-montmorillonite does not have a significant photoactivity, as demonstrated by a decrease of only 12% in the amount of phenol present after 2 hours of UV irradiation. Photoactivity increases parallel with the increase in the amount of TiO_2: the mixture containing 25% TiO_2 degrades 70% of the phenol present in 60 min, whereas the samples containing 80% TiO_2 and pure P25 TiO_2 break down 95-98% in 40 min. In all cases, the decrease in phenol concentration

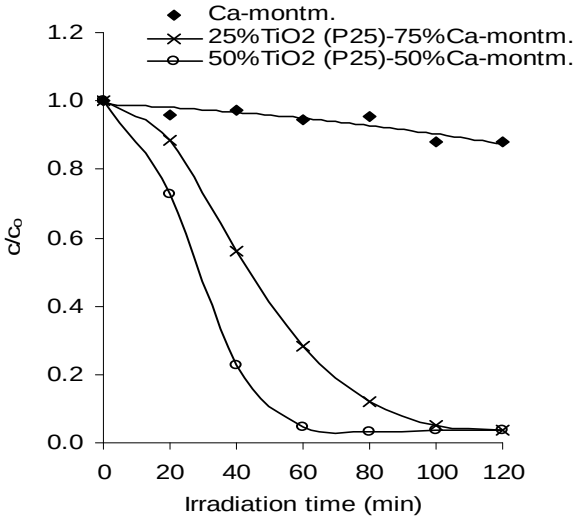


Figure 2. Photooxidation of phenol on Ca-clay and Ca-clay/TiO_2 composites

achieved in 60 min is expressed as ΔTOC. ΔTOC = TOC (t_0') – TOC (t_{60min}), i.e. ΔTOC means CO_2 production realized in 60 min, starting at the onset of irradiation. When a theoretical phenol consumption is calculated for the TiO_2-content of composites, taking into account phenol consumption measured in the case of pure TiO_2 (Fig. 3), the degrading capacity of each mixture surpasses the theoretical value. Significant excesses were observed in the case of the mixtures containing 50% and 75% Ca-montmorillonite. When ΔTOC values are normalized to unit weight of TiO_2 and represented as a function of the TiO_2/clay mineral ratio, the synergistic effect is even more conspicuous.

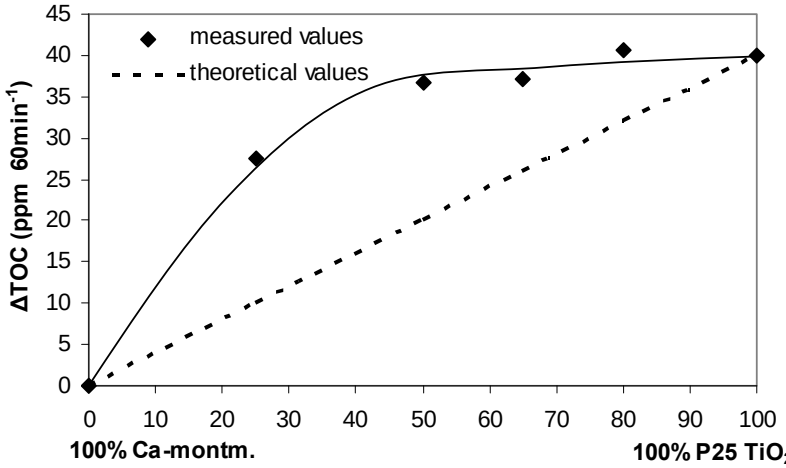


Figure 3. The synergistic effect of photooxidation on Ca-montmorillonite/TiO_2 composites

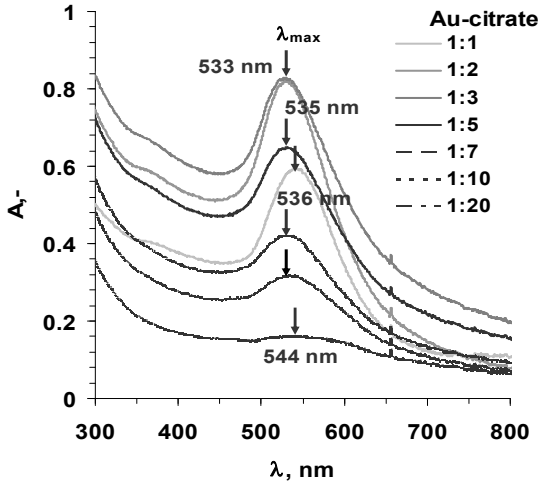


Figure 4. Absorption spectra of gold nanoparticles at ratio of gold/citrate 1:1-1:20 ($c_{citrate}$ =0.2-4mM and $c_{Au^{3+}}$= 0.2 mM) after 30 min reduction time and 24 hours

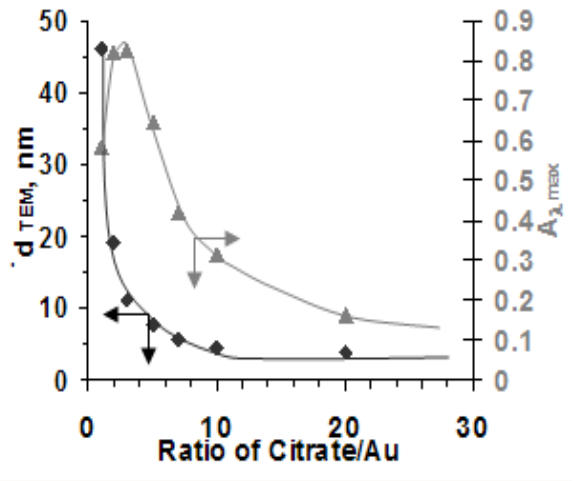


Figure 5. Relation between the maximum absorption values and the diameter at increasing citrate/gold ratio ($c_{Au^{3+}}$ =0.2 mM) after 30 min reduction time and 24 hours

Interaction of nanostructured gold particles with cysteine

A method was developed for the controlled synthesis of gold nanoparticles in aqueous medium by reduction using trisodium citrate dihydrate at 25°C, and the size and size distribution of the particles formed and the colloid stability of the gold dispersions obtained were studied. The size and size distribution of the particles formed were determined by the analysis of TEM images. The most commonly used preparative method is reduction by trisodium citrate. We studied the effect of variations (i) in the gold:citrate ratio in the composition range of 1:1 - 1:20 (where c_{Au3+} =0.2 mM and $c_{citrate}$=0.2-4 mM) (Fig. 4) and (ii) in the initial gold concentration (in the range of 0-1 mM, $c_{citrate}$=2 mM) on the size of the nascent particles (Fig. 5). It is clearly shown in Fig. 4 that the plasmon resonance maximum of gold nanoparticles varies within the wavelength range of 533-544 nm, depending on citrate concentration. No systematic shift is observed. Maximum absorbance values are seen to increase when the amount of citrate added is increased from a ratio of 1:1 to 1:3 and to decrease in the ratio range of 1:3 - 1:20, which may be due to the formation of particles of different sizes depending on citrate concentration. The more citrate is present, the smaller are the nascent particles owing to the stabilizing effect of citrate. Relatively large gold nanoparticles are

distinguished by narrow, well-defined peaks, whereas smaller particles are characterized by broader, less sharp maxima (Fig. 4). To determine the size of the Au nanoparticles formed in the various gold dispersions on the basis of TEM images, samples were prepared on copper grids. Particle diameters determined in TEM images decrease exponentially with increasing amounts of citrate and absorbance maxima change in a nearly parallel fashion, i.e. an initial maximum is followed by nearly exponential decrease (Fig. 5).

According to Fig. 6 increasing the initial concentration of $HAuCl_4$ (in the range of 0.1-1 mM) results in a continuous increase in particle size at a constant citrate ion concentration of 2 mM. As precursor concentration is increased, increasingly larger particles (5-18 nm) are obtained by the evidence of the particle size distribution curves based on TEM images. Particle sizes determined by dynamic light scattering (DLS) (10-22 nm) (Fig. 6), however, do not match those determined on the basis of TEM images (5-18 nm), although the two sets of results are within the same order of magnitude. The TEM image of gold nanoparticles formed in the solution containing 0.8 mM $HAuCl_4$ and their size distribution are shown in Fig. 7. The average diameter of the particles is ~18 nm, whereas in the samples containing 0.2 mM $HAuCl_4$ particles measuring ~5 nm were formed (Fig.8). Size distribution is more homogeneous in dispersions containing smaller particles than in those containing larger particles. The higher extent of homogeneity is due to the presence of larger amounts of citrate ions. The application of lower citrate/Au ratio (1-5) leads to a decrease in the stability of Au dispersions, resulting in the aggregation of gold nanoparticles.

a

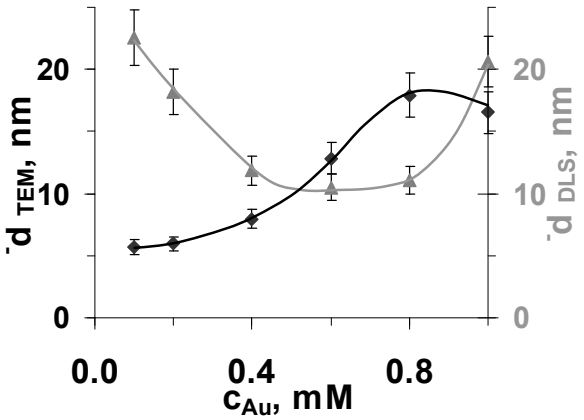
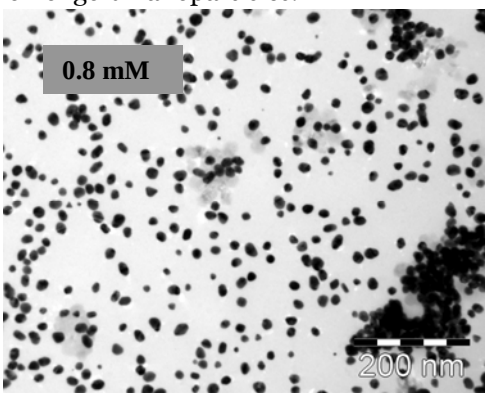


Figure 6. Relation between the particle size measured by TEM and DLS and the original gold concentration ($c_{Au^{3+}}$= 0.1-1 mM and $c_{citrate}$=2 mM).

b



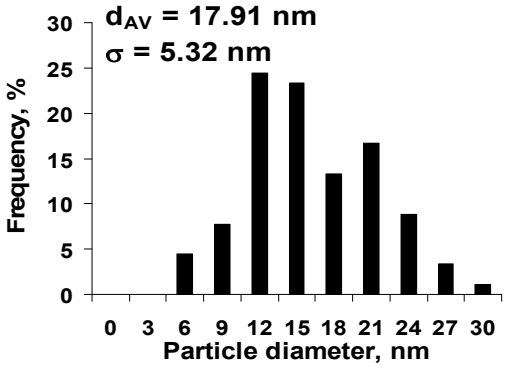
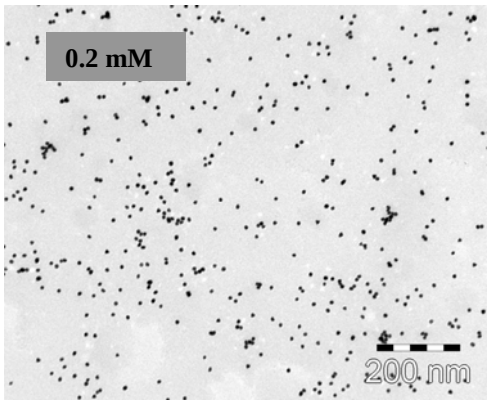


Figure 7. TEM pictures of c_{Au}= 0.8 mM (~18 nm) gold.

c



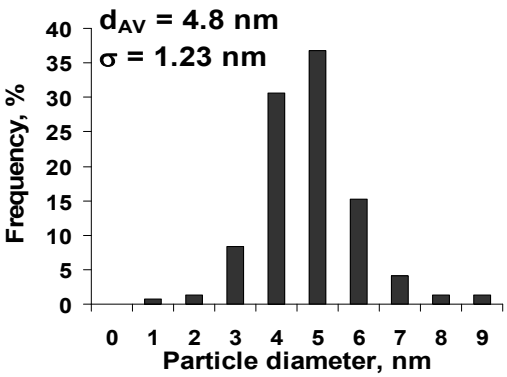


Figure 8. TEM pictures of c_{Au}= 0.2 mM (~5 nm) gold

Gold nanosols reduced and stabilized by citrate were also used for growing gold nanorods, and the kinetics of growth and the detectability of functionalized surfaces by recording UV-Vis spectra were investigated. Nanorods were grown in the following way. Previously synthesized gold nanoparticles were spread on the surface of microscope slides that had been thoroughly cleaned in chromosulfuric acid and functionalized by mercaptopropyl-trimethoxysilane (MPTMS) (Fig. 9). The silanized glass plates were let to stand in the gold sol for 25 min. The surface-modified glass plates carrying the gold nanoparticles were next submerged into the "nanorod growth solution" consisting 0.1 M cetyltrimethylammonium bromide (CTAB), and 0.05 M $HAuCl_4$ and 0.1 M ascorbic acid. Gold nanoparticles were generated in the growth solution via reduction by ascorbic acid, forming gold nanorods on the surface.

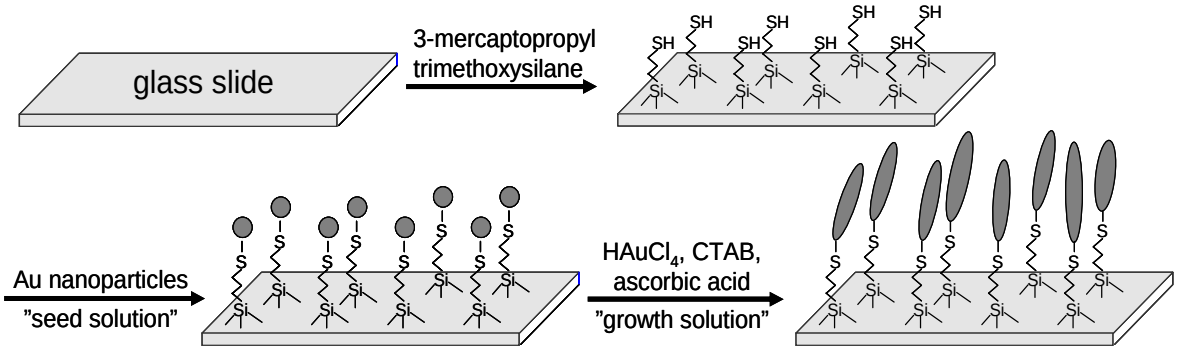


Figure 9. The scheme of the formation of gold nanorods on modified glass surface.

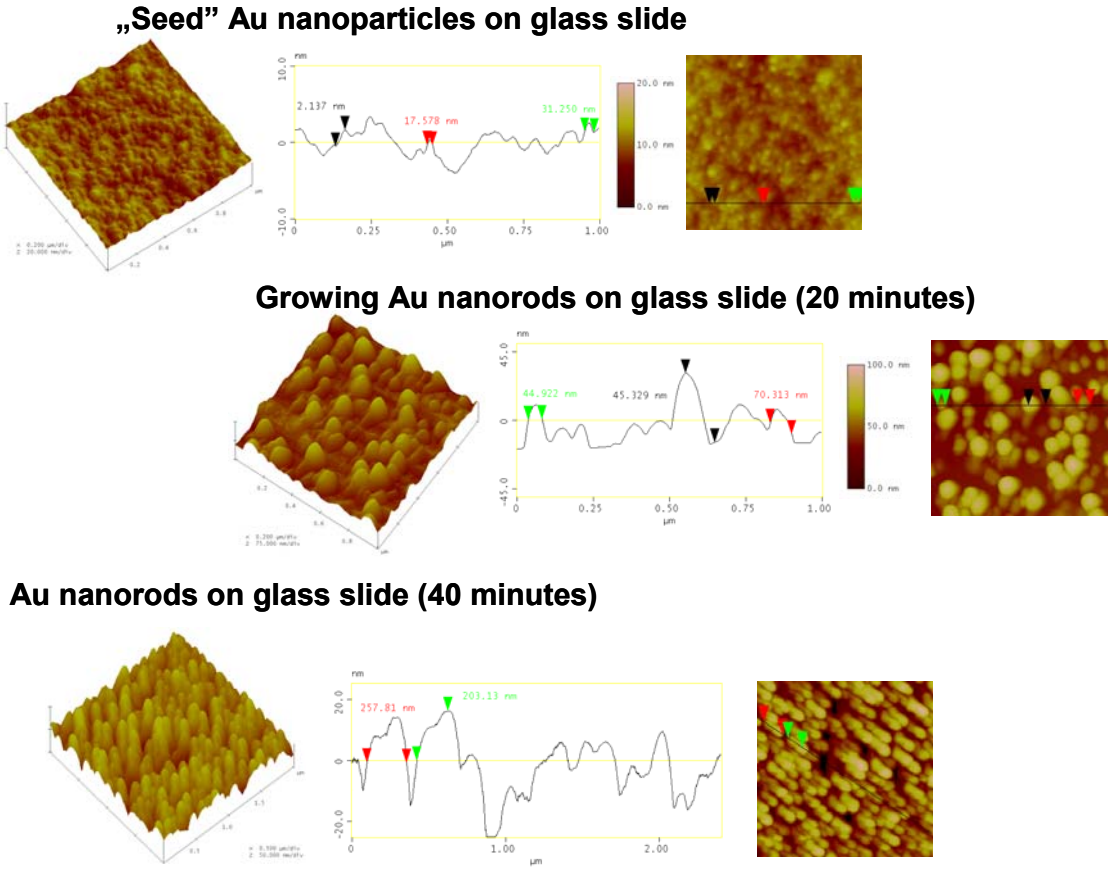


Figure 10. Growing of the gold nanorods on modified glass surface

The nanorod growth process was studied by AFM (Fig. 10). In the course of growth, the difference between rods grown for 0, 20 and 40 min is well discernible in the diameter analysis plot based on the AFM images. The diameter and height of rods grown for 20 min were ~45 nm, whereas the height of rods grown for 40 min was ~200 nm and their diameter was ~120 nm. After growth for 40-45 min the height of rods did not change any more.

4. CONCLUSION

Photocatalytic efficiency of TiO_2/Ca-montmorillonite composite suspensions was studied in liquid phase. We developed a double-walled photoreactor, in which TiO_2-composite thin films are spread on glass surface, for measurements on the solid/liquid interface. It was established that aqueous phenol solution and VOCs are degraded at a significantly higher efficiency on TiO_2/Ca-montmorillonite composites than on pure (Degussa P25) TiO_2.

Size quantized gold nanoparticles reduced and stabilized by citrate were synthesized. The particles were identified on the basis of their plasmon resonance maxima by UV-Vis spectrometry and their sizes were determined by particle size distribution functions calculated from images obtained by transmission electron microscopy. It was demonstrated by UV-Vis spectrometry that the rate of particle formation depends on the gold/citrate ratio: the higher the concentration of reductants and stabilizers in the dispersion, the lower are the apparent rate constants, i.e. the rate of particle formation decreases. The rate of aggregate formation in the liquid phase of dispersions containing gold and cysteine at various ratios was also studied by DLS. These experiments revealed that large aggregates are not formed in samples containing high amounts of cysteine and, due to the stabilizing effect of cysteine, the rate of aggregation is slower. Nanorods were synthesized on silanized glass surfaces and particle growth was followed by AFM. Our experience shows that growth solutions containing relatively high concentrations of $HAuCl_4$ deposit thicker gold layers on the surface; the thickness of the gold layers was determined as ~200 nm by AFM measurements.

ACKNOWLEDGEMENTS
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INTERNATIONAL SYMPOSIUM on
ADVANCED ENGINEERING & APPLIED MANAGEMENT
– 40th ANNIVERSARY in HIGHER EDUCATION (1970-2010)
4 – 5 November, 2010, Hunedoara, ROMANIA

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RESEARCHS REGARDING THE PELETIZING PROCESS OF FEROUS PULVEROUS WASTE

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ABSTRACT:
This paper summarizes the technologies laboratory experimental phase to determine solutions for material recovery and compatible ferrous powder and small to produce pellets using a series of small and dry waste, from the steel industry, energy and mining, such as electric steelworks dust, dirt (sludge) from agglomeration, blast-scale (the scale slurry) sideritic waste, slag foundries (ferrous fraction), coal dust, coke or graphite, fly ash, dust lime, cement, bentonite.
KEYWORDS:
waste, pellets, recovery, steel, technology

1. INTRODUCTION

Small waste processing and powder technology is all the operations which are processed for use under the conditions required by the user. Technological operations are crucial in the process of recovery (recycling) of secondary materials (waste powder and small).

Reduction process based oxide material, technology solutions that we propose take into account the recovery of secondary materials consisting of waste powder (steelworks dust from sintering, blast furnaces, lime powder, etc.) and small (dross, slag fraction ferrous foundries, etc.).

Approach, resolution and implementation of technology depends:

- Nature of material submitted for processing in case of waste as secondary materials must Recycling;
- Form the finished product as these materials are processed.

We felt, based on documentation in the literature [1,2] and based on experiments and their results [3,4], as well as fundamental solutions compatible material after processing these wastes as raw materials in steel, the following: briquetting, pelletizing, congestion, mechanical mixture.

2. METHODOLOGY AND DISCUSSION

In order to achieve phase laboratory experiments, we sampled several powdery waste sections of a steel platform and ponds, storage, representative samples were collected from the following types of waste:

- Electric steelworks dust;
- Dump the dross and dross;
- Dust from sintering-blast (agglomeration slurry-blast)
- Lime powder.

Each waste sample was subjected to the operation of mixing (the homogenization was processed drum). Evaluating the quality of waste powder, determinations were made of physicochemical characteristics, namely: chemical composition and size.

It was also tested in the reaction pellet heating (combustion). In Fig.1 is presented aspects of these experiments.

The chemical composition of pellets is given in table 1. Fig.2 shows aspects of the pelletizing process (using a flat plate pelletizing machine) and the resulting micro-pellets, observing the technological flux of producing pellets (fig.3).

Pellets that can be used as foaming agent in the final slag smelting electric arc furnace load, which was placed in charge of the final metal tip (possibly together with other auxiliary materials).

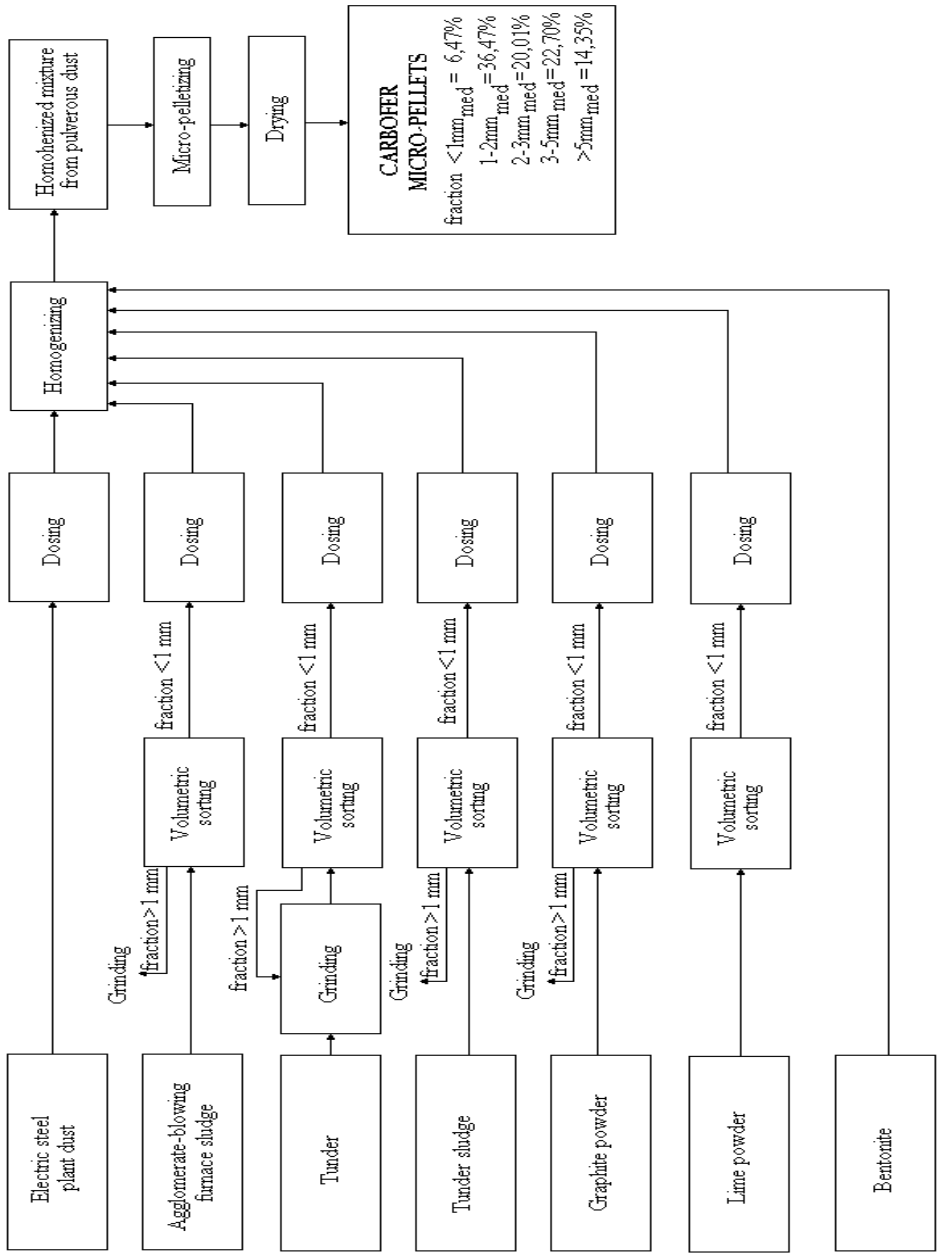


Fig.1. The technological flux of producing pellets

Table 1. The chemical composition of pellets

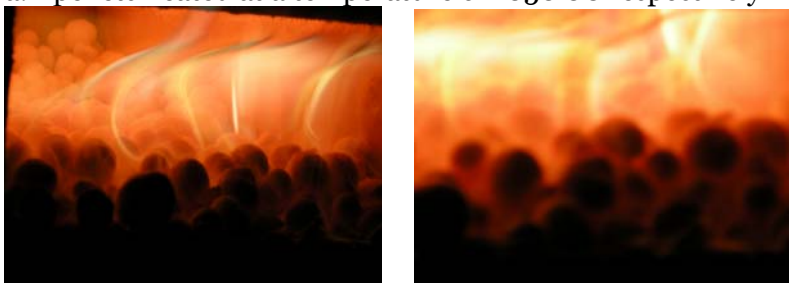
Recipe no.	Content of recipes [%]										
	SiO_2	FeO	Fe_2O_3	P_2O_5	S	C	Al_2O_3	CaO	MgO	MnO	other oxide
R1	6,74	3,97	38,32	0,10	0,44	13,94	3,53	20,98	1,14	1,37	9,47
R2	7,45	3,97	38,34	0,10	0,44	14,92	3,65	19,10	1,13	1,36	9,53
R3	9,01	3,83	32,68	0,09	0,47	19,19	4,06	18,38	1,19	1,16	9,93
R4	8,45	4,11	34,94	0,10	0,49	17,59	4,06	17,54	1,20	1,19	10,34
R5	8,15	4,11	40,10	0,10	0,44	14,92	3,76	16,25	1,11	1,37	9,68
R6	8,37	4,19	36,38	0,10	0,48	18,39	3,98	15,53	1,15	1,19	10,24
R7	7,80	4,34	34,19	0,09	0,50	21,69	4,00	14,68	1,16	1,04	10,51
R8	7,89	4,28	33,60	0,09	0,51	22,84	4,08	13,81	1,17	1,07	10,66
R9	8,03	4,41	33,25	0,09	0,53	21,24	4,21	14,93	1,22	1,04	11,04
R10	8,03	4,59	36,79	0,09	0,53	20,26	4,20	12,05	1,19	1,14	11,14

Fig.2. Aspects of the process of producing pellets

Combustion was performed in an oven with forced bars. Was found from the temperatures above 7000C is generated due to intense flames burn carbon monoxide resulting from the combustion of iron oxides.

Burning iron oxide increased the temperature, leading to partial melting pellets (from which came in contact with flame, that top load).

a. pellets heated at a temperature of 1050 0C respectively 1250 0C



b. Burning pellets in volatile release and clearance of carbon monoxide

c. Molten pellets

Fig.3. Aspects of these experiments

3. CONCLUSIONS

The ecological advantages are clear, namely: cutting down the amount of powdery wastes by their continuous recycling, the diminishing of soil pollution with metallurgical waste by reducing the dumping areas, the valorization by recycling of these wastes, without any negative impact upon the environment.

The economical advantages have both an immediate impact, i.e. transferring the depositing costs to other scopes, the obtaining of secondary raw materials, the low costs of processing by

means of this procedure, as compared to others, and also long term advantages, such as cutting down costs by partial replacing of some raw materials. Considering that processing the powdery materials resulting from steel making in view of recycling and/or re-using them represents an issue with real ecological and economical implications we found it appropriate to carry out researches in the field of their superior valorization.

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DETERMINATION OF POROUS MATERIALS' ACOUSTICAL PARAMETERS

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ABSTRACT:
One of the most frequent problems faced by noise control engineers is how to design sound absorbers that provide the desirable sound absorption coefficient that minimizes the size and cost, does not introduce any environmental hazards, and stands up to hostile environments. The designers of sound absorbers must know how to choose the proper sound absorbing materials, its geometry and the protective facing. Porous sound-absorbing materials are utilized in almost all areas of noise control engineering. This paper deals with the acoustical parameters of porous materials and their measurement.

KEYWORDS:
porosity, flow resistivity, tortuosity, measurement

1. INTRODUCTION

A small part of the acoustical parameters used to describe the visco-inertial and thermal behavior of acoustical porous materials are directly measurable. This is the case for the open porosity, the static air flow resistivity and the high frequency limit of the dynamic tortuosity.

2. OPEN POROSITY

The open porosity, term commonly reduced to "porosity", refers to the ratio of the fluid volume occupied by the continuous fluid phase to the total volume of porous material. For acoustical materials, its range of values is approximately [0.70 0.99]. The schematic representation of an acoustical porous medium is shown on figure 1. The fluid phase, in white, is made up of a network of connected pores. The closed pores are considered to be a part of the solid phase, in grey. [9].

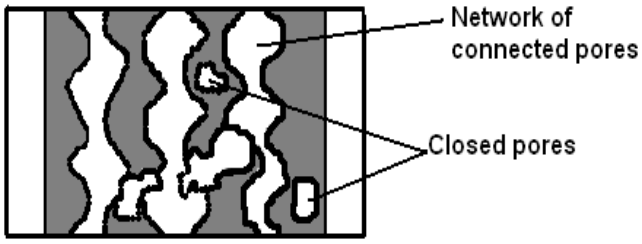

Figure 1 Schematic representation of an acoustical porous medium [9]

Open porosity measurement

The porosity can be directly measured and there are several methods to do so [2].

The **gravimetric measurement** of porosity requires the weighing of a known volume of dry material. Shot can be separated from fiber by a centrifuge process. The dry weight can be used together with the sample volume to calculate the bulk density ρ_B. Subsequently an assumed solid density is used to calculate the porosity h from [7]:

$$h = 1 - \frac{\rho_A}{\rho_B} \tag{1}$$

where: h – is the porosity, ρ_A– is the solid density [kg.m^{-3}], ρ_B – is the bulk density [kg.m^{-3}].

A **gravimetric method** may be used with some consolidate granular materials is to saturate the sample with water and deduce the porosity from the relative weights of the saturated and unsaturated samples. Mercury has been used as the pore-filling fluid in some applications, but for many materials the introduction of liquids affects the pores.

The **dry method** of porosity determination has been developed by Champoux et al.[3] is based on the measurements of the change in pressure within a sample container subject to a small known change in volume. The lid of the container is a plunger, which is driven by a precise micrometer. The pressure inside the chamber is monitored by a sensitive pressure transducer and an air reservoir connected to the container through a valve serves to isolate the system from fluctuations in atmospheric pressure. The system has been estimated to deliver values of porosity accurate to within 2%. This method measures the porosity of connected air-filled pores. However the gravimetric methods do not differentiate between sealed pores and connected pores. The open porosity measurement apparatus is shown on figure 2.

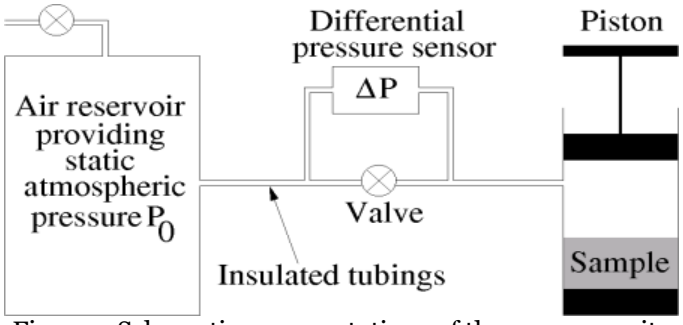

Figure 2 Schematic representations of the open porosity measurement apparatus presented by L. Beranek [9]

An **acoustical (ultrasonic) impulse method** for measuring porosity using the impulse reflected at the first interface of a slab of air-saturated porous material has been proposed and has been shown to give good results for plastic foams.

3. STATIC AIR FLOW RESISTIVITY

The static air flow resistivity, term commonly reduced to "resistivity", is one of the two most known parameters, with the open porosity, used to describe the acoustical behavior of porous materials. It characterizes, partly, the visco-inertial effects at low frequencies. Sound is vibrations in the air, so it is easy to imagine that sound cannot easily propagate through materials which air can hardly pass through [10]. In other word, flow resistivity can represent the difficulties of the propagation of sound (air-borne sound) in the gap in porous materials. A material such as iron and rubber etc. which air cannot pass through easily does not propagate the air-borne sound but propagate only the structure-borne sound (vibration). The models by Delany-Bazley [4] and Delany-Bazley-Miki [6] use only this parameter to describe the behavior of fibrous acoustical materials.

For bulk -, blanket -, or board-type porous materials the flow resistivity R_1 is defined as specific flow resistance per unit thickness [7]:

$$R_1 = \frac{R_f}{\Delta x} \quad [\text{N.s.m}^{-4}] \text{ or } [\text{Pa.s.m}^{-2}] \tag{2}$$

where: R_f – is the airflow resistance [N.s.m^{-3}] or [Pa.s.m^{-1}],
Δx – is the thickness of the layer [m].

The flow resistivity is a measure of the resistance per unit thickness inside the material experienced when a steady flow of air moves through the test sample. Flow resistance R_f represents the ratio of the applied pressure gradient to the induced volume flow rate and has unit of pressure divided by velocity. [7]

$$R_f = \frac{\Delta p}{\upsilon} \quad [\text{N.s.m}^{-3}] \text{ or } [\text{Pa.s.m}^{-1}] \tag{3}$$

where: Δp – pressure [N.m^{-2}] or [Pa],
υ – velocity [m.s^{-1}].

If a material has a high flow resistivity it means that it is difficult for air to flow through the surface. For acoustical materials, its range of values is approximately [10^3 10^6]. [9]

4. STATIC AIR FLOW RESISTIVITY MEASUREMENT

The resistivity can be directly measured [5]. The measurement of the flow resistance and flow resistivity of porous building materials has been standardized on a compressed-air apparatus [1]. In this measurement the pressure gradient across the sample in a fixed sample holder is monitored together with various flow rates. Compressed air is passed through a series of regulating valves and very narrow opening into chamber E. This creates an area of low pressure immediately in front of

the three tubes connected to the rest of the system. Air is drawn from the environment through the sample as a result of the pressure differential. The rate of airflow through the system is controlled by three flowmeters, giving a total measurement range between 8.7 and 0.1 L/min. Normally the flow rate must be kept below 3 L/min to avoid structural damage to the sample. The schematic representation of compressed-air apparatus for laboratory measurement of flow resistance is shown on figure 3. [7]

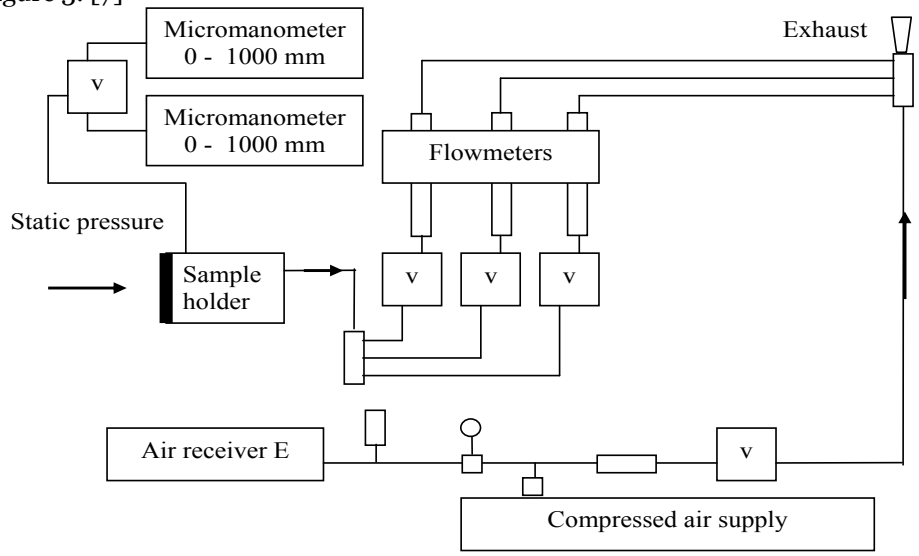

Figure 3 Schematic representation of a compressed-air apparatus for laboratory measurement of flow resistance [7]

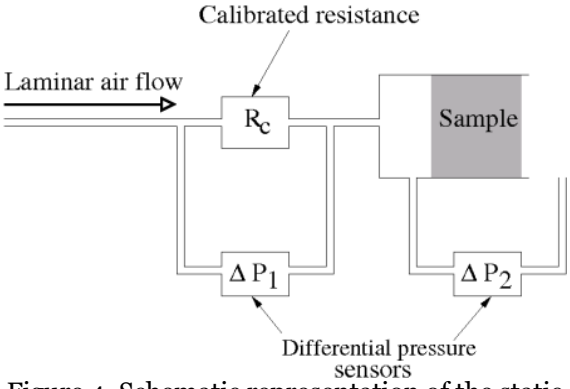

Figure 4. Schematic representation of the static air flow resistivity measurement apparatus presented in [ISO 9053]

A comparative method [8] makes use of a calibrated known resistance placed in series with the test sample. Variable capacitance pressure transducers are used to measure pressure differences across both the test sample and the calibrated resistance. For steady, nonpulsating flow, the ratio of flow resistance equals the ratio of measured pressure differences. The schematic representation of this apparatus is shown on figure 4.

5. TORTUOSITY

The tortuosity or the structural form factor of the material takes into account the curliness of the pores (see figure 5).

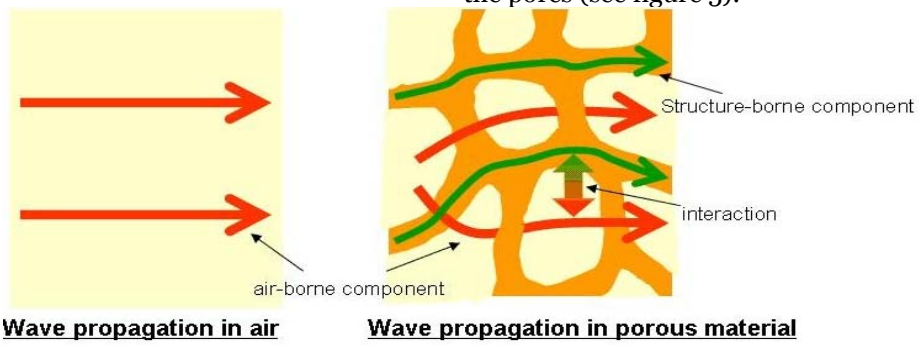

Figure 5. The sound propagation in the air (left) and in a porous material (right)[10]

Tortuosity is responsible for the difference between the speed of sound in air and the speed of sound through a rigid porous material at very high frequencies. Tortuosity is related to the formation factor used to describe the electrical conductivity of a porous solid saturated with conducting fluid. Indeed tortuosity can be measured using an electrical conduction technique in which the electrical resistivity of such a saturated porous sample is compared to the resistivity of the saturating fluid alone. Thus:

$$T = \frac{F}{h} \tag{4}$$

where: h – is the porosity of the sample,

F – is the formation factor defined by $F = \frac{\sigma_S}{\sigma_f}$ where σ_f and σ_S are the electrical conductivities of the fluid and fluid saturated sample, respectively. These in turn are defined by $\sigma = \frac{GL}{A}$ where L is the length of the sample, A is the area of the end of the sample, and G is the ratio of the resulting current to the voltage applied across the sample. [7]

Tortuosity measurement

Tortuosity measurement is based on the measurement of formation factor. To measure the formation factor, first a cylindrical sample of the material is saturated with a conducting fluid. Saturation is achieved by draving the fluid through the sample after forming a vacuum above it. Agitation of the sample is also required if the pore sizes are small. A voltage is applied across the saturated sample placed between two similarly shaped electrodes at a known separation. The conductivity of the fluid is measured at similar voltages within a separate fluid-tight unit. The use of separate current and voltage probes assures a good contact between the end of the sample and the electrodes, eliminates problems associated with voltage drop at the current electrodes, and allows the simultaneous measurement of the electrical resistivities of the fluid and the saturated porous material. Tortuosity can be measured by measuring the velocity of sound which is transmitted in the fluid that fills the porous material, in ultrasonic domain. Therefore, the measurement system is composed of sensors for transmitting and receiving ultrasound, power amp and oscilloscope.

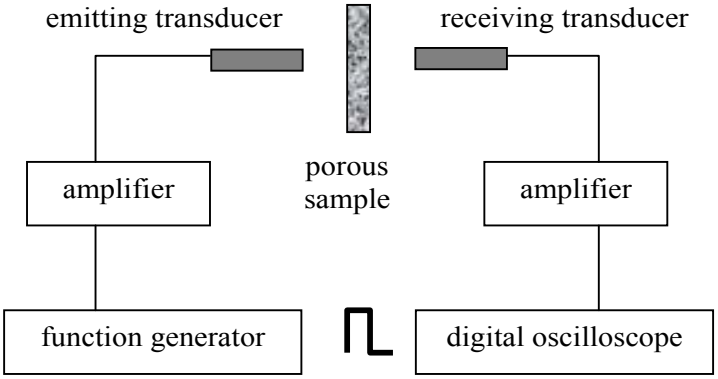

Figure 6. Schematic representation of the tortuosity measurement apparatus [11]

6. Conclusion

Acoustical parameters of porous materials give the necessary and important information for noise control engineers. Profound knowledge their physical characteristics enable an effective sound absorber material design. The theory of sound-absorbing materials has progressed considerably during the last decade. A noise control engineer with serious interest in sound absorbing technology is advised to study all this parameters.

Acknowledgement

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INHIBITOR MULTIENZYME BIOSENSOR SYSTEM IN DYNAMIC MODE – PHOSPHATE MEASUREMENT

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ABSTRACT:
In this paper a multienzyme inhibitor system is investigated. A hybrid inhibitor biosensor for measuring concentration of phosphate is used. Enzymes kinetic of Michaelis-Menten and ping-pong kinetics are accepted. Partial differential equations of that complex system are solved numerically and are received concentration profiles of five reagents. The influence of starting concentration of inhibitor is investigated and influence of reaction rate constant of inhibitor

KEYWORDS:
mathematical modeling, inhibitor biosensor, simulations, phosphate

1. INTRODUCTION

Biosensors are analytical devices which tightly combine biorecognition elements and physical transducer for detection of the target compounds. Biosensors useful serve ecological purposes by enabling precision pollutant control [1, 2, 3]. In practice the most important are biosensors that identify water conditions [4, 5, 6, 7, 8] and to a lesser extent air [9, 10] and soil condition [11]. Two main water pollutant are phosphates and fluorides. For determination of phosphate and fluoride ions enzyme, microbial and multienzyme biosensors can be used. Multienzyme biosensors however are very complex devices.

2. DESCRIPTION OF THE MATHEMATICAL MODEL

The starting concentrations of substrate, co-substrate and inhibitor in the research medium are denoted with So,Co, Io. The concentration profiles for substrate S(x), co-substrate C(x) and inhibitor I(x) are formed in the active membrane. In this paper a hybrid biosensor with two enzymes acid phosphatase (AP) and glucoseoxidase (GOD) is used for the investigation.

Operation principle of the hybrid biosensor is based on the given biochemical reaction:

$$\text{glucose} - 6 - \text{phosphate} + H_2O \xrightarrow{AP} \text{glucose} + HPO_4^{2-} \qquad (1)$$

$$\text{glucose} + O_2 \xrightarrow{GOD} \text{gluconolactone} + H_2O_2$$

Under the activity of the enzyme acid phosphatase the glucose-6-phosphate is hydrolyzed to glucose and inorganic phosphate. In the second reaction the oxygen present oxidizes the obtained glucose. The amount of hydrogen peroxide being produsedis measured electrochemically. In the presence of phosphate the hydrogen peroxide is produced at a slower rate. This happens because of the inhibitory effect of those element have on the catalytic activity of the acid phosphatase. As a result the glucose production is decreased which leads to more production of H2O2. As the AP is inhibited from the phosphate the substance can be identified with a biosensor according to its ability to support the formation.

The reactions above can be present with following successive enzyme reactions with competitive inhibition

$$S \xrightarrow{E_1} P_1 + P_2$$

$$\xrightarrow{E_1} I \qquad EI \tag{2}$$

$$P_1 + C \xrightarrow{E_2} P_3 + P_4$$

AP is the first enzyme, let denote its reaction velocity with V_1, GOD is the second enzyme let denote its reaction velocity with V_2; **P_1** – glucose, first product; **P_2** – second product, not informative; **S** – glucose-6-phosphate, substrate; **I** –(KH_2PO_4) measured inhibitor, **C** – oxygen, co-substrate; **P_3** – product H_2O_2 and **P_4** –galactonic acid.

We admit that indicatory electrode has symmetrical geometry and assume that diffusion is one-dimensional in space and is described with second Fick's law than we can write the system of equations for those bi-substrate sensitive amperometric system

$$\frac{\partial S}{\partial t} = Ds\frac{\partial^2 S}{\partial x^2} - \frac{V_1 S}{Ks\left[1+\frac{I}{k_I}\right]+S}; \quad \frac{\partial I}{\partial t} = Ds\frac{\partial^2 S}{\partial x^2} - \frac{V_1 S}{Ks\left[1+\frac{I}{k_I}\right]+S};$$

$$\frac{\partial C}{\partial t} = Dc\frac{\partial^2 C}{\partial x^2} - \frac{V_2}{1+\frac{Kp_1}{P_1}+\frac{Kc}{C}}; \quad \frac{\partial P_1}{\partial t} = Dp_1\frac{\partial^2 P_1}{\partial x^2} + \frac{V_1 S}{Ks\left[1+\frac{I}{k_I}\right]+S} - \frac{V_2}{1+\frac{Kp_1}{P_1}+\frac{Kc}{C}}; \tag{3}$$

$$\frac{\partial P_3}{\partial t} = Dp_3\frac{\partial^2 P_3}{\partial x^2} + \frac{V_2}{1+\frac{Kp_1}{P_1}+\frac{Kc}{C}},$$

where: *Ds, Dc, Dp_1, Dp_2* and *Dp_3 are diffusion coefficients for substrate, co-substrate, product 1 and* product 3, Ks - reaction constant for substrate, Ki - reaction constant for inhibitor, Kc - reaction constant for co-substrate, *Kp_1* - reaction constant for product 1, *Kp_3* - reaction constant for product 3. The output current is proportional to gradient of H_2O_2 concentration at the electrode surface

$$I = nFAD_{P_3}\left.\frac{\partial P_3}{\partial x}\right|_{x=d} ,[A] \tag{4}$$

where: n is the number of electrons taking part in electrochemical reaction, F is the Faraday's number, A is the electrode surface [m^2].

Let we denote x = 0 for the bulk/membrane interface and x = d for the electrode surface. The action in biosensor starts when some quality of substrate is appears into biological recognition element – active membrane. The initial conditions are:

t = 0 *S(x,0) = So* *I(x,0) = Io* *C(x,0) = Co* *P_1(x,0) = 0* *P_3(x,0) = 0*

Limiting conditions are:

x = 0 *S(0,t) = So* *I(0,t)= Io* *C(0,t) = Co* *P_1(0,t) = 0* *P_3(0,t) = 0*

The substrate, and co-substrate didn't react with the electrode, oxygen and glucose fully exhausted and medium is well stirred and it remain constant at the electrode surface, then the limiting conditions are

x = d

$$\left.\frac{\partial S}{\partial x}\right|_{x=d} = 0, \quad C(d,t) = 0 \quad P_1(d,t) = 0 \quad \left.\frac{\partial P_1}{\partial x}\right|_{x=d} = 0, \quad P_3(d,t) = 0$$

3. RESULTS AND DISCUSSIONS

For solving system (4) of non-linear partial differential equations (PDE) we use Matlab solver *pdepe*. It use both finite difference and finite element methods as described in [12]. *pdepe* solve initial-boundary value problems for system of parabolic-elliptic PDEs in the one space variable x and time t. The ordinary differential equations resulting from discretization in space are integrated to obtain approximate solutions at times specified in a time vector. Time vector specifying the points at which a solution is requested for every value in distance vector. The *pdepe*

function returns values of the solution on a mesh provided in a distance vector. Distance vector specifying the points at which a numerical solution is requested for every value in time vector.

Concentration profiles of substrate, co-substrate, inhibitor, product 1 and 3

Because oxygen is consumed during enzymatic conversion output current of biosensor is descending function. Parameters used for simulations are

n = 2 , So =100 mM, Co = 0,25 mM, Io = changed, Po1 = 0,0mM , Po3 = 0,0 mM

F = 96,5A.s / mmol - Faraday's number

A = 7,85.10-7 m2 - diameter of cathode is 1mm

K_s = 80 mM - reaction rate constant for substrate

K_c = 0,5 mM - reaction rate constant for oxygen

K_i = 0,1 mM, K_{P_1} = 100 mM - reaction rate constant for inhibitor and products 1

D_S =2,50. 10^{-10} m^2/s, D_C =2,5. 10^{-11} m^2/s, D_I =2,50. 10^{-9} m^2/s, D_{P_1} =2,5.10^{-10} m^2/s, D_{P_3} =2,5.10^{-10} m^2/s,

d = 60 μm

Vm1 = 1 mM/s , Vm2 = 20 mM/s ,

At fig.1, 2, 3, 4 and 5 in three dimensional size are given concentration profiles of substrate S(x,t), inhibitor I(x,t), co-substrate C(x,t), product 1 P_1(x,t), product 3 P3(x,t) in active membrane with thickness d = 60μm for the time t = 8s, for values of reaction velocities V_1 = 1 mM/s and V_2 = 20 mM/s. The value of inhibitor is Io=0.0 mM and the value of substrate is So=100 mM.

Figure 7 shows the output current *I* which is proportional to the concentration of the oxygen. It is seen that oxygen is consumed very rapidly for the case starting concentration Io =0, because there is no inhibitor in the research medium. Hydrogen peroxide (product P3) has value about 0.25 because the oxygen is almost exhausted. The velocity of changing of concentration of co - substrate depends of presence of the inhibitor (eq.3), because now there is no inhibitor oxygen is consumed very rapidly- fig.4.

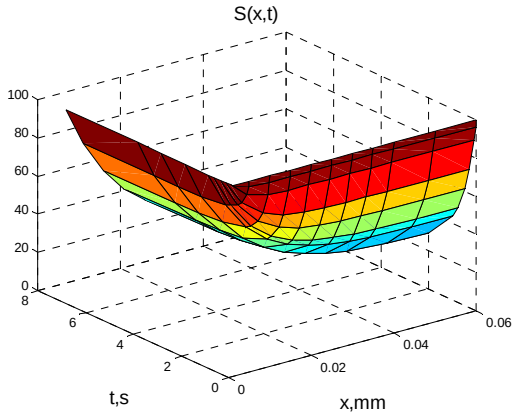

Fig. 2. Concentration profile of substrate. Io = 0 mM.

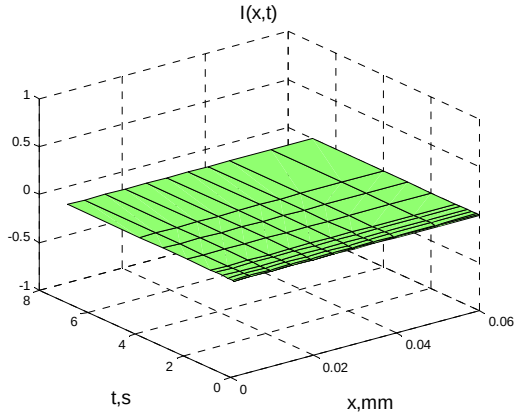

Fig. 3. Concentration profile of inhibitor. Io = 0 mM.

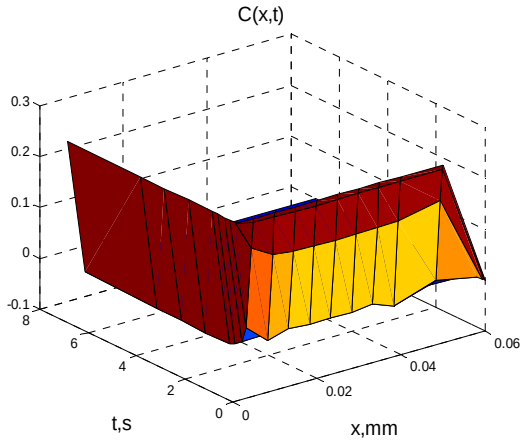

Fig. 4. Concentration profile of co-substrate. Io = 0 mM.

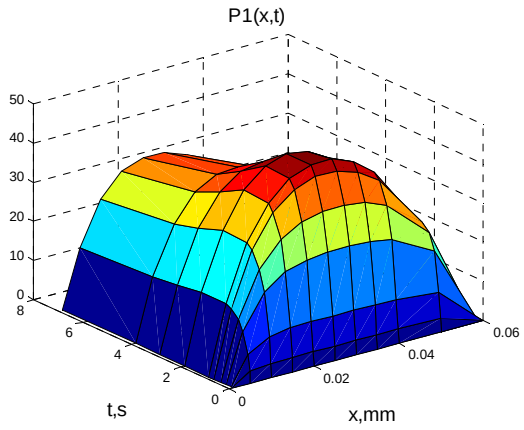

Fig. 5. Concentration profile of Product 1. Io = 0 mM.

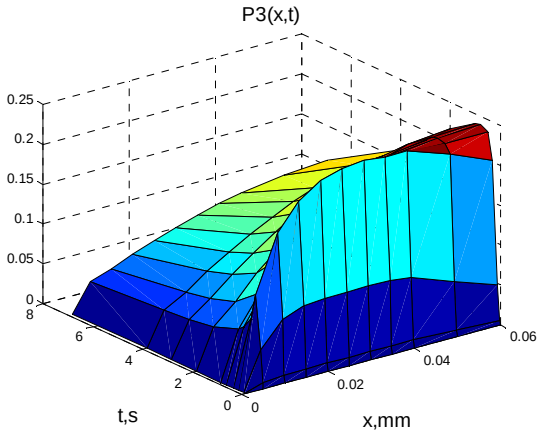

Fig. 6. Concentration profile of Product 3. Io = 0 mM.

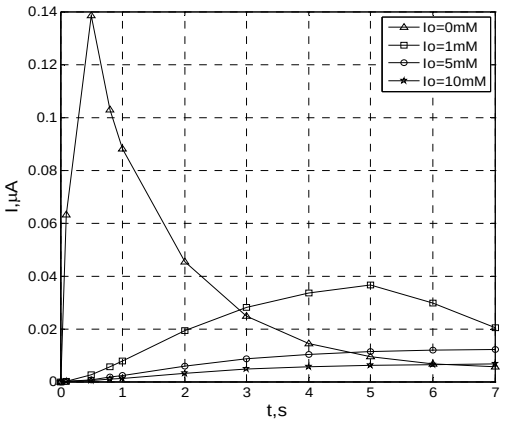

Fig. 7. Output current of the biosensor.

The investigated biosensor is co-substrate sensitive and because of that it is important the analyze of changing of co-substrate C and inhibitor I. At the next pictures are given the dependence of the output current of the biosensor and concentration profiles of substrate, co – substrate, inhibitor and products for the values of I = 1.0 mM.

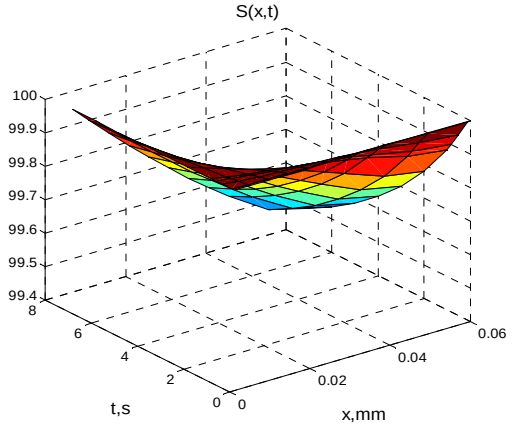

Fig. 8. Concentration profile of substrate. Io = 5 mM.

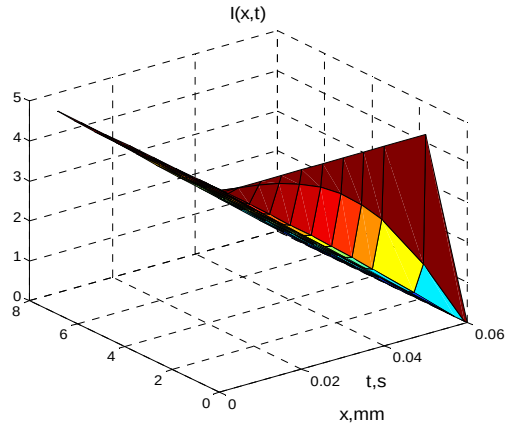

Fig. 9. Concentration profile of inhibitor. Io = 15mM.

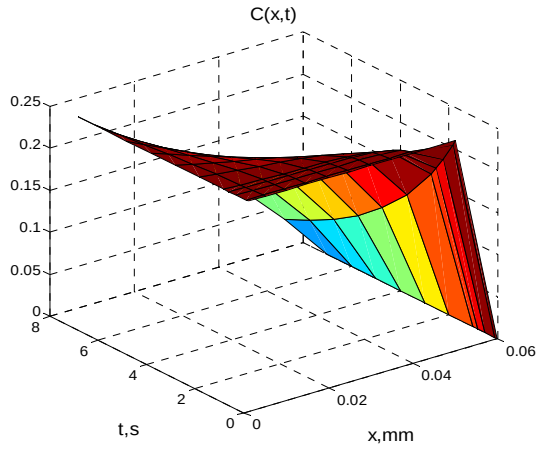

Fig. 10. Concentration profile of co-substrate. Io = 5 mM.

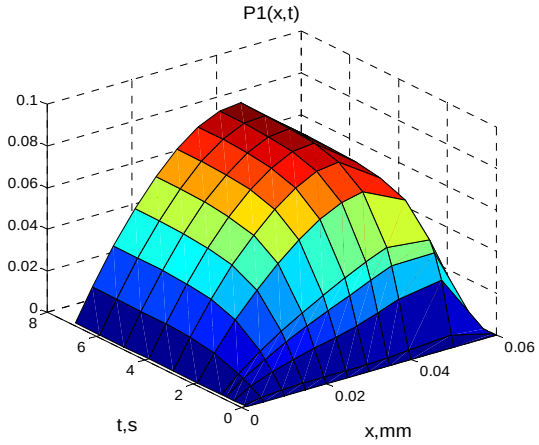

Fig. 11. Concentration profile of Product 1. Io = 5 mM.

At fig.8, 9, 10, 11, and 12 are given concentration profiles of substrate S(x,t), inhibitor I(x,t), co-substrate C(x,t), product 1 $P_1(x,t)$, product 3 P3(x,t) for the starting value of inhibitor Io = 5.0 mM. It is seen clearly how the inhibitor effects over the all reagents. Substrate decreasing very little – from 100mM to 98mM, for the difference at figure 2 where the decreasing is from 100mM to 20

mM when there is missing inhibitor in the medium. Consuming of the oxygen is less, product 3 formation is increase (fig.12) with the time for the difference at fig.6 where is poorly.

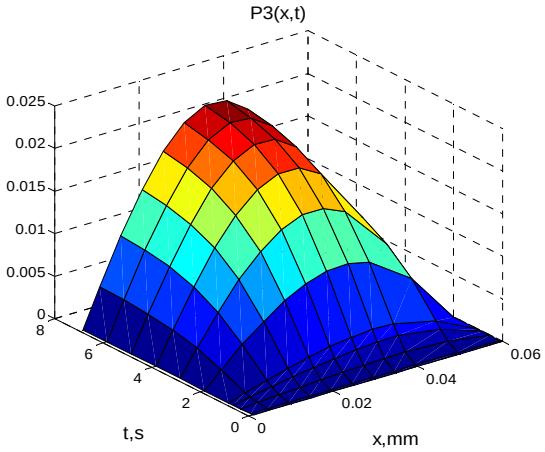

Fig. 12. Concentration profile of Product 3. Io = 5 mM.

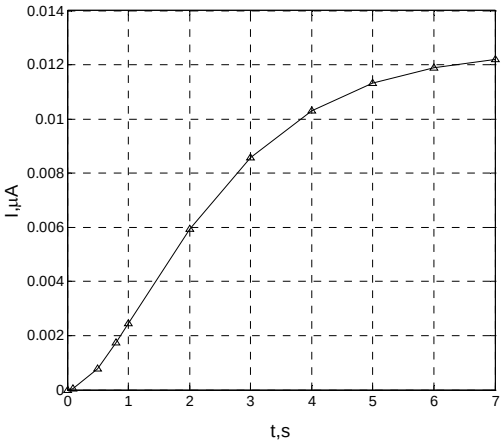

Fig. 13. Output current of the biosensor. Io = 5 mM.

At fig. 7 is given the transient process of the output current for the four values of starting concentration of inhibitor Io = 0, 1, 5 and 10 mM. For the bigger starting concentration of Io the value of steady state of the current is increasing (this is the value fo rthe time biggre thet 7 s), but it is seen that the dependancy is non linear. At fig. 13 it is seen more precise, value of Io are –0, 1, 3, 5, 7, 9, 11, 13, 15, 17, 19 mM.

At fig. 14 is invstigated the influence of reaction rate constante for inhibitor Ki – 0,05 0,1 0,5 1 2 5 mM at the constante starting concentration of Io = 5mM over substrate concentration profile S (x,t) for x=d. With increasing the Ki substrate consentration in active membrane is decreasing.

At fig. 15 is invstigated the influence of reaction rate constante for inhibitor Ki – 0,05 0,1 0,5 1 2 5 mM for the constante starting concentration of Io = 5mM over the output current. It is seen that transient proceses for the output current strongly depend from Ki. With increasing the reaction rate constante for inhibitor transient process of the current loosing it first order system form.

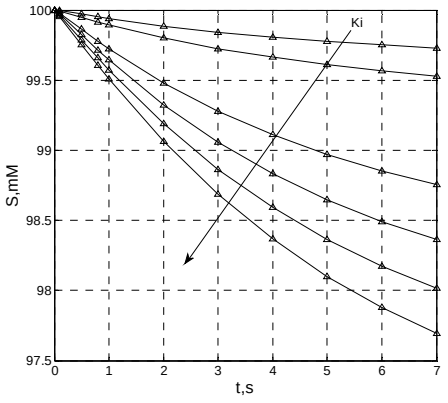

Fig.14.Influence of reaction rate constante over substrate concentration.

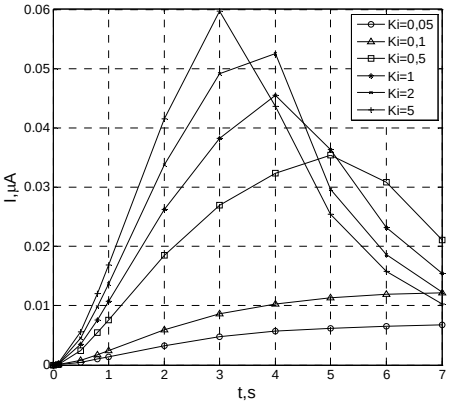

Fig. 15. Influence of reaction rate constante over output current.

4. CONCLUSION

In the paper is investigated the influence of inhibitor starting concentration over biosensor output current for the hybrid biosensor with two enzymes - acid phosphatase and glucoseoxidase in the dynamic mode. Partial differential equations of that complex system are solved numerical and received concentration profiles of five reagents. In the future it will be investigated the influence of enzymes rate over biosensor response and some technical parameters.

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CAPITALIZATION OF POWDERY WASTE THAT CONTAINING IRON AND BASIC OXIDES UNDER BRIQUETTES FORM

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ABSTRACT:
Methods of waste reusing and restoring the economic cycle are a concern both waste generators and those of any processors. From this perspective, the paper presents a possibility of recovery of small and powdery wastes containing iron and basic oxides by produced CARBOFER product used in electric arc furnace as slag foaming agent. Are used waste storage or waste ponds and also waste streams currently on technology: electric steelworks dusts, sludge from agglomeration-blast furnaces, tunder (tunder sludge).

KEYWORDS:
Pulverous wastes, briquette, steel plant dust, agglomeration-blast furnace sludge, lime dust

1. INTRODUCTION

Small and powder waste processing technology is an operations which are processed for use under the conditions required by the user. Technological operations are crucial in the process of recovery (recycling) of secondary materials (waste powder and small). [1.2]

The main methods of processing small and powdery materials, for their reintroduction into the economic circuit, are:

- briquetting;
- pelletizing;
- agglomeration.

Briquetting process has the advantage that allows a variety of wastes containing iron both in terms of chemical composition (primarily Fe content) and granulometric. Thus, in terms of iron content, we consider a limit of 25-60% Fe and granulometry, from dust to about 10mm size (tunder and steelworks slag, ferrous fraction less than 10mm). Therefore, the solution for these materials is the ***briquetting process***.

2. THE STUDY

For recovery in the form of briquette to small and pulverous waste from the steel industry, energy and mining, we consider the following wastes: electric steelworks dusts, sludge from agglomeration-blast furnaces, tunder (tunder sludge) and as binder: lime, bentonite, cement. [3]

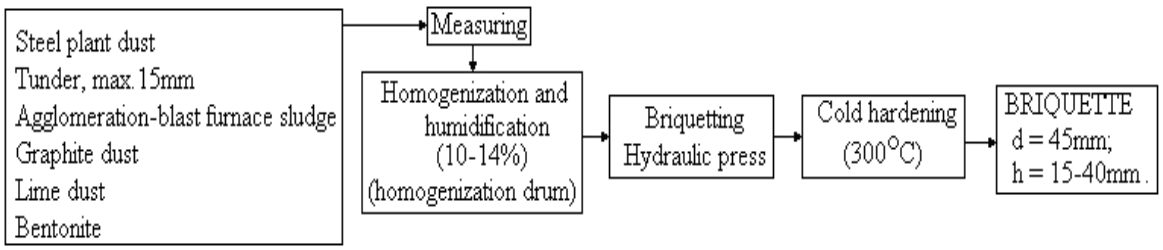

Figure 1. Waste flux processing technology in the form of briquettes

Figure 2. Facilities and equipment used in the experiments.

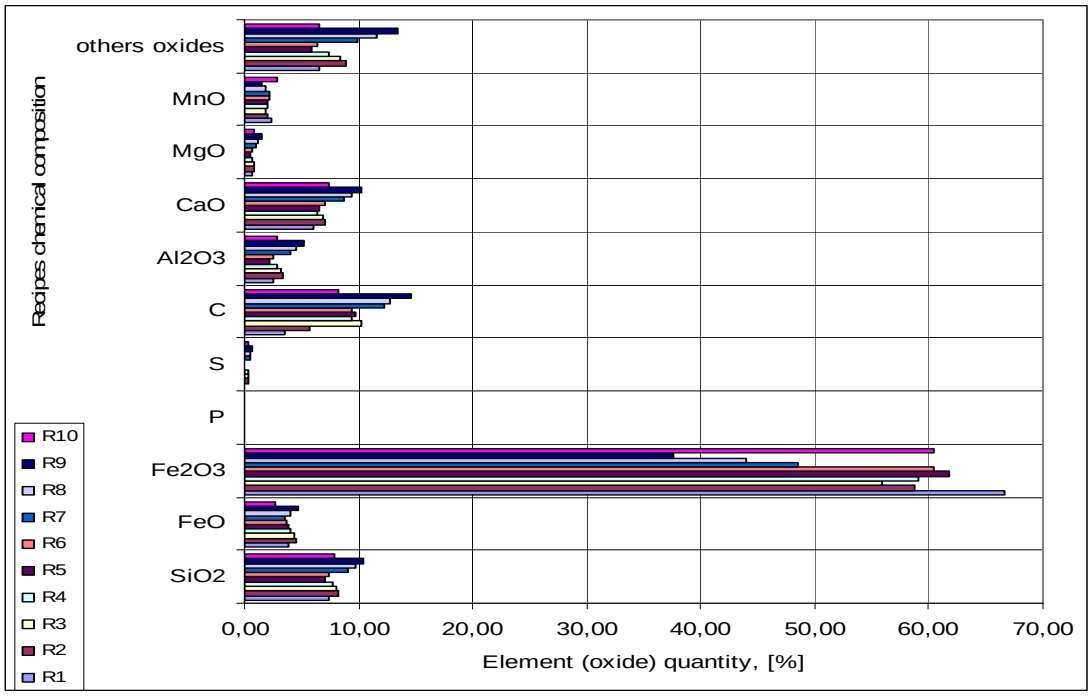

Figure 3. Briquettes chemical composition

Considered waste used in laboratory experiments were processed according to the technological flow shown in Figure 1, using the facilities and equipment existing in the laboratories of the Faculty of Engineering of Hunedoara. Issues during trials and several briquette obtained are presented in Figure 2. In laboratory phase we made a total of 10 recipes briquettes, the recipes chemical composition is presented in graphical form in Figure 3.

3. DISCUSSIONS

Below we presented the results of research on resistance lighters from recyclable materials [3, 4, 5, 6,7], research conducted to know:

- ❖ the changing of the briquette resistance according to the weight (in the preparation recipe) of the steel plant dust particles (EAF), rolling-mill tunder, sludge from agglomeration-blast furnace, lime, bentonite;
- ❖ the influence of some chemical compounds (found in the materials recycled through briquetting) on resistance.

To evaluating the resistance qualitative characteristics during handling and transportation of the briquettes, we determined, through experiments, three technological characteristics:

- Crack resistance: $R_F = \frac{F_f}{A}, [kN/cm^2]$ (1)

where: F_f – crack force, [kN]; A – area of the sample (briquette) section, [cm²].

The crack force F_f is considered to be the applied force at which we can see the first cracks. After performing a quite large number of preliminary tests, we consider that this force has the value recorded at τ = 2 seconds.

- Crushing resistance: $R_S = \frac{F_s}{A}, [kN/cm^2]$ (2)

where: F_s – crushing force, [kN]; A – area of the sample (briquette) section, [cm²].

Based on the preliminary observations, we considered that the crushing force has the value recorded at τ = 12 seconds.

- Crushing interval: $\Delta R_{fs} = R_s - R_f, [kN/cm^2]$ (3)

In case of the studied briquettes (cylindrical), past relations becomes:

$$R_f = \frac{4 \cdot F_f}{\pi \cdot d^2}, \ [kN/cm^2] \quad (4)$$

$$R_s = \frac{4 \cdot F_s}{\pi \cdot d^2}, \ [kN/cm^2] \quad (5)$$

A number of correlations carried out for experimental recipes are presented in figure 4, 5 and 6; so we represented the variation of resistance to cracking, breaking and crushing interval according to the proportion of steel plant dust, dust (sludge) from agglomeration - blast furnace and tunder [6].

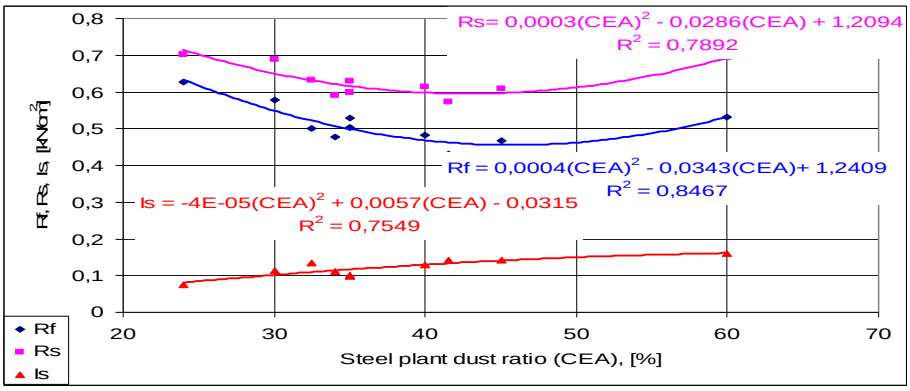

Figure 4. Rf, Rs, Is according to the proportion of steel plant dust

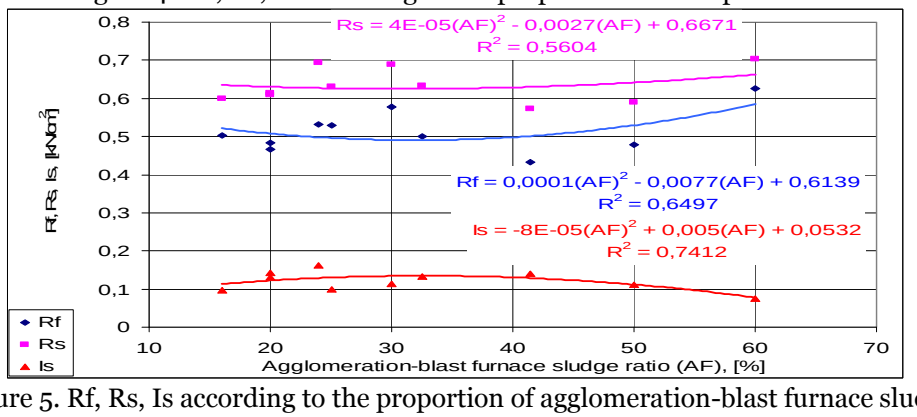

Figure 5. Rf, Rs, Is according to the proportion of agglomeration-blast furnace sludge

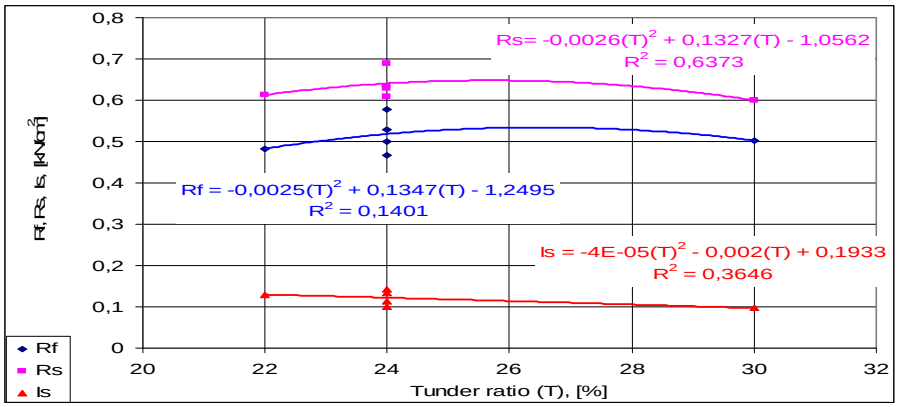

Figure 6. R_f, R_s, I_s according to the proportion of tunder

4. CONCLUSIONS

From analysis of data results in laboratory experiments were obtained the following conclusions:

- best limits of variation of ferrous waste proportions: 50-60% of steel plant dust, agglomeration-blast furnace sludge from 20-30% and 22-24% tunder;
- the appropriate behavior was a recipe No. 9, composed of agglomeration-blast furnace sludge, steel plant dust, tunder, bentonite, lime, graphite powder;
- for this recipe, bulk density was 0.7899 kg/dm3, the degree of reduction of 91.92%. As a result of good mixing of the burden of briquetting and fine grains of agglomeration-blast furnace sludge and graphite respectively, to obtain a contact surface Fe_2O_3 - reducing (C) high, so a large reduction front. In addition, develops CO reduction reaction.

After laboratory testing can be concluded that CARBOFER product under the form of briquettes can be used as a slag foaming agent, especially at lower capacity furnaces or aggregates that not using gaseous oxygen.

ACKNOWLEDGMENT

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POSSIBILITIES OF APPLICATIONS OF TOOLS FOR ECODESIGN IN VARIOUS STAGES OF DESIGN PROCESS

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ABSTRACT:
Organizations that develop new products need to consider many factors related to the environmental impact of their products, including government regulations, consumer preferences, and corporate environmental objectives. Although this requires more effort than treating emissions and hazardous waste, in not only protects the environment but also reduces life-cycle costs by decreasing energy use, reducing raw material requirements, and avoiding pollution control. Ecodesign tolls and strategies have therefore become an important set of activities for product development organizations.
KEYWORDS:
Ecodesign, non-software, tools

1. INTRODUCTION

The current situation may seem at first sight very difficult to comprehend, since the eco-design tools are a large number. Such a situation arose because the development and application of software and non-software tools was done spontaneously and uncoordinated. Any company, enterprise or other institution that has developed tools for their specific conditions. Remarkably, however, that the basic philosophy and methodological basis of these instruments tend to be not very different, since they were subject to the same goal - to improve their level of eco-products in the crucial stages and throughout their life cycle [4].

2. APPLICATION OF SOFTWARE TOOLS OF ECODESIGN

Based on the facts, the usual intermediate targets developers of software tools may be different, which earned their distinction. This is as follows:

- analysis of existing products and processes and use of recorded information as feedback to improve the environmental performance of the product - **LCA / LCI tools**
- analysis of existing products and processes and use of information found to improve certain aspects of the product - **DFX tools**
- comparison of certain materials and processes in order to detect different levels of their impact on the environment - **PP and WP tools**, meaning to prevent pollutants (PP) and waste (WP)
- application of improvement methodology throughout the design process to improve the entire design process - **I - tools**, while here include tools like EIME and EcoDesign Tool.

The designations of these instruments means:

LCA - Life Cycle Assessment,
LCI - Life Cycle Inventory,
DFX - Design For X, "X" means that area, department, etc.,
PP - Pollution Prevention,
WP - Waste Prevention,
I - Improvement,
EIME - Engineering Information Management Executive.

This approach (goals difference) leads to the differentiation of basic eco-design software tools. It should be noted that the amount of applied data and calculation procedures, the use of these tools required is considerable work with a high proportion of routine activities. For these reasons, the rational use of those tools and methodologies they developed in the form of software products. [2] Answers to questions - where, how, when and in which stages of the design process will be advantageous to deploy these tools indicated in table 1.

Table 1 Application of eco-design software tools in various stages of the design process

Stage / Tools	Marketing	Shedule of product	Conceptual design	Design group	Detail design	Production
LCA/LCI		Past results				
DFX						
PP / WP			Targets	Targets	Targets	Targets
I - TOOLS						

Legends: - **Field of application**

3. APPLICATIONS OF NON-SOFTWARE TOOLS OF ECODESIGN

A feature of the ecodesign tools non-software nature is that their application is possible and often without a rational means of computing. On the other hand, it should be emphasized that these tools and their combinations are usually based software tools based on design requirements. This was more - less forced practice and legislative measures States regarding the protection of environment and promotion of sustainable development at local, regional and global level. It is in the interests of manufacturers that their products throughout their life cycle in the least impair the environment and are compatible with this. Not every company, and also for economic or other reasons (eg, specific peculiarities of manufactured products) can be deployed in the process of designing an environmentally-oriented software tools. In such cases it is preferred and must use the non-software tools of ecodesign. [2,3]

Answers to questions - where, how, when and in which stages of the design process will be advantageous to deploy these instruments provides us with table 2.

Table 2 Application of eco-design non-software tools in various stages of the design process

Stage / Nástroj	Marketing	Shedule of product	Conceptual design	Design group	Detail design	Production
EDM metod						
EI– 99 metod						
Ecodesign PILOT						
Metod of DfE matrix						
Metod of MET matrix						
Metod of comparator analysis						

Legends: - **Field of application**

4. CONCLUSION

Defining prevention as the primary goal in attempting to avoid the waste and toxic substances is the primary task in taking up so. net generation (clean production). As a next step, which should be pursued to minimize environmental impact? Those efforts should be applied to the entire environmental life cycle of a product, from raw material extraction to final disposal (clean product). The intention is to optimize the socio-economic system of the product and its use in accordance with the criteria of sustainable development in the future. This meets all its meaning and concept of ecodesign principles, which it brings, which is in accordance with progressive prosperity, meaning a reduction in "consumption" of the environment. [1]

The process begins here ecodesign product modeling system, taking into account specific conditions in the company. It draws on environmental parameters and information that are

specific to individual phases of the life cycle of a product as the newly designed products, as well as existing, to be on improving their environmental analysis. These are based on progressive analysis tools and methods, some of which are more or less considered in the EU as a standard.

Ecodesign brings a new dimension to the design and development of new engineering products and processes to improve existing products. The challenge is to provide the most relevant information as soon as possible to continue with the development of this knowledge. Providing external and internal incentives for environmentally responsible design - ecodesign should be part of defining the product and its creative cycle.

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APPLICATION OF ACOUSTIC CAMERA FOR MACHINE NOISE VISUALISATION AND DIAGNOSTIC

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ABSTRACT:
The Acoustic Camera was the first commercially viable system using beam forming to visually localize acoustic emissions. The tool is now used in a variety of industries and has a growing customer base worldwide. The advantage of the Acoustic Camera: it is a light-weight, modular and therefore flexible system which is rapidly set up and ready to use. After a few minutes only, you get the first acoustic images on your computer screen. The software allows a clear, exact and fast analysis of noise sources. The benefits of the Acoustic Camera are straightforward: Noise sources are visualized, quality problems are detected and development times are reduced.

KEYWORDS:
Acoustic Camera, Measurement, Noise

1. INTRODUCTION

A digital camera is taking an image of the noise emitting object. At the same time an exactly computed array of microphones acquires and records the sound waves emitted by the object. Special developed software calculates a sound map and combines the acoustical and the optical images of the sound source. The Acoustic Camera can extend the time and frequency selectivity and add a location-selective component. With this method the sound signal is shown and also a sequence of acoustic images can be acquired – acoustic films are generated. Nevertheless the Acoustic Camera comprises traditional analysis methods as well, like A-weighting, one-third octave band and narrow band analysis.

With the Acoustic Camera it can be precisely analyzed when, where and which part is occurring the sound emission. The so far used analyses do have an important disadvantage as the location of the emission is limited or not possible. If the sound from several spots of an appliance is to be acquired simultaneously, individual microphones are required for each reading point, and they must be placed very close to the object – a time consuming and costly method.

The whole measurement and subsequent analyses are characterized by:

- high accuracy,
- high speed,
- dynamic operational mode,
- high effectiveness,
- transparent result processing (colored acoustic maps, movies, records).

2. APPLICATION OF ACOUSTIC CAMERA

The fields of application are as various as the world of sound and range from measurements in the open field, acoustic labs to the use in automation engineering.

The benefits of the Acoustic Camera are straightforward: Noise sources are visualized, quality problems are detected and development times are reduced.

Application of acoustic camera:

- localization and identification of noise sources,
- quantitative and qualitative analyze of noise sources,
- diagnostic and control measurements of machine and equipment,
- noise records,
- acoustic video and picture records,
- noise reduction.

The acoustic camera comprises traditional analysis methods as well, like A-weighting, one-third octave band analysis and narrow band analysis, filters, and many more. Based on these methods far more detailed research becomes possible. In a spectrogram, for example, sounds can be highlighted in the time and frequency ranges. The acoustic camera then shows the exact origin of this sound. The approach can also be made from the other end: After selection of a spot on the measured object, the sound originating from that spot can be reconstructed, visualized and broken down into its spectral components. It is also possible to replay the sound via speakers - any time after the measurement is completed.

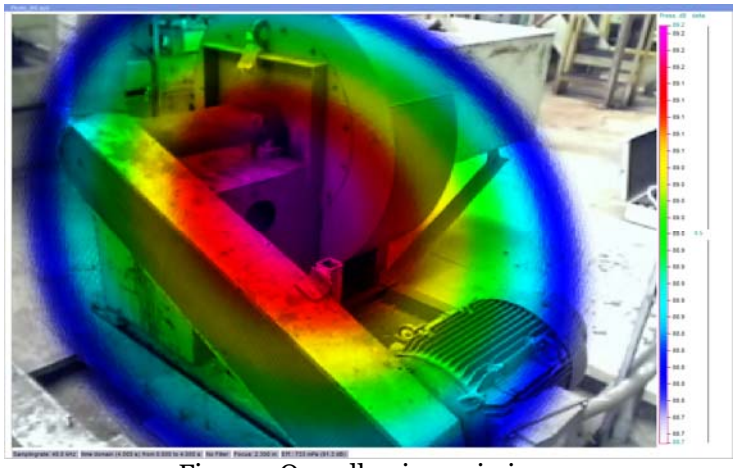

Figure 1 Overall noise emissions

Acoustic pictures and videos acquired by the acoustic camera is possible also use for quality control and diagnostic different machines and equipment which are producing noise during their activity.

Next acoustic pictures and diagrams presents results of measurement air cooling equipment. First acoustic picture present overall noise emissions of whole equipment.

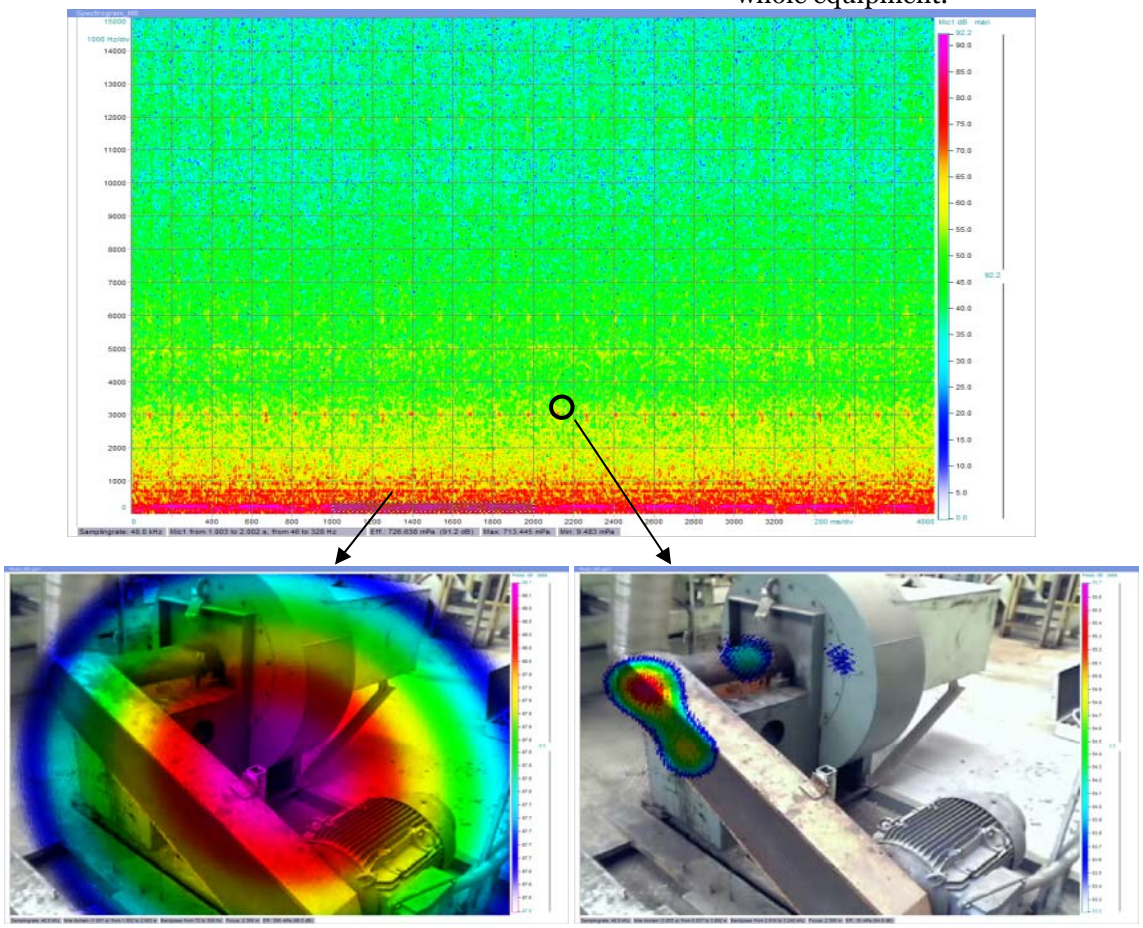

Figure 2 Spectrogram and acoustic pictures

Next picture presents noise spectrogram for this equipment. From this spectrogram was created two different acoustic pictures for two different frequency band. First acoustic picture was created for frequency band 200 – 300 Hz. This frequency band is the most critical and the share of overall noise emissions. Also was created second acoustic for frequency about 3000 Hz where is significant cyclic repeat noise. Creation of acoustic picture clearly show noise source at the field 3000 Hz. This noise was not hearable due the reason of lower noise intensity and was covered by the noise of other parts. Next maintenance discovers wrong seating of driving shaft.

3. CONCLUSION

By the use of Acoustic Camera in field measurements it is possible to localize different sources, even with other dominating sources present. It is possible to cover a large number of measurements per day if one makes proper preparations. The measurements results from the Acoustic Camera shows good correlation with sound level meter measurements, after applying correction. By the use of the various new evaluation possibilities such as Acoustic Photo, Acoustic Movie and Spectral Frames it is quite possible to localize noise sources, also when these do not really dominate the overall levels.

Acknowledgement
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RESEARCH ON WATER QUALITY IN THE CITY HATEG

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ABSTRACT:
Water pollution is a growing challenge in many countries. The choice of modern methods of wastewater treatment, to discharge or recirculation in their natural receptors, leading to the arrest and the formation of large quantities of sludge which includes both raw water polluting materials, and those formed in the process of treatment. The study presents aspects of the qualitative and quantitative levels of water pollution in the area Haţeg.
The study presents qualitative aspects and quantitative assessment of water pollution levels in the area Haţeg. Haţeg City currently has a network of sewerage system divider network in which 49% are domestic, 10% of the storm and 41% in areas without sewer systems. Wastewater volume represents 80% of drinking water distributed by the centralized water population of the city. Mode operation and efficiency of the treatment plant was evaluated by Cole. Samples of ground water, waste and surface water ere also evaluated for chemical content of organic and inorganic substances. High levels were observed as indicators of sewage out of the station (pHentry = 6.89, pHoutput = 6.76; suspension entry = 22.7, suspensions output = 48.6) indicating adequate treatment plant malfunction.
The influences of environmental factors studied were characterized by the location of the pollution index and indices of quality IP-Ic. In a study of IP has values between 0 and 20.0 - which compares with a level of reliability expressed by grades 1 to 10 depending on the value of IP and Ic-quality indices. In a study of IP have values between 0 and 20.0 - which compares with a level of reliability expressed in notes 1 to 10 depending on the value of IP and to reveal the degree of environmental pollution factor analysis and its effects on the environment. Ic values are between -1 and 1 were also compared with the scale of creditworthiness.
Stresses the lack of efficiency results in appropriate handling WWTP discharged water from the city and the need Haţeg reconstruction and rehabilitation of existing stations.
KEYWORDS:
water pollution treatment processes, wastewater treatment Hateg IP pollution index, quality index Ic.

1. INTRODUCTION

Water is an essential element for life and natural processes. Our existence and our economic activities are entirely dependent on this precious resource. It is equally important climatic factor that supports the development of ecosystems and key components of substance and energy exchange in the hydrological cycle. Moreover, globally, water is a scarce resource, which requires addressing it, so to ensure water resources for future generations. The main strategic objective of Romania in the field of water is linked to European integration, which requires the harmonization and implementation of the acquis communautaire in the field of water quality protection. Romania's water resources consist in surface waters - rivers, lakes, the Danube River (≈ 90%) - and groundwater (≈ 10%).

For years, the entire world population puts more often the same questions. It is mankind into a state of slow death? The issue of environmental degradation? Natural resources are so indispensable to life? Gradual degradation of the environment in the whole world is mainly due to human action, that the need to improve their living conditions, cause damage to the landscape. Through this work we tried to reveal the problem of the environment, seen from the perspective of pollution and water quality.

Situated at the confluence of the River Great Strei Haţeg depression (310-350 m altitude) is the meeting of three roads linking the main regions of south-western Transylvania. The administrative area of the city covers an area of 61.6 square kilometers and includes the towns Nalatvad, Silvaşu Upper Lower Silvaşu. The natural environment is hilly, mountainous, like a natural fortress defended by Orastie Mountains to the east, south of Parang, Poiana Rusca Retezat west and north, forming the very core of whether state and Romanian Dacia. There is also a very dense river network

2. THE STATE WATER QUALITY

Water quality status of water pollution is altering the physical, chemical and biological characteristics of water, produced directly or indirectly, natural or man. Polluted water becomes unfit for normal use. Pollution can take place:

- continuing (permanent), where sewage from a city, or from industry and Fire residues discharged into the waters,
- batch, at regular intervals or irregular time - temporary (eg temporary colonies)
- accidentally Fail

Water pollution sources are classified according to several criteria, given their diversity:

- After source: household activities, industry, agriculture and transport.
- After the range of pollutants - local sources (sewage pipes, ramps download) - diffuse, when pollutants are spread over a large area. It is sometimes difficult to locate the source or sources of Evolution.
- After their position: - Fixed sources - mobile (cars, homes and facilities, moving, etc.).

For example, industry chemicals discharged into natural waters, organic and inorganic, vegetable and animal waste, solvents, hydrocarbons, heat, etc. Materials can be solid or liquid, miscible or immiscible with water, light or heavy volatile, more or less toxic. By their nature are pollutants: organic, inorganic, biological, radioactive, thermal aggregation by Status different particulates (insoluble in water) water-soluble pollutants, dispersion colloidal.

Once during natural degradation in water are distinguished: easily biodegradable pollutants, poorly biodegradable (the natural degradation takes less than 30 days), non-biodegradable (degradation in 30 - 60 days), and refractory (with degradation and over two years).

Water self-purification processes are all physical, chemical and biological weapons that discard pollutants contained water without human intervention. Wastewater means all operations carried out to reduce levels of pollutants, so that the remaining concentrations do not cause pollution of receiving waters.

3. WWTP OVERVIEW

Presentation perimeter interested WWTP is located in the east of the city Haţeg at approx. 700-800 downstream of the city on the right bank of the Yellow River, its major riverbed in the distance. 2.5 km from the confluence with the Yellow River Valley High. Within this site perimeter treatment plant is in its Depression-Drastic Haţeg, depression Haţeg compartment in the central part of it.

City wastewater treatment plant was carried Haţeg in two stages:

Stage I - in 1962 started the construction of wastewater treatment plant. The project requires only a mechanical stage technological scheme, with a treatment capacity of 1631 cubic meters per day (19 l / s). The evolution of the city, the emergence of industry and population increase led to the need for an extension of the station.

Phase II - was launched in 1976 an investment to increase capacity from 55 l / s (4741 m³ / day) provided with mechanical and biological. Work on new investment began in 1980 and were discontinued after 1990 due to lack of funds.

Currently, sewage is passed only through the old station, which is obsolete in terms of capacity and efficiency of treatment. In general, operation is "at random" because the station does not have a laboratory to manage daily station output and, accordingly, to have the operation (emptying sludge from settling tanks, fermentation processes, floating sludge, etc.).

4. QUALITATIVE AND QUANTITATIVE ASSESSMENT OF WATER POLLUTION LEVELS IN THE AREA HAŢEG

Haţeg City currently has a network of sewerage system division (separation)

- about 11,700 m of sewage collectors
- about 2200 m of rainwater collectors.

For wastewater with high organic load, obtained from the slaughterhouse Hațeg (currently in idle state there are two drains - one for waste water by faces which are run by the city's wastewater treatment plant - one for conventional clean water in Yellow River discharge directly.

In the residential area in the eastern part of the city, sewage is unitary, rainwater, together with domestic wastewater treatment plant being conducted.

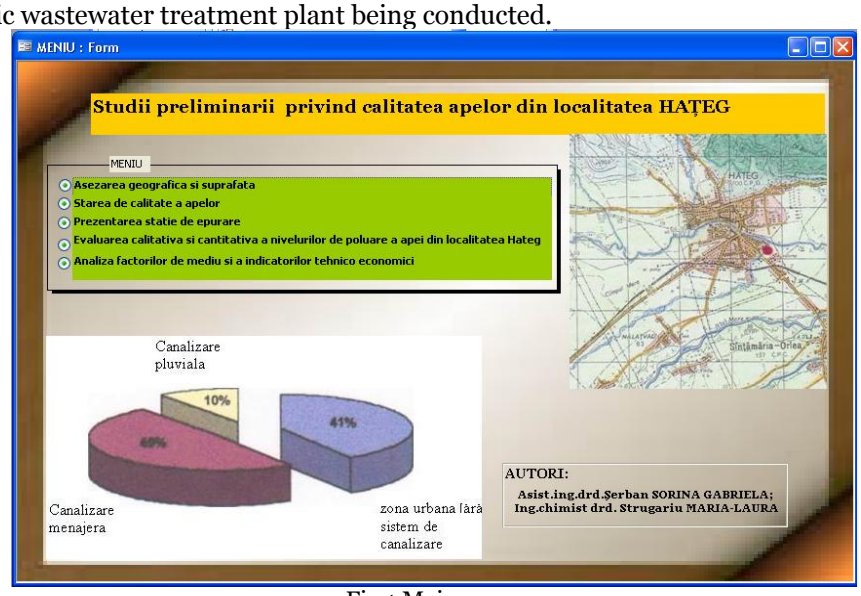


Fig.1 Main menu

Monthly average flow is necessary city:

Q u max = 76.000m3/month of which - 51.000 m³/month population
- 25.000 m³/month operators

Currently, sewage is passed only through the old station which is exceeded in terms of treatment capacity and efficiency.

The existing facility is partially operational, is undergoing a process wastewater treatment mechanical treatment technology does not comply with the characteristic (transition times are much smaller than projected).

In order to determine how and efficiency of operation of the station were collected wastewater samples from the following points: - city station entrance, beer station entrance, exit station emissary. Data from the tests performed are presented in Table 1, and the situation of treatment effectiveness and efficiency station which currently makes only a mechanical treatment, and additional load of the Yellow River after discharge clean effluent is presented in Table 2.

Tabelul1

Indicator	UM	Intrare oras	Intrare fabrica	Iesire statie emisar
pH	-	6,89	6,77	6,76
suspensii	mg/l	22,7	20,2	48,6
reziduu filtr.	mg/l	278	269	310
CCO-Mn	mg/l	322,5	141,8	335,5
CBO5	mg/l	178,6	65	195
NH4	mg/l	7,39	9,78	10,27
detergenti	mg/l	0,5074	0,3974	0,097
extractibile	mg/l	5,3	4,5	4,1
CCO-Cr	mg/l	-	-	3,94

Fig.2. Data collected

Tabelul2

Indicator	Intrare ape	Iesire statie	Randament epurare	Pr Galbena amonte	Pr Galbena aval	Incarcare suplimentara
CCO Mn	800	2,00448	640	1,60358	17,6	144%
CB05	414	1,03732	347	869,44	8,93	186%
Azotați	-	-	-	-	2,99	26%
Azotiți	-	-	-	-	0,08	33%
P04	452	11,33	2,36	5,91	1,34	
P total	148	3,71	0,769	1,93	-	
NH4	284	71,16	8,95	22,43	6,94	290%
Suspensii	243	608,86	162	405,91	25	79%
Sulfuri	914	22,9	10,02	25,11	6,8	530%

Fig.3. Situation of wastewater treatment plant performance and efficiency

5. ANALYSIS OF ENVIRONMENTAL FACTORS AND ECONOMIC

I Indicators for evaluation of the limits permitted in pollution of the environment in the location studied, Ip pollution index was used that resulted from the ratio of the maximum determined by the physico - chemical on specific pollutants and the maximum permissible concentration. Introducing the first two blocks measured concentration and maximum concentration, we get the third box index

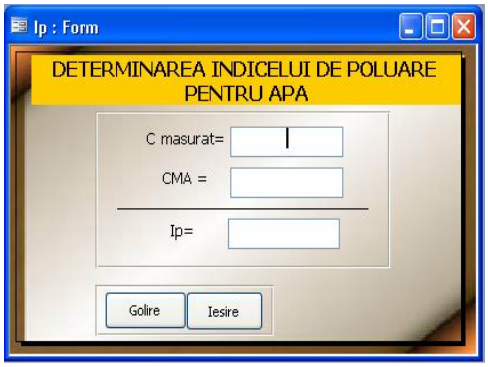


Fig.4. Calculation of pollution index

Sampling was done from a point located near considered significant discharges of wastewater (from the grease trap) on the soil unprotected by the downstream flow direction to the phreatic water catchment area of the course. Sample groundwater, in theory, should correspond to specific water quality conditions (STAS 1342/1991). The quality of groundwater was determined taking into account the two regulatory laws MAPPM: Order 184/1997. The test results are presented in Table 3.

Tabelul3

Indicatori	Concentratii masurate	CMA STAS 1342/91
Concentratia ionilor de hidrogen pH	6,7	6,5 - 7,4
Amoniac NH4	7,3	0,0
Azotiti NO2-	0,9	0,0
Azotati NO3-	2,3	45,0
Cloruri Cl-	380,0	250
Fenoli	0,02	0,001
Fosfati PO4-3	1,5	0,1
CCO - Cr	32,5	3,0
Sulfati SO4-2	248,0	200
Sulf S	10,2	0,0
Zinc Zn	97,0	5,0
Plumb Pb	32,5	0,05
Cupru Cu	5,7	0,05
Mangan Mn	29,0	0,05
Magneziu Mg	26,2	50

Fig.5. The test results

Tabelul4

Caracteristici	Ip	Nb
Amoniac	-	1
Azotiți	-	1
Azotați	0,05	10
Cloruri	1,52	6
Fenoli	20	2
Fosfați	15	2
CCO-Cr	10,8	3
Sulfați	1,24	6
Sulf	-	1
Zinc	19,4	2
Plumb	650	1
Cupru	114	1
Mangan	580	1
Magneziu	0,52	7

Fig.6. Pollution index

Compared to the results determined physico-chemically, we have interpreted the pollution index and determined the water sample (Table 4). In order to identify the efficiency of municipal wastewater treatment plant and to quantify the effects of water discharges in the area of the Yellow River, and have collected two water samples:

- A1 - from raw sewage entering the treatment plant;
- A2 - out of treated water treatment plant

The data collected are presented in tabelul5.

Compared to the results determined physico-chemically, we interpreted and determined discharged effluent pollution index, the limits reported NTPA 001 (tabelul6), and the situation of treatment effectiveness and efficiency station is currently only a sewage mechanical load and further purified effluent after discharge of the Yellow River, are shown in Table 7.

Tabelul5

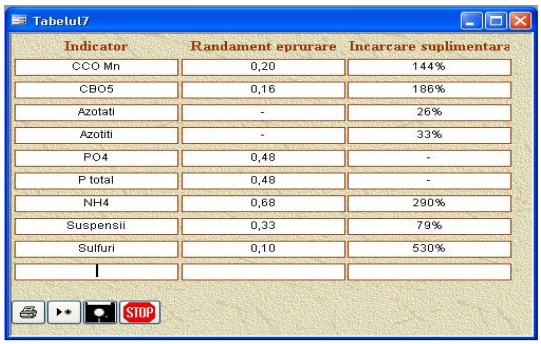
Indicatori	Concentratii masurate A1 influent	Concentratii masurate A2 effluent	NTPA ptr evacuare in Galbena
pH	7,1	7,0	6,5-8,5
CB05	414	347	20,0
CCO - Mn	800	640	-
Fosfor total	1,40	0,76	1,0
Suspensii	243	162	35,0
Amoniac - NH*	28,4	8,95	2,0
Sulfuri	9,14	10,02	0,5
Fosfați - P04*	4,52	2,36	-

Fig.7.Date taken

Tabelul6

Caracteristici	Ip	Nb
CBO5	17,35	2
Fosfor total	0,76	7
Suspensi	4,6	4
Amoniac – NH4	4,47	4
Sulfuri	20,04	1

Fig.8. Pollution index



Tabelul7

Indicator	Randament epurare	Incarcare suplimentara
CCO Mn	0,20	144%
CBO5	0,16	186%
Azotati	-	26%
Azotiti	-	33%
PO4	0,48	-
P total	0,48	-
NH4	0,68	290%
Suspensii	0,33	79%
Sulfuri	0,10	530%

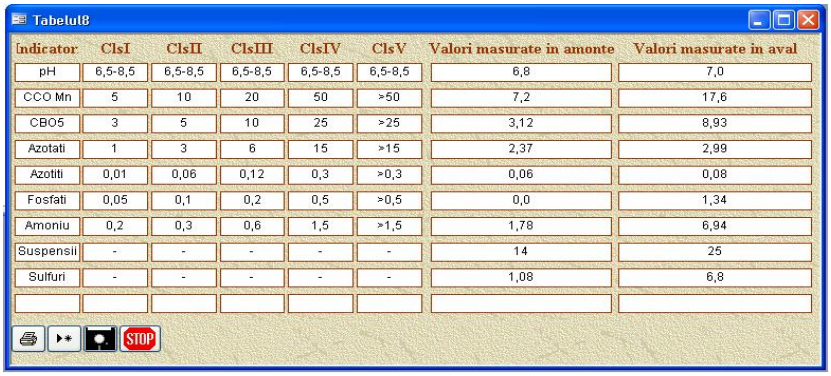
Fig.9. Statement of effectiveness and efficiency

Two samples were taken from surface water to establish categories of Yellow River water quality before and after evacuation:

- ❖A3 - upstream water treatment plant discharge,
- ❖A4 - treatment with the downstream discharge station. 100m (to allow dilution of effluent).

The test results were compared with the Order 1146/27.03.2003 on surface water quality classification, which according to article 2 Order. STAS-4706 repealed the "Surface - categories and quality technical.

Data are presented in tabelul 8.



Tabelul8

Indicator	ClsI	ClsII	ClsIII	ClsIV	ClsV	Valori masurate in amonte	Valori masurate in aval
pH	6,5-8,5	6,5-8,5	6,5-8,5	6,5-8,5	6,5-8,5	6,8	7,0
CCO Mn	5	10	20	50	>50	7,2	17,6
CBO5	3	5	10	25	>25	3,12	8,93
Azotati	1	3	6	15	>15	2,37	2,99
Azotiti	0,01	0,06	0,12	0,3	>0,3	0,06	0,08
Fosfati	0,05	0,1	0,2	0,5	>0,5	0,0	1,34
Amoniu	0,2	0,3	0,6	1,5	>1,5	1,78	6,94
Suspensii	-	-	-	-	-	14	25
Sulfuri	-	-	-	-	-	1,08	6,8

Fig.10.Rezultatele obtained

6. CONCLUSIONS

At present, sewage is passed only through the old station which is exceeded in terms of capacity and efficiency of treatment. The existing facility is partially operational, is undergoing a process wastewater treatment plant mechanic who does not comply with treatment technology feature (time crossings are much smaller than projected).

In order to determine how and efficiency of operation of the station were collected wastewater samples from the following points: the city station entrance, beer station entrance, exit station emissary. It is noted high levels of quality indicators out of treatment plant, resulting in the fact that the station is not working properly.

For businesses that discharge wastewater treatment plant in the city, it is proposed the implementation of local stations pre-treatment before discharge into the sewer system. Referring to the garbage coming technology and effluent treatment plant exclusively, we can say that they are insignificant from raw municipal wastewater flow entering the station.

Following this report - resulting values between 0 and 20.0 – IP value to be compared with a level of reliability expressed by grades 1 to 10 depending on the value of IP and to reveal the degree of pollution factor environmental analysis and its effects on the environment.

If the effluent discharged into the yellow surface is observed in almost all indicators exceeded watch (except the total phosphorus and pH). Deviations are explained considering the fact that currently the treatment of municipal wastewater is confined to a mechanical treatment stage, nor properly exploited this.

Note that the average creditworthiness water sample has a value of 3 which corresponds to the average lifetime of lethal effects of exposure, the environment is degraded level, however I have noticed, the depreciation of the Yellow River water quality from discharge of & quot; treated & quot; in treatment plant, the area is classified in Class lll the quality on most indicators. limit values in that class are 2-3 times higher than those of targets mean.

To achieve certain calculations we used an application made by Microsoft Access. The results of tests carried out lead to inefficiency & quot; Station municipal wastewater treatment & quot; of the city Haţeg, reconstruction and rehabilitation of existing stations is imperative.

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THE POTENTIAL OF WIND ENERGY AND ITS USAGE IN THE CONDITIONS OF THE SLOVAK REPUBLIC

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ABSTRACT:
The main aim of this paper is to bring near wind energy as one of the mostly used renewable energy source.
The article's purpose is to familiarize the reader with the concept of the wind energy usage, its effects on the environment, current status of use and plans how to increase the use of wind energy in the Slovak Republic.
KEYWORDS:
wind energy, wind energy plants, renewable energy sources, environment

1. INTRODUCTION

The energy that we use today in the form of heat, electricity and fuels for motor vehicles, has its origins mostly in fossil fuels (coal, oil, natural gas). These fuels are below the surface, where it originated millions of years after the decomposition of prehistoric plants and animals. Although fossil fuels the action of natural forces (heat and pressure) ever created, its current consumption far outweighs their formation. The fact that they are not replenished nearly as fast as they are being consumed means that in the near future they run out. For this reason, fossil fuels are considered non-renewable energy sources. The main negative consequences of burning fossil fuels is serious damage to the environment and therefore it is today, when rising demand for electricity we must seek alternative sources of energy. Between a so-called renewable, "green", energy sources we include biomass, geothermal, solar, water and wind energy.

2. USAGE OF WIND ENERGY

The exploitation of wind force has been known for a couple of thousand years and it is being linked to the beginning of the human civilization when man decided to make use of this kind of energy.

Since wind energy is being counted into unexhaustible renewable energies without direct impact on the environment and represents a clean form of energy with no waste production, no air pollution and no negative effect on the human health, a tremendous development of wind energy plants, which is the fastest growing branch in energy producing, is being observed.

The currently mostly used forms of wind use are wind energy plants using turbines. They are converting kinetic energy of the air molecules to mechanical work of the turning rotors which, through a geared mechanism, drive electric generators that transform work energy into electricity.

Figure 1 Wind turbines [3]

An effective step in transforming wind energy into electricity is also building wind energy plants/parks where the main concept is to maximize the possibilities of the given location. Therefore, several turbines are built in the same location.

Figure 2 Wind farm [3]

3. EFFECT ON THE ENVIRONMENT

Every form of energy production creates negative effects on the environment, however while using wind energy plants, the negative effects are minimal in comparison with other, traditional electric production. [1]

Replacing the production of electricity from fossil fuels with wind chargers brings positive facts: [2]

1. Saving the fuel that is not renewable
2. Reducing the amount of CO_2 that would be produced while burning this fuel
3. Reduction of gas emission (SO_x, NO_x)
4. Reduction of dust outlet
5. Reduction of liquid and solid waste
6. Reduction of the waste heat leaking into the atmosphere or water systems

4. CURRENT STATUS OF WIND ENERGY UTILIZATION

Although the wind energy is one of the youngest technologies of energy production and does not have such background as other commercial sources of electricity production, with time its usage as a renewable source of energy grows more and more.

Despite the massive development in Europe in the field of wind energy began in the early 90's, many of those managed to establish world leadership in a relatively short time. Wind energy and its usage reached the highest growth from the entire spectrum of renewable energy sources in the EU (tab. 1). Together with solar energy, it is considered to the "second generation" technologies.

Table 1. The development of renewable energy sources in the EU [3]

Order	Energy	Year			
		1990	2000	2010	2020
1	Solar Energy	0.1	0.2	0.9	3.2
2	Wind Energy	0	0.1	0.4	2
3	Geothermal Energy	0.1	0.3	0.5	0.8
4	Modern Biomass	1.4	2.2	3.5	5.1
5	Small water generators	0.2	0.3	0.4	0.6
	Total	1.8	3.1	5.7	11.7

The reduction of electricity prices is a commonly observed trend in the wind energy field. This is tightly bound to the power increase of the new wind turbines. As a side effect, the competitiveness of the wind energy with commercial energy production is growing as well. At the same time it gets less dependent on the state grants reflected mainly in the buying prices of the renewable energies. It is to be expected that the prices of electricity will continue to drop, as well as the competitiveness of wind energy with current energy sources will continue to grow. The development of the equipment is also foreseeable.

5. THE POTENTIAL OF WIND ENERGY UTILIZATION IN SLOVAKIA

Slovakia as an inland country has its potential in utilizing wind energy rather limited as in comparison with the west European countries. It has been estimated to 600GWh/r which, in comparison with other renewable energy sources potential (biomass, water), is very low.

Despite relatively large occurrences of wind during the year, not every region is suitable for electing a wind charger. In our latitude and average altitude of 600m above sea level, the wind speed is averaging to 2-3m/s while the ideal wind speed would be 12m/s. In the mountain terrain that is characteristic for Slovakia, is the wind flow relatively inconsistent. As a result of terrain obstacles the wind intensity and direction is changing and inapt turbulences occur. Therefore multiple year long specific measurements with special analysis needs to take place to estimate the suitability of the locality for wind chargers.

Despite the good wind conditions with speeds over 5,5m/s are certain areas, like the National Parks (High Tatra National Park etc.), excluded from electing wind parks for environmental reasons.

6. BARRIERS IN THE UTILIZATION OF WIND ENERGY IN SLOVAKIA

Among the barriers that are complicating the utilization of wind energy in Slovakia are being counted:

1. lack of knowledge of the wind climate (wind intensity and its temporal and geographic variability)
2. a strong dependence on wind climate
3. lack of knowledge of the effects of a high proportion (approximately over 5%) in electricity production and fluctuations in transmission and distribution system
4. negative impact on power system stability
5. problems in perception, mainly related to changing visual environment
6. restrictions in protected areas
7. lack of awareness of health and environmental impacts of operational wind farms

Another important criterion is the economic return of wind power in the form of electricity generation. The cost of installing 1 kW wind power in Slovakia are from 1500 to 2000 Euros, the price paid for electricity generated from wind power is 94 Eur / MWh. From that follows that the period for the return of total investment is about 17 years.

7. WIND POWER PLANT IN SLOVAKIA

Even though we are not a country with ideal conditions for the use of wind energy, there are currently 9 wind turbines in operation in Slovakia in three operating wind parks located in (Fig.3).

Figure 3 Wind farms in Slovakia [6]

These power plants annually produce about 6 GWh of electricity (as of 2004). Slovakia uses only about 1% of its full potential The reason is the wide range of economic, legislative and environmental barriers, of which the introduction of fixed prices for electricity generation from renewable sources eliminate at least some. Highly actual issue, which divides the professional community impact assessment, is mainly impact of the construction of wind farms on the environment.

8. VISION OF SR WIND ENERGY UTILIZATION LISTEN

Slovak Republic as a European Union member country is obliged under their obligations to contribute to increased share of renewables in the total resources, thereby reducing negative environmental impacts, the European Union's heavy dependence on imported fossil fuels and vulnerability to fluctuations in energy prices.

Setting targets for the years 2010 and 2015 gives a real opportunity for Slovakia to increase the current 4% share of renewables in total energy consumption to 12% share in 2020.

Basis for setting a binding target for Slovakia in 2020 will be elaborated in a forthcoming material, energy security strategy of the SR, which is an indication of the outlook to 2030.

According to ZVES (Association of wind energy in Slovakia), Slovakia has the potential to increase the current total installed capacity of 5 MW to approximately 600 MW over the next 5-7 years and the prospect to further enhance the technology up to 1000 MW. This objective can be considered as a realistic and feasible in the horizont of 2020.

9. CONCLUSION

If we are to get even closer to achieving the objectives of increased use of wind energy as a renewable energy source and thus avoid possible sanctions from the EU, it is essential to use all available and economically and environmentally sound electricity generation from renewable energy sources, which include the use of wind energy.

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NOISE AND ITS SOURCES FOR THE REDUCTION IN WORK ENVIRONMENT

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ABSTRACT:
This post is dedicated to acoustic waves, which is part of the physical fields that surround the man, acting on the body, affecting his health, behavior, activity, efficiency and wellbeing. Frequency distribution of sound waves, infrasound and ultrasound affecting human biosphere. However, if the rate exceeded the intensity of the initiative, becoming the acoustic load producing a stress event with the following characteristics of nonspecific adaptive responses with normal speech.
KEYWORDS:
Working environment, noise, noise pressure level

1. INTRODUCTION

In terms of interactions between man and environment is characterized by physical factors, several common characteristics: increasing energy consumption (thermal, electromagnetic, acoustic); the man can act as a "field" (acoustic, electromagnetic); in some cases they cannot perceive the senses.

The severity of these factors stems from the fact that usually affects large population groups, and since their effects on health are not visible immediately, the public underestimates their importance. [1]

Physical working environment factors are ionizing radiation, ultraviolet radiation, visible light, infrared radiation, lasers and electric, magnetic and electromagnetic fields. Other physical factors are noise, vibration, and shock and heat-humidity microclimate. [2]

2. NOISE AS PHYSICAL FACTOR OF WORKING ENVIRONMENT

The main source of noise in the workplace are machinery and technological equipment, some of the activities carried out using hand tools and material handling, for example. When using pneumatic tools, noise occurs mostly in the range from 100 to 110 dB, the power tool is 90 to 100 dB, in forging about 130 dB. High noise levels can be observed even in woodworking machines, it's more than 90 dB. [4] A very important and frequent source of excessive noise is powered hand tools. There is serious risk of noise and operating machinery in metallurgy and heavy machinery where sources of noise are both great machines, but also technological processes. In such operations noise often exceeds 100 dB. [5]

As a result of adverse exposure to noise at work on health, many employees become manifest hearing loss. In the last decades of the 20th century the number of newly reported occupational diseases diagnosed with "Noise-induced hearing impairment" repeatedly exceeded 200 cases per year. The principal enforcement of new legislative measures to protect employees from noise for this number decreased significantly in the 47 cases a year. Noise at work determining the noisiest source. In measuring and assessing noise in the workplace is a distinction:

- Noise in the workplace, i.e. in the area where the workers during the work resides
- Noise in the area of work, i.e. in the area where the workers during the work moves

- Noise levels for the individual who expresses an individual's noise exposure during work time. [4]

In assessing the noise in the working environment of man is paramount to determine what sort of traffic goes, what types of machinery and equipment are at work used, as addressed issues of noise, in which technical condition are used machinery and equipment and the like. Measurement and objectivity to determine what the noise exposure a person is working in the service exposed. [5] The work environment is a way of measuring the noise determines the inspection of workplaces. Measurement of jobs is mainly carried out when employees are staying longer in jobs and the nature and noise are different for different jobs. If employees at work often change jobs and noise at different locations do not differ too, measured the noise in the workspace. Measurement of individual noise load is performed if the workers at work places and frequently changing noise levels at individual sites vary greatly. If the worker persists in the workplace throughout the work shift, characterized by data noise in the workplace also virtually noise load of the individual. The measured value of noise at work then, depending on the method of measurement gives the noise burden on staff or noise at work then, depending on the method of measurement gives the noise burden on staff or noise in the workplace.

Way to evaluate noise and maximum values defining the parameters for the noise in the workplace down the provisions on health protection against noise respectively. Technical standards specifically for the current audible sound, infrasound, ultrasound, high frequency sound and low-frequency sound. [4]

3. EFFECTS OF EXCESSIVE NOISE ON THE HUMAN BODY AND DISEASES

Noise can be adapted to subjective, but objectively his action on the human body cannot be avoided. Noise is mainly the effect of harassing, harmful and disruptive activities and welfare of man. These effects of noise depend on several acoustic and human factors, which are listed in Table 1. [3]

Table 1 Health and comfortinteractiv factors of human [3]

Acoustic factors	Non acoustic factors
▪ type of noise and distance from source ▪ intensity, respectively. sound pressure level, ▪ the amount of frequency emitted noise ▪ tonal spectrum of sound components, ▪ frequency spectrum ▪ interval operation and conduct of exposure ▪ interruption frequency noise levels and the difference between the noise source and background noise ▪ vividness and distinctiveness noise and its unexpectedness.	▪ gender, age and health, ▪ subjective relationship to the noise source, ▪ time perception of noise operators (day, night, seasons) and the immediate disposition of man, ▪ need noise associated with human activities, ▪ social status, ▪ Experience with noise from the past ▪ economic dependence on the noise source, ▪ relaxation and sleep.

The crucial characteristics of noise in terms of its influence on human organism are intensity, frequency and time course. Sounds above 2000 Hz with a narrow frequency range are effective, short and irregular sounds that cause fright response and disruptive. Effects depend on the noise parameters in addition to a large extent on the individual susceptibility of humans, age, lifestyle, legacy disease, current health status, but also with regard to the sound and its source. [2]

The effect of noise level below which there is damage normal healthy ear of habitual noise exposure is known as the criterion of risk of hearing damage. It should be noted that hearing damage is **cumulative result of sound level and time of exposure** and any criterion must take into account the sound level and time of exposure. [3]

Health effects of noise: Noise is not active only on human hearing, but also affects the function of various organs. One-off **short-term** effect of over-intensity sound can cause **acoustic trauma**, which has been considered as an occupational accident. **Long-term** intense noise causes temporary threshold shift and later at noise levels higher than 85 dB, there is the constant increase and the **onset of hearing loss professional.**

Occupational exposure: Acute **acoustic trauma** resulting from rare may occur after heavy sound impulses such as. Shot blast.

The clinical picture of disease: **acoustic trauma** is manifested resound feelings, pressure and pain in the ear and ear subjective tinnitus. Symptoms may take several minutes to days and then the condition usually normalizes. Tinnitus (ringing in the ears) may be permanent. **Hearing loss from noise** there is repeated exposure to excessive noise on the auditory analyzer. It is a symmetrical two-sided type of cochlear sensory disorder.

Diagnosis of the disease: Diagnosis of occupational hearing loss from noise is based on:

- work anamnesis and establish long-term exposure to excessive noise
- typical clinical picture of disease, confirmed by repeated otorhinolaryngological and repeated audiometric testing. In complicated cases, using the method of objective audiometry.

Rate and Importance of damage is rated from liminal tonal audiogram would Upshot of percentage deficit by Fowler. This calculation performed with, that first must calculate hearing loss in% for each ear separately, this is performed, that is recorded each hearing loss on audiogram in dB for tones of 500, 1000, 2000 and 4000 Hz frequencies will assign matching percent of hearing loss from Table 2.Total of those four values gives percentage loss for right and left ear. Total hearing loss in% is Calculated, that a hearing loss less damage ear Expressed in% is added ¼ of difference between both ears. [6]

Table 2 Hearing loss calculation in per cent by Fowler [6]

Hearing loss	Hearing loss in per cent [Hz]			
dB	500	1000	2000	4000
10	0,2	0,3	0,4	0,1
15	0,5	0,9	1,3	0,3
20	1,1	2,1	2,9	0,9
25	1,8	3,6	4,9	1,7
30	2,6	5,4	7,2	2,7
35	3,7	7,7	9,8	3,8
40	4,9	10,2	12,9	5
45	6,3	13	17,3	6,4
50	7,9	15,7	22,4	8
55	9,6	19	25,7	9,7
60	11,3	21,5	28	11,2
65	12,8	23,5	30,2	12,5
70	13,8	25,5	32,2	13,5
75	14,6	27,2	34	14,2
80	14,8	28,8	35,8	14,6
85	14,9	29,8	37,5	14,8
90	15	29,9	39,2	14,9
95	15	30	40	15

In total hearing loss in 20% of the affected disorder generally unaware of the loss of up to 40% can be offset by increased attention and to higher losses in the communication difficulties. Initially only understand speech in difficult acoustic conditions, and then do not understand even in normal communicative situations and a quiet room. Specifically, communication difficulties associated with frequency and disability cannot be unreservedly committed to the disability rate in% according to Fowler. [6]

4. LIMIT AND ACTION VALUES OF NOISE EXPOSURE

On the major workplace part of production and introduction sector employee can be exposed by different work and working environment factor. I tis very important, that employee health would be protected before negative work and working environment effects, and eventually that bad affects were adjusted, or their rubbish was reduced for the lowest possible rate.

At present according to Parliament European and council directive no. 2003/10/EC are establishing concepts to our legislation:

- **limit value exposure** $L_{AEX,8h,L}$ = 87 dB (or L_{CPk} = 140 dB at individual impulses),
- **high action value of exposure** $L_{AEX,8h,a}$ = 85 dB (or L_{CPk} = 137 dB at individual impulses),
- **lower action value of exposure** $L_{AEX,8h,a}$ = 80 dB (or L_{CPk} = 135 dB at individual impulses).

Action value of exposure is noise value in the work environment, where at going beyond that has to be done precaution for noise decrease.

Limit value exposure is noise value, which **at employee can not be exceeded for any conditions**, even with earmuffs applications. [7]

5. OBJECTIFICATION METHODS

In measuring and assessing noise in the workplace will use 3 types of limit values and biological, emissions and air pollution.

Biological evaluation of noise and its harmful effects is performed when the noise exposure of workers can not accurately assess the physical measurements, when the hearing impairment and other factors involved and there is no known relationship between exposure, the incidence and size of workers' hearing from noise damage. The basis of the **audiometric examination** of the exposed workers in a quiet audiometric chamber, which measures the increase of hearing loss across the group for one year.

Noise emission values of equipment characterized in terms of their ability to radiate acoustic energy. Using these figures, it can calculate the distribution of noise levels in a certain area, thus the ability to characterize the source of a sound the space. This property is expressed in sound power level. Noise emission values are fundamental and technical characteristics of

machines used to assess the quality of machines in terms of noise and efficiency of technical measures taken to reduce their noise.

Imitated noise values are used for ranking noise on workplaces in terms of potential effects on human organism. The basis of the measurement noise nuisance, i.e. the noise in places of residence of workers. We distinguish between direct measurement of noise load, measurement noise in the workplace and measurement noise in the workspace.

Noise on working place is measured when, during the shift workers are mostly working on one place and outside of this place do not enter into area with Massively A higher noise level than on permanent working place.

Measurement noise in the work area is carried out when in a noisy area moves more people, space is filled with a greater number of noise sources of the same type and level of noise in the workspace does not change significantly. Workers are mostly working part time staying in this area and outside it are not exposed to greater noise. Integral part of measuring and assessing noise in the workplace survey is the type of activity and duration of exposure. Evaluation of noise in the workplace is against the measured values of noise, the type of work and duration of exposure to the permissible limits in the legislation. [2]

6. PREVENTIVE MEASURES AGAINST NOISE

Measures used to prevent or reduce the noise in the work environment can be divided into several groups:

- **technical steps** to eliminate potential sources of noise in the manufacture of machinery and technological equipment, selection of equipment with lower noise, acoustic coatings, noise-absorbent wall materials, preventing transmission of the building structure, isolation of man from the noise source (noise cab), acoustic wall tiles,
- **technological measures**: low-noise technology, covers material transport routes,
- **organizational measures**: reducing the number of exposed workers, reducing exposure (e.g. emergency breaks, which they must spend in the so-called. Quiet noisy areas outside the workplace), relief workers, integrating noisy operations to less busy changes, determination of hazardous work, preventive medical examinations,
- **personal Protection:** failing to implement such measures, or they reached the noise below **85 dB**: earplugs, earmuffs, the noise over 95 db: helmets restrict the bone conduction of sound, and used in noise above **100 dB**. [2]

7. EXAMPLE NOISE REDUCTION BY OPTIMIZATION OF TECHNOLOGICAL ELEMENTS OF MECHANICAL SYSTEM

It should be noted that the real structure contains many discontinuities, which can be considered as a kind of insulator, in which the change of intensity of vibro-acoustic waves, respectively power flux and thus reducing the information content signal. Examination of the vibration transmissibility of the structure, such as detecting the transfer function from point B to point C (Figure 1) does not lead to information that would adequately identify the transmission path. When using traditional construction materials, if not in the way of discontinuity, the attenuation per unit length is negligible. It is therefore important to examine the transmission through the discontinuity. [3]

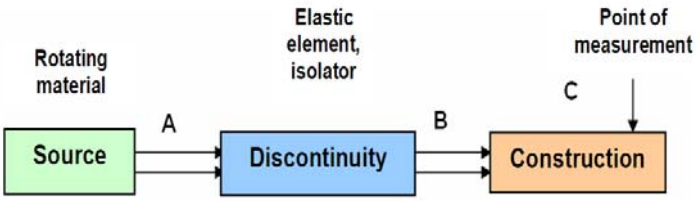

Figure 1 Power flow of mechanical vibration signal [3]

Figure 2 Mechanical system

One example of how to reduce vibration in our mechanical system studied is the change of stiffness of elastic pneumatic clutch and changing the pressure in the compression chamber. For measuring and evaluating the effectiveness of coupling, we used acoustic

camera that can record the sound pressure levels throughout the measured frequency spectrum. An example of such mechanical system is shown in Figure 2.

Measurements were carried out in various modes of speed of mechanical systems and various pressures in pneumatic clutch. Also measurements were made when the system elastic clutch was not located; it means that the shafts were combined fast. From the measured data we have in frequency spectrum indicated a frequency of 570 Hz, which is most pronounced in the system. Figure 3.

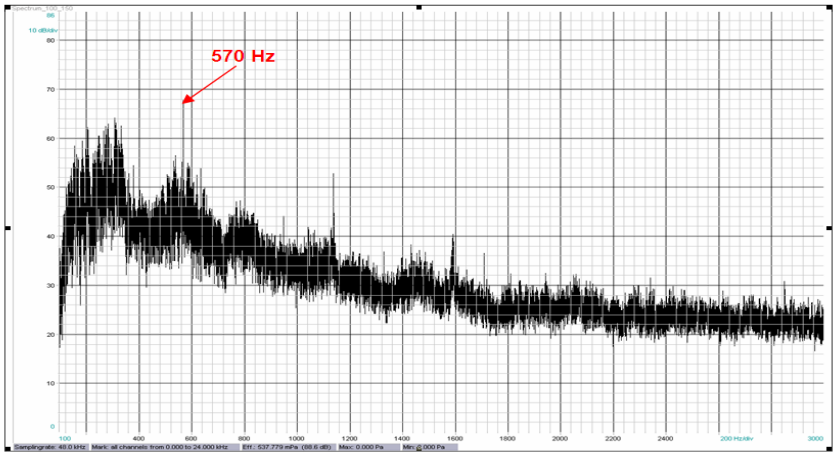

Figure 3 Selection of the frequency in spectrum

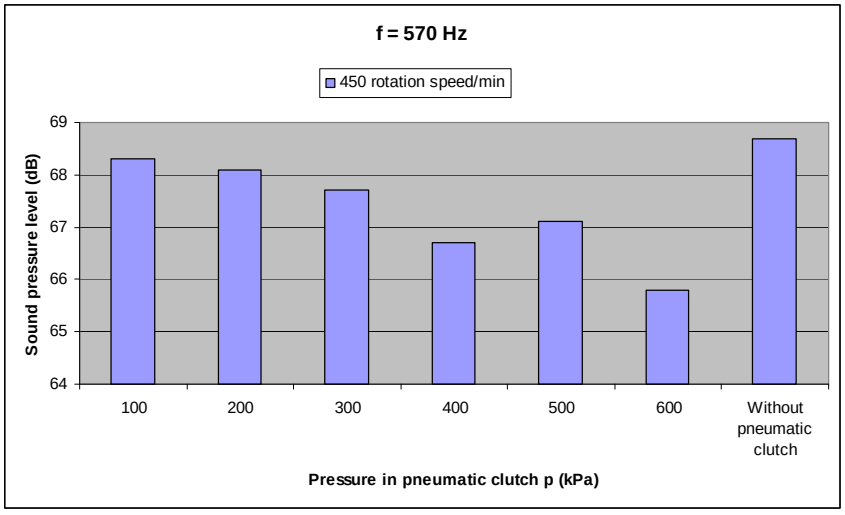

Figure 4 Result measurement and analysis

Evaluation of measurement is presented in the following chart, which is dependent noise pressure level of frequency 570 Hz at mode 450 rpm and different pressure changes in the elastic clutch. Figure 4. With regulation and tuning of rotating mechanical system components the whole mechanism decreasing noise level also occurred following decreasing of sound pressure level in work environment.

8. CONCLUSION

This article provides basic terminology, determinants and physical properties of acoustic wave propagation environment. Discusses the effects of sound waves to a man and an example of noise reduction by optimizing technological elements of the mechanical system.

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DEVELOPMENT OF MEMBRANE WASTEWATER PURIFICATION PROCESS FOR MEAT INDUSTRY SME'S

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ABSTRACT:
Meat processing industries generate a great amount of wastewater. Because of the remote locations of companies in Northern Finland, they face the problem of low efficiency of traditional biological wastewater purification and the need for a decentralized energy supply system. Membrane separation processes integrated in wastewater purification technology could provide an eco-friendly, and economical solution for the small and medium sized meat processing enterprises (SME's). The main aim of our research project was to find technology for the treatment of food industry wastewater, which is suitable for producing recyclable process water, and on the other hand, could provide an economical pre-concentration stage before anaerobic digestion (AD).
KEYWORDS:
membrane technology, wastewater, food industry

1. INTRODUCTION

Food processing companies generate a great amount of wastewater because of the processed high water contented raw materials, dehydration processes, and the high water demand of flushing and cleaning procedures. The level of wastewater pollution and the adaptable purification technology is highly dependent on the characteristics of the processed material and the possibility of a separated process waters collection. The purification technologies should be dynamically fitted to the fluctuated wastewater production and to varied composition. The fluctuating wastewater output is a peculiar problem of small meat processor with periodical operating. One of the possible treatment and utilization methods for food industry wastewater is the irrigation onto land, by which the nitrogen and phosphorus content can be utilizable to increase the biomass production but the cation composition of wastewater is not perfectly suited to the demand of plant cultivating. Luo et al. [1] reported that the long term using of meat processing wastewater damages soil quality due to the varying in exchangeable cations of fertilized soil, and this problem makes uncertain the sustainability of the application of effluents for irrigation.

The membrane technology is known as a flexibly adaptable technique for varying capacity and for the diverse chemical composition of processed water [2]. In RO processes, where the fluid is forced through the porous membrane by the pressure difference, the permeate flow rate depends on the permeability of membranes (L), the physical properties of processed fluid (ρ, η) and the pressure gradient (d_p/d_x). However, the RO process is additionally affected by diffusion through the membrane (D). The mass flux (N) through the membrane pores can be described by Eq. 1. [3]

$$N = \frac{\rho\ L}{\eta} - D\frac{d_p}{d_x} \tag{1}$$

Based on the solution-diffusion transport model, the mass flux across the membrane depends on the permeability of the membrane for water (L), the transmembrane pressure (Δp) and

the osmotic pressure difference ($\Delta\pi$). The osmotic pressure is in large measure affected by the temperature of the fluid (T) and the concentration difference (ΔC) between the two sides of the membrane. For ideal solutions it can be calculated by Eq. 2. using the ideal gas constant (R):

$$\Delta\pi = \Delta CRT \tag{2}$$

If the thickness of the membrane (l), the solubility (S) and the water partial volume (V) are known, the water flux can be given by the formula of Wijmans and Baker [4]

$$J = \frac{DSV}{RTl}(\Delta p - \Delta\pi) \tag{3}$$

Considering Eq. (1) and Eq. (3), the mass flow through the membrane and the permeate flux are affected by the transmembrane pressure and the temperature. The increasing of the temperature decreases the viscosity of fluids and therefore increases the water and the salt permeability but simultaneously increases the osmotic pressure [5].

The high rejection for organic materials and for detergents makes the RO process suitable for the recycling of food wastewater. Bohdziewicz et al. [6] found that applying RO for meat industrial wastewaters after simultaneous precipitation the organic matter removal efficiency reached the value of 99.8%; the ammonium retention and the total nitrogen retention was 97% and 99%, respectively. In a latter paper of the authors, the performance of RO operation after activated sludge pretreatment was investigated and it was concluded that without chemical precipitation the retention for total nitrogen and total phosphorus was 90% and 97.5%, respectively. The removal of biodegradable materials (expressed by BOD_5) was just 50%, but despite the lower organic matter removal performance the purified wastewater was found suitable for reuse in the production cycle of the plant [7]. In the study of Vourch et al. [8], the efficiency of a one-stage RO, a combined system of nanofiltration (NF) before RO and a two-stage RO+RO operations for dairy process water treatment was compared and it was concluded that there was no significant difference in the retention for electric conductivity and total organic carbon (TOC) between the RO and the NF+RO system.

With RO operations pure water can be obtained and the UF systems are capable of producing clear and transparent wastewater permeate with reduced bacteria content, but the presence of alive microorganisms in the feed solution can assist in depositing the polarization layer on the membrane surface, facilitating membrane fouling [9]. Kornboonraksa et al. [10] found that in membrane bioreactor the total membrane resistance increased by a large scale and the permeate flux decreased because of the released carbohydrates of piggery wastewater which were deposited easily on the membrane surface due to the microbial degradation.

Under high pressure the diffusion rate is reduced due to the more compact (less porous) deposited layer, and the resistance increases with the enhanced local osmotic pressure. This phenomenon is described as biofilm enhanced osmotic pressure (BEOP) [11-12]. During long-time RO concentration operations the membranes can be considered as non-porous materials for the dissolved solids, flocs and colloids and a so-called surface fouling (external fouling) phenomenon is observed on the feed-side surface of the membrane [13]. During the scale formation the salts of feed can crystallize on the surface of a membrane and additionally the rejected solid can form a cake layer [14]. In the formed cake-layer a complex flow pattern can be observed; moreover, the flow direction may even be the reverse of the pressure gradient because of the inter-connectivity of the neighboring pores [15]. Pore blocking with the adsorption of foulants on the pore wall may occur if the foulants' size is comparable with something pore sized or smaller [16]. Internal fouling can also be experienced if the structure of the membrane is irreversibly altered due to the extremely high hydrostatic pressure or chemical degradation.

The effect of fouling can be characterized by the flux decline versus operation time, and to examine the flux behavior and the fouling mechanisms the resistance-in-series model can be used in various membrane processes. In the model the relationship between the permeate flux, transmembrane pressure and the total resistance can be described by the series resistance equation

$$J = \frac{\Delta p}{\eta\ R_t} \tag{4}$$

where η is the viscosity of the feed fluid and R_t is the total resistance.

The R_t can be defined by the sum of the hydraulic (intrinsic) membrane resistance ($R_{m)}$, the polarization layer (external fouling) resistance ($R_{p)}$ and the (internal) fouling resistance (R_f).

$$R_t = R_m + R_f + R_p \tag{5}$$

The model is successfully adopted for the examination of flux behavior during the RO concentration of manure [17] or juice [18], separation of oil in water emulsion [19] and for the control of fouling phenomena in several ultrafiltration processes [20-22].

The traditional concept of the membrane water purification systems, when the concentrate is handled as waste stream, can be changed because the concentrated feed streams with high biodegradable organic matter content are utilizable for anaerobic digestion (AD). Furthermore, in the Northern region the temperature sensitive biological wastewater treatment can be replaced with the membrane processes; hereby the time demand of the purification technology can be reduced and the membrane operation can fulfill the requirements of the periodic and fluctuating wastewater product.

According to the above mentioned concept, the dual aim of our work was to concentrate the organic matter content with membrane processes to get a suitable raw material for AD, and on the other hand to produce pure permeate which can be recyclable or reusable. In our work presented in this paper we examined the effect of transmembrane pressure, recirculation flow rate and the temperature of feed on the permeate flux and resistances concentrating meat industrial wastewater. For the calculation of resistances the resistances-in-series model was used to determine the main influential parameters, and to optimize the conditions for RO operation response, surface methodology was applied.

2. MATERIALS AND METHODOLOGY

2.1. Wastewater sample

The real wastewater samples originated from a medium-sized meat processing company; the sampling point was after the grease tap. The process water originates from meat processing technology, mainly from the flushing and rinsing of equipment (slicing and packaging machines, smoking chambers). To remove grit and other large-sized solids a cloth filter was used. The characteristic of wastewater is shown in Table 1.

Table 1. Characteristic of wastewater

Parameter	Mean value	SD
TS (mgL^{-1})	3210	296
TOC (mgL^{-1})	834.1	35.3
Lipid (mgL^{-1})	115.1	21.7
Protein (mgL^{-1})	379.4	21.2
pH	6.13	0.23
Conductivity* (μScm^{-1})	983.2	14.2
Density* (kgm^{-3})	1005.3	3.2
Viscosity* (mPas)	0.877	0. 009

** at 30°C*

2.2. Analytical measurements

During the RO and UF operation the total organic carbon (TOC) content, the fat content and the protein content were assayed. TOC content was measured by a Sievers 900 portable TOC analyzer with a membrane conductometric detector (GE Analytical Instruments, U.S.).

The photometrical protein assay was based on the Lowry method [23] using the bovine serum albumin (BSA) standard. The samples were diluted to avoid interference with lipids, ammonium ions and salts and to minimize the effect of the sample on the pH of the reaction mixture.

The lipid content of wastewater samples was determined by partition-gravimetric procedures after extraction according to the Bligh and Dyer method [24]. For the viscosity measurements of wastewater samples a glass capillary viscometer was used.

2.3. Membrane filtration procedure and calculations

For the pilot-scale filtration test series flow, a B1 module of Paterson Candy International (PCI) was used. The tubular module was equipped by AFC99 polyamide RO (99% nominal retention for NaCl) membranes (ITT PCI Membranes Ltd.). Each 1.2 m long tubular membrane had a 12.5 mm inner diameter, and the total effective membrane area was 0.85 m^2.

The recirculation flow rate (Q_{rec}) varies between 600 and 1000 Lh^{-1}. Considering the nominal pressure range of the PCI module and the membranes and, furthermore, based on experimental design, the operating pressure for RO tests was 25-35-45 bar, respectively. The temperature of feed was controlled by a coil-type heat exchanger. In each experiment 60 L wastewater was concentrated to reach a 3.75 value of volume reduction ratio (VRR), calculated by Eq. (6)

$$VRR = \frac{V_f}{V_f - V_p} \tag{6}$$

where V_f is the volume of feed, and V_p is the volume of permeate.

The retention for total organic carbon (R_{TOC}), fat (R_{fat}) and proteins (R_{prot}) were calculated using the following equation (Eq. 7)

$$R(\%) = \left(1 - \frac{c_p}{c_0}\right) \times 100 \tag{7}$$

where c_p and c_0 are the concentration of measured components in the permeate and feed, respectively.

The connection between pressure, permeate flux and the resistance components can be described by Eq. 4. From this general expression the hydraulic resistance of the clean membrane (R_m) can be calculated by the data obtained from the permeate flux (J_w, $m^3m^{-2}s^{-1}$) measurement with deionized water at different transmembrane pressures (Δp, Pa) and from the dynamic viscosity (η_w, Pas).

$$R_m = \frac{\Delta p}{\eta \ J_w} \ (m^{-1}) \tag{8}$$

During the concentration process the solid and dissolved components build up the polarization layer (cake layer), which can be removed by intensive flushing with water. From the pure water flux measured after flushing (J_f) and using R_m the fouling resistance can be given by Eq. 9.

$$R_f = \frac{\Delta p}{\eta_w \ J_f} - R_m \ (m^{-1}) \tag{9}$$

After knowing R_m an R_f and calculating R_t from the permeate flux obtained from the wastewater filtration test the polarization layer resistance can be determined by the combination of Eq. 4. and Eq. 5.

3. RESULTS

3.1. Determination of influential parameters

To examine the possible interactions between the operating conditions and to optimize the influential parameters for membrane purification, central composite face centered (CCF) experimental design and response surface methodology (RSM) was performed using MODDE 8.0 statistical experimental design software (Umetrics, Sweden). RSM is an adequate method to fit a model by a least squares technique when a combination of independent variables and their interactions affect the desired response [25].

For the modeling and optimization the studied factors were the transmembrane pressure (p) of 25 and 45 bar, recirculation flow rate (Q_{rec}) of 600 and 1000 $Lm^{-2}h^{-1}$ and the temperature of 30° and 40°C (Table 2). The values of pressure and the recirculation flow rate were chosen based on the membrane characteristics and considering the specification of the RO unit and the membrane module. The operating temperatures were varied according to the temperature range of produced industrial process water.

The selected responses were the average permeate flux (J), the organic matter retention (R_{TOC}), the total resistance (R_t) and the polarization layer resistance (R_p). To evaluate the reproducibility of the fitted model, five center points were used in the experimental design (Qrec=800 Lh^{-1}, p = 35bar at a temperature of 35°C). In order to reduce the systematic error, the runs of the experiments were randomized.

Table 2. The factors and responses of experimental design

Exp. No.	Factors			Responses			
	Q_{rec} (Lh^{-1})	p (bar)	Temp.(°C)	J_{perm} ($Lm^{-2}h^{-1}$)	$R_t \times 10^{14}$ (m^{-1})	$R_p \times 10^{14}$ (m^{-1})	R_{TOC} (%)
1	600	25	30	54.35	2.604	0.716	99.28
2	1000	25	30	55.04	2.556	0.698	99.20
3	600	45	30	71.38	3.211	0.767	97.93
4	1000	45	30	72.27	3.102	0.749	98.04
5	600	25	40	60.21	2.652	1.036	98.77
6	1000	25	40	61.06	2.588	0.998	98.74
7	600	45	40	76.42	3.258	1.057	98.01
8	1000	45	40	78.13	3.189	1.091	97.96
9	600	35	35	69.99	2.954	0.936	98.86
10	1000	35	35	71.51	2.878	0.909	98.71
11	800	25	35	58.25	2.613	0.912	97.21
12	800	45	35	73.21	3.239	0.934	98.99
13	800	35	30	69.40	2.843	0.783	99.09
14	800	35	40	73.65	3.024	1.104	98.51
15	800	35	35	70.87	2.885	0.921	99.05
16	800	35	35	70.95	2.884	0.924	99.12
17	800	35	35	70.85	2.881	0.928	99.06
18	800	35	35	70.93	2.880	0.925	99.15
19	800	35	35	70.96	2.879	0.921	99.17

Retention for TOC, lipids and proteins has not changed significantly with the varying of factors, because the retention of AFC99 membrane for different components is higher than 97%. The calculated value of R_m for the AFC99 membrane was 1.409×10^{14} m^{-1}. In our case the range of R_f was obtained from 8.761×10^{13} to 1.034×10^{14} m^{-1} but the change was not significant at the 95% confidence interval; therefore, the fouling resistant cannot be used as a response parameter.

To determine which factors have important effects on the response, one factor is varied while the others are kept at the average value. Fig. 1 shows the effects of single parameters and their interactions on the permeate flux (J_p), total resistance (R_t) and polarization layer resistance (R_p).

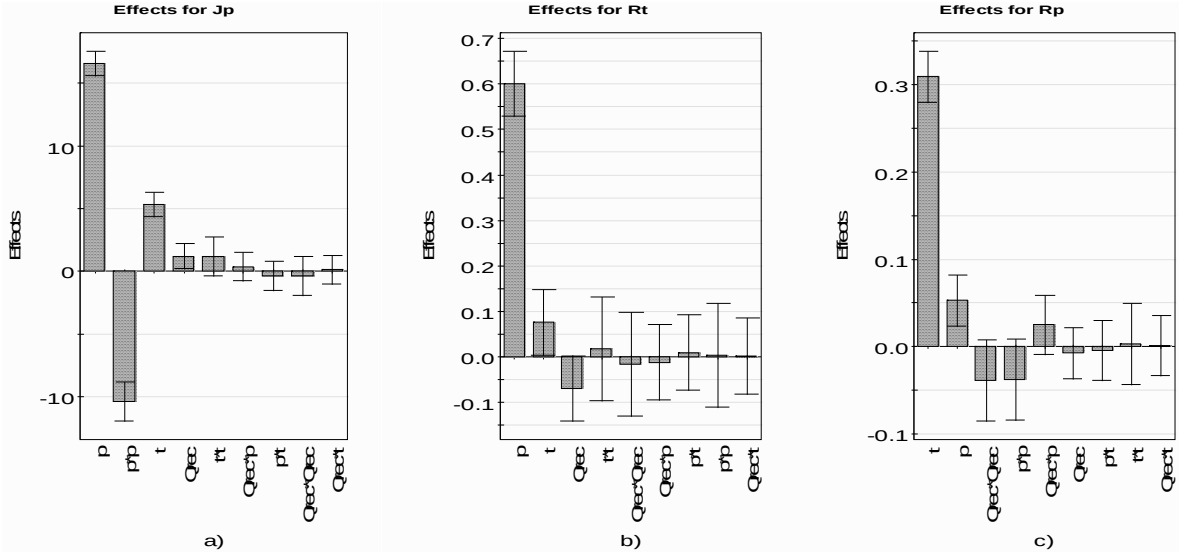


Figure 1. Effects of factors and interactions on the permeate flux (a), Total resistance (b) and polarization layer resistance (c).

Our results show that mainly the pressure and the temperature have an effect on the permeate flux, R_t and R_p; furthermore, a smaller influence of Q_{rec} was obtained on permeate flux and total resistance. The other factors and the interactions between them have just a negligible effect on response parameters. The significant effect of temperature on flux can be explained by studying Eq. 1 and Eq. 3. With temperature increasing, the permeate diffusivity through the membrane increases and the viscosity decreases simultaneously, which has a positive effect on permeate flux.

Our calculation, based on the resistance in series model, showed that the hydraulic resistance of the membrane (R_m) was in all cases higher than the fouling resistance (R_f) and the ratio of R_m to R_t was from 39.3 to 51.9%, depending on the experimental conditions. The main part of R_m in R_t can be explained by the composition of the wastewater, and the low amount of organic matter could not form a thick polarization layer in the turbulent feed flow; furthermore, the concentration of low molecular size compounds was not high enough to significantly increase the internal fouling.

3.2. Modeling and optimization of RO process

During the refinement the non-significant terms were removed. Since the value of R_t contains the R_p, the change of the two parameters are not independent; therefore, R_p was removed from the responses to obtain a correct statistical model. After refinement a quadratic model was refitted with multiple linear regressions (MLR). The mathematical relationship between the independent variables of pressure (p, bar), recirculation flow rate (Q_{rec}, Lh^{-1}), temperature (t, °C) and the response function for permeate flux (J_p, $Lm^{-2}h^{-1}$) and total resistance (R_t, m^{-1}) are presented by Eq. (10) and (11), respectively.

$$J_p = 71.0214 + 8.25\,p + 0.5659\,Q_{rec} + 2.711\,t - 4.989\,p^2 \quad (10)$$

$$R_t = 2.9009\times10^{14} + 2.986\times10^{13}\,p - 3.659\times10^{12}\,Q_{rec} - 3.95\times10^{12}\,t + 3.107\times10^{10}\,p^2 \quad (11)$$

The response function predictions were in good agreement with the experimental data; the R^2 for J_p, and R_t was 0.996 and 0.994, respectively (Fig. 2).

In addition, the goodness of fit (Q^2) for J_p and R_t was 0.991 and 0.988, which indicates good predictive power of the models. The reproducibility was over 99.9% and the standard deviations of the fitted models were higher than the standard deviation of the residuals (R^2_{adj} >0.98 in both cases).

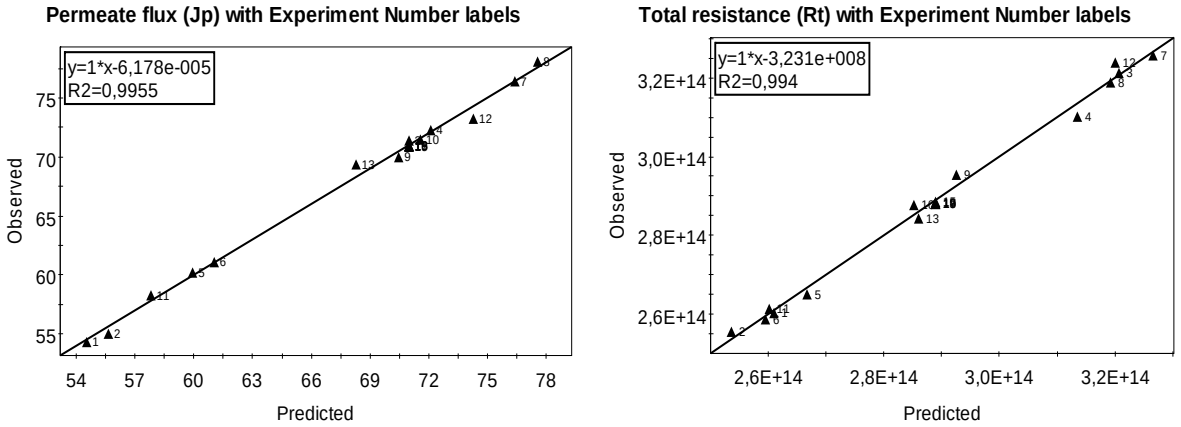
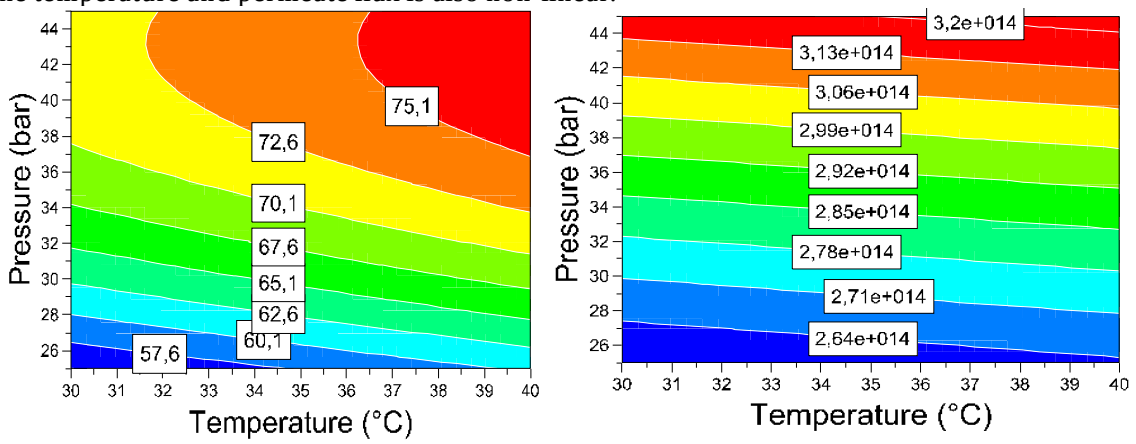


Figure 2. Observed versus predicted values for permeate flux and total resistance

To analyze the effects of factors the characteristic contour plots are shown in Fig. 3. As Fig. 3 shows, the permeate flux is strongly dependent on the pressure and temperature. The difference between operating pressure and osmotic pressure decreased during the concentration and therefore there was a non-linear correlation between the permeate flux and the pressure.

In addition, during the concentration process the deposited cake layer caused a slower diffusion (via longer diffusion path and lower diffusivity) and a higher hydraulic resistance. The temperature increasing caused the viscosity to decrease, which predicted higher permeate flux (Eq. 4), but the higher temperature is also expressed in the higher osmotic pressure, decreasing the driving force of the RO process (Δp-$\Delta \pi$). Considering this phenomenon, the relationship between the temperature and permeate flux is also non-linear.



a) *b)*

Figure 3. The combined effect of temperature and pressure on permeate flux (a) and r_t total resistance (b)

In our case the highest permeate fluxes can be reach by applying pressure over 37 bar and a temperature over 36.5°C but to achieve the best permeate flux the recirculation flow rate can be set at a value over 750Lh^{-1} (Re number can be over 20,000). In this region the retention for TOC and protein was higher than 97% and 99%, respectively. On the other hand, the pressure increasing from 25 to 45 bar increased the total resistance by approximately 17% but this effect can be reduced by the application of elevated temperature and/or higher recirculation flow rate.

The antagonist effect of the pressure increasing total resistance and permeate flux can be explained by the altering of the structure of the polarization layer. Under high pressure, the formed cake layer has become less porous, which can increase the hydraulic resistance of the layer [26]. Although Hoek et al. [14] reported that the fouling can improve the selectivity of the membrane; this establishment is acceptable just for removal of larger sized molecules via size-exclusion mechanisms.

Using the refitted model, based on the date obtained from the response surface analysis, the optimal condition of the RO process of meat industrial wastewater was for the highest permeate flux and the lowest total resistance determined at a transmembrane pressure of 38.5 bar and a recirculation flow rate of 1000 Lh^{-1} at 40°C.

4. CONCLUSIONS

The RO concentration of meat industrial wastewater was carried out in a pilot-scale filtration unit equipped by AFC99 polyamide membranes. For the experimental design and optimization, MODDE 8.0 software was used, investigating the effects of the operation pressure, temperature and recirculation flow rate on the organic matter retention, permeate flux and the resistances calculated from the resistances in the series model.

Our results show that the investigated parameters did not significantly affect the retention but the permeate flux and the total resistance are suitable for the response parameter of modeling. Based on our results, the increasing pressure positively affects the permeate flux but at elevated pressure the total resistance increases as well. The increasing of the temperature and the recirculation flow rate could enhance the permeate flux and decrease the total resistance. The fitted quadratic model was significant at the 95% confidence interval and showed good predictive power as well as high reproducibility.

The optimal conditions for RO concentration of meat industrial wastewater were determined at an operating pressure of 38.5 bar, recirculation flow rate of 1000 Lh^{-1} and temperature of 40°C. The TOC content and the conductivity of permeate was lower than 5 ppm and 20 μScm^{-1}, respectively, which allows for the recycling and reusing, for example, in cleaning, in the flushing process or for cooling water. The average TS content of RO concentrate was higher than 9% with a TOC content of 2.8 gL^{-1}, protein content of 1.2 gL^{-1} and fat content of 0.35 gL^{-1}.

ACKNOWLEDGEMENTS

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STUDY OF HOUSEHOLD ATTITUDE TOWARD RECYCLING OF SOLID WASTES: A CASE STUDY

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ABSTRACT:
Solid waste management is a growing problem in Malaysia. For this reason the government of Malaysia through The Ministry of Housing and Local Government (MOHLG) have taken various measures to promote recycling amongst its population. Recently, a nationwide campaign was launched to get the people to recycle their wastes. Recycling centers equipped with separate recycling bins for different recyclables have been set up across the country. In addition, publicity drives using the newsprint, the electronics media on top of the other modes of information dissemination such as seminars, workshops and meetings were held on a continuous basis over the years. However, despite the effort little has been achieved due to the lack of participation from the households. This paper identifies the reasons for the failure of the campaign. Data were gathered using a mail-out questionnaire to 400 randomly chosen households. Quantitative analysis made based on 347 responds received indicated that although all of the respondents had a positive attitude towards recycling only a few did recycle. The poor response is largely due to the lack of facilities provided. Many residents are turned down when they are unable to locate the recycling centres and if they are able to locate one, it seems too troublesome to be needed.

KEYWORDS:
Recycling, Solid Wastes, Household Attitude, Malaysia

1. INTRODUCTION

The concept of attitude has played a major role in the history of social psychology. It is undeniable that the concept of “attitude” has become something of a factotum for both psychologists and sociologists (Fishbein, 1976). Nowadays, solid waste recycling is a problem of major relevance for all societies. Moreover, finding acceptable strategies to cope with such a problem is becoming a quite hard task, owing to the increasing awareness of environmental issues by population and authorities. However, Malaysia, with a population of over 24 million in 2005 generates 17,000 tons of domestic waste daily (Noor, 2005). At present, the per capita generation of solid waste in Malaysia varies from 0.45 to 1.44kg/day depending on the economic status of an area, the national average being 0.5 – 0.8 kg/person/day but may increase up to 1.7 kg/person/ day in major cities (Agamuthu, 2001). Perak is the second largest state in Peninsular Malaysia. It is bordered on the north by Kedah and Thailand, on the east by Kelantan and Pahang, on the south by Selangor and to the west by the Strait of Malacca. Perak means silver in the Malay language. The name comes most probably from the silvery colour of tin. In the 1890's, Perak, with the richest alluvial deposits of tin in the world was one of the jewels in the crown of the British Empire. However, some say the name comes from the "glimmer of fish in the water" that sparkled like silver. Perak's population is now approximately 2 million. Once Malaysia's most populous state, the decline in the tin mining industry caused an economic slowdown from which it has yet to recover, leading to a massive drain in manpower to higher-growth states such as Penang, Selangor and the Federal Territory of Kuala Lumpur. Modern Perak is divided into 10 administrative divisions, or “Daerah” in Malay.

However, the Executive Council is the highest administrative body in the state. At the local government level, the state has one local authority, namely the Municipal Councils of Ipoh (MCI). The average throw away in Perak is around 0.9 - 1.1 kg of waste/person/day, which is higher than the national average (MOHLG, 2005).

This paper reports on the results of a research study that evaluated attitude of household towards recycling solid wastes. The research aims of shed to light upon the level of environmental awareness of the different household in Perak state at Malaysia concerning recycling of solid wastes and their perception on the success of the recycling campaign. The main objective of the research was to study the attitude of households, their awareness as well as the problems which was related to failure of the recycling campaigns. The findings of this research study may be used in decision making as a measure of attitude of household and should help households to recognize how important the environmental issues of recycling solid wastes recently.

2. THE RECYCLING CAMPAIGN

As mentioned earlier, the Ministry of Housing and Local Government, Malaysia launched a nationwide recycling campaign (Kempen Kitar Semula) in 1993. However, the campaign failed due to lack of response and participation from the people. A bigger and more aggressive campaign was initiated in 2000. Sixty-five (65) drop-off or collection centers, located at schools, gas stations, shopping malls and other convenient public places are opened nationwide.

Table 1: Recycling related activities (January – July 2003). Source: Ministry of Housing & Local Government, Malaysia.

	Type of Activity	Occasions
1	Talks/Speech	13
2	Exhibition	26
3	Meetings	27
4	Actual recycling activity	7
	Total	73

Table2: Location of Recycling Collection Centers. Source: Ministry of Housing & Local Government, Malaysia.

	State	Frequency
1	Penang	16
2	Kedah	210
3	Kelantan	0
4	Terengganu	0
5	Perak	180
6	Pahang	138
7	Selangor	177
8	Negeri Sembilan	109
9	Melaka	98
10	Johor	108
11	Sabah	150
12	Sarawak	217
	Total	1403

Year round programs aimed at increase awareness and participation of the population were initiated or organized by the Ministry of Housing and Local Government, Non-Governmental Organization's and Consumer groups. These include talks, exhibition and actual recycling activity. (Table 1)

3. METHODOLOGY

The study sought to evaluate the attitude of households in Perak, Malaysia on recycling of solid wastes. Specifically it is aimed to discover reasons why the nationwide recycling campaign organized by the Ministry of Housing and Local Government Malaysia failed to attract households to recycle. Four Hundred (400) questionnaires were distributed within the period of three months beginning the2nd of February 2006 to 27th of March 2006. To ensure good response, the strategy used was to distribute the questionnaire at randomly selected houses on Perak State. Three Hundred and Forty Seven (347) useable questionnaires (87%) were received and analyzed. Although, the number of questionnaires received was small, it is sufficient to give some indication of the overall attitude of the households of Perak on recycling of solid wastes and is adequate to enable the findings to be generalized for the whole population of Perak. The descriptive analysis of the data collected is presented below.

4. RESULT AND DISCUSSION

4.1 Awareness of the recycling activities/campaign

A majority (84.7%) of the respondents claimed that they are aware of the ongoing campaign. Most knew it through ads in the newspaper. TV and Radio ads ranked second followed by newsletter and billboards.

4.2 Importance of recycling

Asked on the importance of recycling, all participants (100%) indicated that recycling is important. However, only about 71% (247) of the respondents indicated that they participated in the recycling activity. The main reasons given, ranked in order of importance are i) Concern for the environment; ii) Concern about availability of landfill; iii) Encouragement from their children/others. A small number indicated that they recycled for money.

4.3 Participation in recycling

Amongst those who did not participate in the recycling activity (29% or 100 respondents), the main reasons given are inconvenience and lack of facilities (62%). It is interesting to note that about 18% of the non-participating respondents indicated that they "don't bother" or find it unimportant (13%). Although the number of respondents within this group is small, particular attention should be taken to 'convert' them. Comparing with a Singapore the research by Foo (1997) was found that only 9 % of the respondents practice regular was recycling and another 11 % practice recycling 'some of the time', whereas the rest only practice recycling once in a while (64%).

4.4 Facilities provided

Respondents were also asked about the facilities provided for recycling. When asked whether they know the location of the nearest collection point for their area, 61.7% indicated they knew the location. However, more than 52% complained that the location could not be easily located. In term of distance, only 33 % indicated that it was within 1 kilometer from their house, 16 % was within the radius of 2 – 3 kilometer and 44 % indicated that it was more than 5 kilometer radius. Undoubtedly, the farther the location of the collection point, the more discouraged will the householders be. Adenso-Díaz (2005) commented that when citizens who are environmentally concerned have bins near to home, they appear to be willing to recycle more fractions than when they have to walk for a longer time to drop off the waste, due to the inconvenience of carrying the large volumes that this type of waste usually occupies. He concluded that distance and access to the bins is obviously an incentive to recycling. The benefit of facility may bring to local residents can influence attitudes (Lima, 1996). However, citizen's attitudes depend on knowledge about a facility (Rahardyan, 2004). It was observed that, the farther the location of the collection point was the more discouraged were the householders were to recycling.

4.5 Types of materials recycled

Amongst those who recycled, the type of materials recycled ranked in term of quantity is newspaper, aluminum cans, plastics, cardboards and glass. In response to the question "How often do you recycle", 46% indicated they sent their recyclables weekly while about 24% indicated they need to recycle more often i.e. twice or three times a week.

4.6 Perception on the success of the recycling campaign

The respondents were asked to give their opinion on the on-going recycling campaign hosted by the Ministry of Housing and Local Government. On the question whether the campaign succeed or failed, a huge 90 % or (311) indicated that it fails and it can be seen in the Figure (1). Asked for the reasons for the failure, their responses can be divided into the following five broad categories:

i) Little improvement in the surrounding. The surrounding area, public places and rivers are still littered or polluted.
ii) People continue to throw recyclable items such as papers, glass and aluminum cans in ordinary dustbins. Not many took the effort to separate them before throwing.
iii) Not enough facilities provided. Many areas are not provided with the facility for recycling. Many people do not know the location of the nearest collection point. Location of collection points is either not good or too far. Easier to throw the recyclables than to bring it to collection point.
iv) Some people are selfish. They continue to litter and do not bother about the negative effect of their action. Some think of it as a waste of time.
v) Have very little knowledge about what recycling is. Do not realize the importance of recycling. Never heard of the campaign and never participated.

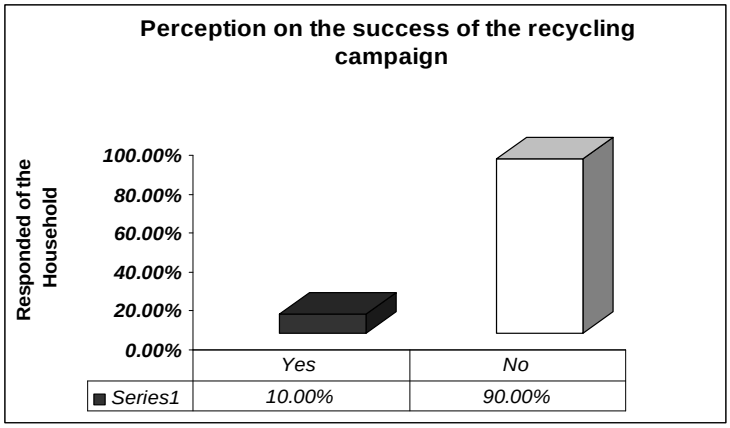

Figure 1: Perception on the success of the recycling campaign

4.7 How can it be improved?

The respondents were also asked of their views on how the situation could be improved. The majority of respondents suggested, "more facilities be provided". There should be "local collection centers", which is within easy reach for each community or housing areas. Community or group recycling should be encouraged and more effort is needed to educate the people of the need and importance of recycling. Monetary incentives may also be considered, for example by improving the community facilities in an area as a reward, based on the quantity of recyclables collected. In this regard, it is observed that the high rate of newspaper recycling might be due to the ready market for it. When asked whether they will recycle in the future, if all facilities are provided, all 99 % of the respondents said that they would participate and this will be different comparing with the research by Grodzińska-Jurczak (2003) in Jaslo City, Poland when he asked the same questions to the household whereas got 41 % of 932 interviewed they would to recycle and the rest refused any participation (22%) or did not respond (37%).

5. CONCLUSION

Recycling has become a household word in Malaysia, based on the finding of this study; it is evident that the households in both states are of the opinion that recycling is a very important activity. However, result of the study gave a clear indication that the recycling campaign by the Ministry of Housing and Local Government in Malaysia failed. Even though the households agreed that recycling is important, not many of them did recycle. The quantity of recyclables collected in both states is indeed very small. The main reason, as indicated by the study result, is due to misdirection in the campaign. Although much money was spent on advertisements, there is a clear misinformation. It is observed that advertisement campaigns are focused on informing households to sort their recyclables and place them in separate bins. However, such bins can only be found at designated public places, which are usually at a distant from residential areas. It is therefore not surprising that most of the households find it too troublesome to bring their recyclables to the collection centers. Furthermore, reasons such as "lack of facilities" or "distance of facilities too far from home" are also clear proof that most households are not aware that they can do their bit in recycling by simply putting the recyclables and non recyclables in separate bags and placing them in the ordinary rubbish bins available at home which will then be collected by the council or appointed agents. Therefore, the location of the recycling station is essential and the public attitudes are knowledge about source separation in general and recycling stations in particular are of interest for the functioning of the whole system (Petersen *et. al,* 2004). In the final analysis, it is interesting to note that the actual reason for the failure in terms of recycling, the lack of support and participation of households in Perak on recycling are not due to their negative attitude towards recycling but due to misinformation on the part of the authorities. In order to increase the rate recycling of solid waste and at the same time to reduce the social problem related to solid waste management at the following suggestions were made to the Perak People of Committee as followed:

1. Improving the publics' general knowledge and awareness concerning these issues is of prime importance to the minimization of waste, in general, and harmful effects of landfills on the environment, in particular.
2. Efforts are also needed to involve the public in the policy-formation, development of plans, and implementation of waste management programs and landfill sitting decisions. Public support is essential for the success of such decisions.

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ENVIRONMENTAL ASPECTS SAFETY RISKS

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ABSTRACT:
This contribution mention for demand creating complexer definition of safety risks. Aspect of environment is unimproved in last decades, but it make worse with tendency of accretive trend. For all that is needs on define safety risks on a large scale take into debate safety of environmental community,too. This article commend for answer problems come out mainly from results performed safety audit. These give to real basis and starting – points for exact definition existent concept. Destination of safety audits is analyse risks complex in a concern, treat them, make a proposal and install principles managering of safety so that it didn´t peter out to a creation menace and predicamental situations prevented.

KEYWORDS:
safety, environmental risks, menacies, crise, audit of safety

1. INTRODUCTION

1.1. Claim exacter definition concept safety risks

Safety risks are inseparable component all sociable processes. Although this concept like a corpus wasn't till complexly and expressly defined in literature of specialistic. From that argument is needs this problem analyze to specify.

Term dictionary of emergency control, which come out from decree government SR n. 523/2005, define concept of safety like a aspect system of social, nature, technical, technological, or other system, which enable pursuase defined functions and them evolution on the behalf of human and society in concrete inside and outside conditions.[1] For concept of safety is key factor managering of risk, exploration with purpose minimalization. Probably allege, that potentional alternative violation safety this system, object or process is risk. From data shown follow that safety is directly pro rata size unadopted risk.

On basis these dates is possible concept safety risks define also as follow: Safety risks indicate alternative interfere with parallel processes, actions and activities in the concrete points depending up inside and outside conditions. Safety risks manifest in corrupted individual factors safety and they activate due level of menace.

En arere were concepts safety, risk, safety risk analyzed in context with defense and safety of state, prevention of citizens and property, eventually work safety. Now get with evolution community into all areas associated with human activities, a savoir technical, economical, information, cultural, but also ambit environment. [2] Change reception and circulation these concepts and create new attitudes, not only to merit rating, but also to answer accrued situations is due to especially social, commercial, perhaps even economical crises, which community hit in last years in world – wide criterion. [4]

1.2. Environmental – healt aspects safety risks

Now big commination represent come-down quality environment. Biggest contaminator environment is industry, and in the view of his massive evolution we suppose that he will be in the future. In commonness global warming, climatic charges, constantly drawings natural resources, falling-off quality water and atmosphere has not effect only on environment, but massive impact

show also in social, economical ambit and over components of environment and on health state population.

From this argument dwell on environmental safety and health risks with that conjoint in a large constant many international organizations tell quel NATO, OSCE, UNEP, UNECE etc. On word levels were accepted follow international contracts:

- Aarhus Convention (International convention about access to informations, interest community on process of decision and access to justice in rebus environment);
- Basel Convention about control moves hazardous wastes over border states and them destruct;
- Framework Convention OSN about climatic changes;
- Kjots protocol to global convention OSN about climatic changes;
- Montreal Protocol about materials, that damage ozone layer;
- Ramar Convention about marshland;
- Berlin Convention about safety European free living organism's; and more another's;

In conditions SR is environmental safety solution or covered following laws and rules:

- Law no. 17/1992 codex about environment;
- Law no. 543/2002 codex about safety natural and country;
- Laws about safety individual organs environment (safety of water, air, land, etc.);
- Law no. 24/2006 codex about appraisal effect to environment (EIA), etc.

Zone of environmental safety relating to all regions human activities, that are any way to relationship between human and environment and is partially care more agreements and codex's relevance to environment. Thereupon is necessarily definition of safety risk expand to the territory of environmental aspects, effects and risks.

This definition must come out from extensional and real defined accessions and conditions and must by legislative fixing.

2. ENVIRONMENT – SAFETY AUDIT

Adequate instrument in solution problem of environment safety is also environmental managering (EM). As the largest polluter environment is factory, is advisable the systems, forms and tools environments management, based on principles spontaneity start application on level of business firms and organizations in a broad sense. This tools offer structural and systematic method of incorporation environmental care to the all business activities. Destination of building environmental orientate management systems is not only respect legal enactment and minimalizing risks, but all the time environmental improvement for purpose of expansion economical and environmental safeties. Optimum instrument which is useful make this conditions which a view to been unbroken safeties on all levels of corporation and at the same time been possible detecting eventual hazard this safeties is environmental- safety audit. His object is not only cut down, eventually preventing geneses risk, but also realize activity so that result was perfect and size of risk been lower to minimum. Purposes, which they should by in ambit of company available. is possible bring together to the next steps:

- Identification low and strong elements system;
- Creating conditions for controlling risk in company;
- Proposition of electivity method for activity in zone „complex safeties";
- Positive influence other level controlling of company, with purpose push up quality final commodity or service as part of integrate control system;
- Higher achievement of economical corporation. [3]

Basic elements of environmental-safety audit and progression their realization is visible on image 1.

Environmental-safety audit is assigned company that wants analyzing and controlling environmental-safety risks his company net, handle them and implementate to global (integrated) management organization. Result of environmental-safety audit is report about global

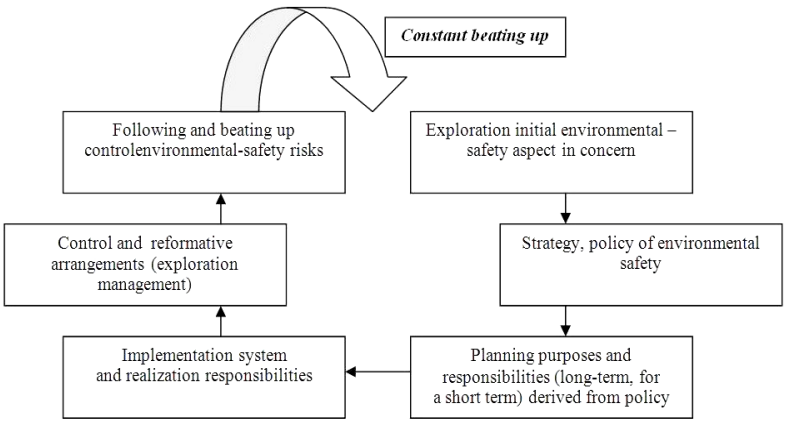

Figure 1. Components environmental – safety audit [2]

reviews in all places of company. This is advisement deuces with relevant standards, legislative and company safety policy.

Managering environmental – safety risks in praxis enable prevent concrete menaces, which invade system of stability and they bring into planned proccesses, they preclude real prognoses and commercial strategy in the future. [6]

3. CONCLUSION

It is necessary be aware, that neither this complex audit is not absolutely able eliminate all environmental-safety risks. However is applicable instrument for reveals, characterization, analyze and managering safety risks concern complexer. It is necessary show off, that alone audit is only instrument environmental-safety managering. Now Managering of concern risks (his accreditation and certification) is world over coordinated over ISO standards and methodical components. To greates belong: Certification managerial systems environment by ISO 14000; Certification managerial systems BOZP by OHSAS 18001; Certification managerial systems safety of information by ISO 27001 and in ambit SNAS that are e.g.: Methodical regulations MSA CR/01 systems of managering risks ISO/IEC 17 021, ISO/IEC 17011; Systems of environmental managering (EMS)-ISO/IEC GUIDE 66; Systems of managering safety and defense health at work (OH & S MS); Systems of managering safety data's (ISMS); Systems of managering safety foodstuffs(FSMS).

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INTERNATIONAL SYMPOSIUM on
ADVANCED ENGINEERING & APPLIED MANAGEMENT
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GENERAL PROCESS HOW TO ASSESS EXPOSURE TO SOLID AEROSOL IN WORKING ENVIRONMENT

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ABSTRACT:
The paper is focused on solid aerosols and evaluate of their exposure. It describes individual parts of assessment (from identification of potential exposure to concluding). At the end of paper there are described the results of assessment as three possible enclosures. Evaluate exposure of solid aerosol and comparison with limit values is one of the reasons why to do this. In the paper there are noticed other reasons why to do this action.
KEYWORDS:
Exposure, solid aerosol, working environment

1. INTRODUCTION

Solid aerosol can be produced from many sources. Generally, any activity which involves burning of materials or any dust generating activities are sources of solid aerosols. People are exposed to a variety of potentially harmful agents in the air that they have to breathe.

Solid aerosols are very important chemical factor in working environment. It has significant impact on human health. It is also important to know impacts of this factor to human health. This impact depends on exposure to solid aerosol in the working environment.

Measurement or estimation of actual human exposure, coupled with appropriate assumptions about associated health effects or limit values (e.g., acceptable daily intake, tolerable daily intake), is the standard method used for determining whether intervention is necessary to protect and promote human health.

2. ASSESSMENT OF EXPOSURE TO SOLID AEROSOL

Procedure of assessment of exposure to solid aerosol is based on standard EN 689. It is very universal procedure. It can be also modified. The modification depends on many factors for example type of solid aerosol.

Assessment of exposure to solid aerosol consists of three steps:

- assessment strategy,
- measurement strategy,
- measurement procedure,
- conclusion of assessment.

Assessment of exposure to solid aerosol is realized at the first evaluation and then after every significant change of working conditions, change in technology or change of limit values in legislation.

The figure 1 shows procedure of assessment of exposure to solid aerosol.

3. ASSESSMENT STRATEGY

Assessment strategy is introduction to assessment of exposure to solid aerosol. It consists from three parts. Table 1 describes details of individual parts. There are presented concrete activities.

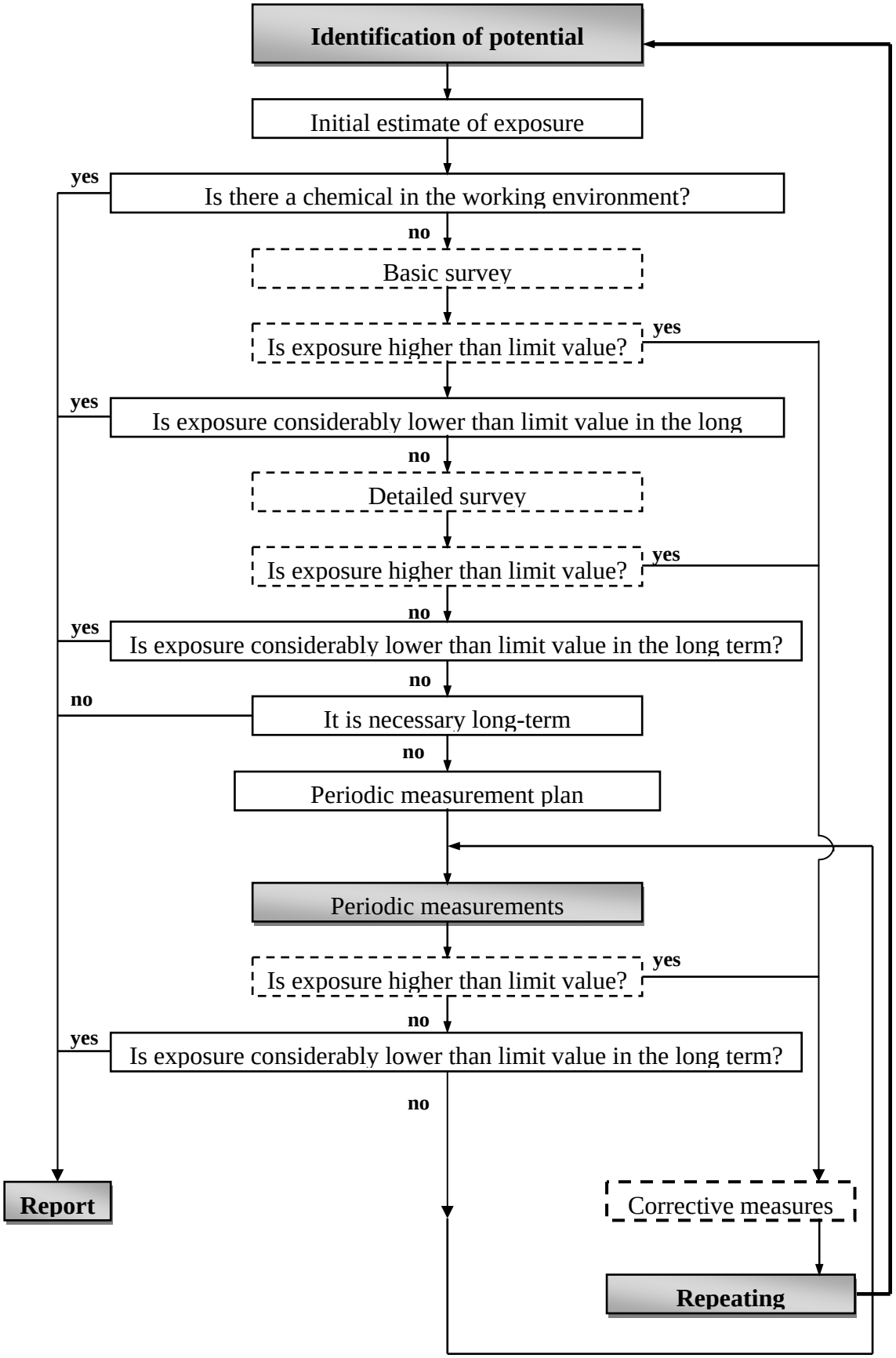

Figure 1 Procedure of assessment of exposure to solid aerosol by EN 689

Table 1 Details of individual steps

step		action
1.	Identification of potential exposure	– preparing the list of chemicals, – determination limit value for chemicals.
2.	Determination of workplace factors	– determination of working process and procedure,
3.	Evaluation of exposure	– initial estimate, – basic survey, – detailed survey.

4. MEASUREMENT STRATEGY

Measurement strategy is selected on the base of the assessment strategy. It includes the following steps:

- employees selection. It can be: casual, grouping workers into homogeneous groups or based on to the experience.
- measurement in the fixed point. It can be used only in certain cases. The measurement is realized close to employees' breath area.
- selection measurement conditions. It depends on kind of measurement.
- progress of measurement. It can be affected by different conditions: the frequency and duration of work tasks, analytical conditions etc. If conditions during the measurement are without significant changes, sample time could be shorter and minimal number of samples could be lower.

5. MEASUREMENT PROCEDURE

Measurement procedure must offer representative results.

Process of measuring includes:

- specification chemicals,
- sampling procedure,
- analytical procedure,
- sampling points
- duration of sampling,
- timing measurement and interval between measurements,
- calculations of concentrations of chemicals in the work environment of individual analytical values,
- other technical instructions for measurement,
- work activities which should be monitored.

In the case if is possible, it should be used equipment for personal sampling. This equipment is placed directly to the employee's clothes. Sampling head is placed close by employee's breath area. It is the best way how to obtain relevant results.

6. CONCLUSION OF ASSESSMENT

It is necessary to formulate conclusion of assessment irrespective of previous three steps of assessment. This conclusion is formulated based on comparison. It means comparison between calculated results and the limit value – highest permissible exposure limit. These limit values are notice in legislation. Limit values are determined by the whole working time as average value of the overall concentration exposure of solid aerosol or respirable fraction of solid aerosol. There are three possibilities:

- exposure is higher than limit value – it is necessary to adopt appropriate corrective measures and also periodic measurements are necessary,
- exposure is considerably lower than limit value – it is not necessary to adopt corrective measures and periodical measurements,
- exposure is just below the limit value – periodic measurements are required.

The highest permissible exposure limit is for two basic groups of solid aerosols:

- solid aerosols mostly with toxic effects,
- solid aerosols without toxic effects.

If there is in working environment more than one substance, they will influence together. Limit value will be calculated by the equations. These equations are notices in legislation. Whole process of assessment exposure to solid aerosol is finished after the elaborating of Report of measurement.

7. FINAL REMARKS

In this paper there was shortly characterized process of assessment exposure to solid aerosol in the working environment.

This process also enables:

- ❖ assessment dustiness in working environment,
- ❖ evaluation effectiveness of the used measures for decreasing dust production,
- ❖ assessment risk of dust or assessment individual dust load,
- ❖ appreciate machines, technological process or working operation,
- ❖ provide background papers for epidemiological research.

The procedure described in this paper can be used for different chemicals (not only solid aerosol).

ACKNOWLEDGEMENT
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POSSIBILITY OF USAGE A NONSTANDARD SOURCES FOR WIND ENERGY

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ABSTRACT:
At the present time the usage of alternative source of energy is really actual from the point of view to save the natural sources for the next generations, to decrease the pollution of environment. Energetic economy measure has high influence on decreasing emission of materials as well as green house gasses which are conducive to fulfill state's strategies in environment area and climate changes. This article is focused on the problematic of usage the wind power to produce the electric energy as an alternative source of energy. It also highlight the positive effect of the nonstandard source of wind energy using the M.A.R.S. turbine.

KEYWORDS:
Wind energy, offshore wind energy, turbines M.A.R.S.

1. INTRODUCTION

Offshore Wind Energy (OWT) stations produce clean energy without any emissions, which neither cases any climatic changes nor pollute the air. This kind of electric energy production represents the home source of energy production, that we have not have to pay for it to the foreign companies and we become more self-sustaining and energy independent.

2. OFFSHORE WIND ENERGY

Currently are mostly construct OWT with watts in the range of 1,5 – 2,5 MW. Modern OWT are less noisy than the old one, that's why they are also accepted by vicinetum. The designed life of those OWT is 20 till 25 years. During the designed life, the OWT should work at least 120 thousands of hours.

Suitable areas for an OWT are areas where the average wind speed is at least 6 m/s in the high of 60m above the terrene. The areas with lower average wind speed are not suitable due to lower power of a wind. The best areas are the mountain areas and the lowlands. The construction of an OWT is forbidden in the national parks which decreases the amount of suitable areas with enough wind power. This kind of restriction eliminates a huge part of suitable areas in Slovakia to construction an OWT, nevertheless there are a lot of areas where they can be built the OWT ranches. It is also important to mention, that the enough wind power is just one part of requirements to build an OWT ranch. The other requirements are: ability to connect to the distribution network, area that does not affect the national parks or the diversity of human population in near by areas. Those factors also eliminates a lot of suitable areas [1].

3. MAGENN AIR ROTOR SYSTEM (M.A.R.S.)

The system Magenn air rotor system (M.A.R.S.) is one of the types of OWT. This kind of turbine is lighter than the air. It uses the wind power to produce electric energy. The reason why it is possible to stay in higher level of atmosphere is the Helium that is used to fulfill the turbine. This helps the turbine to be in areas where wind has higher speed, than on the lower levels of atmosphere. The M.A.R.S. spins around the horizontal axis following the wind direction. This way

is produced more energy from the wind power, which is transferred to the surface transformer station using the cables. It has a lot of advantages comparing to the conventional OWT e.g. low cost of produced electric energy, lower noise, turbine is placed in higher location, lower constrains where it can be placed, high mobility level, it is not required to use a heavy duty machines, lover risk to harm a birds or bats.

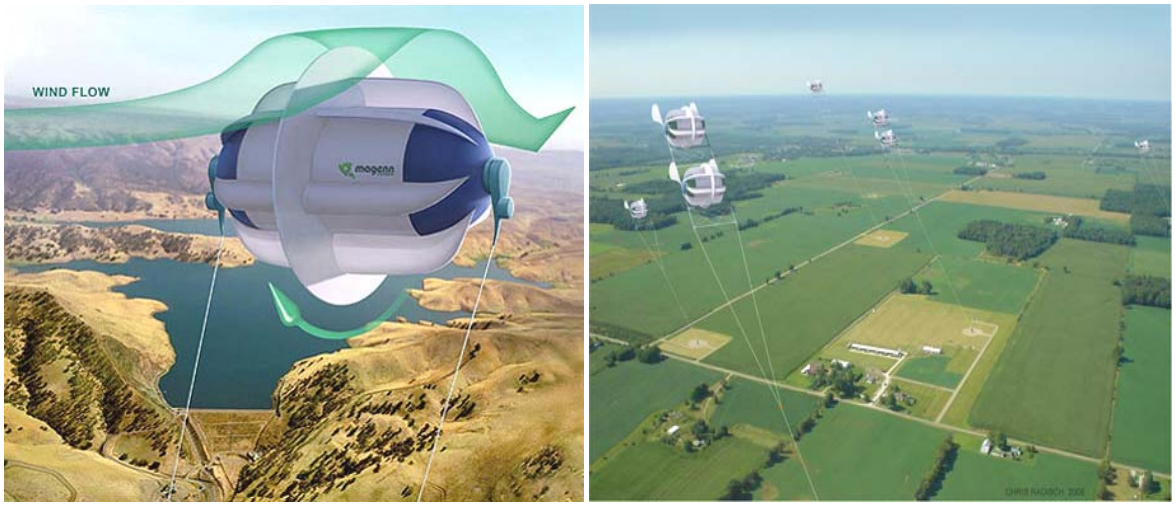

Figure 1 Turbine M.A.R.S. [2]

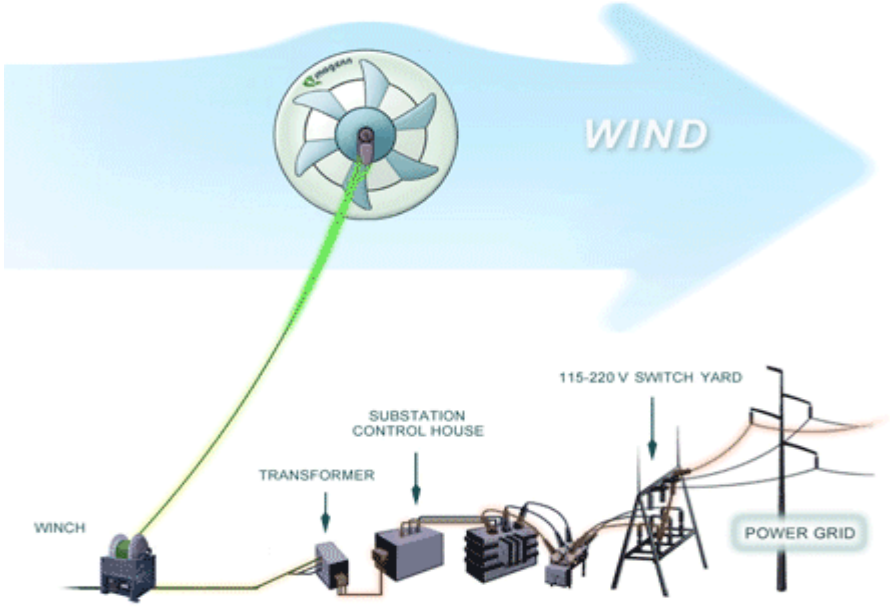

Figure 2 Schema of wiring connection for the M.A.R.S. [2]

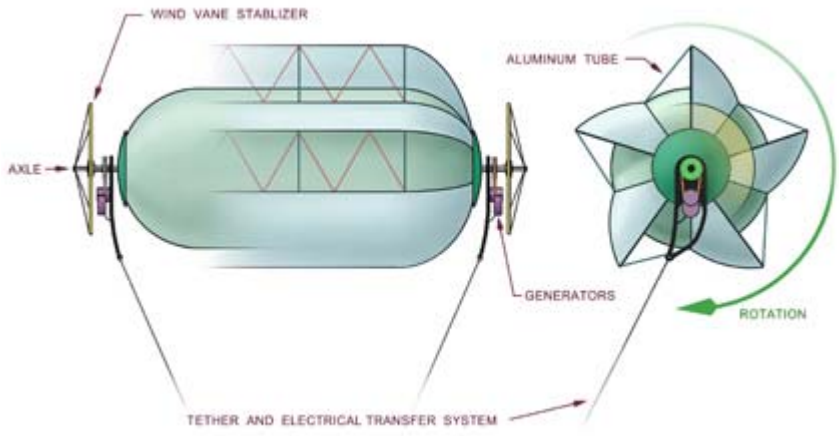

Figure 3 System functioning fundaments of M.A.R.S. [2]

The OWT M.A.R.S. can be taken out higher over the surface, than the conventional systems, so it can catch more power full wind. The conventional systems are placed in areas where the wind is higher over the surface e.g. coastlines or mountain terrenes. The most suitable areas are in national parks, areas far away from the consumers of the electric energy, which raise up the energy losses during the long-distance power transmission. This mentioned problems are able to be solved using the M.A.R.S..

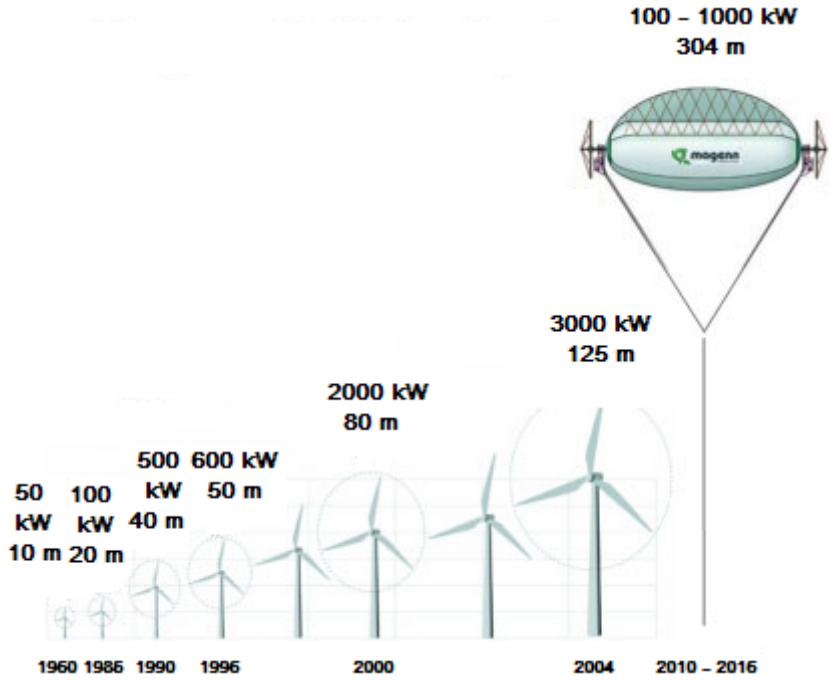

Figure 4 Overview of wind turbines. [2]

The OWT M.A.R.S. cannot be placed in any air-space nor closer than 8km from the airport. The caring balloon contains the reflex material and also radar using the frequency in the range 200 - 2700 MHz. The cover and backband of the M.A.R.S. system is made of material that are lighter and stronger then the steel, has almost no absorbability, abrasively resistance and UV rays.

4. IMPACT OF WIND TURBINES ON THE ENVIRONMENT

The biggest problem of the classical OWT is that there is a direct contact with birds and bats that end by death. The rotors of turbines are moving, which case a lot of problems to avoid for them. The advantage of the M.A.R.S. is that it stays on one place without moving, which allows the birds and bats to easily avoid it.

5. CONCLUSION

The OWT M.A.R.S. is suitable to produce the electric energy due to its ability to use in the developing countries with reduced infrastructure or in the areas of country where is no infrastructure. This approach of energy producing is also able to use on islands, outlying farms, during the nature catastrophes.

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GROWING GREENHOUSE CUT FLOWER IN HYDRO-CULTURE

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ABSTRACT:
The importance of hydro-cultural growing is significantly increasing. We have been dealing with the hydro-cultural growing of cut flowers at the Department of Ornamental Plant Growing and Maintenance of Gardens at the College Faculty of Horticulture at Kecskemét College since 1988. We started our experiments by growing carnation in growing establishment without soil then we introduced other species of cut flowers and potted ornamental plants into our research work (*Lévai et al.*, 2010/b). Our aim was to examine the effect of Grodan and PU-sponge media on the growth, the yield of flowers, the diameter of the flowers and the length of the stem concerning the species of carnation 'Pink Castellaro'. In case of comparing the species our aim was to examine the effect on the development of the plants, the yield and the characteristics of the flowers: the diameter of the flower and the length of the stem.
The Phytomonitor instrument is placed in the French Filclaire greenhouse and we at the Floriculture and Park Maintaining Department measure rose culture parameters in hydroponics. We measure the following factors: air temperature, leaf temperature, radiation, relative humidity of air, stem diameter and soil moisture (*Lévai- Turiné*, 2009.)
Using Phytomonitor data processing make it possible to use nutriments in an optimal level thus apply a low-cost environmentally friendly technology.
KEYWORDS: hydroculture, carnation, Rose, PU sponge, Grodan, Phytomonitor

1. INTRODUCTION

The effect of the species on the flower diameter of carnation: Most of the species in the experiment reached or exceeded the parameters of 1st class products determined by the standards, minimum was 7.0 except for the values of 6,91 and 6,96 of 'Candy' and 6,87 and 6,89 of 'Ondina' average yearly flower diameter *(Lévai et al, 2010)*.

The largest flower diameters of the red species were experienced in the case of 'Iury' and 'Rodolfo', from the point of flower diameter these species are worth being involved in hydro-cultural growing. In case of the 'Castellaro' species 'Pink Castellaro' produced significantly larger flowers *(Lévai – Turiné, 2005)*.

Experiments with the species:

- 'Danton' is of high growth, of good yield, with large flowers and long stem
- 'Gigi' is of high growth, of good yield, with large flowers and long stem
- 'Iury' is of high growth, of average yield, with large diameter of flower and long stem
- 'White Castellaro' is of high growth, of good yield, with large diameter of flower and long stem
- 'Pink Castellaro' is of high growth, of excellent yield, with large flower and long stem
- 'Candy' is of average growth, of excellent yield, with average size of flowers, with average long stem
- 'Rimini' is of high growth, of good yield, with large flowers, really long stem
- 'Rodolfo' is of high growth, of excellent yield, really large flowers, really long stem
- 'Ondina' is of average growth, of good yield, with average size of flowers, long stem
- 'Olivia' is of high growth, of excellent yield, with large flowers and long stem

Each of the species in the survey is adequate for hydro-cultural growing *(Lévai – Turiné, 2005a, b; Lévai – Turiné, 2007).*

2. MATERIAL AND METHODS

We made experiments of hydro-cultural growing of carnation with the following species: 'Danton', 'Gigi', 'Iury', 'White Castellaro', 'Pink Castellaro' and 'Candy', 'Rimini', 'Rodolfo', 'Ondina', 'Olivia'.

The experiments of carnation were carried out by the French Filclair growing establishment, growing was arranged in a closed, circular system. The planting of shoots with roots was arranged by 40 pieces/m^2 at the end of May. We applied PU-sponge as the medium of plantation for the comparative experiments, the length of the growing season was one year. The experiment was carried out by repeating the procedure four times. The supply of nutritional material was made by using complex chemical fertilizer, the pH of the nourishing solution was 5,0-6,5, the conductivity was 2,5-3,5 mS and these parameters were continuously controlled. We measured the quantity of the picked flowers from the beginning of blooming each time. We chose 10-10 of the picked flowers by random choice and measured the characteristics of flower quality: the diameter of the flower and the length of the stem.

A PhyTech company plays a pioneer role in the Phytomonitoring ™ system, it detects the plants remotely. It uses advanced methods, collects and analyses the data derived from wireless communication sensors and innovative softwares. The main purpose is the detection of early plant stress, optimal growth and quality of product to increase income.

Results

The effect of the media on the height of the carnation

In case of the hydro-cultural growing of carnation both the polyurethane-ether sponge and Grodan had a good effect on the growth of the plant, both are adequate as a plantation media but the stock grown in the sponge was higher.

The effect of the media on the yield of the carnation

We managed to reach the average flower yield of 7-9 flowers per stem (Figure 1.) characteristic of the traditional chemo-cultural growing in case of hydro-cultural growing in polyurethane-ether sponge and in Grodan that is both are adequate plantation media for hydro-cultural growing.

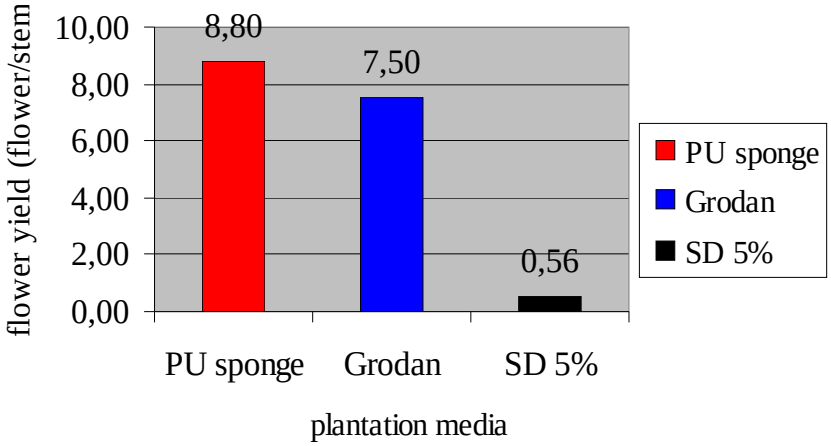

Figure 1. The effect of plantation media on the yearly yield of carnation 'Pink Castellaro' (Kecskemét, 1999-2000.)

The effect of the media on the flower diameter of the carnation

During the two growing seasons of the experiments the average diameter of the flowers planted in polyurethane-ether sponge and in Grodan reached the parameters of 1st class flowers that is 7-cm flower diameter. We did not experience significantly better results in case of the two media so both are adequate for the hydro-cultural growing of carnation.

The effect of the media on the length of the flower stem of carnation

The plantation media influenced neither the yearly nor the monthly length of the stem significantly in the years of research.

Taking the yearly average into consideration we reached the requirement of 1st class quality that is 55-60-cm stem length in case of both media.

Considering all the above both polyurethane-ether sponge and Grodan are adequate media for hydro-cultural growing.

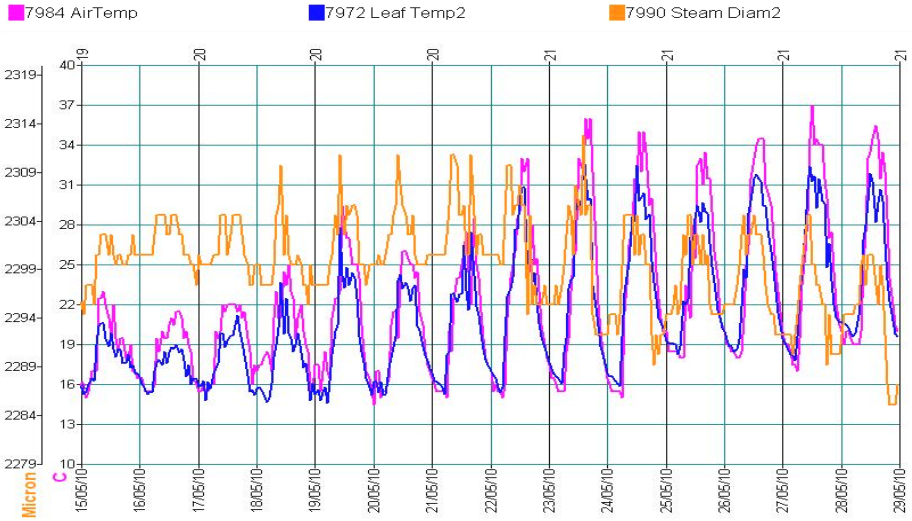

Figure 2: The effect of air temperature on rose leaf temperature and expansion of stem (2010.Kecskemét)

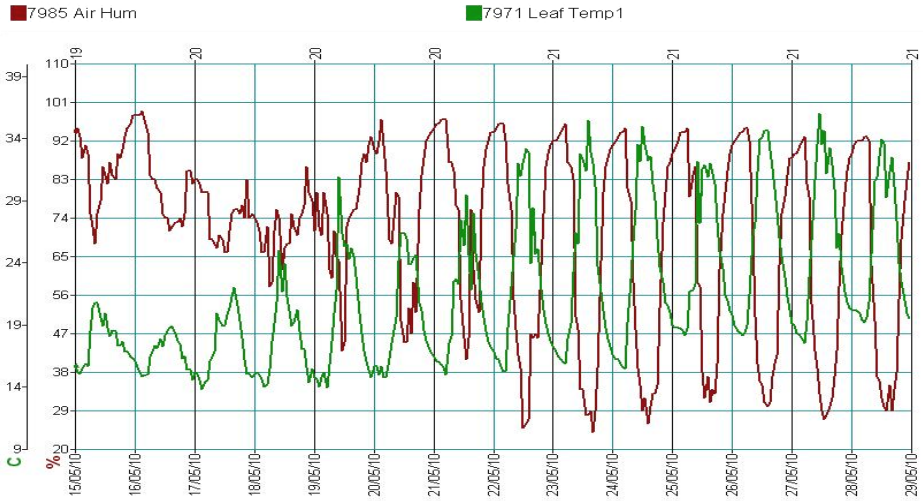

Figure 3.: Rose leaf temperature in relation with the air humidity (2010.Kecskemét)

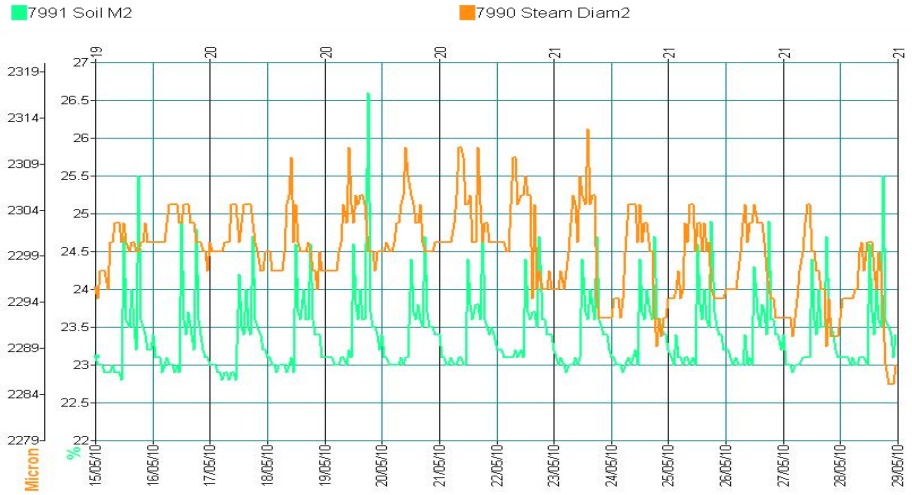

Figure 4: The expansion of rose stem in accordance with soil wetness (2010. Kecskemét)

The fluctuation of air temperature well indicates the change of the phases of the day (Figure 2). The expansion of stem follows this cycle. It was pointed out that the higher was the daily maximum temperature the expansion of stems was more intensive. Respectively the fewer daily fluctuation made the stem expansion more stable. By the increase of daily temperature the

expansion of stems are significant. The temperature of leaves increases paralell with the air temperature.

By the increase of temperature the relative humidity decreases. The temperature change of leaves follows the change of air temperature (Figure 3). According to it the relative humidity is higher in the night and lower in the day.

The wetness of soil indicates the time of irrigation (Figure 4). The expansion of stems well follows the wetness of the soil.

3. DISCUSSIONS

Concerning environmental protection PU sponge is more and more adequate media for growing carnation since it can be used until complete decomposition. Both PU sponge and Grodan have got a favourable effect on the growth of the plant, the yield of the flowers and the flower quality characteristics that is why Grodan is also an adequate media for the hydro-cultural growing of carnation. Phytomonitoring is one of the growing decision support devices which gives fast information about the tendency of plant development. It is an information technology which provides the grower with incredibly valuable information about the plant physiologic stage.

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INTERNATIONAL SYMPOSIUM on
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METHODS FOR RECOVERY AND RE-USE OF SLUDGE RESULTED FROM WASTE WATER TREATMENT

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ABSTRACT:
Most of the water treatment plants discharge their sludge to the environment without consideration of possible side effects. Since this kind of sludge is generally considered pollutant, the sludge treatment of water industry seems to be an essential task. These sludges from wastewater treatment process must be treated in a safe and effective manner. There are many ways to manage these sludges. One very important is this use on agriculture, as support for different crops, after their pre-treatment thus the content of hazardous pollutants to be reduced and even totally destroyed.
KEYWORDS:
sludge, soil, biodegradable wastes, biogas

1. INTRODUCTION

Sludge originates from the process of treatment of waste water. Due to the physical-chemical processes involved in the treatment, the sludge tends to concentrate heavy metals and poorly biodegradable trace organic compounds as well as potentially pathogenic organisms (viruses, bacteria etc) present in waste waters. Sludge is, however, rich in nutrients such as nitrogen and phosphorous and contains valuable organic matter that is useful when soils are depleted or subject to erosion. The organic matter and nutrients are the two main elements that make the spreading of this kind of waste on land as a fertilizer or an organic soil improver suitable.

2. THE BIODEGRADABLE WASTES

The Sewage Sludge Directive 86/278/EEC seeks to encourage the use of sewage sludge in agriculture and to regulate its use in such a way as to prevent harmful effects on soil, vegetation, animals and man. Treated sludge is defined as having undergone "biological, chemical or heat treatment, long-term storage or any other appropriate process so as significantly to reduce its fermentability and the health hazards resulting from its use". To provide protection against potential health risks from residual pathogens, sludge must not be applied to soil in which fruit and vegetable crops are growing or grown, or less than ten months before fruit and vegetable crops are to be harvested. Grazing animals must not be allowed access to grassland or forage land less than three weeks after the application of sludge. The Directive also requires that sludge should be used in such a way that account is taken of the nutrient requirements of plants and that the quality of the soil and of the surface and groundwater is not impaired.

Within the term “biodegradable waste” we can consider livestock manures, sewage sludge, organic fraction of municipal solid waste and the residues of some industries (food processing, paper, textiles, wood, etc).

It is a difficult task to estimate the industrial and agricultural quantities of bio-waste (waste versus byproducts), the variable or unknown water content and the “in situ” recycling operations. The quantity of sludge has been increasing greatly in Europe after the implementation of Council Directive 91/271/ECC on urban wastewater treatment. Recent official reports coming from a survey financed by EU results in a production of 7,5 millions of tones (dry matter).

In our country, the Council Directive 91/271/ECC is implemented by Order no. 344 / 2004 referring to wastewater sludge requirements in case of theirs use onto agriculture soils.

The environmental balance of the various options available for the management of this waste can depends on a number of local factors, inter alia collection systems, waste composition and quality, climatic conditions, the potential of use of various waste derived products such as electricity, heat, methane-rich gas or compost. Thus, the objectives followed for managing the wastes are:

- The promotion of the biological treatment of organic waste by harmonizing the national measures in order to prevent or reduce any negative impact on the environment.
- The protection of soil and the insurance in the use of bio-waste results in agricultural benefit.
- The insurance that human, animal and plant health are not affected by the use of bio-waste.

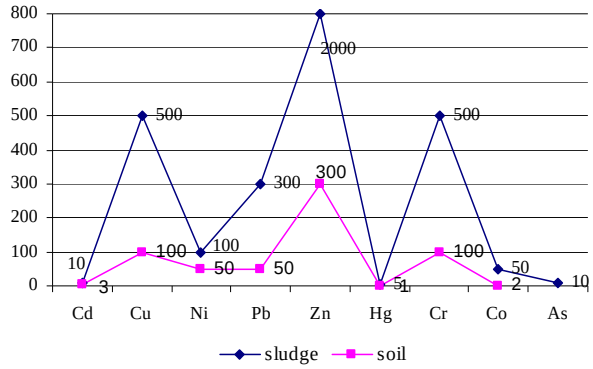

Fig. 1: Maximum admitted values, mg/kg dry soil, for metals from sludge and from soil where the sludge is use

Only treated bio-waste is allowed to be spread on land. High quality standards for compost are required.

In the next graph, the maximum admitted values are given for metals, as mg/kg dry soil, from soil and also from sludges, as comparison.

The main steps for wastes management is the separate collection, composting, anaerobic digestion (biogas recovery), biological treatments and finally uses on land.

3. Methods for re-use of biodegradable wastes

In wastewater treatment plants, the high quantities of sludges may be *an important source of organic matter for agriculture soil*. This type of sludge contains fertilizing substances, about 50% from nitrogen and potassium being present in fermented sludge. There are also other ways to re-use the sludge.

The agricultural use or land application of organic waste is considered the best environmental option.

One of the alternatives for re-use of biodegradable wastes is the use of these as *road construction materials*, combined with a marine alga. This represents a new re-use alternative in order to preserve natural resources, having in mind the difficulty of choosing a proper method for diminution of environmental impact. Using a proportion of 0, 20, 50, 80 % clay content, it can be obtained palletized aggregates with density between 1,48 and 2,25 g/cm^3, in comparison with 2,56 g/cm^3 as granite density.

Another re-use option is the obtaining of *biogas*, as a mixture of combustible gasses formed by organic matters decay in wet atmosphere and without oxygen. The main component of biogas is the methane. The process of biogas formation is the anaerobic fermentation between 20 – 45 °C, in the presence of two bacteria species:

- Bacilus cellulosae methanicus, responsible for methane formation and
- Bacilus cellulosae hidrogenicus, responsible for hydrogen formation.

With the help of anaerobic fermentation, the microorganism decomposes the organic matter, releasing some metabolites as carbon dioxide and methane.

Among the chemical components of organic matters, the highest conversion rate belongs to the cellulose, hemicelluloses and fats.

An industrial biogas plant has as components:

- Wastewater pump station;
- Settling tank;
- Sludge dewatering device;
- Sludge pump station;
- Anaerobic fermentation chamber for biogas capture.

By help of anaerobic fermentation the high quantities of biogas may result. From anaerobic fermentation is obtained a stabilized sludge which can be valorized into agriculture or used as inert material for disposal.

There are some factors influencing the quality of anaerobic fermentation, from material quality and installation parameters to enzymatic equipment, more difficult, with complex methods for investigation. Some of process factors are presented below:

- *Solids substances concentration from sludge* chosen to assure water consumption for bacteria; it is important a concentration about 5-10% solids; highest concentration made difficult the pump and homogenized process.
- *Organic component of the solid phase* is very important parameter for gas production; it is assumed that about 50% from organic component means a relative stability for sludge. The gas composition is influenced by decomposition rate of organic matter. The main groups which influenced the quantity and gas fermentation composition are: carbon hydrates, proteins and fats.

Anaerobic fermentation is suitable for almost organic substances, except lignin and mineral oils.

- *Mineral components,* especially nitrogen and phosphorous salts, are important for anaerobic fermentation. Some cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, NH^{+}) have an inhibiting action for anaerobic fermentation for concentrations higher than 10 g/l. In table 1, the limits for some substances influencing the fermentation process are presented.

Table 1. The limits for concentrations of some substances with influence on fermentation process

Substance	Conc. (mg/l)	Substance	Conc. (mg/l)
Sulfides	200	Calcium	2000-6000
Soluble heavy metals	1	Magnesium	1200-3500
Sodium	5000-8000	Ammonia	1700-4000
Potassium	4000-10000	Free ammonium	150

- *Optimum value pH* is situated between 6,8 and 7,6;
- *Temperature influence*; anaerobic fermentation takes place between 4 and 60^0C; the microorganisms are very sensitive with temperature variations even between 2-3^0C.
- *The mixing – recirculation – inoculation* has as objective the mixing of the settled sludge with the upper sludge from surface, obtaining a fast decay of organic substance and in this way a short time for fermentation process.

Aerobic fermentation represents as well as anaerobic fermentation a biochemical decay process of degradable organic compounds. This alternative, it is possible by separately aeration of sludge (primarily, secondary or mixed) in open tanks. This alternative it is recommended when there is not primarily treatment and for high quantity of activated sludge. The equipment for aerobic fermentation is designed for about 8 – 15 days, depending on sludge characteristics.

Comparing the two systems, it is obviously that anaerobic stabilization is more efficiency then aerobic one, especially energetically point of view. These aspects are presented in table 2. In case of high content of hazardous organic and inorganic compounds in sludges, the incineration may be a solution.

Tabel 2. Data referring to aerobic and anaerobic fermentation

Characteristics	Aerobic Fermentation	Anaerobic Fermentation
Retention time (days)	8 - 15	15 - 20
Energy consumption (KWh/m^3 sludge)	5 - 10	0,2 - 0,6
Comments	Low cost for investment; high energy consumption	High cost of investment and exploitation; Low energy consumption; Energy resource by gas production

The incineration of the sludge lead to the completely oxidation of the organic compounds and metallic compounds may be found as ash. Incineration equipments have to be designed with washing and filter equipments for exhausted gasses and it is very important that the sludge for incineration to be dewatered. Also, the anaerobic and aerobic stabilization is very important because in this way is diminished the caloric value of the waste. The sludge processing before incineration has to lead to auto - combustion.

The usual equipment for sludge incineration consists of circular rotary kilns with multiple hearths or fluidized beds. Also, in case of neutralization of a dewatering sludge, the *disposal* can be an option.

The disposal involves landfills. These may be on public land such as a municipality owned landfill, or on private land. Landfill operators commonly require 15 to 30 % sludge (solids). The minimum concentration required is often determined by local sanitary landfill regulations. For example, for alum sludges, effective landfilling requires the solids concentration to be at least 25%. At lower concentrations, land application is more appropriate.

4. CONCLUSIONS

In Romania, the most wastewater treatment plants use only mechanical and biological treatment stages. The mechanical treatment consists of screening and primarily settling. Biological treatment consists of aeration, secondary settling, and pump station for recirculation of the sludge.

Sludge treatment plant is rarely used or its function is difficult. In case of its operation, this consists of gravitational thickening tanks, fermentation equipments and dewatering platforms.

According to the latest reports regarding the use of sludge in agriculture, it is can be observed that in 2003, the quantity used for agriculture was about 12% and in 2008 was about 14%, for our country.

The first condition for sludge use into agriculture is its anaerobic fermentation, followed by natural or mechanical dewatering and disposal for at least 60 days.

The spreading of the sludge onto agriculture soil is a very well method, with benefits regarding the crops and the soil quality.

Limits of the application are given by inadequate composition of the sludge (heavy metals) and by the difficult option to find a proper site at a covenant distance.

The management of biodegradable wastes may be a tool for the future use of them as soil amendments by help of the neutral obtained compost. For our country, as well as for European Union countries, the limit of these methods is given by metals presented in sludges (especially heavy metals).

Also there appears a difficult situation in funding the proper site not too far from sludge source to spread them.

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FILTER NOZZLE TESTING BY THE INSTALATION WITH COLUMN AND MANOMETER

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ABSTRACT:
This paper deals with filter nozzles which are used for water treatment. They are applied in many sectors including drinking water, water demineralization process, urban and industrial waste water treatment, filtration of river or well water for irrigation, water for swimming pools, etc. The filter nozzles are made from the thermoplastic material, with different number and widths of gaps at the head of the nozzles. It is necessary to determine performance curve of filter nozzle before it is installed. The performance curve actually represents the nozzle water gauge head as a function of flow rate. This performance curve has been traditionally determined by measuring of hydrostatic pressure above the nozzle with level meters (graduated scale, ultrasound, capacity etc.). In order to measure a couple of meters water gauge head, a reservoir is necessary. This research is aimed to examine possibility to apply the installation with column and manometer instead of the reservoir, in order to determine filter nozzle performance curve. The water gauge head is measured by manometer and flow rate through the filter nozzle by mass method. Authors are of the opinion that installation with column and manometer could be successfully applied to determine filter nozzle performance curve. In comparison with the reservoir, the installation with column and manometer is more compact and comfortable.
KEYWORDS: Filter nozzle, column, filtration, washing

1. INTRODUCTION

Filter nozzles are placed in:

- open systems – for preparation of drinking water, industrial waste water treatment, filtration of river or well water for irrigation, water for swimming pools and
- closed systems – for preparation of feed, technological and cooling water.

The filter nozzles are made from the thermoplastic material, with narrow gaps at the head of the nozzles. They enables preparation of water using ion exchangers. The number and width of the filter nozzle gaps vary by model. Thanks to the installed nozzle, this kind of filter has very fast filtration. Filter nozzle enables collection and drainage of filtrate evenly. In the process of washing, nozzles make possible water and air to be evenly distributed. In this way filter nozzles contribute to fast, stabile and economic exploitation of filter stations.

One of the most important characteristic of filter nozzle is to deliver sufficient volume of water in processes filtration and washing. In order to check filter nozzle it is necessary to conduct test before installation. Also is necessary to determine performance curve of filter nozzle before installation. The performance curve actually represents the nozzle water gauge head vs flow rate. This performance curve has been traditionally determined by measuring of hydrostatic pressure above the nozzle with level meters (graduated scale, ultrasound, capacity etc.). In Fig. 1 is shown performance curve of model with 40 narrow gaps, 0.2 mm in width at the head of the nozzles (producer BRAN & LUBBE) [2]. In order to measure a couple of meters water gauge head with this method, a reservoir is necessary.

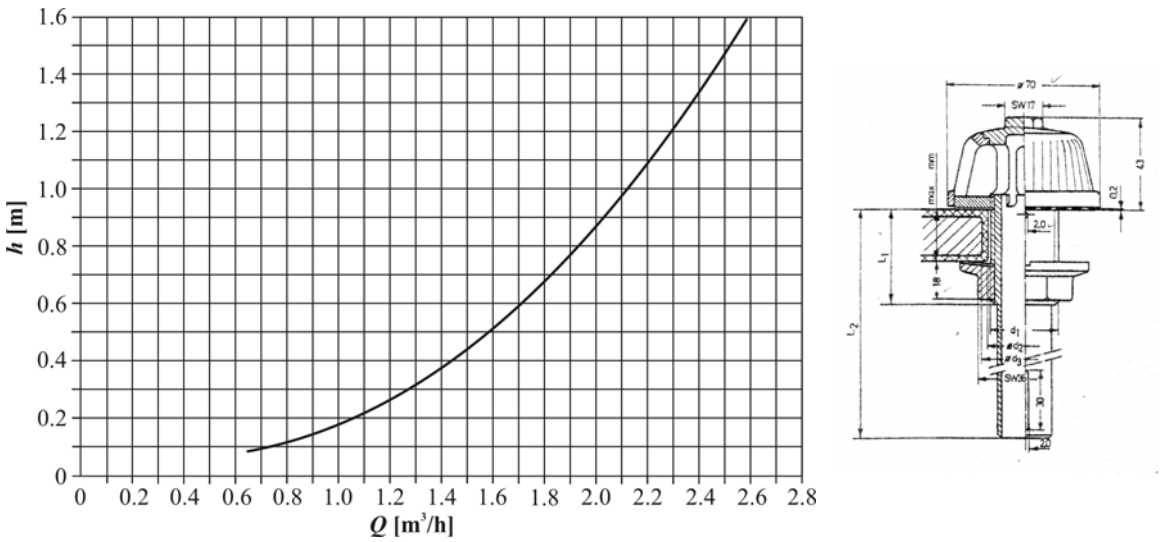

FIGURE 1. The performance curve of filter nozzle of model with 40 narrow gaps, 0.2 mm in width at the head of the nozzles (producer BRAN & LUBBE) [1]

This research is aimed to examine possibility to apply the installation with column and manometer instead of the installation with reservoir, in order to determine filter nozzle performance curve. The hypothesis of work was that installation with column and manometer could be successfully applied to determine filter nozzle performance curve. The report on filter nozzles testing of models RV001/A, RV001/B and RV001/D (producer RAVEX) provides background for this paper [2]. The RAVEX Company from Vrbas, Serbia, is a leader of filter nozzles production in the Balkan region [3].

2. METHODOLOGY OF INVESTIGATION

An installation with column and manometer for filter nozzles testing has been designed at the Faculty of Technical Sciences, Laboratory for Fluid Mechanics. The filter nozzle model RV001/A was tested to verify method with proposed installation. The model RV001/A corresponds to model in Fig. 1, 40 narrow gaps, 0.2 mm in width at the nozzle head [3]. The tests were carried out for two processes: filtration (Fig. 2) and washing (Fig. 3).

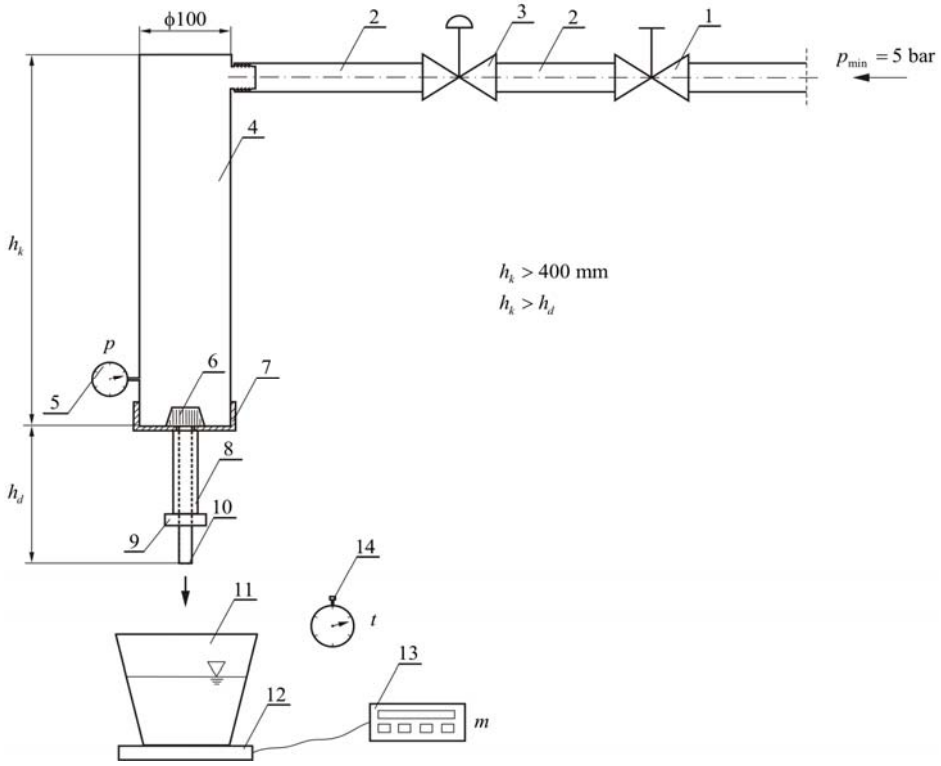

FIGURE 2. Scheme of installation with column and manometer for filtration process

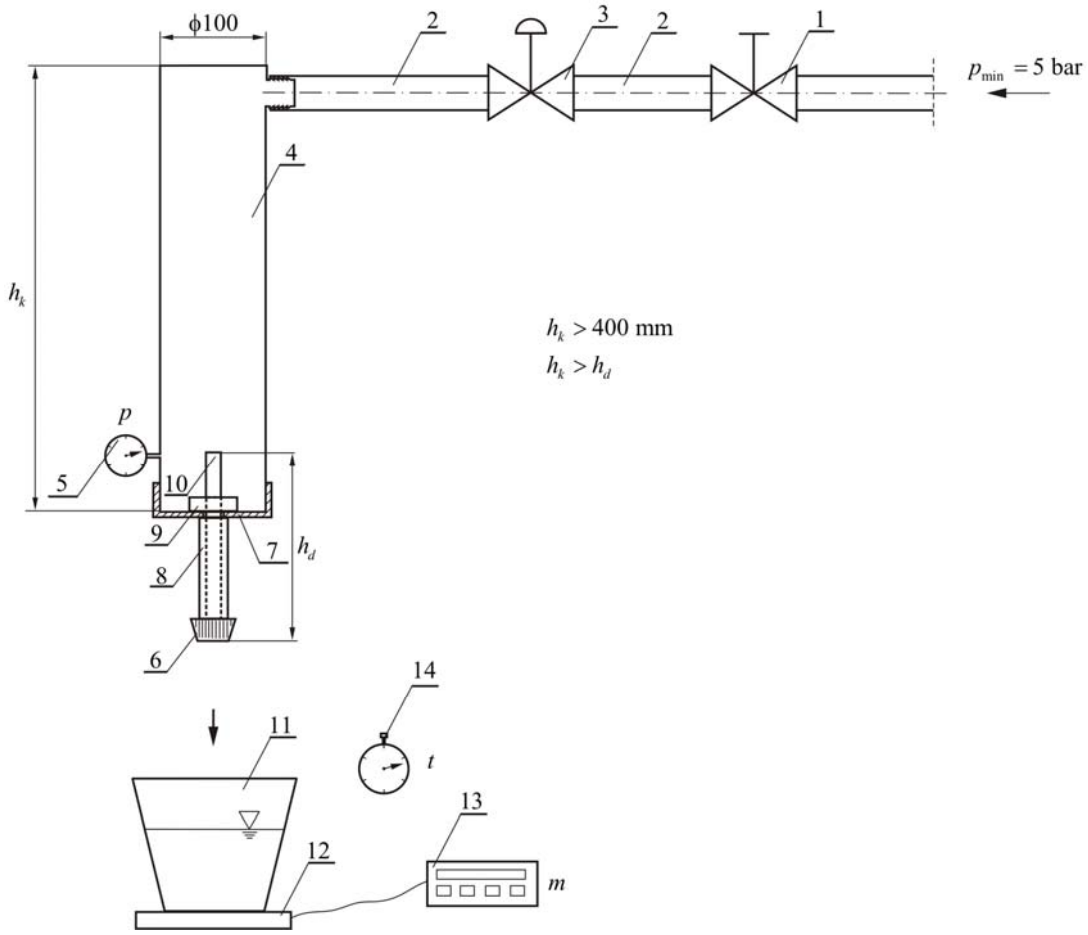

FIGURE 3. Scheme of installation with column and manometer for washing process

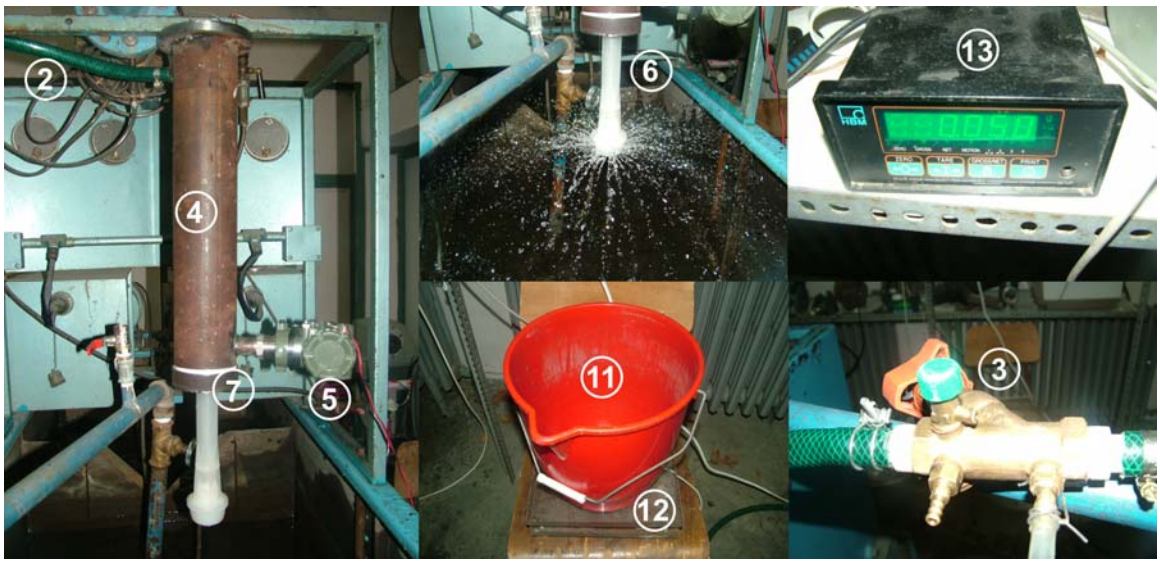

FIGURE 4. View of installation with column and manometer for washing process

In Fig. 2, Fig. 3 and Fig. 4 are: 1-valve, 2-rubber hose, 3-regulator, 4-housing, 5-manometer, 6-filter nozzle, 7-bottom with threaded connection, 8-built in piece, 9-screw nut, 10-nozzle neck, 11-vessel, 12-precision balance, 13-data acquisition and 14-stopwatch.

The length of the housing is $h_k = 550$ mm, which is more than the length of the nozzle neck ($h_d = 400$ mm). Regulation of water flow rate ($\dot{m}$) was carried out by balance valve (3). The pressure at the position 5 was measured by manometer of producer YOKOGAWA, model EJA530A [4]. The measuring range of manometer is $p = 0 \div 400$ mbar, with uncertainty of $\pm 0{,}35$ %. The

change of filter nozzle position for two testing processes (filtration in Fig. 2 and washing in Fig. 3) was enabled by bottom with threaded connection 7 and built in piece 8. The mass of water (m) was measured with precision balance (12) with uncertainty of $\pm 0,02\,\%$, while the time (t) was measured with digital stopwatch (14).

Mass flow rate is as follows: $$\dot{m} = \frac{m}{t}.$$

Volumetric flow rate is: $$Q = \frac{\dot{m}}{\rho}.$$

The water gauge head is: $$h = \frac{p}{\rho g},$$

where are:
p – preassure [Pa];
ρ – density of water [kg/m^3];
g – earth accelaration [m/s^2].

The water gauge head (h) depends on determined volumetric flow rate (Q). The flow rate was varied by regulator and relation equation $Q = f(h)$ was formed.

3. EXPERIMENTAL RESULTS AND ANALYSIS

The results of filter nozzle testing of producer RAVEX, model RV001/A are shown in Fig. 5 and Fig 6. In the Fig. 5 is shown performance curve for the filtration process and in the Fig. 6 performance curve for the washing process.

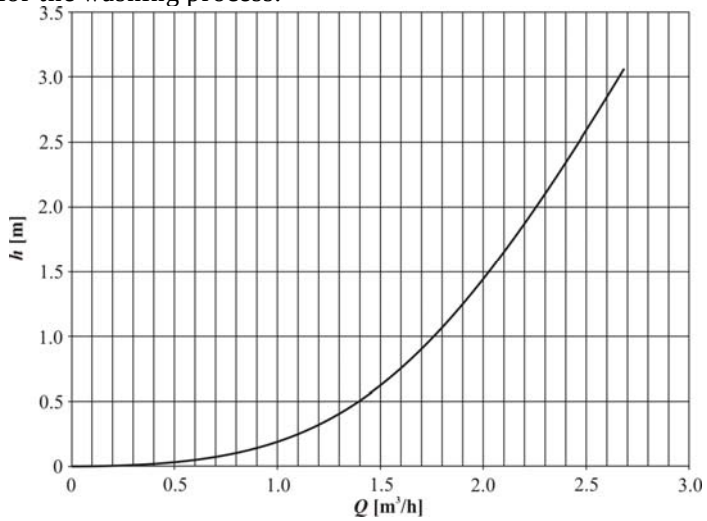

FIGURE 5. The performance curve of filter nozzle model RV001/A for the filtration process

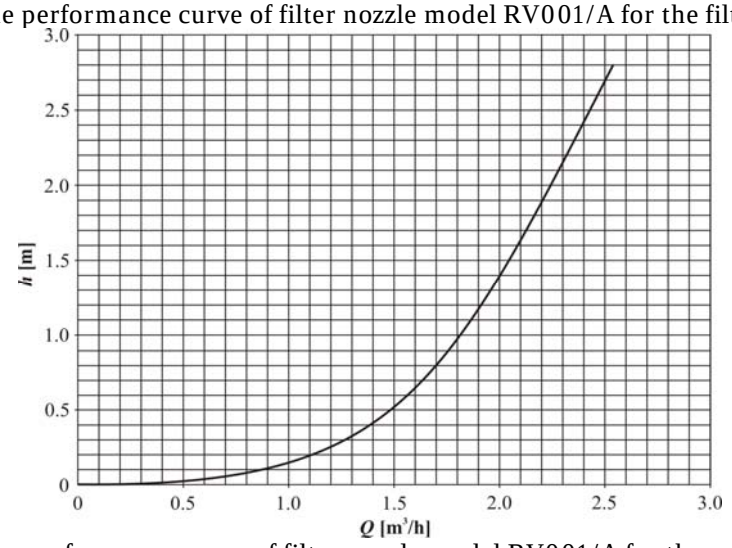

FIGURE 6. The performance curve of filter nozzle model RV001/A for the washing process

The gained performance curves for filtration and washing processes in Fig. 5 and Fig. 6 were expected. These curves thoroughly suit curves for filter nozzles with 40 narrow gaps, 0.2 mm in width at the nozzle head. In this way hypothesis of work was proved and installation with column and manometer could be successfully applied to determine filter nozzle performance curve. In comparison with the reservoir, the installation with column and manometer is more compact and comfortable. The performance curve in filtration process which was determined by installation with the reservoir had up to 1.6 m water head gauge, as shown in Fig.1. It means that maximal level of water in the reservoir is 1.6 m. The performance curve in filtration process which was determined by installation with column and manometer had up to 3 m water head gauge, as shown in Fig. 5. For the same water head gauge, the level of the water in the reservoir should be 3 m. On the other hand the height of column was only 0.5 meter.

4. CONCLUSIONS

The same model of filter nozzles was tested with the help of the installation with reservoir and the installation with column and manometer, respectively. Very good agreement between these two performance curves was obtained. Authors are of the opinion that column could be successfully applied to determine filter nozzle performance curve. In comparison with the reservoir, the installation with column and manometer is more compact and comfortable.

Acknowledgement
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ENERGY AND METAL SAVING IN THE HEATING FOURNACES MEANS A CLEANER ENVIRONMENT

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ABSTRACT:
As a major consumer of energy the steel producers are always mentioned as interesting field of investigations. The aim of this paper is to establish the basic relations for a model in order to help to evaluate the parameters of the heat transfer and energy consumption in the case of some metallurgical heating furnaces for billets reheating. Starting from considerations about the burning process of the fuels, the paper establishes connections between the heat exchange coefficients, energy and metallic material saving. Saving energy and lost metal due to the oxidation process, means to have a cleaner environment. A new disposing system of the burners inside the furnace can lead to saving energy and metal. The paper offer also a model to calculate the temperature in the furnace (temperature of the flue gases) taking in consideration the global heat exchange, the technological temperature of the billet in order to evaluate the thermal energy looses.

KEYWORDS:
oxidation, heating, energy, furnace, thermal regime, clean environment

1. INTRODUCTION

1.1 Oxidation and heating process

In the case of the heating process in furnaces using the combustion in view of rolling of the cast billets, the source of energy can be analyzed from tow points of view:

a) as component which can reduce the material looses due to the oxidation process

b) as component which assure the technological conditions for the heating process

In order to analyze the source of energy as component influencing the steel oxidation process one can use the partial pressures (p) of $H_2O_{(gas)}$, H_2 CO_2 and CO in the flue gases. So, it is obtained the K_a coefficient:

$$K_a = \frac{p_{H_2O} / p_{H_2}}{p_{CO_2} / p_{CO}} = \frac{K_H}{K_C} \quad (1)$$

In the figure 1 there are presented the influence of type of the fuel, the furnace temperature and the air coefficient φ, on the quantity of the oxides.

In order to analyse how to influence the heat exchange and to assure the thermal technological conditions, one start from the equation of heat exchange between the flue gaze, the furnace thermal isolation and the metallic material. It is necessary to considerate that the heat exchange is simultaneously by radiation and convection. So, the thermal energy, Q_{gp}, received by the furnace isolation from the flue gases is:

$$Q_{gp} = S \cdot \alpha_{gp} \cdot \varepsilon_p \cdot (\theta_g - \theta_p) + S \cdot \alpha_c \cdot (\theta_g - \theta_p) \quad \text{[kJ/h]} \quad (2)$$

S : internal surface of the thermal isolation, m^2

θ_g: temperature of the flue gases, ^oC

θ_p: temperature of the thermal isolation, inside the furnace, ^oC

α_{gp}: radiation heat exchange coefficient between the gases and the thermal isolation, $kJ \cdot m^{-2} \cdot h^{-1} \cdot K^{-1}$

α_c : convection heat exchange coefficient between the gases and the thermal isolation, $kJ \cdot m^{-2} \cdot h^{-1} \cdot K^{-1}$

ε_p: emission coefficient of the thermal isolation

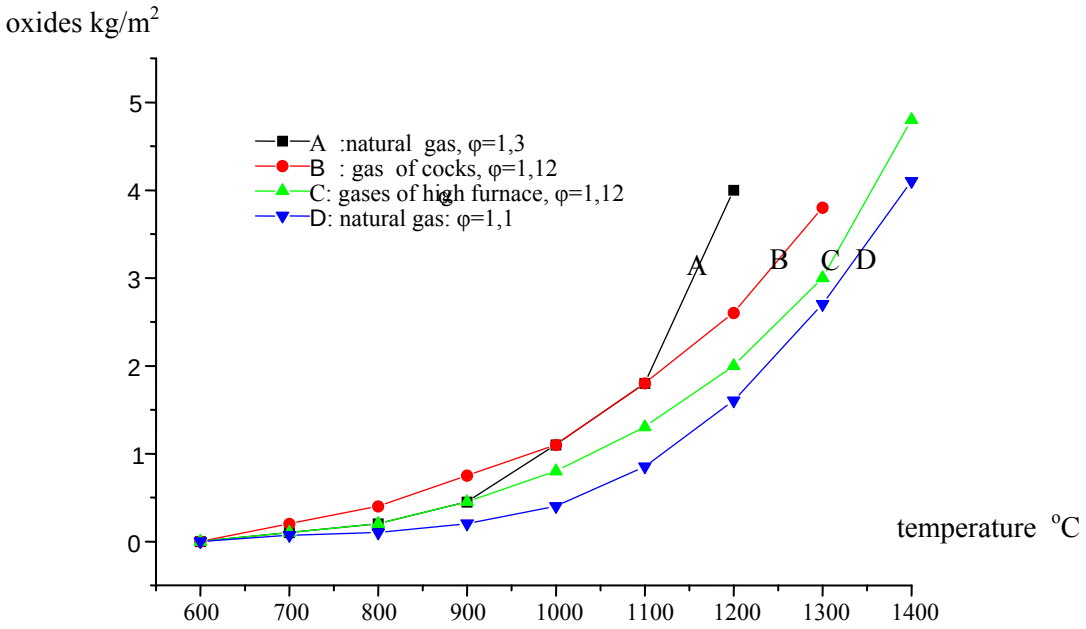

Figure 1 : Dependence of the quantity of the iron oxides, during the heating process of the non alloyed steels on the fuel, temperature and air excess coefficient, φ

In the same time:

$$Q_{gp} = Q_{pm} + S \cdot q_{ex} \qquad [kJ/h] \tag{3}$$

Q_{pm} : thermal energy from the isolation of the furnace to the heated billets, $kJ \cdot h^{-1}$

q_{ex} : thermal flow thru the furnace's isolation , $kJ \cdot m^{-2} \cdot h^{-1}$

The computation of the heat exchange by radiation between the thermal isolation components can be calculated using the angular coefficient of radiation, [1].

In the case of heating pushing type furnaces and walking type furnaces, [1; 2], it was obtained (4), (figure 2):

$$\beta = \frac{1}{\pi}\left[\frac{1}{B \cdot L} \cdot \ln \frac{(1+B^2)(1+L^2)}{1+B^2+L^2} - \frac{2}{B} arctg(L) - \frac{2}{L} arctg(B) + \frac{2}{L}\sqrt{1+L^2}\, arctg \frac{B}{\sqrt{1+L^2}} + \frac{2}{B}\sqrt{1+B^2}\, \mathrm{arctg} \frac{L}{\sqrt{1+B^2}}\right] \tag{4}$$

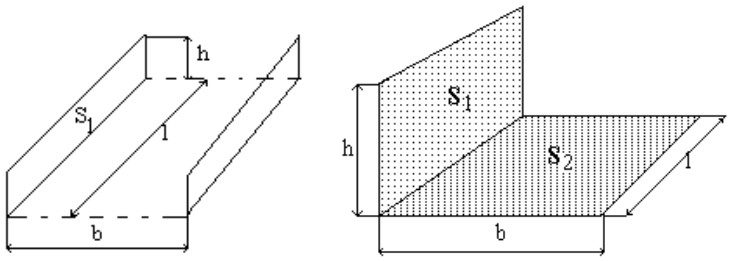

Figure 2: dimensions referring to the continuous furnaces in order to establish the coefficient φ [B=h/b ; L=l/b]

In the case of heat exchange between the thermal isolation (figure 3) and the billets, the coefficient β is [2]:

$$\beta = \frac{1}{2\pi}\left(\frac{B}{\sqrt{1+B^2}} \cdot \arcsin \frac{L}{\sqrt{1+B^2+L^2}} + \frac{L}{\sqrt{1+L}} \cdot \arcsin \frac{B}{\sqrt{1+B^2+L^2}}\right) \tag{5}$$

1.2 Energy source and material losses during the heating process

Starting from the equation (1) it can be observed that it is necessary to calculate the quantity of oxygen, resulted from the fuel and from the combustion air:

$$O_x = O_{2c} + 0{,}21 \cdot v_{oa} \cdot \lambda = CO_2 + 0{,}5CO + 0{,}5H_2O$$

v_{oa} : specific air volume, necessary for the reaction with 1m³ of fuel, $m^3_{N(air)} \cdot m^{-3}_{N(fuel)}$

λ : coefficient of air excess

CO_2: in flue gazes

It is obtained:

$$H_2O = 2O_x - C\,\frac{0,5 + K_c}{1 + K_c}$$

where $C = CO + CO_2$

Analysing the oxidation phenomena of the steel in the case of the must usual fuel (the natural gas), it can be deduced that the oxidation process is very fast for the temperatures up to 800°C. In order to reduce the oxidation process, the theoretic burning temperature must be under 1360°C. If the heating temperature of the steel in view of rolling must be 1200...1250°C, this case is not economic from energetic point of view.

The calculation of the temperature of the source of energy starting only from the equation (1) is valid if the oxygen content of the air combustion and of the fuel together can assure the transformation in CO of the carbon resulted from the dissociation of the carbides. If the air excess coefficient is to small to assure this transformation, the flue gases will include particles of black pigment.

Due to the law values of the equilibrium constant $K=(p_{CO_2}/p^2_{CO})= 10^{-2}\div10^{-4}$, for the Bell-Boudoir reaction ($CO_2+C \Leftrightarrow 2CO$), the presence of the black particles in the flue gazes is of low importance in the case when the coefficient of air excess is over the normal values resulted from the chemical reactions.

2. METHODOLOGY

2.1 The heating furnace temperature and steel oxidation

The theoretical output η_t, indicate the efficiency of the use of the energetic sources (the fuel).

If in the furnace is introduced a quantity of thermal energy, resulted from the fuel combustion:

$$Q^t_{cb} = Q_{cb}\cdot\eta_t + v_{ga}\cdot\theta_{ga}\cdot c_p \qquad (6)$$

v_{ga} : the volume of the flue gases related to a thermal unit of the fuel (for example to 1000kJ), [$Nm^3/10^3Kj$]

θ_{ga}: temperature of the flue gases at the exit from the furnace, °C

c_p : thermal capacity of the flue gases, $kJ\cdot m^{-3}_N\cdot K^{-1}$

If Q_{cb}, is a unit of the fuel, it can be written:

$$v_{ga}\cdot\theta_{ga}\cdot c_p = v_{ot}\cdot\theta_{ga}\cdot c_p + (\varphi_a - 1)\cdot v_{oa}\cdot\theta_{ga}\cdot c_a \qquad (7)$$

v_{ot}: theoretical volume of the flue gases related to the thermal unit of the fuel, [$Nm^3/10^3kJ$]

v_{oa}: theoretical volume of air combustion related to the thermal unit of the fuel, [$m^3_N/10^3$ kJ]

c_a : air combustion thermal capacity, $kJ\cdot m^{-3}_N\cdot K^{-1}$

If the fuel and the air combustion are heated and the real air combustion volume is $\varphi_a\cdot v_{oa}$, it results:

$$\eta_t = 1+\varphi_a\cdot v_{oa}\cdot\frac{\theta_a\cdot c_a}{Q_{cb}} + \frac{\theta_{cb}\cdot c_{cb}}{H_i} - \frac{v_{ot}\cdot\theta_{ga}\cdot c_p}{Q_{cb}} - (\varphi_a - 1)\cdot v_{oa}\cdot\frac{\theta_{ga}\cdot c_a}{Q_{cb}} \qquad (8)$$

The equation (8) establishes a correlation between the theoretical output, the nature of the fuel and the air excess coefficient [by the factor $(\varphi_a - 1)\cdot v_{oa}\cdot\frac{\theta_{ga}\cdot c_a}{Q_{cb}}$].

Else, the oxidation process of the metal can be controlled by the air excess coefficient.

If it is defined "the factor of the fuel":

$$K_{cb} = 1 + \frac{\theta_{cb}\cdot c_{cb}}{H_i} \qquad (9)$$

it is obtained:

$$\eta_t = K_{cb} + \frac{1}{Q_{cb}}\left(\lambda_a\cdot v_{oa}\cdot\theta_a\cdot c_a - v_{ot}\cdot\theta_{ga}\cdot c_p - (\varphi_a - 1)\cdot v_{oa}\cdot\theta_{ga}\cdot c_a\right) \qquad (10)$$

The equations (8) and (10) can be used to choose the thermal source (gas fuel) in correlation with the preheating degree of the fuel and the air combustion and with the coefficient of air combustion excess which control the oxidation process in the heating furnace.

2.2 Heat exchange coefficients and the thermal process in the heating furnace

If all the thermal energy radiated by the isolation, Q_{pm}, is receipted by the heated metal, it is possible to write:

$$Q_{pm} = \alpha_{pm}\cdot\varepsilon_{pm}\cdot s\cdot(\theta_p - \theta_m) \qquad (11)$$

θ_m: temperature of the metal, °C

α_{pm}: heat exchange coefficient by radiation between the thermal isolation and the metal, kJ·m^{-2}·h^{-1}·K^{-1}

s : heated surface of the metallic material (billets), (reception surface, S_2, in fig. 3), m^2

But, a part of this radiation is absorbed by the flue gases. The absorption process depends on the partial pressure of CO_2 and H_2O. The absorbed thermal energy by radiation, Q_{abs}, is equal with the quantity of energy which the metal could receive from the flue gases if the temperature of the gases is equal with the temperature of the thermal isolation:

$$Q_{abs} = \alpha_{gpm} \cdot \varepsilon_p \cdot s \cdot (\theta_p - \theta_m) \tag{12}$$

α_{gpm} : heat exchange coefficient from the gases to the metallic material, if it is considerate that the temperature of the gases is the same with the temperature of the thermal isolation, kJ·m^{-2}·h^{-1}·K^{-1}

So, the real value of Q_{pm} is:

$$Q_{pm} = s(\alpha_{pm} \cdot \varepsilon_{pm} - \alpha_{gpm} \cdot \varepsilon_p) \cdot (\theta_p - \theta_m) \tag{13}$$

Replacing, it is obtained:

$$S \cdot (\alpha_{gp} \cdot \varepsilon_p + \alpha_c) \cdot (\theta_g - \theta_p) = s \cdot (\alpha_{pm} \cdot \varepsilon_{pm} - \alpha_{gpm} \cdot \varepsilon_p) \cdot (\theta_p - \theta_m) + S \cdot q_{ex} \tag{14}$$

If $\sigma = {}^{s}/_{S}$, equation (14) will be:

$$\begin{aligned} \theta_g \cdot (\alpha_{gp} \cdot \varepsilon_p + \alpha_c) = \theta_p \cdot (\alpha_{gp} \cdot \varepsilon_p + \alpha_c + \sigma \cdot \alpha_{pm} \cdot \varepsilon_{pm} - \sigma \cdot \alpha_{gpm} \cdot \varepsilon_p) - \\ - \theta_m \cdot \sigma (\alpha_{pm} \cdot \varepsilon_{pm} - \alpha_{gpm} \cdot \varepsilon_p) + q_{ex} \end{aligned} \tag{15}$$

Equation (15) correlates the temperature of the flue gases, temperature of the thermal isolation and the temperature of the billets (θ_m). But, the establishing of the values of the heat exchange coefficients is yet difficult.

The thermal flow sanded to the metallic material (billets) includes:

- radiation thermal flow from the thermal isolation

$$q_{pm} = (\alpha_{pm} \cdot \varepsilon_{pm} - \alpha_{gp} \cdot \varepsilon_p)(\theta_p - \theta_m) \quad [\text{kJ·m}^{-2}\text{·h}^{-1}] \tag{16}$$

- radiation and convection thermal flow from the flue gases

$$q_{gm} = (\alpha_{gm} \cdot \varepsilon_m + \alpha_c)(\theta_g - \theta_m) \tag{17}$$

The total thermal flow received by the billets is:

$$q = q_{pm} + q_{gm} \tag{18}$$

Starting from the equation (15), it is noted:

$$(\theta_p - \theta_m) + (\theta_g - \theta_p) = (\theta_g - \theta_m) \tag{19}$$

Then, the coefficient of the global heat exchange can be calculated:

$$\begin{aligned} (\alpha_{gp} \cdot \varepsilon_p + \alpha_c) \cdot [(\theta_g - \theta_m) - (\theta_p - \theta_m)] = \sigma(\alpha_{pm} \cdot \varepsilon_{pm} - \alpha_{gpm} \cdot \varepsilon_p)(\theta_p - \theta_m) + q_{ex} \\ (\theta_p - \theta_m) \cdot [\sigma(\alpha_{pm} \cdot \varepsilon_{pm} - \alpha_{gpm} \cdot \varepsilon_p) + (\alpha_{gp} \cdot \varepsilon_p + \alpha_c)] + q_{ex} = (\theta_g - \theta_m)(\alpha_{gp} \cdot \varepsilon_p + \alpha_c) \end{aligned} \tag{20}$$

Replacing the expressions of the thermal flows, it is obtained:

$$q = (\alpha_{pm} \cdot \varepsilon_m - \alpha_{gm} \cdot \varepsilon_p) \cdot (\theta_p - \theta_m) + (\alpha_{gm} \cdot \varepsilon_m + \alpha_c) \cdot (\theta_g - \theta_m) \tag{21}$$

Eliminating (θ_p-θ_m) and (θ_g-θ_m) from the last two expressions, there are obtained the following expressions regarding the complex heat exchange in the analysed furnace:

1. The heat exchange coefficient between the thermal isolation and the billets:

$$\alpha_1 = \frac{\alpha_{gm} \cdot \varepsilon_m + \alpha_c}{\alpha_{gp} \cdot \varepsilon_p + \alpha_c} \cdot \left(\alpha_{gp} \cdot \varepsilon_p + \alpha_c + \sigma \cdot \alpha_{pm} \cdot \varepsilon_{pm} - \sigma \cdot \alpha_{gm} \cdot \varepsilon_p + \frac{q_{ex}}{\theta_p - \theta_m} \right) \quad [\text{kJ·m}^{-2}\text{·h}^{-1}\text{·K}^{-1}] \tag{22}$$

2. The heat exchange coefficient between the flue gases and the billets:

$$\alpha_2 = \frac{\alpha_{pm} \cdot \varepsilon_{pm} - \alpha_{gpm} \cdot \varepsilon_p}{\alpha_{gp} \cdot \varepsilon_p + \alpha_c + \sigma \cdot (\alpha_{pm} \cdot \varepsilon_{pm} - \alpha_{gpm} \cdot \varepsilon_p)} \cdot \left(\alpha_{gp} \cdot \varepsilon_p + \alpha_c - \frac{q_{ex}}{\theta_g - \theta_m} \right) + \alpha_{gm} \cdot \varepsilon_m + \alpha_c \quad [\text{kJ·m}^{-2}\text{·h}^{-1}\text{·K}^{-1}] \tag{23}$$

3. RESULTS, DISCUSSIONS, ANALYZIS

A general solution to modeling the thermal regime

Using the ratio $\sigma = {}^{s}/_{S}$, it can be deduced the temperature of the flue gases:

$$\theta_g = \theta_p \frac{\alpha_{gp} \cdot \varepsilon_p + \alpha_c + \sigma \cdot \alpha_{pm} \cdot \varepsilon_{pm} - \sigma \cdot \alpha_{gpm} \cdot \varepsilon_p}{\alpha_{gp} \cdot \varepsilon_p + \alpha_c} - \theta_m \cdot \sigma \cdot \frac{\alpha_{pm} \cdot \varepsilon_{pm} - \alpha_{gpm} \cdot \varepsilon_p}{\alpha_{gp} \cdot \varepsilon_p + \alpha_c} + \frac{q_{ex}}{\alpha_{gp} \cdot \varepsilon_p + \alpha_c} \tag{24}$$

In the case when heating the billets in view of rolling there are used, in the most of the cases, natural gas, high furnace gas and cocks gas (fig.1). In this case the values of the emissive coefficients are:

$$\varepsilon_p = 0,77\ldots0,8 \qquad \varepsilon_m = 0,8\ldots0,88 \qquad \varepsilon_{pm} = \frac{1}{\frac{1}{\varepsilon_m} + \sigma\left(\frac{1}{\varepsilon_p} - 1\right)} = 0,8\ldots0,81 \tag{25}$$

In these conditions it is obtained in (23):

$$\alpha_p = \frac{0,8 \cdot \left[\alpha_{gp} + \alpha_c + \sigma\left(\alpha_{pm} - \alpha_{gpm}\right)\right]}{0,8 \cdot \alpha_{gp} + \alpha_c} \quad [kJ \cdot m^{-2} \cdot h^{-1} \cdot K^{-1}] \tag{26}$$

$$\alpha_m = \sigma \frac{0,8\left(\alpha_{pm} - \alpha_{gpm}\right)}{0,8 \cdot \alpha_{gp} + \alpha_c} \quad [kJ \cdot m^{-2} \cdot h^{-1} \cdot K^{-1}] \tag{27}$$

So, the temperature of the flue gases will be:

$$\theta_g = \alpha_p \cdot \theta_p + \alpha_m \cdot \theta_m + \frac{q_{ex}}{0,8 \cdot \alpha_{gp} + \alpha_c} \quad [^oC] \tag{28}$$

where the conduction thermal flow is:

$$q_{ex} = \frac{\theta_p - \theta_{pex}}{\sum_{i=1}^{n} \frac{\delta_i}{\lambda_i}} \quad [kJ \cdot m^{-2} \cdot h^{-1}] \tag{29}$$

θ_{pex}: temperature of the outside of the thermal isolation layer, ^oC

Using practical data from [3], [4], [5], [6], for the steels, thermal isolation materials and chemical composition of the flue gases, there where established the values for the coefficients α_{gp}, α_{pm}, α_{gpm} (figures 4 and 5).

In the equation (25) the temperature of the billets is considerate as "known data" from the technological conditions. So, it is necessary to establish the values for θ_p.

In order to follow, it is necessary to use the equations (20) and (23). For the beginning it is considerate that $\theta_g = \theta_p$, in order to establish the necessary data for the equation (23) (fig. 4 and 5).

The exact value of the temperature of the thermal isolation (inside the furnace) will be:

$$\theta_p = \theta_m - \frac{q_{ex}}{\sigma \cdot \left(\alpha_{pm} \cdot \varepsilon_{pm} - \alpha_{gpm} \cdot \varepsilon_p\right)} \quad [^oC] \tag{30}$$

Equation (30) can be in correlation with the particularities of a kind of furnace. For example, in the case of a rotary type furnace for circular billets it can be established the dependence of the flue gases at the exit from the furnace (θ_g), furnace's productivity (P) and the disposal mode of the burners [7]. It can be deduced using the equation (28):

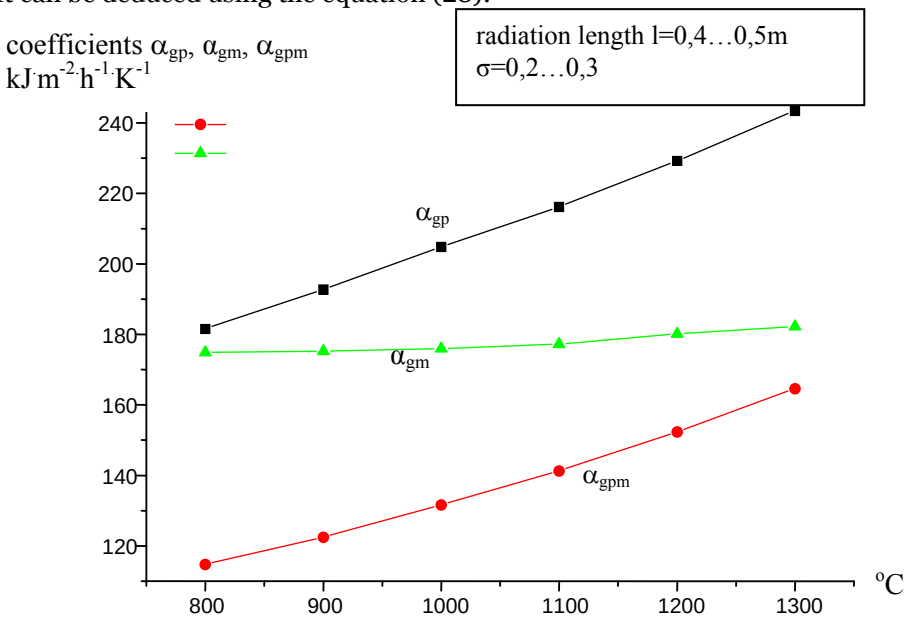

Figure 4: Variation of the coefficients α_{gp}, α_{gm} *and* α_{gpm} depending on the temperature of the furnace, thermal radiation's length and the ratio σ

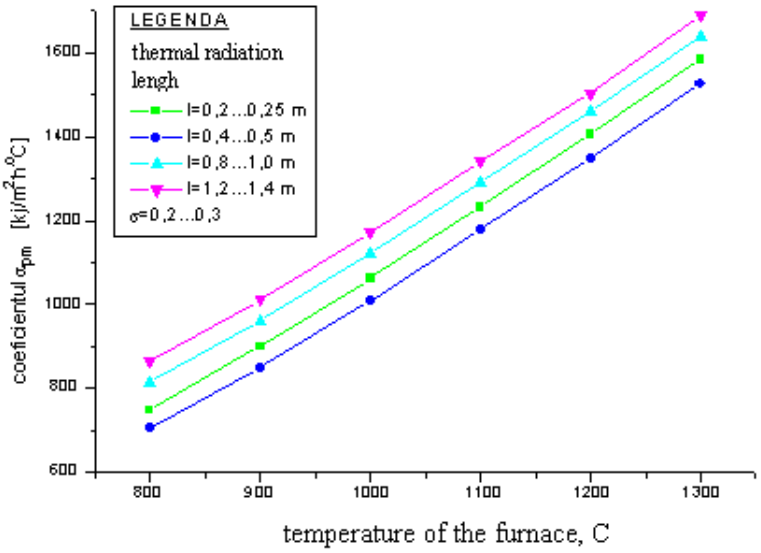

Figure 5: Variation of the coefficient α_{pm} depending on the temperature of the furnace, thermal radiation's length and the ratio σ

$$\theta_g = \alpha_p \cdot \theta_p + \alpha_m \cdot \theta_m + \frac{Q_p}{0{,}8 \cdot \alpha_{gp} + \alpha_c} = \frac{A}{y} - B \cdot y + C \quad [^oC] \tag{31}$$

where: Q_p: total looses due to the heat conduction in the furnace's isolation

$$A = \frac{Q_p}{\pi(D+d) \cdot V_g \cdot c_p} \qquad B = \frac{4 \cdot P \cdot c_m \cdot (\theta_2 - \theta_1)}{\pi \cdot K \cdot b \cdot (D+d)} \tag{32}$$

D, d: dimensions of the circular furnace, m
θ_1, θ_2: final and initial temperature of the billets, °C
V_g: flue gases debit, $m^3 \cdot h^{-1}$
K: coefficient of the furnace, depending on the design, dimensions, output and working temperature [7]

4. CONCLUSIONS

- ◊ The quantity of the metallic material lost by oxidation during the reheating of the billets depends on the chemistry of the atmosphere in the heating furnace, on the temperature and on the duration of the thermal process.
- ◊ During the reheating process, the soaking duration of the billets at the high temperature must have a minimum value. This is recommended from the points of view of oxidation a decarburising process and for energy saving too. In practice, in most of the cases, the soaking duration of the billets is too long and the temperature is too high. It is necessary to impose that the plastic deformation temperature (the rolling beginning temperature) are reached by the billets moment of the defournement or just a few minutes before. On the other hand, the deformation temperature must be minimum admitted for the category of steel.
- ◊ To reduce the oxidation and decarburising process an important action regards the control of chemical composition of the flue gases. This is possible by the control of the air combustion excess coefficient and the designee of the heating furnace.
- ◊ Using the proposed general solutions for the remodelling of the thermal regime it can be obtained a better control of the temperatures in each heating zone of the furnace and to correlate it with the necessary temperatures of the billets. It is also possible to control the temperature of the thermal isolation, and by this to save thermal energy.
- ◊ Using the above established equations it is possible to control the flue gases temperature in each heating zone of the furnace in correlation with the temperature of the metallic material. It is possible also to control the temperature of the thermal isolation and by this to save important quantities of thermal energy.
- ◊ The coefficients α_p, α_m, α_{gpm} are at the basis of the control process of heat exchange between the flue gases, metallic material and the thermal isolation. The values of this coefficients are established in the present work

◊ The basics of the general solution to modeling the thermal regime allowed establishing the disposal mode of the burners in connection with the design of the furnace and the necessary output. The design of the furnace can be also changed having in view the thermal and the dynamic particularities of the flow gases.

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PROMOTION OF PASSENGER RAIL TRANSPORT AS A FRIENDLY SOLUTION TO ENVIRONMENT

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ABSTRACT:
The paper presents the objectives of the ECORailS project (Energy Efficiency and Environmental Criteria in the Awarding of Regional Rail Transport Vehicles and Services co-financed by IEE – Intelligent Energy Europe program.
The regional passenger rail transport presents advantages from the energetic efficiency point of view and its impact of performance on the environment. However, rail transport has not yet given the full measure of its potential. Under the conditions of growing energy prices and increasing environmental problems, this potential must be exploited.
The ECORailS project relates to improving energy efficiency and reduces environmental impact of rail transport. The target groups are Public Transport Administrations (PTA) currently playing a key role in terms of improving the quality of rail travel and the impact of this performance. Auctions, other types of procurement procedures and Public Service Contracts (PSC) are appropriate tools for optimizing energy and environmental performance of rail services.
ECORailS will provide a Guide so that PTAs include successfully criteria related to the environment in their procurement procedures. The aim of the ECORailS project is to reduce the energy specific consumption of the regional passenger rail transport with 15 % till 2020.
A first version of the Guide ECORailS will be tested in four-point test in Europe: Copenhaga /Oresund (Danemarca), Berlin-Brandenburg (Germania), Timişoara (Romania) and Lombardia (Italia), PTAs in these regions are partners within the project. Experiences resulted after applying tests will be included in the final version in order to provide its utility in the current practice both for diesel functioning and the electric one. The duration of the project: May 2009 – June 2011.
KEYWORDS:
ECORailS project, regional passenger rail transport