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Volume III

University of Agronomic Sciences
and Veterinary Medicine of Bucharest
Faculty of Land Reclamation
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COPPER REMOVAL: KINETIC AND THERMODYNAMIC STUDY

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Abstract

The capacity of one material synthesized from ash to remove Cu^{2+} from aqueous solutions was evaluated. Adsorption kinetics measurements were performed at 298, 308 and 323 K and thermodynamic parameter was calculated. The adsorption process was found to be feasible and spontaneous due to negative value of Gibbs free energy (−6.91 kJ mol^{-1} at 25 °C). Kinetic studies have been carried out to evaluate Cu^{2+} adsorption using a number of three parametric equations: the pseudo first order, pseudo second order and intra-particle diffusion model equations. Results obtained showed that for all the studied temperatures the adsorption process follows a pseudo second order kinetic model, which demonstrates that the chemical adsorption process is predominantly.

***Key words*:** adsorption, copper ions, kinetic, low cost adsorbent, thermodynamic

INTRODUCTION

Heavy metals pollution in the aqueous system is still a worldwide concern due to their detrimental effects to human health and living ecosystem (Idris et al., 2012; Doskočil and Pekař, 2012; Javadian et al., 2013; Buema et al., 2014). Copper ion is the most commonly metal found in contaminated waters. This toxic metal ion is being introduced into natural water system from various industrial activities. The only health-based guideline value for copper proposed by the World Health Organization is 2 mg Cu L^{-1}. The common treatment processes for wastewater treatment can be physical, chemical and biological. From these methods, adsorption proved to be the most accepted treatment method to eliminate diverse types of heavy metals from wastewaters. In present modified ashes obtained by different methods were frequently used as adsorbents for wastewater treatment. However, the specialized literature recommends the use of modified ash for removal of heavy metals due to its higher capacity uptake (Harja et al., 2012; Harja et al., 2013; Kouamo Tchakoute et al., 2013; Shoumkova and Stoyanova, 2013; Sommerville et al., 2013; Vereshchagina et al., 2013; Zhang et al., 2013).

In this study, the modified ash obtained by alkaline treatment was used as low-cost adsorbents for the removal of copper ions from aqueous solution. The ability of this material in the copper ions removing was studied by batch technique. The kinetics data were modeled using three kinetics models: pseudo-first order, pseudo-second order and intra-particle diffusion models, in order to understand the adsorption mechanism of copper ions onto considered low-cost adsorbents.

MATERIALS AND METHODS

Methods of analysis

The material used for this work was selected based on previous studies. The modified material was characterized by different techniques such as: SEM–EDS, BET surface area, FT-IR and XRD. The chemical and the mineralogical characterizations results are presented in the literature (Harja et al., 2012;

Harja et al., 2013; Curteanu et al., 2014; Buema et al., 2014).

The adsorption experiments

Adsorption study was determined using the batch equilibrium method. An original solution of Cu(II) ions was prepared by dissolving 1.9661 g of accurately weighed $CuS0_4 \cdot 5H_20$ in 1 L distilled water to give a Cu(II) ions concentration of 500 mg L^{-1}. The pH of Cu(II) solutions was adjusted to 5 with HCl. At certain time intervals, the samples were collected and filtered. The concentration of Cu(II) ions was measured by spectrophotometrically and calculated from absorbance in the visible spectrophotometer. The adsorption of Cu(II) was studied after adding 2 g of adsorbent into 200 mL of aqueous solution containing Cu(II) and shaking at 300 rpm for 2 hours at 298, 308 and 323K.
The adsorption uptake was calculated by following relation:

$$q = \frac{(C_0 - C)}{m_s} V$$

where q is the uptake (mg g^{-1}), C_0 and C are the liquid phase concentration of copper at initial and equilibrium (mg L^{-1}), V is the volume (L) and m_s is the amount of adsorbent (g).

RESULTS AND DISCUSSIONS

Effect of temperature on the adsorption

Fig. 1 shows the effect of temperature on the adsorption of Cu(II).

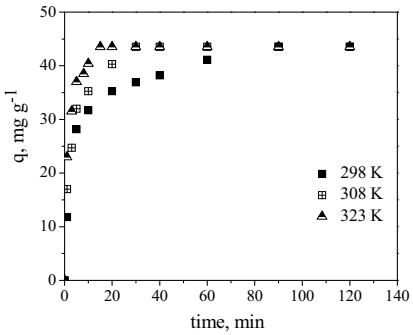

Figure 1. Effect of temperature on adsorption

The equilibrium adsorption capacity of Cu(II) is 43.53 mg g^{-1} at 298, 308 and 323 K, respectively, obtained after 90, 30 and 15 minutes, indicating that the adsorption of Cu(II) on adsorbent is endothermic (Sheng et al., 2010; Hashemian and Mirshamsi, 2012).

Adsorption kinetics analysis

In table 1 are presented the kinetic parameters obtained from the graphs by plotting $log(q_e - q)$ against t, t/q against t, q against $t^{1/2}$, respectively.

Table 1. Kinetic parameters

T,K	Pseudo first model	Pseudo second model	Intra-particle diffusion
298	$R^2 = 0.889$	$R^2 = 0.997$ $q_e = 43.53$ $k_2 = 0.0063$	$R^2 = 0.766$
308	$R^2 = 0.926$	$R^2 = 0.997$ $q_e = 43.53$ $k_2 = 0.0165$	$R^2 = 0.667$
323	$R^2 = 0.928$	$R^2 = 0.997$ $q_e = 43.53$ $k_2 = 0.0406$	$R^2 = 0.471$

In the case of pseudo second order model, the values of correlation coefficients, R^2, are found to be all extremely high ($R^2 = 0.997$) for all the temperatures which further indicates that the mechanism concerning adsorption of Cu(II) can be explained by pseudo-second-order reaction kinetic model (Table 1).
In the figure 2 is presented plots of the pseudo-second order kinetics.

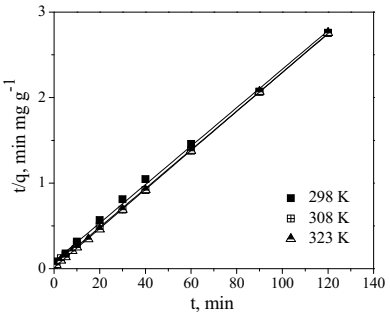

Figure 2. Plots of the pseudo-second order kinetics

Besides, increasing the temperature leads to an increase in the value of k_2 shows that the adsorption of is endothermic and increasing temperature favors the adsorption, which is the same with the result described above.

Also, it was calculated the initial adsorption rate, h, as t → 0 by:

$$h = k_2 q_{eq}^2$$

The values obtained for the adsorbent were: 11.94 mg/g min, 31.26 mg/g min and 76.93 mg/g min at 298 K, 308 K and 323 K.

Adsorption thermodynamic analysis

The Gibbs free energy (ΔG^0) and the activation energy (E_α) for Cu(II)-adsorption onto adsorbent were calculated on the basis of the experimental data.

The Gibbs free energy (ΔG^0) was calculated using the following equation:

$$\Delta G^0 = -RT\ln K$$

where R is the universal gas constant (8.314 J/ mol K), T is the temperature (K), and the K value was obtained by Langmuir equation.

The ΔG^0 values obtained was −6.91 kJ mol^{-1} at 25^{0}C.

The values of $\ln k_2$ versus 1/T are plotted and shown in Fig. 3. There is a good linear relationship with the values of slope and intercept proved by the correlation coefficient R^2 - *0.978.*

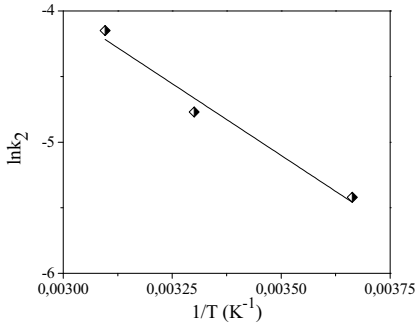

Figure 3. A plot against $\ln k_2$ to 1/T for removal of Cu(II)

The E_α value obtained was 16.62 kJ mol^{-1}. This result is well above the characteristic range for the physisorption (5-20 kJ mol^{-1}), fact that could be taken as indication of the complexity of the overall uptake process (Ho et al., 2001).

CONCLUSIONS

Adsorption kinetics measurements were performed at 298, 308 and 323 K and thermodynamic parameter was calculated.

Copper ion adsorption is dependent on temperature, with the increase of this parameter, the maximum capacity being achieved after 90, 30 and 15 minutes at 298, 308 and 323 K.

The adsorption process can be described well by pseudo-second-order kinetic model.

The adsorption process was found to be feasible and spontaneous due to negative value of Gibbs free energy (−6.91 kJ mol^{-1} at 25^{0}C).

The study of thermodynamic parameters have shown the feasibility and spontaneous adsorption process of Cu^{2+} onto the material obtained by treating ash with the solution of NaOH (solid/liquid ratio 1:5) for 4 h at 90^{0}C.

The experimental results presented in this study shown that this material can be an efficient alternative for the removal of copper ions from wastewater at different temperatures, because is available in large quantities and is simply to obtain.

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VOLATILE ORGANIC COMPOUND EMISSIONS FROM *QUERCUS* GENUS UNDER ABIOTIC STRESSES

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Abstract

Volatile organic compounds (VOC) emitted by the plants constitute a sensitive signal of stress response. Quantitative relationships between volatile emissions and the stress severity have been demonstrated only for a few stresses. Among important stresses, heat stress can particularly significantly influence all the metabolic processes of the deciduous trees. We studied the effects of heat shock treatments on leaf photosynthesis and the emission of the volatile products of lipoxygenase pathway (LOX) and mono- and sesquiterpene emissions in Quercus genus (including here Q. robur, Q. petraea, Q. cerris, and Q. rubra) to gain quantitative insight into temperature stress elicited volatile emissions. Heat stress treatments ranged from mild that only weakly affected foliage photosynthesis to severe that almost completely inhibited photosynthesis. As well it have been demonstrated that all photosynthetic parameters are less affected for the plants which emit isoprenes due to the thermo-protector role of this VOC. Under non-stressed conditions, LOX emissions were close to detection limit, and terpene emissions were low. The emission of all metabolic compounds exhibit "breaking points" which are species specific. We suggest that the quantitative relationships between the stress strength and emissions observed in this study provide an important means to characterize the severity of cold and heat stresses.

Key words*: Volatile organic compounds, abiotic stress, Quercus genus, green leaf volatiles*

INTRODUCTION

Almost all plant species are emitters of different volatile organic compounds (VOC). It is known that plants emit more than 100,000 chemical products and at least 1700 of these are known to be volatile (Kesselmeier and Staudt, 1999). Plants emissions consist of a complex blend of chemically heterogeneous volatile isoprenoids. Often more than 20 different monoterpenes are emitted by a single species (Loreto et al., 2009; Niinemets and Reichstein, 2003). Isoprenoids are very different functionally and structurally and have diverse functions in photosynthesis, respiration, membrane fluidity and as well they play an important role in alleopathic and plant-pathogen interactions (Vranova et al., 2012). The studies devoted to plants mechanism show that all isoprenoids are synthesized *via* two different pathways from one common precursor, namely isopentenyl diphosphate. The mevalonate pathway (MVA) is localized in cytoplasm and is used to synthesize cytosolic and mitochondrial isoprenoids (sesquiterpenes, sterols). The second pathway, 2-C-methyl-*D*-erythritol 4-phosphate pathway (MEP) is responsible for monoterpene and diterpene production in plastid (Edreva et al., 2007). A vast array of VOC is involved in stress-dependent signalling within a single plant as well as communication between plants and between plants and insects (see for review (Dicke et al., 2009).

Lipoxygenase (LOX) pathway products are induced in a variety of plant species during different stress conditions in a process where free octadecanoid fatty acids are released from plant membranes by phospholipases. LOX activity produces 9- or 13-hydroperoxylinoleic or -linolenic acid or a mixture of both. Then, a hydroperoxide lyase catalyzes the breakdown

of 13-hydroperoxylinole(n)ic acid to a C6-compound, (Z)-3-hexenal, and a C12-product, 12-oxo-(Z)-9-dodecenoic acid. (Z)-3-hexenal can further give rise to (Z)-3-hexenol, (E)-2-hexenol, (E)-3-hexenol or (E)-2-hexenal in consequent reactions (Feussner and Wasternack, 2002; Matsui, 2006). The emissions of the green leaf volatile or LOX were presented in many studies and they are induced by different types of stress abiotic as heat and cold (Copolovici et al., 2012), flooding (Copolovici and Niinemets, 2010), drought (Rodriguez-Calcerrada et al., 2013) and biotic (Copolovici et al., 2011).

Quercus (oaks) are the largest genus in *Fagaceae* family which include deciduous trees and shrubs at around 400 species many of them being monoterpene and/or isoprene emitters. *Quercus* genus is dominating the forests with deciduous trees in temperate zones including Romania (Popa et al., 2013).

Our hypothesis has been that VOC emission from plants can be used to quantify the stress impact on the plant. As a consequence, different *Quercus* species leaves were exposed to heat stress and the VOC emissions were measured.

MATERIALS AND METHODS

Plant material

Seedlings of *Quercus robur, Q. petrea*, *Q. cerris*, and *Q. rubra* are from local origin (Arad National Forest Department ROMSILVA) and were grown in a local greenhouse in 5 L clay pots filled with a 1:1 mixture of commercial potting soil and sand. The plants were watered daily and fertilized once per month with a fertilizer containing microelements. In all experiments, we used similar-sized 2-yr-old seedlings with 20-25 leaves. The experiment was conducted with plants having fully mature leaves

Stress application

The procedure of heat stress application (5 minutes) has been used according to Frolec et al. (2008) and Copolovici et al. (2012). The temperatures were applied in sequence 25, 35, 47, 53, 56, and 58 °C. Individual plants were used for each treatment.

Isoprene and green leaves volatile measurements

After stabilization following the stress application, the leaves subject to stress were mounted in the clipping cuvette of a commercial gas-exchange system (GFS-3000, Heinz Walz GmbH, Effeltrich, Germany). VOC sampling was performed on adsorbent cartridges via the outlets of each cuvette every day with a flow rate of 200 ml min^{-1} for 15 min by using a constant flow air sample pump (1003-SKC, SKC Inc., Houston, TX, USA). Adsorbent cartridges were analyzed for isoprene and lipoxygenase pathway products concentrations using a Shimadzu TD20 automated cartridge desorber and Shimadzu 2010Plus GC-MS instrument (Shimadzu Corporation, Kyoto, Japan) according to the GC-MS method detailed in our previous studies (Copolovici et al., 2009; Toome et al., 2010). The background (blank) VOC concentrations were subtracted from the emission samples with the seedlings.

RESULTS AND DISCUSSIONS

The emission of isoprene from *Quercus* genus plants have been shown in many other papers (Monson et al., 2013). *Quercus robur, Q. petrea*, and *Q. rubra* have been demonstrated to be isoprene emitters while *Q. cerris* is not emitting isoprene. The standard isoprene emission (at temperature 30^{o}C and 1000 nmol m^{-2} s^{-1} light) have been found at 23.54 nmol m^{-2} s^{-1} for *Q. robur*, 25.76 nmol m^{-2} s^{-1} *Q. rubra* and 26.45 nmol m^{-2} s^{-1} *Q. petrea*. The temperature dependences for isoprene emission from different *Quercus* species have been fitted using a hyperbolic function based on Guenther algorithm (Guenther et al., 1991; Guenther et al., 1993).

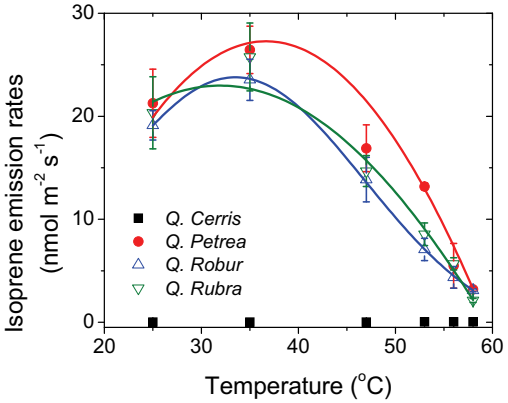

Figure 1. Changing in isoprene emission rate function on temperature for different *Quercus* species

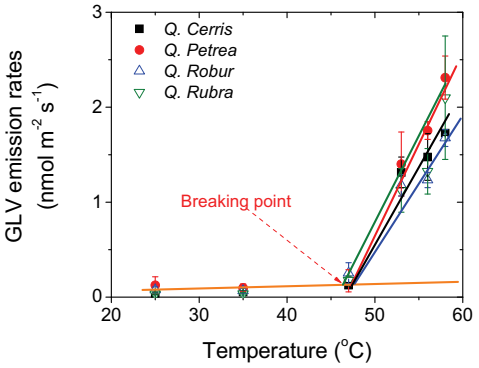

Figure 2. Changing in green leaf volatiles (GLV) emission rate function on temperature for different *Quercus* species

An Arrhenius type response was used for the isoprene emission function on temperature.
This function describes a curve with an optimum at usually 30 °C. The supraoptimal temperatures for photosynthetic processes of isoprene biosynthesis in the *Quercus* leaves could be limited by the availability of isoprenoid precursors. The same type of response have been found by Staudt and Lhoutellier (2011) for temperature dependence of monoterpene emission in *Quercus coccifera* based on metabolic investigation made by Rasulov et al. (2010).
The green leaf volatiles (GLV) have been emitted usually by plants due to different type of stress (see (Niinemets, 2010)). In case of the temperature stress, there are a burst of green leaf volatiles (GLV) in the first minutes after the stress application (Brilli et al., 2011; Copolovici et al., 2012). The GLV found in the samples were 1-hexanol, (*Z*)-3-hexenol, (*Z*)-2-hexenal, and (*Z*)-3-hexenyl acetate. In our determinations we have been shown that the emission of GLV function of temperature has breaking points which are at around 47 °C (Figure 2).
After that the GLV emission rates increased with increasing the temperature. Quantitative relationships between the GLV emission rate and stress severity have been previously shown for other abiotic stresses such as flooding ozone (Beauchamp et al., 2005), antibiotic concentrations (Opris et al., 2013) and flooding (Copolovici and Niinemets, 2010).

CONCLUSIONS

The sum of green leaf volatiles was quantitatively associated with the dose of the treatment Thus, monitoring volatile emissions is a promising tool for quantitative evaluation of abiotic stress.

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STUDY REGARDING THE USE OF SLUDGE AND EFLUENT FROM WASTE WATER PLANTS IN AGRICULTURE

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Abstract

In this paper was studied the possibility of use the sludge from wastewater treatment plant in agriculture. Under current legislation the sludge from treatment plants of Prahova county is divided into: sludge washing separator sludge from oil / water, sewage interception, sludge or emulsion desalination residues from stations of wastewater and drinking water treatment, refusals to grills / screens wastewater treatment plants, waste from desanding mixtures of fats and oils from separating fat from wastewater, sludge from industrial wastewater, sludge from municipal wastewater treatment solutions, sludge from regeneration of ion exchangers. In this study were determinate quality characteristics from the effluent and sludge: pH, BOD – total biological oxygen demand), BOD5, COD - chemical oxygen demand, SS - suspended solids. N - nitrogen, (TNK), P – phosphorus, specific resistance to filtration. This results show a possibility to use the sludge and effluent from wastewater treatment plant in agriculture according with national legislation. Testing time was about 12 weeks. It was calculated the risk factor of the process and has been studied the possibility of reducing the risk through appropriate measures.

Key words*: sludge, effluent, quality, agriculture.*

INTRODUCTION

The use of sludge and wastewater in agriculture represents a permanent preoccupation because of the increasing need of water, nutrients and because of the environment protection norms imposed by the use of water and sludge (Management Plan, 2012). Sludge application on the soil needs protection of the soil according to the European legislation.

The directive 86/278/CCE establishes the framework of use in agriculture of the sludge from the wastewater treatment stations (Harris at al., 2005, Panaitescu at al. 2008) and this directive was transposed in Romania in the ministry order nr. 344/2004.

The application of the national legislation according to the European legislation prevents the appearance of harmful effects for the soil, encouraging the correct use of sludge in agriculture, establishing compulsory limit values for harmful components such as heavy metals (cadmium, copper, nickel, lead, zinc, mercury) in sludge and soil (table 1).

In this study have been determined the quality characteristics of the effluent from the municipal wastewater treatment stations and of the sludge corresponding to the treatment steps. The sludge has been deposited in sludge beds for their further use.

Table 1. Limit values of concentration for heavy metals in soil (mg/kg of dry matter)

Parameters	Limit values
Cadmium	20 – 40
Copper	1000 – 1750
Nickel	300 – 400
Lead	750 – 1200
Zinc	2500 – 4000
Mercury	16 – 25
Chromium	–

MATERIALS AND METHODS

The characteristics of the sludge that is to be used in agriculture have been chosen according to the applicable legislation (Directive 2000/60/EC/2000).

The pH was determined using the HANNA device, by direct measurement, the total solids

(TS) was measured with Standard Method EPA 2540B1 (table 2).

The limit values of heavy metals contained by the sludge and the methods used to determine them are presented in table 3.

Table 2. Physicochemical indicators and their methods of determination

Physico-chemical indicator	Determination method	Device
pH	Direct measurement	WTW
BOD	STAS 6560-82 and SR ISO 6060/96	VELP with BOD sensors
CCO	SR ISO 6060-96	DR 2800 spectrophotometer and Thermoreactor
SS	STAS 6953-81	DR 2800 spectrophotometer

Table 3. Limit values of the physicochemical indicators in sludge

Parameters	Analytical technique	Standard analytical methods	Limit values (mg/kg dry matter)
Cadmium	ICP-EOS	SR EN 11885-09	10
Copper	AAS	SR ISO 11047-99	500
Nickel	AAS	SR ISO 11047-99	100
Lead	AAS	SR ISO 11047-99	300
Zinc	AAS	SR ISO 11047-99	2000
Mercury	AAS with cold vapours	SR EN 1483-03	5
Chromium	AAS	SR ISO 11047-99	500
Cobalt	ICP-EOS	SR EN 11885-09	50
Arsen	ICP-EOS	SR EN 11885-09	10

Table 4. Value for water quality indicators

Value	Quality Indicator			
	SS mg/l	pH, pH units	BOD, mg/l	COD, mg/l
MAXIMUM LIMIT VALUE	60	6.5-8.5	25	125
Indicators value	58	7.0	18	118

Table 5. Value for sludge quality indicators

Indicators	Value
pH	7.0
Total suspended solids, %	3.21
Specific resistance to filtration, 10^{16} cm/g	1011

The water quality indicators and the analysis methods are presented in table 4.

The treated water samples were taken in accordance with SR ISO 5667-6:2009. The

physico-chemical indicators and the methods of determination are presented in table 3.
The sludge from the sludge beds has been injected in the soil in a testing area approved by the competent organisms. Initially, the sludge was applied instead of chemical fertilizer and for 12 weeks has been watched both the evolution of plants and the quality of the soil. The area where the sludge was applied had about 5000 m^2, the quantity of sludge applied being of about 12 tons.

RESUTS AND DISCUSSIONS

After taking samples of treated water and analysing them, their physicochemical characteristics were within the maximum limits imposed by legislation (table 4).
The effluent resulted from the wastewater treatment station has an acceptable quality for irrigations. So the water has been taken with the help of a mobile unit and transported for irrigations. For 12 weeks it has been used for the irrigation of the studied area.
The quality of the used sludge is presented in table 5.
After using the sludge and the wastewater, the carbon concentration in the soil increased to approximately 57%. The quantity of heavy metals did not overcome the maximum values. The values registered after 12 weeks were: lead-51.08%; copper-5%; zinc-1.81%; cadmium-11%; nikel-9.4%; manganese-2.1%.
The quantity of dry substance increased to the 2.4 t/ha, which shows a better value than the mature (unfertilized) soil of 1.1 t/ha.
The risk factor of the process was calculated and the possibility of reducing the risk was studied with adequate measure.
The risk factor associated and expressed in IU (importance units) was calculated as being 3 (*Panaitescu at all, 2013*).
The measures needed to reduce this risk are:
- the sanitation of the treatment sludge
- the mixing of the treatment sludge with supplements that can improve its quality, preferable within the composting process
- the usage of materials as substrates in the sludge composting process
- the avoidance of using volume agents so the soil will not be poor in organic carbon.

CONCLUSIONS

The usage of the sludge obtained from the wastewater treatment plant in agriculture can be a solution for the soil fertilization and for reducing the impact to the environment by reducing the quantity of existing sludge.
Using the injection in the soil and irrigating with the effluent from the wastewater treatment plant on an experimental area foe 12 weeks has shown an increase of the organic carbon concentration in the soil to almost 57%.
The heavy metals concentration was kept under control because the effluent and the sludge have had acceptable values of these pollutants.
The quantity of dry substance has been increased within the experiment with 2.4 t/ha, unlike of the unfertilized soil with 1.1 t/ha.
The risk factor associated with the use of sludge and of the effluent in agriculture was been calculated to be 3 IU. To keep under control the risks associated with this soil fertilization solution, there have been proposed measures for the sanitation of the sludge, adding additives, using the composting process, avoidance of the use of volume agents and the usage of substrates for the composting process.

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COMPARATIVE STUDIES ON REMEDIATION TECHNIQUES IN LABORATORY OF SOILS CONTAMINATED WITH OIL PRODUCTS

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Abstract

In developed countries, as well as in Romania, were produced numerous technical incidents that lead to changes in soil quality. An enumeration of the types of incidents may include:
- discharge of crude oil, salt water and drilling fluids in oil exploitation in the area of extraction and probes scaffold-extraction, drilling.
- contamination of the soil, subsoil and groundwater in the area of transport pipe of crude oil and fuels due to breakage of pipes for various reasons;
- traffic accidents and the railway involving specific means of transport (tanker);
- technical incidents in technological installations and tanks of oil refineries and petrochemical enterprises.
In this paper we propose a review of the particularities of soil pollution with oil products and remediation opportunities currently. Process analysis remediation of soils contaminated by oil products highlights the advantages and disadvantages of each method.

Key words*: oil products, contaminated soil, depollution..*

INTRODUCTION

The remediation issue of soils contaminated with liquid oil products is one of the most complex environmental activities in both the theoretical, economic, and organizational. Soil pollution and negative effects involve extending the subsoil to groundwater (Neag, 1997).
In Romania, it was only in recent years has managed the implementation of pollution control technologies based on thermal methods, thus removing and treating of petroleum products from refineries located near battle of petroleum products, soil decontaminated being played in such a circuit. There were also decontaminated applying biological methods of decontamination Biological methods of decontamination efficiency depends on numerous factors, which must be taken into account, because there is no standard process in place to ensure success in any conditions and proved that some pollutants are resistant to biodegradation under aerobic conditions, and are biodegradable under anaerobic conditions.
Choosing the right technology for the remediation of a contaminated soil with liquid petroleum products is a very important and difficult decision because of the very large number of variables and interactions which depend on the final results.
Composition and structure of the soil in correlation with physic-chemical characteristics of pollutant specific systems that form certain approaches in the choice of pollution control technologies. The coordinator of an action of a compliant ground contaminated with petroleum products must bear in mind when choosing and implementing a remediation technologies four determinants:
a. The final remediation degree desired or required;
b. Duration of the remediation actions;
c. The total cost required to conduct routine cleaning;
d. Side effects produced during the implementation of pollution control technologies and their application.
Remediation technologies of soil contaminated with petroleum products do not respond optimally while the four factors listed This leads to the necessity of ordering it priorities in the choice of pollution control technologies in the specific conditions of each case.
Choosing the most appropriate decontamination is very difficult because you

have to consider a lot of factors technical, technological and economic development
Pollutant composition together with the type of contaminated soil is a very complex system, which requires certain conditions for routine cleaning. If you take that as a determining factor in the choice of variables of decontamination time of execution of the cleaning and the cost necessary to achieve them, in the event that none of the remediation technologies available does not satisfy in full the conditions imposed. There is a concern of researchers around the world to these issues (Lemaire at all, 2013, Taok at all 2010, Baek at all 2004, Banks at all 2005, Patrascu at all 2005, Popa 2013).

MATERIALS AND METHODS

The present paper aims to compare remediation methods applied in the laboratory for soil samples from different areas of impact. Remediation methods applied are: thermal depollution by combustion method and chemical depollution by extraction method with solvents.
We selected two samples of soil contaminated with petroleum products: test 1 soil polluted by spills from rail transport and test 2 soil polluted in the near of the battle of petroleum product.
For both variants were analyzed control samples, unpolluted close of the sampling area.
Depollution by combustion method was applied in the laboratory (Figure 1).

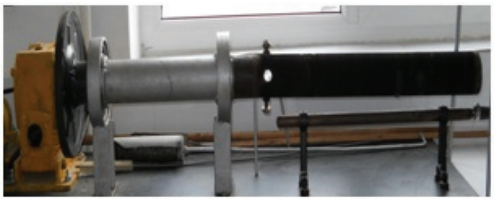

Figure 1. Installation diagram for combustion

Depollution of soils contaminated with petroleum products by combustion method consists of burning oxygen derived from air
The mixture of Ground combustion of petroleum products is performed so complete removal of pollutant organic material and soil structure. During the combustion of hydrocarbon molecules combine with the oxygen in the air, turning into carbon dioxide and water in vapour phase, both of them being disposed in the waste gas flow.
The introduction of the polluted soil in the test tube can be carried out before or after the start of heating the initial heating.
The sample is introduced inside the combustion tube, in the area corresponding to the heating with the help of a special cup which allows delivery of the sample by rotation. Burning occurs inside the tube until the complete consumption of the oil product as well as the structure of the organic portion of soil.
Mass loss produced by combustion for unpolluted soil sample P1 is calculated as:

$$P1 = [(m_1-m_2)/m_1]\cdot 100, \% \quad (1)$$

$$m_0 = m_1 - m_2, g \quad (2)$$

where,
m_1 - mass of the original sample of unpolluted soil, g;
m_2 - mass of the sample remaining after combustion of unpolluted soil, g;
m_0 – mass of sample burned (initial organic material), g.
The sample of soil contaminated by petroleum products is also subjected to the combustion process.

$$P2 = [(m_3-m_4)/m_3]\cdot 100, \% \quad (3)$$

$$m = m_3 - m_4, g \quad (4)$$

where,
m_3 - initial sample mass polluted soil, g;
m_4 - mass remaining after combustion of polluted soil sample, g;
m - burned sample mass (initial organic material + oil products), g.
Considering that by the method of combustion, burning oil product entirely, we can determine the concentration of oil in the sample analyzed.

$$c_0 = P2 - P1, \% \quad (5)$$

Remediation by extraction method was performed in Soxhlet extraction apparatus (Figure 2).

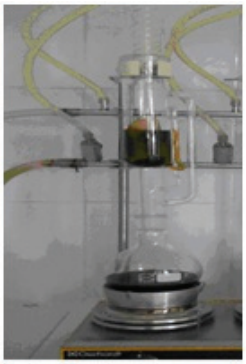

Figure 2. Installation diagram for extraction method

It was applied to successive solvent extraction method using petroleum ether and benzene.
To achieve the degree of depollution with successive extractions method will apply the following relation:

$$GD = \frac{m_5 - m_6}{m_7} \cdot 100, \% \quad (6)$$

where:
m_5 - polluted sample mass after extraction, g
m_6 - unpolluted sample mass after extraction, g
m_7 - mass of the sample subjected to extraction, g.

RESULTS AND DISCUSSIONS

Table 1. Results for unpolluted soil samples

Sample analyzed	m_1, g	m_2 , g	m_0, g	P1 %
Unpolluted soil for Test 1	100	98.2	1.8	1.8
Unpolluted soil for Test 2	100	98	2.0	2.0

Table 2. Results for polluted soil samples

Sample analyzed	m_3, g	m_4, g	P2, %	P1, %	m, g	c_o, %
Polluted soil Test 1	100	95.2	4.8	1.8	4.8	3
Polluted soil Test 2	100	35	65	2.0	65	63

Table 3. Results for unpolluted soil samples subjected to extraction

Sample analyzed	m_7, g	Quantity pollutant extracted with, g		m_6, g
		Petroleum ether	Benzene	
Unpolluted soil for Test 1	13.3	0.001	0.019	0.02
Unpolluted soil for Test 2	14.5	0.001	0.015	0.016

Table 4. Results for polluted soil samples subjected to extraction

Sample analyzed	m_7, g	Quantity pollutant extracted with, g		m_5, g
		Eter de petrol	Benzene	
Polluted soil Test 1	13.3	0.3	0.85	1.15
Polluted soil Test 2	14.5	5.4	1.8	7.2

Remediation of polluted soils with petroleum liquid products is generally for agricultural use playing surfaces affected. By disappearance of the organic part where remediation by combustion is applied reduces total germination potential of soil.
Ecological reconstruction of such land has to firstly restore its germination potential by the appearance of organic parts in composition, optimal in terms of quantity and quality.
Among numerous methods of soil organic reconstruction decontaminated by thermal methods to accomplish the simplest of technical and cheapest in economically de-polluted soil is mixed with unpolluted soil, usually the same or higher quality in terms of agro.

CONCLUSIONS

Technologies for remediation of soils polluted with petroleum-based liquid thermal methods are less applicable in Romania, although in other countries have taken a competitive position on the market for remediation.
Decontamination procedures subjecting samples contaminated with petroleum liquids whose composition is not known it can be concluded that it is easily combusted contaminated soil. This method involves burning completely to the pollutant.
Applying successive extraction is observed that is difficult to remove the entire amount of oil. Degree of depollution obtained for Test 1 was 8.5 % and for Test 2 was 49.5 %. There are various filling

solvent. In this regard were initiated studies on the use of a third solvent, a mixture of benzene and methyl alcohol.

Unfortunately, these substances are unfriendly to the environment and the economically costly. Combustion method has the following disadvantages:

-Investing achieve the necessary equipment is relatively high, even if its depreciation can be done very quickly;

-Application of thermal remediation technologies of soil contaminated with petroleum products requires fuel consumption leading to an increase in operating expenses;

- Decontamination of fixed or mobile installations can be equipped with heat recovery, making to increase the value of the investment and operating costs, even if the recovered energy can be harnessed.

After mixing unpolluted soil with thermal de-polluted soil, germination potential of the soil can be recovered, so can play agricultural circuit.

Any remediation method should be applied, are important both soil nature and the nature of the oil product.

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BIOREMEDIATION OF CIMUKA RIVER STREAM BY THE CONSORTIUM OF *BACILLUS COAGULANS, BACILLUS PUMILUS, BACILLUS SUBTILIS, PAENIBACILLUS AMYLOLITICUS* AND *NITROSOMONAS* SP.

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Abstract

Research has been conducted to determine the ability of the bacterial consortium in bioremediation of Cimuka River in terms of reduction in BOD, COD, Ammonia, and TSS. The method used in this study is experimental method with Complete Randomize Design (CRD) consist of 2 factors and 3 replications. The first factor were the type of indigenous of bacteria onsortium (K), the consortium of bacteria are: (k_1) microbial consorsium Bacillus coagulans, Bacillus pumilus, Bacillus subtilis dan Nitrosomonas sp., (k_2) microbial consorsium Bacillus pumilus, Bacillus subtilis, Paenibacillus amylolyticus dan Nitrosomonas sp., (k_3) microbial consorsium Bacillus coagulans, Bacillus subtilis, Paenibacillus amylolyticus dan Nitrosomonas sp., (k_4) sterilized water river without indigenous bacterium neither additional bacterium., (k_5) water river with existing indigenous bacterium. The second factor is Retention time (T) consist of 8 stages, i.e.: (t_0) day- 0, (t_1) day- 4, (t_2) day-8, (t_3) day-12, (t_4) day-16, (t_5) day- 20, and (t_6) day- 25. The results obtained indicated that consortium of Bacillus subtilis, Nitrosomonas, Bacillus pumilus and Bacillus circulans (k1) is capable of effectively reducing BOD values of 77.3 %, COD 76.7 %, Ammonia 81.8%, and TSS 79.5%.

Key words*: bioremediation*, *microbial consortium, BOD, COD, ammonia, TSS*

INTRODUCTION

Bioremediation is a technique that involves the use of organisms to solve problems or environmental pollution using biological organisms, for example, to overcome the soil or groundwater contamination. In other words it is a technology to remove pollutants from the environment so as to restore the original natural environment and prevent further pollution. Currently, bioremediation has grown on waste water treatment containing chemical compounds that are difficult to degrade and is usually associated with industrial activity, such as heavy metals, petroleum hydrocarbons, and halogenated organic compounds such as pesticides and herbicides (Tortora, 2010), and nutrients in the water such as nitrogen and phosphate in stagnant waters (Great Lakes Bio Systems. Inc.. Co. Orb - 3.com).

In fact, at this time, a common flocculant Alum raw material to degrade pollutants river water could have been replaced with the microorganism as bioflocculant isolated from activated sludge process and is known to decrease by 84-94 % turbidity (Buthelezi, SP, et al, 2009). In addition, the reliability of microbes including bacteria, fungi, and protozoa in wastewater treatment and its role in maintaining the ecological balance has been elaborated (Gerardi, 2006). Another example is the bacterium Pseudomonas can reduce the toxicity of detergent on the river ecosystem.. For these reason, indigenous bacteria from Cimuka River was isolated to degrade liquid waste within Cimuka River water that contain industrial and domestic wastewater. Cimuka River which is one part of a sub Regional 3 River Drainage: Cigugur - Cimahi - Cimuka flowing through industrial areas are concentrated in South Cimahi dominated by textiles, clothing and leather industries.

MATERIALS AND METHODS

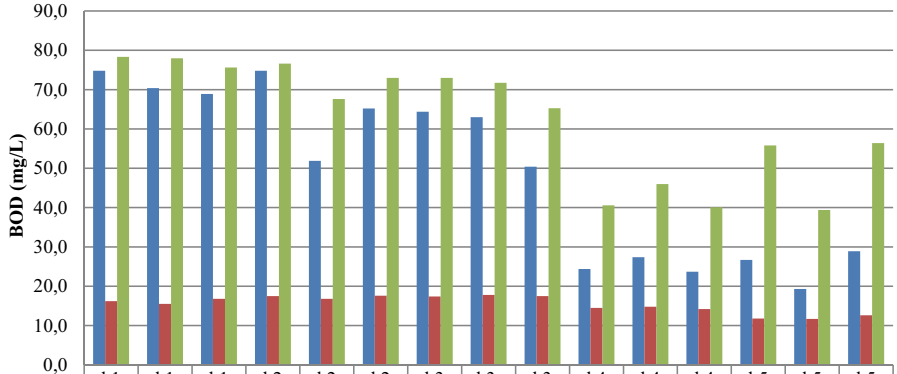
The method used in this study is experimental method with Complete Randomize Design (CRD) consist of 2 factors and 3 replications. The first factor were the type of indigenous of

bacteria consortium (K), the consortium of bacteria are: (k_1) microbial consorsium *Bacillus coagulans, Bacillus pumilus, Bacillus subtilis dan Nitrosomonas sp.*, (k_2) microbial consorsium *Bacillus pumilus, Bacillus subtilis, Paenibacillus amylolyticus* and *Nitrosomonas sp.,* (k_3) microbial consorsium *Bacillus coagulans, Bacillus subtilis, Paenibacillus amylolyticus* and *Nitrosomonas sp*., (k_4) sterilized water river without indigenous bacterium neither additional bacterium., (k_5) water river with existing indigenous bacterium. The second factor is Retention time (T) consist of 8 stages, i.e.: (t_0) day- 0, (t_1) day- 4, (t_2) day-8, (t_3) day-12, (t_4) day-16, (t_5) day- 20, and (t_6) day- 25.

RESULTS AND DISCCUSSION

Reduction of BOD value by bacterial consortium

The decrease in BOD values are influenced by the activity of bacteria through the process of optimizing the continuity of contact time of bacteria with organic matter and the presence of oxygen in wastewater. The nature of the bacteria that spread (disperse) in water (through aeration) optimize suspected bacterial contact with organic materials. Aeration is provided, in addition to supplying oxygen to function, it also serves the wastewater stirring continuously, thus increasing the chances of bacterial contact with organic materials. In general, bacterial consortium (k1) resulted in decreased levels of BOD is highest with an average of 77.30 % (Duncan 's Multiple Range test) on day 20. This suggests that there has been interaction between bacterial consortium B. coagulans, B. pumilus, B. subtilis and Nitrosomonas sp overhaul of organic matter in industrial wastewater, causing a decrease in the levels of BOD in large numbers. B. coagulans is a bacterium that is able to remodel lipids because it produces the enzyme lipase (Hasan et al 2006). B. coagulans can be obtained from soil, activated sludge (Kotay and Das, 2007). B. subtilis is a type of bacteria producing cellulase enzyme that functions decompose cellulose in the waste industry. Decomposition is the process of splitting cellulose anhydroglucose polymers into simpler molecules such as cellobiose, selotriosa, glucose monomers as well as CO2 and water (Lynd et al, 2002). B. subtilis is a bacterium that is most widely used for the production of enzymes such as amylase, and protease (Kosim, 2010).



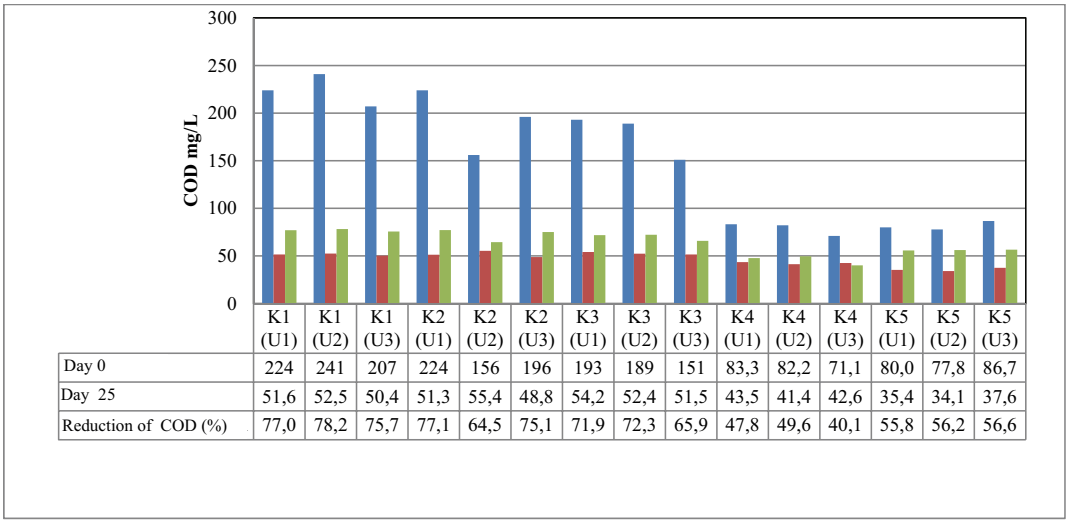
	k1 (U1)	k1 (U2)	k1 (U3)	k2 (U1)	k2 (U2)	k2 (U3)	k3 (U1)	k3 (U2)	k3 (U3)	k4 (U1)	k4 (U2)	k4 (U3)	k5 (U1)	k5 (U2)	k5 (U3)
Day 0	74,8	70,4	68,9	74,8	51,9	65,2	64,4	63,0	50,4	24,4	27,4	23,7	26,7	19,3	28,9
Day 25	16,2	15,5	16,8	17,5	16,8	17,6	17,4	17,8	17,5	14,5	14,8	14,2	11,8	11,7	12,6
Reduction of COD (%)	78,3	78,0	75,6	76,6	67,6	73,0	73,0	71,7	65,3	40,6	46,0	40,1	55,8	39,4	56,4

Figure 1. Decreasing Levels of BOD (%) During Biodegradation Process of Cimuka River Water

Mean of BOD levels after the end of the bioremediation process is 15.5 mg/l (Figure 1) has met the Liquid Waste Quality Standard BOD of (50 mg/l). Thus, decreasing of BOD levels by the addition of bacterial consortium showed that the bacteria used plays a role in lowering levels of BOD.

Reduction of COD value by bacterial consortium

The ability of the consortium (k1) was the highest in the decreasing levels of COD, average of 76.97 % (Duncan 's Multiple Range Test) due to the ability of these microbes to produce three enzymes that can break down the organic matter content of river water. In this consortium, Bacillus sp has an important role in decomposing of lipids and cellulose. According to Roheim (2011), Bacillus sp. can degrade lipids into glycerol and fatty acids that can be easily digested by microbes as a source of nutrients. Industrial wastewater contains organic matter is very high, one of which is the content of cellulose. Cellulose is a polysaccharide that is built by a glycosidic bond that is stable and not easily interrupted, causing the natural decomposition process longstanding industrial wastewater. To speed up the process of decomposition of the waste is necessary cellulase enzymes able to break glycosidic bonds (Howard, 2003). B. coagulans and Bacillus B. subtilis known is a group that is able to produce high amounts of cellulase enzymes, so the use of both of these bacteria strongly supports reform of industrial liquid waste organic materials. On the other hand Nitrosomonas sp. able to decompose ammonia into nitrogen compounds much simpler. Thus it can be said that the more organic materials are broken down by bacteria, the greater the amount of reduction in COD of industrial wastewater. The study results indicated that the average COD concentration obtained is 51.5 mg/l (Figure 2) that already meet the effluent quality standard (100 mg/l). Therefore, decreasing of COD levels by addition of bacterial consortium showed that the bacteria used plays a role in lowering levels of. COD.



	K1 (U1)	K1 (U2)	K1 (U3)	K2 (U1)	K2 (U2)	K2 (U3)	K3 (U1)	K3 (U2)	K3 (U3)	K4 (U1)	K4 (U2)	K4 (U3)	K5 (U1)	K5 (U2)	K5 (U3)
Day 0	224	241	207	224	156	196	193	189	151	83,3	82,2	71,1	80,0	77,8	86,7
Day 25	51,6	52,5	50,4	51,3	55,4	48,8	54,2	52,4	51,5	43,5	41,4	42,6	35,4	34,1	37,6
Reduction of COD (%)	77,0	78,2	75,7	77,1	64,5	75,1	71,9	72,3	65,9	47,8	49,6	40,1	55,8	56,2	56,6

Figure 2. Decreasing Levels of COD (%) During Biodegradation Process of Cimuka River Water

Reduction of ammonia level by bacterial consortium

Nitrification process is one of methods apply to overcome the accumulation of ammonium in the wastewater. Nitrification process may occur due to the activity of ammonium oxidizing bacteria and nitrite or also called nitrifying bacteria. Nitrifying bacteria was applied in the biodegradation process in this study is derived from the genus Nitrosomonas sp.

Bacteria of the genus Nitrosomonas sp. a bacterium capable of oxidizing ammonium to nitrite. An autotrophic bacteria are those bacteria which use CO2 as a carbon source and can grow at a pH optimum ranging from 7.5 to 8.5 (Ratledge, 1994). The addition of the genus Bacillus bacteria also have an important role to decrease ammonia levels. Edwards (2011), states that the genus Bacillus can reduce levels of ammonia due to its ability to oxidize ammonia content in the waste and to utilize these in heterotrophic ammonia as a source of nutrients. Organic compounds break down into simple compound can be used as a source of nutrition for nitrifying bacteria in the wastewater industry. According to Adhi (2008), based on the nitrogen cycle, nitrification bacteria are bacteria found in wastewater containing organic compounds, so the nitrifying bacteria that gets the extra nutrients able to work more effectively in the decomposition of ammonia in the wastewater industry. The addition of bacteria Nitrosomonas sp. assist the process of nitrification and ammonia monooxygenases produce enzymes to break down ammonia into nitrite with the help of oxygen. Initially the ammonia is oxidized to hydroxylamine compound by enzymes produced ammonia monooxygenases Nitrosomonas sp

The decrease in ammonia also occurs in sterile waste control (k4) and non-sterile waste (k5). In the sterile waste (k4) a decrease in ammonia levels may be due to evaporation during the biodegradation process is aided by the presence of aeration. Meanwhile, in the non-sterile wastewater (k5) are also given aeration, decreased levels of ammonia can be caused due to the persistence of indigenous bacteria in the waste can reduce levels of ammonia. As is known, Nitrosomonas sp. spread on fresh water, sea water and soil (Holt et al., 1994). The percentage decrease in ammonia levels high enough on industrial wastewater that has been treated and control allegedly due to change ammonia into a gas that is released into the air through evaporation process. Figure 3 shows the curve of changes in levels of ammonia and its the percentage decline during river water biodegradation process

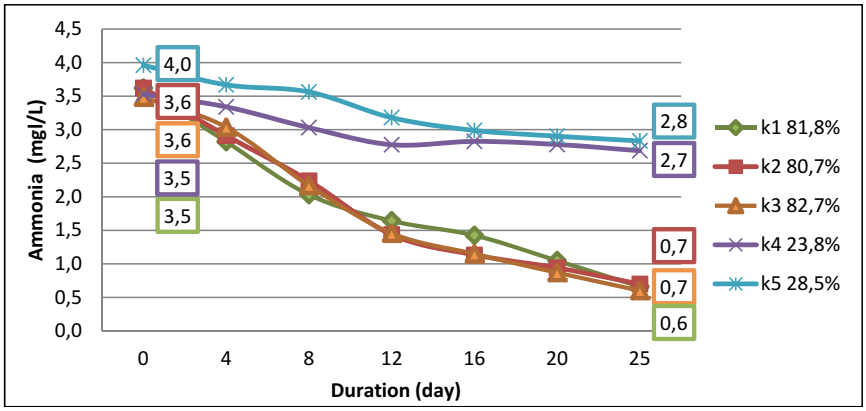


Figure 3. Curve of changes in levels of ammonia and its the percentage decline during During Biodegradation Process of Cimuka River Water

Consortium of bacteria (k1) can reduce ammonia levels by 81.8% This shows that there is a synergistic interaction between B. coagulans, B. pumilus, B. subtilis and Nitrosomonas sp. resulting in decreasing of ammonia levels is high. Sastrawijaya (2000) consider that the concentration of TSS in the water generally consists of phytoplankton, zooplankton, human waste, animal waste, sludge, crop residues and animal, as well as industrial waste. The materials were suspended in natural waters are not toxic, but if excessive amounts can increase turbidity which further inhibits sunlight penetration into the water column (Effendi, 2000).

The decrease in TSS by bacterial consortium (k1) B.coagulans, B. pumilus, B. subtilis and Nitrosomonas sp. not significantly different from the bacterial consortium (k2) B. pumilus, B. subtilis, P.amylolyticus and Nitrosomonas sp. resulted in decreased levels of TSS best. This can be caused by the ability of the bacteria contained in the consortium is able to remodel the organic material in the suspended substances in the wastewater industry. B. coagulans and B. subtilis has a high cellulolytic ability, thus containing cellulose dissolved solids will be described. Besides B. coagulans and B. the genus Bacillus subtilis includes groups that have the ability to decipher crude fiber and lignin are difficult to decompose lignin and delignification process through hydrolysis of cellulose so solid that dissolved organic matter in the form of lignin, lipids, and cellulose in industrial wastewater can be reduced.

Figure 4 shows a decreasing of TSS level, during biodegradation process of Cimuka River Water by bacterial consortium (k1) 79.5 % and effectively occurred on day 25.

The survey results revealed that the average TSS concentration obtained is 131.8 mg / l TSS has met the quality standards of industrial wastewater is 150 mg / l. Thus, a decrease in TSS levels in the addition of bacterial consortium showed that the bacteria used effectively contribute to lower levels of TSS.

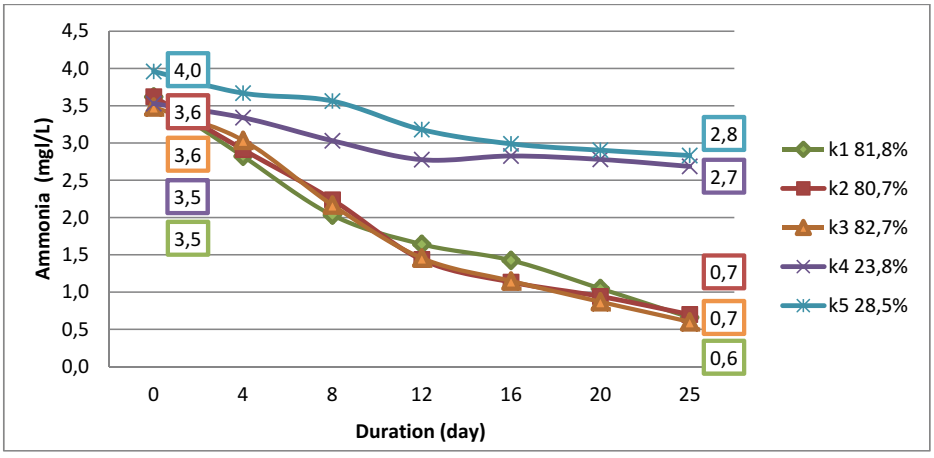


Figure 4. Changes in levels of TSS during During Biodegradation Process of Cimuka River Water

CONCLUSIONS

1. Consortium (k1) consisting of B. coagulans, B. pumilus, B. subtilis and Nitrosomonas sp. can reduce levels of contaminants of Cimuka River streams 77.3% of BOD, COD 76.97%, 81.8% and TSS Ammonia 79.5%.
2. Consortium of bacteria (k1) may reduce organic wastes 70% of the initial content of industrial wastewater streams Cimuka River streams

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TOURISM - SOURCE FOR DURABLE RURAL SPACE DEVELOPMENT

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Abstract

Since independence Republic of Moldova did a lot of efforts to align with the big family of European Union and in November 2013 has made a huge step towards signing the Association Agreement and Free Trade Agreement with the EU. These impose our country to accelerate reforms and take all possible measures in order to reduce the gap of economic and socio-cultural development adjusting it to EU standards.
One of the most sensible issues is rural area development that needs wide types of actions in almost all aspects. In the article we'll consider if and how tourism could be a catalyzer for rural space conservation and further durable development that will be ended by some conclusions and recommendations to be implemented in the Republic of Moldova.

Key words: *tourism, development, rural area, infrastructure, European Union.*

INTRODUCTION

Nowadays it is impossible to imagine a big city, or any known place without tourists. The tourism industry has now engulfed the entire world from the warm shores of the oceans to the snowy area of the Poles. In many countries, tourism is one of the three leading industries of the country, which is developing quite rapidly and is of a great social and economic importance. In the tourism sector are employed more than 250 million people. It accounts for 7 % of the total investments, 11% of the global consumer spending, 5% of all tax revenues and a third of the world trade in services. Tourism has a huge impact on key sectors of the economy such as transport and communications, trade, construction, agriculture, goods consumption and many others, acting as a catalyst for the social and economic development. Experts predict that the 21st century will be the one of the tourism. Particularly promising forms of tourism, up to date, are considered the rural, environmental and cultural ones. In our country, tourism also figures prominently in the structure of the economy. Thus, the country has 274 travel agencies providing travel both inland and abroad. According to various statistics, the agro-tourists in the world are from 7 % to 20 % of the total tourists and their growth rate is of about 30 % per year. The relevance of the topic for the Republic of Moldova is due to the fact that rural, ecological and medical tourism sanatorium has all the possibilities to increase the share of industry in the GDP of the state. In addition, these types of tourism are beneficial not only for the public authorities, they also allow to raise living standards of life in rural areas, create new jobs, increase incomes of the villagers, etc. For this reason, in our country it is necessary to develop these types of tourism, inviting tourists from abroad, but at the same time to open new places for the citizens of our country. In this paper we want to illustrate that tourism - is not only a vacation for the soul, but also an excellent opportunity to develop the rural environment of the Republic of Moldova. We consider the facts that reflect the actual situation in tourism, and also offer a range of measures, which, in our opinion, will ensure long-term socio-economic development through tourism.

MATERIALS AND METHODS

In order to characterize the tourism in rural space of Moldova, the following indicators were used: the number of foreign visitor arrivals in Moldova, number of foreign visitor arrivals with purpose of holiday and business in Moldova.
The period analyzed in this study was 1995-2013. The data, collected from Statistical

Yearbook of the Republic of Moldova, have been statistically processed and interpreted, building diagram.

RESULTS AND DISCUSSIONS

Thus, briefly about the Republic of Moldova and the tourism performed in it. General data.

GNI per capita, Atlas method (current US$) – 2070

Poverty headcount ratio at national poverty line (% of population) – 16.6

Employment in agriculture (% of total employment) – 26.4

Rural population (% of total population) – 51.62

International tourism, number of arrivals – 11000

International tourism, receipts (current US$) – 262 millions

Travel services (% of service imports, BoP) – 34.078

Travel services (% of service exports, BoP) – 19.89.

Types of tourism in Moldova

Rural Tourism

This type of services allows visitors to learn about the sightseeing of the Republic of Moldova, plunge into country's history, local customs and traditions, and get acquainted with the way of life of the rural population.

Well kept farms, own wine, houses in traditional style, Moldovan food on the table and love for the homeland.

On the territories of interest to tourists are set up specific national tourist zones.

Rural tourism is especially popular. The rural environment of the Republic of Moldova, of the agricultural community and picturesque villages are an important source for:

- Provision of services by the traditional placement to visitors in rural settings;
- Providing them the opportunity to participate in country pursuits and activities;
- Familiarization with the local folklore, entertainment and traditions;
- Displaying handicrafts with the opportunity to participate in these activities;
- Enabling them a chance to purchase items made by folk artists.

Wine Tourism

Vineyards are also an important tourist destination in the rural sector.

The wine produced in the Republic of Moldova, thanks to its quality, has an international demand.

The republic has 142 wineries, 23 of them have experience of reception of visitors, 4 of which have tastings programs (CRICOVA, MILESTII MICI, PURCARI, CHATO VARTELY).

Here the tourists can get acquainted with the technology of the production of wine, watch the process of bottling and, of course, sample the final product.

Republic of Moldova, as a wine country, can offer visitors a rich choice of routes: underground cellars and towns, wineries, wine processing enterprises, those for the production of sparkling wines, Brandy's, balsams, etc.

Wineries in conjunction with the surrounding vineyards are part of the tourist route "The Wine Road in Moldova" and represent an important reason to visit the country.

Cultural tourism

The Republic of Moldova has a rich cultural heritage, which can be successfully used in tourism.

The earliest preserved heritages are the Geto - Dacian sites and Roman fortresses.

The remains of medieval fortresses, archaeological complexes such as the Old Orhei, monasteries, nobles' mansions and peasant houses represent a variety of visitor attractions.

In total, there are 140 monuments of cultural heritage that can be included in tourist itineraries.

In Chisinau there are many cultural heritage sites of domestic architecture from the nineteenth and twentieth centuries, which can be used as tourist attractions.

Most museums are located in the Republic of Moldova buildings of special architectural significance, and a rich collection of exhibits.

A part of the national tourist product is the variety of cultures of different regions of the country.

The Republic of Moldova is a mixture of nationalities and cultures with many traditions, languages, folklore, cuisine, etc. The country has about 880 folk groups. Many of them reflect the distinct traditions of the region, and ethnic origins.

Medical - Health Tourism

The Republic of Moldova has a rich and varied potential for developing medical tourism.

Sanatoriums and resorts offer the necessary conditions for health tourism.

Sources of mineral water in the Republic of Moldova are also important for spa treatment.

The most promising are: "Bucuria-sind", Vadul lui Voda, "Codru", Hirjauca, Calarasi, "Nufrul alb", Cahul.

Mineral waters with curative properties in the Republic of Moldova (more than 47 sources) are the determining factor in the development of health tourism.

Analysis of tourism statistics for 2013 and in dynamics. Tourism activity of travel agencies and tour operators from the Republic of Moldova in 2013

Of those 13.2 thousand foreign tourists who visited Moldova in 2013 and benefited from the services of travel agencies and tour operators 48.2% arrived for rest, recreation and leisure, 45.3% - business and professional activities, 4.5 % for treatment, 1.9 % - other purposes. The most significant share in the total of foreign tourists arriving in the Republic of Moldova is for the citizens from Romania (17.5 %), Russian Federation (12.2 %), Ukraine (7.9 %), Poland (6.3%), Germany (6.1%), Italy (4.5%), USA (4.4%), Turkey (4.2%), United Kingdom of Great Britain and Northern Ireland (3 8%), France (2.8 %), Netherlands (2.6%), Austria (2.3%), Sweden (2.1%), Japan (2.0 %), Montenegro and Bulgaria (each by 1.9%), Switzerland (1.8%), Israel (1.1%). Through travel agencies and tour operators in 2013 went abroad 157 600 tourists and backpackers, with 7.3 % more than in 2012. Most Moldovans went abroad for rest, recreation and leisure (97.9 %). Moldovan citizens preferred to travel mainly in Turkey (36.6 % of total working abroad), Bulgaria (33.5%) , Romania (9.0 %), Ukraine (5.8 %), Greece (5.4%), Egypt (1.6 %) and the UAE (1.2%).

Table 1: The number of arrivals by the purpose of the visits

	1995	2000	2005	2006	2007	2008	2009	2010	2011	2012	2013
The number of foreign visitor arrivals in Moldova, total	32821	18964	25073	14239	14722	8710	9189	8956	10788	12797	13150
Purpose: - holiday and rest	3256	7108	7840	6170	5804	5682	6459	5438	5892	7025	6343
- Business and professional reasons	24743	11577	16372	7444	8572	2541	2308	2971	4330	5190	5962
other purposes	4822	279	861	625	346	487	422	547	566	582	845

For Moldova a major interest are the foreign visitors that would contribute significantly to the development of the national economy. The number of arrivals of foreign visitors to our country was marked by reduction from 18964 in 1995 to 32821 in 2000 (Table 1) or with 42.3%. Then in 2005 there was an increase in the total number of arrivals of foreign visitors to Moldova up to 25073 or by 32.2 percent compared to 2000. There followed a categorically decline up to 8956 in 2010, or by 2.8 times more than in 2005 and again a slight increase in the years 2011-2013.

Among the factors that have influenced the dynamics and structure of international tourist traffic in our country there are identified some with positive character (enhancing integration and international cooperation, globalization and internationalization of economic and social modernization of all sectors of the economy, the rapid development of services, etc) as well as ones with a negative nature (periods of economic recession, expanding poverty and unemployment, the outbreak of conflict whether internal or external) . We believe that the categorical decrease in the total number of foreign visitor arrivals in Moldova most influenced the increase in poverty.

A major interest presents the aim of arrival in our country of the foreign visitors. The number of arrivals with holiday and recreation purpose

increased from 3256 in 1995 to 7108 in 2000 or by 2.18 times and to 7840 in 2005 or by 10.3 percent compared with 2000, then it decreases to 6343 in 2013.

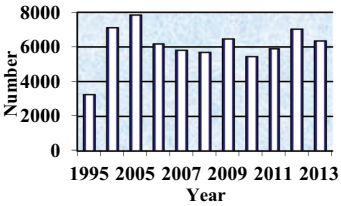

Figure 1. The number of the visitors by the purpose of rest in dynamics

The number of arrivals for business and professional reasons in 2000 is reduced by about 2.5 times, and in 2005 recorded an increase of 14 per cent compared to 2000 and follows the reduction of the arrivals for this purpose up to 5962 in 2013. In general, it should be noted the increasing trend of tourists on a business trip in Moldova, so in 2010 they were in number of 2971, and in 2013 - 5962.

Out of the 13.2 thousand foreign tourists who visited Moldova in 2013 and benefited from the services of travel agencies and tour operators 48.25% arrived for rest, recreation and leisure, 45.35% - business and professional activities, 6.4% - other purposes. If during the years 1995-2007 dominated the number of arrivals for business and professional reasons of foreign visitors to our country, then in 2008-2013 dominated the number of arrivals of the foreign visitors for holiday and recreation purpose. But at the same time, in the recent years, a growing interest in Moldova is from a business standpoint. Of particular interest is the domestic tourism. We will trace the change in the number of domestic tourists from 2008 to 2013:

The table 2 shows that the number of domestic tourists in 2013 decreased sharply compared to 2008. If in 2008 there were 48,456 people, in 2013 they became less than 29.5%. A downward trend is noticed since 2009, although in 2011 the number of tourists slightly exceeded the number of 2009, but continued to decline in 2012-2013.

Table 2. Evolution of number of domestic tourists

Year	2008	2009	2010	2011	2012	2013
The number of domestic tourists	48456	37159	35594	37764	34363	34172

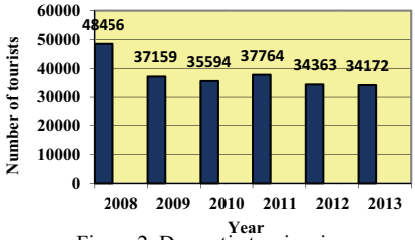

Figure 2. Domestic tourism in dynamics

These statistics clearly show that the decline in domestic tourism – is one of the most important tasks that must be addressed. Of course, the focus on the foreigners is a need, but what about our tourists? Foreigners come to Moldova often in warm holiday season, while ours are tourists in the country for all the year round. Namely the domestic tourists require developing both the summer and wintering tourism, providing a variety of year-round activities, excursions and entertainment.

Problems of tourism in Moldova

The biggest problem is the lack of a tourism infrastructure: bad roads, lack of toilets equipped at the stops, the annoying behavior at customs and more others. Further in details.

1. No roads - no tourism.

One of the obstacles in the way of the tourists is our roads. According to the chairman of the National Association of Travel Agencies of Moldova (NATA) Sebastian Botnari, this is the number 1 problem, because the access to the main tourist attractions is very problematic. "Moreover - he says - in addition to roads, a special need is equipment of the bus-stops for the tourists, like a tourist stop, where the foreigner will be able to drink, eat and visit a clean comfortable bathroom. Even if the last question will be solved in time (the option of building institutions on the basis of roadside service stations is considered), then the problem of the roads will not leave the urgent category pretty soon."

NATA position is sustained by some firms engaged in the inbound tourism to Moldova. "In order for the tourists to come to us and travel through our country, the roads should be repaired - emphasizes the director of the tourism department of Amadeus Travel Lufthansa City Center firm, Alla Grachev. – This should be done in the first place not for

tourists, but primarily for ourselves. After all, every time when a tourist trip to Tipova or Saharna is planned, it is frightening to remember our own local drivers. Anyone pities his own car! If to speak directly about tourists, so a definite problem is regarding toilets, which lack along most of those broken roads, or either are there, but are far from a proper format. They primarily shock the guests of Moldova. Everything else for them - is exotic. "

2. Through thorns to 2-3 stars

As a second barrier for coming to Moldova stands the high cost of the hotels. Accommodation in a Chisinau business class hotel today costs a foreigner from 100 euros per day, and this price includes only breakfast, in the same time in Turkey, you can live in a five-star hotel for 40 euros a night, and all inclusive. "That is why Turkey is visited yearly by 6 million tourists.

In order to solve this issue, NATA tries to establish communication with the 2 -3- star hotels that have recently become fewer.

Another option for accommodation – is the home of people who will gladly lodge tourists. It is really profitable and increasingly popular in nowadays, but there is a BUT! The standalone tourists, who do not use the services of travel agencies, hardly will find the address of the family by themselves, providing low-cost services and conveniences “the house in the village".

Many tourists coming to Moldova prefer to rent an apartment because it is cheaper than to stay in a hotel, and it is for this reason that the hotel sector is suffering.

3. Information for the tourist

Information about attractions: worldwide, even in small towns with a sickly attraction there is a tourist information center, where you will be given a map and answered all your questions. In Chisinau, during the day you will not find even with the candle anything like streets pointers, tablets in English, public transport schemes, drivers of transport speaking at least a foreign language and a lot of things you will not find, too. Even for our residents is difficult to know whether there is at least one driveway to a Nature Reserve from Moldova, a parking lot, the infrastructure, is it possible to take a tour-guide. Of course, there are not many guides through Moldova.

4. Transport

Transport: it is no secret for anybody that in Moldova the air tickets are wildly expensive, because of the monopoly of Air Moldova.

Finely, the tourists decided to come to Moldova by train. But far from it, the site of the railway station is not translated into English, and you will never and for anything be able to buy tickets. The same thing applies in most cases to the buses, just for fun, try to call to the bus station - you will be provided at least half an hour waiting.

5. Home vacation

One of the major problems is the lack of interest of local tourism people to take a vacation in their own country. Hence, few people would agree to exchange a week vacation in Europe or to the sea, on a tour of the sights of Moldova. Periodically are arranged tours to schoolchildren to sites such as Saharna, Dolna, Old Orhei, Capriana, and others, but, as a rule, they are organized by teachers or parents. Speaking about the adults, they are not attracted to visit the memorable places in their homeland. Travel agencies offer this possibility, but do not offer guided tours.

6. Incomes and prices

The most important problem of domestic tourism is the enormous disparity in income and prices for travel services. The problem of the high cost of guesthouses, hotels, cafes and restaurants, and excursions themselves repels domestic tourists from traveling to the country. For example, the cost of a travel to Cricova can reach 1300 lei/person, and to Milestii Mici 1650 lei/5 pers.

How are the problems solved?

The National Tourism Agency has developed a strategy to attract foreign tourists for 2014-2020. According to the document, the number of foreign tourists visiting our country should increase each year by 3%. But this requires investment in rural, sanatorium and religious tourism. On the last place is the cultural and gastronomic tourism.

1) Foreign media

The main target markets for the tourism sector are the United Kingdom, Germany, France, Russia, Romania, Poland. The project supports the participation of Moldovan tour operators in major international exhibitions, as well as inviting foreign journalists in Moldova.

"Articles about Moldova appeared in Lonely Planet, San Francisco Gate, Newsweek Magazine, Touristik Aktuell, Heilbronner Stimme, Freizeit Stimme, Badische Tagblat, Sudwes Presse, Horizon, Krasivaya Jizni. It was also published the first tourist guide for Moldova in German.

2) Information platform

An important role in promoting a new image of the country was played by the site www.moldovaholiday.travel, which today is the only Moldovan tourist information platform.

3) EU investments in infrastructure

A great help for the development of infrastructure is given by the EU that provides grants and loans for the construction of roads and other works.

CONCLUSIONS

Based on the above information, it can be concluded that tourism, both external and internal, is not developed in Moldova. Even though, there are created projects, held conferences to address tourism issues, but this is not enough. There is a need for actions that will at minimum cost of time and money to attract maximum number of tourists, both foreign and domestic.

Analyzing statistical data in dynamics, it is evident that the number of visitors has significantly increased in recent years (13.2 million in 2013). A growing interest to Moldova comes from a business standpoint, so the number of visitors for business purposes is growing (5190 thousand - in 2012, 5632 thousand - 2013). At the same time reduces the number of visitors for rest purposes (2012 - 7025 thousand, in 2013 - 6343 thousand), which is a problem for our tourism.

In completion of the paper we would like to suggest a few ways to solve the problems of tourism in Moldova, which require some investment, but will require a short time of achievement.

1) For example, journalists from Italy, Germany and other countries could be in Moldova for a few days, and then write about Moldova as a tourist direction in their newspapers, magazines and other publications. Such things are done by many countries. This is an effective way of tourism promotion. However, for this purpose the support of the state is needed.

2) It is also possible to attract the tourists who are visiting Romania or Ukraine, to come to Moldova. In these countries, there are many tourists that focus on different types of tourism. Besides, we could conclude an interstate agreement so that the tourists from Ukraine and Romania would also attend the Moldovan attractions. For this, a state decision is needed.

3) Developing some specific programs for domestic tourists based on a flexible system of discounts and benefits, such as for: children, students and pensioners. This enables by reducing prices, to make tourism in the country more attractive for its population. When resting in the country will be cheaper than abroad and no less interesting, a certain percentage of the population will want to spend their vacation here.

4) The development of special tour programs for pupils/students.

5) Cooperation of the Ministry of Tourism with large and small, private and public enterprises. This will allow, for example, every year the best department of the company to go on a tour of Moldova. If everything is organized adequately, employees will want to visit more than one place, taking the rest of the team at the same time or family members.

6) Improvement of infrastructure in such details as the installation of signs, information boards in English, improved bus stops, sanitary conditions on them.

7) Placing more information among foreigners. Many of our compatriots are leaving to work in other countries, where they can advertise our state, calling to the acquaintance with the culture of this small but beautiful country. Cooperation with foreign tourism agencies, placement of posters about the trip to Moldova, etc.

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PREVENTING AND CONTROL OF SOIL EROSION ON AGRICULTURAL LANDS BY ANTIEROSIONAL SHELTER-BELTS

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Abstract

In Romania, one third of territory is affected by soil erosion process, doubled by a dry trend in climate, therefore, there are necessary ample measures of antierosional works. Among these, antierosional forest belts and plantations establishment represent a major approach.

The present work has as the main objective to Romanian bibliographically reference the types and establishment modalities of antierosional works, as well as main areas where they have been established. In recent observations, we have analyzed the behavior of the tree species, forest belts spatial design and its antierosional efficiency in different zones from the country. Antierosional forest belts are to be established on contour lines of the affected or predisposed to erosin versants. Space between belts is determined based on the criticial erosion distance, as varying between 100-150 m to 300 m, depending on the erosion degree, lands topography and land use. Belts width is set upon both rainfall and land features, as varying between 10 - 20 m up to 60 m on strongly eroded slopes.

Regarding the species assortment, the most efficient, both in terms of halting erosion and stand evolution, shows the mixes of principal, secondary and shrubs woody species, in a designed spatial structure with tallest tree species centrally positioned, while other species are placed toward the edges of belts in descending height order to bushes on both sides. Most promising tree species for further use in the composition of the antierosional forest belts are: oaks, sycamore, maple, ash, common walnut, cherry, locust, honey locust, flowering ash, Siberian elm, field maple, Tartarian maple, osage-orange, oleaster, cherry-plum, as well as shrubs: hazelnut, male dogwood, blakthorn, dog rose, under different shares depending on stational conditions. The antierosional forest belts previously established, through their both exceptional functional value and rich biodiversity, represents ecologic, social and economic environmental assets, offering the basics the future action of designing and execution works. Based on obtained results there were prepared appropriate recommendations; toward continuing of establishment of antierosional forest belts under different conditions.

Key words: *antierosional shelter-belt, soil erosion, agricultural lands.*

INTRODUCTION

Increasing agricultural areas to the detriment of the forest has made large areas planted to remain completely treeless, thereby causing profound changes in the spectrum of climate and have at result increasing climatic aggressiveness (heavy rains, drought, extreme temperatures) and serious consequences for soil: erosion, landslides in mountainous and hilly; flood, drying pronounced - in the lowlands (meadows, plains). All these processes have negative effects on crop development and of ecosystems biodiversity.

Large areas devoid of forest vegetation were converted into dry land, so farmers and other responsible factors in society were convinced of the need to take urgent measures for ecological restoration.

This measures are necessary to:

a) protecting crops against pests climatic factors (drought, extreme temperatures) as a result of climate change that led in the last 50 years to a climate aridity in Romania, with dramatic accents in southern and eastern regions; such as, after map areas in Romania prone to desertification (Stanescu et al., 1994, quoted by Giurgiu, 2004), the East and the South of the country are the areas most exposed to desertification; land in these areas fall into the category of deserts, semi-arid and dry sub-humid, relationship between precipitation and potential evapotranspiration is much below subunit.

b) preventing and combating soil erosion and landslides as the expression of specific geomorphology, with considerable relief energy; is estimated that in Romania, the water

erosion affects about 47% of the agricultural area of the country, meaning more than 6 million hectares, wind erosion affects 378 hectares and landslides over 700000 ha; out of which, about 2-3 million hectares of agricultural land are strong to excessive degraded, unfit for efficient agriculture, soil losses estimated at 126 million tons (Giurgiu, 2004).

MATERIALS AND METHODS

The main aspects regarding of the species used in the composition of shelter-belts and their behavior, resulting from observations and research carried out recently in the antierosional shelterbelts installed in the period 1950 - 1980.
Observations on the behaviour and evolution of the forest plantation and of the species used to make forest belts, in relation to environmental conditions, allowed the establishment / improving of afforestation compositions for installing antierosional shelter-belts

RESULTS AND DISCUSSIONS

1. Measures and actions to prevent and control soil erosion

To prevent degradation by erosion processes (and slides) of land is needed urgent protection measures and works of soil and for stopping soil erosion processes are necessary measures and ecological reconstruction works (afforestation) of these lands.
The complex soil erosion protection is achieved through planning projects and antierosional development of sloping land and watersheds with different uses and include the following measures:
• allocation for agriculture on slopes under climatic conditions and relief orientation of fields in the general direction of the contour ;
• implementation of antierosional agrotechnics, agro working on the general direction of the contour, growing alternative crops in strips with grass strips, crop rotation, antierosion asolment etc;
• establishing a network of channels for evacuating excess water on the slopes and gully erosion;
• establish an optimal network of technological paths, and their location right on the slopes;
• making arrangements phyto-supplying (turning the meadows of the badlands pastures, shelter-belts, agroforestry systems, grassing and afforestation of slopes with inclination greater than 200);
• gully erosion through a proper arrangement;
• stabilizing landslides.
Designing, execution and operation of anti-erosion works in conjunction with the work of the water, hydropower, forestry, roads, according to the interests of landowners and town planning documentation and landscaping, taking into account the protection requirements environment (Moţoc et al., 1975; Munteanu et al., 1991, Law 84/1996).

2. Types of antierosional shelter-belts and plantations

The forest vegetation is a real barrier in soil degradation by rainfall erosion.
A stronger need to implement the results of research on agroforestry planting anti-erosion shelter-belts is emerging in developing sustainable agricultural systems, with their many protective effects of crop agrobiocenotic stability and balance, biodiversity and preventing pollution by pesticides etc. (Malschi et al., 2009).
Antierosional sheter-belts are crops in strips (at least three times) performed on eroded slopes around water reservoirs anti-erosion purposes, on sandy soils to prevent drifting and flood land of the dig-shore waves dams defense and floods (Ciortuz, 2004).
Antierosional shelter-belts are bedded on sloping lands along the contour and are designed to turn runoff into underground drain, which is why they are called absorbing belts.
Shelter-belts for water accumulations protection are installed around lakes and have the role of strengthening the role of bank, filter rainwater draining the lake, reducing evaporation from the water surface and to beautify the area. The shelter-belts is made up of two bands, namely a reinforcement band (between the mean and maximum water, comprising the hydrophilic species) and a filter band (above the maximum water level, the

width of at least 20 m, having different species composition of deciduous and coniferous) .

Shelter-belts for sandy lands are bedded in areas with mobile and semi-mobile sands and are designed to ensure stability, preventing drifting. Such shelter belts form a network of main curtain (in the direction of the prevailing wind perpendicular consisting of 5-7 rows, spaced at a distance equal to the 15 heights of the shafts, respectively to 200-300 m) and the side (perpendicular to the main formats 3-5 rows, spaced at 45 heights, i.e. 500-1000 m apart).

Shelter-belts for protection of dams are installed in the dam - shore, 10 m from the foot embankment outside and are designed to protect the dam destructive action of waves and thaw formation. Have variable width of tens or hundreds of meters, consisting of 1-3 bands.

Agroforestry systems - are another category of anti-erosion protection systems being practiced little or nothing nowadays. They were rather known by the forester, but now it would be good to be better publicized, as is an opportunity to earn the interest of landowners in rural areas. Ultimately, it is about land use systems in which forest seedlings are planted in combination with crops grown on the same land .

Forest plantation of protection - if highly eroded portions of land to the parent rock or even the beginnings of gullies, steep slopes kidnap, ravines and valleys near the bottom of the valleys and ravines as is recommended afforestation drive of the affected areas .

In the next paragraph we will refer to antierosional shelter-belts.

3. The chracteristics of some antierosional shelter-belts from our country

The main aspects of the species used in the composition of antierosional shelter-belts and their behavior, resulting from observations and research carried out recently (Constandache et al., 2006), are presented below.

● Antierosional shelter-belts from Perieni (Vaslui - figure 1), land slope to 100, chernozem soil type, moderately to strongly eroded installed before 1950, with a width of 25-30 meters are composed of basic species: greyish oak, acacia; species mix and help: Norway maple, smooth-leaved elm, european sweet cherry, field maple, Tatarian maple (among marginal and apricot); shrub: common hawthorn, dog rose, indigo bush, red dogwood etc.

Figure 1. Antierosional forest-belts at Perieni (photo: Constandache C., Popa N., 2006)

Regarding the behavior of the species were found as follows:

- if the composition of oak mixed with maple, cherry, maple Tatar, maple and shrubs 0.7-0.8 shelter-belt are consistence and active state of vegetation, remarking natural regeneration species composition, oak heights achieved 17 to 18 m and diameters between 28 and 44 cm, other species carried different sizes, rising from the edge inwards (heights of 2-3 m and 4-5 m in the bushes Tatar maple, maple, Prunus cerasifera outward up to 12-16 m in maple and cherry inside the curtain, so the shelter-belt structure is one of the most effective;
- if the locust composition, consistency shelter-belt is lower (0.6-0.7), being quite active

vegetation (dry locust affected due to the age of 60 years) being carried regeneration works, dimensions made locust are pretty good inside the curtain (height 19-20 m , diameter 30-36 cm) and decreases towards the edges (up to heights of 8-10 m) in composition appears maple, but out of natural regeneration (locust was probably installed after thinning, with height of approx. 3 m) and shrubs (dogwood , hawthorn, privet), providing good anti-erosion efficiency.

● Network antierosional shelter-belts of Cean-Boldut of SCDA Turda (Cluj County – figure 2), installed in the years 1950 to 1952 is located in a typical area of low hills of the Transylvanian Plain. It occupies 14 hectares in an area of 342 hectares of farmland and meadows affected by different degradation processes: erosion, landslides, colluvium (Malschi et al., 2009). Relief is slightly troubled, with altitudes between 280 and 460 m and a moderate slope from northeast to southeast. Some portions are steep or vertical fractures or slipping (at the top of the slope).

The shelter-belts are composed of over 36 tree and shrub species (Malschi et al., 2009), among which: greyish oak, ash, cherry, field elm, Siberian elm, lime tree, mahaleb cherry, etc, on land slope of 12-15^0 affected by erosion and landslides medium - deep shift in bulk soil type chernozem, or black pine, mahaleb cherry and shrubs (privet, European bladdernut, hawthorn) detachment surfaces, slopes of ravine with slopes greater (Untaru, 1975).

Following recent observations (2006) carried out some of these shelter-belts, it was found to be composed of 5-7 rows placed at distances of 1-1.5 m (to the side) and 2-2.5 m (inside) and the distance between shelter-belts is 200-250 m tree species were usually placed in the middle of the shelter-belts. The shelter-belts analysis at the age of 50-55 has the following characteristics:

- if the target species is within the shelter-belts ash (three times), and the composition is 0.6-0.7 active growing state, the average height of the ash is from 14 to 15 m and the average diameter 20 cm;

Figure 2. The location of shelter-belts network in Cean-Boldut farm of SCDA Turda

- the shelter-belts with the core (3-5 lines) consists of oak mixed with maple, maple and shrubs (dogwood, elderberry, hawthorn) the consistency is 0.8-0.9, the growing state is very active, the oak heights achieved 12 to 15 m in the upper part of the shelter-belts 16 to 18 m, and the slope at the bottom and the shaft diameter between 20 and 30 cm;

- marginal - lines made of cherry plum, hair, common hawthorn, hazelnut, red dogwood, colutea arborescens have very active vegetation condition ensuring proper density .

Research conducted by agronomists showed that ,,the protective forest agroecosystem at Cean-Boldut is a model of green technology for pest control and sustainable development of cereal crops in the hills of central Transylvania" (Malschi et al., 2009).

● Observations made in antierosional shelter-belts from Balta Alba (around the lake), under steppe chernozem soil type influenced by humidity and salt content in Balta Alba, revealed that species gave good results was white poplar, ash from Pennsylvania and oleaster (last marginal rows). In higher areas, and shelter-belt with the composition acacia (middle shelter-belts), cherry plum and oleaster (among marginal) has good vegetation. The shelter-belts has a variable width (from 10 m to 20 m), highest field slope greater than 100, and is located 20-30 m from the lake.

● The helter-belts for the protection of dams analyzed in the dam-bank of the River Prut, having particular composition of poplar and willow species, although it felt following

changes in the hydrological regime of the soil as a result of engineering hydrology of the last time, exerted a significant role in defending premises dams, dykes and banks protection , under exceptional floods in recent years.
The antierosional forest belts analyzed, shows generally good condition and have a role in the dissipation of surface leakage, increase soil water infiltration, reducing soil erosion and stabilization of areas affected by landslides.
Antierosional forests belts previously installed, through their exceptional functional value and the richness and diversity of flora, are of special importance to environmental, social and economic, providing the basics needed for future action planning and execution of these works.

4. Technological aspects regarding installation of antierosional shelter-belts

The layout of the antierosional shelter-belts, width, composition and implementation schemes were the subject of concern for a large number of researchers.

4.1. Location of antierosional shelter-belts

Placing antierosional shelter-belts is such that parcels bounded by them to have a ground and a uniform slope and length as required to obtain maximum yield of agricultural machines .
In previous work (Lupe 1953) recommended that short slopes up to 200 m to 300 m in the forest steppe and steppe, to sit two shelter-belts, one ridge or shelf edge and one at the bottom of the slope. The long slopes, with a slope uniform, except for the bars is recommended to install a number of intermediate shelter-belts, depending on the length of the slope, the inclination thereof by the exposure to wind and the degree of erosion. The undulated terrain with slopes with variable slope, position and width curtains will be determined by the transverse profile of the land.
The distance between the shelter-belts is typically 15-20 times the height of trees, and in the more exposed to erosion of up to 100-150 m distance between the shelter-belts can be determined in relation to erosion and critical distance ranges, usually between 50 and 100 m (Ciortuz, 2004). Following other authors minimum distance between the shelter-belts located on arable land (12% slope) is 300 m and between those located in meadows, 200 m, depending on the degree of erosion landform to (Popa et al., 2005) .
Width of shelter-belts can be calculated using the equation (Ciortuz , 2004):

$$b = \frac{d*k*i}{y-i} \ (m),$$

where “b” is the distance between the shelter-belts, in meters; “k” - coefficient calculation drain the rain, and - computing the intensity of rain, in mm / min, “y”- the intensity of the water absorption by the ground, in mm / min.
Normally, there are adopted widths of 20 to 40 m, reaching 60 m in heavily eroded slopes and 10-14 m on slopes less eroded (Lupe, 1953; Ciortuz, Pacurar, 2004), recommended that if the calculation results in an unacceptably large width, to use a width of 20 m, provided on condition where between rows of seedlings to be made for water retention ditches wave.

4.2. Species, afforestation compositions

Regarding the composition of antierosional forest belts, the authors previously conducted research recommends using the results obtained in our country, based on the recommendations of experiments and less foreign literature often contradictory and do not correspond to our stationary conditions (Catrina, 2005; Lupe, 1953).
Research on the behavior and evolution of culture protection forest on degraded land (Traci, 1985; Untaru, 2005) as well as the latest on the species used to make forest belts against environmental conditions (Constandache et al., 2006, 2007, 2012, 2013) allowed the establishment of afforestation compositions for installing the anti-erosion forest belts as follows.
Afforestation compositions based on oak tree species, namely: i) grayish oak (St.b) in the lowlands forest steppe on chernozem/faeoziom soils type ii) common oaks (St) and sessile oak (Go) (in wetter areas) in areas of low hills, lowland forest on chernozem, faeoziom, luvosol, eutricambosoil type soils and fertile aluviosol without salts.

Afforestation composition is: 30 St.b (St.p, Go) 10 Pa.c, Ul 20 Ar.t (Cd, Ul.t, Ju, Mr) 40 Sg (Mc, Sa, Co, Pd).
The osage-orange (Mr), cherry plum (Cd), dog rose (Mc), common hawthorn (Pd) tree species will be placed on marginal lines.
Afforestation composition based on locust (Sc), in forest steppe zones (steppe), low hills, on light soils (chernozems, psamosoil etc.) with low carbon content and *composition with honey locust (Gl)*, in the same areas, on carbonated soils (kastanoziom soil type or chernozems/ faeziom), and other heavy soils. Afforestation composition: 60 Sc (Gl) 20 Ar.t (Ul. T, Mr, Cd, Ml, Sl, Pr, Dd) 20 a (Pd, Po, Lc, Mc, etc.);
The locust and honey locust will be placed on interior lines and other species on marginal lines.
Afforestation composition based on field elm (Ul) (on calcareous chernozem, alluvisols) or Siberian elm (Ul.T) (on poor or heavy soils, with carbonates and salts) of forest steppe and forest plain. Afforestation composition is 30-50 Ul (Ul.T) 30 Ju, Ar.t, Mj, Vi.t , Pr, Cd, Mr, Sl 20 – 40 a (Pd, Po, Lc, Mc, Sp, Sâ, Ct.r).
The oleaster (Sl), osage-orange (Mr) and dog rose (Mc) will introduce only marginal lines and among other species, predominantly among interior shelter-belt.
Afforestation compositions based on common ash (Fr) or Pennsylvania ash (Fr.p), in meadows of the forest and forest steppe, on soils with excess water (alluvisols, or hidrisoils class):
40Fr (Fr.p) 40 Ci, Pr, Cd, Vi.t, Mr, Ar.t 20 a.
The ash tree will be used on fertile soils. The osage-orange and dog rose will introduce only marginal and among other species, predominantly among interior .
Compositions based on Siberian elm (Ul.T), Chinese poplar (Populus simony – Pl.s) or oleaster (Sl) on alluvisols or other salty soils: 40Ul.T (Pl.s, Sl) 20Ar.t (Cd, Pa.c) 40 a (Po, Ct.r).
If the shelter-belt are not exposed to grazing in their composition, a particular economic interest presents the introduction of fruit species such as walnut, cherry wood, apple and pear tree, cherry, blak cherry, cherry-plum, apricot, horn, hazel, hawthorn, red courrant bush, wild rose, blackthorn which to capitalize, may be placed on rows marginal of shelter-belts. Also included are species such as acacia honey, lime-tree, oleaster etc.
The significance of other forestry species symbol is: Te-lime tree, Pa.c. - Norway maple, Ar.t-Tartarian maple, Ju – field maple; Vi.t - mahaleb cherry, Pr-wild pear, a – shrubs.

5. The efficiency of antierosional shelter-belts

The efficiency of shelter-belts is recognized in the fight against drought and other climate related adversities storms, blizzards (Constandache, et al., 2013), in order to prevent and combat soil degradation processes (erosion, landslides), and for land protection biodiversity conservation, landscape.
Protecting soil and crops, shelter-belts have a decisive role in ensuring environmental effects and socio-economic.

a) The functional effects (ecologic) protection of natural resources and the environment in general, namely:
- reducing or maintaining the erosion to an acceptable value;
- reduce the loss of water and nutrients, reducing the speed of surface drainage;
- maintaining and improving the productive capacity of the soil;
- enhancement of biodiversity (habitat provide shelter for many species of flora and fauna) and reducing.

The study in arable land protected against erosion mainly by using a contour strip-cropping system and two forest belts (Perieni-Bârlad) in a period of approx. 50 years, show that the forest belts contributed to additional reduction of soil loss with values representing from 8 to 14% of the net erosion. Also, monitoring soil moisture dynamics over a period of 10 years along a cross-section through the entire basin, it was revealed the contribution of shelter-belts in mitigating effects of drought in dry years. Thus, in the area protected by the forest belts, in years when the sum of rainfalls was lower by 20-30% than the multiannual average which is 492mm, the soil water reserve in the 0 to100 cm layer was up to 14% for peas and up to 22% for winter wheat higher than those from surrounding unprotected areas (Popa et al., 2011).

Also, the positive effect of shelter-belts consist in crop protection against pests. The abundance and activity of entomophagous populations were higher in cultures of protective forest system, existing since 1952, the farm Cean-Boldut a S.C.D.A. Turda, where a natural biological control of major pests was registered. By comparison, cereal agroecosystems out in the open, it was necessary to apply insecticide treatments as developing pest populations exceeded the capacity limitation of entomophagous arthropod fauna (Malschi et al., 2009).

Monitoring of wastewater and sludge storage areas of wastewater treatment, show the risks that may affect the quality of surface waters (Panaitescu, Onutu, 2013), especially by discharge in the rivers or lakes. Antierosional shelter-belts may be very useful in such situations, having an important role in reducing runoff, filtration / retention of silts or nutrients from the water/assurance of needed quantity and quality and drinking water, but in camouflage storage areas or sludge treatment plants.

b) Social and economic effects:

-can provide the necessary heating of the heat in the hot days of summer, both for people working in agriculture and domestic animals, etc;

-can provide small, but not negligible amounts of firewood and small rural construction through forest exploitation at the end of life cycles (exploitability), which can be quite short, for 20 to 30 years (the locust) .

CONCLUSIONS

Soil conservation programs have no radical methods or universal recipes. Thus, soil conservation action should not act as one, but only after an plurifactorial analysis and wisely use of all means available to modern hydrology, agricultural and forestry equipment.

In the various categories of works for conservation and soil erosion control, antierosional shelter-belts have a significant role in reducing the leakage superficial slopes.

Organizing judicious planning, using the practice of agrotechnical anti-erosion, must be linked organically, the antierosional shelter-belts representing a basic link in the purview of this complex work.

Anti-erosion measures and work with biological character must be based on thorough research of vegetation to establish assortment of species that meet the conditions in the selected area.

Antierosional shelter-belts must be judiciously designed, requiring a harmonious combination with other measures and agro works to obtain maximum ameliorative effects.

Forest species that need to be given greater attention in the future to be included in the composition of protective erosion are: oak, Norway maple, ash, walnut, European sweet cherry, Siberian elm, field maple, Tartarian maple, honey locust, osage-orange, cherry plum, apricot, and among shrubs: hazelnut, cornel-tree, blackthorn, pigeon, wild rose.

In our country, although performed extensive work was perforemd in order to combat water and wind erosion, to the extent of these phenomena, lately reactivated, we consider that the resumption and continuation of these actions as necessary.

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SEISMIC PROTECTION OF INDIVIDUAL BUILDINGS LOCATED IN RURAL AREAS

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Abstract

According to the new seismic design code of buildings, Campina - Doftanei Valley area /Prahova County has a ground acceleration of 0.28 g. This value places it as the second seismic area after Vrancea epicentral area. In these conditions, the article presents some seismic protection measures considered by the owners in the execution of own buildings. Some structural shortcomings of buildings with one or two storey, which were observed at the incidence of intermediate Vrancea earthquake of March 4, 1977, will be emphasized. Also, strengthening solutions are presented as a result of lessons learned from this seismic event. Some structural types like timber structure with bracing and walls with OSB paneling, timber-frame structure filled with masonry brick and mixed structure, with rigid base from masonry and floors with timber frame structure. It is interesting how the transition is made from the rigid structure to the flexible one, knowing that the amplification of efforts appears at the top of them. It is studied how it is treated "the design" of these buildings which is the evidence of local seismic culture, where the flexible system is stiffened by bracing and the beams are arranged by the two orthogonal directions in the plane. The general idea is that in rural areas, even in those affected by earthquakes, an acceptable vulnerability of buildings with a minimum transfer of knowledge in the local community can be maintained.

Key words*: masonry, timber, bracing, belt beams.*

INTRODUCTION

Seismicity of Doftana Valley-Campina area

The Vrancea seismogenic zone is the most important seismic zone, taking into account the energy, the extent of the macroseismic effects and the persistent and confined character of the earthquakes that occur in this narrow area.
A very small mantle volume of about 30×70×160 km hosts earthquakes that occur repeatedly with magnitudes in excess of 7.5. All intermediate-depth earthquakes are contained in the high-velocity volume beneath Vrancea which is bigger than the seismogenic volume [Wenzel et al, 2002].
After Vrancea, as the second seismic area Doftana Valley-Campina region is considered. The Prahova County is situated on the moesic subplate, including the contact zone with the inter-alpine subplate. Thus, according to the new seismic design code of buildings, all seismic areas were assigned higher pga, and in this context, Campina - Doftanei Valley area/Prahova County has the peak ground acceleration of 0.36g, for earthquakes with the mean recurrence interval IMR = 475 yr., and of 0.28g, for earthquakes with the mean recurrence interval IMR = 100 yr. The value for control period is T_c = 1.0s, and the seismic intensity is VIII (on MSK scale) according to SR 11000/1-93.

Some existing categories of dwellings in Doftana Valley-Campina area/Prahova County

The rural residential buildings (non-engineered buildings) can be divided into two main categories. The first category of non-

engineered buildings is those built according to tradition, their types suiting the culture and materials available in that area- the traditional rural dwellings. The second category of non-engineered buildings is the rural city type dwellings or a combination of traditional look only, but not adopting the traditional skills and crafts in detailing, material use etc.

Their structural systems can include timber, load-bearing masonry (stone, adobe, kiln brick), wooden-clay mixed structures, clay or compacted clay structures and with some reinforced concrete elements of buildings.

Most of the rural dwellings are of traditional shape, with a regular building plan, and, in both cases of non-engineered buildings, the local culture imposed some resistance elements in order to provide gravity and lateral load-resisting systems.

Due to the "honeycomb" building configuration, the load-bearing walls are well connected and carry the loads uniformly. The use of the mortar brick walls, belts and tie rods, wall-ties and floor-joists anchors, wooden columns, arches of light materials, the presence of interior walls etc. are considered as providing sufficient lateral bracing. On the other hand, using concrete hollow blocks, reinforced concrete columns, slabs and collar beams, reinforced concrete frames or reinforced concrete skeleton (masonry bordered by reinforced concrete columns and collar beams), a more lateral load resisting is obtained.

Further some of the structural systems of traditional and city type rural dwellings are described in the following tables, Table 1…5 [Georgescu and Crainicescu, 1979; Georgescu, 1986].

Table 1. Timber structures

Structural system	**Non-engineered buildings- traditional rustic dwellings**	**Non-engineered buildings- city type rural dwellings**
Foundation	thick wooden beams under external and main transversal walls and stone boulders below	ground floor is often in stone and brick; foundation in stone or plain concrete or hollow blocks
Walls	horizontal wooden beams or planks; keys at half section, nut and father or dowel joints; walls are sometimes plastered for protection	similar
Floors	collar, main and secondary beams, ceiling	sometimes reinforced concrete slab over basement or gound floor
Roof	wooden structure with round wood, in 2-4 slopes, rafters and purlins joined with superior collar beams; cantilever eaves; roofing with wooden tiles, straws or reed	galvanized sheets and asbestocement plates
Layout	rectangle, symmetrical for single story houses; asymmetrical for two storied houses when first floor is usually with stone walls	urban influence in room distribution

Table 2. Masonry structures - Stone masonry

Structural system	**Non-engineered buildings- traditional rustic dwellings**	**Non-engineered buildings- city type rural dwellings**
Foundation	stone plates walled with clay or lime mortar or in dry masonry	similar
Walls	walled stone plates (40-50 cm wall thickness) wooden lintels; lime or mud mortar	similar
Floors	vaults in old buildings basement; wooden floor over first story	reinforced concrete collar beams and floors
Roof	in 2-4 slopes, wooden structure with round wood rafters and purlins; cantilevers; roofing with woden tiles, straw, reed, tiles; local roofing with stone plates (5cm) cut in tuffa, limestone	similar
Layout	rectangle, symmetrical for single story houses	similar

Table 3. Masonry structures - Kiln brick masonry

Structural system	**Non-engineered buildings-traditional rustic dwellings**	**Non-engineered buildings-city type rural dwellings**
Masonry structures- Kiln brick masonry		
Foundation	brick or stone with lime mortar; basement on masonry vaults in old buildings	plain concrete or concrete hollow blocks
Walls	masonry in kiln brick and lime mortar (clay-sand mortar in por houses); wooden lintels or arches for openings	masonry made of pressed brick, hollow brick, concrete hollow blocks, ytong blocks, reinforced concrete columns and collar beams
Floors	wooden beams and timber ceilings; masonry vaults in old monumental buildings	reinforced concrete slabs
Roof	in 2-4 slopes with wooden structure, with round wood rafters and purlins; cantilever eaves; roofing tiles, lead or copper sheets	wooden structures, new forms with reinforced concrete slab roof
Layout	rectangle, T or L; 1-3 stories with towers, external stairs, balconies	similar

Table 4. Framed wall structures - Timber frame structure with infilling materials

Structural system	**Non-engineered buildings-traditional rustic dwellings**	**Non-engineered buildings-city type rural dwellings**
Framed wall structures- Timber frame structure with infilling materials (padlle or trellis work)		
Foundation	sometimes river stone boulders below the wooden beams at the wall base in the foundation trench	ground floor is erected in stone or masonry with plain concrete foundation
Walls	timber frames with corners columns and opening bordering posts as well as horizontal beams, sometimes horizontal wattled tree branches; inclined bracings; infilling in the timber frame with: mud, clay brick and clay, stones and clay; plastering with clay or lime sand mortar	finishing works in stucco
Floors	wooden collar beams and main beams connected plastered timber or tree branches ceiling	similar
Roof	in 2-4 slopes; structures connected with frames and collar beams; roofing with wooden tiles, tiles, galvanized sheets	similar
Layout	rectangular, symmetrical	similar

Table 5. Framed wall structures - Plated timber frame structures

Structural system	**Non-engineered buildings-traditional rustic dwellings**	**Non-engineered buildings-city type rural dwellings**
Foundation	river stones; wooden beams at wall base	plain concrete with rc perimetral beam
Walls	timber frames with corner columns and opening bordering posts as well as horizontal beams	rc frames or rc scheleton; masonry bordered by rc columns and collar beams
Floors	main and secondary beams, timber ceiling	reinforced concrete precast hollow strips or monolithical slabs
Roof	in 2-4 slopes using wooden structure joined with frames and superior collar beams; roofing with wooden tiles, tiles, galvanized sheets	in 2-4 slopes or flat terrace, tiles or galvanized sheets
Layout	rectangular, T or L	villa type

MATERIALS AND METHODS

The behaviour of residential buildings with non-engineered construction systems at the Vrancea earthquakes

Some architectural and constructive elements that impose a good behaviour to the Vrancea earthquakes are as follows:

- reduced dimensions of Romanian rural buildings and a relatively simple layout;
- a relatively light roof, in 2-4 slopes having a structure well tight with the masonry and the walls;
- the room floors are built with dense beams tightly connected with the masonry walls;
- the height of only 1-2 levels, the floor being made of lighter materials (wood, trellis work);
- the existence of a sufficient number of elements that take over the horizontal loads (columns, masonry walls, wooden walls with corner joints, bracings);
- a relative symmetry of the building layout and a symmetrical distribution of the doors and windows openings;
- the pressure of certain elements that provide the spatial interaction: wooden contour beams at the foundation and roof levels, working as belts, wooden horizontal elements at corners in the earthen walls.

Some typical damages to non-engineered buildings (the structural systems of traditional and city type rural dwellings) which equates to a poor behaviour to the Vrancea earthquakes are as follows:

- roof covering tends to be dislodged or separate from its supports;
- walls tend to tear apart, to shear off diagonally in direction or to collapse;
- additional shear due to twisting or warping for unsymmetrical building;
- concentration of stresses in openings and failure at corners of openings; failure at corners of walls;
- failure due to sudden change in mass or stiffness;
- weak connection between wall and wall, wall and roof, wall and foundation;
- failure of rigid and insufficient strength of structural elements and connections;
- poor quality of construction (poor material and poor workmanship) etc.

Behaviour of rural structures during 1977 Vrancea earthquake and others (1986, 1990)

Generally, at the earthquakes from 1977, 1986 and 1990, the damages of dwellings from some villages ranged from apparently no damage, or a slight one, to heavy damage and even collapse. Many roofs, chimneys and walls of the buildings were damaged. Apparently few roofs collapsed, but many were displaced laterally. Vertical and horizontal cracks and evidence of torsion were observed in chimneys. More chimney damage was observed in buildings with high-pitched roofs. This may have been due to the fact that chimneys on buildings of this type were higher, and consequently more flexible. Gable walls supported on columns were displaced up to some cm. There was also some damage to buildings as a result of foundation settlement [Georgescu, 1979, 1986; Vlad, 2008].

From the point of view of structural system, the timber structures withstand earthquakes without collapse or major damage [Georgescu, 1979, 1986]. Several nonstructural damage have occurred (plaster and chimneys failure). The stone structures have presented cracks and partial failure due to bad mortar quality or poor workmanship. The masonry structures have presented damage by wall corners and crossings cracking, diagonal cracking, local failure of untied walls. The quality of mortar and brick, the overall layout and conception of the building played an important role. The timber frame structures with infilling or timber plated behaved better than masonry. Nonstructural damage by plaster falling and lintels cracking were often observed. The spatial braced wooden frame makes this type of structure proper for seismic zones.

Types of failure mechanisms and damage to residential buildings with traditional construction systems. Some seismic protection measures considered in the rural area.

During an severe earthquake, certain effects are seen to occur, the roof tends to separate from the supports, the roof covering tends to be

dislodged; the walls tend to tear apart and if unable to do so they tend to shear off diagonally in the direction of motion; infill walls within reinforced concrete or timber framing tend to fall out bodily unless properly tied to the framing members. From those facts, an analysis of the mechanism of damage is performed.

Timber floor construction may be in the form of wooden beams covered with wooden planks, ballast fill, and tile flooring. In most cases, timber joists are placed on top of walls without any positive connection; this has a negative effect on seismic performance.

After the strong earthquakes, in the absence of belt in the floor the propagation/expansion of inclined cracks can be observed on the masonry walls.

Some seismic protection measures considered in the rural area

Reinforced Concrete coating to masonry with independent bars and concrete, pillars in the corners of building are layout, Fig. 1.

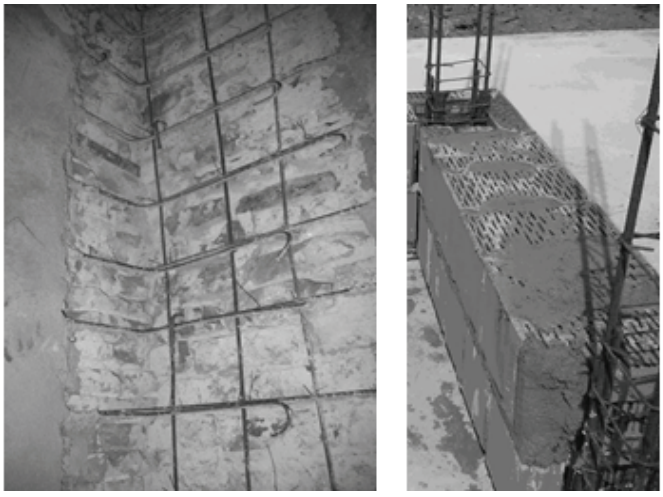

Figure 1. RC coating to masonry wall with independent bars and concrete; layout pillars in the corners

Reinforced Concrete Floors/Roofs. It is a common structural/seismic rehabilitation practice to replace the original floor structures in old buildings with either a precast concrete joist system or solid Reinforced Concrete slabs.

Seismic Bands (Ring Beams). Usually provided at lintel, floor, and/or roof level in a building, the band acts like a ring or belt, as shown in Fig. 3-8. Seismic bands are constructed using either reinforced concrete or timber. Seismic bands hold the walls together and ensure integral box action of an entire building. Also, a lintel band reduces the effective wall height. As a result, bending stresses in the walls due to out-of-plane earthquake effects are reduced and the chances of wall delamination are reduced. In some cases, a lintel band is combined with a floor or roof band.

The system of seismic bands participates in ensuring the spatial character of the structure through: the connecting of walls on the two directions; the formation of a spatial skeleton with reinforced elements, capable of taking up the tensile stresses, by the binding of all pillars in each floor; increasing the rigidity in the horizontal plane of floors; the transfer of seismic forces from the floors to the walls of the structure. The seismic bands/belts contribute to limiting crack propagation from one level to another. This type of damage can lead to wall collapse under the combined effect of seismic action in the plane and perpendicular to the wall.

Some illustrative examples of rural residential buildings are shown in Fig. 2-12.

Figure 2. Strengthening of the external walls with some buttress to a traditional dwelling

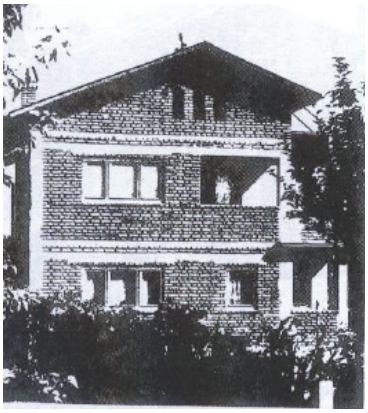

Figure 3. City type rural two storied brick masonry dwelling with embedded RC columns and RC slabs (the collar beam as a frame beam)

Figure 4. City type rural two storied ytong blocks dwelling with RC members (RC window beam lintel parallel to the collar beam and floor slab acting as a frame with columns; foundation is made of concrete)

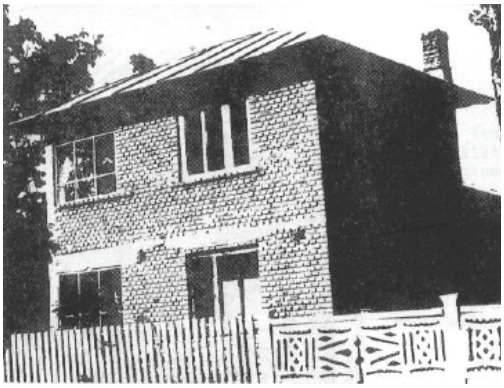

Figure 5. City type rural two storied brick masonry dwelling with RC floor slabs (lintels are embedded in RC floor slab)

Figure 6. City type rural two storied brick masonry dwelling with embedded RC columns and RC slabs (the collar beam as a frame beam)

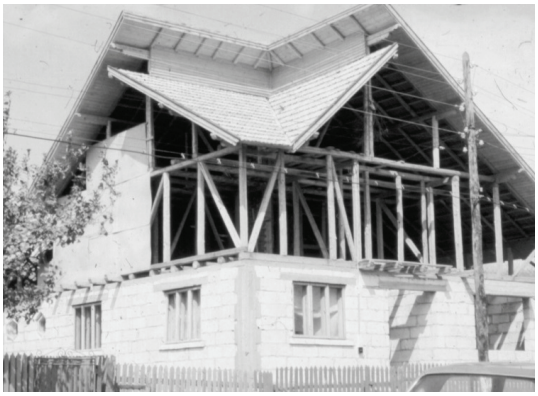

Figure 7. A traditional dwelling with roof band and RC lintels, pillars at corners, a light roof, in 2-4 slopes having a structure well tight with the masonry

Figure 8. A traditional dwelling with roof band and rc lintels, without pillars at corners, a light roof, in 2-4 slopes having a structure well tight with the masonry

Figure 9. A traditional dwelling with RC floor and without RC belts

Figure 10. A traditional dwelling with RC floor slabs (lintels are embedded in RC floor slab)

Figure 11. City type rural three storied brick masonry dwelling RC skeleton mixed with timber beams

Figure 12. City type rural three storied brick masonry dwelling with RC floor slabs and without RC belts

Vulnerability characterization of non-engineered construction systems using quantitative indicators.

In order to characterize the vulnerability of non-engineered construction systems, the following simple indicators may be considered [Sandi et al, 1985]:

- the area indicator, $I_{ar} = \frac{A_{active}}{m}$, where

A_{active} = the total area of horizontal sections of shear resisting members, oriented along a direction considered (m^2)
m = the mass generating seismic forces to be transmitted through A_{active} (t)

- the acceleration indicator, $I_{ac} = I_{ar} R_s$, where

R_s = the ultimate shear strength of the material
I_{ac} = the ultimate static acceleration corresponding to the shear strength of the structure considered (critical acceleration).

As a general observation, regarding non-engineered buildings-traditional rustic dwellings, the area indicator has high values, I_{ar} = 0.02…0.05 m^2/t, and this leads to high values of the acceleration indicator too, I_{ac} > 5m/s2. By comparison, for non-engineered buildings-city type rural dwellings, with ground floor and stories, but with lack of internal walls (replaced by reinforced concrete pillars or columns not designed to resist to earthquakes), the area indicator has low values, I_{ar} = 0.005…0.01 m^2/t, leading to values of the acceleration indicator of around I_{ac} = 1m/s^2.
For dwellings with masonry bearings walls and flexible floors and buildings with masonry bearing walls and rigid floors the vulnerability characteristics are analysed and the damage degree corresponding to the VIII intensity on MSK scale may be 2…3, which would mean moderate or heavy damage according to EMS-98; the structural damage cost can be 20%...50% of total repair cost.

CONCLUSIONS

From the above, it is shown that, in rural areas, according to a local seismic culture, the non-engineered dwellings may contain some elements which give them a good behaviour to Vrancea earthquakes. Breakdowns occur when parts of these houses are not connected properly, and work independently, or they are insufficient and have few ductility sources. Thus, the total area of horizontal sections of shear resisting parts of structural systems, oriented along the earthquake direction and, also, the mass generating seismic forces to be transmitted through this area are very important for all residential buildings with non-engineered construction systems. The damage degree corresponding to the VIII intensity on MSK scale may be 2…3, which would mean moderate or heavy damage according to EMS-98; the structural damage cost can be 20%...50% of total repair cost.

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ENERGETIC AND DYANMIC ANALYSIS OF MODERN AND ORIGINAL MASONRY BUILDINGS

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Abstract

The paper aims to emphasize the performance of confined masonry with polymer grids comparing to masonry with steel reinforcement, in terms of energy consumption, strength and stiffness. In the state-of-the-art there are two known types of masonry. The first type is the original brickwork, composed of burnt soil brick units bonded together with lime mortar. The second type is made of ceramic bricks burnt up to the point of vitrification, using cement mortar. There are important differences between the two types of masonry, which confer them different properties. Masonry is reinforced in order to increase its resistance to seismic activity. Original masonry can be reinforced with non-metallic, polymer-based reinforcements, while the modern masonry is reinforced with steel reinforcements. Energy consumption needed to produce a building will be carried out by calculating the embedded caloric energy that includes phases of production and transportation of materials: bricks, mortars and reinforcements. An ergonomic calculation will indicate the mechanical work needed for the construction of the two compared situations: original and modern reinforced brickworks. Increased elasticity and strengthen to earthquake in these two reinforcement situations is shown by a dynamic and modal analysis of structure with adequate software. The analysis will be made on two models taking into account requirement of seismic design code on plane and vertical irregularity.

Key words*: reinforced and confined masonry, polymeric grids, dynamic response, embedded energy.*

INTRODUCTION

Embedded energy is a concept that defines the total energy required to obtain a product, taking into account all stages of production, such as raw material extraction, transportation, manufacturing and commissioning work.
Recently, embedded energy has gained particular importance in respect to reducing the consumption of non-renewable resources in the context of concerns for environmental protection.
From an economic perspective, this concept covers the need to assess the cost of a construction, taking into account that the selling price of construction materials varies according to the manufacturing technology, trade margins and - in addition -the daily fluctuations of currency exchange rates.
Embedded energy is measured as the amount of non-renewable energy per unit of construction material, component or system. It is expressed in megajoules (MJ) or gigajoules (GJ) per unit weight (kg or tonnes) or area (m^2).The process for the embedded energy calculation is complex and involves numerous data sources.
In the present paper we provide a unique study for Romania and Eastern Europe achieved in the conditions of centralized economy, when significant information was available on manufacturing technologies and energy quantities employed, and interest for energy saving was very high.
The study, conducted in the 80th years by the Institute for Building Materials Research and

Design (ICPMC), has determined the total energy embedded in construction materials and products used across the entire manufacturing process, ranging from the raw material extraction to transporting the product to the site (without unloading).
To structure the research, the following were specified: a unique terminology aligned to the one used worldwide, a unique calculation of the caloric energy of conventional fuels, the yield of electricity and other basic parameters and a unified methodology for the analysis of energy consumption for each stage of all technological processes (Georgescu, 1979).

In order to obtain a clearer and more complete information on all the energy involved in carrying out the construction, the indices corresponding to the articles in the inventory indicators C, Iz and Ts have been calculated. Their values resulted from multiplying the normalized specific consumption according to the standardized analysis (quantity of materials, half-finished goods and machine hours per unit of measurement) by the energy indices (Radu, 1980).
As a result, the following average values for the embedded energy of construction materials have been determined (Table 1):

Table 1. The energy embedded in construction materials (Radu, 1980)

Construction materials	Average embedded energy (MJ/m^3)
Ceramic products	
Porous bricks	4253
Pressed solid bricks	4506
Ceramic hollow bricks	5194
Mortars	
Mortar M10 T	3278
Mortar M25 T	2903
Mortar M50 T	2287
Mortar M100 T	2756
Mortar M4 Z	3638
Mortar M10 Z	1873
Mortar M50 Z	2413
Mortar M100 Z	2521
Metal reinforcements	
Rebar	351792
Welded meshes	353518

MATERIALS AND METHODS

Energy embedded in masonry

As a building material, masonry has been used since ancient times as the key component for housing, together with wood and earth.
It is known that since the beginning of construction industry, builders have played an important role in the balance of constructive solutions. If the beginnings consisted mainly in stone masonry solutions for building constructions, today there is a large diversification and specialization in masonry materials.
In masonry, bricks occupy 85% of the total volume while mortar represents 15%. The total amount of primary energy required to achieve a cubic meter of masonry was obtained from the sum of 85% of the embedded energy in bricks with the 15% of mortar energy.

Energy embedded in confined masonry with welded meshes

To improve the performances of resistance, brickwork is reinforced by confinement (jacketing). Networks typically use thin steel bars or welded meshes.
In this study we refer to meshes RΦ4, RΦ6 and RΦ8 (bars of 4, 6 and 8 mm diameter, welded at 10 cm, 15 cm and 20 cm equal distances respectively, across two perpendicular directions) (Figure 2); the specific weight is considered γ_{STNB}=78.5 kN/m^3(Codita, 2011).
Since the lime found in the composition of mortar is known to attack the metal reinforcement by corroding it, for the reinforcing of

masonry is used only lime mortar, of type M100 (C17-82 Technical instructions).

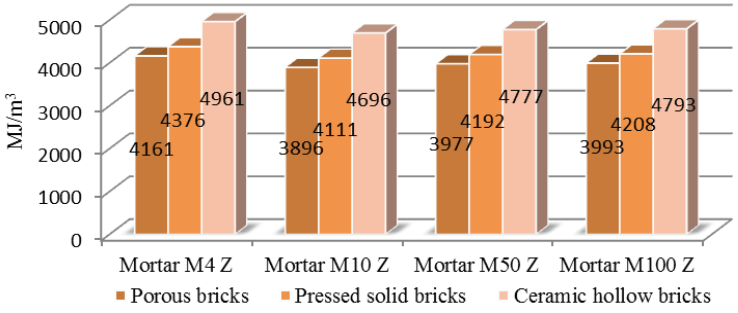

Figure 1. Energy embedded in various types of brick masonry and mortars

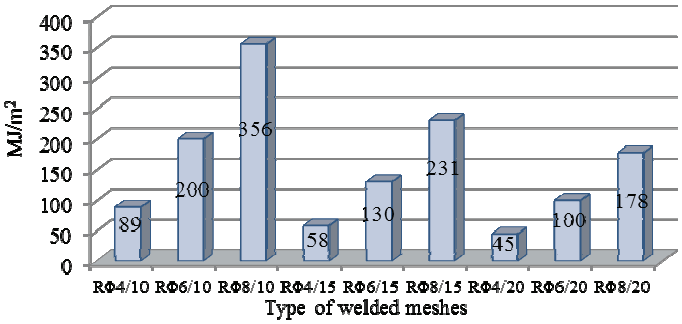

Figure 2.Energy embedded in welded meshes

The metal reinforcement is buried in a layer of 2,5 cm of cement mortar M100 T(Figure 1). The total volume per square meter of concrete reinforced plaster is 0.025 m^3, and the energy embedded in the layer of plaster mortar M100 T is 69 MJ per m^2 (Figure 3).

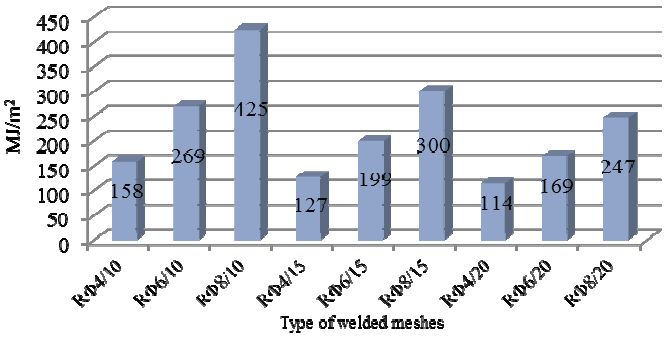

Figure 3. Energy embedded in the reinforced plaster

Polymer reinforcement

As polymer reinforcement three types of grills are used, which are manufactured according to the license held by Tensar International Limited: RG 20, RG 30 and RG 40 (Sofronie, 1995).

Since the TENSAR manufacturer considers the quantity of energy embedded in the polymer grids used in this study to be a trade secret, we

have relied on values from other sources (Figure 4). The article "Earth Reinforcement and Soil Structures" by Colin JFP Jones (Colin, 1996), provides information on the amount of energy contained in a tone of high-density polyethylene, but as a membrane (sheet). According to this source, the amount of energy is 84 GJ/tonne or 84 MJ/kg. In order to better represent the manufacturing process, we have added an arbitrary 50% amount of energy, which accounts for punching and stretching (Sofronie, 2004).

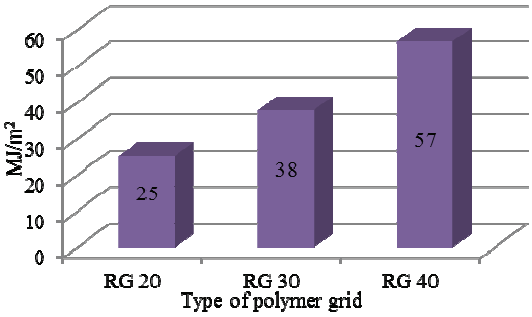

Figure 4. Energy embedded in polymer grid

Energy embedded in masonry confined with polymer grids

Confining with polymer grids is increases the bearing capacity of masonry, by creating a three-dimensional effect. The confinement is applied only on the outer surfaces of masonry and must be fully closed.

The mortar can be lime without cement or lime-cement. A small quantity of cement is needed because in this composite the mortar plays the role of a matrix involved in transferring the stress from the reinforcement to the masonry (only synthetic reinforcement is responsible for the resistance of jacketing).

The minimum thickness of plaster is 18 to 20 mm and can reach up to 30 mm in normal conditions. Thicker plasters increase the weight and raise the cost of construction; besides that, they reduce the interaction between masonry and confinement (Figure 5). One m^2 of plaster requires 0,02 m^3 of mortar.

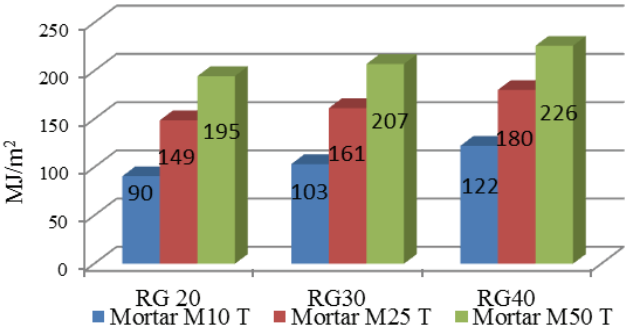

Figure 5. Energy embedded in plaster reinforced with polymer grids

RESULTS AND DISCUSSIONS

Comparative study of embedded energy and seismic response of structures with masonry walls

To model masonry structures, simple and confined, four models have been selected, having the same irregular shape in plan, but with different height regimes (Dragomir, 2012). A comparative study was conducted for a concrete frame structure with brick panels in three structural variants: simple masonry, reinforced masonry at 4 joints, and reinforced at 4 joints and confined with polymer grids

(Dragomir, 2009). The table below shows the values calculated for the energy content of perimeter masonry panels (Table 2):

Table 2. Energy content embedded in masonry panels

Height	Masonry (MJ)	Reinforced masonry in joints (MJ)	Reinforced and confined masonry (MJ)
P+3	545356	552716	642988
P+5	818034	829074	964482
P+7	1090712	1105432	1285976
P+9	1363390	1381790	1625870

The final values submitted in the table are influenced by parameters such as: type of bricks (pressed solid bricks), polymeric grids (RG40 for example), plaster mortar (M50 T for confinement and M100Z for masonry) masonry panel thickness (0 30m) and height regime.

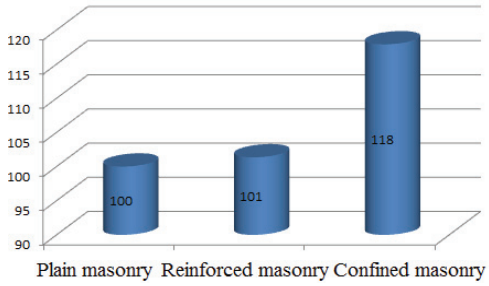

Figure 6. Percentage variation of the energy embedded in the three types of masonry

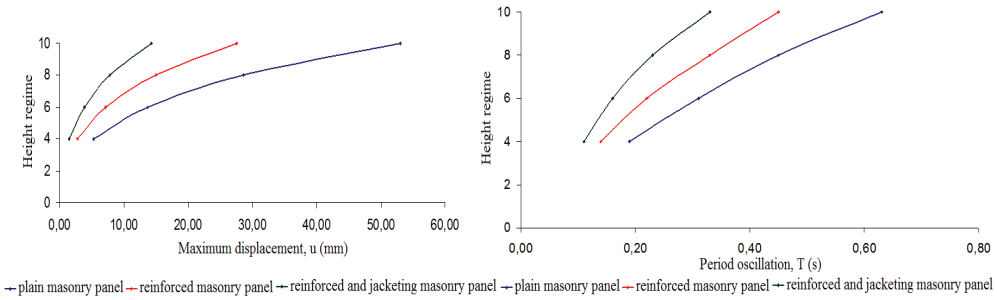

Figure 7. Maximum displacements and oscillation periods obtained by structural analysis

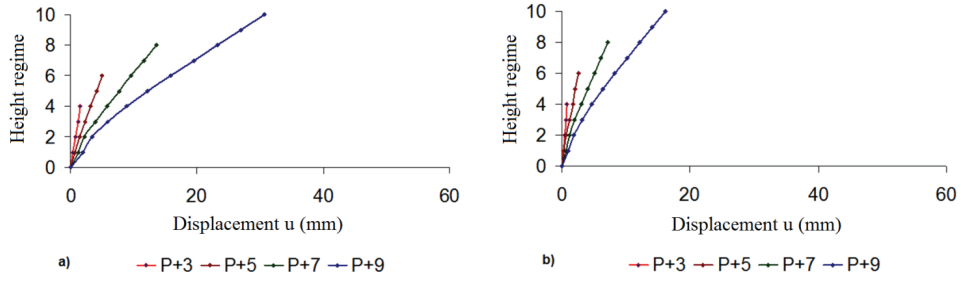

Figure 8. Recorded seismic response of considered masonry types:
a) simple masonry, b) reinforced masonry in joints with polymer grids

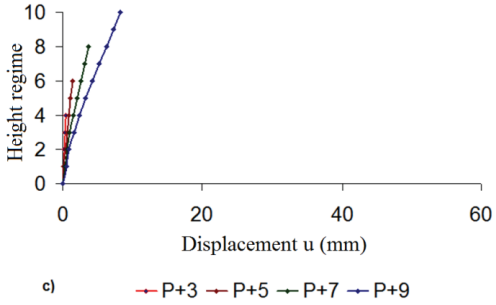

Figure 8. Recorded seismic response of considered masonry types: c) reinforced and confined masonry with polymer grids

The results shown in Figure 6-8 demonstrate the efficiency of polymer grid reinforcements in masonry joints and the influence of polymer grids confinement on masonry walls.

CONCLUSIONS

By comparative energy calculation, the investment required for the development of masonry and confined masonry buildings has been indirectly revealed. According to calculations, RG grid polymeric jacketing is more economical in terms of embedded energy when compared to welded meshes.

The fundamental values of oscillation periods, the displacement values in the nodes of the modelled structures and the upper deformations for each structure have been determined.

In all the considered cases the effectiveness of joints reinforcement as well as of the confinement with polymer grids of masonry panels has been demonstrated.

In conclusion, through the two aspects presented, the energy one and the structural one, the present work has met its objective, to provide a study on the influence of energy embedded in masonry buildings on its structural response.

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TRIAXIAL GEOGRIDS IN ROAD TECHNOLOGY PROGRESS

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Abstract

The paper deals with the design and construction of unpaved access roads where large quantities of triaxialgeogrids have been incorporated. In the last 5 years in Romania big wind farms were set up in order to increase the national production of green energy. Tens of kilometers of unpaved access roads have been executed for the establishment, operation and maintenance of the wind farms. Geosynthetic materials and, specifically, triaxialgeogrids, brought important benefits in the construction of these roads: a decrease of the execution period, a decrease of construction costs and a better quality of the completed works.

Key words**:** *congruence, durability, isomorphism, strength, topology.*

INTRODUCTION

Soils, as material for foundations, absorb the actions defined by Newton as vectors, meaning moments of a force, only after their conversion into unit stresses as tensors, meaning surface forces. There are only two types of such unit stresses: 1) Normal unit stresses, marked with σ, originating from the fundamental mechanical phenomena of axial extension, axial compression and pure bending and 2) Tangential unit stresses, marked with τ, originating from pure shearing and free twisting mechanic phenomena. There are no other types of unit stresses in any other construction material and the two defined above are always perpendicular on each other. In the equilibrium equations, written based on Newton's reciprocal actions 'law, the two unit stresses σ and τ never occur explicitly and independently of the surfaces on which they operate. Since these equations are vectorial, to these actions, which are external forces and moments, are opposed the sectional stresses which are internal forces and moments and thus creating the products of the unit stresses with the surfaces they occur on (Timoshenko, 1951). Morphologically, soils for the construction foundations are of two types: 1) cohesive or aluminous and 2) non-cohesive or granular as sand, aggregate and ballast. What distinguishes them is their way of yielding in compression in the gravitational field under their own weight. The cohesive soils yield through cutting after curved cylindrical surfaces of hyperbolic type, while the granular soils yield in shearing or sliding, after plane surfaces assigned to Coulomb as recognition for the Law of friction. Cohesive soils have large compaction accompanied by transversal plastic deformations and reduced bearing capacities, while the non-cohesive soils have low compaction and high bearing capacity. To increase the mechanic performance of soils, both cohesive and non-cohesive, in time several consolidation procedures with fill mass were tried, but composites were never obtained. Nowadays, composites are seen as a mix or association of two materials with complementary physical-mechanical characteristics which obey the principle of geometric continuity of deformations formulated by Saint Venant (Feodorov, 1997).
Practice proved and history also retained only the reinforcement of the non-cohesive or granular soils. The reinforced soil was invented by the French Henri Vidal and patented in London in 1962. Vidal's reinforcement Principle is based, for the transfer of unit stresses between the soil and reinforcement, on the "anchorage effect" which uses the tensile strength of the reinforcement through the σ normal unit stresses. Reinforced soil is a composite material and is essential different from the reinforced concrete. The latter was invented in 1867 by the French gardener Joseph Monier from Versailles to protect the flower vases made of concrete with English

cement. However, reinforced concrete is a composite material which is based, for the transfer of unit stresses between concrete and reinforcement, on the "grip vice effect" which uses the resistance to shearing obtained through the tangential unit stresses τ from the interface between concrete and steel metal reinforcement. It is interesting to note that at less than 20 years from the patenting in London, in 1981, at Politehnica Iasi from Romania, Prof. Tudor Silion initiated and guided the doctoral thesis "Contributions to the dimensioning of reinforced soil works" of Anghel Stanciu engineer who afterwards became university teacher at the same University (Stanciu, 1981). Both French inventors, Monier and Vidal, from different eras, separated by almost one century, had the same inspiration source for their inventions and namely the interaction between the plant roots and granular soil. But they considered the same truth from two different perspectives that can be symbolically called σ and τ. As a matter of fact, there is no third solution.

At the beginning metallic reinforcements were used, at first of steel and then of Aluminium. But steel oxidizes quickly in the ground and Aluminium is far too expensive for such works. That is why the definitive transition was made to synthetic, non-metallic reinforcements in less than two decades. In the mid 80s the use of synthetic reinforcements spread in all countries with earthwork advanced technologies, but especially England and Germany perform reinforced soil retentions. Being actually self-retentions, these works are much cheaper, may be performed in the cold season as well, after the ending of agricultural works, have remarkable draining qualities, do not affect the agricultural lands and preserve perfectly the environment. Still, for 33 years, the reinforced soil structures have been used cautiously because their behaviour to dynamic actions in general and seismic in particular was not known. Only from 1995 earthquake from Kobe consecrated their use in seismic areas and established them definitively and Japan's contribution in promoting these structures was remarkable. Immediately after this earthquake, the British standard BS 8006:1995 was issued and implemented opened the way for the application of reinforced soil without any restrictions throughout the world. Two years later, in 1997, the Romanian contribution to the composition concept of the reinforced and confined soil structure was recognized (Feodorov, 1997; Feodorov, 2003; Sofronie and Feodorov, 1995; Sofronie and Feodorov, 1998). Then followed attempts of 3D models at reduced scale, the first in Europe, on the seismic tables INCERC Iasi for geocells and at Bristol University, England, for reinforced soil retentions (Sofronie, 2000; Sofronie, Taylor and Greening, 2000; Sofronie, Taylor and Crewe, 2000). The only country after Romania that carried out trials at natural scale is Japan, but their results are according to some national standards, very different than the European ones.

Since they offer safety at the lowest price, in a relatively short time, of only of few decades ago, the reinforced soil found many applications, especially in the critical or vital structures. Among these, in order to establish the ideas, we remind only three types of works. The first type includes the retention works. These massive structures of granular soil become auto-retentions, miraculously, through reinforcement and under gravity's actions. But if the gravity is diminished by immersion or seismically, the effect of soil reinforcement with geogrids will weaken. Gravitational variable actives, applied usually on the crown, are small compared to the permanent ones, under own weight and active pushing of the upstream soil, but favourable when they have the direction of the gravity. Instead accidental actions from earthquakes are dangerous due to the high inertia forces developed because they increase the initial eccentricity with which, by construction, the reinforced soil retentions occur (Feodorov C., 2012; Feodorov, 1997; Feodorov, 2003; Feodorov, 2012). The second type includes the road systems. Here occur higher concentrated vertical forces which, in addition, are mobile. The conversion of these concentrated forces in unit stresses represents a classic problem of the mathematics Theory of elasticity solved theoretically by Boussinesq (Tensar, 2011). Actually, the first innovative step was taken by producing the geogrids with rigid integrated nodes. The second innovative step concerns the geogrids ribs while concur in nodes. The geogrids' level of conformation to

the ribs has reached outstanding performance and, apparently, the development process is in progress. The functions of geosynthetic reinforcements in road systems are currently well known (Voinea, 1989). For this reason, this article is dedicated to this subject. Finally, the third type includes the geocellular systems. These are spatial structures of granular soil, gravitationally confined or self-confined. By geocells' confinement is obtained a triaxial compression state and thus their bearing capacity may be increased by up to five times compared to the monoaxial compression. By virtue of the logical relation between the part and the whole, the increase of the bearing capacity from the level of individual cells is extrapolated to the spatial structure in its entirety and thus safety and cost performance is obtained. Once the granular soil confinement's effects are proved, the procedure may be identified or, if applicable, reedited in other constructive versions.

The first part of the article, named *Materials and Methods*, presents successively the mono- and biaxial geogrids production of technology, their conformity, their final geometry, the transfer of the σ and τ unit stresses trough geogrids and finally what the innovation brought by triaxialgeogrids.

The second part of the article, named *Results and discussions*, presents three case studies and each of them is commented.

The conclusion of the article highlights the fact that the remarkable progress in the road technology was made possible only by correct the applying in practice of the scientific knowledge already existing at the date of their issuance.

MATERIAL AND METHODS

Triaxialgeogrids as reinforcing materials

1. Geogrids Producing

Appropriately selected and proportioned mixes of polyethylene and polypropylene are extruded into stripes of polymer. Then, holes are drilled in the stripes, arranged according to octagonal networks. The perforated stripes are heated and extended uniformly and uniaxial until the circular holes become rectangular meshes with rounded corners. If the extension is repeated furthermore, but this time crosswise, perpendicular on the movement's direction, the biaxial geogrids with square curvilinear meshes are obtained (Figure 1).

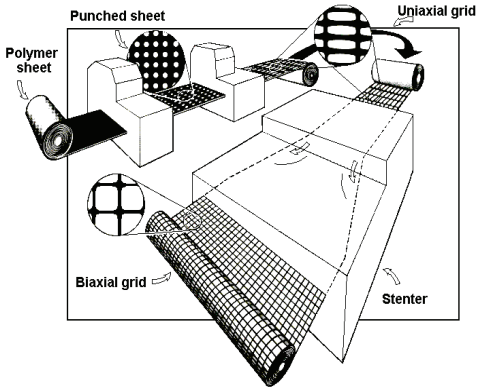

Figure 1. Manufacturing procesof geogrids

2. Geogrid conformation

The extension process with a constant axial *N* force is produced according to the equilibrium Law

$$N = \int_A \sigma dA \qquad (1)$$

Considering that all geogrid's ribs have technologically identical cross sections, it is acknowledged that the normal unit stress σ from the ribs is constant across the entire cross section *A*. Under these circumstances, the Bernoulli formula is obtained through integration

$$\sigma = \frac{N}{A} < f \ (2)$$

where*f* is the tensile strength*Pa* If the tensile axial force *N* remains constant, which is perfectly possible from a technological point of view, and even convenient, between *A* cross section area and the normal unit stress σ is established a relation of reverse proportionality, expressed in Bernoulli hyperbole (Figure 2)

The constancy of the tensile force expressed by the relation,

$$Af = const., (3)$$

denotes the fact that the solution used is the most economical. Furthermore, as the *t* thickness of the geogrid is constant and the ribs

have rectangular sections, results the widths b of the ribs are still variable, so that:

$$p = bf = const., (4)$$

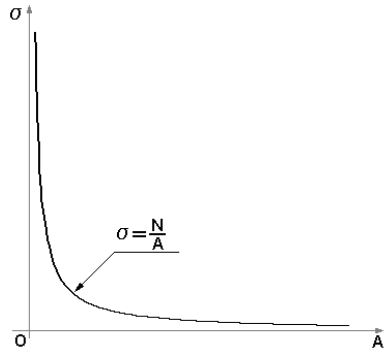

Figure 2. Bernoulli's equilateral hyperbole

What defines the *p* constancy of the tension flux constancy in *N/m* of the fins. This remarkable characteristic had not been yet identified in any reinforcing metallic or synthetic material. For this reason the producer defines the geogrids according to tension flux *p*named the quality control resistance. For example, *biaxial geogrids* means *p=20kN/m.*
Then, the polymeric geogrids were conformed to the same tension flux law. It is a natural self-confirmation process. Indeed, through the successive congruence or mirroring of the Bernoulli's hyperbole, after the two coordinate axes is obtained the image of an integrated node of the geogrids described above (Figure 3). Then, through repeated successive mirroring of the obtained nodes, and operation called auto Topology or iso-morphism, the mono and biaxial geogrid images are obtained (Figures 4 and 5)

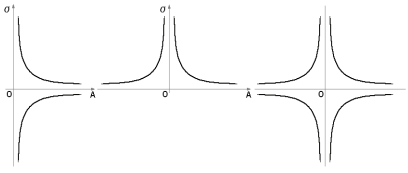

Figure 3. The Bernoulli's hyperbole congruency

3. Geometry of the grids
Practically, polymeric geogrids consist of flexible fins and rigid nodes. The connection between the nodes and fins follow continuous curves.

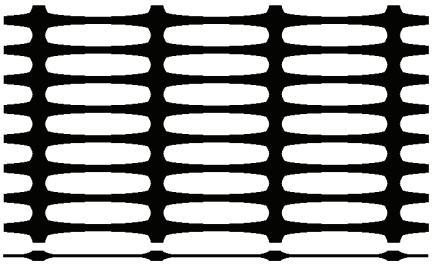

Figure 4. The geometry of the monoaxial grid

The lack of discontinuity excludes the local concentrations of efforts and ensures the stress flow fluency. Monoaxialgeogrids have two symmetry axes while biaxial geogrids have four axes.

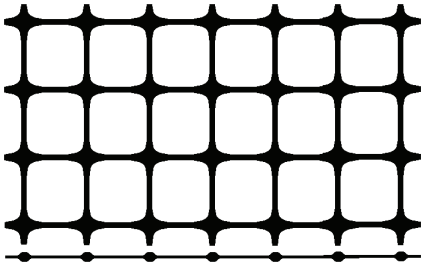

Figure 5. The geometry of the biaxial grid

By this geometry, the geogrids state Bernoulli's hypothesis regarding equal and small deformations in both directions, which entails an uniform state of unit stresses.

4. Unit stress transfer
Polymeric geogrids with integrated nodes are used to reinforce non-cohesive granular soils by the interlocking mechanism. The reinforcement is passive and the transmission of the unit stresses from the soil to the geogrids is performed in discontinuous manner through the rigid nodes. These nodes convert the normal unit stresses in sectional stresses. These are tensile stresses and make the connection of each node with the nearby nodes (Figure 6). Due to their thinness, the ribs never take compressions. Otherwise, they have a certain cross stiffness and that's why when through the redistribution of the unit stresses around nodes cutting forces occur these are taken from ribs (Figure 7).

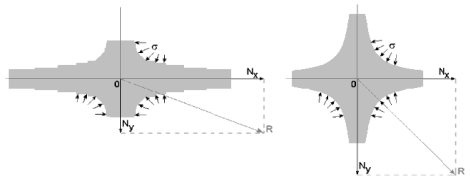

Figure 6. The transfer of the unit stresses in the integrated nodes from axial forces

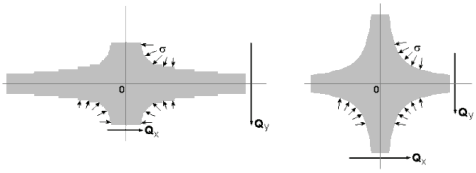

Figure 7. The transfer of the unit stresses in the integrated nodes from cutting forces

In all loading cases, the reinforcement from the polymeric geogrid becomes deformed. The deformations occur both in nodes and ribs and they are always elastic and plastic at the same time. The elastic stresses and deformations form together the potential energy, which, upon discharge converts into mechanical work. On the other hand, plastic stresses and deformations form together part of the induced energy which is dissipated through heat. Through this energetic mechanism, due to the polymeric grids' ductility, the reinforced soil is protected against local concentrations of unit stresses. This is a spontaneous and self-adjustable mechanism, typical for the geogrids with rigid, integrated nodes. Indeed, if the ribs weren't being fixed on the nodes and would move freely, then the creation of the stresses wouldn't occur as in figure 6 and the movements in both directions would be larger. Furthermore, if the grids would be perfectly elastic, without ductility qualities as fibres, then the amount of accumulated elastic energy would be much greater and upon discharge it would become dangerous due to the sudden occurrence of damages or even dislocations.

5. Triaxial Geogrids

It was natural that after uniaxial and biaxial geogrids the innovative thinking of the producer would provide an increased capacity to cover the efforts and deformations plan. Maintaining the same topological congruency and automorphism rules, but also the rigid character of the nodes, by arranging the geogrids according to three directions at a distance of 60°, the so-called *triaxialgeogrids* are obtained (Figure 8). The performance is technological because a few centuries ago, the simultaneous extension on two perpendicular directions was a problem.

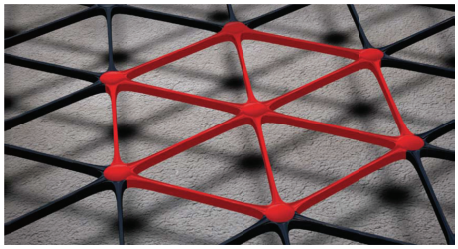

Figure 8. The perspective geometry of triaxial geogrids

The mechanic performance is illustrated suggestively by the comparison between the bearing capacity under concentrated force of the biaxial geogrid in blue and that of the triaxialgeogrid in red. It is about the coverage capacity which is greater in triaxialgeogrids than in biaxial geogrids (Figure 10). The consequence of this innovation is economical. For road works, where the concentrated forces are dominant, the triaxialgeogrids are cost effective than the biaxial ones. For retention works, uniaxial geogrids continue to remain the most efficient.

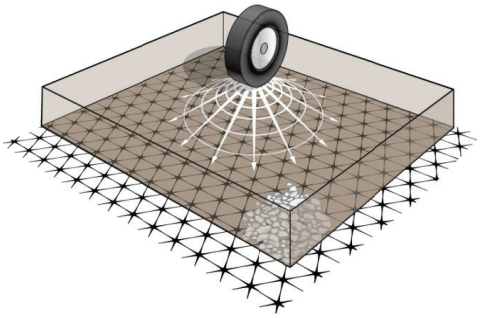

Figure 9. Load distribution at 360 degrees

Load distribution is 3-dimensional in nature and acts radially at all levels in the aggregate (Figure 9). For a stabilised layer to be effective it must have the ability to distribute loads through 360 degrees. To ensure optimum

performance, the geogrid reinforcement in a mechanically stabilized layer should have a high radial stiffness throughout the full 360 degrees. Biaxial geogrids have tensile stiffness predominantly in two directions. TriAxgeogrids have three principal directions ofstiffness, which is further enhanced by their rigid triangular geometry. This produces asignificant different structure than any othergeogrid and provides high stiffness through 360 degrees. A truly multi-directional productwith near isotropic properties (Tensar, 2011).

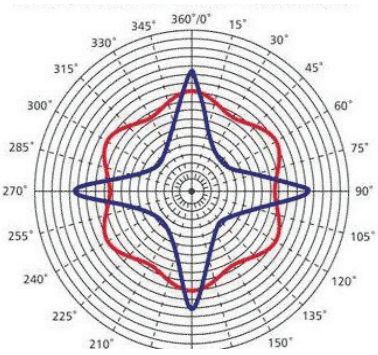

Figure 10. Radial coverage at biaxial geogrid with blue and radial coverage at triaxial geogrid with red

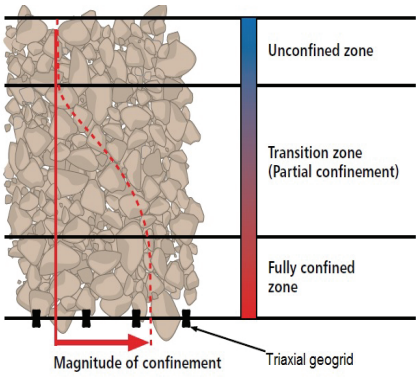

Figure 11. Interlock and confinement of triaxial geogrid

In a mechanically stabilized layer, aggregate particles interlock within the geogrid and are confined within the apertures, creating an enhanced composite material with improved performance characteristics. The structural properties of the mechanically stabilized layer are influenced by the magnitude and depth of the confined zones. The shape and thickness of the geogrid ribs and the overall structure of triaxialgeogrid has a direct influence on the degree of confinement and efficiency of the stabilised layer (Figure 11).

Triaxialgeogrid increases the magnitude of confinement and increases the depth of the confined zones (Tensar, 2011).

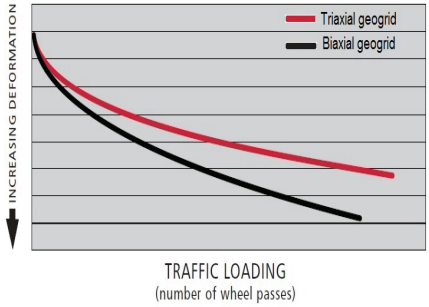

Figure 12. The advantage of triaxial geogrid compared to biaxial geogrid regarding performance.

A number of tests and trials have been conducted to prove the performance benefits of the triaxialgeogrid compared with conventional biaxial geogrids. Tests included trafficking trials at the University of Nottingham and, on a large scale, at the Transport Research Laboratory (TRL). Installation damage assessment, bearing capacity and field tests were also conducted as part of the comprehensive and rigorous testing programme (Figure 12).

Facilities at the Nottingham Transportation Engineering Centre (NTEC) at the University of Nottingham was used to identify the design features required for improved performance and to help shape and define the triaxialgeogrid. Trafficking trials were conducted on a much larger scale at the Transport Research Laboratory. Both triaxialgeogrid and biaxial geogrids were tested across varying aggregate depths each up to 10,000 wheel passes. The results showed that wheel track deformations were consistently smaller for triaxialgeogrids and proved conclusively the structural benefits of geogrid. The trafficking test facility at NTEC was used to produce a large quantity of trafficking data across both triaxialgeogrid and biaxial geogrids, confirming the much improved performance benefits of the triaxialgeogrids compared with biaxial geogrids (Tensar, 2011).

TRIAXIAL GEOGRIDS IN WIND FARM

Access to a wind farm site, often in a remote location, can be a challenging part of any wind energy project. Roads and crane lifting platforms are often constructed over poor soils and are frequently subjected to extreme weather conditions. Add to that the enormously heavy loads that they are expected to carry, and then traditional solutions can be costly, time consuming and not environmentally friendly. These roads are usually required for the construction, maintenance and ultimately the dismantling phases of a wind farm project.

The structural contribution made by triaxialgeogrid is to reinforce the unbound layers of roads and trafficked areas in order to create a mechanically stabilized layer. Aggregate particles interlock with the geogrid and are confined within the stiff geogrid apertures, creating an enhanced composite material with improved performance characteristics.

The greatest challenge when the wind farm is being constructed can be when the large turbine components are unloaded and lifted into position using a crane. The load spreading capability of a triaxialgeogrid layer increases the bearing capacity of working platforms for heavy-duty plant, cranes and piling rigs. For the contractor this means that less natural aggregate is required to construct the platform which can result in quicker construction and less cost when compared with a traditional unreinforced construction (Tensar, 2011).

Figure 13. Easy to install triaxialgeogrid.

WIND FARM ACCESS ROADS

Geogrids have been used since the early 1980's to stabilise aggregate in access roads constructed over compressible peat. Such 'monolithic' geogrids were used to provide safe access over soft ground in public roads in the Shetland Islands and infrastructure works on the Falkland Islands. The first recorded UK wind farm access road to use geogrids was Ovenden Moor near Halifax, UK in the mid-1980.

In Romania we start to use triaxialgeogrid for wind farms project since 2008, the first big project was Wind Farm Fantanele.

Since that time, numerous wind farms projects have been constructed with triaxialgeogrid.

A typical contemporary wind farm (Figure 13) consists of primary access roads such as the roads from the site entrance. These join secondary roads containing arrays of turbines. In turn, these lead to spurs, which are relatively short lengths of roads containing perhaps only one or two turbines (Figure 14).

The primary function of these roads is to provide safe, reliable access for materials, turbine components and the passage of cranes to the turbine locations. However, the most intense traffic is usually the aggregate delivery vehicles which are used in the road construction itself (Tensar, 2011).

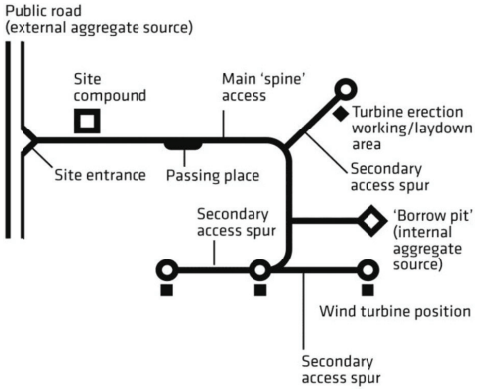

Figure 14. Schematic of the salient features of a wind farm layout

The required thickness of the road is most strongly influenced by the traffic activity that has to be supported during the road construction stage and which is engaged in the

act of importing the fill for further construction activity along the route. The in-service-traffic generated by the importation of concrete and steel, the delivery of the turbine components and the passage of the turbine erection crane is usually a design check on bearing capacity and edge stability rather than the principal determinant of the designed thickness. The triaxialgeogrid will create a mechanically stabilised layer to provide the benefit of minimising the road thickness (Tensar, 2011).

RESULTS AND DISCUSSIONS

WIND FARM FANTANELE, Constanta County, Romania

West Fantanele Wind Farm with 139 wind turbines, each turbine having a power of 2.5 MW. Existing tracks had to be widened and new access roads built over the site which soil (loess). Using thick stone layers to accommodate site traffic would have involved large numbers of vehicle movements and excessive road settlement. Instead, one triaxialgeogrid layers was installed and combined with crushed stone. This solution delivered excellent trafficking performance and achieved a significant carbon emissions saving over an unreinforced solution (Figures 15,16).

Figure 15. Relevant photos during the execution Wind Farm Fantanele

Road execution phases:

I. Natural soil after 20 cm uncovering
II. 250 g/sqm Geotextile
III. 5 cm repartition layer of split or natural sand
IV. Triaxialgeogrid
V. 25 cm crushed stone 25-63 graded, compacted
VI. 15 cm crushed granite 16-25 graded, compacted and bituminous treated

Figure 16. The road of Wind Farm Fantanele after the execution

WIND FARM PESTERA, Constanta County, Romania (Figure 17).

The site for wind farm Pestera was located a long distance away from the nearest source of suitable granular fill material. Access roads were needed for construction traffic, as well as the heavy turbine delivery vehicles and cranes which initially required large thicknesses of granular fill. Working platforms were also required to support the heavy crane operational loads and once again large amounts of granular fill were going to be needed.

Figure 17.Relevant photos during the execution Pestera Wind Farm

Triaxial geogrids was designed to form the new access roads and working platforms for the wind farm site, which took into account the low strength soils and anticipated high trafficking loads and produced thinner and therefore more cost effective construction (Figure 18).

Figure 18. The road Pestera Wind Farm after the execution

Execution phases:

I. natural soil after 20 cm uncovering
II. 300 g/ sqmGeotextile
III. Triaxialgeogrid
IV. 30 cm crushed stone 25-63 graded, compacted
V. 20 cm crushed stone 0-25 graded, compacted

WIND FARM Chirnogeni, Constanta County, Romania

The triaxialgeogrid it was used in Wind Farm Chirnogeni to stabilise well-graded aggregate over low soils to allow stabilised access onto the areas in question. The access roads support 100 kN standard axeles. The project involved the erection of 32 wind turbines. There will be access roads to separate working platforms required for lifting operations. The road width at the top of the road construction is 4,0 - 4,5m.

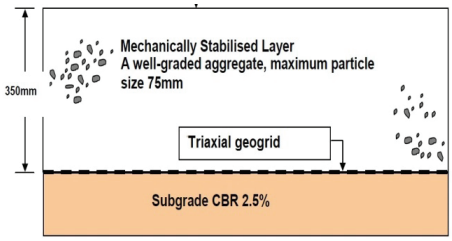

Figure 19. Section of the access roads, ChirnogeniWind Farm

Assessment of these granular layers is based on direct trafficking of the aggregate layers by construction vehicles (Figure 20).

Figure 20. Relevant photos during the execution road Chirnogeni Wind Farm

CONCLUSIONS

Since Romans times, roads and bridges were classified in the category of engineering works of art. In their turntriaxialgeogridsare produced bytheperformancerequirements of the XXIst century. The performance is, firstly, an intellectual one. Their conformity responds in a precise manner to the confinement function which needs to be met by putting them into practice. The triaxial geogrids have thus become the quality of functional aesthetics. Secondly, these geogrids have been fabricated through a technological performance. The simultaneous stretching on three directions, along with the conservation of all the physical and mechanical properties of isotropy and uniformity, is without precedent at this scale and industrial conditions. Finally the ease of installation of the triaxial geogrids as well as their reversibility offers them unmatched qualities. It was a privilege for the wind farms in Dobrogea to be serviced by an operational network of high-class roadways with solid durability guarantees.

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GREEN ROOF AND LIVING WALL IN THE ROLE OF ECOSYSTEM IN SUSTAINABLE URBAN DWELLING

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Abstract

It has been said that something as small as the flutter of a butterfly´s wing can ultimately cause a typhoon halfway around the world. Chaos Theory effect can be applied in an actual climate change issue. Forests, fields, gardens, and natural areas are being replaced with concrete, bituminous and unnatural surfaces. Necessity of recovering green spaces and natural areas is becoming more critical. Questions of sustainability, improving quality of life, solving current ecological issues are goals urban and architecture community can solve. Key factor of not forgetting about nature we have been given is designing healthy green cities, covering building in plants, integrating wildness in cities, designing and constructing vegetative roofs, living walls, implementing green policies. Integrating nature to city may seem fashionable, expensive and not necessary. Microclimate and building´s ecological footprint is very high. Balance of artificial and natural environment is way how to maintain sustainability. Co-operation of landscape and dwelling is bringing nature to city. Green is one of the key elements in environmental strategy. Balance means minimizing of breaking close ecosystems. Designing one big artificial ecosystem that wouldn´t be destroying real natural ecosystem is the goal of this paper. Urban ecology and environmental issues need to become an integral of development, construction, policy and way people think. Green roofs and living walls offer solutions how to find a place for nature in designed world. Positive approach on local scale may cause positive worldwide impact. Like the flutter of a butterfly´s wing.

Key words*: balance of artificial and natural environment, ecology, four infrastructures, nature in cities, sustainability.*

INTRODUCTION

Here it is. You said you love gardens."
"What is this place?"
"I made this place. This is my work. I was a landscape architect. I had my own company for a while."
"I´ ve been here before."
"What do you mean?"
"Here it is. You said you love gardens."
"What is this place?"
"I made this place. This is my work. I was a landscape architect. I had my own company for a while."
"I´ ve been here before."
"What do you mean?"
"I know this is gonna sound really strange, but I dreamed of this place. These flowers, everything. It´s beautiful. I had no idea. What a joy it must be to create a place like this."
Very simple dialogue from really simple romantic movie, Just like heaven, describes a little bit main theme of this article. Gardens, green roofs, living walls have captured people´s imagination all over the world. They keep surging the popularity because of very simple reason. They just seem right. Right because of the way they look good, because of all the benefits they are bringing to a building´s user, because of all the aesthetic pleasure to the people who see the building and also to all the wider surroundings. The sense of giving nature back what we have inherited, putting plants and nature back into the hard and stark environment full of concrete, bituminous and unnatural surfaces touches something deep within us. It doesn´t matter if the roof or wall is big or small, it is an act. Act full of symbolism and deep meaning.
Bringing nature into cities and urban dwellings has always been a very desirable amenity of urban planners and architects.
Many masterplans with lots of green areas and free spaces were representing symbolic meaning of people owning land. Being close to nature, able to touch the tree, walk barefoot on

the grass has so deep meaning and idea for every human that it sets to zero all the negatives.

The act of greening a building, act of greening a bus stop, kiosk, placing garden on existing building makes deep statement about the way we see, or the way we should see the world. Buildings with green tops should become fascinating objects. Grass and vegetation has on earth its natural horizontal space. So why should it be a problem putting soil on top of the building and have things growing. There is something strange about it, more than ecological. This reconciles humans with nature (Dunnett, 2011).

The truth is that for most of us, all this may seem very idealistic. To put a garden on our garage. Why not. But this is where it should start. Lots of joy, beautiful gardens, small domestic green roofs or sheds, garden offices, studios, bicycle sheds and other small structures. This article is about installing, constructing and planting a green roof whether it is on little houses, work places, anywhere, where is an opportunity to bring nature back to a place where it had been previously banished and its relationship and impact on all the other environments surrounding us.

MATERIALS AND METHODS

"We love to make new things, to experiment with materials and create a very unusual encounter between the rough and the natural, the smooth and the artificial, to incorporate nature so there can be the smell of a garden where you would not expect it.", said Jacques Herzog (Blanc, 2012).

Michael Van Valkenburgh has created little 130 m^2 green roof (Figure 1) for the building of the American Society of Landscape Architects in the heart of Washington D.C that was installed in April 2006. The project was undertaken with the goals of demonstrating the environmental and aesthetic benefits of green roofs (Jodidio, 2009).

The building´s original roof was a rubberized membrane, which had already begun to develop pinhole leaks. Two HVAC units were located toward the center of the roof. The roof held also another three HVAC units. Access to the roof was limited to a wall-mounted ladder and hatches. That is why part of the project was to design a stairway to provide an access for viewing and maintenance.

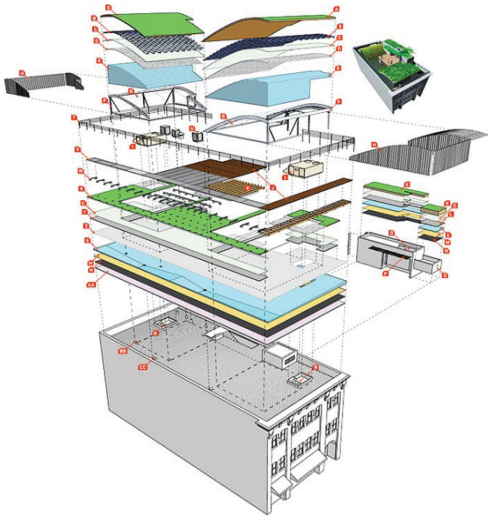

Figure 1. ASLA green roof scheme

Significant parts of this new roof design are two elevated forms in shape of wave (Figure 2), formed from rigid insulation. Both forms are covered with a green roof system. One wave is covered with semi-intensive green roof planting medium, the second one is covered with extensive green roof planting medium (Figure 3). The depth of the soil was calculated to correspond with the roof´s structural capacity in each area. The effect of the waves is to bring the plants up to eye level, create an intimate, semi-enclosed space on the roof, in the middle of a big city. All HVAC units are removed and covered with designed waves. The forms are constructed from layers of extruded polystyrene insulation with a structural steel skeleton anchored to the roof deck. Sides of polystyrene are covered with galvanized steel material that protects the insulation. Thanks to the fact that this vegetative roof is a project, it was very important that the top of the designed roof top would be visible from the street. Next signature element of this roof top is intent of greening the maximum possible area. Extensive green roof system – rest green coverage of the roof placed in the central zone and access path of the roof. This part of the green roof is covered by an aluminum grating walking surface to maximize

both usable space and environmental benefits. The area under the grating has soil depth of 70 mm. The grating floats 70 mm above the soil surface, when mature. Walking on the grating helps the sedum trim back. Of course it is anticipated that the sedum growth is going to appear in some places of the grating. Design of the top of the stairway is also green, but the roof designed here is intensive. 300 mm of soil and roses. Design of the top of the elevator shaft is covered with 500 mm of soil and sumac trees. Metal trellis on the elevator shaft and on the stairway is designed for several species that are being trained to grow on it. An irrigation system is placed on both of the sides to facilitate watering (Somerville, 2007).

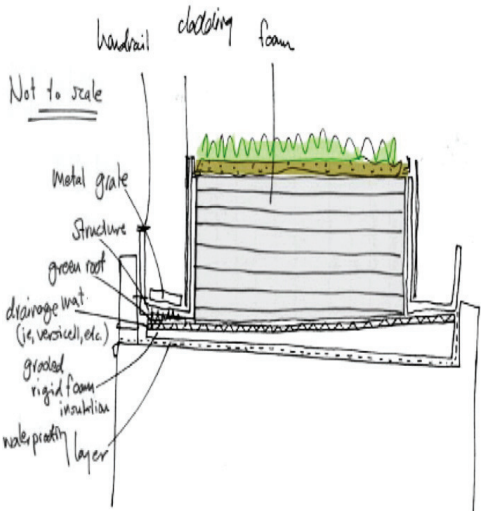

Figure 2. Sketch of green roof´s wave

Using artificial materials to make lightweight mounds, he in a sense invents a new landscape in a very small area, providing users not only with a bit of greenery, but also changing their perspective on the city. Given that roof space is generally underused and ugly in most cities. The roof is transformed into an expressive display of green roof technology. Nature brought into a city is an example of support of active social space. This project might be seen as a small example of what might be done on a much larger scale, given sufficient public space interest and financial incentive (Jodidio, 2009).
Processes that are being monitored are: process to track stormwater retention, temperature, water quality and plant performance. Here are few extensive and semi-intensive green roof performance data of full report. Energy savings: Engineering analysis showed that the green roof created a 10% reduction in building energy use during winter months and negligible difference in the summer. Further analyses showed that ASLA should show a 2-3% savings in the summer in the identified cause of this deficit - overcooling of the building. Following the engineer´s guidance, ASLA will change cooling of the building and will follow up with further monitoring. Water retention: From July, 2007 to May, 2007, the green roof retained nearly 75% of the total rainfall (736mm). This kept 105 000 liters out of the city sewer system. The roof typically retained 100% of (25 mm) rainfall. Water quality: The green roof did not add any nitrogen to the runoff. Water quality testing shows that the water runoff contains fewer pollutants than typical water runoff. Most significantly, the roof is reducing the amount of nitrogen entering the watershed (Somerville, 2007).

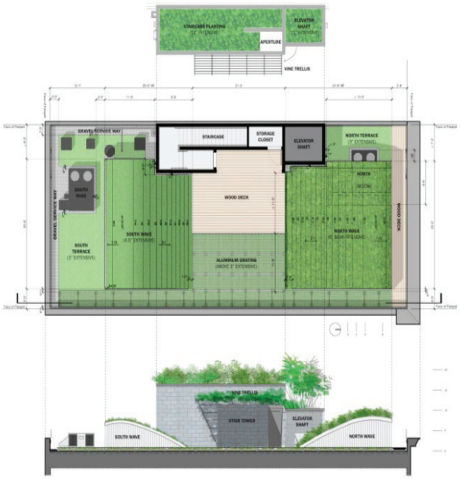

Figure 3. Overhead and cross section schematics

Temperature differences: The green roof has been as much as 15 ^{0}C cooler than conventional black roofs on neighborhood buildings. Temperature differences are greatest on the hottest days. Temperatures on the ASLA roof differ by area - areas with thicker growth and better coverage are cooler. The coolest is the stairwell roof, followed by the plantings under

the grate. The hottest area is the south terrace, which has the most exposed gravel/growing medium. Temperature differences are a result of both shading and plants evaporation. Temperature differences should increase over time in all areas on the roof as the plantings mature and fill in. Plant performance: Different plant species were planted in different areas based on soil depth and expected heat, light and water conditions. As part of the experimental nature on the roof, the planting palette was particularly broad and included both commonly used green roof plants and species not typically used on green roofs. All of the plantings under the grating are highly successful, showing excellent growth and coverage. On the extensive portion of the roof, hard species of Sedum performed well over other Sedum species. Growth was slowest on the south mound and on the south terrace, where initial planting coverage was thinnest and where the hottest temperatures were recorded. Some of the experimental plants used in these areas did not grow well (Somerville, 2007).

RESULTS AND DISCUSSIONS

"Biodiversity is what we build on national environment. We have to do it with great care on ecology of the land, use of water on the use of energy. If we don´t do this with care, there will not be a future for other generations. Sustainability is very important. It is no point to have a success today, and not have it tomorrow. Sustainable, low carbon buildings, buildings that don´t need that much energy, well planned buildings. We need to design building of 21´st century, buildings responsible to its environment." This is what Ken Yeang says about sustainability, environmental problems, earth´s issues and human´s part in this ecological loop.

Key factor of designing health cities is bringing nature and wildness into dwellings, covering roofs and buildings in plants, integrating natural life in cities, designing and constructing vegetative roofs, living walls, implementing green policies and changing people´s minds about ecological issues. Integrating nature to city sometimes seems fashionable, expensive and of course not necessary, but the potential of artificially designed ecosystem that improves sustainability, microclimate etc. in dwelling is really high. Balance of artificial and natural environment, co-operation of landscape and dwelling is needed. Artificial environment deals with importance of greenery in it and natural environment deals with new ecosystem built in it. Ken Yeang, father of bioclimatic skyscraper, claims that green design is the blending of four infrastructure strands into a seamless system. Each of the system is represented by its colour.

The grey (engineering) infrastructure is the usual urban engineering infrastructure of roads, drains, sewerage, water reticulation, telecommunications, energy and electric power distribution system. These engineering systems should integrate with the green infrastructure rather than vice-versa, and should be designed to be sustainable (Yeang 2009).

The green (eco) infrastructure parallels the grey. This is an interconnected network of natural area and open spaces that converses natural eco-system values and functions. It also enables the area to flourish as a natural habitat for a wide range of wildlife, delivering benefits to humans. This eco-infrastructure is nature´s infrastructure and it is very vital to have it in the masterplan. Linear wildlife corridors connect existing green spaces with larger green areas, and can create new habitats in their own right. These may be in the form of newly linked woodland belts of wetlands, or existing landscape features such as overgrown railway lines, hedges and waterways. Any new green infrastructure must also enhance the natural functions that already are there (Yeang and Spector, 2011).

Eco-infrastructure takes precedence over other engineering infrastructures in the masterplan. By creating, improving and rehabilitating the ecological connectivity of the immediate environment, the eco-infrastructure turns human intervention in the landscape from a negative into positive. Its environmental benefits and values are framework for natural systems that are fundamental to the viability of the area´s plant and animal species and their habitat, such as healthy soil, water and air (Hart, 2011).

The connectivity of the landscape with the built environment is a horizontal and a vertical process. An obvious demonstration of

horizontal connectivity is the provision of ecological corridors and links in regional and local planning which are crucial in making urban patterns more biologically viable. Connectivity over impervious surface can be achieved by using eco-bridges, undercrofts and ramps. Besides improved horizontal connectivity, vertical connectivity is also necessary, since most buildings are not single but multi-storey. Designers must extend eco-corridors upward, with greenery spanning a building from its foundations to the rooftops (Yeang and Spector, 2011).

The blue (water) infrastructure. The water cycle should be managed to close the loop, although this is not always possible. Rainwater needs to be harvested and recycled. Surface water needs to be retained within the site and returned to the land for the recharging of groundwater by means of filtration beds, pervious roadways and built surfaces, retention ponds and bio-swales. Water used in the built environment needs to be recovered and reused wherever possible (Hart, 2011).

Site planning must consider site´s natural drainage patterns and provide surface-water management so that rainfall is not allowed to drain away. Combined with green eco-infrastructure, storm water management enables the natural processes to infiltrate, evapo-transpire or capture and use storm water on or near site, potentially generating other environmental benefits. Waterways should be replaced by wetlands and buffer strips of ecologically functional meadow and woodland habitat. Sealed surfaces can reduce soil moisture and leave low-lying areas susceptible to flooding from excessive run-off. Wetland greenways need to be designed as sustainable drainage systems to provide ecological surfaces. Buffers can be combined with linear green spaces to maximize their habitat improvement potential. Eco-design must create sustainable urban drainage systems which can function as wetland habitats, not only to alleviate flooding but also to create buffer strips for habitats. Surface-water management maximizes habitat potential (Hart, 2011).

The red (human) infrastructure is the human community. It´s built environment. Buildings, houses, hardscapes and regulatory systems like laws, ethics etc. This is the social and human dimension that is often missing in the work of green designers. It is clear that our lifestyles, economies, and industries, mobility diet and food production all need to become sustainable (Yeang and Spector, 2011).

Balance of these four infrastructures, strands, means minimizing of breaking near ecosystems. Using four infrastructures for creating one big artificial ecosystem that wouldn´t be destroying real natural ecosystem, is the goal of this paper.

CONCLUSIONS

Can we imagine that cities were like forests? Plenty of shade, diverse and rich in variety. Offering lots of fresh air and daylight. Access to clean water, animals, ants and bees living in it. Real integrated natural system and designed system in true balance. More compact mixed-used neighbourhoods full of streets crossed with parks providing livable and healthy habitat for all living things in it.

Ecological design is still very much in its infancy. The totally green building or totally green city does not exist yet. There is so much theoretical work, technical research, environmental studies etc. that have to be done and tested before we can say that we have a green building, or dwelling. On the other hand, ecological design as we know it today, offers enormous potential to transform our buildings into products, systems. For every problem that humans currently face, closed loop made of four strands using own resources is an answer.

In this article, two very strong ideas have been presented. First, extraordinary example of very sophisticated way of bringing nature into city. The building was not touched or even changed. Author of the green roof literally made a construction that was put on the roof top so the building wasn´t touched just because of the reason of bringing nature to the city. The green roof is a demonstration project how to teach the benefits of green roof technology and so it is designed. With research and education in mind. The success of each part of the constructed roof, success of soil, each plant species is being monitored in order to identify characteristics of the rooftop, but also the characteristics of the areas under it. According to monitored processes- energy savings, water retention,

water quality, temperature differences, and plant performance, it is obvious that situated green roof on the top of the building has positive effects on its reduction in building energy use, rainfall retention, reducing pollutants in water runoff, reducing heating, cooling the building. On green roof, soil and vegetation act like an insulation. When it is raining, water floods down to city´s artificial canyons. A living roof absorbs water, filters it and slows it down. This system helps to reduce overflows, extends drain system´s life and returns water to surrounding watershed.

Urban roof like this is a very challenging place. Lofty ideas of potential acres of green spaces that lie above our cities. Roofs as lifeless place of bituminous surface, violent temperatures contrasts, bitter wind and antipathy to water. As it has been proved, they can be changed into non asphalt wasteland. When we go to the rooftops in cities, we usually look out for a view. Positive change happens in case like this, when you don´t have to look for a view, because it is in front of you. Unexpected green and blue grasses, pink and yellow flowers, roses and little trees in the middle of concrete, glass and steel.

Another important idea of this article is how ecosystem in modern city should work like. The answer to ecological questions is co-operation of grey and green, green and blue and red. These relationships must be understood in smaller detail – building, but also in bigger detail – urbanism.

Both of these theories work in explained example of green roof – new ecosystem integrated in the middle of the city. The relationship between engineering infrastructure that perfectly works with green areas, living part, plants and flowers. The green part of the project is naturally followed by water line of a loop that is trying to be closed. At last, we cannot forget about the human community that is the motive force of all this.

The theory of four infrastructures works on this example and it is working on many others. Living walls, green roofs, little sheds. Urban ecology and environmental issues like these needs to become an integral of development, construction, but mainly the way people think. Green roofs and living walls offer solutions how to find a place for nature and wildness in designed world. They behave like brought natural ecosystems into one big artificial ecosystem, where they must co-operate. Positive approach like this on local scale may cause positive worldwide impact. Just like the flutter of a butterfly´s wing.

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LESSONS LEARNED FROM SOIL-STRUCTURE INTERACTION

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Abstract

The paper deals with the recurrence that naturally occurs between deformable structures and the bearing soil. In one of his preserved sketches Leonardo da Vinci assumed that there are loaded beams that deform under nearly parabolic shapes. The first mathematical model about the beams on elastic foundation is due to the German railroad engineer Emil Winkler in 1867 when he was teaching Strength of Materials at the Polytechnic Institute in Prague. It is a linear model independently of time that seems inspired from the Law of Elasticity published by Robert Hooke in 1678 as Ut tensio, sic vis, *and meaning* As the extension, so the force. *It looks like Winkler only replaced the tension by compression in Hooke's Law. By coincidence, in the same year 1867 Joseph Monier from Versailles obtained in Paris his patent for reinforced concrete. Winkler's Theory of beams on elastic foundations under static loads was gradually extended on thin and thick plates, piles and sheet piles, circular tanks and reinforced pipes. Later the elastic stability and dynamic behavior of the same structures was developed. In order to simplify the non-linear analysis in 1997 the finite difference theory was successfully introduced. All results of non-linear analysis are strongly influenced by the bi-local boundary conditions of Sturm-Liouville type. The practical consequence of this analysis consists in the need to provide appropriate joints between structures. There are simple joints with one degree of freedom only, for horizontal thermal contraction/expansion or vertical gravity settlement and seismic joints with six degrees of freedom, i.e. three translations and three rotations. For including in any analysis, the foundation soil should be carefully investigated by geotechnical and geology techniques. Particularly, the foundation soil in Bucharest requires high attention and competence in practical use. For evaluating the behavior in time of bearing soil, its viscous properties have to be accordingly considered in analyses. Soil-structure interaction is controlled by a legislation that satisfies the European Standards. All the existing study cases confirm that in Civil Engineering, sooner or later, any mistake should be paid.*

Key words*: critical infrastructure**, degree of freedom**, elastic foundation**, seismic joint**, settlement..*

INTRODUCTION

Human relation with foundation soil is lasting since the Megalithic Civilization in Egypt and Middle East. Later on, an incipient science of building, mainly based on the equilibrium in the gravitational field, was developed. The few ancient buildings that have been preserved from those old times prove their laws of discharging were correctly understood. Most of them disappeared due to different faults, wrong foundation concepts including. It is, for instance, the case of the Babel Tower. Built up during the reign of Hammurabi the Great (1792-1750 BCE), on soft foundations made of adobe masonry in a weak and oozy soil, after the death of Alexander the Great (356-323 BCE) the Tower reached an advanced state of damage and was abandoned. One of the first lessons of founding the buildings is due to Archimedes from Syracuse (287- 212 BCE). After discovering the lever he stated his ability to move with that device the Earth if a supporting point will become available. But such a miracle never happened. A building cannot be discharged on the foundation soil with the aid of a force, directly applied on a point, as a vector. Only a force applied upon a surface, as a pressure and tensor can practically complete such a task. This lesson remained as a golden rule for generations of builders. Most of the knowledge that Greeks and Romans accumulated during ancient history in foundation engineering was lost during the Middle Ages. Only in Renaissance the interest for the art of building was resumed and further developed. Leonardo da Vinci (1452-1519), who was greatly interested in Mechanics, observed that the foundation beams were bent together with the deformations assumed by

supporting soil. He initiated several testing programs aimed to enrich the knowledge of building more consciously. Galileo Galilei (1564-1642) extended the experimental research. Based on the obtained results he published the book "Two New Sciences" as a synthesis of the knowledge of his époque. Rather soon after Galileo, in England, Robert Hooke (1635-1703) discovered the Law of elasticity as *Ut tensio, sic vis* meaning *As the extension, so the force*. It was published in 1678 in the paper suggestively entitled *De Potentiâ Restitutiva.* At the middle of eighteen century, during the so called Industrial Revolution that occurred in England, many technical innovations came to surface. In the next century the first railway networks were created. Due to the experienced gained in railway engineering, in 1867 Emil Winkler (1835-1888) published in Prague his Theory about beams on elastic foundations. By coincidence, in the same year 1867 Joseph Monier from Versailles obtained in Paris his patent for reinforced concrete. Since that year the history of controlled soil-structure interaction started.

The paper deals mainly with the lessons identified by five doctoral students and that were presented in their dissertations during last six years. With those occasions the lessons from the rich experience of the two Romanian famous builders Aurel A. Beleş (1891-1976) and Emil Prager (1888-1985) were also mentioned . The data have been obtained from the existing engineering works in Bucharest or country side and are of practical interest either for designers or researchers. The two existing actions, in the original Newtonian approach, that were considered in the paper, are the long lasting actions and the short time ones. According to Eurocode 1, and Romanian Code CR 0-2012 as well, they are classified as permanent and accidental actions. The first ones are of gravitational origin while the second are mainly generated by earthquakes. The lessons selected for paper refer to the types of foundations and their depths, the shape and size of the buildings they are supporting, the joints between them and seismic tests. Finally, the economic effects of soil-structure interaction, higher education matters and legislation provisions are briefly commented.

WINKLER's THEORY

As a young employee to a railway society Emil Winkler, at only 32 years, was fascinated by the dance of steel rails under the wheels of passing trains. Well educated in structural engineering at Dresden Polytechnic he was aware by Hooke's law of elasticity. Under the evidence of seen rails he had the inspiration to replace in Hooke's law the tension with compression. In addition he took the courage to assimilate the elastic rails with foundation beams. The rest what followed was mathematics. Winkler adopted a simply linear model of analysis . Indeed, the intensity of soil reaction $p(x)$ to the loads applied upon a continuously supported beam is proportional with the vertical deformation $v(x)$, common to both soil and beam, i.e.

$$p(x) = -kv(x) \tag{1}$$

where k is the characteristic modulus of soil assumed constant. Whether the stiffness of beam EI_z is also constant along the beam length, then from the simplified equation of bending, due to Euler-Bernoulli, one obtains

$$EI_z \frac{d^4 v}{dx^4} + kv = 0. \tag{2}$$

With the aid of notation

$$\frac{k}{EI_z} = 4\beta^4 \rightarrow \beta = \sqrt[4]{\frac{k}{4EI_z}} \tag{3}$$

where β is called *damping factor* and is measured in m^{-1}, the previous equation (3) takes the form

$$\frac{d^4 v}{dv^4} + 4\beta^4 v = 0. \tag{4}$$

This homogeneous equation assumes a general solution like this one

$$v(x) = e^{-\beta x}(A\cos\beta x + B\sin\beta x) + \\ + e^{+\beta x}(C\cos\beta x + D\sin\beta x) \tag{5}$$

Where the integration constants A, B, C, D are determined from both the bi-local conditions of Sturm-Liouville and the continuity conditions of Saint-Venant. Further the whole philosophy of soil-structure interaction is based on the above presented theory of Winkler.

STRUCTURAL APPLICATIONS

Winkler's Theory was extended from beams to thin and thick plane plates. The difference between the two types of plates is made in second case by sharing forces. Then, for computational purposes, Winkler's Theory was converted with aid of finite difference equations. They were associated with boundary and external support conditions, internal support conditions, prescribed displacements and decomposition process. This computational method was first applied to circular concrete tanks, circular tanks with sliding or pinned joints, circular tanks with walls integrated in their bases, temperature effects on the walls of circular tanks and pressurised concrete tanks. The subsequent group of applications regard laterally loaded single piles, pile groups and sheet piling. Finally, the last applications were devoted to aqueducts, base slabs of conventional retaining walls, continuous foundations and footings, and cross support beams. The available computing program entitled *Analysis of beams on elastic foundations* or shortly *bef* seems very useful.

The elastic medium has a favourable influence also on the stability of structural components. In the case of pile elastic stability the problem was simultaneously solved since 1914, independently by each other, by A. Beleș in Romania and S. Timoshenko in Rusia. The Eulerian critical force assumes the expression

$$P_{cr} = \frac{\pi^2 EI_z}{l^2}\left(n^2 + \frac{kl^4}{n^2\pi^4 EI_z}\right), n=1, 2, \ldots \quad (6)$$

where the second term contains the contribution of the elastic soil.

Similarly, in the case of rectangular plane plates, with the sides *a* and *b,* the critical force one obtains by minimisation the expression

$$P = \left(\frac{m^2\pi^2}{a^2} + \frac{n^2\pi^2}{b^2}\right)D + \frac{k}{\frac{m^2\pi^2}{a^2} + \frac{n^2\pi^2}{b^2}}, m\ n=1, 2, \ldots \quad (7)$$

where

$$D = \frac{Eh_p^3}{12(1-\mu^2)} \quad (8)$$

is the cylindrical stiffness of the plane plate of thickness h_p.

The dynamic response of the structural members on elastic medium was also similarly solved.

FOUNDATION SOILS

The soil devoted to foundation should fulfil three conditions: 1) No biodegradable contents; 2) No freezing influence and 3) Bearing capacity to compression. Usually, this information is obtained from a geotechnical study. In spite of NP 074/2007 provisions, regarding the homogeneity and uniformity of soil structure, all geotechnical studies are referring to the existence of soil layers. For current construction sites the infill layers are assumed to take the same thickness like the freezing depth that is untrue. For instance with the aid of geophysical devices it was determined that on a large zone around the Arch of Triumph in Bucharest the infill layer is strongly no uniform, and its depths randomly vary between 2.0 m and 3.0 m. A similar situation, but in less extended areas, can be meet in Cotroceni. And what in Capital happens, anywhere in the country could occur. Another lesson that should draw attention refers to the soils of loess nature that are sensible to come moisten and getting damp. Frequently, some lentils of such soils were naturally inserted in the ordinary soils and if are not identified in due time they remain as hidden perils for buildings. Sometimes they are discovered during earthquakes by the caused damages. Romanian technical legislation is rich in provisions regarding the foundation soils and maintenance rules. Unfortunately, the basic education and elementary consciousness for applying these documents is still lacking. This remark equally

refers to both private owners and official authorities.

TYPES OF FOUNDATIONS

Usually, there are three types of foundations: 1) isolated for columns, 2) continuous under walls and 3) base slabs as general foundations for basements or cellars. Long time ago they were made of stone or brick masonry. Nowadays only concrete and reinforced concrete are used for foundations. From gravitational reasons the soles of these foundations should be perfectly horizontal. When the foundation ground is horizontal is recommended that all foundations to be located at the same level while in the case of inclined grounds, horizontal steps will be provided. In weak soils, like those existing in Bucharest, the isolated foundations should be avoided, and locate the columns together with the walls on continuous foundations or directly on the base slabs. It would be good that all foundations of a building to be balanced in the gravitational field. That means a uniform disposition of foundations in the horizontal plane such as the vertical axis of building to fall either on or near the gravity centre of foundation plane. As long as the depth of foundation is concerned the freezing condition is not enough. There is an important proportion between the foundation depth and building height defined by the ratio 1:6. For buildings well balanced, with symmetric vertical planes for instance, and good foundation soils, this ratio can be reduced to 1:10 or even 1:12. On the contrary, for very irregular buildings that ratio should be increased to 1:5 or even 1:4. Regarding the upper parts of foundations that support building ground floors and called elevation it should be raised at least with 60 or 90 cm over the level of natural ground that surrounds the buildings. Visitors of the Village Museum, located not far by the University of Agricultural Sciences in Bucharest, can easily check out that this old rule is fulfilled without any exception by the exhibited buildings. Paradoxically, at the main building of the Faculty of Civil and Environmental Engineering, built in 1972, the level of building ground floor coincides with that of natural ground. The building neither provided with basement nor satisfies the above mentioned proportion what explains the severe damages that occurred under the 1977 earthquake. The reinforcing works carried on between the years 1987 and 1996 much improved building seismic safety. Generally, basements and cellars improve the soil-structure interaction. The contacts between buildings and foundation grounds are much closer. Without basements and cellars the building with shallow foundations are like boats freely floating on waters. It is the case of the old three-lobbed churches with soft foundations of brick masonry. Due to repeated settlements most of them display cracked walls and artificial wooden steeples because the original ones in masonry were cut by earthquakes.

BUILDING SHAPES AND SIZES

With population growth and its concentration in urban areas a large diversity of buildings does coexist as absolutely necessary. From the perspective of soil-structure interaction they are classified as low-raise, medium-raise and high-raise buildings. Fortunately, the existing advanced technology is able to provide structural solutions for appropriate foundations at proportional costs. There are however some foundation problems when one or more new buildings should be located in the vicinity of old, existing buildings. In addition the shapes of buildings in vertical and horizontal planes should be very carefully considered in seismic prone areas. It is the problem of irregularities which also involve the distribution of masses. The amount of irregularities is evaluated on the basis of distances or eccentricities between mass or gravity centres and rotation or rigidity centres. According to Eurocode 8 and Romanian National Code P100-1/2013 usually, the cross sections of buildings shaped in L, U, T and E forms arise problems. They develop large torsion moments that generate huge sharing forces. The only solution to avoid disasters in the case of new buildings is to divide the four critical shapes in smaller rectangular surfaces. The problem remains open in the case of old existing buildings improperly shaped. Often by inadequate reinforcing of such critical shapes the damaging danger of existing buildings increases.

STRUCTURAL JOINTS

The best lesson ever learned from earthquakes is about joints. Indeed, before the strong EQ that occurred on March 4th, 1977 only two types of joints were recommended in Civil Engineering, namely expansion joints with one degree of freedom, the horizontal displacement, and settlement joints also with one degree of freedom, the vertical displacement. According to a long tradition for many years the adjoining buildings were attached to each other along their blind walls, without any separation between them, like they would reciprocally support in case of danger. During that earthquake it came out that it was a wrong approach that should be immediately eradicated. This is why after 1977 the seismic joint was created, theoretically with six degrees of freedom, three translations and three rotations. All codes of seismic protection in the world adopted this provision. According to Romanian Code P100-1/2013, clause 4.6.2.7 (4), eq. (4.25), the joint width should assume the value

$$\Delta \geq \sqrt{d_{1\max}^2 + d_{2\max}^2} \qquad (9)$$

where d_1 and d_2 are the relevant displacements of the adjacent buildings or parts of the same building. It is worth to be known that seismic joints are not optional, but compulsory. The seismic joints should be included in programs of periodical maintenance and permanent monitoring. In the United States all strategic buildings are continuously supervised along their contours, delimited by joints, with GPS devices because earthquakes or terrorist attacks are unforeseeable. With the aid of seismic joints the response of buildings to earthquakes can be easily controlled and when necessary improve it by involving the soil-structure interaction. The study cases presented in four doctoral theses are summing up this statement [1, 2, 3, 4].

SEISMIC TESTS

Soil-structure interaction is a latent and subtle mechanical phenomenon. This is why any opportunity of experimental checking is of highest interest.

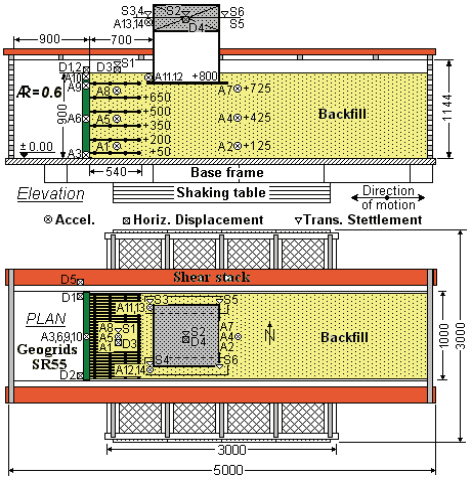

Figure 1. Conventional 3D model

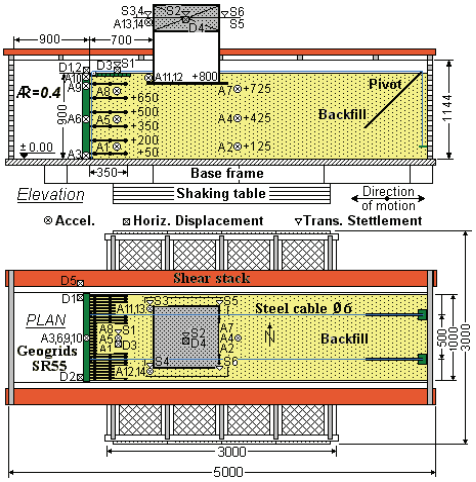

Figure 2. Confined 3D model

Figure 3. 3D model installed on the shaking table

By winning the competition organized by the European Commission for a research project at the Laboratory of Seismic Engineering of Bristol University in UK, its task was devoted to soil-structure interaction.

Two 3D models, one conventional (Fig. 1) and another confined (Fig.2), supporting the same elastic structure of steel, were designed in Bucharest and comparatively tested on the shaking table of Bristol University (Fig. 3). Particularly, this shaking table was provided with an original sharing box patented by Dr. Adam Crewe from Bristol University.

Three types of dynamic excitations were used: harmonic sine (Fig. 4), El Centro '40 (Fig. 5) and Eurocode 8 artificial earthquake (Fig. 6)

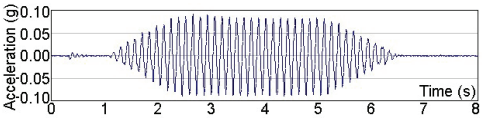

Figure 4. Harmonic sine

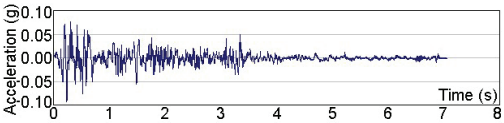

Figure 5. El Centro '40

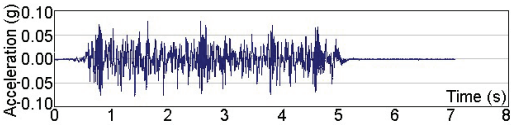

Figure 6. Eurocode 8 artificial earthquake

The results recorded on the shaking table after 53 tests on conventional model and 57 tests on the confined model are comparatively presented below in red and blue colours (Fig.7)

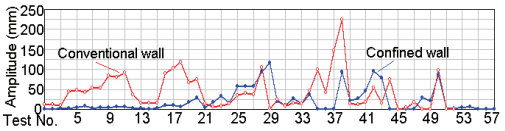

Figure 7. Comparative diagrams of seismic responses

The models displayed essentially different behaviour, the confined model, designed according to a Romanian patent, answered much better to the dynamic excitations. It is worth to be mentioned also that both 3D models reached gradually the ultimate limit state according to *the principle fail-safe.* This result is important when such combined structures are used for critical infrastructures.

CONCLUSIONS

The paper tries to give a holistic idea on the fascinating phenomenon of soil-structure interaction that nowadays became an independent science known under the initials *SSI.* The lessons selected for this brief presentation were inspired by recent doctoral theses appreciated for their practical values. Three final ideas are worth to be also added. The first one refers to the economic effects of the *SSI*. If it is correctly considered by the existing computing programs great benefits can be obtained; benefits not only in investments, but also in the quality of engineering works and their durability. The second idea regards the higher education system. By including *SSI* in the curricula for master degree its value can be much enhanced. Finally, the existing legislation at European level regarding *SSI* should be carefully learn, understood and accordingly applied. The existing case studies confirm that by ignoring *SSI* many avoidable mistakes still occur.

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THE DETERMINATION OF WIND-POWERED IRRIGATION POTENTIAL IN TURKEY

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Abstract

Irrigation is considered a common need for agricultural production in all around the world. Instead of the high priced fossil fuels, wind-powered agricultural irrigation is an alternative usage of renewable energy in Turkey. However, it is necessary to be researched technically and economically before the implementation. In this paper; crop types, geographical frame, and groundwater quantity were taken into consideration in the context of technical feasibility. A cost analysis was done by consideration of the costs of water storage tanks, wind turbine, and pump as an economic feasibility study. The results of feasibility study provided that there is enough irrigation potential based on wind power in Marmara, Aegean and East Mediterranean regions. The increase in wind-powered irrigation will optimize the agricultural water use and preserve the environment from adverse impacts of greenhouse gases.

Key words*:Wind Energy, Irrigation, Groundwater.*

INTRODUCTION

History for utilization from wind power goes to the ancient times. The wind power was used for irrigation in Mesopotamia, drying of polders in the Netherlands and the removal of groundwater accumulated in mines from Roman period and reuse for agricultural purposes. In addition, it was also exploited as a mechanical strength, running of water pumps and water abstraction for domestic and agricultural water use (Doganay, 1991).

Gradual increase in energy consumption due to the global increase in population and urbanization movements in parallel to the developing industry and advancing technology force people to search for new and environment friendly energy sources. On-time, economic, safe, constant and clean energy procurement has become one of the most important problems of the day when energy requirement has increasingly more significant. As to the aforementioned importance of energy, the gradual increase in the demand towards energy causes fossil energy sources to be rapidly consumed (Akova, 2011). Besides, fossil fuel power is a major contribution to carbon-based climate change and air pollution. In addition, rising fossil fuel costs and energy self-sufficiency have made the development of viable sources of clean energy critical for many parts of the world (Kelley et al., 2010).

Irrigation water pumping is one of the most important direct commercial energy end use in agriculture. Groundwater is used for the irrigation needs via by pumps. The present contribution of groundwater to irrigation is very high in terms of area. For irrigation purposes, the water is lifted by traditional means or lifted by diesel and electric pump sets. Diesel and electricity are commonly used for meeting irrigation energy demand in the country. There were reportedly 186 503 electricity driven pumps and 194 776 diesel pumps in operation in the agriculture sector in the year 2012 (Tuik, 2013). For better exploitation of the groundwater potential to meet the increasing irrigation water demand more and more wells would be dug and energized thus increasing the demand of electricity.

In view of the increasing global climate change concerns, interest in the development and dissemination of renewable energy technologies has again been renewed (Kumar and Kandpal, 2007). Wind-powered pumping

for irrigation has been suggested as an application, as it is an energy intensive activity that is well suited for implementation with renewable energy sources. However, to be practical, wind-powered irrigation, like all alternative energy applications, must be both technically and economically feasible. For irrigation, this feasibility is dependent on many factors, such as wind speed data, groundwater resources, irrigated land and crop pattern, unit cost of irrigation water, cost of wind turbine devices, and pumps.

In this study, we are going to match the wind power and groundwater potential of Turkey. The wind-powered water pumping systems offer the appropriate solution to supply water for irrigation in remote regions.

MATERIALS AND METHODS

Wind Energy Potential in the Turkey

The territory of Turkey is more than 1 600 kilometers long and 800 km wide, with a roughly rectangular shape. It lies between latitudes 35 and 43 N, and longitudes 25 and 45 E. Turkey's area occupies 783 562 square kilometers, of which 755 688 square kilometers are in Southwest Asia and 23 764 square kilometers in Europe. Turkey is the world's 37th-largest country in terms of area. The country is encircled by seas on three sides: the Aegean Sea to the west, the Black Sea to the north and the Mediterranean to the south. Turkey also contains the Sea of Marmara in the northwest (Wikipedia, 2013).

Turkey's wind energy potential can be calculated as such: we can assume that the area of Turkey is 783 562 Km^2. 783 562 hectares of land would be used, if only 1 pct (international standard, 0,5 pct for Europe) of the overall area will be opened to wind energy production. Considering overall 77 600 turbines would be used for 10 hectares of land (technical standard), a turbine of 1 MW capacity produces around 2 500 000 - 3 000 000 kWh of energy annually. This would amount to overall 200 billion kWh of energy production (Akin and Zeybek, 2005). An economic RES investment requires wind speed of at least 7 $m.s^{-1}$ (Caliskan, 2011).When considering the wind speeds higher than 7 $m.s^{-1}$ at 50 m high from the sea level in a country-wide examination, the highest wind potentials are available in Marmara, Aegean and Eastern Mediterranean regions as it is indicated in Figure 1 (Altuntasoglu, 2011).

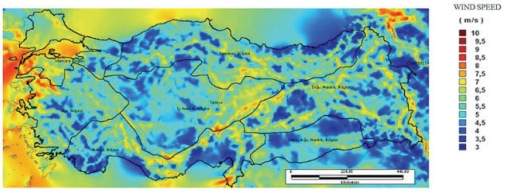

Figure 1. The Distribution of Average Wind Speed (Caliskan, 2011)

The Amount of Groundwater Resources

The water potential of countries emerges from latitude, longitude, geological and topographical frame and also climatic (rainfall) conditions (Bilgin, 1997; Ozguler, 1997). Annual water potential of Turkey was calculated under technical and economic considerations.

In Turkey, the arithmetical average of annual precipitation (80 years data) is 643 mm, ranging from 250 mm in the southeastern part of the country to over 3000 mm in the northeastern Black Sea coastal area. This average annual precipitation figure for Turkey corresponds to an average of 501 km^3 of water per year. Of 501 km^3 of annual precipitation, 274 km^3 is assumed to evaporate from surface and transpire through plants. Out of the remaining 227 km^3 average annual precipitation, 69 km^3 is lost to deep seepage and, therefore, represents a direct recharge to local aquifers, whereas 158 km^3 forms the precipitation runoff. Since it is estimated that a net 28 km^3 of groundwater feeds the rivers, average annual surface water potential is 186 km^3, with the surface runoff of 7 km^3 coming from neighboring countries, total surface runoff within the country reaches 193 km^3. Exploitable portions of surface runoff and groundwater are 98 and 12 km^3, respectively. Thus, the total of exploitable water resources amount to 110 km^3 (Burak et al., 1997; Buyukcangaz et al., 2007;Ozis et al., 1997).

Marmara, Aegean, and Eastern Mediterranean regions which are rich in terms of wind power potential are also well-endowed with

groundwater resources (Figure 2). Away from the coast, wind potential is descending and groundwater potential is also decreasing in Aegean region. The main reason for that is mountains lies parallel to the coasts.

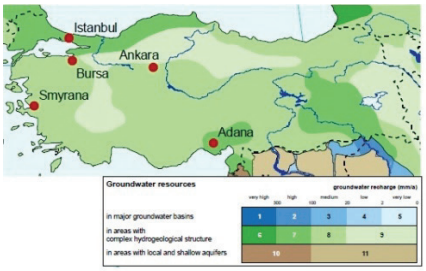

Figure 2. Groundwater Resources of Turkey (Whymap, 2008)

How much water do we need for agricultural production?

Agriculture is major water user in Turkey. Of all freshwater diverted forhuman use in Turkey, industrial and household usesaccount for 12 % and 16 %, respectively, while irrigatedagriculture consumes on average around 72 % andmuch more in specific locations (State Hydraulic Works, 2014). Therefore, exploitation of tools and techniques aiming efficient water use in agriculture would be a major priority amongst many others. More agricultural production may be achieved by environmental-friendly advanced irrigation technologies using less water and manpower. Sustainable use of country's natural resources would only be possible by planning and design of optimal irrigation schemes regarding technical and economic considerations of the country.

Out of the agricultural area of 28 million hectares (mha), the total amount of irrigable land is 25.85 mha.The amount of irrigable land by existing water potential and irrigation technologies is only 8.5 mha (State Hydraulic Works, 2014). However, only a total of 5.5 mha has been equipped with irrigation in Turkey. Although the use of groundwater resources in irrigation is less compared to surface water use, farmers tend to use groundwater resources in meeting water needs of the crops when there is water shortage in surface water resources. There is a tremendous effort by government to raise the total amount of irrigated area throughout the country. The production of high valued crops is also aimed by the extension of irrigation services in Turkey.

Although realized crop pattern in Turkey does not match with planned crop pattern in irrigated areas, there is a huge potential in agricultural production. Spatial distribution of agricultural crops was given by Turkish Statistical Institute (TUIK) based upon 2012 data. Tables 1-3 indicate major crops and their water needs in selected regions (Turkish Statistical Institute, 2012).

Table 1. Monthly net irrigation required (mm) for fully irrigated crops in Marmara region

Month	**Crops**			
	Wheat	**Barley**	**Maize**	**Tomato**
Jan	35.9	35.9		
Feb	39.4	39.4		
March	58.5	58.5		
April	107.5	107.5	52.9	
May	183.2	183.2	80.9	63.0
June	170.8	170.8	164.3	113.0
July	33.5	33.5	292.2	163.0
Aug			193.1	165.0
Sept			84.8	110.0
Oct	32.1	32.1		19.0
Nov	49.5	49.5		
Dec	36.9	36.9		
Totals	**747.3**	**747.3**	**868.2**	**633.0**
L/h/ha	2462.4	2462.4	3927.4	2217.7

Table 2. Monthly net irrigation required (mm) for fully irrigated crops in Eagen region

Month	**Crops**			
	Wheat	**Grape**	**Maize**	**Chickpea**
Jan	16.5			
Feb	25.7			
March	46.5			
April	85.6	66.8		
May	156.2	105.6	84.5	
June	143.0	140.2	155.8	74.8
July	29.5	172.2	200.9	127.6
Aug		196.9	186.7	91.8
Sept		65.6	120.5	
Oct	27.7	41.0		
Nov	30.6			
Dec	22.3			
Totals	**583.6**	**788.3**	**748.4**	**294.2**
L/h/ha	2099.5	2700.3	2646.5	1715.05

Table 3. Monthly net irrigation required (mm) for fully irrigated crops in East Mediterrenaen region

Month	**Crops**			
	Wheat	**Maize**	**Cotton**	**Orange**
Jan	48.0			28.0
Feb	61.0			32.0
March	100.0			54.0
April	146.0		66.0	80.0
May	161.0	94.0	117.0	79.0
June		174.0	158.0	114.0
July		183.0	233.0	129.0
Aug		215.0	144.0	125.0

Sept		137.0	75.0	104.0
Oct			44.0	76.0
Nov				49.0
Dec				35.0
Totals	**516**	**803**	**837**	**905**
L/h/ha	2164.0	2889.8	3131.7	1733.9

When the Tables 1-3 and the crop patterns reviewed, irrigation water is mostly needed for maize production in July in Marmara, grape production in August in Aegean, and cotton production in July in Eastern Mediterranean regions.

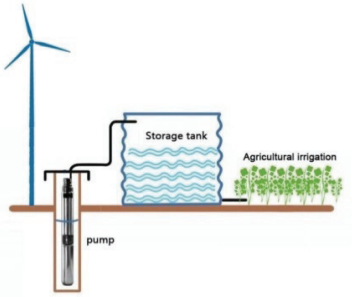

Figure 3. Wind-Powered Irrigation System

Pump and wind turbine selection

The affordability of energy sources is of major concern in utilizing them in agricultural sector. In recent years, solutions for employment of affordable and environmental friendly energy sources have been sought against environmental pollution and increasing energy costs. These conditions dictated the new search on alternative energy sources. Although they were neglected for long time, wind and solar energy potentials are really high considering geological and geographical characteristics of Turkey.

Irrigation is one of the most energy consuming processes in agricultural production phases. Some considerations such as needed time for irrigation, water supply status, amount of water needed, the depth of wells and water storage tank capacity should carefully be examined when the wind energy is employed in agricultural irrigation.

The power generation of a wind turbine at different wind speeds is determined by following equations (Shata and Hanitsch, 2006; Ilinca et al., 2003).

The effective parameters are air density, rotor cross-section area, wind speed, rotor power coefficient of wind turbine and mechanical efficiency. A circular shaped rotor cross section is related with the diameter of rotors (Piggott, 2004).

$$P = 0{,}5 \cdot \rho \cdot A \cdot v^3 \cdot C_P \cdot \eta \quad (1)$$

$$A = \frac{\pi \cdot D^2}{4} \quad (2)$$

In these equations;

v : Wind speed, m/s

P : The power of wind turbine, kW

ρ : Density of air, 1,225 kg/m^3

A :Rotor cross-section area of wind turbine, m^2

D : Rotor diameter of wind turbine, m

C_P : Ideal power coefficient of rotor

η : Mechanical efficiency of wind turbine.

Technical specifications of different pumps which were examined in this research are given in Table 4.

Table 4. Specifications of Pumps (Grundfos, 2013)

Model	Engine Power (kW)	Capacity							
		lt/h	1000	1800	3600	5400	7200	9000	10800
4SP8/5	0.75	Head (m)	30	28	26	24	21	17	12
4SP8/7	1.1		42	39	36	33	29	24	17
4SP8/10	1.5		60	55	51	48	42	35	24
4SP8/15	2.2		90	84	78	72	65	54	36
4SP8/18	3		108	100	93	85	76	63	44
4SP8/25	4		150	140	130	117	105	86	60

System Cost

Initial cost consisting water tank (5 tones), wind turbine with 10 kW, and use of various pump combinations may be calculated as follows:

$$\text{Cost} = \text{Water Tank} + \text{Wind Turbine} + \text{Selected Pump} \quad (3)$$

RESULTS AND DISCUSSIONS

Wind power may be utilized as an alternative energy source based upon wind speed at area of wind turbine installation, water demands of agricultural crops and the elevation of which water needed to be raised.

Power created by a wind turbine with 10 kW will be varied upon speed of prevalent wind at the region (Table 5). Accordingly, this variation will impact the selection of the pump employed at the system. The amount of irrigable area will also be changed by selected pump and crop type. When considering the water obtained from 30 m deep water well to irrigate most preferred crops in the area of interest, the amount of irrigable area based upon different pump types and wind potential was given in Table 6.

Table 5. Power performances of wind turbine swith 10 kW at different wind speeds

Wind speed (m/s) h=50 m	Outlet power (kW)
6	***1.68***
6.5	***2.14***
7	***2.67***
7.5	***3.28***
8	***4***
8.5	***4.78***
9	***5.67***
9.5	***6.67***
10	***7.78***
10.5	***9***
11	***10***

High potential regions in terms of wind power and groundwater resources were matched by the feasibility study. Crop types, geographical frame, and groundwater quantity were taken into consideration in the context of technical feasibility. A cost analysis was done by consideration of the costs of water storage tanks, wind turbine, and pump as an economic feasibility study. As a result of calculations, initial system cost was estimated as 17 170 euros to irrigate maize at 5.5 hectares in Marmara, grape at 8 hectares in Aegean, and cotton at 6.9 hectares in Eastern Mediterranean Regions at optimal conditions.

CONCLUSIONS

Wind power potential which was neglected at past is recently becoming current issue due to energy shortage experienced in Turkey. Various methods were developed to encourage the exploitation of wind power in recent years. Wind energy seems to be a reasonable option to satisfy the energy demands of agricultural sector. Particularly, farmer income is getting down due to increasing fuel cost in agricultural irrigation. Irrigation practices with renewable energy technologies should be disseminated by extension to the farmers to eliminate negative economic conditions.

As a result of study, it can be stated that Marmara, Aegean, and Eastern Mediterranean regions of Turkey offer a suitable option for wind-powered irrigation practices instead of using high-cost pumps with diesel oils. Also, surplus of electrical energy produced by wind may be directed to the non-irrigational agricultural practices. Thus, this could improve the living conditions of the farmer with the help of the development of the local farming.

Table 6. Irrigable area by pumps (ha)

	Marmara (Maize)			Aegean (Grape)			Eastern Mediterranean (Cotton)		
	8 m/s	7 m/s	6 m/s	8 m/s	7 m/s	6 m/s	8 m/s	7 m/s	6 m/s
4SP8/5	0.25	0.25	0.25	0.37	0.37	0.37	0.32	0.32	0.32
4SP8/7	1.8	1.8	1.8	2.60	2.60	2.60	2.23	2.23	2.23
4SP8/10	2.4	2.4	2.4	3.5	3.5	3.5	3.03	3.03	3.03
4SP8/15	3.05	3.05	-	4.44	4.44	-	3.83	3.83	-
4SP8/18	4.58	-	-	6.6	-	-	5.74	-	-
4SP8/25	5.5	-	-	8	-	-	6.9	-	-

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LESSONS TAKEN FROM ITALIAN POST-SEISMIC MANAGEMENT AND THEIR INTEGRATION INTO ROMANIAN ASSESSMENT SISTEM OF BUILDINGS AFTER A STRONG EARTHQUAKE

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Abstract

The paper presents aspects on post-seismic assessment of buildings according with Italian model. The authors of this work participated to international teams for building damage assessment in the framework of STEP (Strategies and Tools for Early Post-earthquake assessment) European project, after L'Aquila earthquake in June, 2009, and as invited experts in the framework of final workshop of Dr. House European Project in April, 2013. The projects were inserted within the framework of the Community Mechanism, whose main task is to facilitate co-operation in civil protection assistance interventions in the event of major emergencies which may require urgent response actions. The STEP project was a pilot project which constituted the technical and technological background for the Advanced Seismic Assessment module. ASA module was developed for strategic and/or complex structures, with dedicated instrumentation. According to the program activities, meetings were related to participation in international teams for post- earthquake assessment of buildings damages, organized by the Department of Civil Protection of the Council of Ministers of Italy as well as to applied of the visual assessment methods of state buildings in the field according to some special forms and exchange of experience at national and regional level with other European countries to develop common methodologies, taking into account national provisions in this regard, including the U.S. and Japan. In the EU context, the main purpose is to evaluate the possibility of participating in the investigation of international teams of experts damages in the event of major earthquakes that will hit some regions. Lessons taken by Romanian experts have been implemented in the post-seismic assessment system developed by NIRD URBAN- INCERC. Will be presented modern techniques used by the experts teams in the field as non-destructive methods, seismic instrumentation, temporary instrumentation, modal and dynamic analysis of buildings, and fast data transmission techniques from the field to clearinghouse. The data taken from the field will update the database created in INCERC Bucharest whose structure and operating will be presented.

Key words*: building assessment, post-seismic management, non-destructive methods, dynamic instrumentation, buildings database*

INTRODUCTION

The accelerated expanding of urbanization at globally level makes that almost half the world's population to live in cities. Many of these are large cities and are expanded through uncontrolled development, although they are located in areas exposed to many natural hazards, including lines that border tectonic plates in areas prone to destructive earthquakes. The presence of numerous types of vulnerable structures aggravates this seismic risk (Dragomir, 2013).

In Europe, the post-seismic investigations are required of practice and tradition from Eurocode 8. Field investigations of national associations in collaboration with ministries from seismic engineering construction and planning domain, in countries affected by destructive earthquakes are known.

Romania is a signatory country from 2002 to "EUR-OPA Major Hazards Agreement", the Open Partial Agreement on prevention, protection and assistance in the event of major

natural and technological disasters. Countries are focused on prevention and early intervention, thus being created European/Euro-Mediterranean centers, including:
- Harmonization of procedures and protocols for data exchange and online information on the effects of disasters and the demands and proposals for emergency assistance;
- Procedures and techniques of risk assessment, of the stability of buildings and civil engineering works, safety of facilities in the chemical, radiological, vital systems, of evaluating losses.

MATERIALS AND METHODS

EUROPEAN EXPERIENCE OF SPECIALISTS FROM N.I.R.D. URBAN-INCERC

Damages investigation after the L'Aquilla 2009 earthquake - STEP Project

In the STEP Project, at the action of damage assessment produced by 2009 earthquake to the constructions, in the L'Aquila region representatives of 11 countries, Greece, Turkey, Romania, Macedonia, Slovenia, Italy, Germany, Spain, Portugal, USA and Japan have participated (STEP Project, 2007).
That, in the context of the European Union, the main purpose of this investigation was to evaluate the possibility of participating in the damages investigation of international teams of experts in the event of major earthquakes that will hit some regions. On the other hand, a comparison between the results, obtained by the application of assessment methodologies specific to the two types of forms, Italian AeDES forms and those used in Bovec, Slovenia, in the STEP Project was desired.
Delegations of participating countries were housed in Celano town, about 50 km from the town of L'Aquila. The earthquake has caused no noticeable effects in this area.
The field inspection program referred to the following activities:
- in the first stage, teams were established to investigate, stating that the investigation will be done in parallel with the Italian expert teams.
- the field international inspectors teams have carried out the following activities:
- assessing visual field investigation of buildings;
- visiting Command and Control Directorate (Figure 1) established in L'Aquila, in the first hours after the earthquake, on 06.04.2009, and viewing a few places and important buildings of L'Aquila, which were badly damaged and subsequently evacuated, including local San Salvatore Hospital.

The specific of the impact of the earthquake on public institutions (Prefecture Hall) from L'Aquila earthquake was given where Prefecture Palace was crashed and therefore the management has moved it in the ItalTelecom Center.
The Department of Command and Control was established in the town of L'Aquila in only three to four hours after the earthquake on his 06.04.2009, carrying on all the activities of coordination and control in a sports hall belongs to the Financial Guard.

Figure 1. Organize command centre DI.COMA.C

Figure 2. Inspection teams with owners of damaged buildings

In the area around L'Aquila, a quasi-military regime was introduced, the access to town without inhabitants, and especially in the "red zone" (the historical centre, with buildings badly damaged), being controlled by the Police, Fire, Military and Financial Guard and being allowed the access only to those authorized to make inspections, accompanied by owners, planned in that day (Figure 2).
After the earthquake, the L'Aquila village was evacuated and about half of the residents were accommodated in tents placed in available spaces by Civil Protection teams (Figure 3).

Figure 3. Camp tent near L'Aquilla town

From the first hours after the earthquake, the fire crews went to secure the buildings seriously damaged (Figure 4). This measure applies, however, and about two months after the seismic event.

Figure 4. Emergency measures to secure a building after earthquake

Advanced Seismic Assessment module – Dr. House Project

The ASA Module is coordinated by Eucentre and it is aimed at performing fast post-earthquake structural evaluation of strategic or complex structures using combined numerical and experimental techniques. ASA technology is based on the technology developed within the European STEP project (Strategies and Tools for Early Post-Earthquake Assessment) (DRHOUSE Project, 2010).
Particularly, a special mobile unit (MU) equipped with instrumentation, workstations and servers, is used to perform and coordinate experimental testing activities as well as advanced assessment of buildings (Figure 5). The mobile unit has also functions of data repository and wireless hub. Field data will be transferred from ASA teams to MU via satellite connections and wireless technology. The safety assessment is based upon a detailed geometrical survey of the building and non-destructive in-situ tests and can be performed on multi-storey reinforced concrete or pre-cast buildings, masonry buildings, towers, churches and landslides.
The main objective is to estimate both the damage level and the residual capacity of the structures.
As general lessons, useful to the preparation for the earthquake in Romania, we mention:
- At European level, the investigation of state buildings is required by law. In the days after the earthquake, some investigation teams dealing with the present state of the buildings on the field. This is particularly important in the restoration of normality shortly before the earthquake.
- It is appreciated that at the investigation of building and data collection assist Civil Protection, Council engineers of Architects, some universities. In the investigation teams were six members of the profession.
- A very important issue for Romania will be to cover the entire affected area. For this reason, the European cooperation is beneficial to the establishment of emergency tent camps in the available spaces, ensuring all the facilities to people would live in these facilities after a strong earthquake.

Figure 5. Devices used for advanced buildings assessment

RESULTS AND DISCUSSIONS

THE CONCEPT OF ROMANIAN SYSTEM OF DAMAGE INVESTIGATION

Regarding the specific seismic hazard and vulnerability, Romania is currently in preparation for the impact of a possible earthquake, unpredictable situation in time, but possibly in the general statistical sense at the beginning of this century. At present, there is a shortage of hard data on the situation of hazard and risk factors of locality, as the effects of previous earthquakes.

In order to design the system for investigating and defining thematic structure, research institutes, universities and institutes in the area of decentralized powers and resources in the investigation were analysed. For infrastructure networks, national agencies and institutions / technical departments, namely research institutes in the field, were analysed. The thematic structure was established from the regulations approved by ministries as well as by European and international requirements in the field.

The created system (Figure 6) will collect the needed data to be taken lessons in engineering and management regulations disasters and to have the knowledge base and calibration for future research. To this system was took into account the fact that, in Romania, Vrancea large earthquakes have features practically unique in the world, occurring every few decades, and the affected area is very large, so the investigation requires a special effort and the loss of the effects would be unrecoverable (Dragomir, 2011).

This fact has imposed the study of problem at system level, finding solutions and developing a regulatory director material, with adequate resolution of the involved resources, to ensure the application through both central and the decentralized authorities.

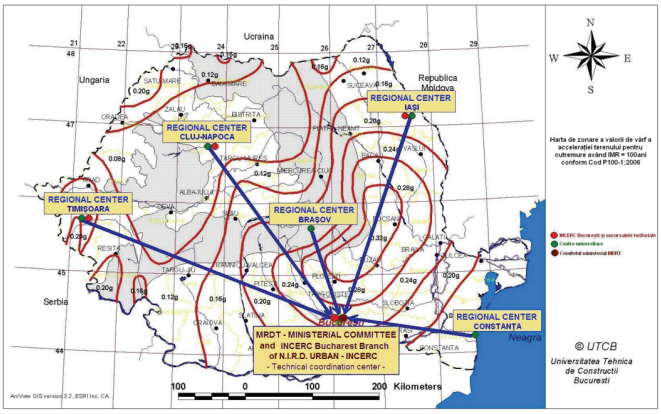

Figure 6. The structure of assessment system

THE STRUCTURE AND OPERATING MODE OF THE DATABASE FROM INCERC BUCHAREST

By exploiting the software created in INCERC Bucharest Branch, one can obtain numerical values and graphs for the six buildings investigated by INCERC Bucharest Branch specialists who travelled to the L'Aquila earthquake dated 06.04.2009.

For SIS INV TEREN.mdb some tables (imported from databases - data collection teams investigare.xls) and the relationships between these tables are presented. Also the output data in the form of reports created in Access are presented.

The input data used to create the database are:

- Input data for achieving domain "Inspectors': badge number, name and electronic signature
- Input data for achieving domain "building": the Land Code, Geographical coordinates, Description, Type, and Destination.
- Input data for achieving domain "Assessment of buildings and proposals"(Figure 7).

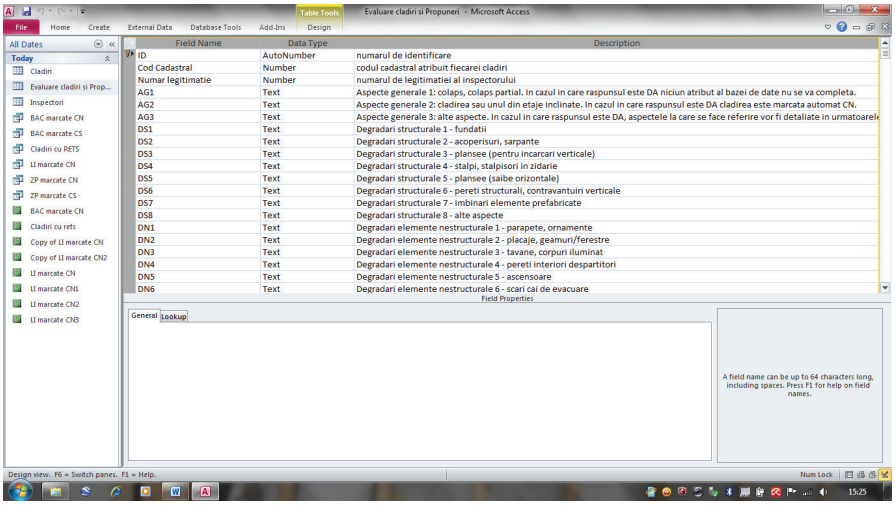

Figure 7. Description of the “Assessment Buildings and Proposals” domain attributes

The output data in the form of lists containing data on investigated buildings using the following query is presented: buildings with reinforced concrete frame structure (BAC) declared SAFE BUILDINGS (CS); buildings with reinforced concrete frame structure (BAC) declared UNSAFE BUILDINGS (CN); masonry bearing wall buildings (ZP) declared

SAFE BUILDINGS (CS); masonry bearing wall buildings (ZP) declared UNSAFE BUILDINGS (CN); individual houses (LI) declared UNSAFE BUILDINGS (CN); public buildings (CP) for which some recommendations on their technical expertise are made (RETS).

CONCLUSIONS

In Romania it was considered that Vrancea large earthquakes have different characteristics from other European countries through the fact that they produce every few decades and the affected area is very large, so the investigation requires a special effort.

On the other hand, Romania cannot afford to lose field observation data and we must correlate them with the instrumental records.

In this respect, the created and presented system proves its usefulness and more of this the database ensures that vital information about structure will be maintained throughout the period of their existence. This is beneficial for any structural interventions, when required knowledge of certain structural features and their evolution over time due to seismic events.

In addition the integrated system ensures the applicability of ME-003-2007 Romanian methodology on emergency assessment of buildings post-seism safety and establishing framework solutions for interventions.

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INFLUENCE OF CLIMATE CHANGE ON SURFACE WATER QUALITY IN THE MANECIU – CHEIA AREA

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Abstract

The need for continuous monitoring of surface water quality in order to produce estimations necessary to maintain and provide the sufficiently sources and quality of groundwater is an ongoing concern of the authorities in the protection of water quality. For drinking water sources such studies are required by European legislation. According to the usage degree of surface water for drinking water established by the Romanian Waters Administration, the Buzau-Ialomita basin represents 3.5% of the total water resources. Inside of this basin, the Maneciu-Cheia area has, besides surface waters, an intensively exploited natural lake being an area sensitive to climate change.
This paper aims to analyze the influence of climate change on forest ecosystems and on water quality in the mentioned area. The study having been developed within the European project CC-WARE. The relevant physico-chemical indicators analyzed in the paper are: temperature, organic matter, nutrients, turbidity and pH. As novelty items, tracking the influence of climate change within the CC-WARE project enables the estimation of water resources vulnerability and the prediction of water quality in the studied area for the years 2015 and 2020, based on the monitoring data.

Key words*: climate change, water quality, forest, vulnerability, quality index.*

INTRODUCTION

Globally and nationally, it can be seen that lately, as a result of climate change the frequency of extreme events has increased (heat waves, droughts, storms and heavy rains accompanied by hail, heavy snow, fire), leading to increasing forest area injuries affected by: the drying (and thus the attacks of insects , fire) and tearing wind and snow , landslides , floods etc. The extension, the structure and the health of forest ecosystems threatened by climate change, are vital to ensure a balanced diet of resources and quality of waters. The interaction between the population's growth, urbanization and development with the need for water, the flood control and the way of exploitation/ change of the utilities, requires the restoration of the degraded land and the improvement of water basins in a manner that enables ecosystem services to become more sustainable. Moreover, these engineering activities closely related to forestry, have been and are accepted worldwide as an effective tool to maximize the ecological services and to ensure clean and stable water resources (Giurgiu at al. 2006).

INFLUENCE OF CLIMATE CHANGE ON THE FORESTS

Considering climate and its changes, the analysis of factors / causes that affect forests is particularly important because it allows highlighting a long chain of interactions with harmful effects, interactions generating risks in terms of the environment, of which there emerge:

- acceleration of floods frequency and intensity, due to rapid runoff of rainwater and soil erosion;
- lowering hydropower potential and drinking water resources;
- instability of agricultural production, by disrupting fluid balance and increased droughts;
- reducing the economic and tourism potential of the affected areas.

Other climatic and anthropogenic factors that may lead to the forests deterioration are (Simionescu et al., 2012): the wind and snow causing significant harm (crashes and ruptures) to softwood forests in the mountain, the exacerbated drought in the last decade, which can trigger the growth of the mass of insects, also drying the forests and forest fires diminishing forest area and increasing fragmentation, exacerbated by the political events of 1989, deforestation, grazing in forests, contributing to the deterioration of environmental conditions and the disruption of specific balance of forest ecosystems.

Regarding the hydrological efficiency of the forest, this is the optimal protective shield against erosion, providing a balanced diet of water or snowmelt runoff, helping to stop hydrology modifications and to reduce flooding (*Constandache et al., 2012*). Research has shown that the hydrological efficiency of an ecosystem is dependent on its characteristics and of the soil's, as appreciated by 3 parameters: retention, runoff, erosion amount.

Forests adjacent basin analyzed in this paper are located in most of the mountainous area and the Carpathian hills that guard stepped terraces and plateaus furrowed by deep valleys, with lithological substrate predominantly of sedimentary nature, which increases land vulnerability to erosion, landslide, clogging etc.

The average altitude of the study area is 600 m, and the altitude increases from south to north and it varies between 490 m, at the confluence of Valea Mare with Teleajen, and 1954 m - Ciucas peak.

The vegetation of the area studied, in the Maneciu village, bordering the lake, shows a wide and diverse range. In alpine mountains, over 3000 ha of forests are composed of coniferous forests where spruce and fir tree predominate, while at lower altitudes one can meet mainly hardwood species: ash, hornbeam, elm, birch, alder and so on; the South hills, just as the terraces, are covered with orchards or crops, ponds and meadows.

The hydrographic network consists of Teleajen river, as main stream, flowing from N to S with many tributaries one of which being Telejenel At its confluence with Teleajen it was built a large engineering goal that created a reservoir with an area of 34 square kilometers and a total volume of 60 million cubic meters of water.

The temperate climate of forest specific to this area is cold and wet with long harsh winters. The average annual temperature is 8 degrees C, the average in July is 19 degrees C and in the January 4 degrees C. The average rainfall is 960 liters with the maximum period in May-June and minimum in winter. Precipitation as snow is quite low, the snow is on average 20-30 cm.

The predominant soil types are brown soils and alluvial with profound acidic characteristics. Out of the agricultural land adjacent to forest areas, about 61% are brown acid soils and alkaline soils are about 13%. Note that of the total area of 23643 ha of Maneciu village, 16971 ha (about 72%) are covered by forest.

CLIMATE CHANGE AND THE HYDROLOGICAL EFFICIENCY OF FORESTS IN MANECIU AREA

Previously reported phenomena associated with specific Maneciu habitat (mountains, hills, valleys) preclude to the multifunctional role of forests, given that they suffer continuous changes in size, structure, diversity / quality, age, etc. The structure and stability of forests in the hills can be imbalanced in case of climate change, in the sense of reducing rainfall and increasing temperatures, as well as increasing the awareness of extreme events.

The softwood forests will be affected by the climate changes by increasing of the areas affected by crashes / tearing wind and snow (spruce) and drying (fir, pine and spruce outside the area), phenomena exacerbated lately. The existence of the upper alpine basins of watercourses, the upper limit, the natural forest is an important variable in assessing vulnerability of water resources. This area is

the most active and the most vulnerable in the formation of flash floods, as it has steep slopes, it is completely bare, rocky bed, with significant rainfall and land configuration that allows rapid runoff concentration. Such areas are transiting through the river in the forest, a large influx of water and large quantities of silt, which loads watercourses with solid material and can clog the lake.

INFLUENCE OF CLIMATE CHANGE ON WATER QUALITY IN THE MANECIU-CHEIA AREA

Within Maneciu-Cheia basin, besides surface water, there is a natural lake intensively exploited, as an area sensitive to climate change. Maneciu Dam is located on the confluence of Telejenel with Teleajen, at the foot Ciucas upstream Maneciu town in Prahova County (Hydrografic area Management Plans, 2013, Hydrografic Buzau - Ialomita Management Plans, 2013). The Maneciu dam has a height of 75 feet and a crest length of 750 meters. Lake formed after raising the dam has a volume of 60 million cubic meters and an area of 192 hectares. The dam and lake at Maneciu were thought to have multiple functions. Thus, they play important roles in water supply to settlements of Prahova, irrigation and power generation, but also for flood control (Panaitescu at al., 2008). Tracking of the influence of the climate change within the CC-WARE project was done by estimating the vulnerability of water resources and water quality in the studied area and forecast for 2015 and 2020, based on previously monitored data (EUROSTAT Requirements).

MATERIALS AND METHODS

Physico-chemical indicators chosen in terms of their climate changing influence on surface water quality in the area studied were: temperature, organic matter, nutrients, turbidity and pH. Experimental determinations were carried out in the year 2012 in the laboratory of wastewater treatment and at PGU Ploiesti. Analyses were performed in accordance with applicable standards and using the appropriate equipment, such as: temperature and turbidity were determined using the apparatus HANNA , organic matter content was determined with the VELP device, equipped with sensor BOD, pH was determine with a WTW device, and nitrate and nitrite with Jenway UV-VIS spectrophotometer.

Corresponding concentrations of organic substances were determined by EPA Method 405 and in accordance with standardized methods of Romania STAS 6560-82 and ISO 6060/96, (EPA 821R00003 Analytical Method Guidance, 2002). Nitrogen content was determined according to STAS 8900/1-71, 7890/1-98 ISO STAS 8900/2-71 nitrogen, nitrogen ISO 6777-96. pH was measured with WTW device (ISO 10523-97), turbidity according to STAS 6323/2008. Water sampling was done according to ISO 5667-6:2009 (Panaitescu at al., 2013).

RESULTS AND DISCUSSIONS

Climate change, as seen in the evolution of the water's average temperature within Maneciu-Cheia basin, was in 2012 as follows: during the summer about 21.1º C minimum and maximum of 24.4º C, and in winter the water temperature varied between -1.1º C and 11° C. High temperatures affect water quality due to lower amount of dissolved oxygen and algal population growth. With the increase in atmospheric temperature, the water surface is heated by solar radiation forming two layers of different density.

The winter stagnation occurred and nutrient concentrations decreased significantly due to the reduced intensity of photosynthesis, which is otherwise characteristic of December and January. Water has a relatively constant temperature of 4-6º C, a lower concentration of nutrients, organic and biological substances (algae, bacteria).

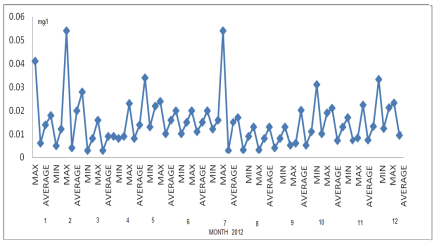

Figure 1. Variation of nitrites concentrations from Maneciu lake in 2012

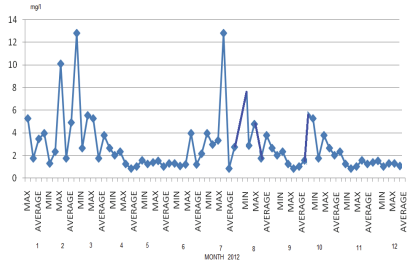

Figure 2. Variation of concentrations of nitrates from Maneciu lake in 2012

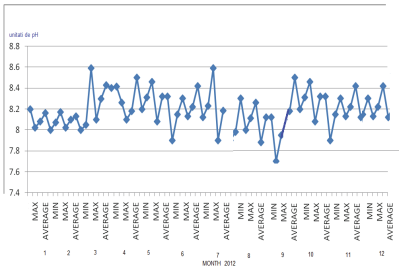

Figure 3. Variation of pH from Maneciu lake in 2012

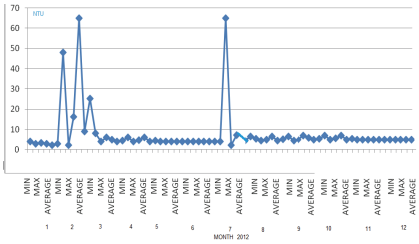

Figure 4. Turbidity from Maneciu lake in 2012

Maximum annual values were recorded when the nitrites were in the range 0.003 mg / L and 0.054 mg / L. Nitrate concentration ranged in 2012 from the value of 0.840 mg/L to the value of 12.82 mg / L. The pH varied between 7.80 and 8.59 pH units, while the turbidity ranged from 2.2 NTU to 65 NTU.

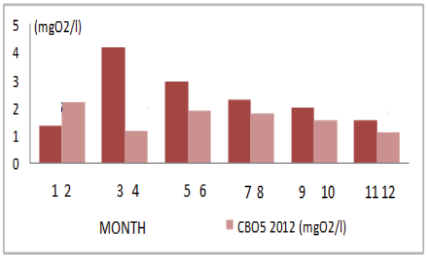

Figure 5. Variation of CBO_5 concentration in 2012

These organic substances in large quantities of about 5 mg / L reduce the concentration of dissolved oxygen, leading to algal population growth due to lower dissolved oxygen concentration. The water quality should be good when BOD5 is maximum 1.9 mg / L.

Estimating the vulnerability of water resources with water quality indices

The quality indicators that may help to estimate the vulnerability of surface waters from Maneciu-Cheia area were chosen WQI (the Water Quality Index) (equation 1, table 1) (Adriano et al. 2006).

$$WQI = \left(\sum_{i=1}^{n} q_i w_i\right)^2 \quad (1)$$

where:
WQI – the Water Quality Index
i – the quality parameter
q_i – the registered value
w_i – the rank of implication of the parameter in the computation formula.

Table 1. Index value intervals and the corresponding quality category

Water quality	Value intervals (percent)
Excellent	95-100
Good	74-94
Moderate	50-74
Marginal	25-49
Poor	0-24

After the calculation of the WQI value, the obtained result of 78% shows that framing water has a good quality. But if we compare this figure with the previous years (Panula Basin Management Buzau-Ialomita, 2012) there may be noticed a degradation of water

quality due to major climate changes in 2012. Water quality class makes it good to be used both for the production of drinking water and for small industry.

Due to climate changes emerged in recent years, the water quality in this area has been classified as good to moderate in 2015 and 2020 (Management Plan). So, based on the data collected by the INS and NARW, there were proposed targets required for the quality of potable water.

Therefore, till 2015, there will be elaborated the drinking water safety plans for urban areas and, till 2020, in all towns with a population higher than 5.000 inhabitants.

CONCLUSIONS

It can be seen that lately, due to climate changes, there has increased the frequency of extreme events (heat waves, droughts , storms and torrential rains, accompanied by hail, heavy snow, fire), factors that determined the growth of forest areas affected by different kind of damage: drying (and henceforth the attacks of insects, fires), crashes and breaks caused by wind and snow, landslides, floods etc.

The analysis of factors-causes that affect the forest is particularly important because it allows highlighting a long chain of interactions with harmful effects, interactions generating environmental risks, in general, and to water quality in the adjacent forest ecosystem, in particular.

For a better performance and a maximum efficiency of the hydrological and ant erosion functions, there are necessary a good proportion, distribution and, especially, a certain structure of the forest in the basin area, and it is required a qualitative analysis of all the utilities in the catchment to assess the vulnerability of the water resources and to establish the management measures and emergency response in terms of climate change.

Forests condition and stability are of major importance in the fulfillment of their environmental, social and economic functions as they are assigned.

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THE HISTORICAL EVOLUTION IMPACT ON THE LAND PROPERTY STRUCTURE AND EXPLOITATION IN AGRICULTURE IN SOME EUROPEAN MEMBER STATES

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Abstract

The purpose of this paper is to present the changes suffered by the property structure and exploitation in the agriculture due to the modifications of historical and political environment suffered by the countries. In order to expose this evolution there are presented historical facts related to the agrarian and agricultural policies adopted by some member states like France, Germany, Italy and Romania. It is also essential, for a better understanding of the agricultural policies, to know the role and importance of the property and exploitation structures as frame for the agricultural and rural development.
The main goal of this study is to show that the decisions related to the agriculture are directly linked to the historical period in which there were taken and that those decisions marked the entire evolution of the agriculture.
The main methods utilized to elaborate this article were collecting and interpretation of information.

Key words*:evolution,property structure, agricultural land exploitation, policies.*

INTRODUCTION

After the war, Europe preoccupied to ensure the alimentary independence, made from agriculture one of the main priority objective of the communitarian construction.
This desire to achieve rapidly the auto-sufficiency explains why the agricultural sector was the first who made the objective of a common policy. It is a key element in the history of the European construction and also in its geopolitical and economic context, even if the agriculture has a low contribution to the GDP of each member state, it continues to play a structural role in the evolution, development and spatial planning of the territory.
The Rome Treaty of 1957 defined the general objectives of the Common Agricultural Policy (CAP) in Articles 38-47 EEC (TEC Art. 32-38). Development has been very rapid after the general principles were defined in Stresa Conference in July 1958. In 1960 the six founding states of the EEC adopted the mechanism and the Common Agricultural Policy which became effective since 1962.
The Common Agricultural Policy still prevails among the most important policy because it represents about 50% of the Community budget and 80% of the legislation. The Common Agricultural Policy has been a long time an important symbol of European integration and has been a controversial subject for reform since the 1960s.
Regarding the evolution of the land and agricultural exploitation, the article 39 of the Rome Treaty specifies:
-The increase of the agriculture productivity by promoting the technique progress, by insuring the rational development of the agricultural production and also by optimal utilization of the resources including the labour force.
-The insuring of a reasonable living standard for the agricultural community, especially by increasing the individual incomes of those who work in agriculture.
Accomplishing those purposes must take into consideration the special character of the agricultural activity which results from the social structure of the agriculture and the natural disparities existing between the agricultural regions.
This article establish a double perspective in the favour of increasing the integration of the agriculture in a dynamic market and corporative investments, along with promoting a model of familial farms situated on the entire territory.

MATERIALS AND METHODS

In order to characterize the evolution of land property structure and exploitation historical facts and policies adopted are analysed.

RESULTS AND DISCUSSIONS

Historical evolution of the land property structure and exploitation in France

The development of the French agriculture competitiveness by correcting the "shredding" of the land property, which conducted to small and underproductive units, and also by rationalization and modernization of holdings, represented the main targets of the juridical arsenal that was elaborated during 20 consecutive years after the Second World War.

The state of the relationship tenant-owner in the favour of the farmer, framing surface by opening the right regarding the exploitation authorization, land control that target to facilitate access to land for young farmers they constituted articulation devices that have helped to strengthen family holdings in an optimal modernization frame.

Beginning with the year 1980, substituting the single European agricultural market to perfectionism implied a number of directives in accordance with the more liberal character of some European countries agricultural legislation and leaded to the reducing of the market support policies. In 1995, the creation of the Committee Department of Agricultural Orientation had as main purpose to ensure the coordination, at departmental level, of the various instruments of agricultural policy.

The elaboration of the agricultural policies in France had as start point the problem of land property whose dimensions were too small to be productive. The article no. 544 of the Civil Code defines the right to property as follows: the disposing and using assets in the most absolute manner. This article suppressed secular habits that led to the collective property or to the existence of several property rights on the same land. In the XIX century the recognition of the individual and absolute private property of the land was necessary in order to eliminate areas set aside and the triennial crop rotation. For these reason France was not capable to satisfy the alimentary independence of the country. After the Second World War the French agricultural was characterized by an important regress compared to Germany, regarding the use of the chemical products and of the agricultural machines. The main cause of the regression was the protectionist policy which maintained a numerous and low productive population in the rural areas. It was not the only cause; the excessive right regarding the property of agricultural land also turn out to be an obstacle in increasing the agricultural productivity. The existence of small size holdings represented an impediment and the development required a regrouping of the land in holdings with more important surface in order to have the capacity to use the technical and technological progress.

The beginning of the 80's marked a crisis of the French agricultural production model that was developed in 30 years. The characteristics of the crisis were described as: chronicle overproduction obtained in agriculture, excessive budgetary costs, negative effects on the environment and on the landscape.

In order to bridge the effects caused by this crisis there were elaborated land policies targeting to ensure the alimentary security and safety, to increase the agricultural products competitiveness, to diversify the activities in the rural areas without neglecting the environmental conditions.

Historical evolution of the land property structure and exploitation in Italy

In the past 150 years, the structure of the italian agriculture was completely modified. The transformation begun with the Unification of Italy when 11 million persons were involved in agriculture. In the course of 1900s begun the first modification regarding the society and agriculture but the real modification starts after the Second World War. Italy after the war was a country in which the population was largely rural, low urbanized and which was supported mainly from the primary sector, especially from agriculture. It was an underemployed population which in the rural context didn't succeed to use its own working capacity.

In the 50's the rural population leaves the rural in an exodus of huge proportion in favour of cities and industry. The demographic exodus from rural to urban determined a quick diminution of persons' number occupied in agriculture. By the end of the century only 1

million of persons still remained in the Italian agriculture sector. The effect of the changes was manifested in a continuous increase of the production and in an accentuated development.

In 1990 entered in force the Law no. 752, adopted on 8 November 1986, regarding the applying of the planed intervention in the agriculture. This law constituted an operative instrument of the National Agricultural Plan from the period 1986-90 and replaced the Law no. 984/1977. Law no. 752/1986 was more flexible, having articles regarding the high dimension holdings and it was not as restrictive as the previous one.

In 1999 it was approved the Law no. 499/1999 for the agricultural sector, that defines the procedure of programming in agriculture until the year 2002. The fundamental objective of this law was to coordinate the varied subjects of agricultural policy.

In Italy the accent put on property has created imbalances due mainly to the detailed description of the rights but the poor exposure of the obligations.

The evolution of the Italian agriculture was made based on modernisation and technologization. The property of the agricultural land did not suffer major changes after the modifications registered at the economy level in general.

Historical evolution of the land property structure and exploitation in Germany

The German agriculture was powerful regulated by policies and it is considerably dependent by the public support. Even if the agriculture represents only a small sector in the German economy and the number of holdings decreased, the production increased. That is the way at the beginnings of the 90s a single farmer was able to produce enough in order to support 75 persons, much over the average in the years 50s or 60s.

Germany has a long history regarding the differentiated organisation in the development of agricultural systems. In 1900, before the unification of the Western and Eastern Germany, there existed a consensus between the interested parts (consumers, farmers, industry, politicians) that favoured the policies and strategies of agricultural system. Those strategies targeted mainly the expansion of the holdings surface but the public interests no longer coincided with the private ones. In the moment that the conflicts regarding the surface started this fact determined a pressure.

Germany has structural agricultural policies that include measures that affect the holdings and the agricultural structures. Their purpose was to conduct to the improving of the capital goods and therefore to increase the income capacity for farmers.

Beginning with 2005 the importance of the environmental consideration and of the land multifunctionality concept is accentuated and it is reflected in the structural policies. In order to develop the rural space in Germany, starting with the year 2001, at federal level was created the Ministry of consumer protection, alimentation and agriculture (BMVEL). The idea behind of this responsibility was to ease an integrated treatment of the agricultural production, distribution, consumption or nutrition. The biggest group in Germany that operates in the field of agricultural policies is The Association of German Farmers („Deutscher Bauerbverband") which represents 90% of the German holdings.

The development of the agriculture that implies holding with a significant surface brings modifications to the structure of agricultural land. This type of change was also made at EU-27 level. Therefore the goal of the policies was to increase the surfaces of the holding and to reduce the population occupied in agriculture, focussed on a healthy development of the agriculture but also of the rural area in general. The goal of thiseobjectives was to protect the farmers interests and to increase the standard of living.

Historical evolution of the land property structure and exploitation in Romania

Romania represented the frame of various agricultural reforms that were in the favour of the farmer's property (reforms of the year: 1964, 1921, 1991, 2000).

The agrarian reform from 1921 had as base the Law from 17 July 1921 and had two parts: the expropriation and the land allotment. Chapter I- The righteousness and the limit of expropriation, article no. 1 states: "The national utility upon expropriating rural properties, as far as the present conditions of the law, in order to increase the extent of peasant rural property, to establish communal pastures, and for

purposes of general interest, economically and culturally. Cultivated land in urban villages across rural property is considered in terms of the law of expropriation."

In the second part that concerns the land allotment, the articles 78 and 79 from the Chapter X regulate the order of selling the expropriated land.

This reform had as effect the diminution of the land property regarding the agricultural surface but the landlords remained with important forest surfaces. In this manner the small property became dominant, the middle size property with a higher importance and the large property with an importance substantially reduced.

Another reform was the one from 1945 which had as base the Law no. 187 from 23 March 1945 regarding the agrarian reform. The article no. 2 from the Chapter I explains the purpose of the reform.

In Chapter II- Expropriation, article no. 3 it is mentioned: "In view to implement land reform, the land should be transferred to the State in order to be divided to the entitled ploughmen for allotment and to create the reserve."

The most controverted reform had as base the Law 18/1991 also named The Land Low. Chapter II – Establishing the right of private property on the agricultural land throw article no. 8 explains:

"(1) the establishing of the right of private property on land found in the patrimony of the agricultural cooperatives is made under the conditions of the present Law, by reconstituting the property right or constituting this right the

(3) establishing of the property right is made on demand by the issuance of a property title within the limit of a 0.5 ha surface for each entitled person - according to this law and maximum 10 ha per family in arable equivalent."

The agrarian reform from 2000 was based on the Law no. 1/2000 for reconstituting the right of property on the agricultural and forestry land, solicited according to the Land Law no. 18/1991 and Law no. 169/1997 provisions: "reconstituting the right of property for individuals for the difference between 10 ha per family and the surface brought to the production agricultural cooperative or taken in any manner, but not more than 50 per dispossessed owner, is made entirely in in areas where there are surfaces of land set aside available to the committee."

All the modifications on the agricultural land level had an impact on the general evolution of the agriculture. After these reforms Romania is facing the problem of excessive fragmentation of the agricultural land and this problem leads to an inefficient agriculture with low yields.

CONCLUSIONS

After analysing of the policies adopted by France, Italy, Germany and Romania it can be concluded that the actual state of the agriculture and the entire development of the rural areas depend directly of policies adopted by each state at a certain historical time. Every decision was made related to the necessity of the period and it affected the evolution on long term. The effects of the political decisions in agriculture are felt even today and are reflected by the level of development, life standard of the farmers, the productivity of the agriculture. But there are also negative effects, as in Romania case, where the policies based on law led to problems in the property structure and the exploitation of the land that are felt nowadays. This proves that in order to satisfy the immediate need, the side effects on long term were not took into consideration.

The important point proved through this analysis is that every country adopted the strategies and policies which responded to the needs at certain period and were made in order to achieve a healthy development of the agriculture and rural areas.

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MOBILITY OF LEAD IN SOILS POLLUTED BY NON-FERROUS METALLURGICAL PLANT IN NORTHWESTERN ROMANIA

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Abstract

The soil contamination with Pb and the Pb mobility in soils near a non-ferrous metallurgical plant in Baia-Mare town, a well-known region for its high level of environmental pollution, were studied using the Community Bureau of References (BCR) Sequential Extraction Procedure. The results indicated a high concentration of the total Pb content, which exceeded the alert thresholds in all samples and the intervention thresholds in more than a half of the samples, according to the Romanian legislation for less sensitive soil uses. About 24% of the total Pb content was found to be in mobile forms and about 48% in mobilizable forms, indicating that, despite the suspending of ore processing activities, a significant soil contamination with mobile Pb fractions occurs. These mobile and mobilizable fractions represent a potential threat to the environment and to human population living around the plant. About 11% of the total Pb content was found in the residual fraction, considered to be immobile and not posing significant risk for the environment.

Key words: *BCR sequential extraction procedure, Pb mobility in soil, soil contamination.*

INTRODUCTION

Metals in soil are associated with different soil components and according to their mobility, are divided into acid-soluble and exchangeable, reducible, oxidizable and residual forms (Tack et al., 1995). In order to accomplish a comprehensive risk assessment of soil pollution with metals, along the total metal content, the identification of the metals mobility in soil is also necessary. The most used methods to determine the metal fraction in soils are the Tessier(Tessier et al., 1979) and the BCR schemes (Quevauviller, 1998).

Usually, metals extracted in the first three steps of a BCR procedure are related with anthropogenic contamination and the metals found in the residual fraction are linked to natural occurrence in the parent rock (Ratuzny et al., 2009).

The town of Baia-Mare, located in the North Western part of Romania, was one of the main mining and ore processing centre during the late 19th and early 20th Century. Mining exploitations and non-ferrous ore processing plants functioned in the town and around the town for a long period of time, but currently, all these facilities are either decommissioned or in the preservation process.

The environmental components in this area have been contaminated for years with metals, due to dust emission, mining and metallurgical wastes (Frentiuet al., 2008a; Frentiu et al. 2008b; Senila et al., 2001). Recently, the area recorded a downward trend of pollution as a positive consequence of measures to limit environmental pollution from industrial activities (Levei et al., 2009; Miclean et al., 2008). Also, in the last years, the metallurgical non-ferrous plants had changed their technological processes and had tried to use cleaner technologies to reduce the environmental pollution in the area.

Since the end of 2012, the Pb metallurgical non-ferrous plant situated in the proximity of the studied area is in a preserving stage.

In order to understand the possible Pb effects that could be generated on the soil component, the Pb fractions were evaluated using BCR sequential extraction procedure (Zimmerman and Weindorf, 2010). This method has a large application in the assessment of soils

contaminated with heavy metals and allows the prediction of metal mobility in soil (Frentiu et al., 2009).

MATERIALS AND METHODS

Sampling

A number of 15 soil samples (S1-S15) were collected near the Pb metallurgical non-ferrous plant, from a hill, covering almost 11,800 m^2. It is supposed that a smokestack was built on the top of the investigated hill, but in the present it is decommissioned. As references, two soil samples (R1-R2) were collected from an area located at approximately 15 km away from the investigated hill, considered to be outside of the polluted area. All soil samples were taken from a 30 cm depth using a stainless steel shovel.

Sample preparation and analysis

The soil samples were dried at 105^0C for 24 h, crushed and sieved through a 2 mm diameter sieve. The fraction below 2 mm was collected, homogenized and stored in polyethylene bags until analysis.

To determine the Pb mobility in soil, the BCR sequential extraction procedure was performed according to Zimmerman and Weindorf (2010). An amount of 1 g of soil sample was weighed into a 50 ml centrifuge tube and sequentially exposed to different reagents.

The acid-extractable Pb fraction (F1) was extracted in 40 ml of 0.11 M CH_3COOH for 16 h at 20±5°C, under continuous shaking (15 rpm). The extract was centrifuged at 4,500 rpm for 10 minutes. The supernatant was filtered in 50 ml tubes.

To determine the reducible Pb fraction (F2), the residue from F1 was subjected to extraction in 40 ml of 0.1 M $NH_2OH{*}HCl$ (pH=2 with HNO_3) for 16 h under continuous shaking at 20±5°C.

For the oxidizablePb fraction (F3) 10 ml 8.8 M H_2O_2 were added to the residue from F2, and shaken for 1 h at room temperature. Then another 10 ml H_2O_2 (pH=2) were added in each tube and heated to 85^0C in a water bath, until the sample volume was reduced to approximately 1 ml. After cooling, 50 ml of 1 M NH_4OAc (pH=2 with HNO_3) were added and shaken for 16 h at 20±5°C.

For determining the residual fraction (F4), the residue from F3 was dried and collected into 100 ml reaction flask. A volume of 28 ml aqua regia (21 ml of 12 M HCl and 7 ml of 15.8 M HNO_3) was added and maintained at room temperature for 16 h. The mixture was then heated under reflux conditions for 2 h. The solution was filtered and diluted to 50 ml with 0.5 M HNO_3.

To determine the total Pb concentration, an amount of 1 g soil sample was weighed, introduced into the reaction flask and extracted in 28 ml aqua regia.

The Pb concentration from the extracts was determined by inductively coupled plasma optical emission spectrometry using an OPTIMA 3500 DV spectrometer.

RESULTS AND DISCUSSIONS

The results indicated a high variability of Pb compounds in the studied area. The total concentration of Pb compared with the alert thresholds and the intervention thresholds for less sensitive soils are presented in Figure 1.

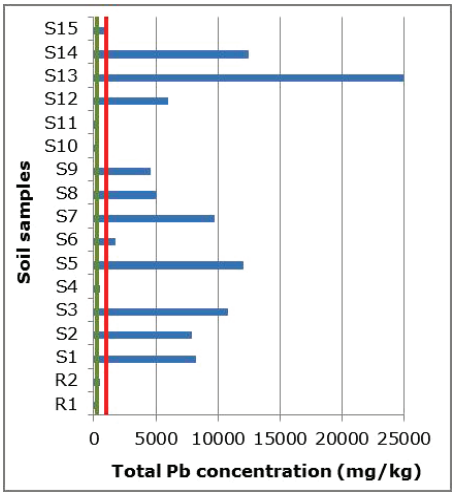

Figure 1. Total concentration of Pb in soil

Total Pb concentration ranged between 300-25,000 mg/kg and exceeded the alert thresholds (250 mg/kg) in all samples, while in 68% of the analyzed samples, it exceeded the intervention threshold (1,000 mg/kg) for less sensitive use, set by the Romanian legislation (Law 756/1997). The highest concentrations of Pb

were found in samples situated at high distances can you be more specific? what means "high distances"? We're talking here about some meters. The total area is about 1 ha, am I right? Could you insert a map with soil samples? and also describe the type of soils. from the metallurgical plant (S13 and S14), prevalent on the East side of the investigated field. The predominant wind directions in the area are Wto E and this can be a reason that favored the particulate Pb dispersion.

The high Pb concentrations found in the two reference samples (380 mg/kg and 530 mg/kg, respectively), situated at 15 km from the investigated area, can be the result of natural background, due to volcanic rocks, holding high concentrations of Pb (Modoi et. al., 2013; Bird et. al., 2009). The values are quite hight! Can you specify the soil type? Or to describe the area from lithological point of view? It might that you have taken the samples from a secondary dispersion aureola of ore deposits. Did you collect the blank samples from Chiuzbaia, maybe? In Cicarlau area (15 km west from Baia Mare), for example, the concentration of Pb values do not exceed 60 ppm. Over 500ppm Pb in soil can't be a natural background in Baia Mare area. In addition, the difference between the two reference samples is to high (150 ppm). This fluctuation is not occurring in natural (geogenically) condition, in an area with the SAME parental rock. The R1 and R2 samples are polluted, for sure!

The results showed that the fractionation of Pb varied from sample to sample, indicating a high variability of the Pb mobility in soil. The distribution of Pb fractions, according to the BCR sequential extraction procedure, is presented in Figure 2.

The acid soluble fraction is considered the most mobile fraction of Pb and ranged between 2-49%, why this high range of values? Can you correlate with soil types, with pH of solution, with redox potential, with organic content or something.with an average of 24%, indicating that significant amounts of Pb can be released into the environment in acidic conditions. Generally, this Pb fraction is absorbed by plants and through the food-chain it can pose significant health risks (Gleyzes et al., 2002).

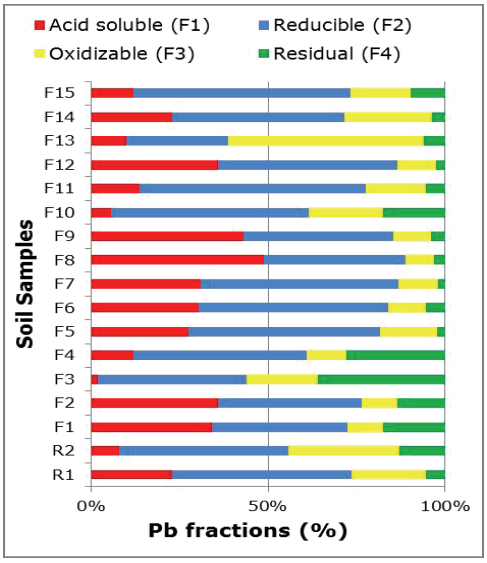

Figure 2. Distribution of Pb fractions in soils

It is considered that the reducible metal fractions have moderate mobility and mobilizable fractions can migrate under extreme environmental conditions. The reducible fraction is formed by Pb compounds bounded to Fe and Mn oxides and the fraction ranged between 29 and 64%, with an average of 48% of the total concentration of Pb. The use of 0.1 M hydroxilamine as a reagent releases metal mostly from amorphous manganese oxide phases and in a lesser extent from iron oxide phase (Schuman, 1983; Vodyanitskii, 2006).

The oxidizable fraction ranged between 8-55%, with an average of 17% and contains the Pb bounded to organic matter and sulphides. It is considered to be less mobile than the previous two fractions. This assumption may be explained by the fact that the Pb organic fraction is supposed to be associated with humic substances which release small amounts of Pb metals in a slow manner, due to their stable molecular weight (Filgueiras et al., 2002). Even though this organic fraction is not bioavailable, it could be mobilized in oxidizing conditions.

The residual Pb fraction, ranged between 2-36% with an average of 11% of the total concentration of Pb, is considered to be immobile and does not represent potential threat to the environment.

CONCLUSIONS

Generally, Pb was found predominately in reducible fraction, followed by the acid soluble, oxidizable and residual fractions.
The high percentage of Pb found in mobile and mobilizable fractions indicates that the metallurgical non-ferrous plant determined a more extensive pollution than initially considered. Therefore, future studies are needed to be conducted and the development of decontamination methods are taken into account for future researches.

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STUDY ON THE APPLICATION OF PHYTOREMEDIATION OF CONTAMINATED INDUSTRIAL SITES

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Abstract

The effect of urbanization and industrialization led in many cases to the deterioration of the environment. During these processes, a lot of contaminants are released and they accumulate in the environment causing important risks. This study presents the technologies of decontamination of industrial sites using phytoremediation. The use of plants to decontaminate polluted sites is a close to nature method. Plants are able to accumulate important amounts of contaminants from soil by uptaking them by roots and transporting them to the aerial parts. Remediation of contaminated sites is a worldwide concern and contributes to the protection and improvement of the environment. One of the solutions is phytoremediation which is a new technology, innovative and with great perspectives. The aim of this study is to characterize the phytoremediation techniques.

Key words*: environment, industrial sites, phytoremediation.*

INTRODUCTION

The pollution of the environment is a major problem worldwide. Many factors affect the environment, but especially the technological progress, population growth and also urban expansion. One of the greatest ecological concern is the soil pollution that can be affected by oil, heavy metals, agrochemicals and different types of waste (Lyubun and Tychinin, 2007).

In urban areas, abandoned sites that were used for industrial purposes must be restored. The contaminated industrial sites are one of the main subjects of remediation strategies. There are also taken into consideration the mining heaps, quarries, dumps etc.

The Commission of the European Communities estimated in 2006 the number of contaminated sites in the European Union at 3.5 million sites. This affects 231 million people and describes a market value of 57 billion euros. The number of contaminated sites is considered to be significantly bigger nowadays. This does not happen only in Europe, but also in well developed countries like United States, Canada, Australia and many countries is Asia (Meuser, 2013).

In the last decade, phytoremediation has developed from a conceptual methodological approach into a technology that is used for the benefit of the environment by cleaning up the organic and inorganic contaminants. In order to be effective, the most important part in the implementation of one of the phytoremediation processes is choosing the suitable plants that can asimilate the contaminants from the studied site (Kvesitadze et al., 2006).

Phytoremediation is worth to be applied because is cost-effective, aesthetically pleasing to the public and also a green solution compared to other remediation strategies (e.g. excavation, chemical in situ stabilization) (Dordio & Carvalho, 2011).

In this context, the study presents the phytoremediation concept and techniques in order to highlight the importance of the applications in different given situations. The decontamination of industrial sites using phytoremediation is important to dealing with serious environmental problems and applying the solution friendliest with nature.

MATERIALS AND METHODS

Phytoremediation is a concept that has been in use since the early 1990s and is composed of a

set of natural technologies that use plants to clean up contaminated areas. The term is composed of two words that are part of its definition: phyto – plant and remediation – to recover (Kvetsitadze et al., 2006). So phytoremediation has been defined as "the use of green plants and their associated rhizospheric microorganisms, soil amendments, and agronomic techniques to remove, degrade, or detoxify harmful environmental pollutants" (Kadukova and Kavuličova, 2011).

Phytoremediation involves the set of technologies that use plants with their microorganisms, enzymes, water consumption to retain, transform or destroy the pollutans that can be found in soil, sediments, sludges, water, groundwater, wastewater and atmosphere (Dordio & Carvalho, 2011).

Applications of phytoremediation include sites where other remediation strategies are too expensive or impractical and the sites that have a low-level contamination and can support a treatment for long periods of time. Also, it can be used in combination with other technologies at sites that include organic, nutrient and metal pollutants that are able to be reached by the roots of chosen plants and to be sequestered, degraded, immobilized, or metabolized in place (Nabais et al., 2007).

Plants can be used to treat diverse contaminants including heavy metals, metalloids, radionuclides, salts, nutrients, xenobiotic organic chemicals, sewage, air pollutants, chlorinated pesticides, organophosphate insecticides, petroleum hydrocarbons (BTEX), polynuclear aromatic hydrocarbons (PAHs), sulfonated aromatics, phenolics, nitroaromatics, explosives, polychlorinated biphenyls (PCBs), chlorinated solvents (TCE, PCE) (McCutcheon & Schnoor, 2003; Kadukova and Kavuličova, 2011; Liu et al., 2011).

Ideal plants to be used in phytoremediation should have the following main characteristics:

- Fast growth and high biomass;
- Deep rooting;
- Harvest easily;
- Translocation and uptake capabilities (Kadukova and Kavuličova, 2011).

When trying to return a site to a state as close to the initial one, the ecological restoration of the polluted site involves the right selection of species. The requirements are to choose from the diversity of native species, instead of non-native species or monocultures (Nabais et al., 2007).

Plant species that are responsive to the uptake of contaminants are divided into four groups (Figure 1):

- Hyperaccumulators – take up very high amounts of contaminants, especially metals;
- Accumulators – take up high rates of contaminants, metals mostly;
- Indicators – take up contaminants to a degree that shows a linear relashionship to the soil level of contamination;
- Excluders – do not take up contaminants (Meuser, 2013).

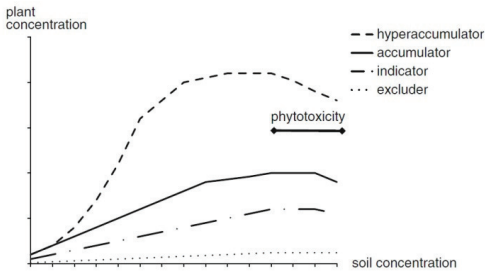

Figure 1. Plant strategies for growing in pollutted soils (Meuser, 2013)

Phytoremediation is both an in situ and ex situ technique. The focus is to accelerate the faster degradation of contaminants. The technologies that have been identified to reduce pollutants in the environment are phytoextraction, phytostabilization, phytodegradation, rhizodegradation, rhizofiltration, phytovolatilization, hydraulic control, vegetative cover, riparian corridors (Figure 2) (EPA, 2000; Dordio & Carvalho, 2011).

If the contaminant fate is regarded, the phytoremediation technologies can be sorted in: degradation, extraction, containment or a combination of these (EPA, 2000).

Phytoremediation has become in the last period a great promise of money saver and its applications can contribute with great succes at cleaning up and healing the Earth (McCutcheon & Schnoor, 2003).

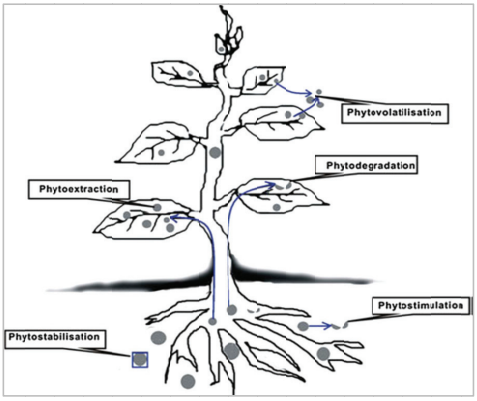

Figure 2. The main technologies of phytoremediation (Zhao et al., 2012)

RESULTS AND DISCUSSIONS

Phytoextraction

Phytoextraction is the uptake of a contaminant by plant roots and the translocation and accumulation of it in the aboveground portion of the plants. It is also called plytoaccumulation, phytoabsorbtion or phytosequestration and the process is illustrated in Figure 3. The contaminant translocation to shoots is important in order to be removed by harvesting the plants (Ali et al., 2013).
The plants used in phytoextraction should not be attractive for animals, especially mammals and birds, and they should not bring toxic elements in the food chain (Meuser, 2013).
This technique is very often used in the case of metal-contaminated soils and the extracted contaminant might be a resource (EPA, 2000).

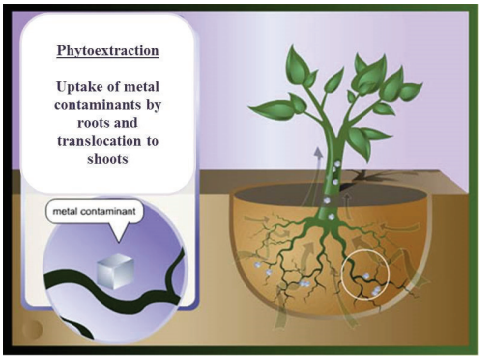

Figure 3. Phytoextraction (http://deoracle.org/learning-objects/phytoremediation-metal-contaminants.html)

Rhizofiltration

Rhizofiltration emphasizes the removal or precipitation of contaminants from an aquatic environment in the root zone. Two strategies are available in this process. One of them involves biochemical processes and removes metals by sorption and the other one is the construction of wetlands or reed beds (EPA, 2001; Kvesitadze et al., 2006).
In this technique, the plant species that are used are often raised hydroponically in greenhouses and then they are transplanted to a floating system that can be seen in figure 4, where it can be noticed that the roots are in direct contact with the contaminated water (EPA, 2001).

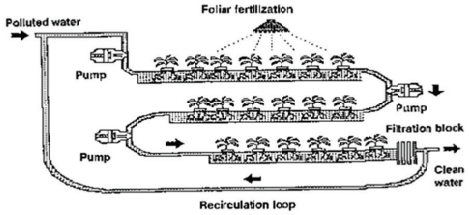

Figure 4. Rhizofiltration system (Henry, 2000)

Phytostabilization

Phytostabilization is defined as the immobilization of contaminants through sorption by roots, precipitation, complexation or metal valence reduction in rhizosphere. The plants are used to limit the mobility and bioavailability of pollutants in the environment and to prevent the contaminant migration caused by wind and water erosion and also to avoid their entry into the food chain. The process (Figure 5) is important because it stabilizes the soil matrix, minimizes erosion and the migration of sediments. It is known as phytoimmobilization and cannot be considered a permanent solution because the pollutants are not destroyed in the soil, only their movement is limited (EPA, 2000; EPA, 2001; Kvesitadze et al., 2006; Ali et al., 2013).
This technology does not ensure the cleanup of the polluted site, but it has an important contribution in preventing the further spreading of the contaminants. It mostly "polishes" less contaminated soils and composts aided by a vegetation cover (Vandenhove, 2006).

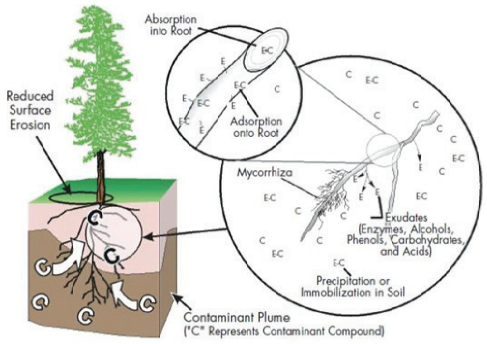

Figure 5. Phytostabilization (http://knowhowtogmo.wordpress.com/)

Rhizodegradation

Rhizodegradation is the breakdown of contaminants in soil and takes place in the rhizosphere. The microbial activity is enhanced in the root-zone and is stimulated 10-100 times higher by the secretion of exudates like sugars, amino acids, flavonoids, organic acids, sterols, carbohydrates, nucleotides, enzymes, growth factors. Due to the presence of the exudates, the number of microbial populations grows and conducts to increased contaminant biodegradation in soil. The microbial activity is stimulated because the plant roots release the exudates rich in nutrients, so the carbon and nitrogen are sources for the microbes in the soil. Rhizoremediation is called plant-assisted degradation, plant-aided in situ biodegradation, plant-assisted bioremediation and enhanced rhizosphere biodegradation (Figure 6) (EPA, 2000; EPA, 2001; Kvesitadze et al., 2006; Ali et al., 2013).

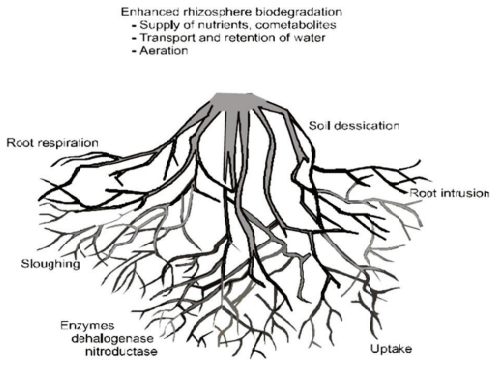

Figure 6. Rhizodegradation (EPA, 2000)

Phytodegradation

Phytodegradation is defined as the breakdown of contaminants that are uptaken by plants, followed by their degradation in plant tissues through metabolic processes. As a result of uptake, the plant stores the contaminants in cellular structures, volatizes or metabolizes them to regular metabolites, CO_2 and water. This process (Figure 7) is also known as phytotransformation and is successfully used at sites contaminated with benzene, toluene, xylene, ethylbenzene, chlorinated solvents, pesticides etc. The enzymes that aid the degradation of organic contaminants are dehalogenase and oxygenase. In the metabolic process, organic xenobiotics are accumulated and detoxified. Phytodegradation does not remove heavy metals which are nonbiodegradable (EPA, 2000; EPA, 2001; Kvesitadze et al., 2006; Ali et al., 2013).

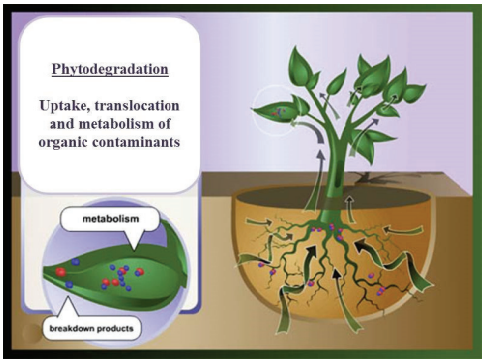

Figure 7. Phytodegradation (http://deoracle.org/learning-objects/phytoremediation-organic-contaminants.html)

Phytovolatilization

Phtovolatilization uses plants to uptake the pollutants, convert them to volatile organic compunds (VOC) and then release the contaminants or modified forms of them to the atmosphere. Because of the release, air monitoring can be required. The processes that take place are uptake, metabolism and plant transpiration. Using this technology (Figure 8) does not ensure the complete removement of contaminants and does not not eliminate VOCs from the environment, only from soil and groundwater (EPA, 2000; EPA, 2001; Kvesitadze et al., 2006, Ali et al., 2013).

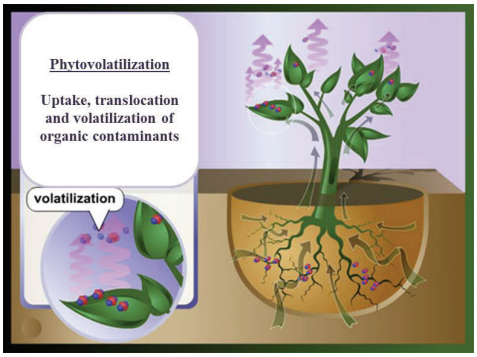

Figure 8. Phytovolatilization (http://deoracle.org/learning-objects/phytoremediation-organic-contaminants.html)

Hydraulic control

Hydraulic control is the use of plants to take up large amounts of water to contain or control the migration of contaminants in groundwater. It is also called phytohydraulics or hydraulic plume control and its mechanism involves plant transpiration that must have a high rate (Figure 9). This depends on plant species, leaf area, nutrients, climatological requirements and the activity can decrease in winter. Hydraulic control is effective within the root zone and does not need an engineered pump-and-treat system. The rooting depth of plants limit the groundwater removal (EPA, 2001).

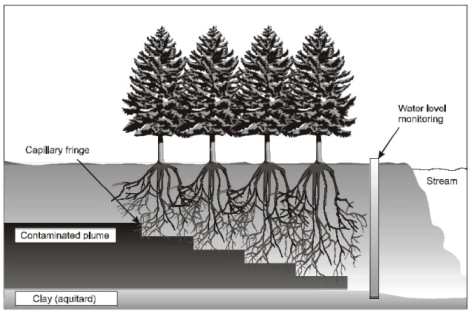

Figure 9. Hydraulic control of contaminant plume (EPA, 2000)

Vegetative cover

Vegetative covers are plants that grow in a system for a long period of time over materials that have an environmental risk. They are self-sustaining and require less maintance. Two types of vegetative covers are known: Evapotranspiration cover and Phytoremediation cover. The first one, presented in Figure 10, is a water-balance cover composed of plants and soil with the purpose of maximazing processes of plants and soil and minimazing water infiltration. The second one, illustrated in Figure 11, is also composed of soil and plants with the scope of minimazing water infiltration and to help in the degradation of underlying waste (EPA, 2000).

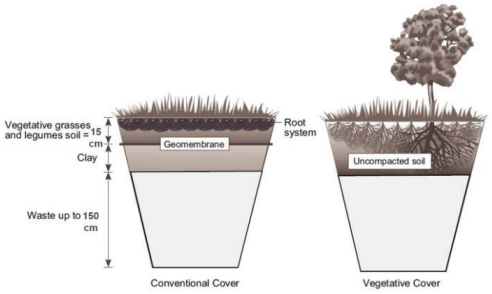

Figure 10. Evapotranspiration cover (EPA, 2000)

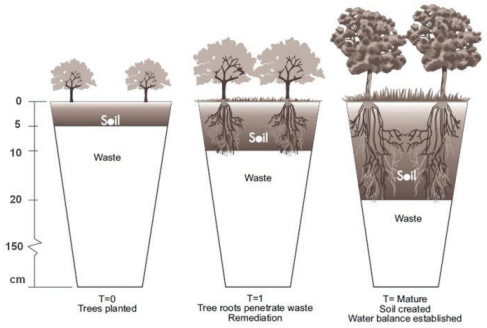

Figure 11. Evolution of the phytoremediation cover (EPA, 2000)

Riparian corridors

Riparian corridors, also known as buffer strips, are applied on river banks and watercourses to control and remediate the contamination found in groundwater and surface water (Figure 12). In the process of water treatment, the system can prevent migration and degrade contaminants in the plume. Water and contaminant uptake and plant metabolism are the mechanisms that are involved in the riparian corridors. In addition, riparian corridors provide stabilization of stream banks and prevent the erosion of soil (EPA, 2000).

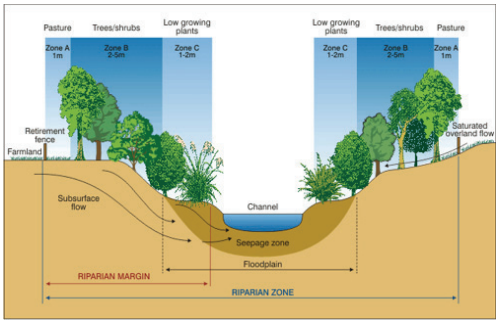

Figure 12. Riparian management (http://www.trc.govt.nz/riparian-management)

Dordio and Carvalho (2011) consider that a contaminant cannot be remediated with only one technology and the contaminant's fate is to be part of a soil-plant-atmosphere continuum. The continuum, presented in Figure 13, shows the contribution at specific points of the different phytoremediation mechanisms in the remediation process.

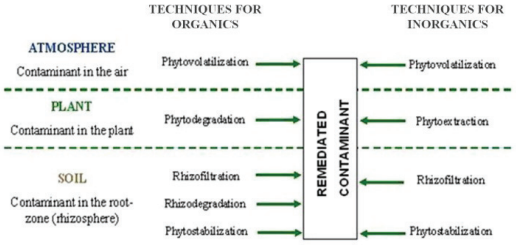

Figure 13. Contaminant fate in atmosphere, plant and soil (Dordio & Carvalho, 2011)

An overview of the phytoremediation techniques including goals, media, plants and contaminants is presented in Table 1 and the potential applications of phytoremediation as presented by McCutcheon and Schnoor (2003) is illustrated in Figure 14.

Table 1. Phytoremediation overview (EPA, 2000; Kvesitadze et al., 2006)

Technique	Process Goal	Media	Contaminants	Typical plants
Phytoextraction	Contaminant extraction and capture	Soil, sediment, sludges	Metals: Ag, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Zn; Metalloids: As, Se; Radionuclides: ^{90}Sr, ^{137}Cs, ^{239}Pu, ^{238}U, ^{234}U; Nonmetals: B; Organics	Indian mustard, pennycress, alyssum, sunflowers, hybrid poplars, *Thlaspi* sp.
Rhizofiltration	Contaminant extraction and capture	Groundwater, surface water, waste water	Metals: Pb, Cd, Cu, Ni, Zn, Cr; Radionuclides: U, Cs, Sr	Sunflowers, indian mustard, water hyacinth
Phytostabilization	Contaminant containment	Soil, sediment, sludges	As, Cd, Cr, Cu, Hg, Pb, Zn	Indian mustard, hybrid poplars, grasses
Rhizodegradation	Contaminant destruction	Soil, sediment, sludges, groundwater	Organic compounds (TPH, PAHs, BTEX, pesticides, chlorinated solvents, PCP, PCBs, surfactants)	Red mulberry, grasses, hybrid poplars, cattail, rice
Phytodegradation	Contaminant destruction	Soil, sediment, sludges, groundwater, surface water	Organic compounds: chlorinated solvents, phenols, herbicides, insecticides, munitions; Inorganics: Nutrients – nitrate NO_3^-	Algae, stonewort, hybrid poplars, black willow, bald cypress
Phytovolatilization	Contaminant extraction from media and release to air	Groundwater, soil, sediment, sludges	Organics: chlorinated solvents; Inorganics: Se, Hg, and As	Poplars, alfalfa, black locust
Hydraulic control (plume control)	Contaminant degradation or containment	Groundwater, surface water, soil water	Water-soluble organics and inorganics	Hybrid poplars, willow cottonwood
Vegetative cover (evapotranspiration cover)	Contaminant containment, erosion control	Surface water, soil, sludge, sediments	Organic and inorganic compounds	Poplars, grasses
Riparian corridors (non-point source control)	Contaminant destruction	Surface water, groundwater	Water-soluble organics and inorganics: nutrient, pesticide	Poplars

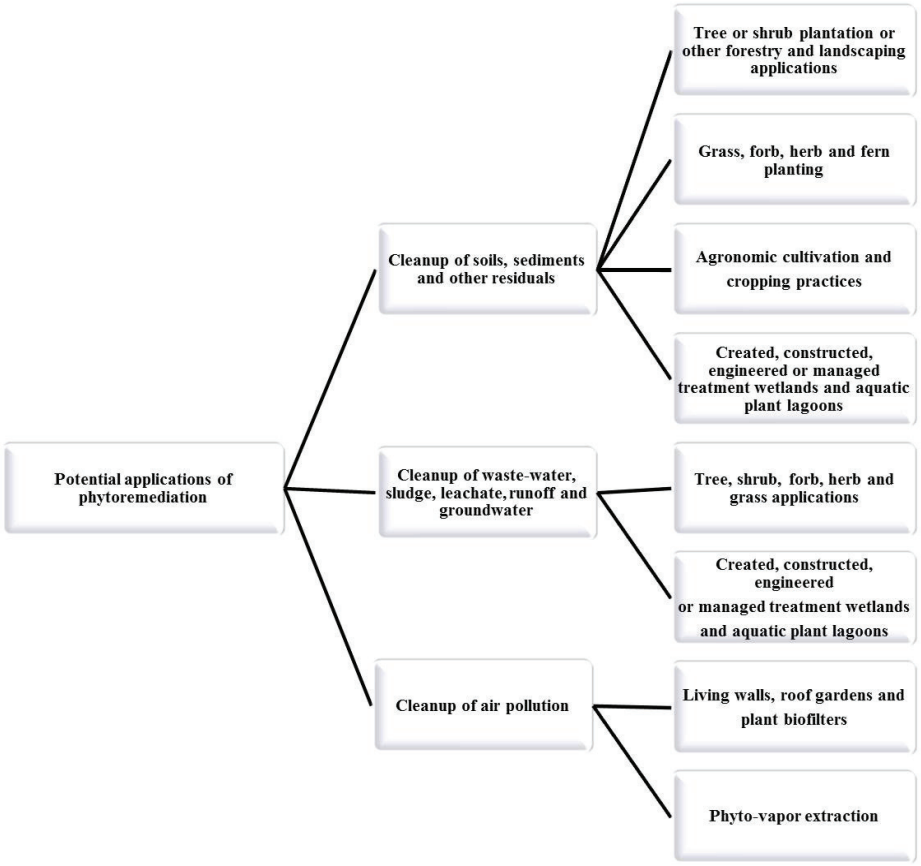

Figure 14. Potential applications of phytoremediation

DECONTAMINATION OF INDUSTRIAL SITES USING PHYTOREMEDIATION

A wide variety of sites can be decontaminated using the applications of phytoremediation. The types of sites where phytoremediation was applied or taken into consideration are: industrial and municipal landfills; pipelines; gas stations; fuel storage tank farms; military bases; army ammunition plants; mining sites; agricultural fields; wood treating sites; sewage treatment plants (EPA, 2001).

The decontamination of industrial sites for environmental benefit aims to transform post-industrial and abandoned sites into a green, aesthetically pleasing landscape. The natural habits that are created during the process give a higher value to the specific site. The regeneration of the contaminated industrial sites demands "innovative, low-cost, ecologically-sensitive and effective techniques" to clean up the environment (Dickinson, 2006).

The plants that can be used for phytoremediation applications in the industrial areas are willows, hybrid poplars that have a strong resistance to air pollution and also birches willows that are found in industrialised zones with severe air pollution (Meuser, 2013).

There are various examples of industrial sites at which phytoremediation is applied at full scale or pilot scale.

At Ashland Chemical Company tank farm in Wisconsin, US, an active industrial site, phytoremediation was required to treat petroleum products and organic solvents and to prevent contaminated groundwater from migrating. The chosen technologies were hydraulic control, phytoextraction, phytovolatilization and rhizodegradation. The used plants were hybrid poplars (EPA, 2001).

Other examples of full scale applications of phytoremediation are: Findlay, Ohio; Laramie, Wyoming; Oneida, Tennessee; Chernobyl, Ukraine; Barje Landfill, Slovenia; Kurdjaly, Bulgaria; YPLMO, United Kingdom; Upper Silesia, Poland etc

CONCLUSIONS

The serious environmental pollution by different types of contaminants requires finding the most effective methods of remediation. The advantages that phytoremediation offers must be taken into consideration when dealing with a contaminated site. Even though it is a new technology and the research is in progress, phytoremediation seems to be a great solution for many sites because of being ecologically friendly and a green technique.

The understanding of the different types of phytoremediation techniques that are presented in this study offers the opportunity of choosing the right methods for the recovery of a site.

The contaminated industrial sites cannot be left at their actual stage, so management plans should be elaborated for their improvement and recovery and the proper types of remediation methods should be selected, phytoremediation having an important place among them.

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INFLUENCE OF THE DEGREE OF CONTAMINATION ON THE EFFICIENCY OF TREATING OIL POLLUTED LOAMY SOILS WITH THERMAL DESORPTION

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Abstract

The purpose of the hereby paper is to present and interpret the results of the lab experiments performed using soil samples of loamy texture, containing three pollutant concentrations (16710.66; 26300.68 and 39256.68 mg/kg dried substance). In the decontamination process, we opted for three time intervals for keeping the samples in the oven, at 350 °C. The results of the experiments indicate that the efficiency of thermal desorption is influenced by the degree of contamination, which shows the importance of choosing the optimal parameters of the thermal desorption treatment process.

Key words*: contamination, depollution, thermal desorption, soil, crude oil.*

INTRODUCTION

Environment protection has become a necessity due to the fact that it was damaged as the industrial activities developed (Buliga, 2002).
Petroleum products can affect soil, one of the three elements of the geographic environment, and through it, affects the life of human beings, animals and plants (Buliga, 2002).
In order to establish remediation methods, the properties of the soils subject to decontamination are of great importance, because the connections among the pollutants and organic substances, clay and soil porosity, influence the destruction of hydrocarbons (Wick et al., 2011).
The use of thermal treatments for improving the soils polluted with petroleum products is widely spread worldwide, being one of the most complex activities in the domain of environment protection (Lee et al., 1999; www.petroleumclub.ro).
Due to the experience obtained by treating contaminated soils with thermal desorption, the company S.C. SETCAR S.A. Brăila states that the value of the hydrocarbons concentration in the soil must not exceed 10 % and humidity should not be over 15 %. Exceeding these limits reduces the efficiency of the technology very much (www.setcar-braila.ro).
The choice of using direct thermal desorption for decontaminating soils shows that the petroleum products in the soil sustain combustion, improving the efficiency of the treatment process (www.setcar-braila.ro).

MATERIALS AND METHODS

Figure 1 shows a simplified plan of the experimental research.
The extraction of the soil samples was performed in the commune of Bonţida, Cluj County, according to the state standards (STAS) 7184/1-75 (STAS 7184/1-75), in the depth interval of 0 – 20 cm.
The decontamination process was performed in the laboratory, using soil samples with loamy texture (figure 2).
For each test we weighed 100 g soil, of which we removed the foreign materials (pebbles, leaves), we polluted them with three quantities of pollutant and we determined the quantity of pollutant of the initial sample and the final one (after the decontamination process).
The quantity of pollutant in the soil samples was determined according to the state standards

(STAS) SR 13511/2007 (SR ISO 13511, 2007), using the Soxhlet method.

The quantity of crude oil in the tested samples is compared to the values of the established alert threshold (1000 mg/kg dried substance) and intervention threshold (2000 mg/kg d.s.) for the less sensible soils, according to Order no. 756 of March 11th 1997 (Order no. 756, 1997).

The equipment needed to apply the technology of thermal desorption was the electric oven with chamber and silicon carbide bars.

The main parameters observed during these experiments were the degree of contamination and the duration of treating the soil samples in the thermal desorption system.

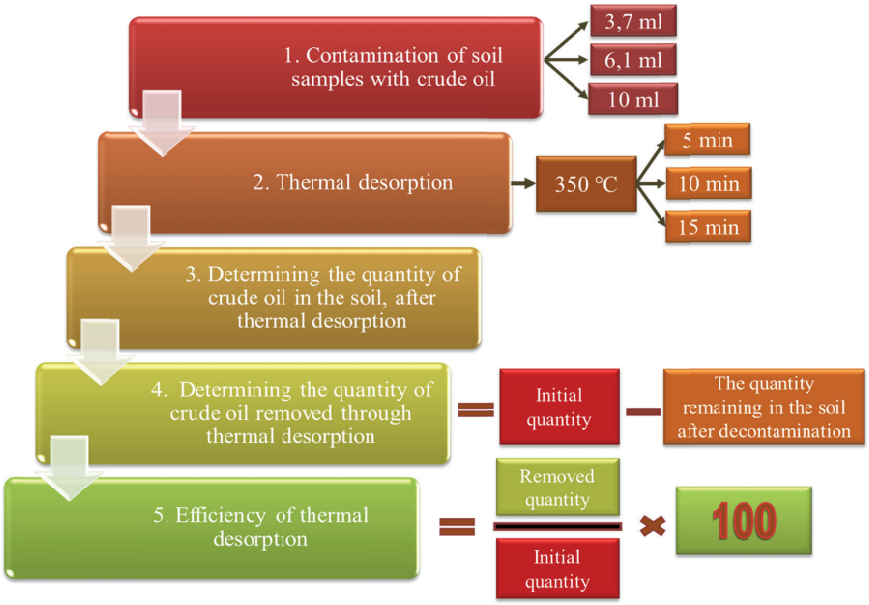

Figure 1. The experimental research plan

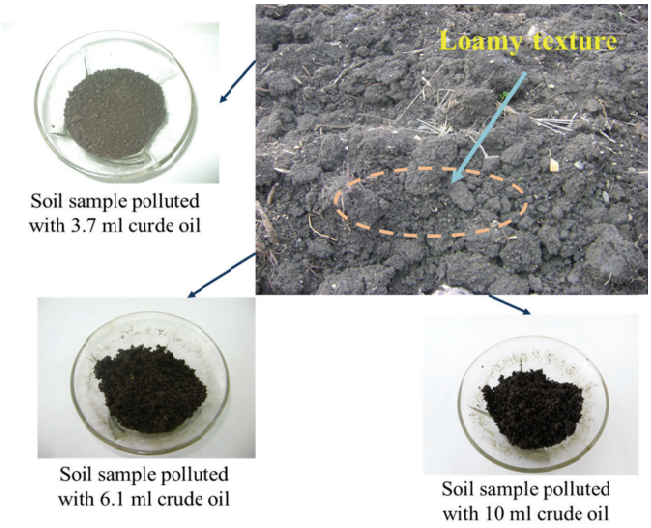

Figure 2. The loamy texture contaminated with the three quantities of crude oil

RESULTS AND DISCUSSIONS

The results obtained after calculating the content of crude oil existing in the control samples are given in table 1. It can be observed that the standard values are highly exceeded.

Table 1. The initial value of the quantity of crude oil in the control samples

Crt. No.	Sample [cm]	Quantity of pollutant [ml]	Initial quantity of pollutant [mg/kg]	Humidity [%]
1.	SA	3.7	16,710.66	22.82
2.	SB	6.1	26300.68	22.82

By analyzing the results (figure 3), after performing thermal desorption on samples SA and SB, it can be observed that the quantity of pollutant in the soil decreased as the duration of treatment of soil samples in the oven increased. The biggest decrease of the concentration was obtained for sample SA, followed by SB.
Studying samples SA, we can observe that the content of crude oil existing in the samples after the desorption performed during the specified amount of time, has dropped below both alert and intervention thresholds, according to Order no. 756 of March 11th 1997 (Order no. 756, 1997).

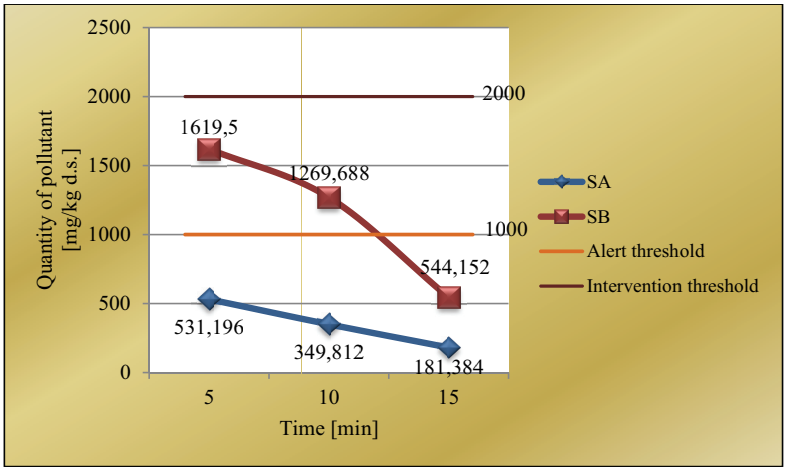

Figure 3. Variation of the quantity of crude oil in the soil samples SA and SB

For the samples SB treated in the oven for 5 and 10 minutes, the quantity of crude oil has dropped only below the intervention threshold, while for the sample kept in the oven for 15 minutes, the value decreased below both thresholds.
The evaluation of the efficiency of the decontamination process using thermal desorption was accomplished by calculating the final extraction efficiency, using relation 1:

$$\eta = \frac{m_{analyte}(solvent)}{m_{analyte}(sample)} \cdot 100[\%] \qquad (1)$$

where: - **$m_{analyte}$(solvent)** – concentration of pollutant extracted through thermal desorption at different temperatures and amounts of time of exposure in the oven, in mg/kg d.s.;

- **$m_{analyte}$(sample)** – initial pollutant concentration, existing in the soil (which can be extracted using the Soxhlet method), in mg/kg d.s.

The interpretation of diagram 4, depending on the level of contamination, reveals that the pollutant was extracted from the soil, with high efficiencies, ranging between 93.84 ÷ 98.91 %.
The results of the performed experiments indicate that: as the duration of treating the samples in the oven increases, the decontamination degree is greater. The highest efficiency is obtained for sample SA, kept in the oven for 15 minutes.

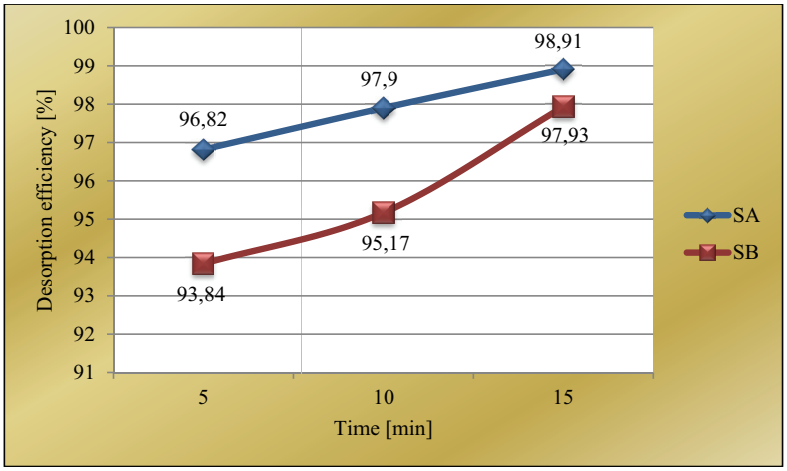

Figure 4. Efficiencies of the decontamination of soil samples depending on the level of pollution

CONCLUSIONS

The results of the experiments performed on soils with loamy texture, polluted with crude oil, treated at 350 °C, indicate a very high efficiency of the thermal desorption decontamination process.

The duration of the treatment is a determining factor in the process of thermal desorption, as we have found during the experiments: as the duration of treatment increases, the decontamination degree increases as well.

By comparing the two concentrations, it can be observed that for a low contamination, the efficiency is higher, and in case of greater pollution, the efficiency is lower.

The highest efficiency of thermal desorption proved to be for sample SA, kept inside the oven for 15 minutes.

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CREATING THE SOLID 3D MODEL OF A BUILDING USING LASER SCANNING TECHNOLOGY

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Abstract

3D Laser Scanning is providing a detailed, reliable, and accurate solution to many surveying and measurement problems, and has become well adopted for complex applications, like plants and other facilities, where accurate three-dimensional detail is critical for efficient design and construction projects. Terrestrial laser scanners deliver a dense point-wise sampling of an object's surface. The most typical example is creation of a 3D As-built model.
This paper describes a typical scanning project from field-to-finish . In many respects, laser scanning follows the same general surveying process as other instruments: data is collected in the field, adjusted to the appropriate coordinate system, modelled and relevant features are extracted to produce 3D CAD drawings, 2D precise plans and elevation, etc.

Key words*: 3D Laser Scanning, surveying and measurement, 3D model, Romania, topographic.*

INTRODUCTION

3D terrestrial laser scanning (TLS) systems have appeared and evolved very fast in the last decade granting them a firm place in geodetic metrology. When TLS laser scanners were introduced on the market, their performances were rather poor, having in general a measurement uncertainty in the range of centimetres (Cuartero et al., 2010).

Nowadays the precision and data collection speed are far beyond what anyone could imagine 10 years ago.

From a user's point of view, a 3D scanner is any device that collects 3D coordinates of a given region of an object surface automatically and in a systematic pattern at a high rate achieving the results in (near) real time (Hook and Lepere , 2007). There are many advantages of the 3D laser scanning, including non-contact measurement, massive and precise digital data, and operation without limitation of light and weather. The technology advances have allowed the surveyor to take advantage of new tools to complete the same surveying tasks that have been performed for hundreds of years faster and in a more precise way. So, this paper describes the workflow we, as surveyors, used to obtain the solid 3D model of a building by using the laser scanning technology.

MATERIALS AND METHODS

Surveying with a 3D laser scanner generates a new set of information – the point cloud.

A point cloud is a collection of XYZ coordinates, in a three-dimensional coordinate system, that also include additional information such as colour and reflectivity values. It can be compared with photogrammetry in that it is derived from a remote sensing instrument, that is, the measurements are taken without physically contacting the target area. Lastly, a comparison can also be made to remote sensing satellites, as additional "non-positional" data is collected from the raw measurements, such as the signal intensity of each point in the cloud, which will vary based on the reflectivity of the scanned object. Each point in the point cloud is measured with respect to the scanner position, and similar to photogrammetry, the position of the scanner (the camera) does not need to be known during the measurements (Davis and Aiken, 2000) . Aligning the point cloud to local

control with laser scanning is similar to photogrammetric control, as overlapping targets can be used to join multiple scans (photos) together and to "fit" it to the desired coordinate system. In order to geo-reference the point clouds to an existing local coordinate system, at least 3 known points in Northing, Easting, and Elevation(NEE) are required on the site. As with most surveying practice, the minimum will provide the answer but will not allow for any checks; typical field procedure suggests setting up and locating more targets than the minimum to isolate and account for uncertainty (Bornaz and Rinaudo 2004) .

We used a minimum of 4 targets on each scan, geometrically positioned on points of known coordinates for the registration to produces an accurate result. Similar to photogrammetry, it is important to place targets that form a strong geometric configuration across the project site. Once the targets were placed in the scene, terrestrial measurements were then made with two GNSS-RTK systems (CHC X91GNSS and HORIZON KRONOS 200) with a precision of 10mm on horizontal and 20 mm on vertical.

Figure 1. Measuring the coordinates of the HDS targets on top of the building

A "fine scan" was done on each of the targets to ensure accurate modeling of the vertices, or geometric centers.

In this case we used a survey control network of points of known location that defined a local reference frame in which all other measurements were referenced. The scanner used in our example is a Leica Scan Station 2 scanner and a laptop PC with Leica Geosystems HDS Cyclone Software. The laptop is used to interface and control the areas to be scanned and to visualize the data in 3D as it is collected. The Leica Scan Station2 has a modeled surface precision(noise) of 2 mm, an accuracy of 6 mm for position and 4 mm for distance at a range of 1m-50 m, the maximum range being 300 m at 90% (134 m at 18%) and a scan rate up to 50.000 points/sec.

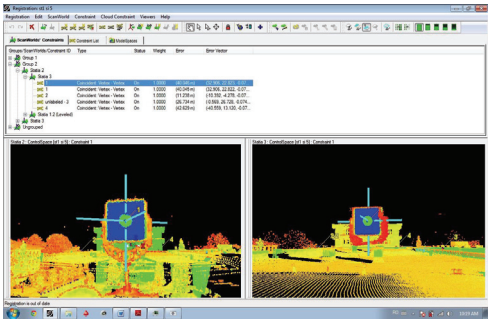

Figure 2. High density scans on special targets

Figure 3. Leica Scan Station2

RESULTS AND DISCUSSIONS

Surveyors commonly produce accurate as-built surveys of structures such as buildings, bridges, or roads, usually for the purposes of checking engineering or building code compliance. In addition to these purposes, as-builds are also created for preservation/conservation, construction archiving, fabrication inspection, interference design checking, etc. As-build surveys that require a significant amount of detailed data capture of certain features of inaccessible areas can be quickly identified, located, and mapped directly from a 3D point cloud. However, there are some surfaces(any transparent material such as glass, mirrors, water, and crystal)which could not scan particularly well, because they will refract the light and give false three-dimensional information (English Heritage, 2007). At first glance, viewing the volume of points in a point cloud can be overwhelming to the surveyor, as

it is difficult to imagine capturing several million points in a topographic survey. With a conventional total station or with GPS, the experienced surveyor typically captures the minimal amount of points to represent the target surface, collecting and annotating data about features in the field. As with all measurement techniques, this process is prone to costly errors and/or omissions in the data, and can sometimes be impossible to collect on the site due to traffic, toxic or prohibited areas, and inaccessible regions. With 3D laser scanning, many of these errors were eliminated based on the fact that scanning blankets the site with 3D points at a user-specified resolution. If the desired objects and features can be "seen" by the scanner, it can be represented accurately in the point cloud and extracted with software such as Autodesk AutoCad. Most surveying tasks, including topographic mapping and as-builds, are typically done at close range to obtain the appropriate level of detail. Regions that are not shown in one scan can be scanned with another setup, and these point clouds will be merged in the software.In our example we used 10 scans of a building witch we referenced, in Stereographic 1970 Coordinate system, and merged to obtain the 3D point cloud of the building. All the scans were made at a resolution(the average distance between XYZ coordinates in a point cloud) of 5 cm. Once a point cloud is registered to the local coordinate system, measurements can be made between points or objects, checking against setbacks, property lines (for encroachment) or clearances between structures. Engineers can make compliance measurements between any points or surfaces of a structure directly in the point cloud.

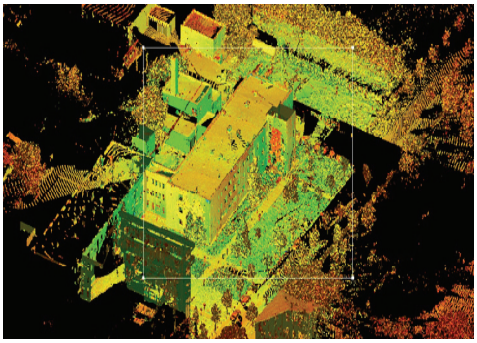

Figure 4. Top view of the raw 3D point cloud

The raw point cloud can be directly used for 3D visualization, point to point measurements just like if the user were physically present on the site and stored for subsequent use. To do this it is necessary to reduce the amount of processing point cloud data between 15–20% before the data post processing. In our case, we selected just the building, from the raw point cloud, by "cleaning" the rest of the point that were not part it. After this filtering operation our remaining point cloud had just 11 millions points left, as everyone of the 10 scans scan had a average of 2 million points.

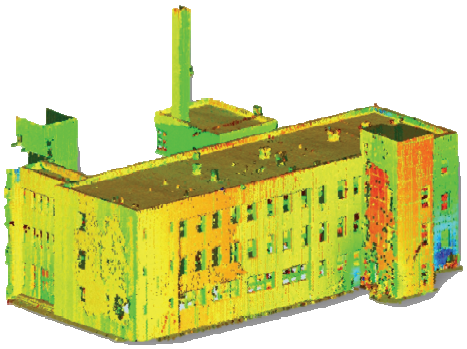

Figure 5. Perspective view of the selected building's point cloud

The resulted point cloud was then exported in *.pts format, in this way it could be used in various modeling software. Before importing the point cloud in Autodesk Revit software, we made a advanced cleaning and inspection of the point cloud in the new Autodesk ReCap software. This is a software specially created for point cloud data, in which we can modify our point cloud (by deleting unnecessary parts of it) or take direct measurements on the point cloud. We used de Autodesk Revit software to create the final 3D model using our building's point cloud. From the 3D model it is possible to realize a section with a horizontal and vertical plane in the different zones of interest and immediate measurements which are essential for huge scale and complex structure.

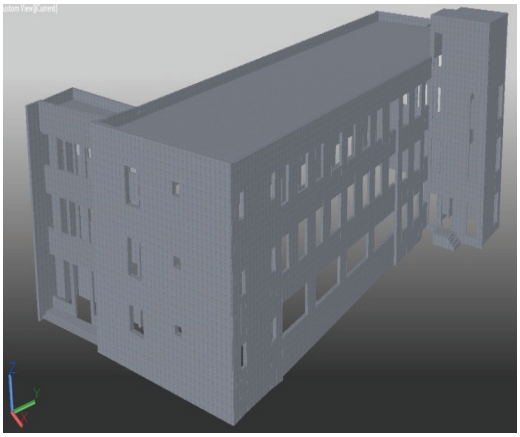

Figure 6. Solid 3D model of the building

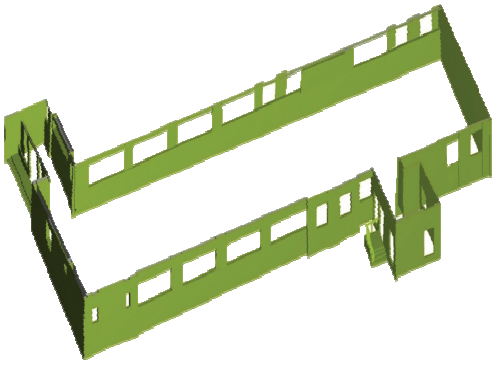

Figure 7. Perspective view of a section in the solid 3D model

CONCLUSIONS

As the design-build process becomes more advanced, requirements for better accuracy and more detail in the construction process will be necessary. The 3D laser scanning represents today's the most advanced technology available for measuring and documenting objects, structures and landscapes. The laser scanner not only performs the wide range, very fast operation and data accuracy acquisition, but also provides the point digital information including three dimensions, returned light intensity and RGB colors. Still it is very expensive, need high skilled operations and post processing can be time consuming, while editing the data to produce meaningful results may be difficult. However, the increasing of computers performances allows management of very large point clouds, and helps discover interesting perspectives for the utilization of 3D models.

3D Laser scanner should be considered as one of the most effective instrument for monitoring (3D monitoring).The availability of the scanned information such as intensity and color values, would make a further study to measure the crack propagation and detect the potential structure weakness of a building.

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INDUSTRIAL PARK EVALUATION BASED ON GEOGRAPHICAL INFORMATION SYSTEM TEHNOLOGY AND 3D MODELLING

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Abstract

A Geographical Information System describes itself as a management system for databases that provides information in a user interactive mode graph organized for storage, query, update and display of information in an efficient manner. (*Imbroane A.M., 2012). This system aims to shape the information into processes and structures that reflect the real world, including past events and possible scenarios in order to analyze, understand and manage the resources and facilities. HG 834/91 concerning the application of the provisions of article 19. 20 of Law No. 15/ 1990 states that land assets of companies with state capital at the time of their establishment, necessary for activity according to their object are established by the judgment of the government organs, according to the law, or by Local State Administration. In this context the present paper proposes an inventory solution for buildings forming an industrial park in order to reorganize the unit to serve the economic urban and regional development or an eventual transformation into a site location for a possible new business, such as a commercial center. The result is the production of graphical data in both digital and analog format, offering solutions to decision-makers who allocate resources.*

Key words*: GIS technology, 3D modelling, real estate evaluation, urban development.*

INTRODUCTION

Before making any GIS analysis and obtaining data for analysing and interpreting the questions related to the objectives that follow, specialists are basically looking for the best solutions in order to have a proper perspective regarding the real situation of the ground areas. Therefore, at this stage we are looking to identify the nature of the results that are expected, the general and local characteristics of the analyzed area, the required data and the types of thematic layers that will be needed and steps to be followed for the final maps and final reports containing the requested information (Shekhar S., 2008).
This paper presents an industrial park, which has undergone several transformations in time: building were demolished, new ones were built. Because they occupy a significant urban area they are of great economic importance for the Public Administration System and raise matters regarding the heights of constructions, impact over environment and population. I considered a scenario in which the trader wishes to make an assessment of the property, buildings, basically an inventory that suggests the land use, built surface, surface movement, considering a possibility of reorganizing its activity for urban development purpose. A solution for a correct inventory is combining the advantages of a geographical information system with the possibilities of visualization into a three-dimensional model. I find this as a rational, intelligent and efficient answer for the increasingly difficult issues related to the use of land resources. The applicability of GIS is practically unlimited for the majority of human activities because of the importance of knowing the location of a certain object in space. Naturally, such a system is used for the production of plans and maps, the public management utility networks, identifying the optimal location for an investment or an objective study over the impact on the environment. (Mihai. D, 2011).

MATERIALS AND METHODS

A Geographical Information System gathers in a unique non-redundant database-graphical, cartographic, tabular and topological components (Miller H.J., 2004). To shape the

world, GIS uses the surrounding objects and spatial relationships. GIS objects are objects or geographical phenomena located on or near the Earth's surface. The objects can be natural (rivers, landforms, vegetation), built (roads, urban networks, buildings, bridges, etc.) or conventional (borders, administrative units, etc.). A GIS object is characterized by position and form in the geographical space and through a series of descriptive attributes. The spatial relationships between objects (neighbourhood, interconnection, continuity, incidence, etc.) help the better understanding of the situations and decisions. Quality information leads to quality decisions (Fisher P.F., 2004). In the first phase, the necessary data was collected, mainly the one that could be freely accessed. Thus, we used a printed location plan that was previously scanned and geo-referenced image-to-image using a high-resolution aerial image which can be found on

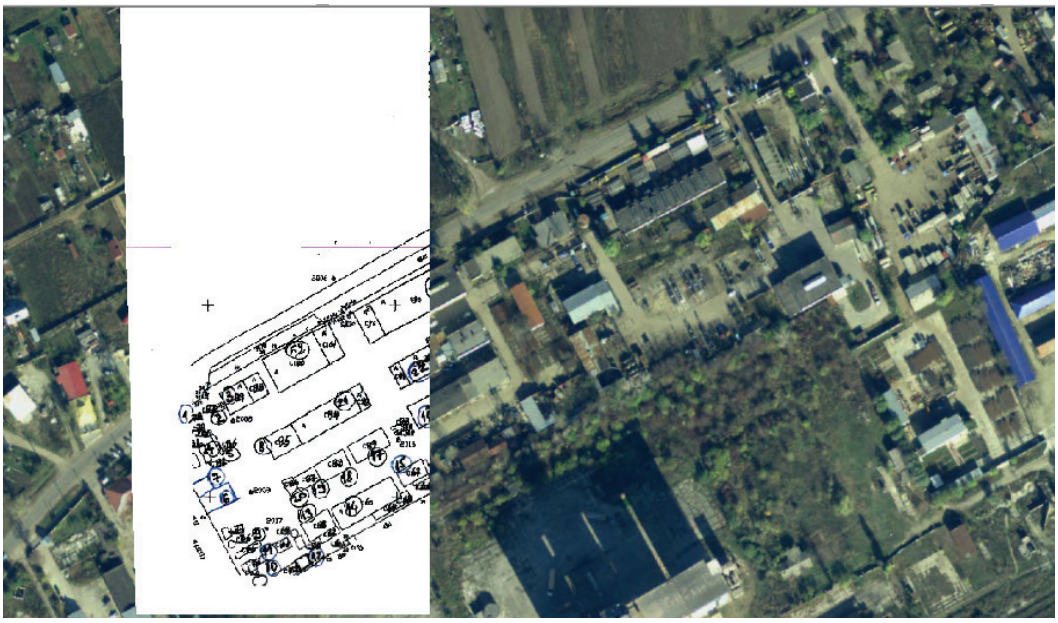

Figure 1: Location plan overlapped on orthophoto 2012 of the study area

the online portal of The National Agency for Cadastre and Land Registration in the national coordinate system Stereo 1970 (fig. 1). In order to do so, I used the software ArcGIS Desktop 1.2. In order to achieve a GIS on the area of interest, I created in ArcCatalog several layers to define the objectives of the ground areas: buildings, green areas, pathways. Then, in order to obtain a 3D model of the industrial park I used a digital terrain model, orthophoto from 2012 specified above and layers created in ArcCatalog. I imported the presented data in ArcScene. This extension allows the visualization and analysis of surfaces by using 3D models and 3D symbols in order to bring virtual objects closer to reality. Regarding the buildings, I first draw the footprints in ArcGIS which I then imported in the Arc Scene where I had the option to extrude the heights, on an estimate based on the number of floors (fig. 2). I also added operational layers: lighting poles, trees and cars. Although it is possible to create them in dedicated programs, I chose to use some of the existing ones from the software catalog. It is important to note that after digitization, the data was processed, to detect any errors by running a topology with certain rules: "most not overlap", "must not have dangles, and

"must not have gaps". Also, because the application allows it, I made a 3D flight which allows visualization of the studied surface from different points of observation, from a global or local perspective (fig 3, 4).

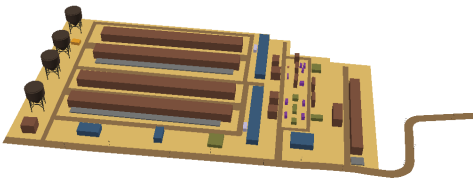

Figure 2: 3D View of a part of the Industrial Park

RESULTS AND DISCUSSIONS

This paper proposes solutions for inventory and real estate evaluation through the use of GIS technology as a set of hardware and software for collecting, manipulating and managing spatial data and their associated attributes. There were a total of 91 buildings in the industrial park on the printed location plan. Compared to the more recent orthophoto from 2012, we found that some buildings were demolished in the meantime (fig. 5). Returning to the initial objective of the project, it should be noted that the database being created along the vector data, enables query after certain criteria, for example the building material, surface.

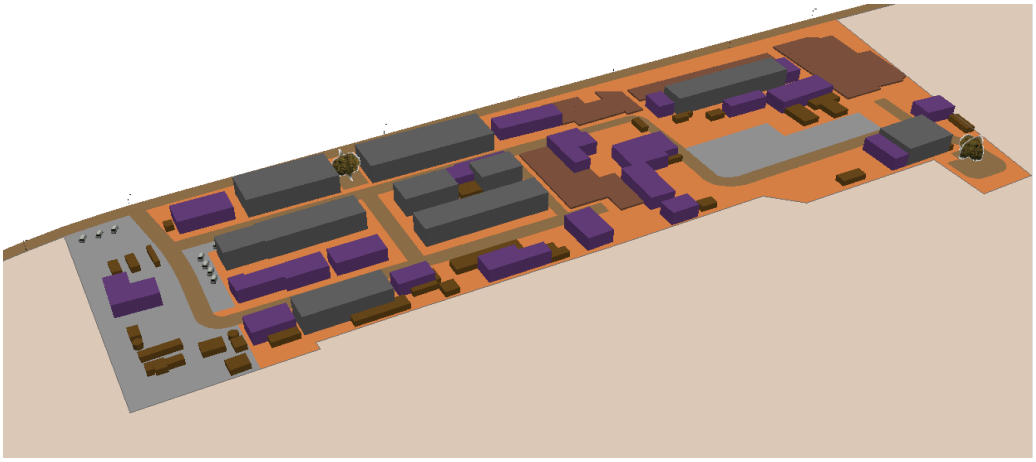

Figure 3: Global visualization of the industrial park

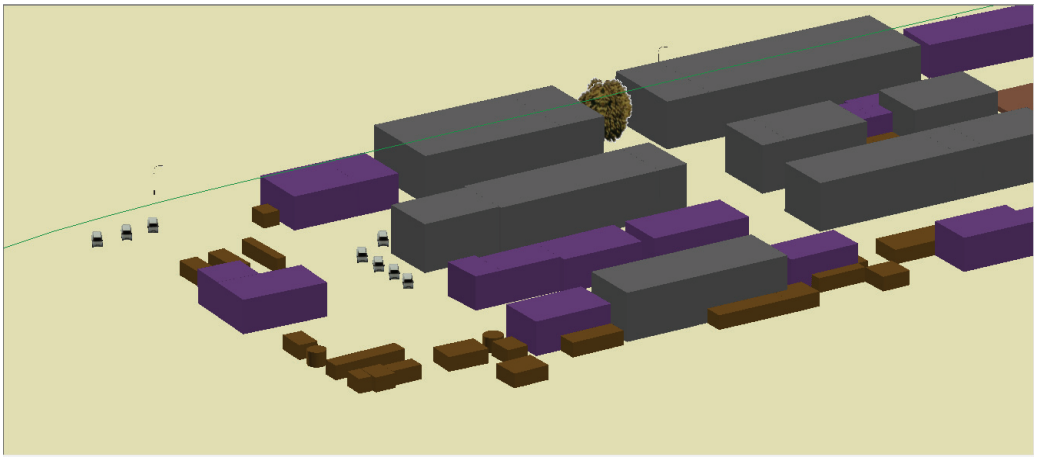

Figure 4: Local visualization of the industrial park

Figure 5: Demolished building

Tabel 1: Excel data export

FID	Shape *	Id	Building	Area
0	Polygon	0	Shed	6.45
24	Polygon	0	Shed	10.49
25	Polygon	0	Shed	12.37
26	Polygon	0	Shed	6.78
27	Polygon	0	Shed	12.09
28	Polygon	0	Shed	10.92
29	Polygon	0	Shed	12.54
30	Polygon	0	Shed	7.46
31	Polygon	0	Shed	7.64
32	Polygon	0	Shed	8.69
8	Polygon	0	Barrack	110.47
9	Polygon	0	Barrack	1691.28
10	Polygon	0	Barrack	1638.39
11	Polygon	0	Barrack	1654.31
33	Polygon	0	Barrack	1691.28
34	Polygon	0	Barrack	27.06
35	Polygon	0	Barrack	20.74

The data can be also exported to Excel (table 1) and be used as base for reports. Thus, we see that in the premises presented, from the total area of the enclosure that is located in the heritage area of the commercial company the built area represents 73% (fig. 6, 7). The level of employment of the other objectives can be seen in the attached chart.

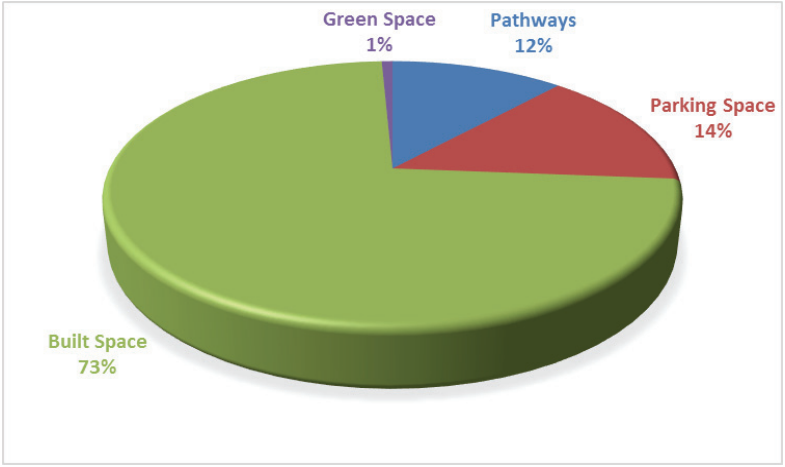

Figure 6: Land coverage

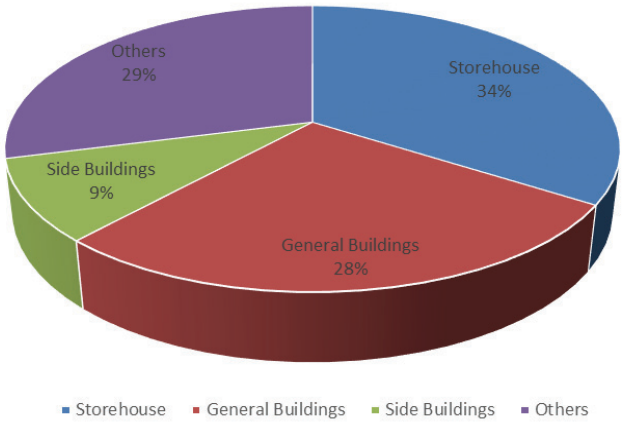

Figure 7: Build area: construction types

CONCLUSIONS

Geographical Information Systems have evolved rapidly and will soon become indispensable in the realization of projects that use spatial information (Balota O., 2009). The results that the Geographical Information Systems provide can be current data, certain categories of data and predictions of the data status at a time. The product consists of complex, spatially referenced information but does not stop at this because it integrates all necessary data to deploy efficient management of resources.

I believe that through the use of information technology and virtual realistic 3D modelling we will be able to better understand the world we live in and we will have a general perspective over the changes that are happening each day. This will bring the decision makers, accurate and relevant data that will allow future long-term development.

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APPLICATION OF GIS IN OPTIMIZING THE AGGREGATE COMPOSITION OF THE SOIL

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Abstract

Tested a new machine for surface treatment of the soil, according to the indicator aggregate composition of the soil. Data were processed with the program for the processing of statistical data and regression equations are derived describing the fragmentation of soil aggregates of different sizes (1 mm, from 1 to 25 mm, over 25 mm) at different speeds. Regression equations are introduced by GIS and the current humidity is set to an appropriate speed. Were created layers of fragmentation of soil aggregates to optimize the aggregate composition.

Key words: *GIS, surface tilling, disk machine*

INTRODUCTION

The process of proceeding of the soil surface is one of the determining factors for the development of plants. The aim of the process is to create optimal agrotechnical conditions for the sowing, germination and the development of the plants, by achieving a condition of cultivated soil unto which soil aggregates have the most favourable structure.
The modern agriculture necessitates the creation and use of agricultural machinery, which allow management of the aggregate composition and use of new information technologies.
Such a information technology is Geographic Information Systems-GIS.
The combination of database objects and geographical location allow: introduction a large volume information, centralization of the data, as a means of the managing them, automating the design process, visualizing and evaluation of the incoming and outgoing information on certain criteria.

MATERIALS AND METHODS

Machine for surface tillage combined kinematics of rotary cultivators with a horizontal axis of rotation and horizontal displacement of soil from disk working body. (Dallev, 2013). It is a rotor with flanges which are attached a disk under Adjusting angle. The rotor take movement named PTO of the tractor by gimbal and reductant. At rotation of the rotor and the forward velocity of the machine, disks enter the ground and ruin layer of soil. (Dallev, 2013)
Unto consideration of the factors of the soil humidity and the forward speed of the machine can be controlled aggregate composition of the soil after treatment.

Preparation of materials and data for GIS

1. Graphic information
- Municipality, digital cadastral map and map of reclaimed property in the studied area. The digital model format is ZEM, CAD. Information source: the Geodesy, Cartography and Cadastre Agency;
- Digital soil map of the area. Information sources: The Soil Resources Agency and the Institute of Soil Science "Nikola Pushkarov", Bulgaria;
- map of the soil samples

2. Attribute information
- soil type - physical parameters, humidity,
- velocity of the agricultural machine ;

Application of GIS

- *Development of interpolation to raster by Spatial Analyst, ARCGIS 10.0.* It was used a *spline regulized method*.

Spline estimates values using a mathematical function that minimizes overall surface curvature, resulting in a smooth surfacethat passes exactly throu the input points (Arnaudova, 2011).

Study area

The experiments were conducted in the agricultural lands of village Banya, Plovdiv region. There are selected a study parcel on Dystric Fluvisol with soil texture 24%

The data were obtained from soil samples on selected areas and were localized by handheld portable GPS - GIS Trimble Juno SB. Used coordinate system WGS 84 UTM zone 35.

The forward speed of the machine is amended to three levels - 3.6, 4.9, 6 km / h

Humidity measured immediately before the passage of the machine is given in the following table:

Table. 1 Soil humidity

№	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Measured humidity of soil with a clay content of 24%	8.3	9.1	10.8	10.3	13.6	14.3	11.7	13.8	14.2	18.3	19.1	14.7	12.9	13.6	14.1	15.7	17.8	18.2	16.9	19.2

The regression equations describing the process of comminuting the soil aggregates of a size from 1 to 25 mm.

Z from 1 to 25 mm % = -78.67 - 0,84W + 59.03V + 0.04W2 + 0.09WV - 6.14V2 (Dallev, 2013)

RESULTS AND DISCUSSIONS

Experiments have been conducted on a Dystric Fluvisols with soil texture 24% of clay? Samples for a momentary humidity were taken from 20 points on the field. On the basis of the equation is a calculated agrotechnical requirement – z from 1 to 25 mm.

Numerical experiments were conducted with humidity ±20% of that obtained in experiments at velocity 3.6 km/h and 6 km/h.

Seen to be that with increasing of soil moisture by 20% at a speed of 4.9 km/h percent fraction ranging from 1 to 25 mm, is increased relative to control (Fig. 1,2).

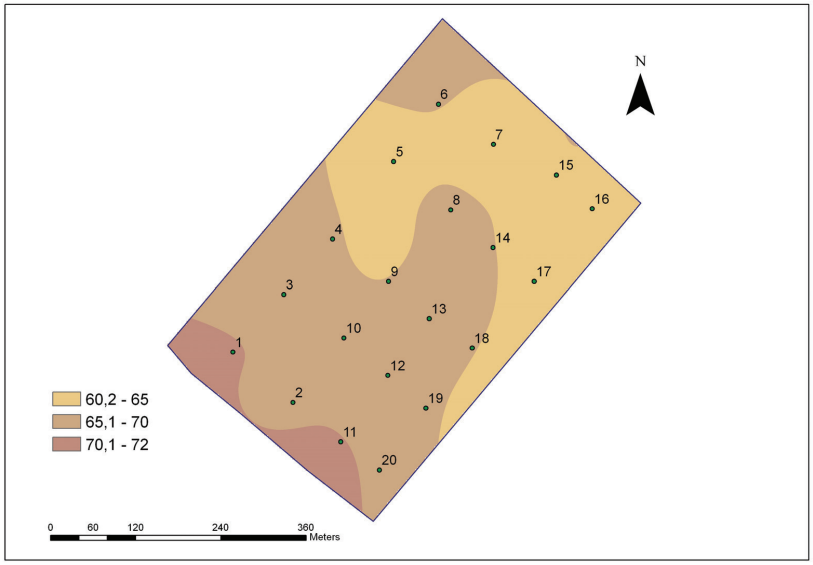

Figure 1. Velocity 4.9 km/h and measured momentary humidity

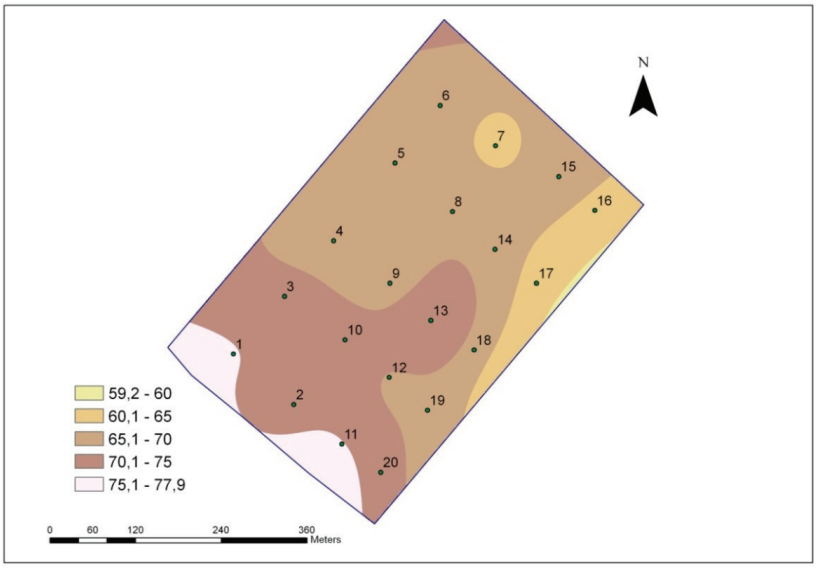

Figure 2. Velocity 4.9 km/h and humidity higher with 20% of FC

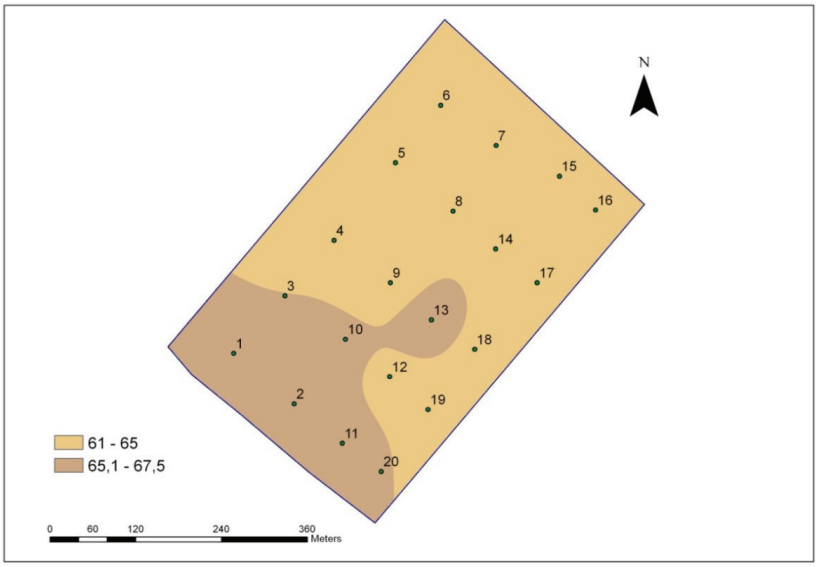

Figure 3. Velocity 4.9 km/h and humidity less with 20% of FC

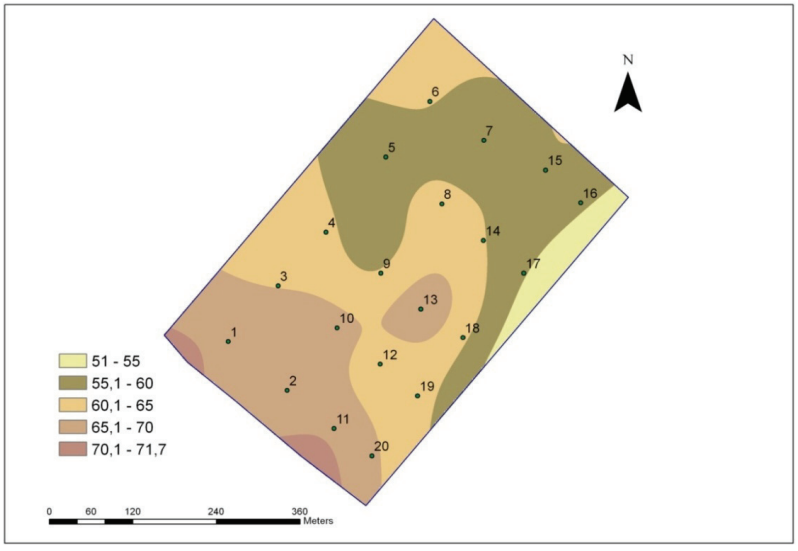

Figure 4. Velocity 6 km/h and humidity higher with 20% of FC

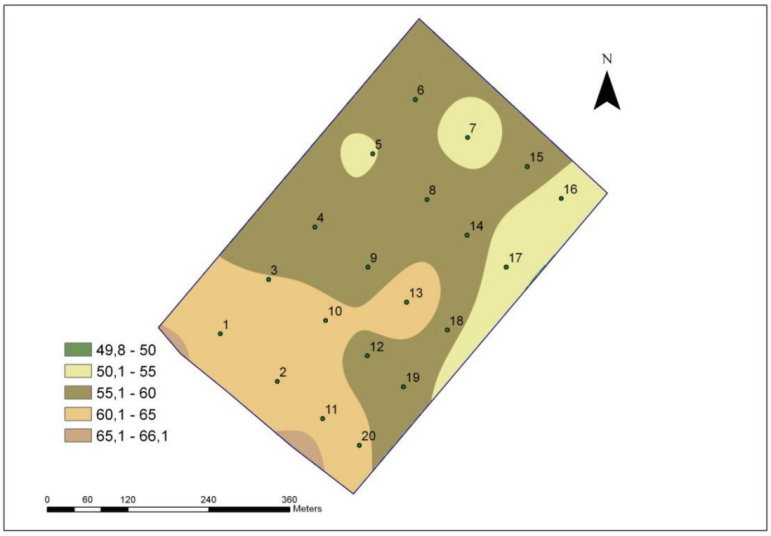

Figure 5. Velocity 3.6 km/h and humidity higher with 20% of FC

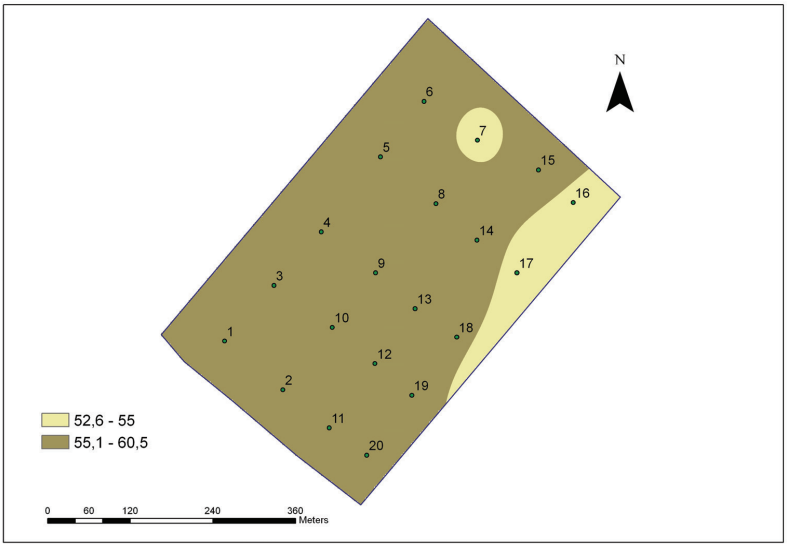

Figure 6. Velocity 6 km/h and humidity less with 20% of FC

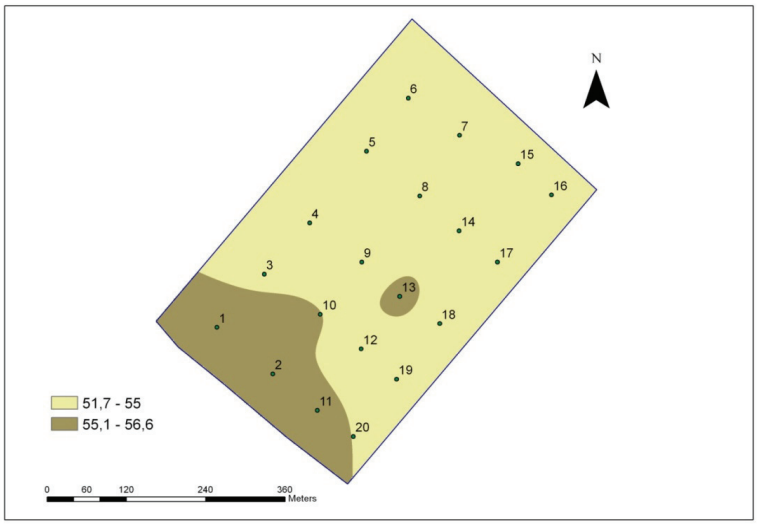

Figure 7. Velocity 3.6 km/h and humidity less with 20% of FC

The effect of the working bodies at a rate of 3.6 km / h on the soil is higher than that at 6 km / h. The soil was ground better, but at 3.6 km / h increased the fraction of aggregates of less than 1 mm. Increasing percentage of 1-25 mm at 6 km/h, due to the fact that the soil is light. Better quality is obtained at a low speed (Fig. 4,5).

By reducing the humidity of 20% of the FC and keeping speeds of 6 and 3.6 km/h in the percent change of the aggregates of 1 to 25mm in the minimum limits, which are not sufficient to satisfy the requirements agrotechnical – from 1 to 25 mm ≥ 70%, by which it can be concluded that the humidity is too low.

Upon reducing the moisture to 20% oFC and speeds of 6 and 3.6 km/ h for the modification of the units of 1 to 25mm is amended to a minimum, which is not sufficient to satisfy the requirements agriculturally - 1-25 mm ≥ 70%. From this it follows that in a low humidity, processing is unsatisfactory(Fig. 5 and 7).

CONCLUSIONS

• Were conducted numerical experiments and made maps in GIS.

• After consideration of all the cards here can draw the following conclusions:

- The trends in the fragmentation case depends entirely on the humidity
- After establishing the humidity field and select the appropriate speed closest to the calculated, can determine whether to process or wait for the right humidity

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PIXEL GEOLOCATION ALGORITHM FOR SATELLITE SCANNER DATA

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Abstract

This work describes the geolocation determination of remote sensing data, utilizing a satellite configuration that supports a sensor designed to scan the surface of the Earth and it presents mathematical algorithm for determining the position of field scanning satellite records, especially those of imaging. In this paper, it is presented a relationship that give us the coordinates of the point of intersection of the line of sight scanning system and the Earth's surface as a function of: terrestrial ellipsoid surface, satellite position, satellite velocity, satellite attitude (spatial situation) and orientation of the scanner. The input parameters include the orbital state and attitude information of the satellite and the look vector of the remote sensing sensor. The process for calculating the pixel geolocation (geodetic latitude and longitude) starts with the calculation of the Instantaneous Field-Of-View (IFOV) matrix in sensor coordinates. Then, several rotations are required to obtain the IFOV in the Earth Centered Inertial (ECI) coordinate system. First there is the sensor-to-satellite rotation that obtains the IFOV relative to the satellite. Next there is the satellite-to-orbital (geodetic nadir pointing) rotation that obtains the IFOV relative to the path of the satellite. The transformation between the scan pixel and the ECEF pixel is expressed in terms of a series of consecutive matrix transformations applied to the line of sight vector. Finally, for any scan pixel, we obtain ECEF coordinates (by intersection of the IFOV with the ellipsoid used to model Earth) and then geodetic coordinates (geodetic longitude and latitude).

Key words*: Earth Observation, Geodesy, Mathematics, Remote Sensing*

INTRODUCTION

A very important issue, but, that can be solved quite easily, is to locate on the Earth's surface of image-points obtained with a satellite scanning system. This problem, has been first studied by Edward F. Puccinelli in 1976 and it presents mathematical formulation for determining the position of the scanning field of satellite records (especially those from remote sensing) (Puccinelli, 1976). In other words, we must find a relationship which gives us the coordinates of the point of intersection between the line of sight scanning system and the Earth's surface, as a function of: terrestrial ellipsoid surface, satellite position, satellite speed, spatial satellite situation ("attitude") and scanner orientation.

In general, a satellite scanner data system consists of three components:

- the sensor data,
- the geolocation information,
- the relationships between data and geolocation.

In this paper we do not proposed to analyze the pixel geolocation accuracy for different types of remote sensing sensors. As we know, there are many factors which influence geolocation, among them the most important are:

- range sampling frequency accuracy,
- stability of signal propagation in ionosphere and troposphere,
- Earth tides (solid earth tides caused by Earth deformations due to gravitational forces of Sun and Moon, pole tides caused by changes in Earth‘s rotational axis due to polar motion, etc).

The satellite is moving, by Kepler’s laws, in an elliptical orbit with the center of the Earth at one of the foci of the ellipse. The velocity is not constant and varies according to the position of the satellite in its orbit. The Earth is rotating with respect to the orbital plane of the satellite, so the motion of the satellite with respect to the Earth’s surface is quite complex.

The basic logic of a scanning sensor is the use of a mechanism to sweep a small field of view (known as an instantaneous field of view - IFOV) in a west to east direction at the same time the satellite is moving in a north to south direction. Together this movement provides the means of composing a complete raster image of

the environment. A simple scanning technique is to use a rotating mirror that can sweep the field of view in a consistent west to east fashion. There are several satellite systems in operation today that collect imagery that is subsequently distributed to users. Several of the most common systems are described in (Dou et al., 2013). Each type of satellite data offers specific characteristics that make it more or less appropriate for a particular application.

The sensor data, which are the direct instrument measurements from which information about the Earth can be derived, are the major component of the swath data. The nature of the measurement may vary from instrument to instrument. Normally, sensor data will be processed by scientific algorithms for retrieving useful information. The sensor data type, as stored in digital format, can have the following standard formats (FGDC, 1999):

- ASCII representation of numerical values,
- 8, 16, 32 and n-bit (n>0) binary integers,
- 32 and 64 bits binary floats.

The elementary data structures for storing both the sensor data and the geolocation information are tables, arrays, or combinations of tables and arrays. A single swath structure can contain any number of tables and multidimensional arrays.

The geolocation information has a special role. It allows identification of the geographical location on the Earth surface corresponding to the data measurements for an individual pixel. Every swath is required to contain some geolocation component and geolocation information can be stored as a table, as a series of arrays, or as a combination of a table and arrays.

As the FGDC standard mentions (FGDC, 1999) "*A swath is produced when an instrument scans perpendicular to a moving point. Perpendicular, in this context, means close to, but not necessarily precisely at, a 90° angle. The path of this point, along which time or a time-like variable increases or decrease monotonically, is defined as the 'Track' dimension (sometimes referred to as 'along track'). The direction of the scan, which is perpendicular to the 'Track' dimension, is called the 'Cross-Track' dimension. Determining geolocation depends on knowing which array dimensions correspond to the 'Track' and 'Cross-Track' conceptual dimensions".*

The swath concept is shown in Figure 1, and it can be applied to measurements from a variety of platforms, including satellite, aircraft, and surface.

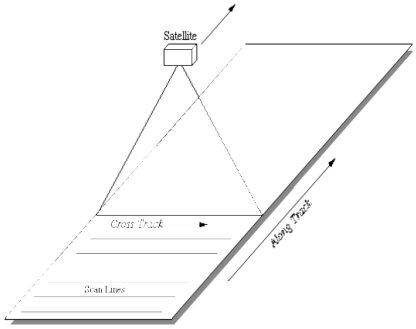


Figure 1. View of a simple swath (FGDC, 1999)

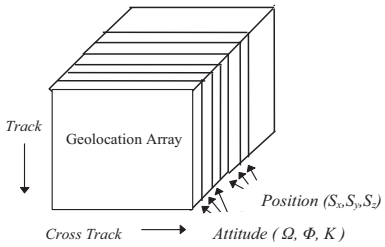


Figure 2. Geolocation Array containing Attitude and Position planes (FGDC, 1999)

When attitude and ephemeris data are provided for a swath structure describing measurements from satellite or airborne platforms, the following information is required to enable the user to calculate both geolocation and viewing geometry for the measurements:

- Date and time;
- Satellite attitude roll, pitch, and yaw angles (Ω, Φ, K);
- Satellite position vector $\vec{S}$ (S_x,S_y,S_z);
- Satellite velocity vector $\vec{v}$ (V_x,V_y,V_z), which is an optional information because it can be calculated.

Each set of date/time and geolocation are attached to an individual measurement (pixel) in the scan. The data set may provide the satellite attitude and position information directly or it may contain other information from which attitude and position can be

calculated. The velocity vector may be calculated from successive values of position vector and time and thus need not be provided explicitly. Other information used in the process of converting from focal plane coordinates to latitude and longitude, such as transformations from individual component coordinate systems to instrument (along-track, along-scan, and nadir) coordinates or instrument to satellite coordinates is normally provided separately. The relationship between the satellite and orbital coordinate systems is defined by the satellite attitude.

The **orbital coordinate system** (Figure 3, extracted from *NASA, Goddard Space Flight Center 2011 - Joint Polar Satellite System (JPSS) Ground Project*) is centered on the satellite and its orientation is based on the platform position in inertial space. The origin is the satellite's center of mass with the Z_{orb} axis pointing from the satellite center of mass to the direction perpendicular to the reference ellipsoid. The Y_{orb} axis is the normalized cross product of the Z_{orb} axis and the instantaneous (inertial) velocity vector. It corresponds to the direction of the negative of the instantaneous angular momentum vector direction. The X_{orb} axis is the cross product of the Y_{orb} and Z_{orb} axes.

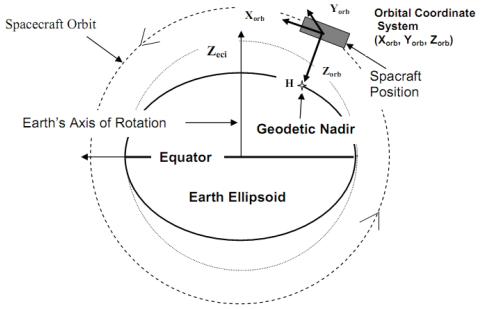


Figure 3. Orbital coordinate system (NASA, 2011)

The transformation from satellite to orbital coordinates is a three-dimensional rotation matrix with the components of the rotation matrix being functions of the satellite roll, pitch, and yaw attitude angles. The nature of the functions of roll ω, pitch φ, and yaw κ depends on how they are generated by the attitude control system.

The **Earth Centered Inertial (ECI) coordinate system** (described in detail by NIMA in 1997) has its origin at the Earth's center of mass. The Z axis corresponds to the mean north celestial pole of epoch J2000.0. The X axis is based on the mean vernal equinox of epoch J2000.0. The Y axis is the vector product of the Z and X axes. This coordinate system is shown in Figure 4.

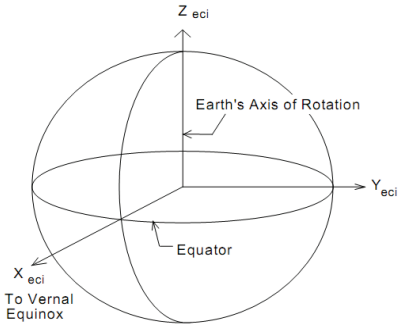


Figure 4. Earth Centered Inertial (ECI) Coordinate System

To determine the coordinates of the scan pixel, we work in ECEF coordinate system. This is a right-handed Cartesian frame of reference having its origin at the centre of the Earth. The Z axis is directed along the rotation axis towards the North pole, and the X and Y axes lie in the plane of the equator; the X axis lies in the plane of the Greenwich meridian, and the Y axis completes the right-handed set (Figure 5).

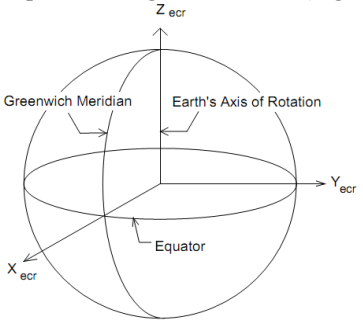


Figure 5. Earth-Centered-Earth-Fixed (ECEF) Coordinate System

The transformation between the scan frame and the ECEF frame can be expressed in terms of a series of consecutive matrix transformations applied to the line of sight vector. In principle this would be done by applying the transformations to each pixel. In practice, to reduce the processing overhead, they are carried out for a subset of tie point pixels, and the coordinates of intermediate pixels are

determined by linear interpolation in scan number and scan angle. That is, the pixel latitude and longitude are regarded as functions of scan number and pixel number, and are interpolated accordingly.

The transformation from ECI to ECEF coordinates is a time varying rotation due primarily to Earth rotation but also containing more slowly varying terms for precession, astronomic nutation, and polar wander. The ECI to ECEF rotation matrix can be expressed as a composite of four transformations (all these transformation terms were described in detail by NIMA in 1997):

$$T_{ECI \rightarrow ECEF} = A \cdot B \cdot C \cdot D$$

where:

A - Polar Motion
B - Sidereal Time
C - Astronomical Nutation
D - Precession

For many purposes it is necessary to control the satellite with respect to translation and rotation. This is realized through an ***attitude control system***. The attitude of a satellite may be defined as its rotational orientation in space with respect to an inertial frame (ECI), like in Figure 6.

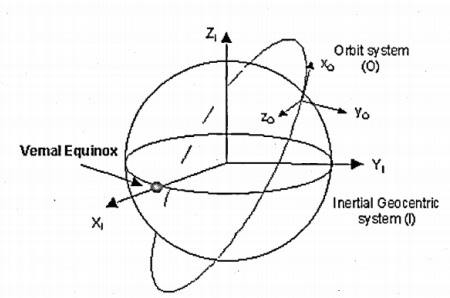


Figure 6. Orbit system and ECI Coordinate System

Components of an active attitude control system may be: accelerometers, gyroscopes, star sensors and GPS arrays.

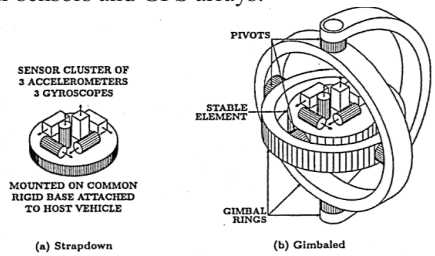


Figure 7. Two types of inertial measurement units (IMU)

Accelerometers are most suitable for sensing translations. Satellites transmit the elements of the orbit, as part of their data message. These are Keplerian elements with periodic terms added to account for solar radiation and gravity perturbations. Periodic terms are added for argument of perigee, geocentric distance and orbit inclination.

MATERIALS AND METHODS

The present paper uses the theoretical and practical experience of public use by NASA and ESA in the last years of international researches in geolocation of remote sensing data. I have used also my previous expertise and applications in some digital photogrammetric projects in Romania.

The method of pixel geolocation is based on the general shape of the Earth ellipsoid of rotation

$$\frac{X^2+Y^2}{a^2}+\frac{Z^2}{b^2}-1=0$$

and the general form of the parametric equations

$$X = X(B,L)$$
$$Y = Y(B,L)$$
$$Z = Z(B)$$

and are obtained parametric equations of the ellipsoid of rotation:

$$\begin{cases} X=\dfrac{a\cos B\cos L}{W}=\dfrac{c\cos B\cos L}{V}; \\ Y=\dfrac{a\cos B\sin L}{W}=\dfrac{c\cos B\sin L}{V}; \\ Z=\dfrac{a(1-e^2)\sin B}{W}=\dfrac{c(1-e^2)\sin B}{V}. \end{cases}$$

Where :

$$c=\frac{a^2}{b} \qquad \frac{a}{W}=\frac{c}{V}$$

$$W=(1-e^2\sin^2 B)^{1/2}$$

$$V=(1+e'^2\sin^2 B)^{1/2}$$

the first eccentricity is:

$$e^2=\frac{a^2-b^2}{a^2}=1-\frac{b^2}{a^2}$$

and the second eccentricity is:

$$e'^2=\frac{a^2-b^2}{b^2}=\frac{a^2}{b^2}-1$$

To solve the proposed problem we choose the coordinates system OXYZ based on a global equatorial orthogonal Cartesian system ("global geocentric system," as E. Grafarend called). The origin O of the system is considered in the vicinity of the center of mass of the Earth and its axis: 0X axis is parallel to the local meridian of Greenwich, 0Z axis is parallel to the axis of the world and the axis 0Y is perpendicular to X0Z. This global geodetic system (for example WGS84) is shown below in the Figure 8.

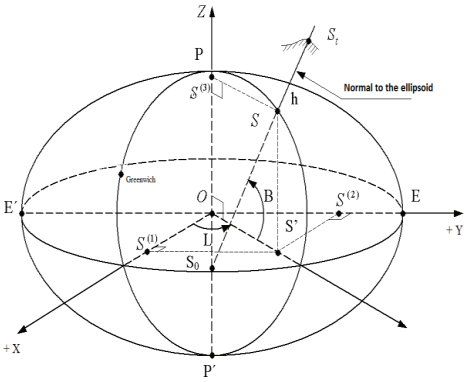


Figure 8. The World Geodetic System 1984 (WGS84)

The World Geodetic System 1984 (WGS84) models the Earth's surface as an oblate spheroid (ellipsoid), which allows Cartesian Earth-Centered-Earth-Fixed (ECEF) positions on Earth's surface to be represented using the angles geodetic longitude and geodetic latitude. The WGS84 was developed by the National Imagery and Mapping Agency (NIMA), now the National Geospatial-Intelligence Agency (NGA), and has been accepted as a standard for use in geodesy and navigation. NIMA expressed simply in 1997 the relationship between ECEF and geodetic coordinates WGS84 in its direct form.

The method, presented in this paper, can be applied to many types of sensors, shown in Figure 9, with some particularities, but I present only the case of linear array or scanners array passive imaging sensors. All sensors data must be geolocated based on the instrument, instrument mode of operation, and instrument coverage swath. The scan pixel center is defined as the geolocation point at the intersection of the look vector and the terrestrial ellipsoid surface.

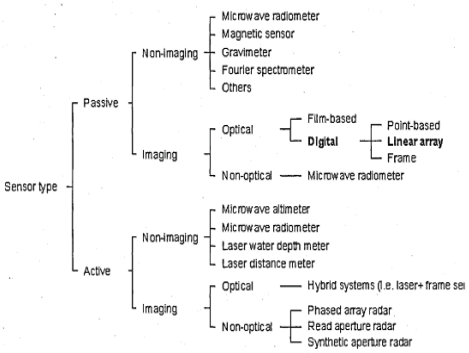


Figure 9. Classification of sensors for data acquisition

RESULTS AND DISCUSSIONS

Considering known the following elements:
- satellite position expressed by the vector $\vec{S}$ with components (S_x, S_y, S_z);
- satellite velocity on the orbit, characterized by the vector $\vec{v}$ with components (V_x , V_y , V_z);
- angles of roll (Ω), pitch (Φ) and yaw (K) measured around the three axes of the same name of satellite;
- Orientation of the pointing direction of the scanning system given by the vector $\vec{w}$ (w_1,w_2,w_3), where w_1,w_2,w_3 are angles measured between the axis scanning direction of the scanner and the satellite axis.

In Figure 10 are shown the two coordinate systems: global geocentric system **0XYZ** (considered basic coordinate system) and satellite coordinate system **o'xyz**.

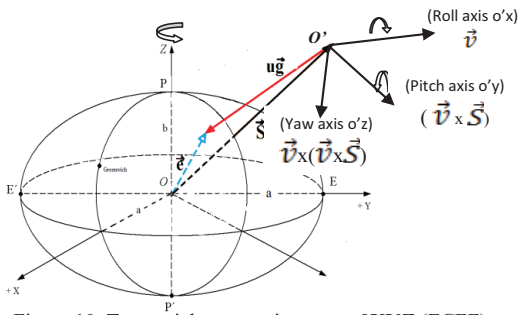


Figure 10. Terrestrial geocentric system **0XYZ** (ECEF) and satellite coordinate system **o'xyz**

The coordinates system of the satellite is as defined to the global coordinate system geocentric of the position vector. Roll axis (o'x) is chosen so as to coincide with the velocity

vector axis $\vec{v}$, pitch axis (o'y) is taken so that the vector ($\vec{v}$x$\vec{S}$) results to be perpendicular to the orbit (and hence on the roll axis) and the yaw axis (o'z) is selected so as to coincide with the vector $\vec{v}$x($\vec{v}$x$\vec{S}$), so being perpendicular to the plane formed by the other two axes.

Position vector of the satellite $\vec{S}$ (S_x, S_y, S_z) and velocity vector $\vec{v}$ (v_x, v_y, v_z) as well as angles of yaw (k), pitch (Φ), roll (Ω) we use to orient the satellite axes to global geocentric system. First we determine the orientation of the axes of the satellite to the base coordinate system by calculating a matrix **D** whose columns represent the unit vectors (versors) of axes roll, pitch and yaw of the satellite, then we compute a matrix **M** with which we can apply corrections "attitude" (the three rotation axes introduced to satellite Ω, Φ, k,). Then we compute the orthogonal matrix **F = D · M** whose column vectors are the axes of roll (the first column of F) of the satellite in the basic coordinate system (after they were introduced rotations Ω, Φ and K).

Calculate the matrix D of satellite axes orientation:

$$\boldsymbol{D}=\begin{pmatrix} D_{11} & D_{12} & D_{13} \\ D_{21} & D_{22} & D_{23} \\ D_{31} & D_{32} & D_{33} \end{pmatrix} = (\underset{\text{versor}}{\overrightarrow{C_1}} \quad \underset{\text{versor}}{\overrightarrow{C_2}} \quad \underset{\text{versor}}{\overrightarrow{C_3}})$$

$$\overrightarrow{C_1}=\frac{\vec{v}}{|\vec{v}|}=\frac{v_x\vec{i}+v_y\vec{j}+v_z\vec{k}}{\sqrt{v_x^2+v_y^2+v_z^2}}=\frac{v_x}{VLG}\vec{i}+\frac{v_y}{VLG}\vec{j}+\frac{v_z}{VLG}\vec{k}$$

If we note: $\sqrt{v_x^2+v_y^2+v_z^2}=VLG$

Then $D_{11}=\frac{v_x}{VLG}$; $D_{21}=\frac{v_y}{VLG}$; $D_{31}=\frac{v_z}{VLG}$

$$\overrightarrow{C_2}=(\overrightarrow{C_1}\times\vec{S})/|\vec{S}|=\frac{\vec{v}}{|\vec{v}|}\times\frac{\vec{S}}{|\vec{S}|}=\frac{1}{|\vec{v}|\,|\vec{S}|}\cdot(\vec{v}\times\vec{S})$$

$$=\frac{1}{\sqrt{v_x^2+v_y^2+v_z^2}\sqrt{S_x^2+S_y^2+S_z^2}}\cdot\begin{pmatrix}\vec{i} & \vec{j} & \vec{k}\\ v_x & v_y & v_z\\ S_x & S_y & S_z\end{pmatrix}$$

$$=\frac{v_yS_z-S_yv_z}{VLG\cdot SLG}\vec{i}+\frac{S_xv_z-v_xS_z}{VLG\cdot SLG}\vec{j}+\frac{v_xS_y-S_xv_y}{VLG\cdot SLG}\vec{k}$$

Where we denoted $\sqrt{S_x^2+S_y^2+S_z^2}=SLG$

$$D_{12}=\frac{v_yS_z-S_yv_z}{VLG\cdot SLG};\quad D_{22}=\frac{S_xv_z-v_xS_z}{VLG\cdot SLG};$$

$$D_{32}=\frac{v_xS_y-S_xv_y}{VLG\cdot SLG}$$

$$\overrightarrow{C_3}=\overrightarrow{C_1}\times\overrightarrow{C_2}=\begin{pmatrix}i & j & k\\ D_{11} & D_{21} & D_{31}\\ D_{12} & D_{22} & D_{32}\end{pmatrix}=$$

$$=(D_{21}D_{32}-D_{22}D_{31})\vec{i}+(D_{12}D_{31}-D_{11}D_{32})\vec{j}+(D_{11}D_{22}-D_{12}D_{21})\vec{k}$$

$$D_{13}=D_{21}D_{32}-D_{22}D_{31}$$
$$D_{23}=D_{12}D_{31}-D_{11}D_{32}$$
$$D_{33}=D_{11}D_{22}-D_{12}D_{21}$$

Thus, based on the above relations, we can calculate all nine elements of the matrix D. The next step is the determination of the elements of rotation matrix M. Matrix M has 9 elements, including 3 independent parameters namely Euler angles (ψ, φ, θ). As is well known, the relative position of the two reference systems consisting of mutually orthogonal axes, which have the same origin is perfectly defined by the Euler angles:

* ψ = angle of precession, defined by the line $0'x_1$ and the nodes line O'N (junction between plan $O'x_1y_1$ with O'xy plan);
* φ = angle of its own rotation, between O'N and O'x;
* θ = the rotation angle determined by the axes $O'z_1$ and O'z.

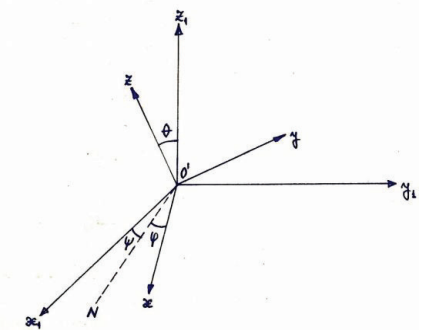


Figure 11. Euler's angles (ψ, φ, θ)

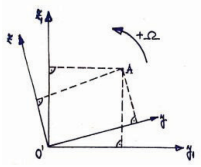
In the problem studied we will denote the three independent parameters Ω, Φ, K, representing

the angles of roll, pitch and respectively yaw of the satellite. O'xyz axis represents the initial position of the satellite at a given time ***t*** (position errors affected by the roll, pitch and yaw). O'$x_1y_1z_1$ axis represents the position of the satellite after they were applied to the three successive rotations Ω, Φ and K.

a) First apply rotation Ω:

Rotation Ω is done in the plane y0'z, positive sense being indicated by the arrow in the figure below:

$$\begin{cases} x_1 = x \\ y_1 = y\cos\Omega - z\sin\Omega \\ z_1 = y\sin\Omega + z\cos\Omega \end{cases}$$



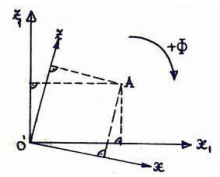
Or in matrix form:

$$\begin{pmatrix} x_1 \\ y_1 \\ z_1 \end{pmatrix} = R_\Omega \begin{pmatrix} x \\ y \\ z \end{pmatrix} \Rightarrow R_\Omega = \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\Omega & -\sin\Omega \\ 0 & \sin\Omega & \cos\Omega \end{pmatrix}$$

b) Apply the rotation Φ:

Rotation Φ shall be made in the plan xo'z (already rotated by angle Ω) with the positive sense showed the figure:

$$\begin{cases} x_1 = x\cos\Phi + z\sin\Phi \\ y_1 = y \\ z_1 = z\cos\Phi - x\sin\Phi \end{cases}$$



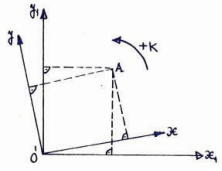
Or in matrix form:

$$\begin{pmatrix} x_1 \\ y_1 \\ z_1 \end{pmatrix} = R_\Phi \begin{pmatrix} x \\ y \\ z \end{pmatrix} \Rightarrow R_\Phi = \begin{pmatrix} \cos\Phi & 0 & \sin\Phi \\ 0 & 1 & 0 \\ -\sin\Phi & 1 & \cos\Phi \end{pmatrix}$$

c) Apply the rotation K:

The rotation K shall be made in the plan x0'y (around the yaw axis of the satellite).

$$\begin{cases} x_1 = x\cos k - y\sin k \\ y_1 = y\cos k + x\sin k \\ z_1 = z \end{cases}$$



Or in matrix form:

$$\begin{pmatrix} x_1 \\ y_1 \\ z_1 \end{pmatrix} = R_k \begin{pmatrix} x \\ y \\ z \end{pmatrix} \Rightarrow R_K = \begin{pmatrix} \cos K & -\sin K & 0 \\ \sin K & \cos K & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

As is known, the matrices of rotation are multiplied in reverse order to carry out rotations, as follows:

$$x_1^{(1)} = R_\Omega \cdot x$$

$$x_1^{(2)} = R_\Phi \cdot x_1^{(1)}$$

$$x_1^{(3)} = R_k \cdot x_1^{(2)}$$

$$x_1^{(3)} = x_{1\ final} = R_k \cdot x_1^{(2)} = R_k\, R_\Phi\, x_1^{(1)} = R_K \cdot R_\Phi \cdot R_\Omega \cdot x$$

$$\begin{pmatrix} x_1 \\ y_1 \\ z_1 \end{pmatrix} = R_K \cdot R_\Phi \cdot R_\Omega \cdot \begin{pmatrix} x \\ y \\ z \end{pmatrix}$$

As noted above relation $R_K \cdot R_\Phi \cdot R_\Omega = M$, where M represents rotation matrix result (including all three single rotations: Ω, Φ and K).

$$\mathbf{M} = R_k \cdot R_\Phi \cdot R_\Omega = \begin{pmatrix} \cos K & -\sin K & 0 \\ \sin K & \cos K & 0 \\ 0 & 0 & 1 \end{pmatrix} \cdot$$

$$\cdot \begin{pmatrix} \cos\Phi & 0 & \sin\Phi \\ 0 & 1 & 0 \\ -\sin\Phi & 1 & \cos\Phi \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\Omega & -\sin\Omega \\ 0 & \sin\Omega & \cos\Omega \end{pmatrix} =$$

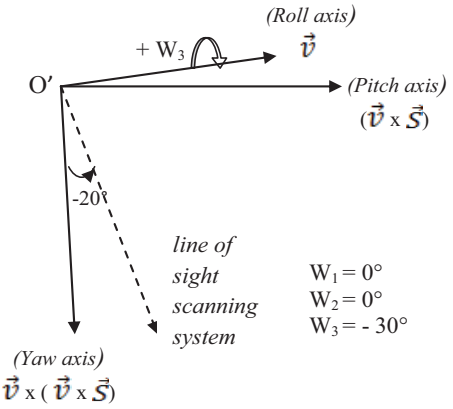
$$= \begin{pmatrix} \cos k\cos\Phi & -\sin k & \cos k\sin\Phi \\ \sin k\cos\Phi & \cos k & \sin k\ sin\Phi \\ -\sin\Phi & 0 & cos\Phi \end{pmatrix} \cdot \begin{pmatrix} 1 & 0 & 0 \\ 0 & cos\Omega & -sin\Omega \\ 0 & sin\Omega & cos\Omega \end{pmatrix}$$

$$= \begin{pmatrix} \cos k\cos\Phi & \cos k\sin\Phi\sin\Omega - \sin k\cos\Omega & \cos k\sin\Phi\cos\Omega + \sin k\sin\Omega \\ \sin k\cos\Phi & \sin k\sin\Phi\sin\Omega + \cos k\cos\Omega & \sin k\ sin\Phi\cos\Omega - \cos k\sin\Omega \\ -\sin\Phi & \cos\Phi\sin\Omega & cos\Phi\cos\Omega \end{pmatrix}$$

Then, calculating the matrix $\mathbf{F = D \cdot M}$ we only orient the satellite axes to global geocentric coordinate system 0XYZ (WGS84). Continue order to work in the same coordinates system will have to orient and order the line of scanning system towards the global geocentric coordinates system. So, we need to specify rotations of yaw, pitch and roll to obtain a coincidence between the yaw axis ($\vec{v}$x($\vec{v}$x$\vec{S}$)) and the line of sight scanning system. All rotations are usually screw (right hand rule) and they will be used to form the vector $\vec{W}$ ($w_1w_2w_3$). Since these rotations are made in the same manner as corrections "attitude" (K, Φ, Ω), the matrix M' can be formed, because is the

same as M except to that it has the angle W_1 rather than the angle K, of the angle W_2 instead of angle Φ and angle W_3 instead of the angle Ω. In most cases the line of sight of the scanning system is located in the plan defined by the pitch and yaw axes of the satellite. For example, the figure below shows the turning axis to align the line of sight vector is only necessary to -20° rotation around the axis of the roll.

Introducing rotations W_1, W_2, W_3 through the rotation matrix **M'**, we obtain an orthogonal matrix **G = F • M'**, whose columns are the new versors of the axes of roll, pitch and yaw.



Because we are interested in only the versor $\vec{g}$ of the line of sight of scanner (which is the same as versor of the satellite yaw axis) we will work with the third column of the matrix M'.

By noting $\vec{m}$ the third column of M', it will have the following form:

$$\vec{m} = \begin{pmatrix} \cos w_1 \cdot \sin w_2 \cdot \cos w_3 + \sin w_1 \cdot \sin w_3 \\ \sin w_1 \cdot \sin w_2 \cdot \cos w_3 - \cos w_1 \cdot \sin w_3 \\ \cos w_2 \cdot \cos w_3 \end{pmatrix}$$

Result $\vec{g} = \mathbf{F}\cdot\vec{m} = \mathbf{D} \cdot \mathbf{M} \cdot \vec{m}$, which represents the versor (unit vector) of the scanner line of sight expressed in global geocentric coordinate system. Because the line of sight vector scanning system to be fully defined we must determine the size (module), in addition to direction and its meaning. For the size determination **u** of the line of sight vector of scanner we will work with parametric equations of the ellipsoid of rotation:

$$E(u_1, u_2) = \begin{pmatrix} a \cdot \cos u_1 \cdot \cos u_2 \\ a \cdot \sin u_1 \cdot \cos u_2 \\ b \cdot \sin u_2 \end{pmatrix}$$

and parametric equations of a straight line in space:

$$\begin{cases} \mathbf{x = S_x + u \cdot g_x} \\ \mathbf{y = S_y + u \cdot g_y} \\ \mathbf{z = S_z + u \cdot g_z} \end{cases}$$

Where: $\mathbf{g_x, g_y, g_z}$ are the cosines guiding of the line of sight regard to scanning system.

Equalizing the two parametric representations (intersecting the line of sight scanning system with terrestrial ellipsoid surface) we obtain:

$$\begin{cases} \mathbf{S_x + u \cdot g_x = a \cos u_1 \cos u_2} \\ \mathbf{S_y + u \cdot g_y = a \sin u_1 \cos u_2} \\ \mathbf{S_z + u \cdot g_z = b \sin u_2} \end{cases}$$

By multiplying the third equation with (**a/b**), then rising to the square part of each equation, and by adding together all three equations, we obtain a quadratic equation in **u** (removing the parameters $\mathbf{u_1}$ and $\mathbf{u_2}$).

$$\begin{cases} (S_x + u \cdot g_x)^2 = (a \cos u_1 \cos u_2)^2 \\ (S_y + u \cdot g_y)^2 = (a \sin u_1 \cos u_2)^2 \\ (\frac{a}{b} S_z + u \cdot \frac{a}{b} g_z)^2 = (a \sin u_2)^2 \end{cases}$$

$$\begin{cases} S_x^2 + 2u\, S_x g_x + u^2 g_x^2 = a^2 \cos^2 u_1 \cos^2 u_2 \\ S_y^2 + 2u\, S_y g_y + u^2 g_y^2 = a^2 \sin^2 u_1 \cos^2 u_2 \\ \frac{a^2}{b^2} S_z^2 + 2u \frac{a^2}{b^2} S_z g_z + u^2 \cdot \frac{a^2}{b^2} g_z^2 = a^2 \sin^2 u_2 \end{cases}$$

$$(S_x^2 + S_y^2 + \frac{a^2}{b^2} S_z^2) + 2(S_x g_x + S_y g_y + \frac{a^2}{b^2} S_z g_z)\, u + (g_x^2 + g_y^2 + \frac{a^2}{b^2} g_z^2)\, u^2 =$$
$$= a^2 (\cos^2 u_1 \cos^2 u_2 + \sin^2 u_1 \cos^2 u_2 + \sin^2 u_2)$$

The coefficient of a^2 in the right member is equal to 1, because:

$\cos^2 u_1 \cos^2 u_2 + \sin^2 u_1 \cos^2 u_2 + \sin^2 u_2 =$
$\cos^2 u_2 (\cos^2 u_1 + \sin^2 u_1) + \sin^2 u_2 = 1$

$$\frac{b^2(S_x^2 + S_y^2) + a^2 S_z^2}{b^2} + \frac{b^2(S_x g_x + S_y g_y) + a^2 S_z g_z}{b^2} \cdot 2u + \frac{b^2(g_x^2 + g_y^2) + a^2 g_z^2}{b^2} u^2 = \frac{a^2 \cdot b^2}{b^2}$$

Since $b \neq 0$ results:

$$[b^2(g_x^2+g_y^2)+a^2g_z^2]\,\mathbf{u^2} + 2[b^2(S_xg_x+S_yg_y) + a^2S_zg_z]\,\mathbf{u} + [b^2(S_x^2+S_y^2) + a^2(S_z^2-b^2)] = 0$$

Written in a shortened form, the above equation becomes a simple quadratic equation in the parameter **u**:

$$A\mathbf{u^2} + 2B\mathbf{u} + C = 0$$

Provided the argument of the square root is positive, which will always be the case in practice, both solutions are real and positive, and the one that we require is the smaller of the two, which we denote by $\mathbf{u}_{min}$; this will be the one corresponding to the negative sign. The other solution then defines the point of emergence of the line of sight at the far side of the Earth. (If the quantity under the square root is negative, the solutions of the equation are complex. This case would arise if the line of sight did not intersect the terrestrial ellipsoid, and will never occur in the normal course of pixel geolocation with the satellite in yaw steering mode).

Ground coordinates of a scan pixel in global geocentric system are even components of the vector $\vec{e}$ (represented in Figure 7) obtained by the sum of other two vectors $\vec{S}$ and $u\vec{g}$:

$$\vec{e} = \vec{S} + \mathbf{u}\vec{g}$$

$$\begin{cases} \mathbf{X = e_x = S_x + ug_x} \\ \mathbf{Y = e_y = S_y + ug_y} \\ \mathbf{Z = e_z = S_z + ug_z} \end{cases}$$

So, the above relations express the ground coordinates of a scan pixel in ECEF coordinate system. Finally, from the ECEF cartesian coordinates of the pixel we can derive its geodetic longitude (L) and geodetic latitude (B) from Figure 8, using the formulas:

$L = \arctan(Y/X)$

$B = (1-e^2)^{-1} \arctan(Z/U)$, where $U = \sqrt{X^2+Y^2}$

CONCLUSIONS

Geolocation of satellite data is a standard part of the post-launch calibration process. For the data to be of value, it is critical that the measured parameters be correctly mapped to the surface of the Earth.

The input parameters include the orbital state and attitude information of the satellite and the look vector of the sensor. The proposed algorithm agrees with the navigation product Satellite Tool Kit (STK), within 0.5 m in ideal situations. STK is a software tool that allows engineers and scientists to design and develop complex dynamic simulations of real-world problems, especially those relating to satellites, spacecrafts, and aircrafts. STK is the same software that space companies use to determine where to place satellites on orbit and to find their satellites once launched.

Satellites and their missions play a critical part in our everyday lives. Everything we do somehow is now connected to satellites in space. We use satellites to communicate, conduct banking transactions, navigate our way around a city – or the country for that matter, forecast the weather, protect our national security, create precise maps, examine the oceans and seas, analyze the Sun activity, map the galaxy, the list is practically endless. The more we know about how satellites work and the environment they operate in, the better we will be in determining additional ways we can use these unique assets in the future. STK will excite users about space and space operations, and should motivate them want to learn more about this critical part of our infrastructure. *STK Aerospace Education Program was designed to educate users on the exciting aspects of satellites, satellite orbits, the types and locations of orbits, and satellite missions using Analytical Graphics Incorporated (AGI) state of the art computer application, Satellite ToolKit (STK)*(CAP-STK Aerospace Program).

Georeferencing an analog or digital photograph is dependent on the interior geometry of the sensor as well as the spatial relationship between the sensor platform and the ground. The single vertical aerial photograph is the simplest case; we can use the internal camera model and six parameters of exterior orientation (X, Y, Z, roll, pitch, and yaw) to extrapolate a ground coordinate for each identifiable point in the image. We can either compute the exterior orientation parameters from a minimum of 3 ground control points using space resection equations, or we can use direct measurements of the exterior orientation parameters obtained from GPS and IMU.

The internal geometry of design of a spaceborne multispectral sensor is quite

different from an aerial camera. The Figure 12 shows below six types of remote sensing systems, comparing and contrasting those using scanning mirrors, linear pushbroom arrays, linear whiskbroom areas, and frame area arrays.

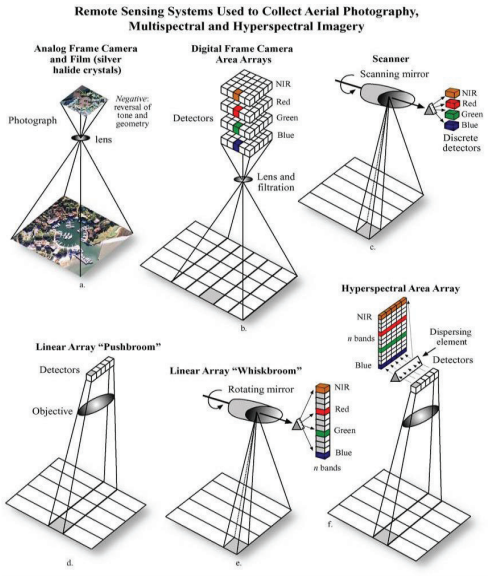


Figure 12. Sensor types of remote sensing systems (Jensen, 2007)

A linear array, or pushbroom scanner, is used in many spaceborne imaging systems, including SPOT, IRS, QuickBird, OrbView, IKONOS, etc. The position and orientation of the sensor are precisely tracked and recorded in the platform ephemeris. However, other geometric distortions, such as skew caused by the rotation of the Earth, must be corrected before the imagery can be referenced to a ground coordinate system.

Each pixel of imagery is captured at a unique moment in time, corresponding with an instantaneous position and attitude of the aircraft. When direct georeferencing is integrated with these sensors, each single line of imagery has the exterior orientation parameters needed for rectification. However, without direct georeferencing, it is impossible to reconstruct the image geometry; the principles of space resection only apply to a rigid two-dimensional image.

We can relate that the units of satellite position error (meters in space) and platform attitude or instrument pointing error (arc seconds) to absolute geolocation error (meters on the ground). Earth location errors are scan angle dependent, growing larger with increasing scan (or view) angle. NASA describes in (NASA, 2011) the corresponding growth of the viewed ground pixel, which also increases in size with increasing scan angle.

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EFFECT OF CLIMATE CHANGE ON DOBROGEA AGRICULTURAL AREA

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Abstract

In this paper I intended to investigate climate change evolution, comparing period 2001-2013 with reference period 1961-1990 for the agricultural area from Dobrogea region. Data for temperature, rainfall and moisture reserves were used for drawing GIS maps. In conclusion we will see what are the consequences and the necessary measures for the optimal development of agricultural production. This study was made possible with data provided by the ANM.

Key words: *GIS technology, temperatures, soil moisture, climate change, extreme weather phenomenon, environment problems*

INTRODUCTION

In Romania, climate data from the last decades highlights a progressive warming of atmosphere, an increase in the frequency of extreme events. Increasingly evident is the rapid change between heat wave/severe draught and abundant rainfall/flash floods.
Considering predictable climatic scenarios it's estimated a increase in thermal and hydrologic stress based on continual rise in air temperature and drop in rainfall, primarily during the summer month which correspond to the critical period for crops (flowering-filling of grains). Adapting to climate change will be based on experience gained from reaction to extreme climate events, and also on implementing alert plans and integrated management for climate risks (Mateescu, 2012).

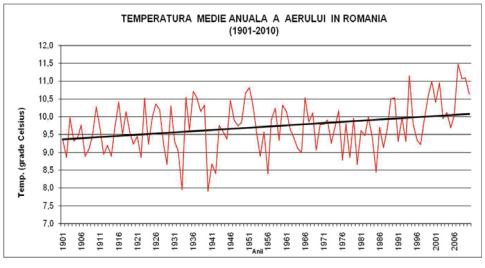

Figure 1. Trend of average air temperature in Romania (1901-2010)

During the first decade of XXI century, in Romania, the year tot year average temperature has risen by 0.4…0.5 degrees Celsius compared to every decade starting from 1961 until present day (Fig. 1).

MATERIALS AND METHODS

This paper was made possible with help from ANM which provided data about average month temperatures and monthly rainfall in the reference interval 1961-1990 and the years 1991-2913 for the following meteorological stations: Adamclisi, Constanta, Corugea, Harsova, Jurilovca, Mangalia, Medgidia, Sulina and Tulcea in the region of Dobrogea. For each station data was processed with Excel creating tables for average temperatures and average rainfall in the following intervals: 1961-1990, 1991-2010 and 2010-2013.
The resulting tables were inserted in ArcGIS and maps made with a well defined classes legend as follows in this paper.

RESULTS AND DISCUSSIONS

We made a table with yearly average air temperatures for the two intervals 1961-1990, 1991-2013 in the region of Dobrogea. Looking at this we can see that the average temperatures from the period 1991-2013 are higher then the temperatures in the other period (Fig. 2).

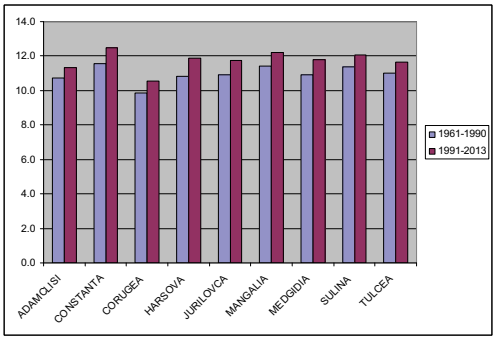

Figure 2. Yearly average air temperatures for the Dobrogea Region

STATION	1961-1990	1991-2013	Difference
ADAMCLISI	10.7	11.3	0.6
CONSTANTA	11.6	12.5	0.9
CORUGEA	9.8	10.6	0.7
HIRSOVA	10.8	11.9	***1.1***
JURILOVCA	10.9	11.7	0.8
MANGALIA	11.4	12.2	0.8
MEDGIDIA	10.9	11.8	0.9
SULINA	11.4	12.1	0.7
TULCEA	11.0	11.7	0.7

Figure 3. Temperature difference between the two periods for Dobrogea region

In Figure 3 we can see that the biggest difference in average air temperature of 1.1 degrees Celsius was recorded at Harsova station, the next station are Constanta and Medgidia with a 0.9 degrees Celsius, followed by Jurilovca and Mangalia with a 0.8 degrees Celsius, Sulina, Tulcea, Corugea 0.7 degrees Celsius and Adamclisi station with a 0.6 degrees Celsius difference. For precipitation I made tables and GIS maps in order to highlight and survey the precipitation quantities fallen in Dobrogea region.

STATION	1961-1990	1991-2010	2011-2013
ADAMCLISI	447.7	***533.4***	***455.9***
CONSTANTA	396.3	***464.8***	***441.1***
CORUGEA	410.9	***458.7***	395.4
HIRSOVA	421.1	***430.6***	***511.8***
JURILOVCA	376.4	369.2	309.7
MANGALIA	398.4	***471.5***	***439.9***
MEDGIDIA	430.1	***485.9***	***480.0***
SULINA	281.4	223.2	249.2
TULCEA	445.9	***491.6***	***490.1***

Figure 4. Average precipitation quantity fallen in Dobrogea region

In Figure 4 we can see that the average precipitation quantity fallen during period 1991-2013 is higher than the reference mainly for the stations: Adamclisi, Tulcea, Medgidia, Mangalia, Constanta, Corugea and Harsova. For Jurilovca and Sulina station, the precipitation were lower then the reference period. To highlight this I made the following GIS maps (Fig. 5,6):

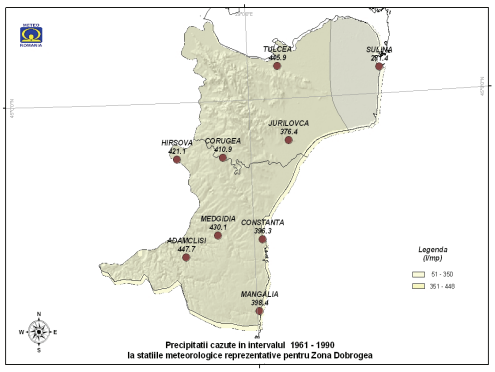

Figure 5. Average precipitation quantity (1961-1990) in Dobrogea region for every single station.

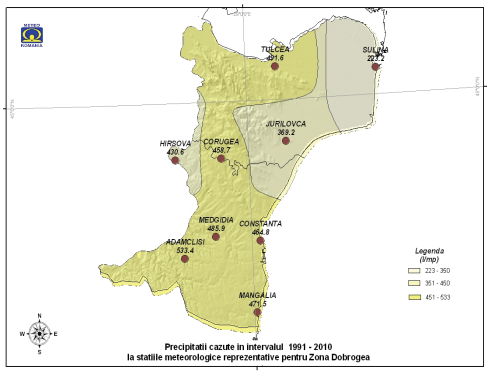

Figure 6. Average precipitation quantity (1991-2010) in Dobrogea region for every single station.

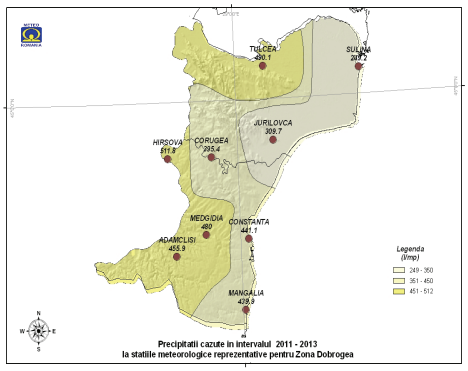

Figure 7. Average precipitation quantity (2011-2013) in Dobrogea region for every single station.

It can be seen how precipitation quantity rises in the north, north-west, west and south parts of Dobrogea during the years 1991-2013.

In the next table are shown the average precipitation quantity for every month of the two reference intervals and the differences for precipitation (l/m^2) (Fig. 8).

MONTH	1961-1990	1991-2013	Difference
January	28.1	28.2	0.1
February	28.6	19.5	*-9.1*
March	24.7	29.9	5.2
April	29.0	31.5	2.5
May	41.7	42.2	0.5
June	45.6	45.5	-0.1
July	37.7	48.5	***10.8***
August	35.7	35.7	0.0
September	33.8	48.4	***14.6***
October	26.9	36.4	***9.5***
November	34.8	33.6	-1.1
December	34.4	35.5	1.1

Figure 8. Average precipitation quantity fallen in Dobrogea region

We can see that for the month of July 1991-2013, the average precipitation quantity was exceeded by 10.8 l/m^2, and in September by 14.6 l/m^2, also in the month of October 9.5 l/m^2 this month are considered predominantly rainy, the month of February and November are droughty, recording lower values for precipitation quantities than the reference, this are -9.1 l/m^2 and -1.1 l/m^2.

In figure 9 I showed the total amount of precipitation fallen for the month of September 2005 since it is the rainiest month in the string of month after 1991. During this month the rainfall quantities exceeded 300 l/m^2.

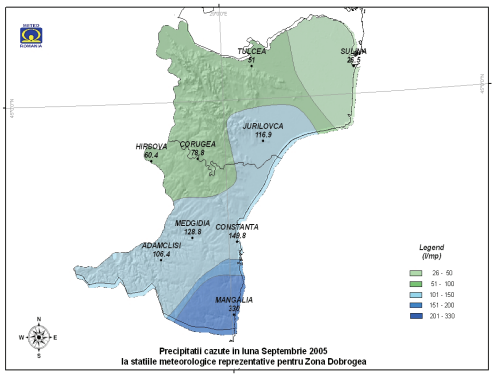

Figure 9. Amount of rainfall in the month of september 2005 at meteo stations from Dobrogea county

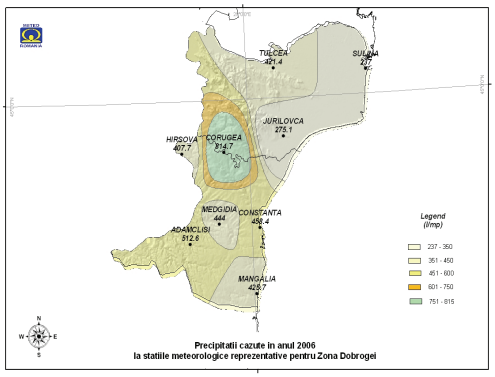

Figure 10. Amount of rainfall in the year 2006 at meteo stations from Dobrogea county

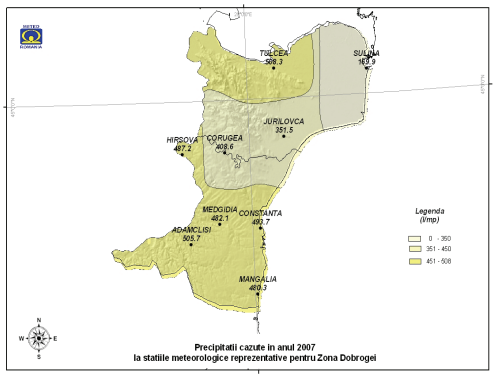

Figure 11. Amount of rainfall in the year 2007 at meteo stations from Dobrogea county

Analysing the data set it's noticed that the years 2006 and 2007 were the most arid years after

1991, compared with the year to year average for the 1961-1990 interval for each station (Fig 10,11).

CONCLUSIONS

In conclusion, a tendency to rise can be seen for the average multiannual temperature (Fig. 12), but also the rise in precipitation shown in figure 13. This confirms the theory of global warming and also the rapid change of extreme events draught/ abundant rainfall, heat wave/ floods. Land reclamation will be needed, draining and irrigation specific to the crop area.

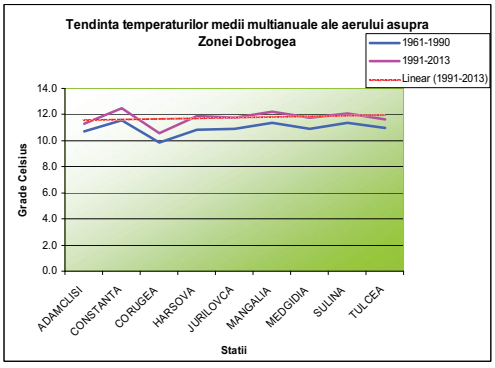

Figure 12. Tendency of average multiannual air temperature for Dobrogea

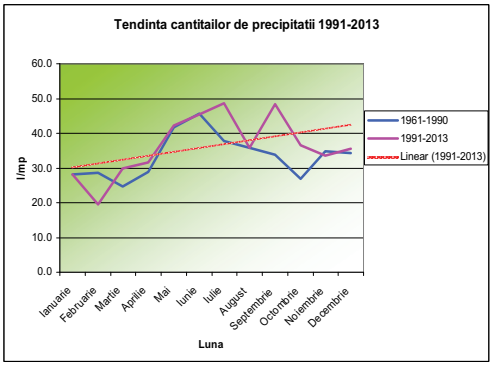

Figure 13. Tendency of fallen precipitation quantity for Dobrogea

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THE EFFECTS OF THE LIFE ANNUITY PROGRAM ON THE AGRICULTURAL LAND EXPLOITATION AND PROPERTY DIMENSION

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Abstract

This paper aims to show the link between the evolution of the land property structure and exploitation and the life annuity program. In order to establish the modification that this program brought to the agriculture it is essential to study it as a program adopted from the French model as a need to relaunch the agriculture by supporting the medium and large sized farms so the main purpose of this paper is to demonstrate the direct connection existing between adopting this program and the increase of the exploitation dimension. As a measure with the main goal of concentrating the agricultural surface in a country such as Romania, which is facing as a huge problem the excessive fragmentation of the agricultural land, fact that makes a profitable and competitive exploitation impossible, life annuity, as this article will conclude had an important role and impact on transforming small sized exploitation into medium and large sized exploitation. The main methods utilized in elaborating this article were collecting ant interpretation of statistical data.

Key words*: annuity, rural development, development region, rent, annuitant.*

INTRODUCTION

Title XI-Life annuity from the Law No. 247/2005 defines the agricultural life annuity as "the amount of money paid to the agricultural annuitant who sells or leases the extravilan agricultural land found in his property or he signs an agreement with the investor with the provisions of article 4, align. 13 from Law No. 1/2000 for reconstructing the right of property on the agricultural and forestry land, solicited according to the provision of the land Law No. 18/1991 and of the Law No. 167/1997 with its ulterior modification and completions having the safety of a life annuity source of incomes guaranteed by the state".

By the practiced policy the life annuity sustains the idea of formatting large dimension exploitations with a high level of competitiveness on the agricultural market by the utilisation of annuity as an extremely efficient instrument in the process of agricultural land alienation from aged farmers to young farmers in order to develop the processes in agriculture. Therefore, the mains purposes followed by life annuity are: the removal of aged persons from the agricultural circuit, the increase of physical dimension of the agricultural exploitations, the ensuring of a stable income for the annuitant and encouraging young population to conduct agricultural activities.

The life annuity program has its origin in the ground rent in France which in the XIX century from its apparition created controversy due to the ambiguity with which it was described. Generally the controversies were highly related to the separation between the production phenomena and the repartition one. The complexity of the land as production input forced to a differentiation regarding the life annuity and therefor the volume of annuity was granted depending on: intrinsic qualities of the soil, terrain positioning qualities unrelated to its natural qualities, intensity annuity marked the influence of holder and property of soil on exploitation and implicitly the results obtained.

MATERIALS AND METHODS

In order to explain the impact that the life annuity program had on the property structure, some statistical data will be analyzed and interpreted. The data are collected from the

operative documents of the Agency for Payments and Intervention in Agriculture for the year 2010.

RESULTS AND DISCUSSIONS

In the past the problem of the connection between life annuity and property structure was vaguely approached but the beneficial effects that life annuity has leaded to deepening the interest manifested for the purpose of increasing the productivity in agriculture by the modification produced on the property structure by life annuity.
According to the Agency for Payments and Intervention in Agriculture, in the year 2010 the situation regarding life annuity was as follows:

Table 1. Agricultural surface-total, sold and leased with rent objective for every development region

Crt. No.	Development region	Agricultural surface(ha)	Sold surface(ha) with rent objective	Leased surface(ha) with rent objective
1.	South-East	2325122	71167.01	37178.67
2.	North-East	2123395	13003.84	7492.15
3.	West	1872375	25728.51	9457.23
4.	North-West	2069766	10843.86	11381.69
5.	Centre	1901554	5752.85	5304.30
6.	South	2063821	39260.05	14135.87
7.	South-West	1799230	13507.01	2487.58
8.	Bucharest/Ilfov	102122	242.23	159.86
9.	Total	14632399	195217.24	84404.49

Table number 1 presents the surface sold and leased with rent objective and the agricultural surface at the level of the eight development regions in the year 2010. It can be noticed from the table that in each development region in the year 2010 existed both rented and leased agricultural surface with rent object. The total sold agricultural surface with rent objective in the year 2010 was 195217.24 hectares and the total leased agricultural surface with rent object was 84404.49 hectares. The values regarding the sold and lease surface are relatively small considering the fact that life annuity begun to operate since 2005. It is necessary to mention that for this situation the fact that the economic measures of increasing the agricultural surface of the holdings are still hard to apply and the rural population was poorly informed regarding life annuity. It can also be talked about the conviction of a population that lived in the communist period to alienate the land, either the property or the utilization process whose complication is also deep by the modest and insufficient amount of rent.

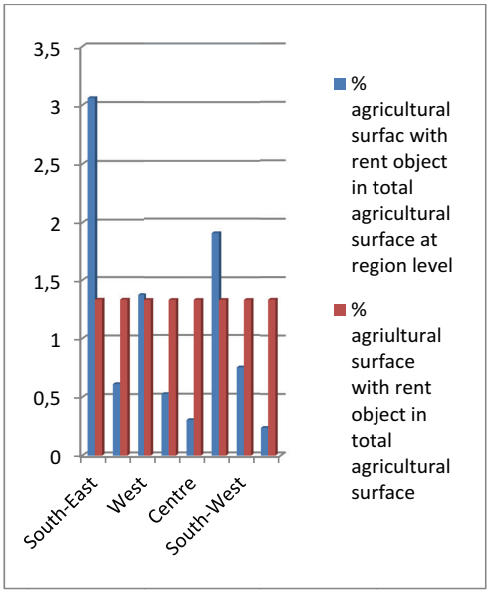

Figure 1. The share of sold agricultural surface with rent object in the agricultural surface

The figure number 1 presents the share of agricultural land sold with rent object in total agricultural surface at each region level and compares it to the share of total agricultural land sold with land object in total agricultural surface in Romania in the year 2010. It can be observed that the regions South-East, West and South exceeded the average while the other development regions are a lot under this average. This situation can be explained by the rural development level of each region, the type of agriculture practiced and the degree of information of persons over 65 years old and which not holds more than 10 hectares of agricultural land cumulated. The decisions to sale explanation can be found in their incapacity to exploit the land and to obtain satisfying production after a potential exploitation.
Therefore in order to contribute to the rural development it is very important to take this fact into consideration when the policies and strategies are constructed and especially when it is applied. This represents the necessity to

adapt to each region needs but also to each region current situation.

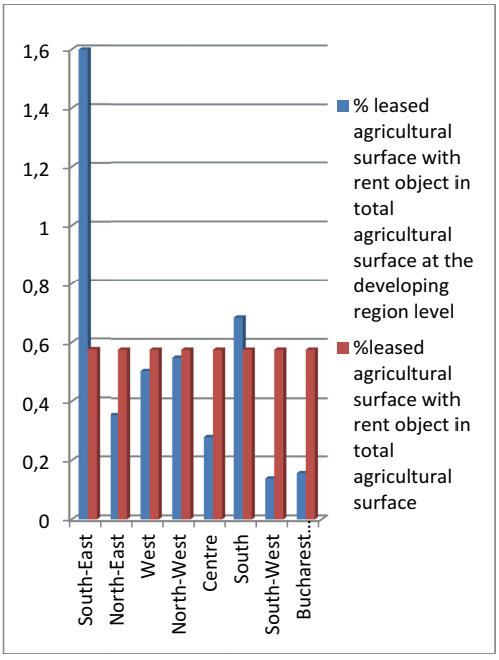

Figure 2. The share of leased agricultural surface with rent object in the agricultural surface

The figure number 2 presents the share of leased agricultural surface with rent object in the total agricultural surface at the development regions level and realises a comparing with the share of total leased agricultural surface with rent object in total agricultural surface. By analysing this figure it can be observed that only the South-East and the South regions exceed the average while the others regions are below the average. The agricultural surface leased with rent objective is below the one sold with rent objective in the year 2010. A potential explanation in regarding this situation can be consider to be found in the provisions of the Law No. 16/1997 updated by Law No. 20/2008(Published in the Official Gazette No. 170 from 05.03.2008) concerning the land lease contract which offers more freedom and decision power to lessee than to lessor. Therefore there is considered that the fear of lessor of losing the rights on his land is one of the impediments that block the aged population to lease their agricultural land and puts them into the situation of choosing to exploit their land on their own, even if the results are not so satisfactory and implies work and resources.

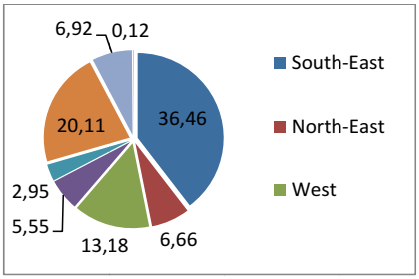

Figure 3. The share of every region agricultural land leased with rent objective in total agricultural land leased in Romania in the year 2010

The figure number 3 presents an analyserelated to the structure of agricultural land sold with rent objective at the development regions in Romania in the year 2010. According to this figure the region with the highest sale of agricultural land with rent objective is the South-East region with 36.46%, followed by the South region with 20.11 and West region with 13.18%; the others development regions brings their contribution to the total with less than 10% each. This situation can be explained by the total surface of agricultural land that every region holds, the number of persons that fulfils the annuitant criteria but also by the rural development strategy that every region has.

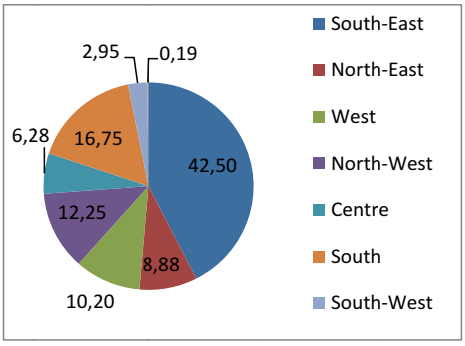

Figure 4. The share of every region agricultural land sold with rent objective in total agricultural land sold in Romania in the year 2010

The figure number 4 present the analyseof the structure of leased land with rent object at the development regions level in Romania. It can be observed that the South-East region

maintains the highest share regarding the lease of agricultural land with rent objective compared to other regions holding 42.5% fromthe total agricultural surface with rent objective at the country level. As in the case of agricultural land sale with rent objective the South region occupies the second place with a contribution of 16.75% to the total agricultural surface sold with rent objective at the country level. The explanation are similar to the lease and can be formulated starting from the agricultural surface that every region holds, the number of persons with annuitant criteria, the degree of information of these persons and the rural development strategies adopted by each region.

CONCLUSIONS

Data analysing regarding the sale or rent of agricultural land with annuity object at the level of the year 2010 indicates the fact that this program has a positive effect on development the agriculture because it encourages the alienation of both property and exploitation of agricultural land.

However there are also barriers in this respect such as:

-the reluctance of the aged people concerning renouncing to their property;

-the poor amounts granted as annuity which are not sufficient in order to ensure some income stability;

-the reduced level of information of people that fulfils the annuitant criteria;

-the excessive bureaucracy and the slow and hard process which allows aged people to obtain the annuitant card;

-interrupting the life annuity program by stopping the grand of annuitant title.

Eliminating these bounds and reviewing the life annuity program can lead, according to the French model, to the agriculture development and even to the rural space development. The main explanation in this respect is given by the current situation of the land fund in Romania characterised by excessive fragmentation, that determines subsistence and semi-subsistence agriculture and blocks the evolution toward a performing and competitive on the market agriculture.

Therefore the life annuity can contribute to the merging by reducing this fragmentation if not at the property level at exploitation level for sure, decreasing the number of small sized holdings incapable to produce important economical results to the detriment of medium and large sized holdings powerful and capable enough to resist on the market. On the other hand life annuity also contribute to the rejuvenation of rural population by attracting their interest into carrying out agricultural nature and by allowing aged population to retire from this kind of activity.

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CORIOLIS FORCE AND THE DURABILITY OF INFRASTRUCTURES

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Abstract

The paper deals with the phenomena developed when along the surface of Earth to the well known Coriolis force some reactive forces are opposed. Since, usually at that level, the Coriolis force is a weak one only long lasting interactions become of practical interests. Regarded from this perspective the Coriolis force is first mechanically defined. Its actions in horizontal and vertical planes are further detailed. The conversion law of energy from an inertial system to a non-inertial one is also presented. As a tribute to History of Science the existence of Coriolis force is proved by the Foucault pendulum. Reactive forces to the Coriolis one are usually developed by engineering works like the protection walls of river banks. For such works the Coriolis force acts as a long lasting disturbing action. Like gravity it is a permanent action, but horizontally directed. During the long service of the works, due to imminent soil deformations some structural damages could occur. According to the clause 2.5 of Eurocode 1 the durability of engineering works should be evaluated. The Coriolis force is a determinist entity while the durability is a probabilistic one. As it was already shown in our paper [6] in 2011, this requirement can be reached with the aid of the Mathematical Theory of Reliability only. Considering several computing schemes for reactive forces, the paper is suggesting a range of numerical values for the risk factor. By including in durability analysis the influence of Coriolis force the results are more reliable and faithful to reality.

Key words: *gravity, inertia, reliability, risk factor, safety.*

INTRODUCTION

World population, estimated at 7,141,000,000 people at the beginning of the year 2014, is non-uniformly distributed on the surface of Earth. Most of population is concentrated in mega-cities, while the rest of it is spread in surrounding satellite settlements. The mega-cities cannot live isolated, only by themselves. For surviving they should remain strongly connected between them by complex engineering works, consisting in ways of communication, energetic lines and auxiliary industrial units, generically called critical or vital infrastructures. In spite of the advanced technologies used for providing the safety and durability of these huge investments the number and frequency of occurring some failures remain rather high. Two of the four Aristotelian elements, namely earth and water, are usually involved in these geophysical events. Apparently they seem to be hazards, but in reality they are due to human errors. Nature never makes mistakes. Its laws are sacred (Sofronie,2012).

The paper brings in actuality a mechanical phenomenon well known for its applications in ballistics and meteorological application, namely the Coriolis Effect (Landau, 1965). The historic circumstances in which this effect was discovered and proved are first presented. Then the hypotheses on which the theory of relative motion is based are discussed. The structure of Coriolis force discloses other possible applications of practical interest in engineering works like critical infrastructures.

HISTORICAL DATA

In 1835 the French scientist Gaspard-Gustave de Coriolis (1792-1843) published in Paris the paper *Sur les équations du mouvement relatif des systèmes de corps*. He has shown that the laws of motion could be used in a rotating system of reference if an extra force is added to the motion equations (Laue,1965). In 1836 Coriolis succeeded Louis Marie Henri Navier on the Chair of Applied Mechanics at the École des Ponts and Chaussées in Paris and also to Navier's place in the Académie de Sciences.

His name is one of the 72 names inscribed on the Eiffel Tower.

In 1851, after only 16 years from Coriolis' paper, the French physicist Léon Foucault (1819-1868) provided an experimental demonstration of the Earth rotation around its axis in diurnal motion. For this purpose Foucault used a pendulum, composed by a canon ball with a mass m=26 kg suspended by a cable with a length l=67m from the roof of the Panthéon in Paris. Foucault wrote in his paper that the time in hours taken for the pendulum to return to its original position depends by the latitude at which the experiment is carried out. So, at the poles it takes 24 hours to return to its original position while at the equator it does not rotate at all. Since that date of 3rd February 1851 in Paris Coriolis' Effect was unanimously world widely recognised.

History of Science is mentioning that in time *The Principle of Relativity* assumed successively three versions. The first one is attributed to Galileo Galilee (1564-1642) who defined the inertial systems of references. Galileo assumed that space is homogeneous and isotropic, time is uniform and reversible while the motion is rectilinear and uniform or at rest. In his version relativity principle states that in the inertial systems of reference all laws of mechanics are the identical, and the same are the proprieties of space and time (Landau, 1966). The second version is attributed to Isaac Newton (1642-1727). From the very beginning Newton introduced as model of analysis the material point. It was defined as a body without dimensions, but with mass. In this way Newton has eliminate the three degrees of freedom due to rotation and reduced the whole motion to translation only. All his three laws of motion are invariants with respect to the inertial or Galilean systems of reference (Voinea, 1989). Newton postulated that the existence of an absolute and immobile space cannot be physically proved. Therefore his version of relative principle states that all inertial systems of reference are equivalent, and the laws of mechanics remain invariants with respect of any of them (Voinea, 1989). In 1905 Albert Einstein (1879-1955) lived his *Annus Mirabilis,* i.e. *a miracle year,* and published *the Special Theory of Relativity* that includes all physical phenomena not only the mechanical ones. His theory states that a preferential system of reference with inertial properties does not exist, or at least was not experimentally proved yet. That means a mobile trihedral is defined as inertial or Galilean when translates uniformly and constantly, therefore only when its initial acceleration of translation together with its velocity and acceleration of rotation are zero. All physical laws are invariants with respect of any inertial system of reference. Stephen Hawking calls Galileo Galilee, Isaac Newton and Albert Einstein the Giants of Science [2].

COMPLEMENTARY FORCES AT EARTH SURFACE

Lev Landau (1908-1968), Nobel prized for Physics in 1962, gave an elegant description of the relative motion of a material point into an external field at the surface of the Earth (Landau, 1966). When the motion of the material point is first reported to an inertial or Galilean system of reference K_o in which the velocity of material point is written by v_o and its potential energy with U, the Lagrange function assumes the expression

$$L_o = \frac{mv_o^2}{2} - U \tag{1}$$

that leads to the equation of motion

$$m\frac{d\vec{v}_o}{dt} = -\frac{\partial U}{\partial \vec{r}} \tag{2}$$

For this motion are also successively defined the impulse

$$\vec{p}_o = \frac{\partial L_o}{\partial \vec{v}} = m\vec{v}_o \tag{3}$$

the kinetic moment

$$\vec{M}_o = \vec{r}x\vec{p}_o \tag{4}$$

and the energy

$$E_o = p_o v_o - L_o = \frac{mv_o^2}{2} + U \tag{5}$$

When the same motion is reported to a non-inertial system of reference K that rotates with

a constant and uniform angular velocity, measured in rad/s,

$$\vec{\Omega} = const. \tag{6}$$

then the recurrence relation between the velocities in the two systems of reference K_o and K, with the same position vector r, does exist

$$\vec{v}_o = \vec{v} + \vec{\Omega} x \vec{r} \tag{7}$$

In these conditions the above defined functions become as follows:
Lagrange function

$$L = \frac{mv^2}{2} + m\vec{v}(\vec{\Omega} x \vec{r}) + \frac{m}{2}(\vec{\Omega} x \vec{r})^2 - U \tag{8}$$

Equation of motion

$$m\frac{d\vec{v}}{dt} = -\frac{\partial U}{\partial \vec{r}} + 2m(\vec{v} x \vec{\Omega}) + m\vec{\Omega} x (\vec{r} x \vec{\Omega}) \tag{9}$$

By comparing the two equations of the motion for inertial and non-inertial systems, (2) and (9) respectively, it is noticed that in the second equation there are two additional terms. Both have the dimension of force, due to the mass m they have an inertial nature and since Ω is the angular velocity of Earth rotation they have a permanent character. The first additional term with the expression

$$\vec{F}_C = 2m(\vec{v} x \vec{\Omega}) \tag{10}$$

was named the complementary force of Coriolis. Since this amount is not generated by an interaction, according to Newtonian definition of force, it is not a proper force, but as long as it is able to cause motion is accepted as such. The second additional term with the expression

$$\vec{F}_{cf} = m\vec{\Omega} x (\vec{r} x \vec{\Omega}) \tag{11}$$

is the complementary centrifugal force. Since the numerical value of Earth angular velocity

$$\Omega = \frac{2\pi}{24}\frac{rad}{hour} = \frac{2\pi}{24x60x60}\frac{rad}{s} =$$
$$= 0.727x10^{-4}\frac{rad}{s}$$

is rather small, its quadratic value becomes much smaller. Generally, since

$$F_{cf} << F_C$$

the centrifugal force could neglected when is compared with the Coriolis one.
Further, the impulse in the non-inertial reference system

$$\vec{p} = \frac{\partial L}{\partial \vec{v}} = m\vec{v} + m\vec{\Omega} x \vec{r} = m(\vec{v} + \vec{\Omega} x \vec{r}) =$$
$$= m\vec{v}_o = \vec{p}_o \tag{12}$$

coincides with the impulse in the inertial system.
Kinetic moment in the non-inertial reference system

$$\vec{M} = \vec{r} x \vec{p} = \vec{r} x \vec{p}_o = \vec{M}_o \tag{13}$$

also coincides with the kinetic moment in the inertial system.
Finally, the energy

$$E = \vec{p}\vec{v} - L = \frac{mv^2}{2} - \frac{m}{2}(\vec{\Omega} x \vec{r})^2 + U \tag{14}$$

where the second term is an additional potential energy called centrifugal energy. Replacing the velocity with its value from (7) one obtains

$$E = \frac{mv_o^2}{2} + U - m(\vec{r} x \vec{v}_o)\vec{\Omega} \tag{15}$$

or shortly

$$E = E_o - \vec{M}_o\vec{\Omega} \tag{16}$$

This last equation represents the law of transformation the energy of material point when one passes from an inertial system of reference to a non-inertial system of reference.

CORIOLIS FORCE

For practical purposes the above vector equations are replaced with their analytical forms. One assumes that the material point is located in the northern hemisphere at the latitude λ, and the origin of reference system O is located in the centre of the Earth. The axis Oz is vertically oriented, the axis Oy downwards, in meridian direction, and axis Ox is horizontally oriented, perpendicularly on the vertical plan yOz (Fig.1).

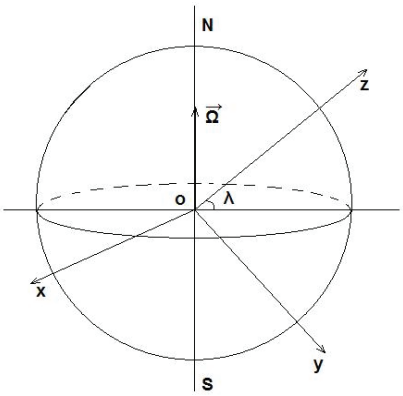

Figure 1. Reference axes

For the three vectors in the expression of Coriolis force

$$\vec{F}_C = -2m(\vec{\Omega} x \vec{v}) \tag{17}$$

with the following notations $\vec{F}_C(F_{Cx}, F_{Cy}, F_{C_z})$, $\vec{\Omega}(\Omega_x, \Omega_y, \Omega_z)$ and $\vec{v}(v_x, v_y, v_z)$ one obtains

$$\vec{F}_C = (\Omega_y v_z - \Omega_z v_y)\vec{i} + (\Omega_z v_x - \Omega_x v_z)\vec{j} + \\ +(\Omega_x v_y - \Omega_y v_x)\vec{k} \tag{18}$$

Since the angular velocity decompose in the vertical plan yOz $\vec{\Omega}(0, -\Omega\cos\lambda, \Omega\sin\lambda)$ the expression (17) assumes the form

$$\vec{F}_C = 2m\Omega(v_z\cos\lambda + v_y\sin\lambda)\vec{i} - \\ -2m\Omega(v_x\sin\lambda)\vec{j} - 2m\Omega(v_x\cos\lambda)\vec{k} \tag{19}$$

In the case of a material point that falls vertically $\vec{v}(0,0,-v)$ the expression (19) becomes

$$\vec{F}_C = -(2m\Omega v\cos\lambda)\vec{i} \tag{20}$$

and its unique horizontal component is

$$F_{Cx} = -2m\Omega v\cos\lambda \tag{21}$$

Due to its minus sign the falling material point is horizontally deviated towards east. The highest deviation occurs at equator where the latitude is $\lambda = 0$,

$$F_{Cx}^{\max} = -2m\Omega v \tag{22}$$

and any deviation does not occur at all at pole where $\lambda = 90°$.

In the case of a material point that moves on a horizontal plan in a direction deviated from the axis Ox with the angle α. In these conditions the expression (19) becomes

$$\vec{F}_C = 2m\Omega v(\sin\lambda\sin\alpha)\vec{i} - \\ -2m\Omega v(\sin\lambda\cos\alpha)\vec{j} \tag{23}$$

where its components are

$$F_{Cx} = 2m\Omega v\sin\lambda\sin\alpha \tag{24}$$

and

$$F_{Cy} = -2m\Omega v\sin\lambda\cos\alpha \tag{25}$$

Since

$$\vec{F}_C\vec{v} = F_{Cx}v_x + F_{Cy}v_y = \\ = 2m\Omega v^2(\sin\lambda\sin\alpha\cos\alpha - \sin\lambda\cos\alpha\sin\alpha) = 0$$

means that $\vec{F} \perp \vec{v}$ and the complementary force Coriolis deviates the motion of material point perpendicular on the direction of velocity $\vec{v}$ and on its right side. At equator, where $\lambda = 0$, $F_C = 0$, and Coriolis effect does not exist while at pole, where $\lambda = 90°$, and for $\alpha = 0$,

$$F_{Cy}^{\max} = -2m\Omega v \tag{26}$$

With the aid of above determined expressions of the Coriolis force it was found out that the period in which the vertical plan of Foucault pendulum completely rotates assumes the simple expression

$$T = \frac{24hours}{\sin\lambda} \tag{27}$$

and for $\lambda = 45°$, $T \cong 34hours$. This period does not depend either by the length or mass of the pendulum used for demonstration.

DURABILITY OF CRITICAL INFRASTRUCTURES

The Coriolis force is as permanent as the gravitational force, but comparatively its amount is much smaller. That means both forces are long lasting and never cease their actions. Like gravitational force the Coriolis one is a stationary force because it does not explicitly depends on time, but however it essentially differs by gravity; Coriolis force is a

circular one because it depends by the velocity of motion and non-conservative because its mechanic work depends on the trajectory of motion. In addition, if the gravitational force is a central one with a unique direction and sense, as that of Earth centre, the Coriolis force follows any trajectory in space, namely that decided by the vector product between the velocity of mobile and Earth's rotation. When the two forces, gravitational and Coriolis, are acting together on the same point usually the last one is neglected as non-significant. On the contrary, when Coriolis force does not feel the influence of gravitational force its action could become significant for the mechanical state of material points. In this particular situation, in engineering applications at least, the complementary Coriolis force has a perception of a disturbing one.

The existence of critical infrastructures, as fixed and not movable constructions, is governed by the laws of equilibrium based on Newton's Third Principle of reciprocal actions. Casual and unavoidable deformations or displacements are restricted by Jacob Bernoulli's hypothesis such as their mechanical state to be the rest. For analysis purpose, according to the existing codes in force, the Eurocode 1 including, two limit states are assumed: 1) The ultimate limit state what is applied for safety analysis and 2) The limit state of service what is applied for durability analysis. Durability is a probabilistic concept based on the Mathematic Theory of Reliability (Sofronie, 2012). In a general form the durability function is defined as

$$\tau(t) = \int_0^{\infty} F(t)dt \tag{28}$$

where the reliability function

$$F(t) = e^{-\int_o^t \lambda(t)dt} \tag{29}$$

dramatically decreases with the function of risk $\lambda(t)$. In the most simplified case the durability and risk factor follow a typical relation of inverse proportionality

$$\tau = \frac{1}{\lambda} \tag{30}$$

Risk factors and risk function as well are evaluated with the methods of Statistical Mathematics. The results obtained are classified on different scales from the smallest to highest risks. Statistical analysis also includes the construction degrees of importance. Obviously, the critical infrastructures being vital ones are credited with the highest degree of importance and consequently even the smallest risks are taken into account.

Critical infrastructures were not discovered by the modern technologic civilization. They were well known by all ancient societies like City Wall in Babylon, Chinese Wall in Far Orient and the networks of roads, bridges and aqueducts built during the Roman Empire, for instance. Only the name of *critical infrastructures* was recently invented. Such a name was necessary to define the massive engineering works, world widely built now.

The risks that could occur in critical infrastructures due to the longtime action of the horizontal components of Coriolis force are coming from the rheological phenomena developed in earthen works and geosynthetic materials for which the elasticity law of Robert Hooke does no longer subsists. The simplest form of the rheological state is expressed by the equation

$$\sigma + n\frac{d\sigma}{dt} = E\varepsilon + m\frac{d\varepsilon}{dt} \tag{31}$$

where *m* and *n* are dimensional parameters.

For *n=0* one obtains the general law of creep phenomenon

$$\varepsilon = \frac{\sigma}{E}(1 - e^{-\frac{E}{m}t}) \tag{32}$$

or for $\sigma = const.$ and $m/n = E_1$

$$\varepsilon = \frac{\sigma}{E} + \sigma(\frac{1}{E_1} - \frac{1}{E})e^{-\frac{E}{m}t} \tag{33}$$

while for *m=0,* the law of stress relaxation phenomenon due to Maxwell

$$\sigma = \sigma_o e^{-\frac{t}{m}} \tag{34}$$

Both phenomena of creep and stress relaxation are latent and slow, but fortunately they are warning by cracks or visible superficial strains.

If by periodical inspections the danger is detected in due time great damages and even fatalities could be avoided.

CONCLUSIONS

Although the theory of Coriolis force is well known for long time it was less applied in engineering works. That is probably because from very beginning it was called a complementary force. The paper emphasized the important role of this force in the maintenance of critical infrastructures. With the existing computing facilities the Coriolis force can be easily included in all engineering analyses. The theoretical base presented in the paper is helpful in correct interpretation on any analysis results.

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ENERGY IN TERMS OF EUROPEAN UNION STRATEGY FOR THE DANUBE REGION

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Abstract

This paper presents energy as an important factor for the development of the Danube Region and all the countries involved in the European Union for the Danube Region. Energy is one of the challenges all confront because of the high prices, unformed markets, low usage of the renewable sources, low efficiency and lack of connection between different countries. Trough this paper is highlighted the importance of the Danube Region from energy point of view. The Strategy for the Danube Region is a new way to overcome 20th century division and conflicts in the Region, and as an important impulse for overall socio-economic development. The involvement of non-EU countries in the Danube Region Strategy is a key priority to the macro-regional cooperation.

Key words: *energy, Danube Region, cooperation, project, agreements*

INTRODUCTION

Danube, the second largest river in Europe, covers about 2850 km, linking the Black Forest to the Black Sea, across ten countries and has tributaries from other four countries.
An ideal location for placement of hydroelectric power plants, a pan-European transport corridor and a refuge for the rarest species in Europe - the pressures on the river are often in conflict with each other and political changes in the region also influenced the way the difficulties are dealt. Following the example of the EU Strategy for Baltic Sea, which was the first macro-regional approach, the eu strategy for the Danube was based on stakeholder efforts in the region, allowing them to create a region where all 115 million people to enjoy security, prosperity and equal opportunities.
European Union Strategy for the Danube Region refers mainly to 14 countries, of which eight are eu member states (Germany, Austria, Hungary, Czech Republic, Slovak republic, Slovenia, Bulgaria and Romania), and six are non-EU countries (Croatia, Serbia, Bosnia and Herzegovina, Montenegro, Ukraine and Moldova).
European Union Strategy for the Danube region is an internal strategy of the European Union which has connected all three riparian states respecting the principles applied and the EU Strategy for the Baltic Sea Region - no new institutions, no new funds without changes in legislation.

MATERIALS AND METHODS

On 16.09.2010 was held in Brussels Plenary Session of the European Economic and Social Committee (EESC) when was adopted the "European Union Strategy for the Danube Region". EUSDR was developed to make better use of the existing EU legislation, financing programs and cooperation structures in order to create a balanced and sustainable development framework for the region.
The Strategy is built around four main pillars: improving connectivity in the Danube Region; protecting the region's environment; building prosperity; and strengthening the local governance systems and improving public security.
As a critical part of any economic and social system, energy has its place in the strategy documents. EUSDR's document mentions energy as one of the complex macro-regional challenges that have to be addressed. High energy prices, fragmented markets, lack of interconnections, low energy supply source

diversification, low energy efficiency are all part of this challenge.
Energy is seen as an opportunity for the Danube region, if renewable energy sources will be increasingly used and if the use of energy can become more efficient, especially in buildings and in transportation.
The new regional energy policy in the frame of the Danube Region Strategy can create more than 1 million local jobs, reduce the risk of fuel poverty, and last but not least improve air quality.

RESULTS AND DISCUSSIONS

The energy actions and projects are proposed under several headings – energy infrastructure, energy markets, energy efficiency and renewable energy – all of them concentrated in the second Priority Area – 'to encourage more sustainable energy' – of the connectivity pillar.
In terms of energy infrastructure and markets, the Action Plan has some realistic proposals:
to increase the gas storage capacities in the region
to implement the interconnector and pipeline projects already supported in the Commission's TEN-E (Trans European Network) policy and in the European Energy Programme for Recovery in the region
to finalise the feasibility study for the New Europe Transmission System (NETS) and implement this regional network integration initiative
to tap potential synergies between the new Strategy and the Energy Community aimed at creating an integrated regional energy market
All the countries of the Danube Region have policies to support the use of renewable energies. Many have large natural potential to develop renewable sources (especially solar and wind).
Natural resources underpin our economy and our quality of life. Continuing our current patterns of resource use is not an option. Increasing resource efficiency is key to securing growth and jobs for Europe. It will bring major economic opportunities, improve productivity, drive down costs and boost competitiveness."
They also have potential for improvement regarding energy efficiency in residential buildings, and district heating.
In the renewable energy and energy efficiency fields, the Action Plan is laudably proposing the development of a Danube Region Renewable Energy Action Plan, as well as a comprehensive plan for the sustainable development of the hydropower generation potential of the Danube River and its tributaries. Local renewable energy sources should be used to increase the energy autonomy in the region and the Energy Community contracting parties and observers should be encouraged to adopt the Renewable Energy Directive. Finally, rehabilitation of the district heating systems and more combined heat and power capacity in the region should be pursued to create regional networking and cooperation opportunities in energy efficiency and renewable energy.
The value added of EUSDR for the energy sector would be:

- to develop the Danube region into a European Energy Corridor;
- to establish a regional cooperation model for the sustainable use of local conventional and unconventional energy resources;
- to stimulate the development and operation of an integrated and flexible energy transportation system from the energy exporting regions to the consumer markets;
- to create a solid framework for equal access to energy and efficient energy consumption.

As energy provides a supranational, interconnected dimension with impact on all of the strategy pillars, success in the energy sector is critical for the successful overall implementation of EUSDR.
Energy prices are high in the Region. Much energy is imported, its transport is costly, the markets are fragmented. Energy infrastructures are not well interconnected. In addition, the Danube Region is specifically vulnerable regarding security of supply, as demonstrated in January 2009 when gas supplies were cut. Energy production and use is also a significant source of pollution. Investment in infrastructure is a key priority. Cooperation is necessary in relation to planning, funding and implementation.

The Europe 2020 Strategy targeted to save 20% (368 Mtoe) of the European Union's primary energy consumption by 2020 compared to projections made about such consumption back in 2007. However, the continent is not on track to reach this energy efficiency goal set for 2020.

The Danube Region Energy Efficiency Concept for Public Buildings is to investigate the current practice of financing energy efficiency investments in public buildings of the Danube Region countries. The concept is to focus on sharing best practices and based on this, to formulate policy recommendations in order to create a more attractive environment for public building renovation projects.

The Danube Region Gas Market Model is the first tangible result of the Energy Priority Area implementing the Danube Region Strategy. This tool is designed to measure the transnational spill-over effects of gas infrastructure projects and project packages on gas prices. The model identified the six most decisive gas-related investments of the Danube Region. The estimated financing need of EUR 560 million into these interconnectors would result in a EUR 1600 million annual saving on gas bills.

Based on the conclusions of the Danube Region Gas Market Model, the Danube Region Gas Storage Analysis was developed and completed by April 2013 in order to enhance the optimal use of the available gas storage capacities in the Danube countries. The analysis attempted to find answers for two research questions. Firstly, whether there is sufficient natural gas storage capacity in the region as a whole to provide security of supply and necessary flexibility for national markets. Secondly, whether the storage infrastructure missing at national level (if there is any) can be supplemented on a regional basis.

The analysis provided a clear picture on the current state of play, stressing that the region has sufficient, but currently substantially underexploited storage capacities. However, the existing storages are unevenly distributed across countries.

The Danube Region Biomass Action Plan provides a comprehensive analysis of the biomass potential, legal framework and regulatory environment of biomass utilization in the Danube Region as well as good practice projects. The Action Plan also lists a group of cross-border policy recommendations formulated to extend the use of biomass in the region.

Based on the results, the aim is to create synergies and coordination between existing policies and initiatives of the countries in the region in order to extend the sustainable use of biomass. The Action Plan builds on already existing practices and success stories, which could serve as guidelines for future development.

A demo project website is constantly being developed with the aim to collect biomass projects which are considered as best practices from the countries of the Danube Region.

The general objective of this project is to enhance the sustainable utilization of geothermal energy in the Danube Region by providing systematic and harmonized information about the geothermal potential and the non-technical barriers in front of exploiting it.

The electricity systems and markets of the Danube Region countries are heterogeneous and their electricity networks are facing very different challenges due to specific production and consumption patterns. The goal of the Danube Region Smart Grid Concept is to discover the bottlenecks of smart grid developments in the Danube Region to eliminate infrastructural barriers, foster the integration of the increased renewable supply into the grid and decrease the ratio of non-payment.

The project is based on a series of workshops with key stakeholders (Transmission System Operators, Distribution System Operators, big consumers and suppliers), desktop research and regional survey.

As a result of the project, Danube countries will be expected to have a clear understanding of their own demand for smart grid solutions and the areas for policy and regulatory interventions will be identified.

Structural and Cohesion Funds and the European Agricultural Fund for Rural Development (EAFRD) are the European Commission's most relevant support budget.

The Structural and European Agricultural Fund for Rural Development provide good funding opportunities for projects, in particular for

decentralised production of energy from local renewable sources, and for research networks. Energy efficiency improvements and increased use of renewable energy are important for the whole area. The Danube Region has a high potential for improvement in energy efficiency, e.g. in residential buildings and district heating, as well as in combined heat and power facilities.

The involvement of non-EU countries in the Danube Region Strategy is a key priority to the macro-regional cooperation.

Taking into consideration its specific situation, the Republic of Moldova was chosen as the first beneficiary of the program. Following a Fact Finding Mission in Chisinau in January 2013, four on-the-spot workshops took place in the Republic of Moldova until July 2013 with the active participation of decision and policy makers, as well as lead experts of the relevant public bodies and players in the energy sector of the country. The concept proved to be a great success involving 18 experts from several European countries covering a large number of topics regarding the practical implementation of the relevant EU law.

Romania and China signed two nuclear cooperation agreements expected to give China General Nuclear Power Group (CGN) a role in Romania's sole Cernavoda Plant as it builds extra reactors. The two delegations signed a total of 13 agreements, including on conventional and renewable energy and agriculture.

Two reactors, using the CANDU technology, are currently operating at Cernavoda, providing about 17 per cent of the country's electricity.

The state company Nuclearelectrica, which runs the Cernavoda Power Plant, has signed a memorandum of understanding with China General Nuclear Power Corporation to build the two new nuclear reactors. Meanwhile, the thermal energy producer Complexul Energetic Oltenia signed an agreement with China Huadian Corporation for a new investment at Rovinari, while Complexul Energetic Hunedoara signed a similar agreement with China National Electric Engineering to revamp parts of a power plant at Mintia.

CONCLUSIONS

The issue of the sustainable energy is a common interest of the whole Danube region whether it is a member state of the European Union or not. Energy efficiency, alternatives, and energy security are key terms.

But how can a citizen be involved or what can we do in order to realize sustainable energy? First of all we need to change our consumer behaviour. Our energy needs have to be reduced by recycling and reusing energy surplus. We need to set a good example and lead the way. This is the reason why I, as the Executive President of the "Ecological Initiative and Sustainable Development Group" Foundation, started organizing debates to promote the EU Strategy for the Danube River, trainings for the civil society, promoting the projects for the Danube River and creating Competitiveness Centers in: Moldova Noua, Orsova, Drobeta-Turnu Severin, Calafat, Giurgiu, Oltenita, Cernavoda, Braila, Galati.

The main purpose of the Competitiveness Centers is to implement the EU Strategy for the Danube Region as well as to support and advice in certain concerns regarding the future projects. The issues covered by the Competitiveness Centers include environment, education, culture, tourism, transportation, disaster protection, energy, labor market, and many others.

We need to start a process of higher organization and to build up a platform for transnational cooperation, consultation and networking.

The activities or the location are not limited strictly to the river Danube, as the EU Strategy is relevant for the entire Danube Basin.

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