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Faculty of Land Reclamation and Environmetal Engineering
Address: 59 Marasti Blvd., District 1, Zip code 011464, Bucharest, Romania
Phone: + 40 784 276 174
E-mail: simpozionifimcad@gmail.com
Web: http://simpozionifimcad.usamv.ro

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University of Agronomic Sciences and Veterinary Medicine of Bucharest
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Address: 59 Mărăşti, Bvd, District 1, Zip code 011464
E-mail: simpozionifimcad@gmail.com
Web: http://simpozionifimcad.usamv.ro
Phone: +40 784 276 174

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SECTION 01
ENVIRONMENTAL SCIENCE AND ENGINEERING

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PERMEABILITY CHARACTERIZATION OF CONSTRUCTION MATERIALS USING ADVANCED METHODS

Andrada BUDUGAN[1], Denisa MUȚ[1], David ANCA[1], Daniel CADAR[2]

Scientific Coordinators: Assoc. Prof. PhD Nicolae POP[1], Prof. PhD Habil. Eng. Tudor SĂLĂGEAN[1], Lect. PhD Eng. Dumitrița MOLDOVAN[2]

[1]University of Agronomic Sciences and Veterinary Medicine of Cluj-Napoca, 3-5 Mănăștur Str., Cluj-Napoca 400372, Romania, Email: andabudu@yahoo.com, denisamut@yahoo.com, davidanca9@gmail.com, popnicolae@gmail.com, tudor.salagean@usamvcluj.ro
[2]Technical University of Cluj-Napoca, 28 Memorandum Str., 400114 Cluj-Napoca, Romania, Email: dumitrita.corpodean@phys.utcluj.ro

Corresponding author email: andabudu@yahoo.com

Abstract

Advanced ^1H Nuclear Magnetic Resonance (NMR) relaxometry is a valuable tool for the characterization of building materials like waterproof mortars. Carr-Purcell-Meiboom-Gill (CPMG) pulse sequence method was used for the measurement of four samples (C65, P88, P288, AQSE) of waterproofing mortars at 7 days after preparation. In general, four dynamics components were observed for the T_2 Laplace distributions at 7 days after preparation. Their characterization shows the evolution and the mobility of protons in the samples. In general, these peaks have T_2 values which can be associated with bound water, free water in small pores, and free water in medium and large pores. The Scanning Electron Microscopy (SEM) was measured for all samples and correlated with NMR parameters.

***Key words**: CPMG, mortars, NMR, pore evolution, relaxometry, SEM, T_2, waterproofing.*

INTRODUCTION

Characterization of building materials has become an increasingly widespread practice in the last decade due to their applicability. Low-field NMR is one of the methods recently used in this characterization and it is a non-invasive method (Moldovan, 2012). 1H NMR method brings a great and quality contribution to the understanding of hydration phenomena. Their characteristic shows the dynamics and mobility of protons (Jumate et. al., 2017; Ardelean, 2021; Fechete 2009).

Mortar cement is a mixture of water, aggregates (different sizes of the particle of sand), and cement materials in different proportions. Water is the main component in producing mortars because it contributes to the chemical hydration reaction between solid compounds (Jaffe, 2001). Waterproofing mortars are used for many applications in the field of construction. The behavior of waterproofing mortars, after application on the surface, is different due to the use of aggregates and polymers from different sources, even if it satisfies the waterproofing needs of the substrate and meets quality standards (Cadar at al., 2021). Water retention capability is the capacity of the mortar to sustain a rapid loss of mixing water to air and absorbent masonry materials (Pop, 2022).

The purpose of this paper is to characterize four different mortars by NMR and to determine the proton dynamics in the samples, to understand what happens at the microscopic level. Three important characteristics of mortar are constructability, workability, and compressive strength. Their degree of impermeability is given by the rigid components in the sample.

MATERIALS AND METHODS

The four waterproofing mortars C65, P88, P288, AQSE, see Figure 1 were purchased from the local market in Romania. From the preparation phase, the ratio between components A (liquid) and B (solid) was different for each sample. The samples C65 and P88 are waterproofing 1k mortars, the component A is only water and in

component, B is aggregate, additives, and polymers.

Figure 1. Pictures of waterproof mortars on day 7 after preparation.

Figure 2. Students Andrada and David are preparing samples for NMR measurement.

The samples P288 and AQSE are waterproofing 2k mortar, component A (liquid) is water plus additives and polymers. The samples have been prepared following the quality standard to SR EN 1015-11:2002/A1:2007 (2007).
Nuclear Magnetic Resonance measurements were performed with the Bruker Minispec low-field NMR spectrometer working at the proton frequency of 19.69 MHz (see Figure 2).
For a qualitative evaluation of the rigid component morphology and the pore dimensions, the scanning electron microscopy (SEM) images were taken at 7 days from preparation, for all samples. The SEM images were captured with a Jeol JSM-5600 LV at an acceleration voltage of 15 kV with magnifications of 1000x. The electron microscope is equipped with an Energy Dispersive X-Ray Detector (EDX), UltimMAX 65 (Oxford Instruments), operated with Aztec Software.

RESULTS AND DISCUSSIONS

In this section, we describe the NMR and SEM measurements for all samples at 7 days after preparation, but this description is a follow-up of a more extensive study done on samples during a more extended period from day 1 to day 28 after preparation to understand the dynamic behavior of the water in the samples (Cadar at al., 2021).

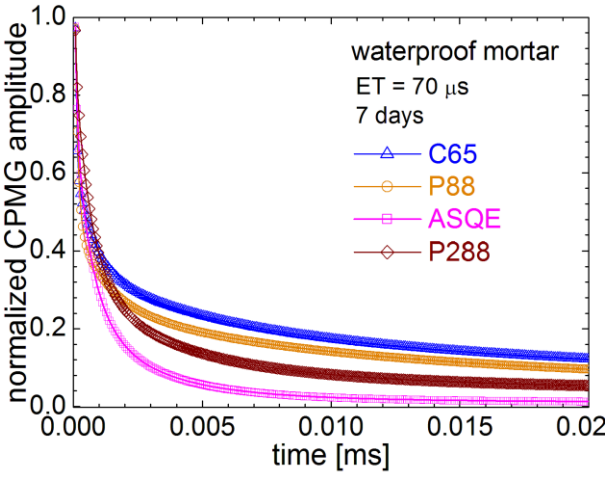

Figure 3. The normalized CPMG echoes decay for a waterproof mortar at day 7 after preparation.

Figure 3 is presented the CMPG echoes decay for all four samples with the echo time of 70 µs for 7 days after preparation. The fastest decay in the representation of Free Induction Decay (FID) measured data is for the ASQE sample and the slowest decay is the C65 sample with magenta respectively blue in figure 3.
To monitor the effects of water consumption and the evolution of pores the curves depicted in Figure 3 can be analyzed using a numerical Laplace inversion algorithm (see Figures 4a and 4b).
In this figure, one can observe a *T2* distribution which is more like that one measured on day 1 after preparation and less than those measured on day 3 for the same P288 mortar according to the previous measurements and characterizations (Cadar at al., 2021). To validate this behaviour, the distributions were measured again for another set of P288 samples, but the result is consistent. The *T2* distribution measured for the sample P288 at 7 days is like those measured for the sample AQSE at 7 days. The difference consists in the fact that the peaks obtained for the sample P288 are better resolved indicating that the mortar P288 is more homogeneous although they are in the same category of 2k mortars. AQSE sample has four peaks but three of them are not so well resolved

(see figure 4a with red). The peaks overlap slightly which indicates that at 7 days after preparation the hydration process has not finished, and water is still migrating from one pore to another. They are between 0.01ms and 0.01s. The peak for the *T2* value under 1 ms can be associated with bound water. A *T2* value of the order of milliseconds is water in small pores and medium pores. The quantity of water content in large pores is quite low in the ASQE sample as compared to the other samples which have a higher water content in these pores.

The NMR data show that the behaviour is similar in these samples even if the amount of water is different in each of them. Also, the amplitude is different. The lowest amplitude of peaks associated with bound water is found in the AQSE sample.

In figure 4b the amplitudes are approximatively equal at both samples and the peaks are well defined. The peak associated with bound water for the C65 sample is at 0.7ms instead for sample P88 which is at 0.1ms.

The pore size and the morphology of the samples were evaluated qualitatively from Scanning Electron Microscopy (SEM) like in figure 5 up.

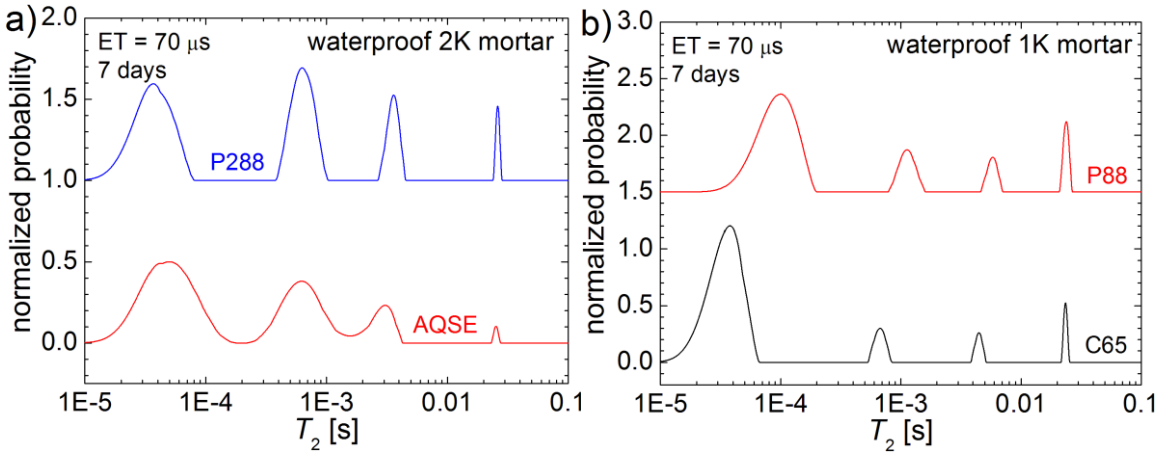

Figure 4. T2 distribution measured for a) waterproof 2K mortar P288, AQSE and b) waterproof 1K mortar P88 and C65.

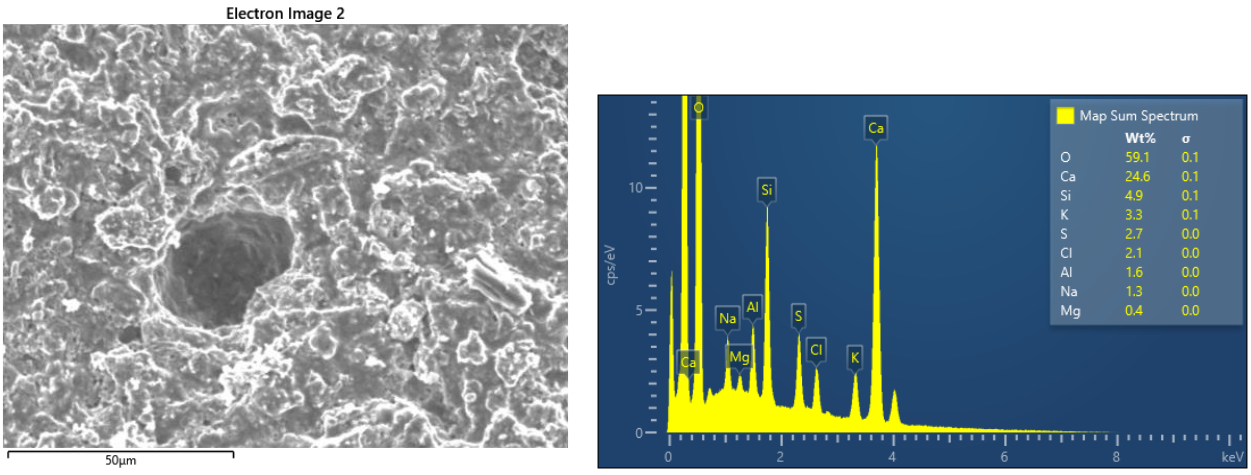

Figure 5. SEM micrographs, at ×1000 magnification for P88, waterproof mortar at day 7 after preparation up to and down the map spectrum in the function of the chemical components

This figure reveals that the homogeneity is high, but the hydration process is not finished yet. The pore sizes are different depending on the sample.

In figure 5 down we can see the chemical structure of sample P88, the highest proportion has 59.1% of oxygen and 24.6% of calcium. The smallest weight has Mg with 0.4% being alkaline-earth metal is supposed to make the sample more rigid.

These NMR and SEM characterizations will

continue, and they will be correlated with measurements at 28 days after preparation since the hydration process was not completed at 7 days in any of the samples. The permeability will be characterized and correlated with classical mechanical tests of building materials, but this will be in future research.

CONCLUSIONS

The 1H NMR Laplace distributions were proved to be a valuable tool to investigate the evolution of permeability of the building's materials. The *T2* distributions reveal changes, in the waterproofing 1k and 2 k mortars. To 7 days after preparation four dynamics components were observed in the *T2* distributions for all samples. AQSE mortar is the most heterogeneous in the early stages of evolution after preparation.

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THE INFLUENCE OF CONSTRUCTIONS ON SOIL C:N RATIO

Elena Mihaela COJOCARU[1], Diana Andreea BENESCU[1], Andrei MOȚ[2]

Scientific Coordinator: Assist. PhD Simona SPÎNU[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: + 4021.318.25.67
[2]Research Center for Studies of Food Quality and Agricultural Products, University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, Bucharest, Romania

Corresponding author email: diana.benescu@yahoo.com

Abstract

It is well known that the construction sector is constantly growing, bringing a negative impact on the environment. Therefore, the purpose of this study is to assess the impact of construction materials on the content of Carbon and Nitrogen in soil. These two chemical elements, especially the Carbon:Nitrogen (C:N) ratio, are extremely important in organic matter and are among the most important in terms of soil structure, especially because they could provide information leading to characterization of the soil. Carbon in soil plays an essential role as food source for soil micro-organisms and as bacteria metabolite, while Nitrogen is an important nutrient for crop production.
In this study, the C:N ratio was calculated in the case of soil samples taken from an area in full development, in Bucharest, where demolition of buildings took place recently. This ratio was compared with the one determined in the soil samples from the immediate surroundings, where vegetation grows.
The obtained results indicated that the C:N ratio was lower in the case of soil samples taken from an area in full development compared with the one determined in the soil samples from the immediate surroundings, which indicates that construction materials influence the Carbon and Nitrogen content of the soil.

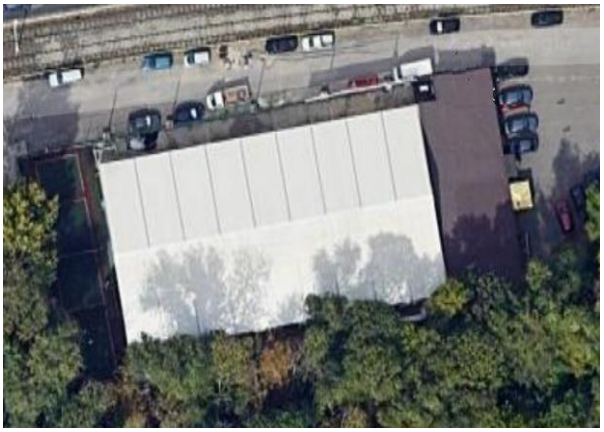
Key words: *buildings, Carbon:Nitrogen (C:N) ratio, construction materials, soil*

INTRODUCTION

The environment is constantly changing according to the growing desire for modernization. The topic of this study was selected to reveal that the world that overbuilding at the national level has a negative impact not only on nature, but also on the soil itself. The main purpose of this study was to identify the impact of construction and building materials on the carbon and nitrogen content of the soil.
The carbon and nitrogen content of the soil was evaluated according to this issue, especially the C:N ratio (the mathematical ratio used to find the connection between carbon and nitrogen), and it refers to the mass of carbon relative to the mass of nitrogen in a sample (Brust, 2019). A microorganism present in the soil needs carbon and nitrogen to survive, namely a C:N ratio of 24:1 (16 parts of carbon are used for energy and 8 parts for survival (USDA NRCS, 2011)). An optimal C:N ratio in the soil of 24:1 (Howell, 2005) influences the soil-protecting layer covering the soil, but the vegetation type affects this ratio (Rowe et al., 2006).
This ratio could be seen as an indicator for soil quality, humidity and organic matter content (Swangjang, 2015). More, it is useful even in the ecosystem nitrogen status investigation.
The soil organic matter is a basic substance which indicate the relationship between soil and carbon storage and could be seen as the sum of living and dead organic matter in the soil, including plant residues and microorganisms.

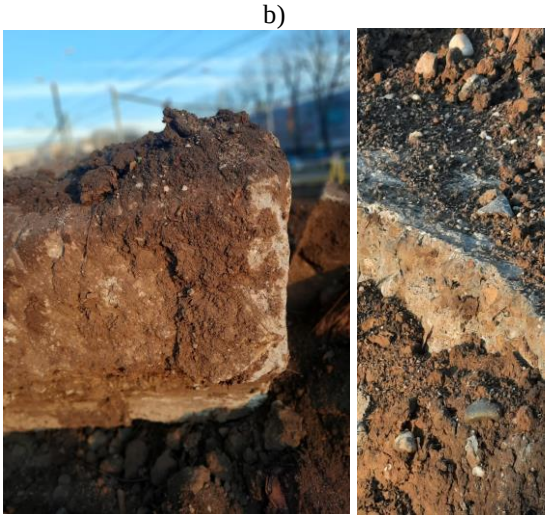
MATERIALS AND METHODS

Soil samples were collected from a crowded area in Bucharest, which is currently under development (Ghencea area). In this study, soil samples collected from areas where the building was recently demolished (Figure 1) and soil samples that were taken from approximately 10-15 meters away from the initial sampling site, where vegetation grows (Figure 2) were compared to find the calculated C: N ratio in both cases.



a)

b)



c)

Figure 1. a) Building before demolition; b) Building after demolition; c) Demolished building soil sample prelevation place.

Analysis of C and N content was performed in the Laboratory of Agrochemistry, Research Center for Studies of Food Quality and Agricultural Products, University of Agronomic Sciences and Veterinary Medicine of Bucharest.

Figure 2. Immediate surroundings where vegetation grows soil sample prelevation place

Soil samples were dried at room temperature, ground with a soil grinder, and passed through a sieve (250 micrometers) (Figure 3). The samples were kept in a dry environment. To determine the total nitrogen and carbon content, 5-10 mg of soil sample were used.

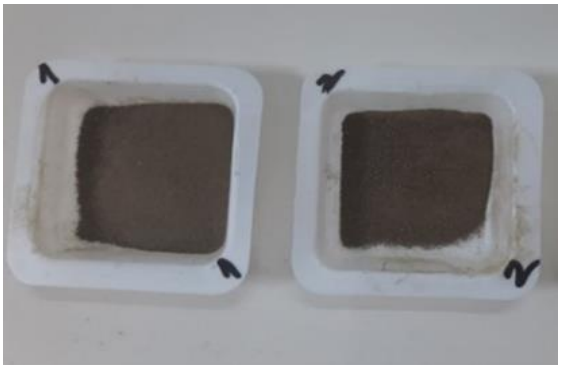


Figure 3. Soil sample: demolished building (left) and immediate surroundings with vegetation (right)

The soil analysis was performed using the CHNS (Carbon/Hydrogen/Nitrogen/Sulf) elemental analyzer (EuroVector EA3100 Elemental Analyzer). Acetanilide EDTA was used as standard reference material. All determinations were performed in triplicate.

RESULTS AND DISCUSSIONS

Soil organic matter could be considered an indicator of soil fertility in natural and managed ecosystems, due to C, N and P contents that are important for plant growth. Soil organic matter is a useful resource which plays an important role in environment and economy management.

Thus, this organic matter could be considered an entire ecosystem at the microscopic level.
Analyses performed to determine the carbon and nitrogen content of the soil samples collected from both studied sites showed a higher carbon content than nitrogen, as expected (Figure 4). Figure 5 reveals a higher mass expressed as micrograms of Carbon content, and a lower mass expressed as micrograms of Nitrogen content, respectively.

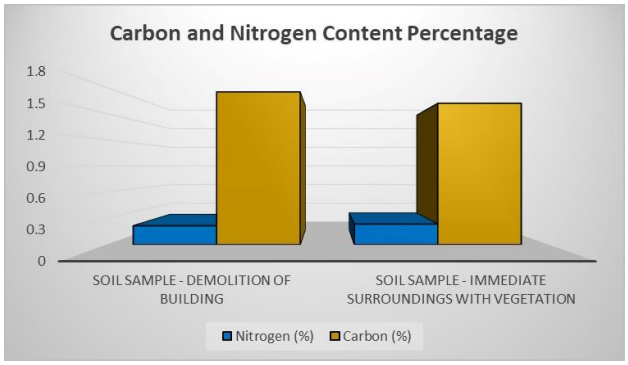


Figure 4. Carbon and Nitrogen Content Percentage

From the analysis of the obtained data it can be seen that the impact of the construction on the fertility of the soil below it is major, a conclusion underlined by the low nitrogen content.

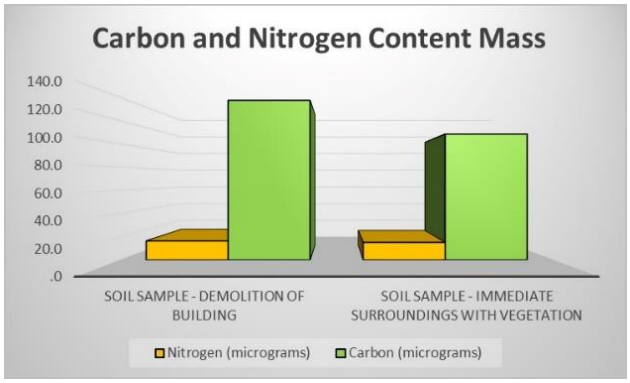


Figure 5. Carbon and Nitrogen Content Mass

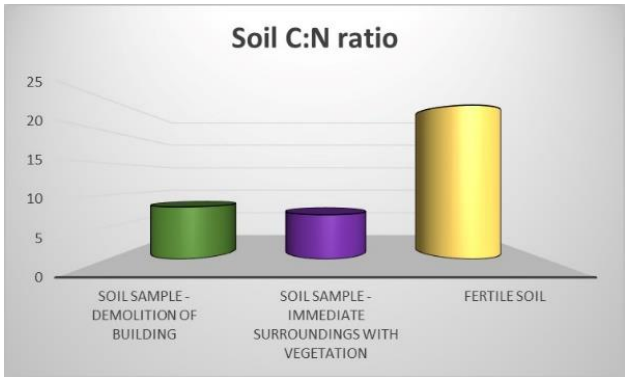


Figure 6. Soil C:N ratio

Figure 6 shows the C:N ratio from the collected samples comparatively to the optimum ratio found in a fertile soil. As can be seen, the C:N ratio in the soil is slightly higher in the case of the soil samples under the demolished building, compared to the values obtained in the case of the samples from the immediate surroundings where vegetation grows. The observed difference (8: 1 versus 7: 1), in contradiction to what one would have expected, can be explained by the fact that under the concrete construction there are several building materials (sand, cement, etc.) that come with a higher intake of carbon stored in the soil, while in the case of soil in the immediate surroundings where vegetation grows, nitrogen is absorbed by plants, leading to a decrease in soil nitrogen content. Moreover, the low values obtained for the C:N ratio even in the areas with vegetation, located at a distance of 10-15 m from the demolition site, confirm the fact that the constructions have a negative impact on the soil, including on that from surroundings.
To these low values contributes also the level of pollution of the crowded area taken into study. It is known that soil organic carbon has an essential role in stabilizing atmospheric CO2 concentration (Zhou et al., 2019).

CONCLUSIONS

In both cases of the sites studied, the value of the C: N ratio was considerably lower than in the optimal case of a fertile soil, when it reaches the threshold of 24: 1, which undoubtedly shows the negative impact of building materials on essential soil compounds. More, as could be seen, in the analysed soil samples, the content of carbon was higher than nitrogen content, which is in accordance with the ratio in organic matter. In conclusion, understanding the C: N ratio of soil to the various building materials applied to it is important for managing a future crop and the nutrient cycle required for it.

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USE OF SOFTWARE FOR THE ANALYSIS OF LANDSLIDE STABILITY AT NATIONAL AND INTERNATIONAL LEVEL

Ionuț Mădălin COSTINESCU

Scientific Coordinator: Prof. PhD Sevastel MIRCEA

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăști Blvd, District 1, 011464, Bucharest, Romania

Corresponding author email: madalin.costinescu@yahoo.com

Abstract

This article is intended to highlight the input of the field stability software and its monitoring programs to implement the best technical measures to prevent and combat the occurrence of landslides. The best software programs at national and international level will be presented briefly, based on the principle of limit equilibrium method and the finite element method. This article will also describe the technical work resulting from the analysis of the implementation of the various programs in Romania, Spain, Algeria, and Iran. In Romania at present time, among the most used software for analysing the stability of slopes are: Geo5, Geostar, Geo-slope, MidasGTS NX, Midas SoilWorks, Plaxis 2D, Plaxis 3D, Phase2, Abaqus, Cosmos. Moreover, the article will mention other programs developed in Romania, following the research outlined in the PhD theses. There are more than 50 programs at world level that can be used in such analyses, of which in this article we mention Plaxis V 8.2, SPSS 18, FLAC slope.

Key words*: slope, landslides, micropilots, software, stability slope, monitoring landslides.*

INTRODUCTIONS

The modeling of geotechnical structures through computer programs, especially slopes and embankment, has seen a rapid development in the last decade. The calculation programs are divided into two main groups:

- calculation programs that have incorporated the principles of limit equilibrium (MEL),
- computer programs that have incorporated numeric analysis procedures, especially the Finite Elements Method (MEF).

It is known that the yielding of massifs of land, slopes and embankment, is similar to a process of shearing on a natural scale, in which the knowledge and evaluation of strength and shearing efforts play a decisive role. Shear strength, characteristic of soils dependent on a multitude of factors, is also dependent on the stage of deformation-displacement recorded at the level of yielding areas, assimilated as potential breaking surfaces in a problem of stability analysis.

Therefore, the accuracy of the methods for determining the parameters of shear strength, analysis and evaluation of the stability of land masses have evolved a spectacular evolution in recent years.

The methods based on the limit equilibrium admit a common hypothesis, according to which the safety coefficient has the same constant value for any point of the yield surface, the stability conditions being characterized by an average value of it. The main purpose of the method is to estimate the size of the safety factor for the "free body" delimited by the sliding surface. Shear stresses are calculated based on the applied forces, and shear strength is calculated based on the normal forces acting on the sliding surface and the shear strength parameters of the earth.

Methods based on numerical calculation procedures that considers the stress-strain relationship, are represented by MEF. The safety factor is determined by the technique of reducing the shear strength, which helps to estimate the stresses and strains that occur in the supporting elements, such as: piles, micropiles, anchors and geotextiles. The technique of reducing shear strength is systematically used to determine a stress reduction factor (safety factor) that brings a slope to the yield point (Luca et al., 2016).

Following the comparative analyzes performed between the two methods, it was found that there is a difference between the research conducted by MEF between 0.88% - 1.93% when the calculations used the parameters of shear strength with maximum values, and between 1.78% - 1.90% when the parameters with residual values were used, instead, the differences between the analyzes performed with MEL are higher, between 5.49% - 5.26% for the parameters considered with residual values.

From the different results it is observed that the finite element method offers a high degree of confidence, which can highlight the vectors of maximum and minimum displacements in vertical and horizontal direction, in different stages of work, effective and total efforts, water pressure in the pores and degree of saturation. The analyzes performed, both in the hypothesis of a soil mass with homogeneous and stratified stratification, show that the volume of mobilized soil is higher with increasing the parameters of the shear resistance (Chirila et al., 2021).

MATERIALS AND METHODS

Within the researched works at national and international level, a review will be made primarily of the programs used in Romania for calculating stability, landslide monitoring, as well as technical measures applied to prevent and combat the occurrence of natural disasters caused by landslides.

A first approach to solving land stability situations is the kinematic elements method, which involves dividing the earth mass into rigid (non-deformable) finite elements that can only move by sliding against each other, based on the breaking criterion Mohr-Coulumb, in the form of forces and not efforts, to have a discreet solution to the problem and not a continuous one. With the help of a program developed in the Matlab platform, stability graphs are presented for slopes with different slopes and heights, as well as their consolidation measures (Muresan, 2013).

In addition to the classical methods of determining the movement of land and buildings, the use of a new method of monitoring them, represented by the "Reflectorless Method", allows full automation of the entire process of measurement, data processing and provision of information without operator intervention the magnitude of displacements with determination errors of ± 2,3 mm can be provided. The "Detect" calculation program, based on which the "Reflectorless Method" operates, implements a new and simplified statistical approach to tracking movements. The program is accessed only through internet browsers without the previous installation of other programs and represents in short, the use of several points per unlimited object, not being materialized physically, without costs, the movement of points being in one direction (the accuracy offered by this program is 6 times higher than the classic ones).

In order to monitor landslides, the Golden Surfer 9 program, which uses Freyssisol technology by placing monitoring marks, offers the advantage of being able to obtain information of the influence of rainwater, soil moisture, water infiltration on the slope with great ease in 3D format, without the need for knowledge of this format (Trifan, 2014).

In the case of analyzing the stability of communication areas, unstable roads, where the phenomenon of frost-defrost has a great influence especially on soils with a composition of dusty sand, sandy clays, you can use the program Plaxis 2D which uses the finite element method by reducing shear-resistant parameters of the land until surrender. This process, called Phi-c reduction, identifies areas of instability on road sections where the main cause is the presence of surface water that has seeped into the body of the road and for which the stability factor can be calculated (Valceanu, 2014).

In Spain, the Slide V5 program (Figure 2) was used, which considers water pressure an infiltration, determining the degree of soil saturation as well as the slope of the land, cohesion, internal friction angle and density. The shear strength of the soil is the most important coefficient to be analyzed because it starts in application methods with differentiation of areas on landslides where the stability factor is greater than or equal to 1.5, and where the value is subunit 1.50 the implementation of the procedure for obtaining a supra-unit coefficient is applied. In a case study in the region of Malaga, the increase in shear strength increased the stability factor, which could be done by

inserting micropiles at 45 cm between the axes and at a depth of 25 m below the endangered building.

Additionally, anchors were introduced at an inclination of 20 degrees with a diameter of 0.6 inches and a limit voltage of 60% of the balance limit. The case study described the steps and the beneficial solution that micropiles have through the Spencer method of limit equilibrium, following which it was established that the degree of safety increased from 0.907 to 1.504 (Alfonso et al., 2021).

In Algeria, to prevent landslides, a procedure has been proposed which involves, first, the identification of the breaking surface, from where there is the greatest risk of detachment of a sloping part from the slope. The identification of this area is done with the help of inclinometers later, to evacuate the water from the precipitations, drains are built located laterally on the longitudinal direction of the rupture with discharge in the lateral parts of the slope (Sellami, 2014).

Once the water is drained, reinforced concrete micropiles are inserted right in the risk of rupture. The evolution of the stability as well as the exact identification of the possible rupture is followed through the Plaxis V program 8.2. As the possible slip is sectioned by a road, the loads exerting pressure on the ground were also considered, studying two hypotheses in which micropiles can be introduced depending on the length of the road and the corresponding pressure expressed in tons/m2. The program was able to express what load can be assigned to each armed micropilot and depending on the maximum moment of rupture of the slope (KN*m) and at what distance they will have to be drilled. One of the calculation examples highlighted that at a specific weight of 140 t, distributed over 36.6 m, a load of 3.86 t or 38.9KN / m2 results, for which the stability check, as well as the related graphs showed that the land will be in perfect safety, the risk of slipping being almost 0. What gives more confidence to this complete system of monitoring and technical implementation is that it can adapt to any type of soil substrate and on slopes with different degrees of inclination.

In order to assess the volume of landslides following landslides, the SPSS 18 program (Figure 3) was applied in Iran on the surface of the Baqi River basin, which helped to calculate the volume of land for 44 localities. For the beginning, the depth of landslide production was determined, this being between 3.3 m and 4.6 m and of the total soil displaced in this river basin, 35% is represented due to landslides. The aim of the study was to find a relationship between the surface and the volume of landslides, their surfaces were identified longitudinally and latitudinally using SPSS software 18 (Abolghasem et al., 2016).

The formula VL = ɛ x AαL was used, based on which the volumes of land were calculated and compared with other models from previous years, finding that the values are quite close. Like the parameters used to estimate the displaced volume, the coefficient of determination (R2) and the mean square deviation (RMSE) were calculated to indicate the efficiency of the model.

The equivalent volume was calculated with VL=2.482 x AL 1.024 and R2=0.99, which led to the estimation of a volume of 922658.42 m3 and an average sliding depth of 4.06 m. Based on the values extracted from the calculations, correlation diagrams were made between the volume and the landslide surfaces, as well as between the calculated depths, resulting in a significant increase in the displaced volume in relation to the monitored areas (example: at 1000000 m2 is 3.9 million m3).

$\bar{O}$ = average of the observed volumes; = average volume calculated; oi = the value of the observed volume; pi = calculated volume; n = number of variables; pi = estimated slop volume.

$$R^2 = \left(\frac{\sum_{i=1}^{n} (p_i - \overline{p})(o_i - \overline{o})}{\sum_{i=1}^{n} (p_i - \overline{p})^2} \right)^2$$

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n} (o_i - p_i)^2}{n}}$$

(Abolghasem et al., 2016).

In the Qinghai region of Tibet, which is prone to landslides due to frequent rainfall, the stability of a road section was analyzed, on the surface of which 3 geological drillings were carried out to

identify the soil stratification and the groundwater level. In this sense, the obtained samples were introduced in the Flac 3D calculation program (Figure 1), based on the finite difference method, after which the parameters of the earth could be determined. Following these analyzes, it was possible to find out where the landslides and the values of the shear coefficient at different depths occurred. As a technical measure, a numerical simulation of an introduction plan for micropiles capable of retaining and reducing landslides was performed (Hu-Tiang Fei et al., 2016).

RESULTS AND DISCUSSIONS

All the cases presented above are important, but for a practical highlighting of the technical works performed based on the analyzes provided by the calculation programs, those projects with significant technological impact were chosen for detailed presentation.

1) Program Flac 3D:

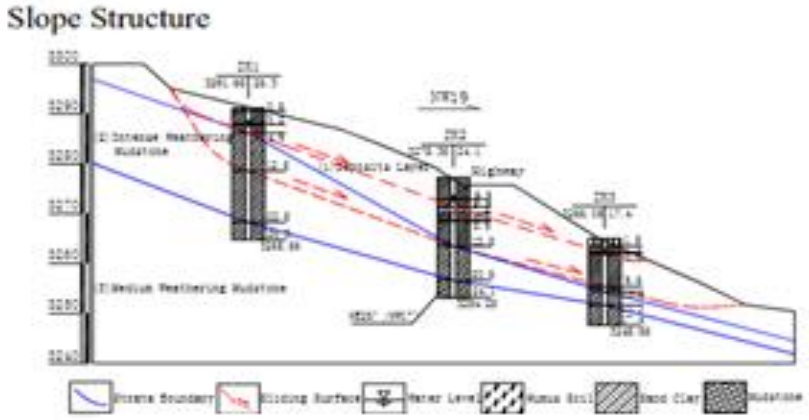

Figure 1. Geological section of colluvial landslides (Hu -Tiang Fei et al., 2016)

2) Program Slide V5:

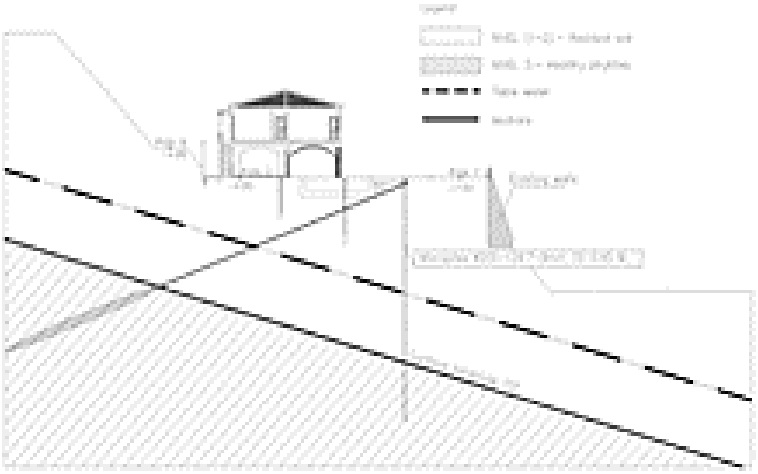

Figure 2. Study example cross section (Alfonso et al., 2021)

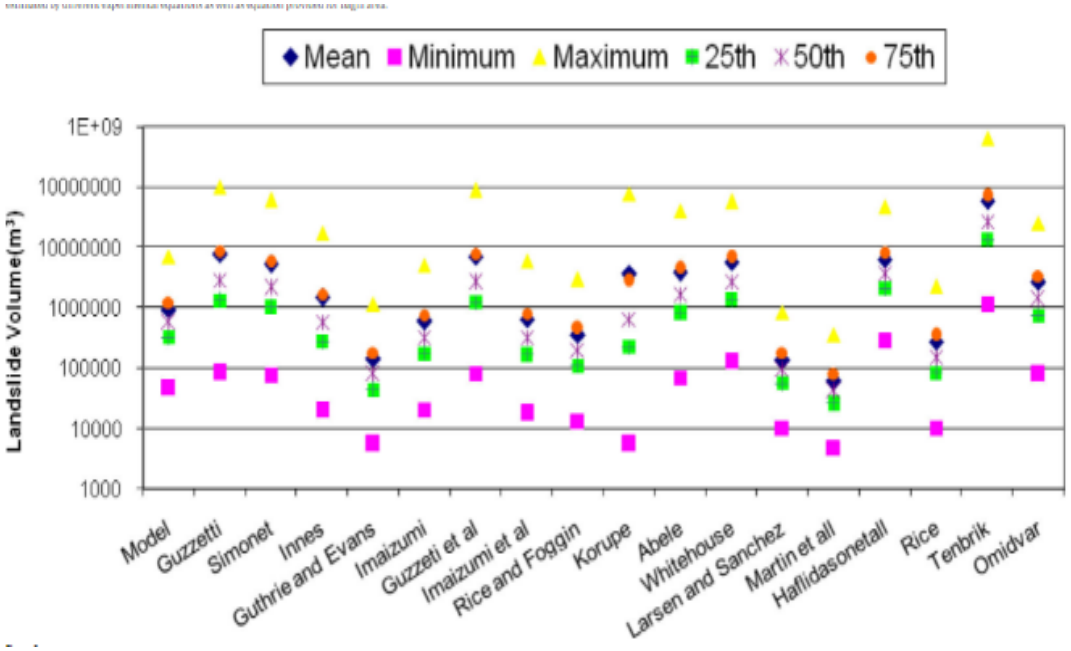

Figure 3. Evaluating the Model SPSS 18 (Abolghasem et al., 2016)

CONCLUSIONS

Relief has a dominant role in the outbreak and development of processes of erosion and mass movement of land. Landslide's intensity is directly proportional to the slope of land, the energy relief or fragmentation density hydrographic network (Constandache et al., 2015).

Following the analyzes performed in the presented projects, the degree of stability of the works has increased significantly in terms of safety and improvement of measures taken to prevent and combat landslides. These high values of the stability factor could be increased due to the calculation programs, which facilitated the accuracy of the calculation of safety in different risk situations as well as the volumes of earth that can be displaced in case of landslides to prevent loss of human lives and material damages.

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HOW TO APPLY THE CONCEPT OF CIRCULAR ECONOMY AT HOME: SIMPLE - MAKE VERMICOMPOST FROM KITCHEN AND GARDEN WASTE

Raluca Maria DINU, Aurelian IOAN, Irina Corina DRĂGAN, Florin Ionuț PITU

**Scientific Coordinators: Lect. PhD Roxana SĂLCIANU,
Assoc. Prof. Biotech. PhD Irina GREBENIȘAN**

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: + 4021.318.25.67

Corresponding author email: dinuraluca.2000@yahoo.com

Abstract

Using waste as a resource - this may be the definition of the concept of circular economy that we have tried to put into practice. The reuse and transformation of organic waste from the kitchen and garden can be transformed by biological and biotechnological processes in which microorganisms and decomposing worms are used.
Composting is a microbial successional process which have progression in breakdown of substrates and the resulted product, work as a substrate for next successive population, whereas vermicomposting is a biotechnological process in which certain species of earthworms (Lumbricus spp. And Eisenia foetida) are used to enhance the process of waste degradation.
It is a mesophilic process that comprises bacterial and fungal degradation with the help of earthworms; all of them are active at 10°C–32°C. Initial degradation takes place in the gut of the earthworm so it is a fast process. Earthworms are often called as friends of farmers because they convert waste into gold. The dominant phyla in vermicompost are dominant uncultured Acidobacteria, Chloroflexi, Bacterioides and Gemmatimonadetes. Highly active bacterial as well as fungal populations are found in compost and vermicompost.
Vermicompost amendment helps plant soil sodicity and salinity and encourages multiplication of microbial biocontrol agents in disease suppressive soils and suppress a variety of diseases.
Earthworms (phylum Annelida), usually red wigglers (Eisenia foetida) or European night crawlers (Eisenia hortensis), are used to compost organic materials, such as pig and cattle manure, agricultural and yard waste, and food waste (e.g., cafeteria, coffee shop, restaurant, and groceries). The worm castings result in organic fertilizer that can be applied to the land. The process of composting is usually odorless. There is a growing group of vermiculture enthusiasts and advocates within the organic food, locally produced food, and urban agricultural movements.
The beneficial effects of earthworm feces and worm casts on crops have been known for more than a century, however, there has been a significant increase in applications of vermicompost in certain types of agriculture over the last decade because of the identification of specific plant growth–promoting properties. The technique of vermicomposting also helps to recycle plant material waste, municipal wastes and animal manure. The use of vermicompost is vital in sustainable agriculture since it is an inexpensive method of managing agricultural wastes, in particular. Vermicompost maintains a stable physical soil structure because of the presence of soil macropores and organo-mineral complexes that allows adequate porosity, good aeration, water holding capacity, microbial activity, balanced mineral nutrients, and colloidal buffering capacity. These properties are due to the presence of humic and fulvic acid. Biostimulatory effects can be obtained from vermicomposts, which can be utilized in agriculture and horticulture to replenish nutrients and improve plant resistance toward abiotic stresses.
There are various formulations of vermicompost available in the commercial market such as their leachates (i.e., the liquid runoff that settles in or below the vermicompost), teas (vermicompost water extracts), and other extracts which are darkly colored, odorless, and rich in nutrients.
This paper presents the results obtained in the research conducted for the case study included in the Bachelor's Thesis. All experiments underlying this study were performed in the laboratory of Ecology and Environmental Microbiology within the Faculty of Land Reclamation and Environmental Engineering within the U.S.A.M.V. Bucharest. In this paper we present the results obtained by testing the vermicompost we produced from organic household waste.

Key words*: earthworms, kitchen and garden waste, Lumbricus spp. And Eisenia foetida, physicochemical and microbiological analyses, vermicompost.*

INTRODUCTION

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Vermicompost is a product of the decomposition process produced by worms such as red wigglers (*Eisenia Andrei* or Eisenia fetida), European nightcrawlers (*Eisenia hortensis*) and the red earthworm (Lumbricus *rubellus*). The beneficial effects of earthworm feces and worm casts on crops have been known for more than a century. However, there has been a significant increase in applications of vermicompost in certain types of agriculture over the last decade because of the identification of specific plant growth–promoting properties. The technique of vermicomposting also helps to recycle plant material waste, animal manure, and municipal wastes. The use of vermicompost is vital in sustainable agriculture since it is an inexpensive method of managing agricultural wastes, in particular.

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market such as their leachates (i.e., the liquid runoff that settles in or below the vermicompost), teas (vermicompost water extracts), and other extracts which are darkly colored, odorless, and rich in nutrients.

Vermicompost and its formulations have gained popularity in both the domestic and industrial sectors because of their versatility—they can be combined with plant growth media (e.g., soil, water, and perlite) or soil conditioners and ameliorants (e.g., biochar coffee grounds, compost, compost tea, manure, coir, straw, peat, sphagnum moss, vermiculite, and hydro absorbent polymers) (Theunissen et al., 2010). VCL (vermicompost leachate) contains large amounts of salicylic acid, benzoic acid, and ACC but low concentrations of jasmonates, cytokinins, and proline (Benazzouk et al., 2020). Garden waste–derived VCL contains plant growth regulators such as, cytokinins, auxins, abscisic acid, gibberellins, and brassinosteroids which could be responsible for its biostimulatory activity. VCL improved plant growth and reduced the impact of salinity on leaf senescence along with Na+ accumulation in salt-stressed (125 mM sodium cyanide) tomato plants (Benazzouk et al., 2020). This was related to its impact on endogenous phytohormones rather than to a passive absorption of exogenous hormonal compounds (Benazzouk et al., 2020). VCLs have been reported to stimulate several physiological responses in a number of treated crops, e.g., banana, red kidney bean (*Phaseolus vulgaris*), and tomato. VCL is applied either as a soil drench, or as a foliar spray at low concentrations; however, it is recommended that VCL is diluted when using it as a foliar spray, as the high-nutrient content may cause burning of the leaves. Many researchers do not recommend VCL for foliar applications, preferring to use a soil drench, after dilution. Vermicompost extracts are also used as media for seed imbibition (Arancon et al., 2012). VCL contains large amounts of nutrients and therefore has the potential to be used as a liquid fertilizer, as well as in various types of hydroponic and aquaponic systems (Narayanan et al., 2017).

MATERIALS AND METHODS

The garden work steps were as follows:

1. Find a place in the garden where the container for vermicomposting can be placed
2. Construction or buying a container for vermicomposting
3. Arranging the layers of paper, cardboard, earth and wetting them
4. Adding layers of vegetable waste from the kitchen: potato peelings, carrots, celery, onions, etc., eggshells, tea bags, coffee grounds and those from the garden: leaves, grass, dried plants, etc.
5. Adding earthworms

The laboratory work steps were as follows:

1. Observation of the vermicompost extract suspension under an optical microscope.

   To highlight some morphological characteristics of microorganisms (the size, shape, and arrangement of cells, types of microorganisms – bacteria or fungi) we prepared living, unstained preparations as a wet mount.
2. Observation of the vermicompost with a stereomicroscope.

   We used the stereomicroscope to observe earthworm cocoons
3. Determination of physicochemical properties of vermicompost.

   To determine N, P, K we used the Hanna Instruments analysis kit and followed the manufacturer's recommended operating instructions.
   (https://hannainst.ro/produse/teste-chimice/single-parameter)
4. Determination of pH with WTW laboratory pH meter

RESULTS AND DISCUSSIONS

In vivo experiments

Figures 1, 2 and 3 show the different areas of the box for vermicomposting. Three distinct areas can be observed.

Zone 1 is represented by the upper part of the box for vermicomposting in which the activity of earthworms is observed.

Zone 2 is represented by the middle zone of the box for vermicomposting in which the stratification of the decomposed organic matter and transformed into compost is observed.

Zone 3 is the basis of the pile for vermicomposting. In this area you can see the cessation of the activity of earthworms, which allows the extraction of vermicompost and its use in the garden for plant cultivation.

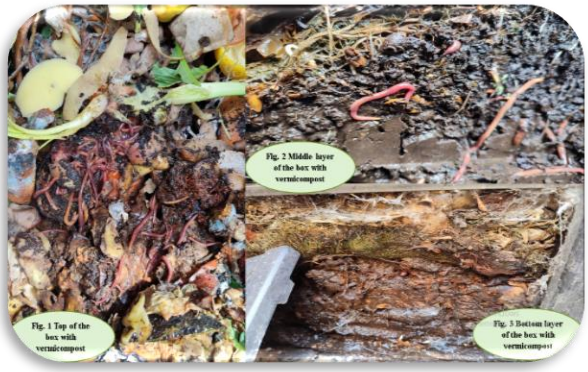

Figure 1. Zones 1, 2 and 3 of the box

In vitro experiments

Figure 2 shows different macroscopic and microscopic aspects of the vermicompost sample (left) macroscopic aspects of the vermicompost sample and (right) the cocoon of earthworm in the vermicompost sample by stereomicroscope.

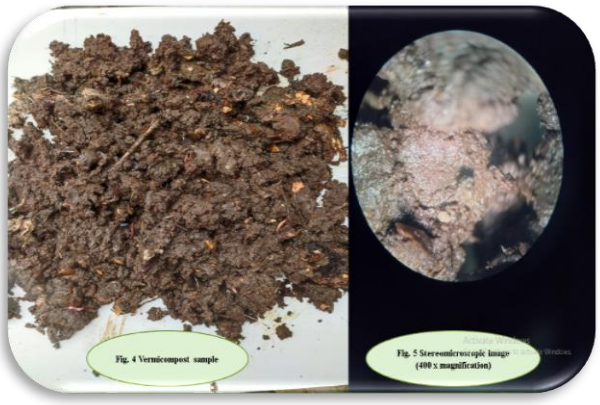

Figure 2. Different macroscopic (left) and microscopic (right) aspects of the vermicompost sample

Figure 3 shows the microorganisms in the vermicompost sample. The presence of bacteria, fungi and protozoa can be observed by light microscope.

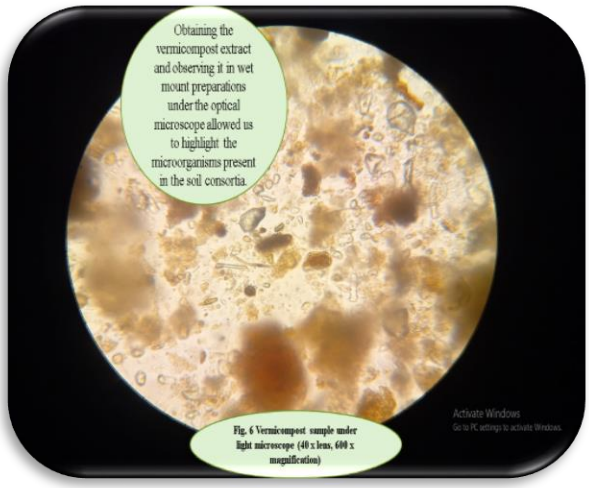

Figure 3. The microorganisms in the vermicompost sample

Results obtained after testing the vermicompost sample using the soil analysis kit from Hanna Instruments. It can be seen that all three macroelements nitrogen, phosphorus and

potassium are present in high concentrations in the vermicompost sample.

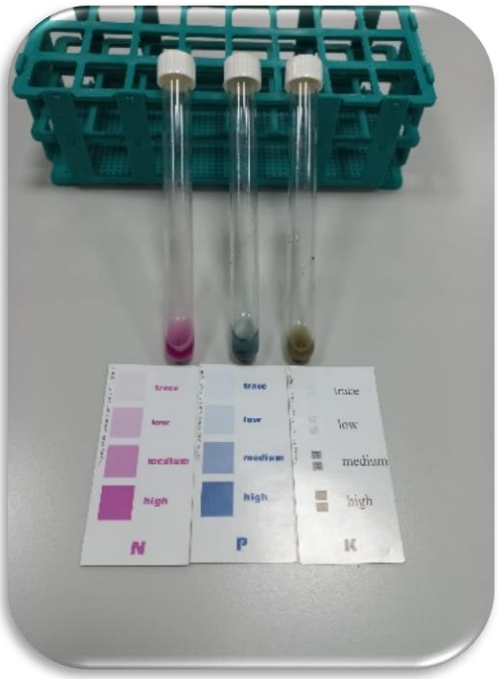

Figure 4. Vermicompost extract results for N, P, K

We obtained the pH value of the vermicompost sample using the WTW laboratory pH meter.

Figure 5. pH value of the vermicompost sample

CONCLUSIONS

The results obtained in this experiment allow us to draw the following conclusions:
The process of obtaining vermicompost is simple to follow and allows the recycling of vegetable waste from the kitchen and garden.
Observations under the light microscope revealed the existence of an abundance of microorganisms in the vermicompost sample.
Microscopic observation of the vermicompost sample revealed the presence of bacteria, filamentous fungi and protozoa.
Results obtained after testing the vermicompost sample using the soil analysis kit from Hanna Instruments.
It can be seen that all three macroelements nitrogen, phosphorus and potassium are present in high concentrations in the vermicompost sample.
The pH value of the vermicompost sample was 7,320 pH unit.

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INTEGRATED LCA-LCC ANALYSIS FOR METAL REMOVAL FROM WASTEWATERS USING MICROORGANISMS

Cătălina FILOTE[1,2], Isabela Maria SIMION[1], Maria APOSTOL[1]

Scientific Coordinator: Lect. PhD Raluca Maria HLIHOR[1]

[1]"Ion Ionescu de la Brad" Iasi University of Life Sciences, Faculty of Horticulture, Department of Horticultural Technologies, 3 Mihail Sadoveanu Alley, 700490 Iasi, Romania,
Email: catalina.filote@uaiasi.ro, simion.i@uaiasi.ro, mariabrinza2007@yahoo.com, raluca.hlihor@uaiasi.ro
[2]"Gheorghe Asachi" Technical University of Iasi, "Cristofor Simionescu" Faculty of Chemical Engineering and Environmental Protection, Department of Environmental Engineering and Management, 73 Prof. D. Mangeron Bldv., 700050 Iasi, Romania

Corresponding author email: catalina.filote@uaiasi.ro, raluca.hlihor@uaiasi.ro

Abstract

The persistance of heavy metals in wastewaters and the environment has determined the scientific community to find innovative and sustainable methods and materials for their removal. In this pursuit, microorganisms have gained increasing popularity due to their diversity, resilience to extreme environmental conditions, complex structure and chemical mechanisms. Most of all, the excellent performance of microbial biomass in the uptake of metal ions is of high interest for the development of more sustainable remediation alternatives to conventional treatment methods. The most applied methodology for sustainability analysis is the Life cycle assessment (LCA) for the environmental component and Life cycle costing (LCC) for the economic one. Applied together these two frameworks can offer a cost-effective and environmentally-friendly way to use microorganisms for wastewater remediation. Thus, this paper aims to look into the LCA and LCC methodologies and the way these can be used in an integrated way to evaluate the metal removal process facilitated by microorganisms.

Key words*: heavy metals, integrated LCA-LCC, microorganisms, sustainability, wastewater treatment.*

INTRODUCTION

The use of living or dead biomass for the uptake of heavy metals contributes to the development of the bioeconomy and circular economy and the replacement of the synthetic conventional materials used in industry, including wastewater treatment area (Hlihor et al., 2021). Although the performance of microorganisms in the removal of heavy metals from wastewaters has been successfully and extensively demonstrated, the sustainability of the microbial remediation processes has received far less attention from the scientific community in both batch and column studies (Filote et al., 2021). The common standardized methodology established for the analysis of the sustainability of processes and products is the Life Cycle Analysis. The framework attributed to the environmental component is the Life Cycle Assessment (LCA or E-LCA). There is also one assigned to the evaluation of the economic impact, named Life cycle costing (LCC) and one for the analysis of the social dimension of the sustainability concept, social life cycle assessment (S-LCA) (Furness et al., 2021). All these three methodologies have been rarely applied together in scientific studies so far. The integrated approach applying LCA together with LCC is more common though in research. The integrated approach of the LCA and LCC methodologies has already been applied in several areas such as the compressed air energy storage system of a photovoltaic power plant (Petrillo et al., 2016), vineyard production (Falcone et al., 2015), construction industry (Alshamrani, 2021) and also wastewater treatment (Harris et al., 2021). To our knowledge, the LCA-LCC integrated approach has not been applied yet though in

case of heavy metals removal from wastewaters using microorganisms. Therefore, the current study aims to provide an overview of the LCA-LCC integrated approach and how it can be applied in the sustainability evaluation of wastewater remediation processes carried out using microbial biomass.

LIFE CYCLE ASSESSMENT (LCA)

The Life Cycle Assessment (LCA) methodology is based on the conversion of emissions and consumed materials into environmental impact values and includes several established steps (Figure 1): the goal and scope definition, inventory analysis, impact assessment and interpretation (Kamble et al., 2019). In terms of damage pathways, the LCA methodology can be applied on several levels: the midpoint level which focuses on a medium time-frame, endpoint which considers the longest time frame and individualist using the shortest time frame (Hoogmartens et al., 2014). Before the life cycle analysis is carried out it is important that the system boundaries of the microbial-based remediation of wastewaters are defined. This includes setting the necessary sequential processes and identifying the optimum parameters for each step.

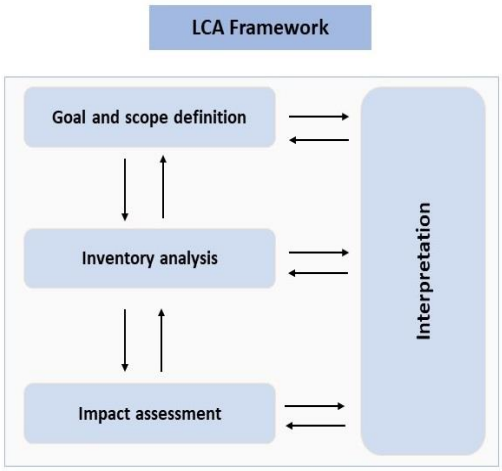

Figure 1. Life cycle assessment (LCA) framework.

The optimization of the microbial bioremediation processes is key for obtaining maximum performances with minimum consumed resources, including financial ones. The number of LCA studies carried out for the environmental impact analysis is scarce in case of both heavy metals removal from wastewaters using microorganisms as adsorbents as well as in case of the application of conventional adsorbents (Filote et al., 2021). Since its increase in popularity and application in the 1990s, LCA methodology has been applied through various methods (Corominas et al., 2013). Nowadays, the most common ones are CML2016 and ReCiPe2016.

LIFE CYCLE COSTING (LCC)

Similar to LCA methodology, LCC can be applied for the analysis of the complete life cycle of the metal removal through bioremediation process, including stages starting with the preparation of the biosorbent or biofilm containing microorganisms down to the disposal of the residual microbial biomass (Simion et al., 2021). The LCC methodology includes several sub-methodologies: societal LCC (sLCC), financial LCC (fLCC), environmental LCC (eLCC), and full environmental LCC (fLCC) (Hoogmartens et al., 2014). In case of metal uptake from wastewaters by microorganisms, similar with LCA, the scientific literature presents few research endeavours. A few studies have been carried out to analyse the environmental and economic impact of using microorganisms in wastewater treatment, for the removal of other pollutants than heavy metals. Furthermore, a strong attention was given to the cultivation of microorganisms for the generation of biofuels and other value-added compounds (Parsons et al., 2018; Resurreccion et al., 2012).

APPLICATION OF INTEGRATED LCA-LCC IN WASTEWATER TREATMENT USING MICROORGANISMS

Due to the fact that they cannot be fully removed in the primary and secondary wastewater treatment phases, metals are necessary to be removed in a tertiary treatment step (Rosca et al., 2021). This is however a challenge for most developing countries, since wastewater treatment facilities are based only on primary and secondary treatment (Parra-Saldivar et al., 2020). To ensure sustainability on both the environmental and the economic dimensions, the integration of LCA and LCC results is required. Most of the research conducted so far has applied the two types of evaluation separately. In order to upscale the

metal removal process using microorganisms, an integrated approach is advisable. The integrated approach is thus very important for developing countries where environmental savings must be ensured with minimum resources.

In case of wastewater treatment, associated costs usually include equipment investments, consumables, chemicals, maintenance costs, data source costs and salaries (Rosca et al., 2021). A summary of the environmental impacts and the costs based on each phase of the microbial-based bioremediation processses is included in Table 1.

Table 1. The environmental impact and the costs associated with each stage of the bioremediation processes of metal loaded wastewaters using microorganisms.

Microbial-based remediation processes (Life cycle phase)	**Environmental impact**	**Economic impact**
Active biomass preparation	Transport Energy Heating	Transport costs Energy costs Heating costs Nutrients cost
Biomass inactivation	Energy	Energy cost
Biosorption	Energy Wastewater loaded with residual metal ions	Energy cost Equipment investment and maintenance costs Environmental impact cost
Biosorbent disposal	Transport Energy Heating	Transport costs Energy costs Heating costs Environmental impact cost

In order to obtain a thorough perspective on the life cycle impact, be it environmental or economic, it is important to apply the integrated LCA and LCC in all main scale-up stages: lab-scale, pilot plant and industrial scale.

Furthermore, to obtain a comprehensive and realistic perspective through the application of integrated LCA-LCC, the mandatory LCI (Life cycle inventory) step for the quantification of inputs and outputs should be carefully carried out before the data analysis (Innocenzi et al., 2021). The integrated application of LCA and LCC methodologies for the evaluation of metal removal from wastewaters using microorganisms has numerous benefits: a larger perspective on the impact of the remediation processes, environmental savings, reduction of energy and materials consumption, financial savings. Environmental savings are doubled by economic efficiency. Thus, a more sustainable process, be it biosorption or bioaccumulation, is obtained.

All of these advantages are even more important at pilot and industrial scale where due to the large quantities of treated wastewater, the environmental impact and the associated costs increase significantly. It is very important to reach a higher number of studies with integrated LCA-LCC results for heavy metals removal using microorganisms at large scale since additional parameters are involved in pilot and industrial treatment facilities in comparison to the ones at lab-scale and values for the common ones can still differ to some extent.

CONCLUSIONS

Microorganisms are complex living systems with insufficiently explored potential in metal removal from wastewaters at industrial scale. The advantages of their use have been highlighted though in various studies through lab-scale research. There are thus many studies available in the scientific literature in this sense. The sustainability of the bioremediation processes using microorganisms has been very briefly considered so far. The current paper therefore reviewed the life cycle analysis methodology applied for the context of metal removal from wastewaters using microorganisms, with a focus on the integrated LCA-LCC approach.

This unexplored area of research is very important for the development of a more sustainable alternative to the conventional treatment methods, from an environmental as well as economic point of view.

To fulfill this, we have discussed also about the three stages of scale-up and how the life cycle analysis fits into the development process. Sustainability analysis of metal removal from wastewaters using microorganisms contributes

to the development of the bioeconomy. Extensive research is necessary to fill the gap.

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THE INFLUENCE OF ENVIRONMENTAL FACTORS ON NATURAL RADIOACTIVITY

Cristian GRIGORE

Scientific Coordinators: Assoc. Prof. PhD Mădălina MARIAN, Lect. PhD Claudiu ȘUȚAN

University of Pitești, 1 Târgul din Vale Street, 110040 Pitești, Argeș, Romania,
Phone: +40 348 453 102, Fax: +40 348 453 123

Corresponding author email: cristian.grigore.gabriel98@gmail.com

Abstract

The paper aimed to present the influence of environmental factors on natural radiactivity, the study shows how radition variates from lowest altitude i have measured to highest, what are the the factors that makes the radiation to vary so much and what are the efects of them in our lives. The study is made in more regions in Romania including Muntenia (Arges), Oltenia (Gorj, Ramnicu Valcea) and central (Brasov). The prcessed data are based on measurements made in the mentioned counties using University of Pitesti as a start point. The effects of a high amount of radtiation can produce a lot of ilness, as the worst one of them being cancer. During the period of colecting data we can see the radiation increases as we go further to the high grounds as it is Ranca or Postavaru mountains. Following of the research i have made, the radiation increases from the lowest altitude to the highest because of the cosmic radiation that comes from space and from the sun.

Key words*: altitude, dose debit, radiation.*

INTRODUCTION

Radiation is part of the daily life of all human beings no matter where they are, its appearance is inevitable because it comes from everything around us. Natural sources account about 80% of the annual effective dose of ionizing radiation received by humans (Rotaru et al., 2020).
An important factor in terms of increasing radiation is the cosmic and the sun radiation. This is a corpuscular radiation that is of two types that comes directly from outer space which is also called primary cosmic radiation or which occurs from its interactions with the atmosphere, this is called secondary cosmic radiation.
Due the high level of penetration of cosmic radiation even trough buildings, there is not mutch that can be done about reducing its contribution to the human exposure dose (Coretchi et al., 2017).
Cosmic radiation accounts for about 13% of the contribution of the average annual dose and is based on gamma radiation that comes from outer space. It varies depending on certain factors such as altitude or weather conditions but also latitude, with slightly higher values at the two poles of the planet (Rotaru et al., 2020).
In this context the paper aims to highlight the evolution of radiation depending on the altitude at which we are, the importance of knowing the environment around us, the effects radiation have on the human body and what are the factors that increase it.

MATERIALS AND METHODS

In order to monitor the radiation at different altitudes we used an Ecotest Terra-P MKS-05 dosimeter that have the following characteristics:

Table 1. Characteristics of Ecotest Terra-P MKS-05 dosimeter

Gamma and X-ray radiation dose equivalent rate (^{137}Cs)	µSv/h	0.1…9 999; ±15%
Gamma and X-ray radiation dose equivalent (^{137}Cs)	mSv	0.001…9 999; ±15%
Beta-particles flux density (^{90}Sr+^{90}Y)	1/(cm²·min)	10…100 000; ±20%
Dose equivalent accumulation time	1min…100h	

The data were collected from different areas of Arges, Gorj, Valcea and Brasov counties between December 2021 – March 2022, by measurements made by my own with the equipment from the endowment of the university laboratory.
Thus, the results were recorded in tables and used to make the graph that shows the evolution of radiation at different points (planimetric and level related) as it can be seen on the map realised in figure 4.

RESULTS AND DISCUSSIONS

The radiation values change continuously (Table 1) from the starting point University of Pitesti where the altitude is 231 meters above the sea level, where radiation reached the value of 0.10 $\frac{\mu Sv}{h}$ to the highest measured points respectively Poiana Brasov at the altitude of 1664 meters above sea level (Figure 1) where the recorded radiation was 0.16 $\frac{\mu Sv}{h}$ and Ranca at 1543 meters above the sea level where the values reached 0.15 $\frac{\mu Sv}{h}$.

Table 2. Dependence of radiation by altitude

Countie	*Location*	*Altitude* (m.a.s.l.)	*Effective dose debit* ($\frac{\mu Sv}{h}$)
Arges	Universitatea din Pitesti	231	0.10
Arges	Dumbravesti	333	0.10
Arges	Malureni	243	0.10
Valcea	Racovita	195	0.09
Gorj	Pociovalistea	375	0.11
Gorj	Ranca (1300 m)	1277	0.14
Gorj	Ranca (1500 m)	1543	0.15
Brasov	Bran	731	0.12
Brasov	Poiana Brasov (1000 m)	1016	0.13
Brasov	Poiana Brasov (1700 m)	1664	0.16

Due the measurements made in the points specified in Table 2, it can be seen that the value of radiation changes quite a lot even when we are at close distances but which altitude differs a lot, for exemple, at the foot of the Sinaia ski slope where the recorded values were 0.14 $\frac{\mu Sv}{h}$ and at the top of the ski slope the values increased quite quickly by 0.02 $\frac{\mu Sv}{h}$ reaching values of 0.16 $\frac{\mu Sv}{h}$.

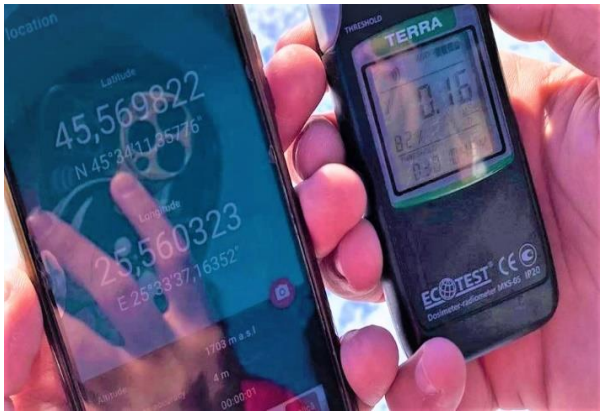

Figure 1. Measurementst performed at the top of the ski slope at Poiana Brasov in March 2022

This tells us that the altitude is an important factor in the amount of radiation we collect.
This study shows the difference in radiation that is taken up by both, people living in the mountanious areas and those who work daily at the high altitudes such as airplane pilots and their personnel.
We can also see the difference when we talk about the value of radiation per county as it is in the case of Brasov (Figure 3) where 3 ascending values were recorded starting with the measurement performed in the city of Bran where the value reached 0.12 ($\frac{\mu Sv}{h}$) at an altitude of 731 meters abouve sea level continuing to ris to 0.14 ($\frac{\mu Sv}{h}$) and 0.16 ($\frac{\mu Sv}{h}$) recorded at the foot and respecively at the top of the slope (Table 3).

Table 3. The dependence of radiation by altitude in Brasov county

Countie	*Location*	*Altitude* (m.a.s.l.)	*Effective dose debit* ($\frac{\mu Sv}{h}$)
Brasov	Bran	731	0.11
Brasov	Poiana Brasov (1000 m)	1016	0.14
Brasov	Poiana Brasov (1700 m)	1664	0.16

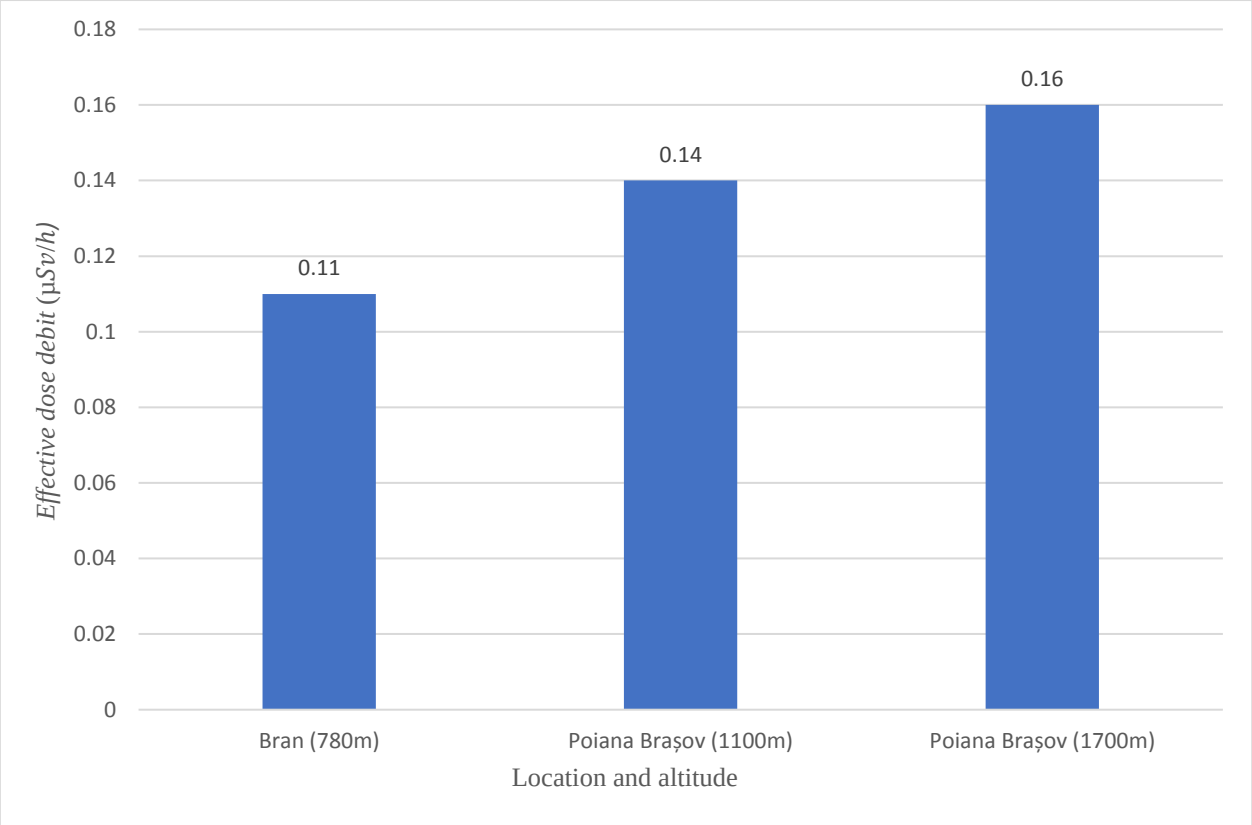

Figure 2. The dependece of radiation by altitude in Brasov, Romania, March 2022

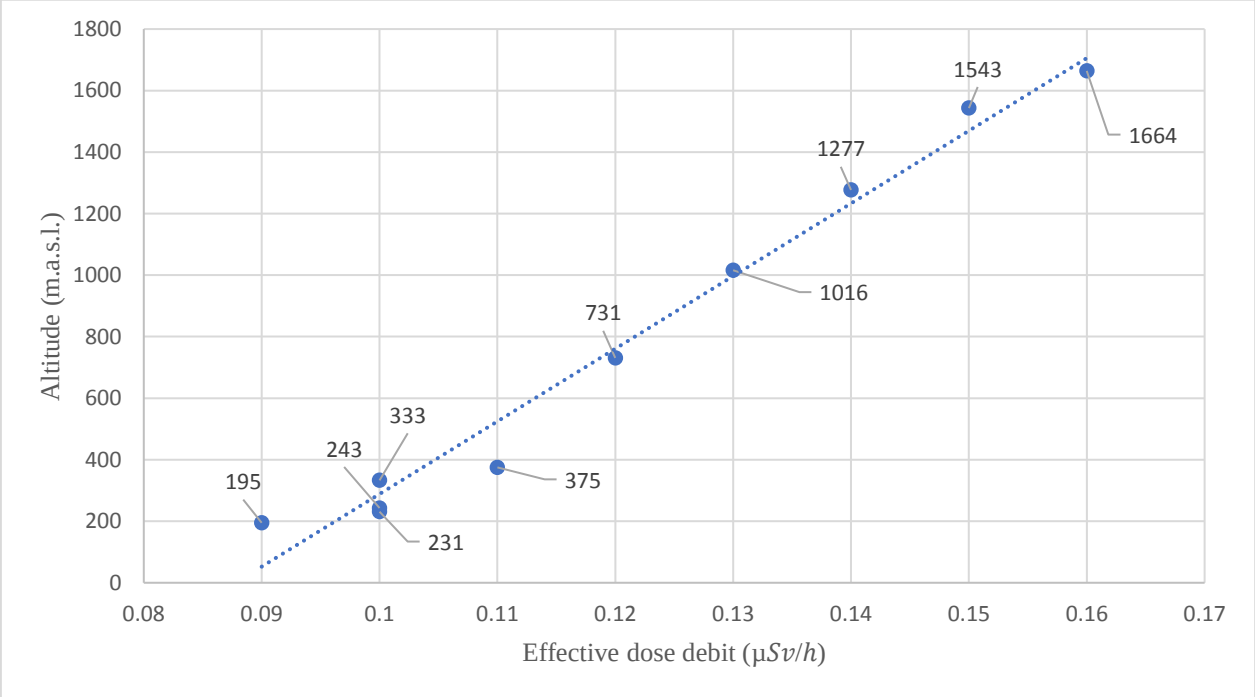

Figure 3. The dependece of radiation by altitude

In figure 2 we can see the increase in the value of radiation when the altitude increases, at the same time it is observed that this increase is defined by large differences in altitude (hundreds of meters), in small differences the values are very similar.

Figure 4. Google Earth capture with the pozitioning of the studying points

CONCLUSIONS

Following the study, it can be seen how effective dose debit is influenced by the altitude at which we are.

From the measurements and the graph from figure 2 it is observed that this increase is not linear, this is due the fact that the cosmic radiation is not the only one that influences the effective dose debit we collect, but also the latitude, longitude, atmospheric conditions and the areas we in because there are different amounts of uranium in the earth's crust. The uranium can influence quite a lot the debit that we collect because of convection currents that are accumulated in the crust, when they do get out from the crust is produced an increase of the effective dose debit because of Radon gas which is derived from the disintegration of Radium, and the Radium being a result derived from the disintegration series of Uranium.

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REPOSITIONING ORGANIC WASTE STREAMS IN THE URBAN AREA

Ionela-Alexandra ION[1], Hugo BEEKELAAR[2], Hanna VERDUIJN[3], Brwa Mohammed MAHMOOD[4], Loredana-Iuliana SPOIALĂ[5]

Scientific Coordinators: Prof. PhD Ana VÎRSTA[1], Lect. PhD Mirela - Alina SANDU[1]

[1]University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, 011464, Bucharest, Romania
[2]Wageningen University & Research, 4 Droevendaalsesteeg, 67008, Netherlands
[3]Utrecht University, Bestuursgebouw, 8 Heidelberglaan, 3584 CS Utrecht, Netherlands
[4]University of Miskolc, Egyetem út 1, 3515, Miskolc, Hungary
[5]Ramboll South East Europe SRL, Phoenicia Business Center, 11A Turturelelor Street, District 3, 030881, Bucharest, Romania

Corresponding author email: ionionelaalexandra@yahoo.com

Abstract

The city of Zwolle values circularity and aims to become the fourth most circular city in the Netherlands, after Venlo, Rotterdam and Amsterdam. Circularity requires reducing, reusing and recycling. One of the challenges concerning circularity regards waste streams. Waste streams need to be reduced and repositioned. Especially in neighbourhoods with many blocks of flats, waste separation requires more attention. Currently, households have the possibility of separating plastic, paper, glass and residual waste, but not organic waste. This is bundled together with residual waste, which is where the problem lies. At this moment, it is impossible to fully separate organic waste from residual waste, which makes repositioning its value extremely difficult. As Zwolle wants to reuse as many raw materials as possible to come as close to zero residual waste as possible, it is important to find a way to separate the organic waste and reuse the valuable materials.

Key words*: biogas, compost, organic* waste*, separate collection.*

INTRODUCTION

Considering that half of the world's population lives in cities and this proportion is expected to increase to two-thirds by 2050 (UN DESA, 2018), it is essential to reassess our current patterns of production and consumption and to adopt more consciously the Circular Economy (CE) approach within the waste and resource sector (Vîrsta et al., 2020). It is the time to adopt a circular economy, in which output (waste) from one process to equals inputs (resources) for another because the current linear "produce-use-waste" economic system is unsustainable (Figure 1). Turning waste into a resource plays a central role of increasing resource efficiency and closing the loop in a circular economy vision (Vîrsta et al, 2020).

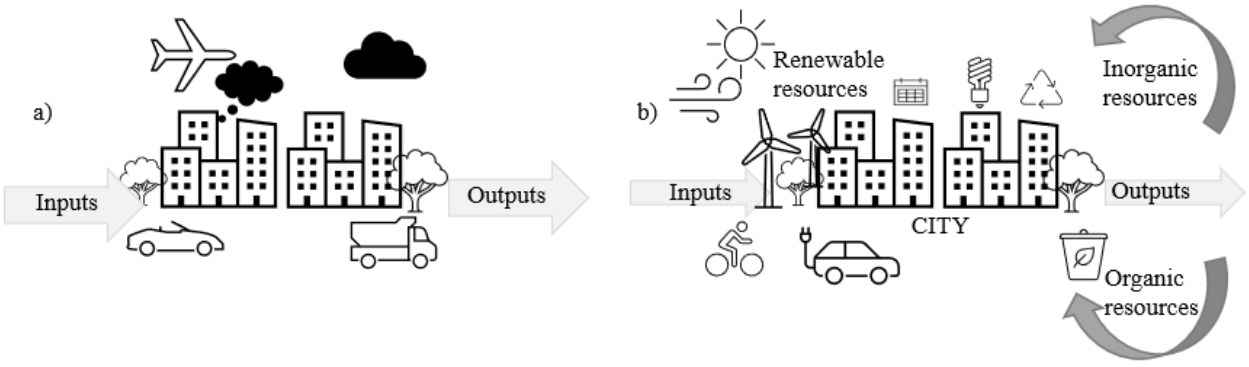

Figure 1. a) A linear model of inputs and outputs. b) A circular model reuses, recycles and recovers resources from urban waste streams, reducing resource inputs and outputs (after Wielemaker et al., 2016)

Urban residents generate growing quantities of waste with over 1.6 million tonnes of organic solid waste every day (Kaza et al., 2018).
Figure 2 shows the trends in municipal waste generation in the European Union (EU) from 2005 to 2020.
In urban areas people still lack access to improved sanitation facilities (WHO and UNICEF, 2017). The problem seems to lie in the lack of (proper) recycling in neighbourhoods with many blocks of flats. This is required to be able to re-add value to organic waste and reach the goal of circularity in the future.
In addition, they rely on unsanitary solid waste management systems, e.g. open dumpsites (Kaza et al., 2018). Overall, this results in huge quantities of urban waste that are discharged into the open environment, with negative implications for human and ecosystem health.

- *EU: estimate*
- *2019 data: Ireland, Italy, Greece and Austria*
- *2018 data: Bulgaria, Iceland and United Kingdom*

Figure 2. The amount of municipal solid waste generated in EU Member States in2005 and 2020, kg per person (Eurostat)

The aim of this paper is to demonstrate how the CE valorisation potential of various organic waste streams in urban areas can be determined through a case study of the city of Zwolle (Netherlands).
The Netherlands is a highly-urbanized country, one of the most urbanized countries in Europe with about three quarters of its population living and working in urban areas (Netherlands Environmental Assessment Agency, 2016).
The composition of the Netherlands residual waste is monitored annually. The results, as illustrated in Figure 3, shows that residual waste still contains large quantities of usable /valuable waste streams that could have been offered for recycling. More than one third of the residual waste consists of organic and garden waste, and more than 20% paper and cardboard.

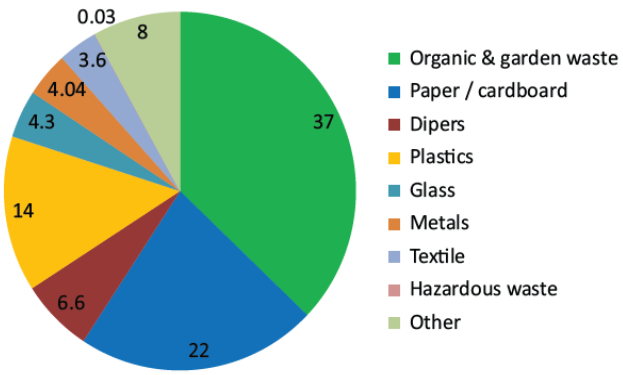

Figure 3. Composition of residual household waste in Netherlands (Goorhuis et al., 2012)

Zwolle is a city with a population of approximately 129 000 people. It is the capital of the province of Overijssel.
In city of Zwolle seem to be several reasons why people do not (properly) separate their (organic) waste in the neighbourhoods with many blocks of flats. Firstly, there is no option for organic waste separation (solely on request). Therefore, they could not do this even if they want to. Secondly, people lack both awareness of what happens to their waste and incentive to separate their waste.
There are two types of approachable solutions: social and technical solutions. Social solutions focusing on creating awareness among the population. Potential social solutions would need to focus on creating a behavioural change, which should be done by creating both awareness and an incentive. Technical solutions could either focus on improving the separation process of organic waste from residual waste or it could focus on making it easier for citizens to separate their waste, so that the effort required is as small as possible. Additionally, an incentive can be created for citizens by cycling the product of the organic waste back to the citizens making it easier for people to separate their waste. Both solutions will result in an improvement of the circular economy of Zwolle.

MATERIALS AND METHODS

The materials and methods were obtained after participating in the Wetskills professional competition, in September 2021. Wetskills is a two-week program in the field of environmental protection, with a focus on water-related issues, where young professionals work together to find innovative and sustainable solutions. This was the 50th edition and the 5th edition held in Romania, in which three teams participated. Our case was provided by City of Zwolle, and the theme was "How can we separate organic waste from general waste so that we can become more circular?".
In order to come up with a solution for our problem, we had many brainstorming sessions with many experts. We had a meeting with the municipality of Zwolle where we learned more about the situation in the city. We talked to the experts about the importance of circularity, about the side effects of not separating the waste and about the lack of awareness people have on this subject. We had a brainstorming session with Frank Tibben, Programme Manager and supervisor at the Wetskills -Romania 2021 programme, and Diana Vlad, former Wetskills participant, about how all this waste affects the water and how we could include water in our process. Finally, we had a meeting with Keimpe Sinnema, owner of Sinnema Advice Water Management and water management specialist where we talked about the mechanism and what we can implement. After that, we brainstormed together and did some background reading to come up with a solution.

RESULTS AND DISCUSSIONS

The first solution is rather simple, to provide flat inhabitants with the possibility for organic waste separation. Additional social measures that could be taken are educational. By teaching children in a playful way, you can also educate their parents. This however is a long-term process, of which the effects in waste separation may only be seen in 10 to 15 years. ROVA, the city's waste collector and recycling centres, are already focusing on the education of children (Leren en doen - ROVA, n.d.). Education could also take place during an event, either a new event or linked to an already existing event like the city's anniversary or the King's birthday. Showing them what happens to their waste is important, for example by inviting them to the ROVA's recycling centres or having a ROVA recycling pop-up stand in the city centre to bring the information to people instead of the other way. This could give inhabitants a sense of the importance of proper waste separation.
Education could also be done in the form of an event, by creating a waste challenge in areas where improvement is needed. This could be between neighbourhoods or between blocks of flats for example. The challenge could be to produce as little (residual) waste as possible with a reward that benefits the winning neighbourhood, e.g. a playground. Also, without a challenge, a reward can provide citizens with an incentive to separate their waste. A financial reward is likely to work best for citizens with little motivation to separate. One option would be to create a savings card where people receive an online stamp when reaching a certain

threshold of waste separation and reward them with a present or a discount in a shop when the card is full. People could also be rewarded with the 'Zwolse Pepermunt', which they can spend in one dedicated or several shops. It is important to make sure this is appealing to low-income citizens as well.

Our technical concept brings organic waste separation closer to people's homes, by collecting it either in the kitchen (organic crusher or vacuum) or in the hallway. After this it is transported through a piping system or a waste slide, where it is checked for metals and plastic (through monitoring and separation), crushed and stored before being transformed into biogas by a biogas compressor. The by-product of this biogas can be converted into compost and the biogas will cycle back to the building, thereby lowering the remaining energy needed and thus the costs for inhabitants. The excess biogas is stored. Cleaning of the piping system can be done using rainwater, which is separated from the organic waste by a bypass. This could be done to be even more circular. Since the compost could also be used to grow vegetables in community gardens, the inhabitants could both grow and cook their food with their organic waste (Figure 4). This concept creates both awareness of what happens to your waste and a financial incentive.

This concept can be applied in several ways, e.g. one could consider to include black water for the biogas production. Depending on the local conditions a tailor-made solution can be chosen.

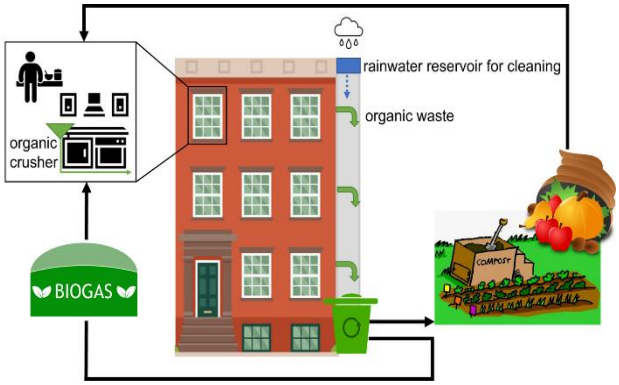

Figure 4. The concept of circular organic waste in city of Zwolle

The concept is a combination of several already existing techniques, which makes it both innovative and easier to implement. The concept of the 'waste slide' has existed for quite some time, as inhabitants of flats used to have access to a waste slide to dispose of their residual waste. In addition, one architectural firm has developed a 'waste/linen slide' for hotels and restaurants, for easier disposal of residual waste and linen (Stansz, 2019). In Rotterdam the idea of a 'waste slide' for different waste streams in a flat building was pitched (AD, 2017). The concept of a 'waste slide' for organic waste has the same purpose but is slightly different. The idea of using a rainwater reservoir for cleaning the pipe system and in this way further increasing circularity is innovative. On a household level it was already possible to transform your organic waste into biogas and/or into compost (New Atlas, 2019).

Our process is similar but on a larger scale and it is used to create an incentive to separate. Also, an organic kitchen crusher that discharges at the sewage system has been previously developed (KWR, 2021). Discharging the crusher to an organic waste collector instead of the sewage system, is not too far off. Our concept applies these separate processes on a different scale or in a different manner and combines them to form one new concept.

Our solution can be implemented in more cities, as it is a general solution for flats and/or apartments. In our case, we came up with a solution for future buildings and for older buildings. In the case of the new buildings, a crusher system (in combination with black water) will provide the organic waste for the biogas producer. Our concept consists of several pre-existing technologies: the piping system, a local biogas producer and an organic waste kitchen crusher. This will make the implementation both much quicker and easier.

CONCLUSIONS

We must learn how people perceives this concept and whether if the buildings are suitable for this solution. We came up with two solutions for two types of buildings: buildings that already exist and future buildings. After that, a calculation needs to be made to see if this concept can be implemented and if there will be enough organic waste to produce the biogas. Also, we calculated the costs for this project. If everything is fine and the municipality and the inhabitants accept it, the project can be

implemented. The Netherlands is phasing out the use of gas in apartment buildings. So, if buildings are no longer operating on gas for cooking purposes, electricity could be produced from the biogas instead.

E-CycloGas delivers citizens the service of organic waste separation, with as little effort as possible. Both the social solutions and the technical solution will help to improve the waste separation and the circularity of the city of Zwolle. Not only will the social solutions improve awareness of what happens to your waste, the technical solution will also do this, as inhabitants are 'reusing' the product of their own organic waste. It also provides them with the incentive to separate through lowering the energy costs of the building. E-CycloGas enhances the circularity of buildings and therefore the city.

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ASSESSMENT OF THE ECOLOGICAL STATUS OF THE BUTIMANU-DÂMBOVIȚA LAKE BASED ON BIOTIC INDICES

Andreea Denisa LAZĂR, Elena Georgiana ZLOTEA,
Daniel Andrei POPA, Diana Teodora SANDU

Scientific Coordinator: Lect. PhD Constanța MIHAI

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Marasti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: +4021.318.25.67

Corresponding author email: lazarandreea31@icloud.com

Abstract

A sea, a river or a lake are not just masses of water, but they must be viewed together with the creatures in them, as ecosystems. Billions of microscopic organisms are located at the bottom of lakes and rivers or found in suspension in their waters, acting on the chemical composition of the water. The anthropization of the environment has profound repercussions on aquatic ecosystems. As a result there is a change in the chemical composition of natural waters and imbalance of stability in biocenoses. Starting from these considerations the objectives pursued in carrying out the present study are: identifying the qualitative and quantitative structure of the diatomaceous flora, establishing their specific diversity, evaluating the level of saprobity, in order to evaluate the ecological status of the Butimanu-Dâmbovița lake water based on the biological diatom index (IBD).

Key words: *Biological Diatoms Index, Diversity Index, Ecological Status, Similiariate Index.*

INTRODUCTION

Aquatic ecosystems are permanently under anthropogenic pressure, and the effects on aquatic communities, which reflect the balance of the ecosystem, are a current concern in the world of science, both worldwide and in Romania. This investigates the response of different aquatic communities to stress factors such as: deforestation, dam construction, intensive agriculture, domestic and industrial pollution and others. The communities of algae, invertebrates and fish are implicitly affected by all these processes, being a fine barometer of environmental changes, having an important role in the ecological processes in the lotic and slow ecosystems (Cîmpean et al., 2018).
According to the Water Framework Directive (2000/60/EC), algae is one of the main groups used to assess water quality in continental aquatic ecosystems, whether natural or anthropogenic, with flowing or standing water.
Diatoms are some of the most common types of phytoplankton. Most of them are unicellular, although they can live in colonies, individuals stick to each other by a mucilaginous substance, secreted by the cytoplasm, which can entirely envelop the colony, in the form of a bow or filament. A special feature of the diatom cell consists in this shape of the body wrapped in a unique cell wall covered by two asymmetrical parts, impregnated with hydrated silicon dioxide, with a crack between them (Figure 1) – hence the name of the algae (Cîmpeanu, 2010).

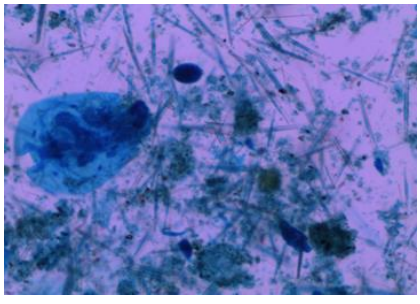


Figure 1. Different forms and types of diatoms

Due to the morphological and ecological peculiarities, diatoms represent a group that can be used efficiently for the qualitative estimation of the lotic periphytic communities, but also in the evaluation of the quality of their living environment (Rasiga et al., 1997, Battes, 2005). Diatoms are used to monitor environmental conditions and in the study of water quality. Diatoms are widely applied in assessing the

ecological status of aquatic ecosystems using indices calculated from pollution sensitivity and species indicator values (Duleba et al., 2021).
The main features that give diatoms the status of good indicators of water quality are the short life cycle, the various ways of spreading and their ability to develop in all types of aquatic ecosystems. These algae constitute a frequently dominant group in aquatic ecosystems in pelagic and benthic habitats and play a significant role in biogeochemical cycling of elements, especially silicon (Burliga and Kociolek, 2016). It has been found that each water basin is characteristic of a certain specific complex of dominant algae, but in all these basins, in the cold period of the year, diatoms develop abundantly, and in the warm time of the year – the blue algae. It is strictly necessary to monitor the current ecological status of surface waters. Aquatic algae communities are the essential indicators of water quality as the most sensitive to changing environment.
In Romania, water resources do not always correspond qualitatively and quantitatively due to poor management, pollution and the lack of a treatment infrastructure. Initially, in our country, the evaluation of water quality for the purpose of its administration, was based mainly or exclusively on the analysis of physico-chemical indicators, methods of biological evaluation, becoming fully accepted in the 70s of the last centuries (Balaban, 2008).
Starting from these considerations, the objectives pursued in carrying out the present study are: identifying the qualitative and quantitative structure of the diatomaceous flora, establishing their specific diversity, evaluating the level of saprobity, in order to evaluate the ecological status of the Butimanu-Dâmbovița lake water based on the biological diatom index (IBD).

MATERIALS AND METHOD

The sampling of diatoms was carried out according to the norms for the collection of algal material from the phytoplankton of surface waters. Phytoplankton samples were collected by filtration using planktonic fillets with variable mesh sizes between 20 and 40 μm (Figure 2). The preservation of the samples of algae from periphyton or plankton is done at the time of sampling with: - Lugol's solution: add 0,3 ml of Lugol's solution to 100 ml of the sample and keep it in the dark,- formol: add 40 ml formol to 1l of the sample, immediately after collection, and for samples in which diatoms predominate, the fixation is made in 10 % solution - ethylic alcohol 95 %.

Figure 2. Plankton fillet

The determination of algae from most systematic groups is made, based on morpho-structural characters, under the optical microscope with the help of wet preparations made between the blade and the slide, using objectives of 10x, 20x, 40x, 60x and with 100x immersion.
The counting of diatomaceous individuals (number of individuals/species) from the samples is done by dragging the sample under a zigzag microscope, so as to avoid returning several times to the same microscopic field.
Biological Diatomical Index (IBD)
In order to apply the Biological Diatom Index, it is necessary to identify taxonomically up to the species level and to count at least 400 individuals/sample. After the numerators are made, the percentage abundance for each taxon is calculated (A‰), and the species that do not have an abundance higher than the threshold value established for each one according to the IBD Methodological Guide are excluded. The following is estimated the probability of presence of a taxon representative of each of the water quality classes, according to the formula: where: Ax = abundance of taxon x (‰); Px(i) =

probability of presence of taxon x for the quality class; Vx = the ecological value of the taxon.
The annexes of the Methodological Guide also provide the values for Px(i) and Vx. Thus, 7 values F(i) are calculated, which lead to the finding of parameter B, according to which the final value of IBD is obtained, after the following transformation:

B	[0;2]	[2;6]	[6;7]
IBD	1	(4.75B)-8.5	20

The Biological Diatomical Index makes it possible to assess river water quality in 5 classes (Table 1), according to the Water Framework Directive 2000/60/EC:

Table 1. Surface water quality classes by IBD values

IBD	IBD ≥17.0	17.0>IBD ≥13.0	13.0>IBD ≥9.0	9.0>IBD ≥5.0	IBD <5.0
Quality class	Excellent (I)	Good (II)	Acceptable (III)	Mediocre (IV)	Lower (V)
Color coding	Blue	Green	Yellow	Orange	Red

The presentation of the results for the surface water categories, according to the Water Framework Directive, is made by illustrating the ecological situation coded on colors as follows: class I, very good ecological status – blue, class II, good ecological status – green, class III, moderate ecological status – yellow, class IV, poor ecological status – orange, class V – bad ecological status – red.

Diversity indices

Diversity indices use the principle that species diversity decreases as negative impacts on the environment increase. Diversity indices relate the number of species (taxa) observed to the number of individuals – their abundance. Some diversity indices provide additional information by also calculating the uniformity of the distribution of the number of individuals in a given taxon relative to the total number of individuals in the sample. The reason why diversity indices have a wide applicability in assessing ecological status is because they are simple to calculate, they can be applied to all types of water bodies, they can be used in comparative analyses.

The most commonly used diversity index is *Shannon-Wiener* (H') which is based on the number of species and their abundance:

$H' = - \sum (P \times \ln (Pi)i$

where: H = number of species;

pi = number of individuals of species i in relation to the total number of individuals in the sample;

P = is the proportion of the species; i represents fairness, with the limit to be between 0 and 1.

Similarity index

Similarity indices provide information about the similarity of two or more samples (small quantity taken from a sample to examine the type, quality or value of the sample). The *Jaccard* similarity coefficient is calculated to compare the diversity between two communities of organisms, according to the formula:

$Cj = c/(a+b)$

where:

a = number of species present only in culture A;

b = number of species present in culture B only;

c = the number of species present in both cultures.

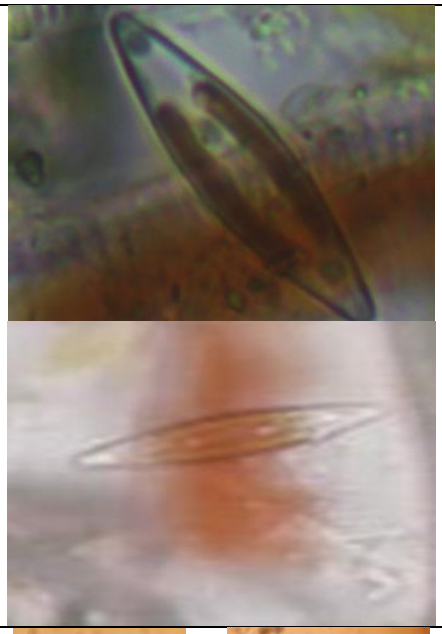
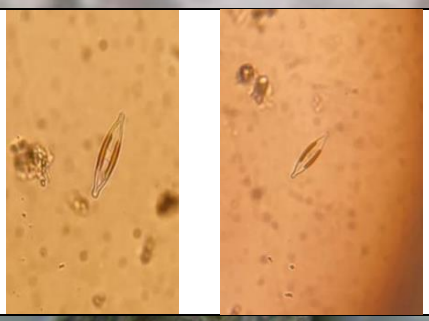
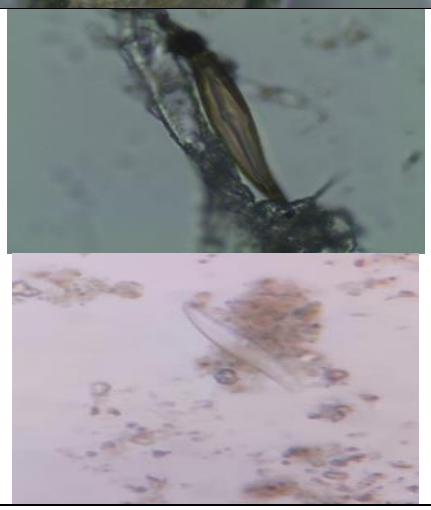
RESULTS AND DISCUSSIONS

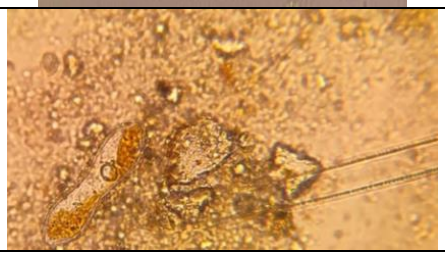
After compiling the list of species, the data contained in it can be processed according to a series of mathematical procedures that can provide, intrinsically or comparatively, information about the quality of the water resource analyzed and about the recent evolution of this indicator.

Regardless of the taxonomic level approached, it is assumed that a richer community (in species, genera, divisions, or all three at once) exhibits better water quality than a less rich one. However, the results of this indicator must be carefully addressed, as it does not differentiate between the ecological characteristics of the identified species, nor between the proportions in which they appear in the samples.

In the planktonic associations identified in lake Butimanu were determined 10 species, the best represented genus is *Navicula*, with 17 specific and intraspecific taxa, the following genera, in descending order of the number of taxa being: *Nitzschia* (12) and *Gyrosigma* (10), (Table 2). Diatomaceous species were identified using the optical microscope, and photo captures were made using the Olympus camera.

Table 2. Diatomaceous species identified

Species identified	Microscopic image capture	Quality class
Navicula sp.		II
Navicula sp.		II-III
Nitzschia sp.		II
Gyrosigma sp.		II

Gomphonema acuminatum		II
Vulgar diatoma		II-III
Synedra sp.		II-III

According to the values of the Biological Diatoms Index (IBD), the water of the studied lake belongs to 2 quality classes: acceptable with IBD = 11.7 (in 46.87% of the processed samples) and mediocre with IBD = 7.8 (in 53.13% of the samples). As a result of the results obtained in the determinations of the biotic indices (Figure 3), it was found that the diversity index relates to the number of identified species (taxa) and to the number of individuals – their abundance through the similarity index.

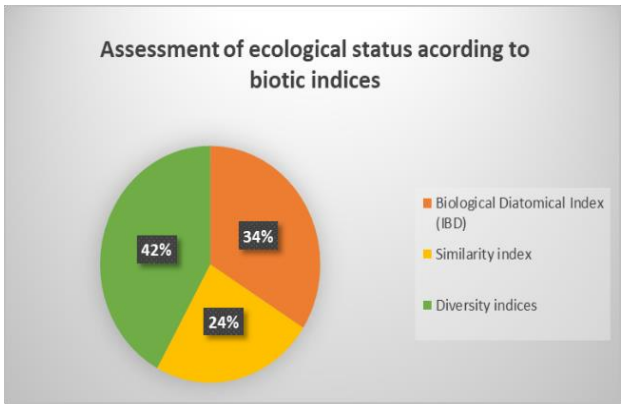


Figure 3. Correlation between determined biotic indices

CONCLUSION

The value of these indices as bioindicators is also complemented by their predominance as an algal group in most water bodies, especially on the upper and middle courses, the rapid multiplication, the prompt reaction to both short-term and long-term changes, for different types of impact, the numerous forms by which they ensure their survival (resistance spores, squeaks, zygotes, etc.) and the various ways of spreading, having as vectors water, wind, animals, man, etc. (Momeu and Péterfi, 2007).
The basic composition of phytoplankton was represented by diatomaceous algae, cyanophytes, greens and euglenophytes, which indicated a water quality that was within the limits of class III, i.e. moderately polluted. Following the results obtained, the evaluation of the quality of the studied surface water, Butimanu - Dâmbovița lake, from the point of view of the Biological Diatoms Index, is its classification in a mediocre class.

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MAPPING NOISE POLLUTION WITH OPEN-SOURCE GIS

Ana-Maria PREDA, Beniamin-Adelin GARVĂN, Adrian-Gabriel LECA

Scientific Coordinators: Lect. PhD Mirela-Alina SANDU, Prof. PhD Ana VÎRSTA

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: + 4021.318.25.67

Corresponding author email: anamaria.preda09@gmail.com

Abstract

As a result of the growing population density in urban areas, environmental noise is nowadays recognized as a public health problem. Directive 2002/49 / EC require the creation of noise maps in the main European cities. Sound is an elastic wave that propagates in a gaseous, liquid, or solid medium. Noise is a complex of sounds of different frequencies and intensities randomly superimposed. The production, propagation and detection of sound waves are related to the vibration of the elastic environment, which the human ear can detect. Now in the "century of speed" when development is the priority, urban areas are the most affected. In this study, we have determined and map the noise pollution levels in a crowded intersection in Bucharest. The values obtained were compared with the limits presented in the current legislation - SR 10009:2017 for the noise level. Obtained data were processed, and noise pollution levels were mapped using a geostatistical analysis software - QGIS software.

Key words*: noise mapping, QGIS software, traffic noise pollution.*

INTRODUCTION

The acoustic noise has been recognised by European Environment Agency the main hazards for human health in urban areas. It is estimated that more than 100 million people are daily exposed to dangerous noise levels (European Environment Agency, 2020). In 2002, the EU issued the Environmental Noise Directive 2002/49/EC in which the countries are obliged to draw strategic noise maps in each city exceeding 250000 inhabitants, for all major roads which have more than six million vehicle passages a year, major railways airports within their territories.

The aim of the Directive is: "to define a common approach intended to avoid, prevent or reduce on a prioritised basis the harmful effects, including annoyance, due to exposure to environmental noise".

Urbanization create environmental problems, like air pollution (Yuan Song et al., 2014), heat island effect (Liu, 2018; Virsta, 2012), loss of biodiversity (Cardinale et al., 2012), soil contamination (Sandu, 2013) and sound levels which are above the permissible limits (Halonen et al., 2016; Oyedepo, S.O., 2012; 2013).

This pervasive pollutant is expanding in scope and intensity commensurate with human population growth and urban development (Slabbekoorn and Ripmeester, 2008).

In urban area, one of the most common pollutants is the persistent noise (Gidlöf-Gunnarsson and Öhrström, 2007; Rosca et al., 2019).

To better understand this topic, it is necessary to differentiate "sound" from "noise".

Sound is a disturbance that is propagated through an elastic medium (air, water, etc.), at a speed that is characteristic of that medium. Sound is determined by vibrations emitted by a sound source, such as a machine, a loudspeaker, or a human voice box. The decibel scale is corrected to represent the auditory sensation, originating the A scale; the unit of measurement is called dBA.

Sounds called "noise" are usually sounds that we perceive as unpleasant or disturbing, although the physical properties of noise are the same as those of sound. Noise can cause symptoms of stress, ringing in the ear, pain, and high risk of heart disease. High-frequency noises are the most harmful to hearing and, as a result, are the main cause for concern.

Noise is a complex of sounds without a periodic character, with random disagreeable insurgency,

affecting the psychological and biological state of people and other organisms in nature.
The direct impact of environmental noise on humans, as well as on ecological heath, is severe. According to World Health Organization noise pollution caused by traffic (cars, trains, and planes) is the root of diseases, dysfunctions, and premature deaths (WHO, 2011). The noise produced by the means of transport can cause various disorders, from insomnia to heart attacks, learning problems and tinnitus (ringing in the ears). The World Health Organization has warned that noise caused by road traffic is "the second favorable environmental factor of illnesses", after air pollution (WHO, 2011), (Figure 1).

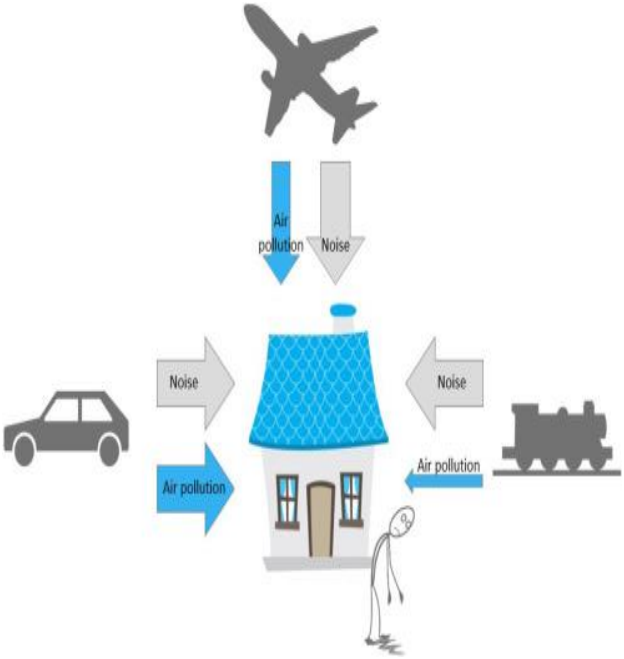

Figure 1. Relative contributions from noise compared with air pollution at the residence for three modes of transportation: road, rail, and aircraft. The size of the arrows illustrates how closely the two exposures correlate at the residence for each of the three transportation sources (Mark J. Nieuwenhuijsen, 2020)

Chronic noise exposure for individuals living near major transportation routes (Figure 2) has been associated with depression and feelings of aggression (Stansfeld and Matheson, 2003).

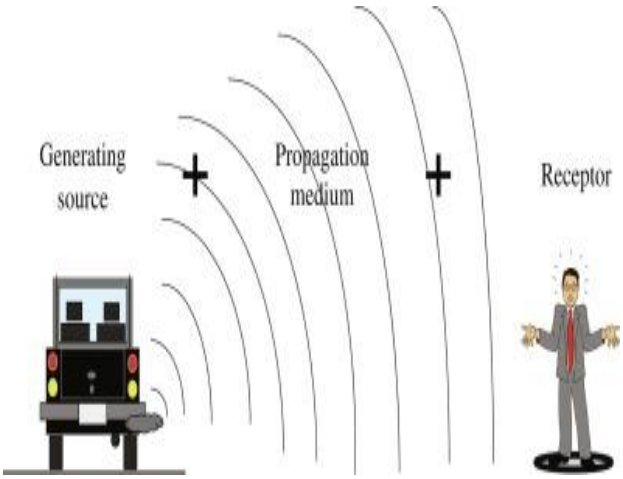

Figure 2. Sound propagation and perception (D'Agosto, 2019)

Seong et al. (2011) describe environmental noise assessment and mapping as the presentation of predicted or measured noise data, indicating breached thresholds together with an estimation of people exposed. There are several noise prediction models designed for assessing environmental noise whose application is largely dependent on the country in question as well as the traffic and environmental characteristics.
In the context of the Directive 2002/49/EC, noise maps are the main tool for investigation and decision-making in the implementation of action plans to reduce noise pollution (EC, 2017). Noise map provides detailed information of noise environment and it is an efficient tool for visualizing noise level in colors (Bouzir and Zemmouri, 2017).
Open source-GIS tools have in recent years increased in popularity. A contributing factor to this development is the optimized handling of datasets which in the case of environmental impact and assessment studies is often of large spatial and temporal extents. A unique strength of open-source methods is the ease of replication through the sharing of methods used. Through this, their capability and functionality are quickly enhanced because of their crowd-sourced nature.
In Romania the problem of noise pollution is widespread and high level of environmental noise reduces the quality of living (Figure 3).

	Lden >= 55 dB			Lnight >=50 dB		
	2007	2012	2017	2007	2012	2017
Road	2.879.000	2.511.100	2.752.700	2.056.500	2.090.900	1.956.700
Rail	273.100	275.400	96.700	206.000	241.600	93.500
Air	25.800	44.300	3.500	27.700	27.400	13.300
Industry	90.400	230.700	15.800	50.400	64.000	7.100

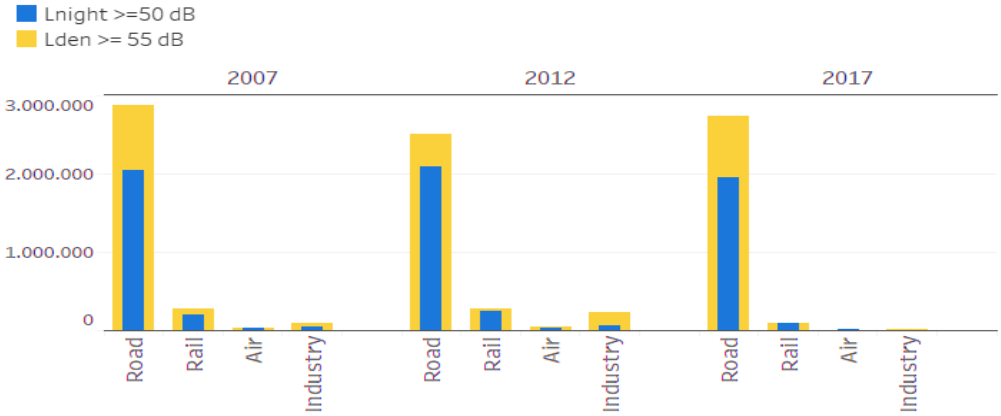

Figure 3. Number of people exposed to high noise levels in Romania (Romania noise fact sheet 2021)

MATERIALS AND METHODS

Bucharest, the capital of Romania, was selected as the study area. The City of Bucharest is characterized by a high level of noise pollution, reflected on to the inner and outer habitat comfort and the health state of the population. This high level of noise pollution is determined by the road and tramway traffic (Patroescu et al., 2002; Moscovici et al., 2015).

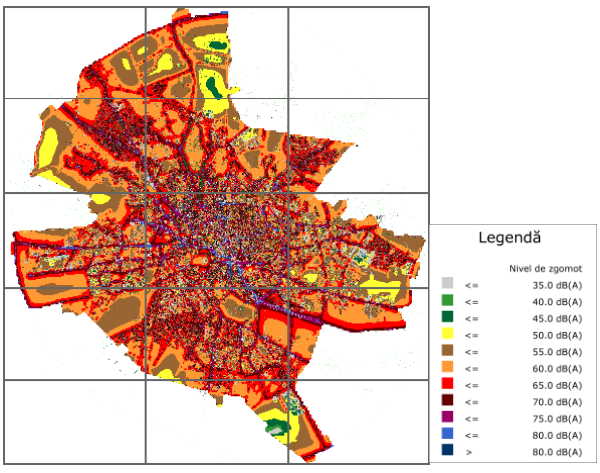

Figure 4. Bucharest road traffic noise map (https://hartiacustice.pmb.ro/)

As can be seen in Figure 4, the centre of Bucharest is constantly "polluted" with an average of over 70 decibels per day. Bucharest City Hall count 228 "conflict zones" - more precisely, 394 streets - in which the noise exceeded 70 dB during the day and 60 dB at night.

As presented in Figure 5, this study focused on the intersection of Timisoara Boulevard with Brasov Street, near Plaza Romania Mall, Bucharest, District 6.

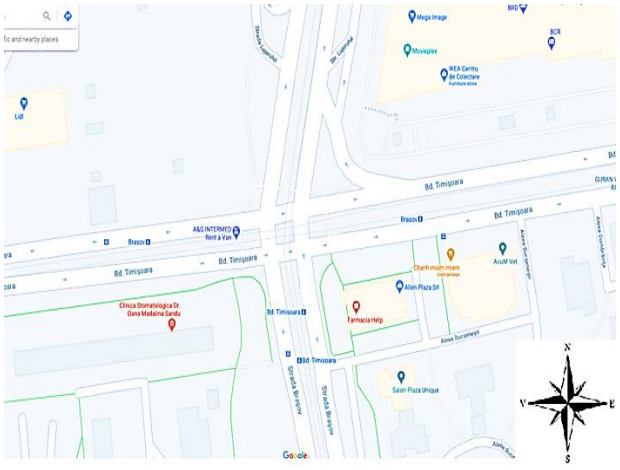

Figure 5. Study area on noise level (road intersection)

To create noise maps with the use of open-source tools, a methodology, organized in three phases, as shown in Figure 6.
The sound level meter model used to measure sound waves is the EXTECH - model 407730 (Figure 7). It is commonly a hand-held instrument with a microphone. The diaphragm of the microphone responds to changes in air pressure caused by sound waves. That is why the instrument is sometimes referred to as a Sound Pressure Level (SPL) Meter.

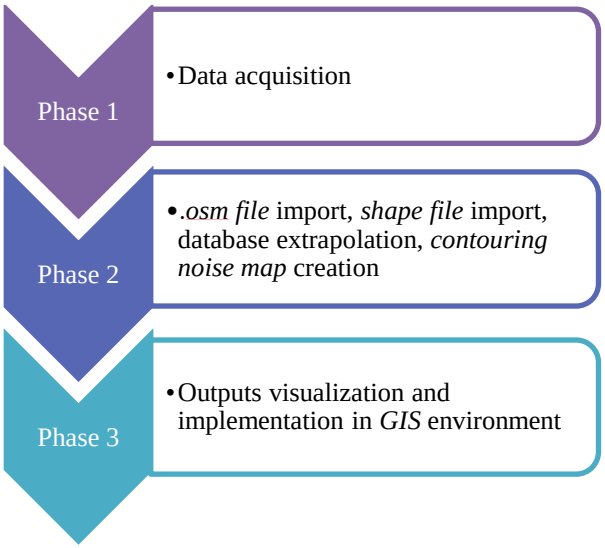

Figure 6. Methodology diagram

Figure 7. Sound level meter - EXTECH - model 407730

Sound meters are frequently used in acoustic pollution studies to determine almost any type of noise, but especially for the industrial, environmental and airport noise fields.
The sound-level meter is designed to respond to sound in approximately the same way as the human ear, with a view to obtaining objective, reproducible measurements of the sound pressure level. With its help, through repeated measurements, a noise map of a locality or area can be obtained.
The measurements were taken at street level (at road junctions, market centres, and residential areas). The sound level was recorded in 39 points in the afternoon on January 15, 2021, when the peak traffic was in full swing.
The instrument was held comfortably in hand with the microphone pointed at main source of noise (SR ISO 1996-1 regulation). During the sound measurements, road and tram traffic monitoring was realized, as this source of noise was considered the most important.
The Geographical Positioning System (GPS) points were also collected for each location for accurate coordinates of the sampling points for the purpose of noise mapping. The noise descriptors for the selected location are presented in Table 1. Each value in the table represents an average of 2-3 measurements made in a maximum interval of 1 minute, to establish the best value corresponding to the situation.

Table 1. The sound level in Timisoara Boulevard with Brasov Street

No.	Decibels (dB)	Latitude	Longitude
1	54.8	44.426871	26.034131
2	52.2	44.426912	26.034501
3	56.7	44.426739	26.033767
4	58.2	44.427184	26.035085
5	57.8	44.427004	26.035139
6	65.2	44.426778	26.032708
7	61.9	44.426974	26.034265
8	65.1	44.427889	26.033822
9	62.7	44.428278	26.03384
10	67.5	44.42667	26.032892
11	65.6	44.426964	26.032359
12	69.3	44.427002	26.033424
13	70.3	44.427701	26.033709
14	67.3	44.427644	26.034575
15	72.5	44.426979	26.033017
16	71.3	44.427182	26.032505
17	74.9	44.426804	26.03349
18	71.8	44.428062	26.033687
19	74	44.427602	26.034163
20	74.5	44.427275	26.03382
21	72.4	44.427234	26.033365
22	77.2	44.427207	26.032958
23	80.2	44.427192	26.032735
24	75.7	44.427318	26.034163

25	78.3	44.427394	26.033481
26	76.8	44.427521	26.033337
27	80.5	44.427439	26.0327
28	86.2	44.427463	26.032923
29	90.1	44.427298	26.03294
30	99	44.427357	26.033131
31	92.6	44.427336	26.032843
32	94.8	44.427313	26.032604
33	79.9	44.427389	26.033454
34	85.3	44.42742	26.033695
35	92.6	44.427573	26.033162
36	90.8	44.427707	26.033195
37	88.4	44.427218	26.033156
38	85.1	44.427074	26.033198
39	87.9	44.426908	26.033259

For the calculation we used QGIS (https://qgis.org/en/site/forusers/download.html).
The calculation was performed only for educational purposes.
The necessary steps to draw up a noise map in QGIS:

1. The data taken must be entered in Excel and saved in "CSV" format to be used in QGIS.
2. First, a "base map" is required. This requires the use of the "QuickMapServices" or OSM plugin (as it is called in the toolbar). The plugin may already exist in the program, or it will have to be installed separately, from the menu bar of the program. After opening the plugin, you can search for the reference area (Figure 8).
3. After selecting the work area, the data taken in CSV format from Excel is added. To add the Excel table opens the "Open Data Source Manager" menu. Enter the table with the data and press the "Add" button to place the reference points over the base map. After adding, the dots will appear on the map (Figure 9).
4. Then from the "Layers" tab with double click opens the properties window of the data table. Here the "Heatmap" variant is selected to highlight the propagation of the sound on the map. The radius of the points must be selected, for this there are 2 variants: the separation of the data into intervals, each interval corresponding to a table and a corresponding radius for that decibel range; or keeping a single table in which, the decibel ranges will be approximated by separate colors (example: green for 50-60 dB or red for 80-90 dB). The points will have a longer radius depending on the decibel level measured at that point and the selected radius. In addition to all this, it will be selected from the option "Weight points by" column in the table that represents the decibel values.
5. Finally, after adjusting the transparency of the points to be able to see the basic map, adjusting the reference scale and selecting the desired colors.

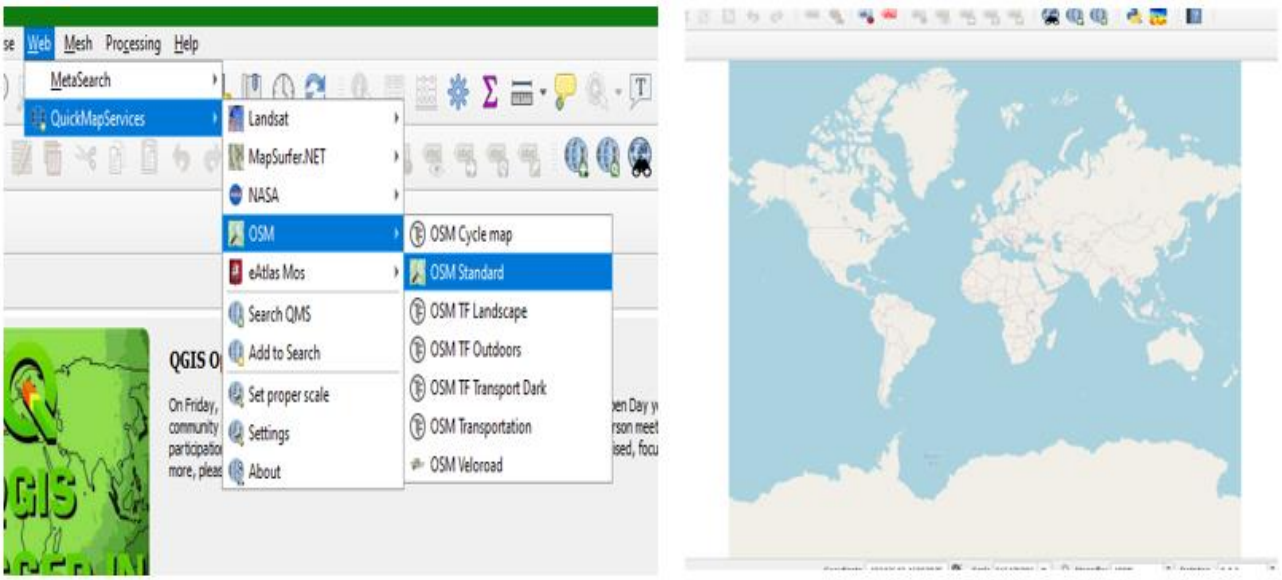

Figure 8. OSM plugin

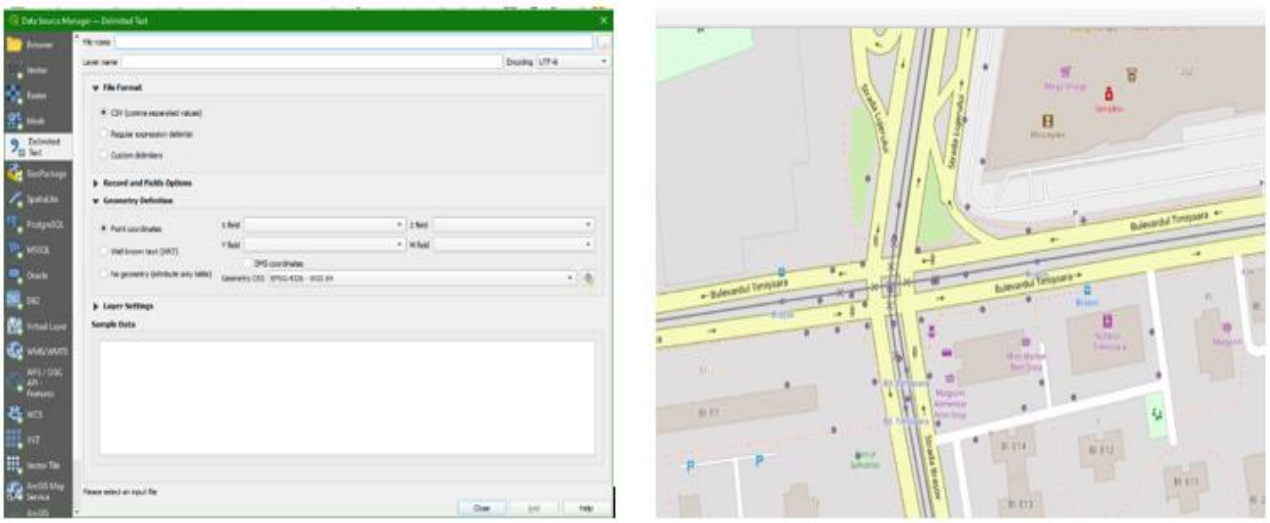

Figure 9. Data Source Manager menu and measured points on the map

RESULTS AND DISCUSSIONS

The spatial variation mapping of noise levels in Timisoara Boulevard with Brasov Street is presented in Figure 10. The value of noise ranged from 52.2 dB to 99 dB. Monitoring points over 55 dB accounts for round 95% of the study area. According to the limits presented in the current legislation: SR 10009:2017 for the noise level for urban areas in the Romania, noise intensity should be 55 dB in the daytime. The obtain results show that most of commercial and residential regions surrounding the main streets are suffering from severe noise pollution.

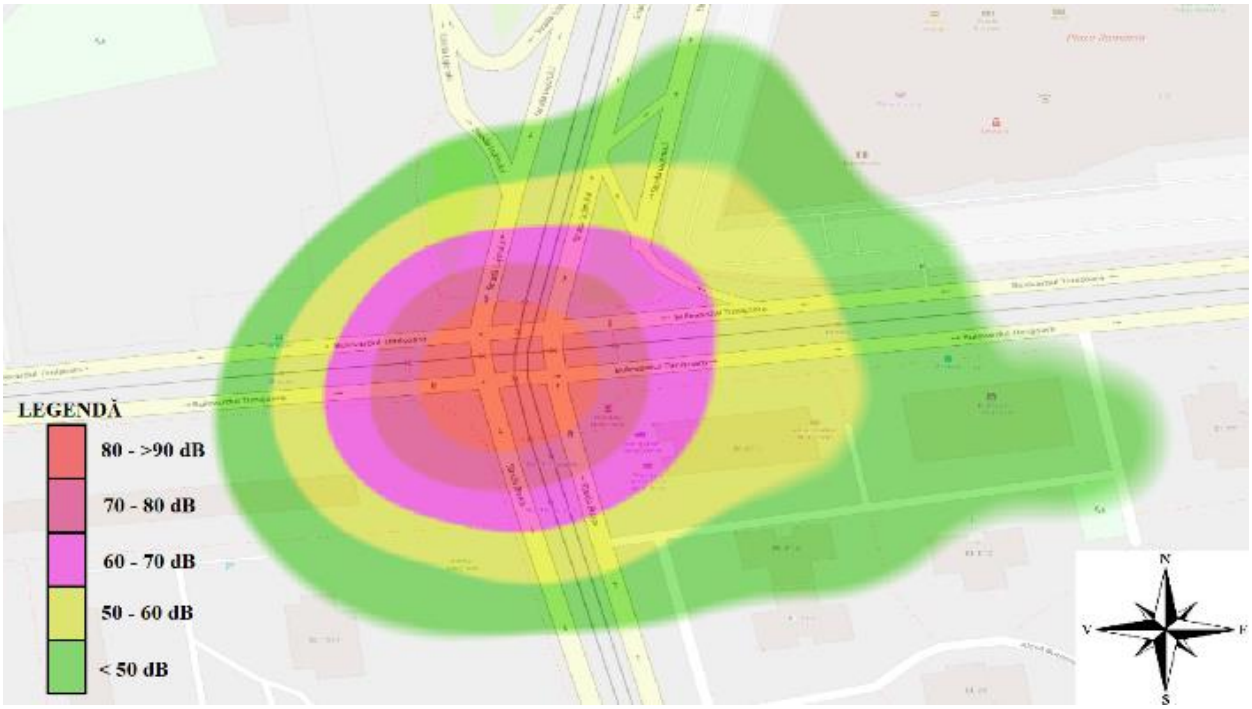

Figure 10. Spatial variation mapping of noise levels in Timisoara Boulevard with Brasov Street

CONCLUSIONS

To exemplify the noise pollution in Bucharest, a noise map of an intersection was map mapped. Results of this study show that in Timisoara Boulevard with Brasov Street the noise pollution by means of sounds exceeding the level of 55 decibels in daytime (Lden >=55dB). The causes of noise pollution are traffic. These sounds turn

into noises that bother people throughout the day.

It could be clearly seen that people passing through that intersection are exposed to a noise between 65 – 85 dBA. If we move a few tens of meters away (on the sidewalk), sellers at kiosks or nearby shops can be exposed to a noise of 60 – 70 dBA. Even if the buildings still protect them to some extent, no one can just sit locked between "four walls".

To solve the problems from Bucharest related to the noise pollution the proposed methods are:

- applying a law to reduce the noise edge of motor vehicles and the development of quieter cars,
- imposing fines for excessive speed and implicitly for producing unnecessary noise in traffic,
- placement of green barriers in areas with an increased share of noise pollution,
- placing sound-absorbing or sound-insulating panels where infrastructure permits, such as on bridges or overpasses,
- the regulation of road traffic on different routes differentiated on categories of vehicles, so that the trucks, which produce a higher noise, interact as little as possible with the internal areas of the cities,
- speed limitation in certain areas,
- penalties for the drivers that abusively use the horn inside the city,
- prioritize public transport and cycling,
- construction of special lanes for bicycles/scooters,
- constructions and buildings protection measures (phonic isolation),
- urban planning,
- raising population's awareness on the medical problems caused by the noise pollution after long periods of exposure.

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CONTRIBUTION REGARDING THE RADIOACTIVE CONTAMINATION OF DRINKING WATER: HEALTH CONCERN, REGULATIONS, METHODS OF ASSESSMENT

Cecilia Ionela TĂBAN[1], Teodora Mihaela CIRICAN[2]

Scientific Coordinator: Prof. PhD Habil. Simona OANCEA[1]

[1]Faculty of Agricultural Sciences, Food Industry and Environmental Protection, "Lucian Blaga" University of Sibiu, 7-9 I. Ratiu Street, 550012 Sibiu, Romania, Phone: +4026.921.13.38, Fax: +4026.921.25.58, Email: tceciliaionela@yahoo.com
[2]Faculty of Sciences, "Lucian Blaga" University of Sibiu, 5-7 I. Ratiu Street, 550012 Sibiu, Romania, Phone: +4026.921.66.42, Fax: +4026.921.66.17, Email: teocirican25@gmail.com

Corresponding author email: tceciliaionela@yahoo.com

Abstract

The presence of radioactivity in drinking-water is a risk factor on human health, including cancer. This article presents the harmful effects of radioactivity on human health, the legislation and the available analytical methods of controlling radionuclides in environmental samples. Several case studies regarding the gross alpha and beta activities of surface, ground and drinking water, were described. According to the International Agency for Research on Cancer (IARC), radon, a radioactive gas that comes from disintegration of radium, is considered a carcinogenic agent of group 1. There are two approaches of monitoring 222Rn in water, WHO and EURATOM. The methods for determination of radioactive content in water can be direct (gamma-spectrometry) or indirect (gamma-spectrometry, emanometry and liquid scintillation counting). Several published reports on radioactive pollution of water in different regions, showed exceeding values of gross alpha and beta activity, depending on geo-climatic factors. This study emphasizes the importance of monitoring water radioactivity and in particular radon, which can be a major risk for consumer health.

Key words: *drinking-water, gross alpha activity, gross beta activity, natural and artificial radioactivity, radon.*

INTRODUCTION

Environmental radiation is due to natural and artificial radionuclides. Radioactivity is present on earth, in different geological formations, in rocks, soil and water (Al-Khawlany et al., 2018). The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) has estimated that the global average annual human exposure to environmental radiation is about 3.0 mSv (UNSCEAR, 2008). Of this, 80% was due to natural sources of radiation, 19.6% to medical exposure and 0.4% was attributed to other man-made sources, e.g. nuclear power production and nuclear weapon testing (WHO, 2011; UNSCEAR, 2008).

Radiation occurs when energy is emitted by a source and then travels through a medium, until it is absorbed by matter (Sangiorgi et al., 2019). Natural radioactivity in water has been widely studied throughout the world in order to establish the radiological risk in humans following consumption of contaminated water (Benedik, et al., 2012; Wallner et al., 2010; Labidi et al., 2010). In the last years, several radioactivity studies on water, soil and air samples have been conducted (Degerlier et al., 2010; Kam et al., 2010; Yarar et al., 2010; Kapand et al., 2012; Taskin et al., 2012), showing that levels of natural radioactivity in water can offer basic information on radiological hazards in drinking-water.

Radioactive materials ingested by humans may affect health as a result of the decay of radionuclides into the body. One of them is 226Ra, which is considered a highly toxic element for human (El-Gamal et. al., 2019). Environmental radionuclides could be absorbed and accumulated in certain organs or tissues causing potential risks for human health (Ogundare et al., 2015). There are studies suggesting that exposure to any dose of

radiations could induce cancer (Liang et al., 2015; Ogundare et al., 2015).

Considering these, there is a high requirement for quality and accurate radioactivity monitoring, in particular in water. Different analytical methods of measuring radioactivity from environmental samples have been described in the literature, such as gamma-spectroscopy (Bonotto et. al., 2009), alpha-spectroscopy (Jobbagy. et al., 2010) and liquid scintillation counting (ISO 11704 Water quality). As a result of the increased potential for radioactive contamination of water, a primary screening of gross alpha and gross beta measurements used as screening methods to detect changes of the radiological characteristics of drinking-water source, is required (WHO, 2011; Bunotto et al., 2008). Gross alpha and gross beta analyses are widely used as the first stage of radiological characterization of drinking-water (Jobbagy et al., 2014; Todorović et al., 2012; Cfarku et. al., 2014; Jobbagy et al., 2010).

International standards and regulations impose permissible limits of the water radionuclides concentration and monitoring their levels using appropriate techniques (Rožmarić et al., 2012; Medley et al., 2015; Al-Hamarneh and Almasoud, 2018; Condomines et al., 2010; Diab and Abdellah et al., 2013; IAEA, 2014; Forte et al., 2018). However, the process of identifying procedures for evaluating the concentration of radionuclides of water samples is time-consuming and expensive. It has been shown that water physical-chemical properties are strongly related to the geological nature of the collecting site (La Verde et al., 2021). Therefore, the easiest practical approach is applying a screening method based on gross alpha and gross beta measurements, regardless of the identity of the specific radionuclides (QCVN 01-1:2018/BYT, 2018; WHO, 2017; Pintilie et al., 2016; Turhan et al., 2013).

THE IMPACT OF RADIOACTIVE CONTAMINATION OF WATER ON HUMAN HEALTH

Most radiations have their origin in the natural environment constituting the natural terrestrial background radiation. Thus, man has been exposed to the following natural ionizing radiation: (1) cosmic radiation – the amount (or dose) of received cosmic radiation being influenced by altitude, atmospheric conditions and the magnetic field of Earth; (2) terrestrial radiation – due to radioactive substances (uranium, thorium and potassium) that exists in rocks, soil and water; (3) radon – radioactive gas element that exists in the environment (air, water) showing major contribution to the natural terrestrial background radiation (Burkhardt et al., 2016).

Radon (Rn) is a chemical element with atomic number 86, belonging to the group VIIIA. This noble gas is radioactive, tasteless, odorless and colorless. Therefore, it is not detectable by human senses alone. It is formed by the disintegration of the heavy elements from the Earth's crust. Once formed, it diffuses into the soil or water gases, being then emanated into the atmosphere. Radon migrates to the surface through the soil pores, fissures and erosions (Corețchi et al., 2020).

The access to a safe drinking-water is essential for the human health (Grande et al., 2015). The permissible radioactive levels of drinking-water are <0.5 Bq/l measured by gross alpha activity, and <1 Bq/l for gross beta activity (WHO, 2011). Additional investigation is required when levels exceed these limits (Cfarku et al., 2020). Regarding the ground water, the EU directives recognized about 1000 types of natural mineral ground water (European Commission, 2015). Considering the ground waters, the physical-chemical conditions and the geological environments strongly influence the level of radionuclides, higher contents affecting the human health by ingestion of drinking-water obtained from wells (Sarvajayakesavalu et al., 2018; Rozmaric et al., 2012; Altikulac et al., 2015).

Of all the dangerous radionuclides in water, radon (^{222}Rn) is of great concern, being produced by the decay of radium, the last one being the decay product of uranium (^{238}U). Radon is considered the main source of natural radioactivity with short-term products of disintegration of ^{238}U, including ^{214}Po, ^{214}Bi, ^{214}Pb and ^{218}Po (Richon et al., 2010; Binesh et al., 2012). Some radionuclides (^{228}Ra, ^{226}Ra, ^{210}Po) may accumulate in bones and teeth (La Verde et al., 2021).

According to the International Agency for Research on Cancer (IARC), radon is a

carcinogenic agent of group 1 (ICRP, 1988). Research indicated that inhaled radon may produce lung cancer, while ingested radon may produce gastric cancer (Binesh et al., 2012; Rafique et al., 2012). Considering smoking as the main risk factor of lung cancer, radon will be the first cause of cancer for non-smokers and the second one for smokers (Lorenzo-Gonzalez et al., 2019). The most amount of radon present in drinking-water is absorbed in the human body by inhalation and not by ingestion (La Verde et al., 2021). All radon isotopes are radioactive, so that the evaluation of adverse effects on human health due to radon exposure requires further consideration. The main health problems occur when the descendants of radon, which are attached to dust particles (called attached fractions) are inhaled, further deposited in airways (tracheobronchial tree), thus repeatedly irradiating cells with alpha-particles as each atom suffers transformations through the disintegration chain. These alpha-particles provide a high dose of localized radiation (Keith et al., 2012).

LEGISLATIVE ASPECTS RELATED TO RADIOACTIVE SUBSTANCES IN DRINKING-WATER

^{222}Rn in water – WHO and EURATOM perspective

Figure 1 presents the two approaches regarding the maximum allowed level of radon in water, according to The Guidelines for drinking-water quality (GDWQ) by WHO and EURATOM.

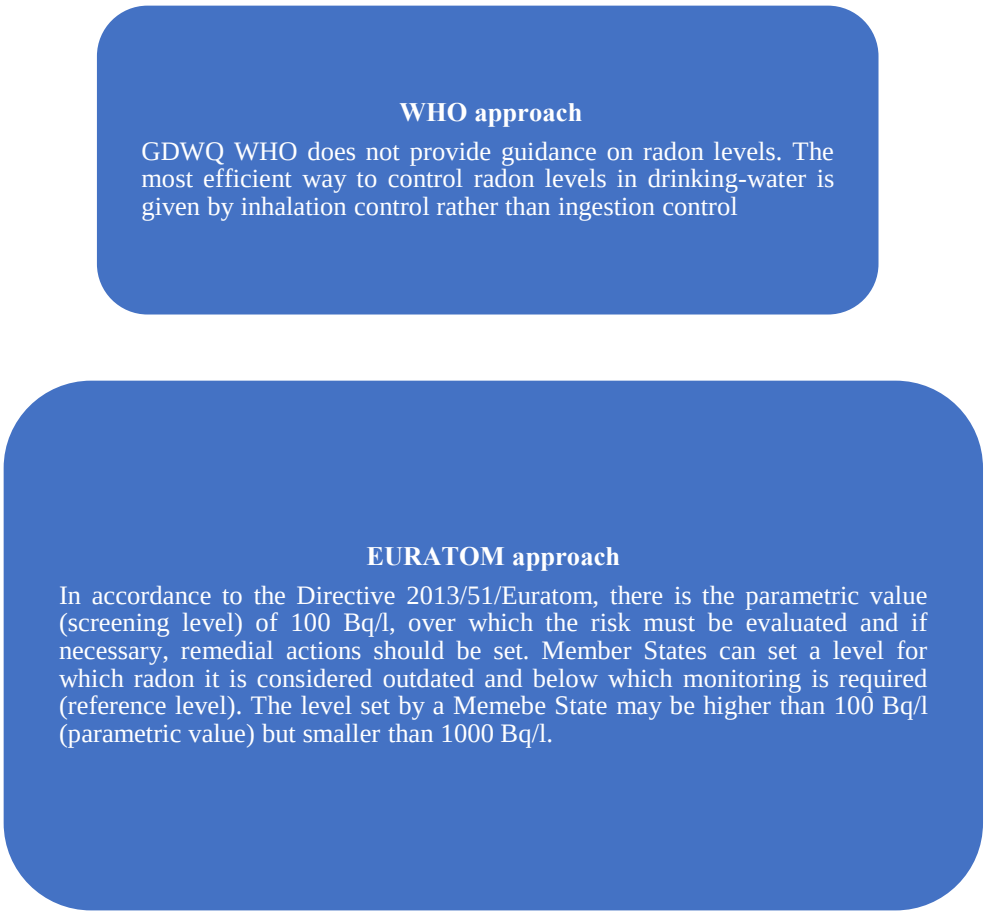

Figure 1. Comparative approach - WHO and EUROATOM – regarding the monitorization of radon (^{222}Rn) in water

Gross alpha and gross beta activity in freshwater

The standard procedure describes the stages required for the measurement of gross alpha and gross beta activity in freshwater. The collected stabilized water samples are evaporated and

subjected to drying, after which the sample residue is calcinated at 350°C for 1 h. The gross alpha and beta activity is measured from the water residue, results being obtained from a standard curve (SR-ISO 9696, 2018; SR-ISO 9697, 2019).

Health protection requirements in relation to radioactive substances in drinking-water

The national legal aspect (Law 301/2015) regulates the quality of drinking-water regarding the content of natural and artificial radioactive substances, by establishing the limit values, as well as frequencies and methods of monitoring radioactive substances in drinking-water, in order to protect the health of the population from the induced risk by the presence of radioactive substances.

According to the EU Council Directive 2013/51/EURATOM on the requirements for the public health protection against radioactive substances in water intended for human consumption, the maximum limit was set at 100 Bq/l (Council Directive, 2013). The WHO recommendation for the maximum level of 222Rn in drinking-water is 100 Bq/l (WHO, 2011), while the U.S. Environmental Protection Agency (EPA) established the maximum level at 11.1 Bq/l (US-EPA, 1999).

CLASSICAL AND MODERN METHODS OF EVALUATION OF RADIOACTIVE CONTENT IN WATERS INTENDED FOR HUMAN CONSUMPTION

Because of the high cost of equipment used for measuring the radionuclides concentration, and long analysis time, the easiest practical approach is a screening method based on radioactivity detection by gross alpha and beta activities (QCVN 01-1:2018/BYT; WHO, 2017; Pintilie et al., 2016; Turhan et al., 2013). Gamma-spectrometrical technique has been used to determine the specific activity of gamma-emitting radionuclides (anthropogenic and natural). The Liquid Scintillation Counting (LSC) method has been frequently applied to measure the activity of beta-emitting radionuclides (tritium, ^{4}C, ^{55}Fe, ^{63}Ni, $^{89,90}Sr$, ^{90}Y, ^{99}Tc, ^{241}Pu, ^{36}Cl, ^{41}Ca, ^{129}I, ^{210}Po, ^{210}Pb, isotopes of uranium, thorium, radium, and radon). The emanometry measurement technique has been used to estimate the activity of the gaseous radon (Caridi et al., 2021).

The methods used to evaluate the radioactive content of water samples are divided into the following categories (Bochicchio et al., 2019):

a) *direct measurement* without phase transfer: gamma-spectometry;

b*) indirect measurement* involving the transfer of ^{222}Rn from the aqueous phase to gaseous phase, before performing the measurement: (a) gamma-spectometry (radon adsorbed on charcoal); (b) emanometry, involving transfer of ^{222}Rn from the aqueous phase to gaseous phase; (c) LSC technique.

The description of the analytical methods, as well as advantages and disadvantages of each technique, is presented in Table 1.

Table 1. The main analytical techniques used to evaluate the radioactive content of water

Method type	Description	Advantages	Disadvantages	Ref.
Gamma spectrometry	The concentration of the ^{222}Rn is determined by measuring the characteristic gamma lines of ^{214}Bi or ^{214}Pb obtained by an HPGe (quantitative) or NaI (qualitative or semi-quantitative) detectors.	• No sample treatment required; • Data analysis is fully automatized; • No specific training is required for the operators; • Generally, the measurement uncertainty could be very low (< 5%) • Corrections for the radon determination equation are required.	• HPGe detectors are highly expensive; • High turnaround time, 4-13 h (few measurements/ week), compared other techniques • The measurement results are influenced by indoor radon in the laboratory air.	Bochicchio et al., 2019. Pujol et al., 2017

Emanometry	^{222}Rn is transferred from the liquid to the gaseous phase in a closed circuit by controlled sample degassing	• Different detectors coupled with the degassing circuit can be used, with low-to-moderate costs; • Measurement uncertainty can be very low (< 5%) if the method is properly managed; • Possibility to perform *in-situ* measurements; • Very low turnaround time, (<1h) => many measurements/ day. • The equipment is portable • Rapid measurement	• Degassing circuit required; • Sub-sampling is required: a certain quantity of water should be transferred from transport container to the degassing circuit; • The technique is sensitive to thoron (^{232}Th)	Bochicchio et al., 2019 Caridi and Belmusto, 2018
Liquid scintillation counting (LSC)	The principle is based on the extraction of ^{222}Rn from water samples.	• The procedure is fully automatized; • Several vials can be analyzed at the same time => many measurements per day; • The lowest detection limit (0.05 Bq/l); • The vial to be measured can be prepared on-site: such procedure avoids the need of sub-sampling; • Indoor radon in laboratory air does not significantly influence measurement procedure and results.	• Instruments for LSC are expensive; • The turnaround time is quite high (approximately the same as gamma-spectrometry), 3-8 h => no rapid results; • Calibration is cocktail specific, so each scintillation cocktail should be studied separately; • *In situ* measurements cannot be performed.	Bochicchio et al., 2019

DETECTION OF RADIOACTIVE CONTAMINATION OF WATER USING GROSS ALPHA AND BETA ACTIVITY – CASE STUDIES

The most accepted protocol for radiological characterization of drinking-water consists in determination of the gross alpha and gross beta activities (Todorovic et al., 2012; Jobbagy et al., 2012) in accordance to ISO standards for freshwater (ISO 9696:2018 and ISO 9697:2019).

The results of several reported investigations of radioactive contamination of surface and groundwater, for the period 2011-2020 synthesized from different international studies, are presented in Table 2.

Table 2. The results of published studies at national and international level regarding the radioactive contamination of surface and groundwater

Water samples	Origin country	Gross alpha activity (mean value) (mBq/l)	Gross beta activity (mean value) (mBq/l)	References
Groundwater	China (Haihe River Plain)	17-362 (112)	18-779 (171)	Yi P et al., 2018
Surface and groundwater	China	0.498-490 (29)	5-1260 (91)	Sang et al., 2020
Groundwater	North Vietnam	4.6-119 (38.7)	0.99-189 (88)	Duong et al., 2020
Groundwater	Iran (Guilan)	12-115 (52)	23-332 (110)	Abbasi et al., 2017
Groundwater	Iordan	180-9460 (1570)	360-7480 (1620)	Alomari et al., 2019
Surface and groundwater	Nigeria (Kaseno State)	24-665(142)	7-1330 (285)	Bello et al., 2020

Surface and groundwater	Nigeria (Kaseno State)	5.8-174	14.7-222.5	Fasae et al., 2015
Groundwater	Orwian / Nigeria	6.4-18.2	46-126	Ogundare, et al. 2015
Groundwater	Ado-Ekiti Metropolis	216-1299	64-582	Polytechnic et al., 2013
Surface and groundwater	Saudi Arabia	194	540	Amin et al., 2017
Groundwater	Hail/ Saudi Arabia	17-541 (215)	480-516 (260)	Shabana et al., 2014
Groundwater	Turkey (Nevşehir province)	13-182 (88)	81-779 (305)	Seref et al., 2019
Surface and groundwater	Serbia	1-13	41-173	Jankovic et al., 2012
Groundwater	Balaton/Hungary	35-1749 (189)	33-2015 (209)	Jobbagy et al., 2011
Surface and groundwater	Galati/Romania	<6.00-85.24 (22.18)	<25-434.85 (75.80)	Pintilie et al., 2016
Groundwater	Bucovina/Romania	0.40-45.40 (12.13)	1.51-47.45 (11.34)	Călin et al., 2016

The radioactivity evaluation of eight sources of thermal and drinking-water from North Vietnam (Duong et al., 2020) showed values of the determined gross alpha and beta activities between 38.7 mBq/l and 88.0 mBq/l. The minimum and maximum alpha and beta activity values were 4.6 mBq/l and 119.0 mBq/l, and 0.99 and 189 mBq/l, respectively. Lower values were reported in the study conducted in Iran (Guilan) (Abbasi et al., 2017) showing gross alpha and beta activity of 12 mBq/l and 115 mBq/l, respectively 23 mBq/l and 332 mBq/l. However, the values did not exceed the levels recommended by WHO: 500 mBq/l for gross alpha, and 1000 mBq/l for gross beta activity. A study conducted in China (Yi P et al., 2018) indicates values ranging from 17 to 362 mBq/l for gross alpha activity and, from 18 to 779 mBq/l for gross beta activity. These values were below the WHO allowed limits, in comparison with another study from China (Sang et al., 2020) in which increased gross beta activity (1260 mBq/l) exceeding the permissible limit was reported. The study conducted in Nigeria (Kaseno state) (Bello et al., 2020) reported exceeding levels both for alpha activity (665 mBq/l) as well as for beta activity (1330 mBq/l). Similar increased values of gross alpha activities (1299 mBq/l) were found in Ado Ekiti Metropolis (Polytechnic et al., 2013). The highest values have been reported in Iordan (Alomari et al., 2019) for gross alpha activity (9460 mBq/l) and gross beta activity (7480 mBq/l), with an average value of 1620 mBq/l, and for Balaton/ Hungary investigation (Jobbagy et al., 2011) showing values of 1749 mBq/l for gross alpha activities, and of 2015 mBq/l for gross beta activities. The results of several studies of radioactivity of surface and ground waters conducted in Romania, in the regions of Galati (Pintilie et al. 2016) and Bucovina (Călin et al., 2016) indicated no exceeding levels. The highest value of gross alpha and beta activities were reported for samples collected from drilled wells in the study of Galati/ Romania.

Regarding the gross alpha and beta activities determined in drinking-water from different European regions, the results are presented in Table 3.

Table 3. The results of published studies regarding to radioactive contamination of drinking-water from different regions of Europe

Origin country	Alpha activity (mBq/l)	Beta activity (mBq/l)	References
Central Italy	18.18 – 128.18	41.57 – 258.59	Desideri et al., 2007
Spain	30-880	40-228	Palomo et al., 2007
Italy	8 - 349	25 - 273	Forte et al., 2007
Bulgaria	177	30 - 980	Kamenova-Totzeva et al., 2014
Portugal	15 – 330	18 – 457	Lopes et al., 2010
Greece	82	283	Karamanis et al., 2007
Albania	18 - 37	150-337	Cfarku et al., 2014

As noticed in Table 3, Spain reported values of gross alpha activity of 880 mBq/l, which exceeded the WHO recommended limit of 500 mBq/l. For the other European regions, values were within the permissible limits recommended by the WHO.
In all of these published studies, the variation of the values regarding the determined radioactive content of analyzed water samples is closely related to the different geological characteristics of the investigated area.

CONCLUSIONS

This article described the aspects regarding the impact of environmental radioactive contamination on human health, legislative aspects on monitoring the radioactive contamination in drinking-water, as well as specific methods for the evaluation of radioactive content of environmental samples.
The impact of natural/ anthropogenic radioactive environmental contamination on human health is related to several tissue injuries, including cancer.
The legislative aspects on monitorization of radioactive substances in drinking-water established their allowed limits, regulating the quality and safety of drinking-water.
Radionuclides analysis from water samples involves the use of different direct and indirect methods (gamma/ alpha-spectrometry, liquid scintillation counting). The easiest practical approach is a screening method based on radioactivity detection by gross alpha and beta activities.
Several case studies on gross alpha and beta activities have been presented, showing values which exceeded the permissible limits, which justifies the ongoing research in this field. Increase of gross alpha and beta activity above the reference level of 500 mBq/l and 1000 mBq/l, respectively, established by the WHO is due to the different geological characteristics, the properties of the soils and rocks specific to each region. The WHO recommendation for the maximum level of ^{222}Rn in drinking-water is 100 Bq/L, while the U.S. EPA established the maximum level at 11.1 Bq/l.

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RESPONSIBLE USE OF GROUNDWATER RESOURCES - OBTAINING ECOLOGICAL LIQUID FERTILIZERS BASED ON PLANTS FROM THE WILD FLORA OF ROMANIA

Florin Tudor ZURINI, Aurelian IOAN, Elena ZURINI

Scientific Coordinator: Assoc. Prof. Biotech. PhD Irina GREBENIȘAN

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: + 4021.318.25.67

Corresponding author email: florin.zurini@gmail.com

Abstract

Responsible use of groundwater resources should be the responsibility of every person, because our very existence on Earth depends on these invaluable resources. Due to the climate change we are currently going through, drinking water resources are becoming less and less qualitatively affected due to pollution and the infiltration of pollutants into groundwater. In agriculture, one of the major causes of groundwater pollution are chemical synthesis substances, which are used as an input for plant growth, for phytosanitary treatments against insects and phytopathogenic microorganisms and for weed removal. That is why the research direction that we approached was that of the responsible use of groundwater and the obtaining of ecological fertilizers based on plants from the wild flora of Romania. In order to obtain the ecological liquid fertilizer, we used plants from the wild flora of Romania, namely nettle (Urtica dioica), comfrey (Symphytum officinale) and horsetail (Equisetum arvense). We tested the organic fertilizers we obtained in the laboratory to see their ability to stimulate the germination and growth of bean seedlings (Phaseolus vulgaris L.). The organic liquid fertilizer we obtained had a very good effect on stimulating the germination and development of bean seedlings.
The groundwater sample was taken from the family well. The drilling is at a depth of 40 m and is located in Crucea de Piatră, Călugăreni commune, Giurgiu county. The groundwater sample was transported in a refrigerated box to the laboratory of Ecology and Environmental Microbiology within the Faculty of Land Reclamation and Environmental Engineering within the U.S.A.M.V. Bucharest. In order to achieve the proposed goal, the groundwater sample taken from the family well was analyzed in the laboratory of Ecology and Environmental Microbiology from an ecological point of view. The experiments performed and presented in this paper represent a part of the studies performed for the bachelor's thesis.

Key words*: comfrey (Symphytum officinale), eco-friendly, ecological liquid fertilizer, nettle (Urtica dioicahorsetail), horsetail (Equisetum arvense), responsible use of groundwater resources.*

INTRODUCTION

Groundwater is invisible, but its impact is visible everywhere. Out of sight, under our feet, groundwater is a hidden treasure that enriches our lives. Almost all of the liquid freshwater in the world is groundwater. As climate change gets worse, groundwater will become more and more critical. We need to work together to sustainably manage this precious resource. Groundwater may be out of sight, but it must not be out of mind (https://www.worldwaterday.org/).

Accounting for approximately 99% of all liquid freshwater on Earth, groundwater has the potential to provide societies with tremendous social, economic and environmental benefits and opportunities. Groundwater already provides half of the volume of water withdrawn for domestic use by the global population, including the drinking water for the vast majority of the rural population who do not get their water delivered to them via public or private supply systems, and around 25% of all water withdrawn for irrigation. However, this natural resource is often poorly understood, and consequently undervalued, mismanaged and even abused.

Groundwater is central to the fight against poverty, to food and water security, to the creation of decent jobs, to socio-economic development, and to the resilience of societies and economies to climate change. Reliance on groundwater will only increase, mainly due to

growing water demand by all sectors combined with increasing variation in rainfall patterns. (https://www.unwater.org/publications/un-world-water-development-report-2022/)

This year the motto of the organization is "Groundwater: Making the invisible visible" and that is why we have chosen this topic for our work, to emphasize the importance of responsible groundwater use.

Bio-fertilizers have begun to gain increasing attention due to the environmental damage that synthetic chemical fertilizers cause. Some of the benefits associated with organic fertilizers include:

- The first and most important advantage of using bio-fertilizers is that they are environmentally friendly, unlike chemical fertilizers that are harmful to the environment.
- They have relatively low costs when used as farmer inputs.
- Their use leads to soil enrichment and soil quality improves over time.
- Although it does not show immediate results, the results displayed over time are spectacular.
- Microorganisms transform complex organic matter into simple compounds so that the plant can easily take up nutrients.
- These fertilizers capitalize on atmospheric nitrogen and make it directly available to plants.
- They increase the phosphorus content of the soil by solubilizing and releasing the phosphorus from the unavailable.
- Biological fertilizers improve root proliferation due to the release of growth-stimulating hormones.
- They help to increase the yield of the crop by 10-25%. (Hazra, 2016)

Organic fertilizers are naturally available mineral sources that contain moderate amount of plant essential nutrients. They are capable of mitigating problems associated with synthetic fertilizers. They reduce the necessity of repeated application of synthetic fertilizers to maintain soil fertility. They gradually release nutrients into the soil solution and maintain nutrient balance for healthy growth of crop plants. They also act as an effective energy source of soil microbes which in turn improve soil structure and crop growth. Organic fertilizers are generally thought to be slow releasing fertilizers and they contain many trace elements. They are safer alternatives to chemical fertilizers. However, the improper use of organic fertilizers leads to overfertilization or nutrient deficiency in the soil. Hence, controlled release of organic fertilizers is an effective and advanced way to overcome these impacts and maintain sustainable agriculture yield (Shaji et al, 2021).

An ecological fertilizer is a substance (free of chemicals) formed by the essential nutrients that the plant needs to grow and develop. Organic fertilizers or **ecological fertilizers** are obtained by mixing substances obtained by the degradation and mineralization of leftovers of an organic, plant and industrial nature, promoting **the circular economy**. This means extending their useful life, maintaining their value for as long as possible.

The main characteristics in favor of ecological fertilizers are:

- **Eco friendly**, this means that they do not carry chemical inputs that can damage the earth and respect the ecosystems. Although chemical fertilizers are a quick and effective solution in the short term, their use entails environmental problems such as water pollution, the risk of toxicity and the degradation of soil life in the long term.
- Organic fertilizers provide a series of **necessary nutrients**, the main ones being the NPK formula: nitrogen, phosphorus and potassium.
- They improve **the structure and properties of the soil, giving it strength, resistance, structure and aeration**. In addition, its ability **to absorb water and carbon fixation** in it also increases positively.
- Its production hardly generates energy expenditure and is a **more economical solution.**
- Has a **regulating effect** on soil temperature and prevents excessive evaporation helping to maintain soil moisture.
- They make it possible to take advantage of **organic waste favoring the circular economy (**https://defeder.es**).**

Liquid organic fertilizers can offer opportunities for more efficient nitrogen use when they are

applied through a drip irrigation system - such an application is called fertigation. Any nutrient in a water-soluble form is readily available for plant uptake just after application, leading to a more efficient use of fertilizers. When nutrients are applied shortly before they are needed, growers can reduce loss of nutrients from the root zone. These liquid fertilizers may be applied on a regular basis, depending on the nutrient need of the crop. This allows the grower greater control over nutrient availability to their crop. Some of the liquid fish-derived and soybean-based fertilizer materials are widely used in organic vegetable production.

A few important considerations before using fertigation are: only use fertilizers that either dissolve completely or have particles that stay in suspension and pass through emitters without clogging, the drip irrigation system should be fully pressurized before injection begins, there should be a filter between the injector and the laterals to ensure that any particles are filtered out, and the irrigation system must be flushed of nutrients to keep drip lines clean and prevent clogging (Brust, 2019).

Responsible use of groundwater resources should be the responsibility of every person, because our very existence on Earth depends on these invaluable resources. Due to the climate change we are currently going through, drinking water resources are becoming less and less qualitatively affected due to pollution and the infiltration of pollutants into groundwater. In agriculture, one of the major causes of groundwater pollution are chemical synthesis substances, which are used as an input for plant growth, for phytosanitary treatments against insects and phytopathogenic microorganisms and for weed removal. That is why the research direction that we approached was that of the responsible use of groundwater and the obtaining of ecological fertilizers based on plants from the wild flora of Romania. We tested the organic fertilizers we obtained in the laboratory to see their ability to stimulate the germination and growth of bean seedlings (*Phaseolus vulgaris L.*).

The groundwater sample was taken from the family well. The drilling is at a depth of 40 m and is located in Crucea de Piatră, Călugăreni commune, Giurgiu county. The groundwater sample was transported in a refrigerated box to the laboratory of Ecology and Environmental Microbiology within the Faculty of Land Reclamation and Environmental Engineering within the U.S.A.M.V. Bucharest. In order to achieve the proposed goal, the groundwater sample taken from the family well was analyzed in the laboratory of Ecology and Environmental Microbiology from an ecological point of view. The experiments performed and presented in this paper represent a part of the studies performed for the bachelor's thesis.

MATERIALS AND METHODS

1. The groundwater sample was taken from the family well. The drilling is at a depth of 40 m and is located in Crucea de Piatră, Călugăreni commune, Giurgiu county.
2. The groundwater sample was transported in a refrigerated box to the laboratory of Ecology and Environmental Microbiology within the Faculty of Land Reclamation and Environmental Engineering within the U.S.A.M.V. Bucharest.
3. In order to achieve the proposed goal, the groundwater sample taken from the family well was analyzed in the laboratory of Ecology and Environmental Microbiology from an ecological point of view.
4. Ammonia, nitrite, nitrate and pH determination. To determine the ammonia, nitrites, nitrates and pH we used the water analysis kit from Hanna Instruments

   Nitrites are an intermediate form of nitrogen produced when ammonia is converted into nitrate during the nitrogen cycle. As organic matter decays, it produces ammonia; the highly toxic ammonia is converted into nitrite by bacteria; and the nitrite is then converted into nitrate by another bacteria.
5. We determined the turbidity of the water sample with the WTW laboratory turbidimeter.
6. We determined the pH of the water sample with the WTW laboratory pH-meter.
7. Production of liquid organic fertilizer. We used plants from the wild flora of Romania - nettle, comfrey and horsetail. After weighing the plant material, we put it in recycled plastic containers, then we added

1 l of well water. The sample was kept at room temperature. The fermentation process of the macerate took 19-20 hours. After the fermentation stopped, the plant biomass began to settle. We analyzed the N, P and K content of organic liquid fertilizer. We also analyzed the pH.

RESULTS AND DISCUSSIONS

In vitro experiments

Figure 1 shows the results of the analysis using the Hanna Instruments water analysis kit. The results of the analysis of the concentrations of ammonium, nitrites, nitrates and pH of the well water sample. The maximum values allowed by law for nitrites are 0.5 mg / L and for nitrates 50 mg / L.

Figure 1. The results of the analysis using the Hanna Instruments water analysis kit.

Figure 2. The result of determining the pH

Figure 2 shows the result of determining the pH. The value obtained, 8 indicates a slightly alkaline pH.

Determining the turbidity of the well water sample. We determined the turbidity of the well water with the WTW laboratory turbidimeter. The value obtained was 0.01 NTU. For drinking water the value accepted by the standard is between 0 and 5 NTU.

Figure 3. Determining the turbidity of the well water sample

The figure 4 shows the positioning and adjustment of the analytical balance.

Figure 4. The positioning and adjustment of the analytical balance

Figure 5 shows the biological material used to obtain the fertilizer – nettle (*Urtica dioica*), horsetail (*Equisetum arvense*) and comfrey (*Symphytum officinale*).

Figure 5. The biological material used to obtain the fertilizer – nettle (*Urtica dioica*), horsetail (*Equisetum arvense*) and comfrey (*Symphytum officinale*)

Figures 6, 7 and 8 show the weighing stages of the plants from the wild flora of Romania used to obtain the liquid ecological fertilizer.

Figure 6. Nettle (*Urtica dioica*)

Figure 7. Horsetail (*Equisetum arvense*)

Figure 8. Comfrey (*Symphytum officinale*)

Figure 9 shows the moment of the fermentation process and that of the cessation of fermentation, respectively.

Figure 9. Fermentation process (left) and cessation of fermentation (right)

Figure 10 shows the determination of the pH value of the liquid ecological fertilizer, dry biomass. The biomass was dried in an oven for 1 hour at 180 degrees Celsius and the containers with liquid fertilizer and dry residual biomass.

Figure 10. Determination of the pH value of the liquid ecological fertilizer

CONCLUSIONS

The results obtained in this experiment allow us to draw the following conclusions:

- In order to obtain the ecological liquid fertilizer, we used plants from the wild flora of Romania, namely nettle (Urtica dioica), comfrey (Symphytum officinale) and horsetail (Equisetum arvense).
- We made determinations of the concentration N, P, K, pH of the liquid ecological fertilizer obtained and we noticed that it is rich in P and K and less in N. The pH value was weakly acidic.
- Regarding the organoleptic quality parameters of the groundwater - taste, color and smell, it had an acceptable taste for consumers and no abnormal changes, it was colorless and had no odor.
- The sampling temperature of the water sample was 10 degrees Celsius.

- The pH is alkaline (basic) with a value of 8 pH units.
- The turbidity was 0.01 NTU (Nephelometric Turbidimetric Units), a value that falls within the range established by law 0 - 5 NTU.
- The determinations of the chemical quality parameters of the groundwater - ammonia (NH3), nitrites (NO2), nitrates (NO3) had values below the maximum allowed limits:

• 0.5 mg / l ammonia;
• 0.5 mg / l nitrites;
• 50 mg / l nitrate.

- Responsible use of groundwater involves its use for domestic consumption, garden and in this case study for the production of liquid organic fertilizer. It is important to use water as wisely as possible because due to the drought we are going through it is a resource that can become limited.
- To obtain liquid organic fertilizers we used plants from the spontaneous flora of our country, which we subjected to a biotechnological process - fermentation and maceration:

• nettle (Urtica dioica);
• sorrel (Symphytum officinale);
• horsetail (Equisetum arvense).

- The experiment was carried out in two variants, a static fermentation, without continuous stirring, which lasted 5 days and a variant with continuous stirring 120 rotations / minute at the incubator with orbital stirring at a temperature of 25 degrees Celsius for 3 days.
- After obtaining the liquid ecological fertilizer, we carried out studies to determine the quality organoleptic and physico-chemical parameters. Observation of the color of the liquid organic fertilizer - it had a matte dark yellow color.
- When determining the content of macroelements N, P, K in liquid organic fertilizer we obtained the following values:

• trace concentrations for nitrogen (N);
• high concentrations of phosphorus (P);
• high concentrations of potassium (K).

- For the use of by-products resulting from the production of liquid organic fertilizer:

• we transferred the liquid and weighed the remaining residual biomass;
• we dried for 1 hour in an oven at 180 degrees Celsius for conditioning the residual biomass.
• the obtained conditioned solid fertilizer was further processed and turned into powder using a grinding machine;
• conditioning of solid fertilizer allows it to be stored for long periods of time without it molding.

- The pH value obtained after the fermentation process was determined with the help of the laboratory pH meter and had the value of 5.063 pH units, which means a weakly acidic value.

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TESTING NEW STRAIN BENEFICIAL SOIL MICROBES TO IMPROVE GERMINATION, PLANT GROWTH AND PROTECTION AGAINST FUNGAL SOIL-BORNE PHYTOPATHOGENS IN *PHASEOLUS VULGARIS L.*

Elena ZURINI, Ana Maria PREDA, Ariana DÎRLECI, Alexandra BĂICOIANU, Ștefan BĂRBULESCU, Florin Tudor ZURINI

Scientific Coordinator: Assoc. Prof. Biotech. PhD Irina GREBENIȘAN

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: + 4021.318.25.67

Corresponding author email: office_eba@yahoo.com

Abstract

This paper presents the results obtained in the research conducted for the case study included in the Bachelor's Thesis. All experiments underlying this study were performed in the laboratory of Ecology and Environmental Microbiology within the Faculty of Land Reclamation and Environmental Engineering within the U.S.A.M.V. Bucharest. In this paper we present the results obtained by testing the microorganisms from the consortium present in the soil sample taken from the vegetable garden of the Zurini family from Crucea de Piatră, Călugăreni commune, Giurgiu county and the new strain of Bacillus sp. isolated. This new edaphic bacterial strain of the genus Bacillus isolated and identified by us has the ability to produce biofilms and inhibitory compounds (like antibiotics and organic volatile compounds) that inhibited the development of phytopathogenic fungi in the complex that creates the fall of seedlings in beans (Phaseolus vulgaris), root rot and hypocotyl (Pythium sp., Rhizoctonia sp., Fusarium sp.,) that are naturally present in the soil or on the beans. Also, the new edaphic bacterial strain Bacillus sp. has the ability to stimulate the germination and development of bean plants (Phaseolus vulgaris), in addition to the ability to provide protection against infection with phytopathogenic fungi from the soil.

Key words*: beneficial soil microbes, improve germination, Phaseolus vulgaris L plant growth, protection against fungal soil-borne phytopathogens.*

INTRODUCTION

Many soil-borne fungal pathogens are widespread throughout dry bean and snap bean growing areas around the world. Yield losses range from a trace to 100 percent, especially when adverse environmental conditions persist after planting and through flowering. The most common diseases and their pathogens are Rhizoctonia root and pod rots (*Rhizoctonia solani*), Pythium damping off, wilt and pod rot (various *Pythium* species) and Fusarium root rot or dry rot (*Fusarium solani* f. sp. *phaseoli*), Fusarium wilt or yellows (*Fusarium oxysporum* f. sp. *phaseoli*).

Root rots are favored by moderate to high soil moisture, various soil temperature regimes, soil compaction, poor drainage, continuous or frequent cropping to beans, and other factors that cause plant stress.

Pathogens survive for years in infected debris and infested soil. Root rot fungi can persist for many years in previously infected bean debris and infested soil by producing overwintering structures. These may be thick-walled spores (*Pythium* oospores and *Fusarium* chlamydospores), hyphae (fungal threads of *Rhizoctonia*), or small dark sclerotia (*Rhizoctonia*).

Overwintering structures are stimulated to germinate by plant exudates from developing susceptible tissue such as bean roots. Structures also may be stimulated by non-host roots to germinate harmlessly or maintain and reproduce themselves until susceptible plant tissue becomes available. The inoculum densities (numbers of survival structures per unit of soil) of these pathogens can be reduced by naturally-occurring soil-borne organisms that are antagonistic to them (Schwartz et al, 2005).

The incidence and severity of each root rot fungus and the disease complex they cause are affected by many environmental, host and cultural factors, such as: soil moisture, temperature, compaction, organic matter, fertility, bean rotation, other crops, plant density, seed quality, cultivation, irrigation runoff.

Rhizoctonia root rot symptoms may occur on scattered plants in a somewhat circular to irregular field pattern. The fungus can cause seedling death (damping off), root and hypocotyl rot, stem cankers and pod rot.

Initial symptoms appear on roots or hypocotyls soon after planting as linear or circular reddish-brown sunken lesions or cankers delimited by a brown to reddish-brown margin. Cankers can enlarge with age and become darker and rough-textured and retard plant growth. The pathogen can invade the central part of the lower stem and produce a brick-red discoloration of older seedlings.

Severely infected seedlings or young plants may be killed or break off at the infected and weakened portions of the hypocotyl. Lesions also can develop on pods in contact with the moist soil surface, and cause pod rotting and seed (Schwartz et al, 2011).

Pythium problems usually are scattered throughout a field, thus the affected sectors do not form a pattern. The pathogen may affect seeds, seedlings, young and older plants, and pods. The fungus can cause seed decay and seedling death. Initial root symptoms appear as elongated water-soaked areas on the hypocotyl and roots. Symptoms usually occur within one to three weeks after planting. Initially, the infected outer tissue of the stem becomes slimy and can easily slip from the central core at this stage. However, eventually it dries out, becomes sunken, and turns tan to brown in color.

Severely infected plants commonly wilt and die. Pods in contact with moist soil also may become infected and exhibit a watery soft rot and mass of white fungal mycelia (but without forming the hard black sclerotia associated with white mold disease). The pathogen can extensively prune roots, reduce overall plant growth, and destroy much of the hypocotyl and main root system. A water-soaked region on infected seedlings or plants may extend several inches above the soil line with little, if any, visible evidence of the fungus discoloration (Schwartz et al, 2011).

Soil-borne pathogens of dry beans and other crops can be managed to reduce but not eliminate damage. Integrated and carefully implemented approaches to crop production reduce disease pressure and plant stress. This enables vigorous plants to more successfully obtain nutrients and moisture during critical vegetative and reproductive periods.

In nature, bacteria form complex and differentiated multicellular communities, known as biofilms. The coordinated actions of many cells, communicating and dividing labour, improve the ability of the biofilm community to resist antibiotics and environmental assaults. In many instances, biofilms can be beneficial in agricultural ecosystems. One example is the biocontrol agents that form biofilms on the surface of plant roots, producing antibiotics that prevent the growth of bacterial and fungal pathogens and inducing the plant systemic response (Hou et al., 2021).

The soil bacterium *Bacillus subtilis* forms beneficial biofilms that induce plant defences and prevent the growth of pathogens. It is naturally found in the rhizosphere, where microorganisms coexist in an extremely competitive environment, and thus have evolved a diverse arsenal of defence mechanisms. The main organic components of its biofilm extracellular matrix (ECM) are exopolysaccharides (EPS), BslA, a protein forming a hydrophobic coat protecting the biofilm and the amyloid-like protein TasA. Amyloid-like proteins such as TasA are extremely common in bacterial biofilms, and their assembly into fibres is important for the integrity and structure of biofilms. In addition to its structural role, the ECM is essential for *B. subtilis* spreading (Hou et al., 2021).

Like other bacteria, *B. subtilis* produces a wide repertoire of volatile compounds (VCs)—biologically active airborne molecules. VCs are used by bacteria to interact with their environment, and were first identified as cross-kingdom signals influencing survival and behaviour of fungi, plants and vertebrates. However, VCs are also used as chemical signals during bacteria–bacteria interactions, altering motility, growth and differentiation, affecting virulence and boosting antibiotic and stress

resistance of various bacterial species. Recent evidence suggests that VCs may also modulate the development of bacterial communities. In nature, biofilms exist in an extremely competitive environment, and thus engage in both positive and negative interaction. While the ability to coordinate biofilm development within a community is beneficial in some cases; the ability to inhibit competing biofilm development is no less significant. In a systematic study of biological activity of VCs on four bacterial species, several VCs (including 1-butanol, ethanol, indole and others) were found to affect biofilm formation as judged by bacterial adhesion to a microtiter plate, but the effects were highly compound- and species-specific. For *B. subtilis*, it has been reported that ammonia and acetic acid produced by *B. subtilis* pellicles (floating biofilms) stimulate neighbouring pellicle formation. On the other hand, one study has shown that biocontrol strain *Bacillus amyloliquefaciens* SQR-9 produced volatiles inhibiting the growth of plant pathogen *Ralstonia solanacearum*. In addition to the effect of VCs on the growth of the pathogen, the VCs also reduced colony spreading, motility, production of exopolysaccharides and surface attachment of their own producers. Those results suggest that in nature, the role of VCs is highly context-dependent, and that additional studies are needed to understand the mechanisms mediating the effects of VCs produced by biofilms during ecological microbial interactions (Hou et al., 2021).

This paper presents the results obtained in the research conducted for the case study included in the Bachelor's Thesis. All experiments underlying this study were performed in the laboratory of Ecology and Environmental Microbiology within the Faculty of Land Reclamation and Environmental Engineering within the U.S.A.M.V. Bucharest.

In this paper we present the results obtained by testing the microorganisms from the consortium present in the soil sample taken from the vegetable garden of the Zurini family from Crucea de Piatră, Călugăreni commune, Giurgiu county and the new strain of *Bacillus* sp. isolated.

This new edaphic bacterial strain of the genus *Bacillus* isolated and identified by us has the ability to produce biofilms and inhibitory compounds (like antibiotics and organic volatile compounds) that inhibited the development of phytopathogenic fungi in the complex that creates the fall of seedlings in beans (*Phaseolus vulgaris*), root rot and hypocotyl (*Pythium sp., Rhizoctonia sp., Fusarium sp.,*) that are naturally present in the soil or on the beans. Also, the new edaphic bacterial strain *Bacillus* sp. has the ability to stimulate the germination and development of bean plants (*Phaseolus vulgaris*), in addition to the ability to provide protection against infection with phytopathogenic fungi from the soil.

MATERIALS AND METHODS

1. Determining the physicochemical parameters of the soil.

We determined N, P, K and pH with the Hanna Instruments soil analysis kit.

The nitrogen, phosphorus, and pH tests are colorimetric tests. During the tests, a colour is developed which corresponds with the fertility of the soil. To determine the fertility, the colour developed has to be compared with one of the supplied colour cards.

The reagents for nitrogen follow the Ned method to determine concentration as nitrate-nitrogen (NO_3--N). These reagents are designed to be used with samples to generally indicate the nitrogen amount in trace, low, medium, and high quantities.

The reagents for phosphorus follow the ascorbic acid method to determine concentration as phosphorus pentoxide (P_2O_5). These reagents are designed to be used with samples to generally indicate the phosphorus amount in trace, low, medium, and high quantities.

The reagents for pH follow the colorimetric indicator method to determine soil pH. These reagents are designed to be used with samples that have an expected pH range of 4 to 9 pH.

The potassium (K_2O) test is a turbidimetric test. If potassium is present in a soil sample, turbidity is formed. A blue colour will also develop to help in reading the test result. To determine the amount of potassium present, the colour developed has to be compared with the supplied colour card.

The reagents for potassium follow the tetraphenylborate method to determine concentration as potassium oxide (K_2O). These

reagents are designed to be used with samples to generally indicate the potassium amount in trace, low, medium, and high quantities.

2. In vitro culture in the laboratory.

Experiment to test the capacity of the new soil isolate *Bacillus* sp., to germinate and stimulate the growth of bean plants (*Phaseolus vulgaris*) and to inhibit the phytopathogenic fungi *Pythium* sp., *Fusarium* sp. and *Rizoctonia* sp. took place in March 2022.

In order to carry out the experiment to stimulate the germination and growth of *Phaseolus vulgaris* bean plants and protection against phytopathogenic fungi in the soil, we went through the following stages:

a) We weighed 600 g of soil and distributed it evenly, 50 g in each container for each of the three replicas of the control, marked M, sample 1, marked P1, sample 2, marked P2 and sample 3 marked P3.

b) The control (M) contained only beans, sample 1 (P1) contained beans and microorganisms from the soil extract with the consortium of microorganisms, sample 2 (P2) contained beans and bacterial suspension from the newly isolated bacterium Bacillus from the soil, microorganisms, and sample 3 (P3) contained soil extract with the consortium of microorganisms and bacterial suspension from the pure culture of the new bacterial isolate Bacillus sp.

After planting the bean seeds in containers containing 50 g of unsterilized soil, 5 mL of suspension was added from the soil extract containing the consortia of microorganisms in sample P1, 5 mL of *Bacillus* bacterium suspension containing 123 x 10^5 cells/ mL in sample P2 and 2.5 mL of suspension from the soil extract containing the consortia of microorganisms plus 2.5 mL of suspension *Bacillus* bacterium containing 123 x 10^5 cells/ mL in sample P3.

c) All samples were kept at room temperature throughout the experiment. During this period, periodic observations were made of the containers containing the control and the three samples, each in three replicas.

The period from planting to germination was noted, observations were made regarding the difference between each sample and control, the degree of development of each seedling, and at the end of the experiment the plants were measured and weighed. Weighing the bean seedlings was done with a Precisa balance. The degree of protection of the plants against the attack of the phytopathogenic fungi Pythium sp., *Fusarium* sp. and *Rizoctonia* sp. was also noted.

RESULTS AND DISCUSSIONS

1. Determining the physicochemical parameters of the soil.

The assessment of the physicochemical results achieved with the help of the soil test from Hanna Instruments is made qualitatively compared to the standard cards provided by the manufacturer. Thus, this type of colorimetric test based on color reactions, as described in the section Materials and Methods for nitrogen, phosphorus and pH, the following values were obtained: nitrogen a medium concentration, phosphorus a high concentration, and the pH value of former 5.

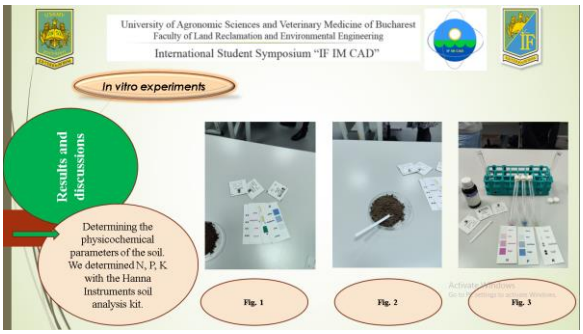

Figure 1. Determining the physicochemical parameters of the soil

The amount of nitrogen and phosphorus is directly proportional to the color intensity obtained in the test tubes. The stronger the coloration, from pale pink to dark pink fuchsia, the more nitrogen there is in the soil sample. The soil sample analyzed by us showed a pink color at level three intensity, which is equivalent to an average nitrogen concentration. In the same way, the concentration of phosphorus in the soil sample is interpreted with the difference that in this color reaction results a blue colored compound.

The soil sample we analyzed for phosphorus showed a blue color at level four (maximum)

intensity, which is equivalent to a high concentration of phosphorus.

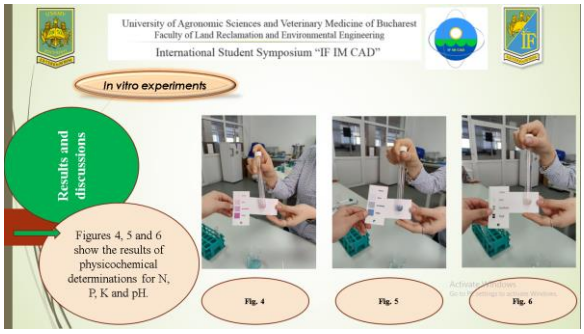

Figure 2. Results of physicochemical determinations for N, P, K

The pH value obtained with the Hanna Instruments colorimetric test was 5, so the analyzed soil has a weakly acidic value.

The analysis for the potassium present in the soil sample is a turbidimetric analysis, which means that the potassium concentration is assessed by observing the test tube with the cardboard provided by the manufacturer and observing how cloudy or transparent the sample is. The more cloudy the soil sample, the higher the potassium concentration in the soil. In the case of the soil sample analyzed by us, we obtained a low to medium potassium concentration.

2. In vitro culture in the laboratory.

Experiment to test the capacity of the new soil isolate *Bacillus* sp., to germinate and stimulate the growth of bean plants (*Phaseolus vulgaris*) and to inhibit the phytopathogenic fungi *Pythium* sp., *Fusarium* sp. and *Rizoctonia* sp. took place in March 2022 in the laboratory of Ecology and Environmental Microbiology.

Five days after planting, the beans began to germinate only in samples P1, P2 and P3 with small differences in rhythm, in sample P1 the least (slowly), in sample P2 the most (fast) and in the intermediate P3 sample between the two samples. In the control containers, the beans did not germinate. The beans planted in the three replicas of the control (M) did not germinate at all, due to contamination with phytopathogenic fungi *Pythium* sp., *Fusaium* sp. and *Rizoctonia* sp.

The control (M) contained only beans, sample 1 (P1) contained beans and microorganisms from the soil extract with the consortium of microorganisms, sample 2 (P2) contained beans and bacterial suspension from the newly isolated bacterium *Bacillus* from the soil, microorganisms, and sample 3 (P3) contained soil extract with the consortium of microorganisms and bacterial suspension from the pure culture of the new bacterial isolate *Bacillus* sp.

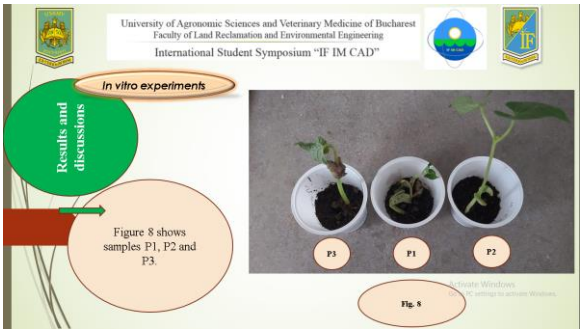

Figure 3. Samples P1, P2 and P3

In the P1 sample containers, we noticed that the seedlings, after they started to grow, were attacked by phytopathogenic fungi present in the soil and on the beans naturally.

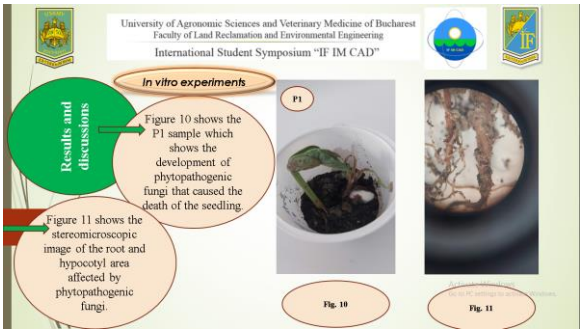

Figure 4. Stereomicroscopic image of the root and hypocotyl area affected by phytopathogenic fungi

In the P2 sample containers we noticed that the seedlings had the fastest growth rate, vigor and showed no signs of infection with the phytopathogenic fungi *Pythium* sp., *Fusarium* sp. and *Rhizoctonia* sp., which means that the applied suspension contained suspension of newly isolated bacteria by us, *Bacillus* sp. stimulated the germination of beans and the development of seedlings. Also due to the antifungal substances that these bacteria can produce in the soil in the niche competition with phytopathogenic fungi.

In the containers with sample 3 (P3) we noticed that the beans germinated, the seedlings

developed, but had smaller dimensions and less weight than those developed in sample 2 (P2).
At the end of the experiment, when the seedlings were removed from containers and weighed, measured and observed under a stereomicroscope in the hypocotyl and root area, we observed that in sample 1 (P1) the seedlings showed signs of damage caused by fungal infection, staining in reddish brown and softening of the hypocotyl area.
The seedlings in sample 1 (P1) had the lowest weight (1.89 g), those in sample 2 (P2) had the highest weight (2.49 g), and those in sample 3 (P3) had an average weight (2.38 g).
Regarding the size of the seedlings, those in sample 1 (P1) were 11 cm without root and 15 cm with root, those in sample 2 (P2) were 36 cm without root and 43.5 cm with root, and those in sample 3 (P3) had 23 cm without root and 30 cm with root.

CONCLUSIONS

In this paper we present the results obtained by testing the microorganisms from the consortium present in the soil sample taken from the vegetable garden of the Zurini family from Crucea de Piatră, Călugăreni commune, Giurgiu county and the new strain of *Bacillus* sp. isolated.
After planting the bean seeds in containers containing 50 g of unsterilized soil, 5 mL of suspension was added from the soil extract containing the consortia of microorganisms in sample P1, 5 mL of Bacillus bacterium suspension containing 123 x 10^5 cells/ mL in sample P2 and 2.5 mL of suspension from the soil extract containing the consortia of microorganisms plus 2.5 mL of suspension *Bacillus* bacterium containing 123 x 10^5 cells/ mL in sample P3.
This new edaphic bacterial strain of the genus *Bacillus* isolated and identified by us has the ability to produce biofilms and inhibitory compounds (like antibiotics and organic volatile compounds) that inhibited the development of phytopathogenic fungi in the complex that creates the fall of seedlings in beans (*Phaseolus vulgaris*), root rot and hypocotyl (*Pythium* sp., *Rhizoctonia* sp., *Fusarium* sp.,) that are naturally present in the soil or on the beans. Also, the new edaphic bacterial strain *Bacillus* sp. has the ability to stimulate the germination and development of bean plants (*Phaseolus vulgaris*), in addition to the ability to provide protection against infection with phytopathogenic fungi from the soil.
This paper presents the results obtained in the research conducted for the case study included in the Bachelor's Thesis. All experiments underlying this study were performed in the laboratory of Ecology and Environmental Microbiology within the Faculty of Land Reclamation and Environmental Engineering within the U.S.A.M.V. Bucharest.
All experiments were performed in triplicate.

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STUDIES ON FINDING MICROBIAL GROWTH AND YIELD ENHANCER FOR PLANTS

Elena ZURINI, Ana Maria PREDA, Florin Tudor ZURINI

Scientific Coordinator: Assoc. Prof. Biotech. PhD Irina GREBENIȘAN

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: + 4021.318.25.67

Corresponding author email: office_eba@yahoo.com

Abstract

The purpose of this work was to find microbial growth and yield enhancer for plants. This paper presents the results obtained in the research conducted for the case study included in the Bachelor's Thesis. The soil sample was taken from the family vegetable garden located in Crucea de Piatra, Calugareni commune, Giurgiu county from a depth of 5 - 20 cm, after removing the vegetal layer from the surface. The soil sample was transported in a refrigerated box to the laboratory of Ecology and Environmental Microbiology within the Faculty of Land Reclamation and Environmental Engineering within the U.S.A.M.V. Bucharest. In order to achieve the proposed goal, the soil sample taken from the family vegetable garden was analyzed in the laboratory of Ecology and Environmental Microbiology from a microbiological point of view. Thus, the in vitro studies carried out highlighted the great biological diversity of the analyzed soil sample and of some relationships that exist between the different groups of microorganisms in this microcosm. Thus, the use of consortia of microorganisms present in this soil sample allowed us to obtain new strains of microorganisms with properties for growing and stimulating plant development, which we can continue to use in other studies that we will do in the laboratory and in vivo in the vegetable garden.

Key words*: new microbial growth and yield enhancer strains for plants, soil microbial microcosm.*

INTRODUCTION

The soil supporting today's agriculture activities is lacking sufficient microbial activity to promote healthy plant growth. This is due primarily to an over reliance on pesticides to control disease and insect infestation. These synthetic chemicals also destroy non-target organisms, namely the essential bacteria and microbes found in healthy soil. Beneficial microorganisms are necessary to promote healthy, vigorous plant growth. When microbial population is depleted the plant growth system becomes stressed giving rise to a myriad of problems. Our soil microbial consortium is an all-natural product with unique microbial systems as a response to this problem (https://www.malatechwater.com/).

This soil microbial consortium should be a microbial system with unique properties like helping soil to establish beneficial microbes by providing certain unique nitrogen fixing, phosphorus solubilizing, and plant growth factor producing natural microbes. It is not only how many bacteria but also the type and functionality of the bacteria that is very important for overall plant growth. These microbes should be able to extract nutrients from the mineral part of the soil and eventually pass the nutrients on to plants.

A good plant growth and yield enhancer should have a number of features, such as these:

- Promotes conversion of soil elements including phosphorus, into plant available forms.
- Increases resistance to plant diseases.
- Revitalizes the soil. Helps decompose soil organics.
- Biodegradable and not harmful to the soil.
- Increases soil buffering properties by increasing humus level.
- Chelates metal ions in alkaline conditions, increasing plant availability.
- Stimulates plant growth by naturally accelerating cell division.
- Increases seed germination and viability.
- Stimulates root growth, thus increasing root density.
- Increases root respiration.
- Stimulates plant enzymes.

- Helps reduce fertilizer load.
- Helps reduce dependence on chemical applications.
- Better quality and yield.
- Helps faster flowering and faster fruiting.
- Completely organic.

Soil bacteria are very important in biogeochemical cycles and have been used for crop production for decades. Plant–bacterial interactions in the rhizosphere are the determinants of plant health and soil fertility. Free-living soil bacteria beneficial to plant growth, usually referred to as plant growth promoting rhizobacteria (PGPR), are capable of promoting plant growth by colonizing the plant root. PGPR are also termed plant health promoting rhizobacteria (PHPR) or nodule promoting rhizobacteria (NPR). These are associated with the rhizosphere, which is an important soil ecological environment for plant–microbe interactions (Hayat et al., 2010).

Plants have co-evolved with soil microbes over hundreds of millions of years. As bacteria colonized the Earth and transformed the atmosphere over three billion years ago, they created conditions which made it possible for the evolution of soil fungi (approximately 900 millions of years ago). Together, bacteria and fungi shaped Earth's soil structure and created habitable conditions for the evolution of plants around 700 millions of years ago.

Soil microbes are ubiquitous, meaning they are abundant in most terrestrial environments. For example, more microbes can be found in one gram of soil than there are people on the Earth! This is important because these tiny soil microbes play a huge role in supporting plant growth.

Bacterial and fungal species work together in clusters (i.e. consortia) to support plant growth along the rhizosphere (i.e. the soil root zone) primarily by delivering nutrients and preventing disease. For example, soil bacteria and fungi continually increase soil nutrient availability by transforming unavailable nutrients into bioavailable forms for plant uptake. Microbes also act as a biofertilizer by releasing critical nutrients when they die. Without microbes, plants wouldn't have the constant supply of nutrients they need to grow.

Beyond nutrient cycling, microbes produce hormones and other chemicals to stimulate plant growth. Soil microbes can also prevent pathogen infection by inducing plant systemic disease resistance and by coating root surfaces to physically shield the plant from getting infected by pathogens (Bell, C, 2021).

Plant growth-promoting rhizobacteria (PGPR) are free-living bacteria of beneficial agricultural importance. The PGPR present encourage beneficial effects on plant health and growth, suppress disease-causing microbes and accelerate nutrient availability and assimilation. Thus, in the quest to improve soil fertility and crop yield and to reduce the negative impacts of chemical fertilizers on the environment, there is a need to exploit PGPR for continued beneficial agricultural purposes. PGPR exist in the rhizosphere and this is defined as the region around the root (Babalola, 2010).

Co-inoculation of multiple PGPRs, inoculation with mixed different strains could be an alternative to inoculation with individual strains, likely reflecting the different mechanisms used by each strain in the consortium. Combined inoculation with N2-fixing bacteria and phosphate solubilizing bacteria were more effective than a single microorganism for providing a more balanced nutrition for plants. There are numerous examples in wheat whereby synergistic effects of multiple PGPRs are observed (Çakmakçı et. al., 2017).

A *Bacillus subtilis* strain showed a variety of colony growth patterns on agar plates. The bacterium grew to fractal colony through the diffusion-limited aggregation process, a round colony reminiscent of the Eden model, a colony with a straight and densely branched structure similar to the dense branching morphology, a colony spreading without any openings, and a colony with centric rings, on plates with various agar and nutrient concentrations. The microstructures of these colonies were also characteristic and dynamic. The patterns of these bacterial colonies were thought to grow in relation to the diffusion of nutrient in agar plate (Fujikawa, 1994).

The Gram-positive, rod-shaped bacterium *Bacillus subtilis* is usually found in soil. *B. subtilis* is considered to be non-pathogenic to humans and was shown to be beneficial to plants when in association with plant roots. The species is widely used in microbiology research and is considered to be a facile model organism for the

study of biofilms, particularly due to its ability to form distinctly segmented three-dimensional colony biofilms. Under conditions of stress, *B. subtilis* forms endospores that can withstand extreme environmental conditions for prolonged periods of time, thus enabling the survival of the organism under conditions such as nutrient depletion or under other various unfavorable environments (Gingichashvili et al., 2017).

This paper presents the results obtained in the research conducted for the case study included in the Bachelor's Thesis. The purpose of this work was to find microbial growth and yield enhancer for plants. In order to achieve the proposed goal, the soil sample taken from the family vegetable garden was analyzed in the laboratory of Ecology and Environmental Microbiology from a microbiological point of view. Thus, the in vitro studies carried out highlighted the great biological diversity of the analyzed soil sample and of some relationships that exist between the different groups of microorganisms in this microcosm. Thus, the use of consortia of microorganisms present in this soil sample allowed us to obtain new strains of microorganisms with properties for growing and stimulating plant development, which we can continue to use in other studies that we will do in laboratory and *in vivo* in the vegetable garden.

MATERIALS AND METHODS

The soil sample was taken from the family vegetable garden located in Crucea de Piatră, Călugăreni commune, Giurgiu county from a depth of 5 - 20 cm, after removing the vegetal layer from the surface. The soil sample was transported in a refrigerated box to the laboratory of Ecology and Environmental Microbiology within the Faculty of Land Reclamation and Environmental Engineering within the U.S.A.M.V. Bucharest.

The laboratory work steps were as follows:

1. Preparation of culture media - in these experiments we used two types of culture media - the culture medium with agar potato extract PDA (20 g dextrose, 200 g potatoes infusion, 15 g agar) and the solid culture medium LB (Luria-Bertani) which after preparation we sterilized for 20 minutes at 120 degrees Celsius in an autoclave;

   Preparation of Potato Dextrose Agar Medium for 1000 mL
   - boil 200 g of sliced peeled potatoes in 1000 mL water for 30 minutes;
   - filter through cheesecloth, saving effluent, which is potato extract, infusion;
   - add dextrose and agar and shake the ingredients in bottle with a magnetic stirrer to dissolve the reagents and add distilled water to a final volume to 1000 mL;
   - sterilize by autoclaving at 1.2 atm pressure (120°C) for 20 minutes;
   - pH 5.6 ±0.2

   Preparation of LB (Luria-Bertani) Agar Medium for 1 000 mL
   - weigh out 10 g tryptone, 10 g sodium chloride (NaCl) and 5 g yeast extract and add to a 1 L Duran bottle;
   - measure out approximately 900 mL of distilled water and add to the Duran bottle;
   - shake the ingredients in bottle with a magnetic stirrer to dissolve the reagents and add distilled water to a final volume to 1000 mL;
   - sterilize by autoclaving at 1.2 atm pressure (120°C) for 20 minutes;
   - pH 7 ± 0.2
2. Obtaining the soil extract - realization of the soil extract for obtaining consortia of microorganisms with potential in stimulating plant growth. We weighed 5 grams of soil with a Precisa balance, which we suspended in 10 ml of sterile distilled water;
3. Observation of the soil extract suspension under an optical microscope. To highlight some morphological characteristics of microorganisms (the size, shape, and arrangement of cells, types of microorganisms – bacteria or fungi) we prepared living, unstained preparations as a wet mount;
4. Cultivation of the soil extract on solid PDA and LB (Luria-Bertani) culture media. The soil extract containing the consortia of microorganisms was inoculated in accordance with the sanitary rules in the microbiological hood, 1 ml

each on petri dishes with solid medium LB (Luria-Bertani) and PDA, then incubated at room temperature for 18-24 hours (LB plate), and respectively 4-5 days (PDA plate);
5. Isolation in pure culture of soil bacteria. We used the serial dilution technique from the soil extract to dilution 1/104. After that we cultured on solid culture medium LB (Luria-Bertani) 1 ml of the last dilution, then we incubated the petri dishes inoculated at room temperature for 18 hours;
6. Obtaining new bacterial colonies with potential properties in germination, plant growth and protection against specific phytopathogenic fungi that come from the soil. We used the loop impoverishment technique to obtain isolated colonies in pure culture of soil bacteria, in order to characterize them microbiologically (macroscopic appearance of the colony, type of colony, color, appearance of colony edges, microscopic appearance of cells, morphology, form and grouping mode).

RESULTS AND DISCUSSIONS

The purpose of this work was to find new microbial growth and yield enhancer strains for plants.
This paper presents the results obtained in the research conducted for the case study included in the Bachelor's Thesis.
The culture media prepared in the laboratory allowed us to observe and identify new strains of microorganisms with properties for growing and stimulating plant growth and protection against infection with phytopathogenic fungi from the soil.
Obtaining the soil extract according to the method presented in the section Materials and methods and observing it in wet mount preparations under the optical microscope allowed us to highlight the microorganisms present in the soil consortia, which we then isolated in pure culture to use in subsequent experiments.
The cultivation of the soil extract on PDA and LB specific media highlighted the development of microorganisms from the consortium of the soil microcosm. Then from these colonies of new microorganisms we isolated in pure culture a new strain of bacteria.
The new bacterial strain from the soil sample taken from the vegetable garden of the Zurini family in the locality Crucea de Piatră, Călugăreni commune, Giurgiu county was isolated in pure culture on solid LB medium.
When cultured on ordinary nutrient agar, the morphology circular colony of this bacteria was rough, opaque, fuzzy white or slightly yellow with jagged edges.
The appearance of cells under a microscope is characteristic of bacillus-type cells, rod-shaped and Gramm staining revealed that they are gram-positive bacilli.

CONCLUSIONS

The purpose of this work was to find microbial growth and yield enhancer for plants. This paper presents the results obtained in the research conducted for the case study included in the Bachelor's Thesis. The soil sample was taken from the family vegetable garden located in Crucea de Piatra, Calugareni commune, Giurgiu county from a depth of 5 - 20 cm, after removing the vegetal layer from the surface. The soil sample was transported in a refrigerated box to the laboratory of Ecology and Environmental Microbiology within the Faculty of Land Reclamation and Environmental Engineering within the U.S.A.M.V. Bucharest. In order to achieve the proposed goal, the soil sample taken from the family vegetable garden was analyzed in the laboratory of Ecology and Environmental Microbiology from a microbiological point of view. Thus, the in vitro studies carried out highlighted the great biological diversity of the analyzed soil sample and of some relationships that exist between the different groups of microorganisms in this microcosm. Thus, the use of consortia of microorganisms present in this soil sample allowed us to obtain new strains of microorganisms with properties for growing and stimulating plant development, which we can continue to use in other studies that we will do in the laboratory and in vivo in the vegetable garden.
Studies conducted in the laboratory of Environmental Ecology and Microbiology have allowed us to isolate in pure culture a new

bacterial strain, which we will use in subsequent experiments to test the ability to stimulate germination and plant growth and also for the ability to inhibit phytopathogenic fungi.

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SECTION 02
SUSTAINABLE DEVELOPMENT OF RURAL AREA

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WATER QUALITY IN RURAL AREAS

Ana Maria PREDA, Beniamin Adelin GARVĂN

Scientific Coordinator: Lect. PhD Constanța MIHAI

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: + 4021.318.25.67

Corresponding author email: anamaria.preda09@gmail.com

Abstract

Water is one of the most fundamental needs to support people's livelihood. Access to water and sanitation is even recognized by the United Nations as human rights, which reflects the crucial role of water in human lives. But we need to keep our water as clean as possible.
In many rural areas, the sewerage system is completely missing. People use the water from the well, and the water used returns either to uninsulated septic tanks or directly to the soil. This can endanger public health and soil quality. The purpose of this work is to determine the physico-chemical indices of water in the Butimanu village, Dambovita county, rural area, to integrate into quality classes and to find a suitable solution that would put an end to this circuit.

Key words*: health, quality, rural, water.*

INTRODUCTION

Romania has an area of 238 000 km², of which 87% is represented by the rural area. (European Commission, 2021). The rural population is currently about 9.24 million people (46% of the population) (Otiman, 2012). Most of these rural areas have something in common: the lack of a sewerage system and a water network.

Figure 1. Position of the village on map

In this study, we chose Butimanu, Dambovita county, Muntenia geographical coordinates: 44°41′34"N 25°53′47"E. According to the census conducted in 2011, the population of Butimanu village amounts to 2,435 inhabitants, up from the previous census in 2002, when 2,359 inhabitants were registered. In this locality, the sewerage system is missing, and in its absence, all the wastewater is ejected into septic tanks, which are not waterproofed, and when they are emptied by a septage, the wastewater is not taken to a purification station, instead it is dumped in the immediate outskirts of the village, in agricultural areas, directly on the ground.
The main activities in this area are, fishing, agriculture and animal husbandry. But agriculture is based on pesticides and insecticides, and animal waste is stored directly on the soil and not on a waterproof platform.
Following these observations, we analyzed samples of water from the shallow depth and surface water, in order to observe the effects of the discharge of waste water in undeveloped places.

MATERIAL AND METHODS

Name of samples and geographical position

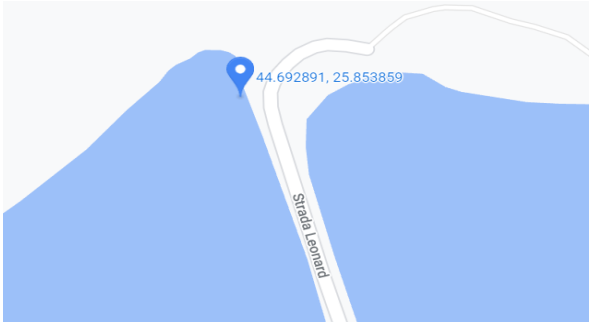


Figure 2. P01- Left side lake test (Surce: Google Earth)

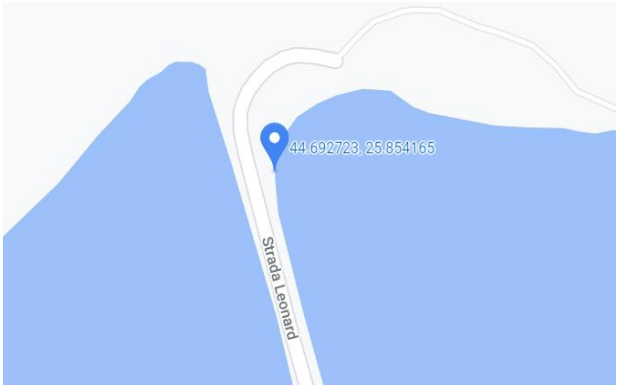


Figure 3. P02- Right side lake test (Surce: Google Earth)

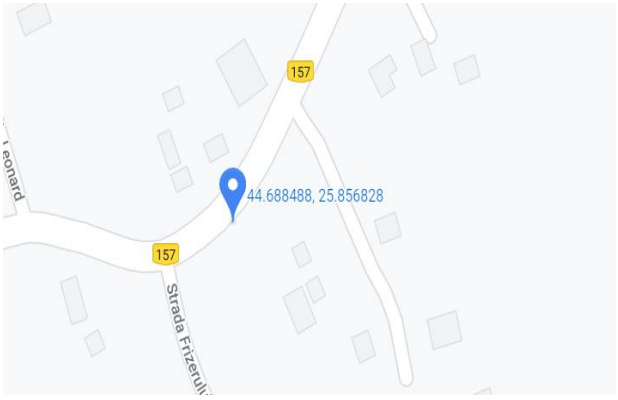


Figure 4. P03- Household test (Surce: Google Earth)

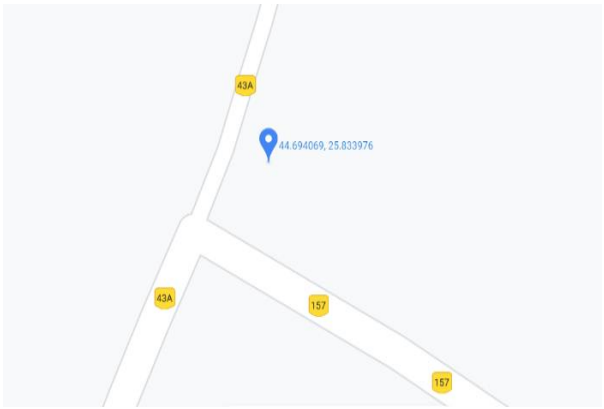


Figure 5. P04- Public well test (Surce: Google Earth)

The collection of water samples was carried out according to the norms for collecting surface and shallow water. Water samples were collected in wrinkle bottles so that the Sun's rays did not change the properties of the sample.

In order to measure the environmental impact and risk we used the colorimetric method for pH, NH4+, NO3, NO2, potentiometric method for E.C and DO. The method of determining TDS in water supplies most commonly used is the measurement of specific conductivity with a probe that detects the presence of ions in water. Conductivity measurements are converted into TDS values by means of a factor that varies with the type of water (12,13).

BOD5 was determined with the tritimetric method, the principle of the method being the determination of the biochemical oxygen consumption within a period of 5 days by the microorganisms in the water, by the difference between the amount of oxygen found in the water sample on the day of harvesting and 5 days after.

This method allows the measurements of impact and risk using specific indicators, which are characterizing the water quality. The specific indicators that characterize the water quality in this study were: pH, E.C, NH4+, NO3, TDS. The time interval for sampling and analysis of the samples started in December 2021 and ended in February 2021. This provided a 3 months window for impact and risk monitoring.

Description of parameters

Dissolved oxygen (DO) is one of the most important indicators of water quality. It is essential for the survival of fish and other aquatic organisms. Oxygen dissolves in surface water due to the aerating action of winds. Oxygen is also introduced into the water as a byproduct of aquatic plant photosynthesis. When dissolved oxygen becomes too low, fish and other aquatic organisms cannot survive. Oxygen levels also may be reduced when there are too many bacteria or algae in water (see Biochemical Oxygen Demand). After the algae complete their life cycle and die, they are consumed by bacteria. During this decay process the bacteria also consume the oxygen dissolved in the water. This can lead to decreased levels of biologically available oxygen, in some cases leading to fish and to other aquatic organisms to die. (Sarasota County, USF Water Institute).

PH Measures the activity of hydrogen ions in water. PH is an indicator of whether the water is acidic, neutral, or basic.

Electrical conductivity measures how well can an electrical current travel through the soil water. Electrical conductivity is an indicator of how much salt is present in the soil

Total dissolved solids (TDS) is the term used to describe the inorganic salts and small amounts of organic matter present in solution in water. (WHO, 2016).

Nitrites NO2, nitrates NO3, these compounds are present in waters as ions, compounds that are involved in the nitrogen cycle. The main source of nitrite and nitrate in water is the wastewater untreated properly, agriculture (inorganic nitrogenous fertilizers), and oxidation of nitrogenous waste in human and animal excreta (World Health Organization, 2011).

Nitrate (NO3) and nitrite (NO2) are forms of nitrogen in the environment, both natural and human-made. Large amounts of nitrate in drinking water can be harmful to a person's health because nitrate can change into nitrite in the human body.

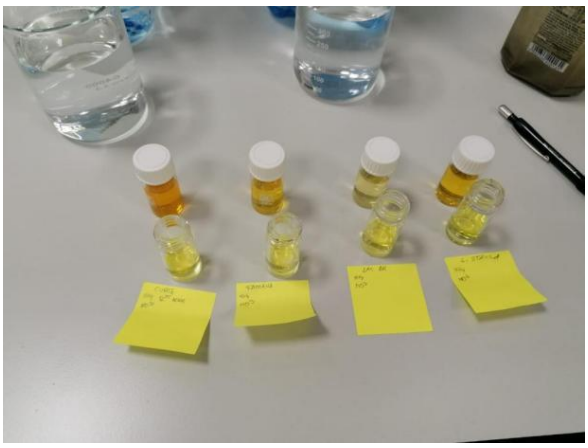
Swallowing high amounts of nitrate and/or nitrite can cause a condition called methemoglobinemia (met·he·mo·glo·bi·ne·mia). This condition affects the blood's ability to carry oxygen. Infants younger than six months of age and pregnant women are more at risk of developing this condition. Others can develop this condition too, such as those with genetic conditions or reduced stomach acidity (MDHHS, 2020).

The presence of NH4+ at high concentrations in a stream or a lake can contribute to eutrophication, that is, massive algae blooming resulting in the depletion of dissolved oxygen in water and the subsequent devastation of aquatic life. Therefore, many countries regulate NH4+ concentration of surface water and wastewater.

Biochemical oxygen demand (BOD) refers to the amount of dissolved oxygen needed by microbes to break down organic material present in a given water sample at certain temperature over a specific time period. BOD is measured in a water sample during 5 days of incubation at 20℃, known as BOD5. BOD represents the amount of organic matter which can be decomposed by aquatic organisms. It also indirectly represents the degree of organic pollution of the water. (Environmental Protection Administration Taiwan, 2020).

Protocol of analysis:

The physico-chemical indices were determined by colorimetric method using the Pro JBL test kit, a quick and easy way to perform for the summary control of NO2, NO3, NH4, and pH inside the surface water as well as the shallow water.



RESULTS AND DISCUSSIONS

Table 1. Date: 01.12.2021

	pH	E.C µS/L	NH4+ Mg/l	NO3 Mg/l	NO2 Mg/l	DO Mg/l	TDS	T℃
P01	7.5	550	0.05	1	0.05	4.5	275	20 ℃
P02	7.8	420	0.05	0.5	0.05	5.9	210	20 ℃
P03	7.2	1970	0.05	80	0.05	5.1	985	20 ℃
P04	7.2	610	0.05	10	0.01	5.0	305	20 ℃

Table 2. Date:27.12.2021 SEMPLES

	pH	E.C µS/L	NH4+ Mg/l	NO3 Mg/l	NO2 Mg/l	DO Mg/l	T℃
P01	8.2	420	0.05	5	0.1	1.1	20℃
P02	8.1	430	0.1	30	0.2	2.2	20℃
P03	7.1	1370	0.05	120	0.05	2.2	20℃
P04	7.5	590	0.05	30	0.025	1.6	20℃

Table 3. Date: 10.02.2022 SEMPLES

	pH	E.C Mg/l	NH4+ Mg/l	NO3 Mg/l	NO2 Mg/l	DO Mg/l	TDS	BOD_5 Mg/l	T℃
P01	7.7	180	0.1	0.5	0.5	7.88	90	2.19	20℃
P02	8.1	220	0.05	0.5	0.1	19.10	110	13.74	20℃
P03	7.2	730	0.05	20	0.01	8.94	365	4.47	20℃
P04	7.3	310	0.05	1	0.01	2.72	155	0.55	20℃

Table 4. Low no 458/2002 CMA for drinking water

pH	C.E **µS/L**	NH4+ Mg/l	NO3 Mg/l	NO2 Mg/l	DO Mg/l	BOD_5 Mg/l
6,5-9,5	2500	0.5	50	0.5	Winter time: 4,0 Summer time: 6,0	3

Table 5. Normative of 16 February 2006 on the classification of the quality of surface water in order to establish the Ecological Status of Water Bodies

pH	C.E µS/L	NH4+ Mg/l	NO3 Mg/l	NO2 Mg/l	DO Mg/l	BOD_5 Mg/l
6.5-9	2500	0.5	1-11,2	1.5	6.2	6

The presence of dissolved solids in water may affect its taste (Bruvold and Ongerth, 1969). The palatability of drinking water has been rated by panels of tasters in relation to its TDS level as follows:

Table 6. TDS water taste

<300 mg/l	Excellent
300-600 mg/l	Good
600-900 mg/l	Fair
900-1200 mg/l	Poor

Interpretation of data for samples P01 and P02 for surface water

The pH value during the three months of observations is between 7.2 - 8.2, these values do not exceed the quality standard of surface water indicating a neutral pH.

Conductivity is a measure of water's capability to pass electrical flow. This ability is directly related to the concentration of ions in the water. These conductive ions come from dissolved salts and inorganic materials such as alkalines, chlorides, sulfides and carbonate compounds. (Langland and Cronin, 2003)

After measuring the electrical conductivity parameters for samples P01 and P02, values between 180 and 550 µS/L were recorded, it can be seen that the concentration of salts dissolved in water is decreasing towards the beginning of spring.

According to the standard of 16 February 2006 on the classification of surface water quality in order to establish the ecological status of water bodies, the electrical conductivity does not exceed the maximum permissible concentration of 2500 µS/L.

After measuring the electrical conductivity parameters for samples P01 and P02, values between 180 and 550 µS/L were recorded, it can be seen that the concentration of salts dissolved in water is also decreasing towards the beginning of spring.

According to the standard of 16 February 2006 on the classification of surface water quality in order to establish the ecological status of water bodies, the electrical conductivity does not exceed the maximum permissible concentration of 2500 µS/L.

Nitrates vary from 0.5-30 mg N/l. There is an increase in the NO3 level at the end of December, unlike the NO3 level at the beginning of the month where the value was 0.5 respective 1 mg N/l.

As can be seen in tables 1, 2 and 3, the level of the N02-N concentration does not exceed the value of the maximum permissible concentration.

The reduction of dissolved oxygen at values of 2 mg of O2/l and less than that leads to the mass perishing of the aquatic fauna. For the winter period, the dissolved oxygen level should not be less than 4 mg / l. In December, for the P01 sample, the dissolved oxygen value is 4.4 mg/l, and for P02 the value is 5.9 mg/l, these values falling within the standards denoted by Law 458/2002. At the end of December, the values dropped to 1.1 mg/l for the P01 sample and 2.2 mg/l for the P02 sample, these values being very low. In the last month of observations, the dissolved oxygen level for P01 is 2.73 mg/l being again a much too low value, but for the P02 sample the determined value is 7.88 mg/l.

According to the Norm of 16 February 2006 ON the classification of surface water quality in order to establish the ecological status of water bodies. Biochemical oxygen consumption for surface waters of 6.0 mg/l. Following the determinations, the values for P01 is 2.19 mg/l and for the P02 sample the value is 13.74 mg/l.

Interpretation of data for samples P03 and P04- drinking water

P03 and P04 are samples of water intended for food consumption.

After determining the Ph value, values between 7.1-7.5 were recorded, these values indicating a neutral pH.

The electrical conductivity indicates values between 310-1970 μS/L. For the water sample that was harvested from the household, the highest values were recorded, between 730-1970 μS/L, these values demonstrating a high concentration of salts dissolved in the water, but still these values do not exceed the maximum concentrations approved by Law no. 458/2002 for drinking water.

P03 and P04 are samples of water intended for food consumption.

After determining the Ph value, values between 7.1-7.5 were recorded, these values indicating a neutral pH.

The electrical conductivity indicates values between 310-1970 μS/L. For the water sample that was harvested from the household, the highest values were recorded, between 730-1970 μS/L, these values demonstrating a high concentration of salts dissolved in the water, but still these values do not exceed the maximum concentrations approved by Law no. 458/2002 for drinking water.

Following further the determined values for NH4+, are 0.05 mg/l throughout the observation range for both water samples, not exceeding the maximum permissible value.

Instead, for NO3 the maximum allowable value is 50 mg/l, and for P03 this value is exceeded. At the beginning of the analysis interval, the water sample had a NO3 concentration of 80 mg/l, increasing to 120 mg/l in the next 30 days, so that in February it would drop to 20 mg/l, this final concentration not exceeding the maximum allowable value.

The NO2 concentration for the P03 and P04 samples is maximum 0.2 mg/l which means that the maximum permissible concentration for the water intended for food consumption is not exceeded.

For drinking water the concentration of dissolved oxygen should not be less than 4.0 mg / l, and in the open summer should not be less than 6.0 mg/l.

The first determination of the P03 and P04 water sample was 5.1 mg/l respectively 5.0 mg/l, being a value that fits into the standard, but at two determinations of dissolved oxygen the values decreased to 2.2 mg/l in the P03 sample, and for the P04 sample 1.6 mg/l.

For February, the concentration of dissolved oxygen began to increase. For the sample P03 OD is 8,94 mg/l and for P04 the value is 19,10 mg/l.

After determining the biochemical oxygen consumption, for P03 the consumption value is 4.47 mg/l being a value that is not adequate for food consumption, and for P04 the value indicates 0.55 mg/l, the maximum concentration allowed according to Law no. 458/2002 is 3 mg/l.

According to the World Health Organization, for water to taste good, TDS values must be lower than 300 mg / l.

For the P03 and P04 water samples, in the first month of measurements, values of 985 mg/l and 305 mg/l were recorded for the P04 sample. The taste of the water in the household, that is, the P03 sample is not satisfactory, and for the water sample from the public fountain is within the parameters that indicate a good quality of the water taste. In the second month of the analysis period for the P03 sample, the value of 685 mg/l was recorded, although the level is lower, compared to the first month, the quality of the water taste still does not fall within the level of excellence. In contrast, for the P04 sample, the recorded value is 295 mg/l, the quality of the taste of the water falling within the excellence class. In the last month of the monitoring interval, the value for the sample P03, being 365 mg/l indicating a good quality of taste quality, and for P04 the value is 155 mg/l remaining at the level of excellent taste quality.

RESULTS AND DISCUSSIONS

Evaluation of quality chemical and physico-chemical elements for rivers and lakes.

Table 7. (Source: Norm 161/2006 on the classification of surface waters)

Nr.crt	Quality indicator	UM	Quality class				
			I	II	III	IV	V
1	Temperature	°C	It is not standardized				
2	Dissolved oxygen	mg O_2/l	9	7	5	4	<4
3	pH	mg/l	It is not standardized				
4	Nitrates ($N\text{-}NO_3^-$)	mg N/l	1	3	5,6	11,2	>11,2
5	Nitrites ($N\text{-}NO_2^-$)	mg N/l	0,01	0,03	0,06	0,3	>0,3
6	Ammonium ($N\text{-}NH_4^+$)	mg N/l	0,4	0,8	1,2	3,2	>3,2

Following the results obtained in the three months of determinations, regarding the variation of the dissolved oxygen quantity, it was found that the values are different depending on the time and season of sampling as it can be seen in Figure 6.

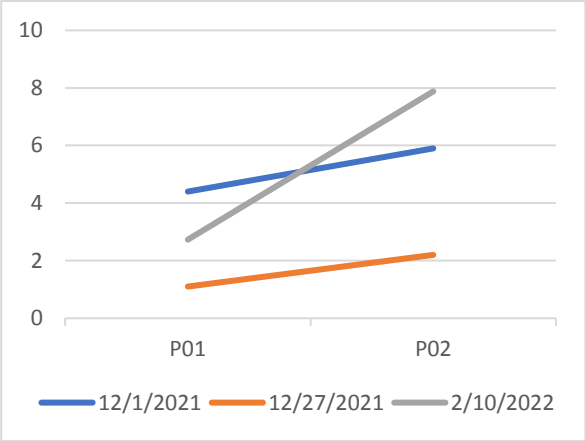


Figure 6. Variation of dissolved oxygen mg/l

The values recorded after the determinations of the NO3 concentration for the P01 sample, the variations were not high, indicating the integration of the water in the I and II quality clamps but for the P02 sample, the values were between 0.5 and 30 mg/l. This result is classifying water in quality class V.

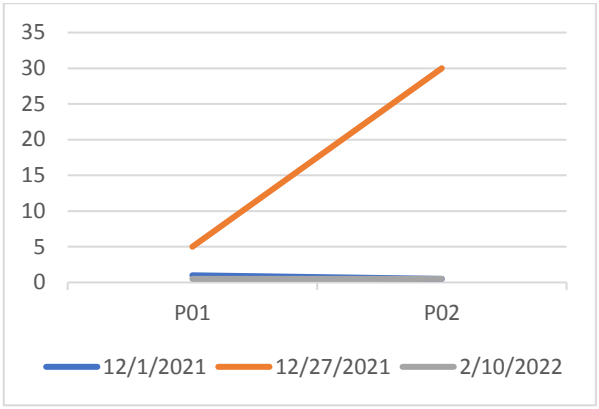


Figure 7. Nitrate variation mg/l

As can be seen in the chart below the NO2 level varies between close values but in no period of testing in this interval of three months, the water does not fall into class I of quality, but varies between class III and class V.

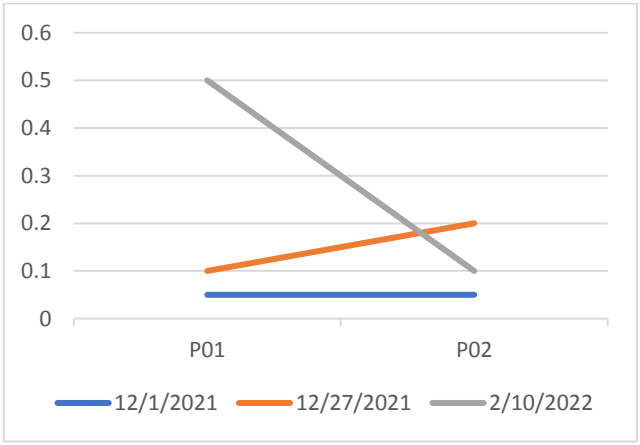


Figure 8. Variation NO2-N mg/l

After determining the NH4-N concentration, the recorded values are between 0.05-0.1 mg/l, this time the values fall into the quality class I.

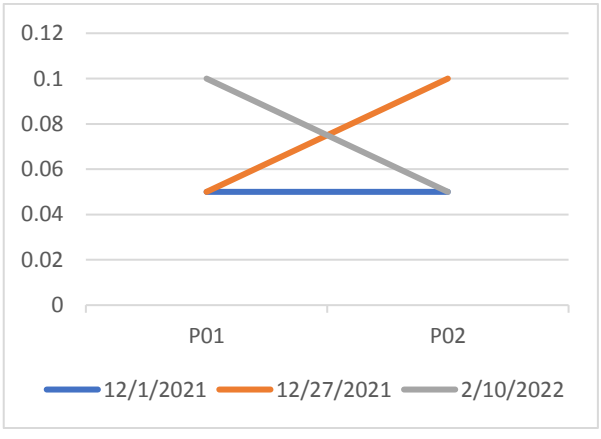


Figure 9. Variation NH4-N mg/l

CONCLUSIONS

During the three months of monitoring of the physico-chemical indices of the surface waters and of the shallow water destined for household consumption, taken from the village Butimanu Dambovita County does not present a danger for the public health but we can not say that the quality of the water is a satisfactory one. However, to avoid high concentrations of NO3 as it was in the case of the P03 sample. The locality needs a sewerage system and a water network. As a solution proposed by us taking into account the activities that people carry out in that locality such as agriculture, animal husbandry and fishing, we propose the installation of a sewerage network system where purified water to return back to lakes or be used for irrigation in agriculture, as can be seen in the examples below.

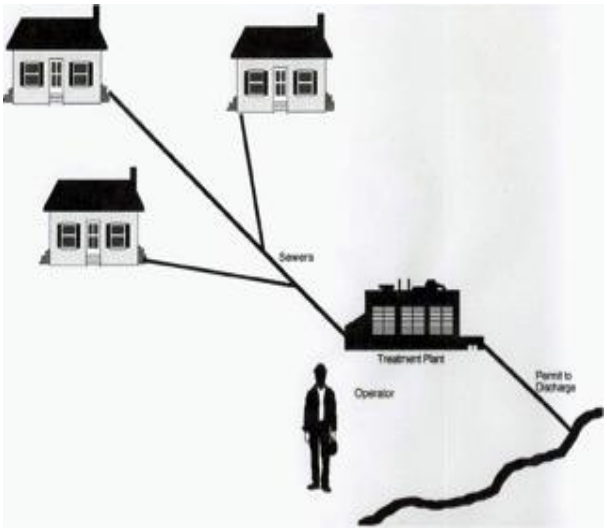


Figure 10. Option 1

Collect wastewater and treat to remove all pollutants before discharge to a stream.
When considering the stream discharge option, the following components are necessary:

- a sewer system to collect all of the wastewater from individual homes
- a body of water to discharge the treated wastewater
- a high-technology treatment plant that can remove all water pollutants
- attentive and highly trained people to operate and manage the collection and treatment system

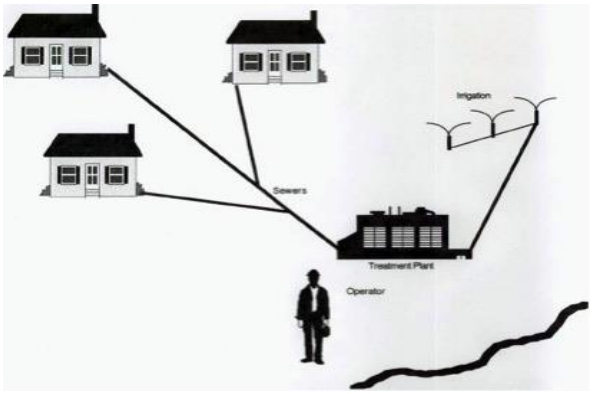


Figure 11. Option 2

Collect wastewater and treat before reuse through irrigation.
When considering the irrigation option, the following components are necessary:

- a sewer system to collect all the
- wastewater from individual homes
- land and an irrigation system
- a medium-technology treatment plant that can reduce odors and pathogens
- attentive and trained people to manage the collection, treatment and irrigation system (Karen Mancl, 2016)

In order to reduce the level of pollution of the soil and water and to improve their quality, I propose to implement one of the options listed above.
Water is a necessary resource for survival but if its quality is not favorable, the whole ecosystem can suffer material losses and even loss of life.
The water in the groundwater as it is also called "the water of our grandchildren" is a limited source of water.
Continuing at this rate of wastewater discharge directly onto the ground, the groundwater can be infected and the entire community suffers.

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SECTION 03
DISASTER MANAGEMENT

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COMPLIANCE OF REINFORCED CONCRETE STRUCTURES SUBJECTED TO SEISMIC ACTION

Cosmin IORDACHE, Simona ADAM, Bogdan CONSTANTIN, Miruna PETRARIU

Scientific Coordinator: Assoc. Prof. PhD Eng. Claudiu - Sorin DRAGOMIR

University of Agronomic Sciences and Veterinary Medicine of Bucharest,
Faculty of Land Reclamation and Environmental Engineering, 59 Mărăşti Blvd,
District 1, 011464, Bucharest, Romania

Corresponding author email: cosmin.iordache3062@gmail.com

Abstract

The present study aims to highlight the non-destructive tests on concrete structures by determining the rebound index and the ultrasonic propagation speed, found in the European standards SREN 12504-2 and SREN 12504-4, respectively; the calculation of plane frames and building structure of the Faculty of Land Reclamation and Environmental Engineering(FLREE) in relation to seismic responses.

Key words*: 3D structure, diagrams, non-destructive testing, plane frames, seismic response.*

INTRODUCTION

The article presents in the first part some of the conclusions of a case study carried out in the FLREE laboratory on a concrete cube, followed by a comparative analysis of the calculation of plane frames on different levels using the Robot program, and at the end we present a comparative analysis of the building bodies belonging to FLREE using the 3D frames component of the same software.

MATERIALS AND METHODS

1. Case study carried out in the FLREE laboratory

For the determination of the physical-mechanical characteristics of the materials, non-destructive tests are used, i.e. the determination of the rebound index and the ultrasonic propagation velocity, according to the European standards SREN 12504-2 and SREN 12504-4 respectively.

1.1. Determination of the rebound index

The sclerometer is placed perpendicular to the test surface. After impact, the rebound index is recorded, but for the measurements to be valid, 10 trials are required, after which they are averaged. The minimum distance between two tests shall be 25 mm and shall not be tested closer than 25 mm to the edge of the structural element.

Required equipment: sclerometer, calibration anvil, abrasive stone. The choice of the surface to be tested should be made taking into consideration the following: strength of the concrete, type of surface, type of concrete, state of humidity of the surface, the curing, movement of the concrete during the test, direction of attempt, other factors.

Table 1. The obtained values of the rebound index

No.	Rebound index
1	43
2	42
3	42
4	42
5	44
6	39
7	46
8	44
9	44
10	41

Using this equipment the rebound index and compressive strength of the surface sample were

determined. The compressive strength values are shown in Table 1. To determine these values 10 determinations were carried out. In addition to the resistance value, the device indicates the minimum and maximum rebound index, standard deviation and rebound value. Based on the conversion curve recorded in the internal memory of this device it has the ability to show the value of compressive strength determined at the sample surface

Figure 1. Test using sclerometer

Figure 2. Displayed value resulted after test

1.2. Determination of ultrasound propagation speed

The determination is carried out on a C16/20 concrete sample and involves: a pulse of longitudinal vibration is produced by an electro-acoustic transducer held in contact with a surface of the concrete under test. After travelling a known path length through the concrete, the vibration pulse is converted into an electrical signal by a second transducer and electronic circuits measuring the transit time of the pulse.

Required equipment: electrical pulse generator, a pair of transducers, an amplifier, an electronic measuring device for measuring distance and pulse time. The expression of the results for the transmission of the direction, half direction and propagation speed of the pulse is given by the formula: $v = \frac{L}{T}$.

V- pulse propagation speed (Km/s)

L- lenght (mm)

T- time in which the pulse crosses the length of the concrete sample (μ*s)

The time periods recorded are in microseconds, the signal needed to travel the 150 mm distance of the cube. On the other hand, speeds were recorded with the signal travelled over that distance, in m/s. Depending on the speed values, the corresponding compressive strength can be determined as in the first test case.

Table 2. Ultrasound propagation speed results

No.	Result (m/s)
1	4348
2	4478
3	4298
Average	4374,6

Figure 3. Electronic propagation speed measuring device

Figure 4. Conducting a test

plane frames on different levels using Robot software

In this analysis we chose the representation of the planar frames of a P+5 building, for the comparison of the results we used the planar representation of the 2, 4 and 6 levels frames following the deformations of the planar frame in the earthquake along the x direction.

2. Comparative analysis of the calculation of

2.1. Plan representation of the 2-level frame

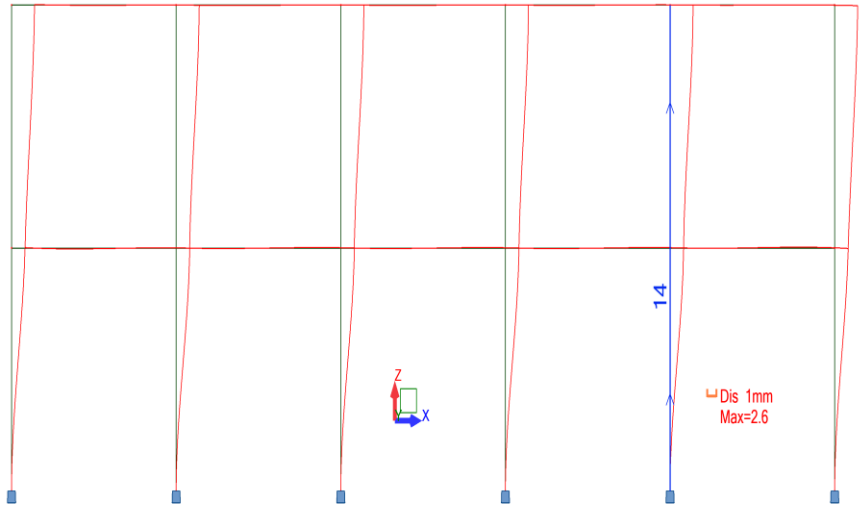

Figure.5. Deformations of the plane frame in the earthquake after x direction: ds = 2.6 mm

2.2. Plan representation of the 4-level frame

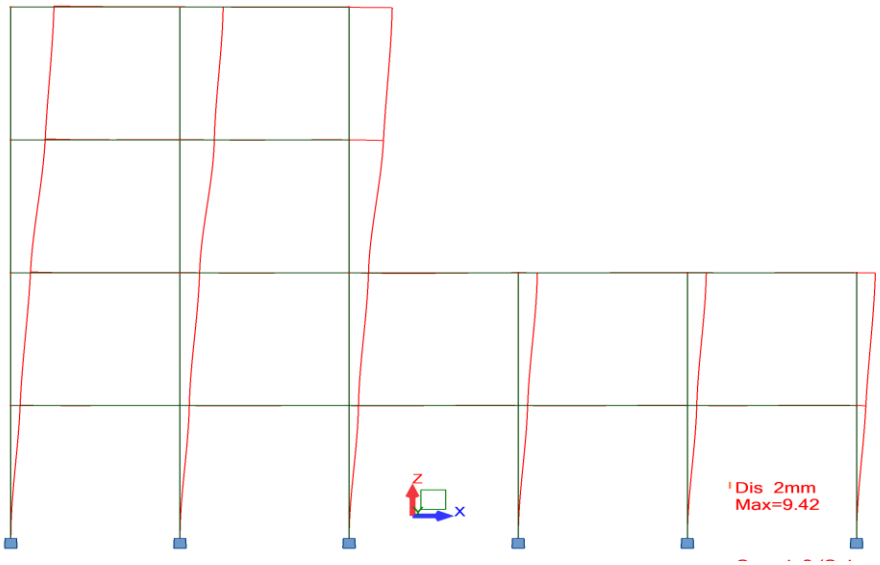

Figure 6. Deformations of the plane frame in the earthquake by x direction: ds = 9.42mm

2.3. Plan representation of the 6-level frame

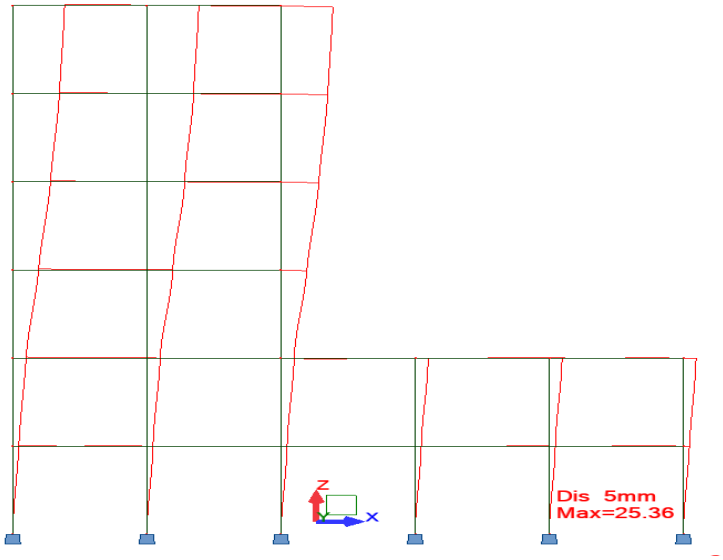

Figure 7. Deformations of the plane frame in the earthquake by x direction: ds = 25.36mm

2.4. Results comparison

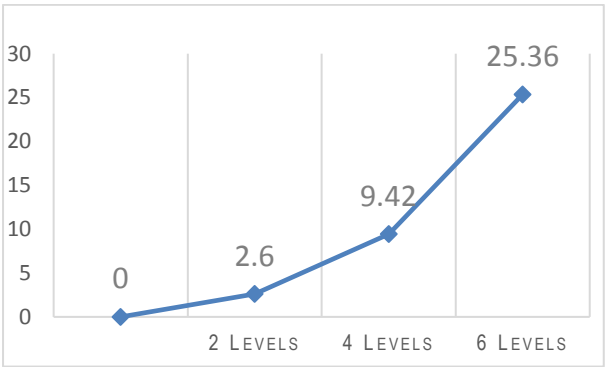

Figure 8. Plane frame displacement

Following the representation of the three particular cases we can observe an increase in displacement that is directly proportional to the number of levels.

3. The comparative analysis of FIFIM buildings using the spatial frames component of the Robot Structural Analysis software

Using this method we can observe the spatial deformation of the 3D structure and the displacement on each level of the building. In Autodesk Robot Structural Analysis Professional software, different types of structures were simulated and determined an axis system. The concrete used is C16/20, the cross-section of the pillars at ground level is 45x45 cm and at the top will be 30x30 cm; the cross-section of the beams is 25x50 cm and the reinforcement is made according to the standards in force.

3.1. C/B body before consolidation

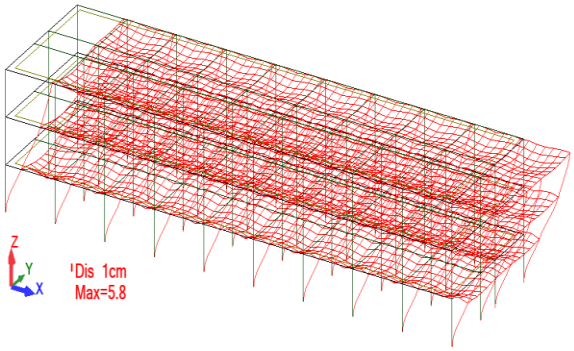

Figure 9. Spatial deformation of the 3D structure

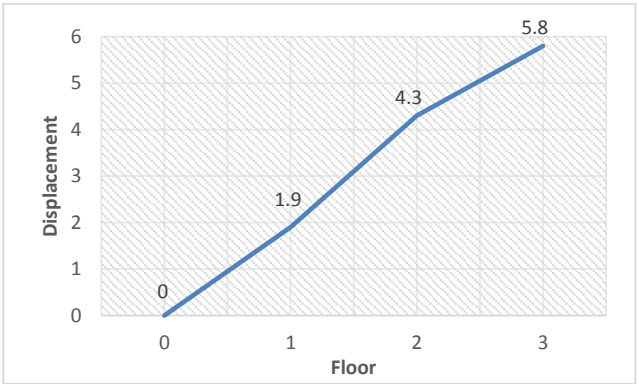

Figure 10. Displacement on the 3 floors

3.2. C/B body after consolidation

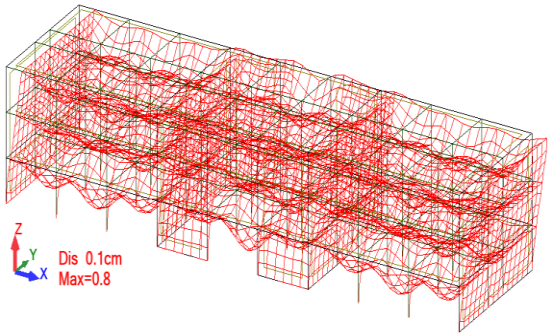

Figure 11. Spatial deformation of the 3D structure

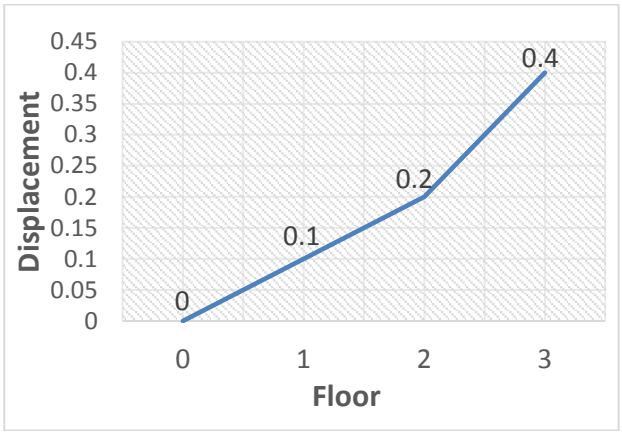

Figure 12. Displacement on the 3 floors

3.3. A body

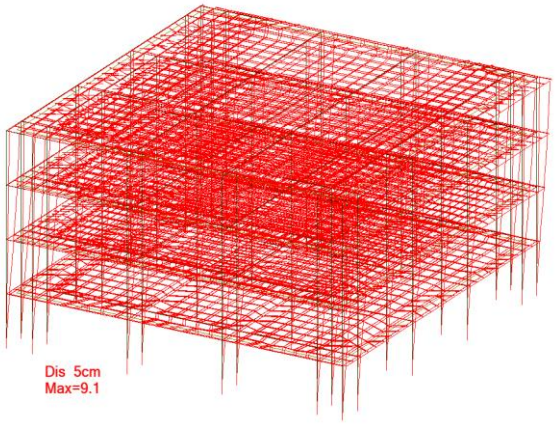

Figure 13. Spatial deformation of the 3D structure

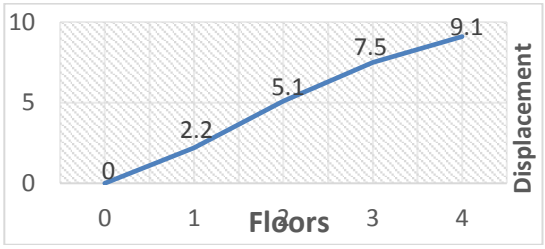

Figure 14. Displacement on the 4 floors

3.4. Results comparison

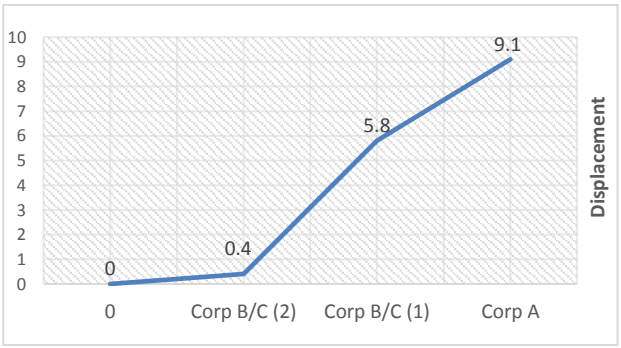

Figure 15. Results comparison

The analysis carried out on the three bodies of the FLREE showed the displacements they suffered during the earthquake.

CONCLUSIONS

Following the analysis carried out in the Robot software on the plane frames on different levels (2, 4 and 5), it is observed that the displacement increases directly proportional to the number of levels.

Using the space frame component of the Robot program, before consolidation, the C/B body of FLREE, subjected to a seismic action, undergoes a significant displacement and, after consolidation, a reduction in it is detected.

The reduction of behaviour factors to take into account uncertainties in the seismic behaviour of irregular structures will be determined according to the degree of this irregularity. As a guideline for case 2 the reference behaviour factor will be reduced by 20% and for case 4 by 30%.

Conditions relating to building masses In order to reduce the adverse effects due to the irregular positioning of mass loads, the aim should be to arrange the gravity loads as evenly as possible on the floors, both in plan and vertically. In order to reduce the seismic inertia forces acting on buildings, the aim should be to construct buildings with the smallest possible masses. Accordingly:

- When building non-structural elements: roofing, thermal insulation, screeds, partition walls, balcony parapets, etc., lightweight materials should be used as a priority. Efforts should also be made to reduce the thickness of rendering and screeds, slope layers and to reduce the weight of ornamental elements in

buildings where they are needed.

- In high-rise and/or high-mass construction it is recommended to use high-strength concrete in structural elements, especially in pillars and structural walls.
- On the roofs of ground floor halls with large openings, including skylight and deflector elements, lightweight material solutions should be applied as a priority.
- In the case of buildings with different functions by height it is recommended that activities, functions, which involve high live loads are placed at lower levels.

Comments on geometrical irregularities and eccentricities between the two centres:

- Construction irregularities cannot be avoided. They arise for functional reasons in plan and technological reasons in height. The theoretical problems of irregularities are dealt with by studying the relative relationship between the centre of rotation CR and the centre of gravity CG. The practical problems of irregularities are solved by diaphragms, strong structural components and rigid slabs.
- The safety of irregular constructions must be checked both locally and holistically (in general). Solutions to avoid damage have a cost. In non-regular constructions the geometry-mass relationship plays an important role and is regulated by the conceptual design principles of Eurocode 8 or Code P100-1:2013. No construction is perfect. Deviation from perfection means cost or collapse.

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MONITORING STEEL STRUCTURES OVER TIME BY USING TERRESTRIAL LASER SCANNING TEHNIQUE FOR DISASTER PREVENTION

Paul Cristian ZDRENGHEA[1], Andreea Diana CLEPE[1], Viktor SZALAI[2]

Scientific Coordinator: Prof. PhD Eng. Ioan Sorin HERBAN[1]

[1]Politehnica University of Timisoara, Civil Engineering Faculty, Department of Overland Communication Ways, Foundation and Cadastral Survey, 1B Curea Street, 300224, Timisoara, Romania, Phone: +40754633143, Email: paul.zdrenghea@student.upt.ro
[2]Politehnica University of Timisoara, Civil Engineering Faculty, Department of Steel Structures and Structural Mechanics, 1A Curea Street, 300224, Timisoara, Romania, Phone: +40753023798, Email: viktor.szalai@student.upt.ro

Corresponding author email: andreea.clepe@student.upt.ro

Abstract

This paper aims to present monitoring the behaviour in time of a steel structure using a revolutionary method, known as Terrestrial Laser Scanning and the advantages of this technique in researching the effects of extreme actions on buildings. The demand for developing new strategies in designing buildings against accidental actions like external explosions has increased significantly in recent years due to the global political and social instabilities. Accelerated technological progress, as well as the need to acquire three-dimensional data for buildings, have led to the development of this new method for acquiring data using laser waves. In this study, laser scanning was used during real-scale field tests, to monitor the behaviour of energy-absorbing envelope systems for a steel structure subjected to external explosions. Based on the obtained data it will be possible to draft new design strategies for non-structural elements like the envelope of a building, reduce the potential for more serious structural failures and protect the occupants of the building.

Keywords*: deformation monitoring, external explosion, façade systems, real-scale field tests, terrestrial laser scanning.*

INTRODUCTION

The overarching goal of researching the effects of extreme actions on buildings (explosions, blast, snow overloading, fire, tsunami, terrorist attacks, vehicle impacts, other actions due to local failure from an unspecified cause) is to better understand and estimate the risks and threats occurring to buildings and occupants and try to implement new design rules or design strategies that will prevent further human losses during this kind of disasters. The current social and political instabilities of the 21st century have led to an increased number of explosions caused by terrorist attacks in densely populated areas and in the immediate vicinity of buildings, so that engineers must provide designs that can resist to this category of actions. At present, there are several strategies for buildings, implemented so that structures can resist explosive threats or blasts such as: mitigation of debris from the damaged façade, isolating internal threats from occupied spaces and establishing a secure perimeter. Unfortunately, there are not sufficient design rules, or the current guidance is limited yet to develop an official framework, because quantifying the effects of extreme actions like blasts can be difficult.

The Eurocode EN 1990 guidance for buildings requires for all structures, survival of local damage, sufficient warning at collapse, low sensitive structural form, and tying members.

Eurocode 1990 also provides a classification of buildings by consequences class which must be considered in the design for accidental actions.

The current version of Eurocode 1991-1-7 (accidental actions) is providing basic requirements and design strategies for internal explosions only (gas explosions, dust explosions or other natural explosions) and not for external explosions (natural or intentional). Moreover, the risks caused by fragmentation and debris

resulted from non-structural elements are not quantified at all in this code.

The main challenge, when considering accidental actions in designing a building, is the identification of the threat. Annex A of Eurocode 1991-1-7 includes strategies for identified and unidentified accidental actions but they are mainly prescriptive rules and prevention methods of the action itself.

For buildings subjected to accidental actions it is simply insufficient to consider a strength-based design method alone. Because of the large deformations that are resulting from these kind of actions, ductility-based design approaches are more appropriate because it must be guaranteed that transfer of loads between structural elements of the building continues even if subjected to accidental actions, to avoid a progressive collapse.

The lack of specific design rules for structural and non-structural elements subjected to accidental actions like external explosions, led to an increased interest in conducting real-scale tests and creating numerical models using advanced non-linear analysis software tools.

Politehnica University of Timisoara in partnership with the Technical University of Cluj-Napoca and the National Institute for Research and Development in Mine Safety and Protection to Explosion: INCD-INSEMEX developed a research project entitled “Safety of building walls and claddings against accidental explosions (SAFE-WALL)” in which the main objective was to study the behaviour of enclosure walls and façade systems and increase their safety level against direct effects (pressure wave) and side effects (fragmentation and debris) following an external explosion. Within this project, the research group conducted full-scale blast tests on wall-frame structure systems and acquired three-dimensional data using a revolutionary technique based on laser waves called Terrestrial Laser Scanning.

MATERIALS AND METHODS

The tested structure within this project was designed based on the existing rules of the Eurocodes and evaluated for permanent loads, live loads, and low seismicity actions with a PGA equal to 0.10g without considering the provisions regarding to accidental actions. The structure was tested at the INSEMEX testing-site in Petroșani, Romania (Figure 1).

Figure 1. General view of the test setup

The experimental model is a prefabricated steel frame structure with two bays in transversal direction with a length of 4.5m each, two bays in longitudinal direction with a length of 3.0m each and two stories of 2.5m each. The columns are made from HEB 260 steel profiles, transversal beams are made from IPE 270 steel profiles, longitudinal beams are made from IPE 200 steel profiles and the secondary beams are made from IPE 180 steel profiles. The used steel grade is S275. On the transversal direction, the beams are rigidly fixed to the columns with M24 gr.10.9 bolts and end plates with a nominal thickness of 16mm. On the longitudinal direction, the structure was designed with bracings.

The longitudinal and secondary beams are pinned to the columns, respectively to the main beams. The columns are fixed at the base.

Two different solutions were adopted for the façade system of the structure:

- PUR100/0.5mm sandwich panels fixed to the columns with C150/2mm wall rulers. The distance between the wall rulers for the sandwich panel solution is 1.9m.
- MBS KS100/600 cassette panels with a thickness of 0.88mm.

In this experimental test, small amounts of explosive charges (143g TNT) were placed at moderate distances from the panels (1.5-3.0m). The two solutions were monitored during the explosion tests and data was collected regarding

their behaviour under blast loads (deformations, displacements, load capacity).

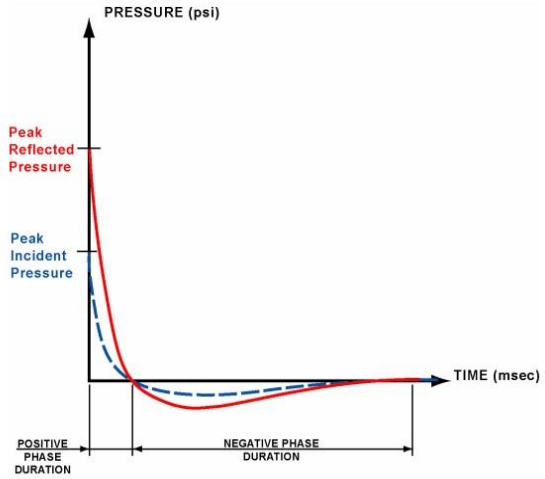

Figure 2. Air-blast as a function in time (FEMA 427)

Evaluating the characteristic parameters of blast waves such as blast pressure, impulse, load duration and shock wave velocity is a key step in defining the blast load (Figure 2). To collect these data in conjunction with the blast waves and its effects on the structure, several systems were used for measuring: pressure sensors, strain gauges, accelerometers, digital image correlation and laser scanning.

Surveying methods based on laser scanning are very effective to obtain accurate visual documentation of full-scale structures while monitoring the deformed shape and maximum values of displacements.

The terrestrial laser scanner Z+F IMAGER 5010C was used to monitor the deformations of the two façade systems of the steel structure caused by the external explosion.

The Z+F IMAGER 5010C scanner is a static ground scanner mounted on a rigid tripod and has a fixed position throughout the data acquisition. It also belongs to the category of active scanners, which emit controlled radiation in the form of a laser wave and determinate the position of the laser point on the scanned object using the built-in camera.

The integrated HDR camera (High Dynamic Range) has a resolution of 60 megapixels, and it is perfect for capturing high-resolution, high-quality images.

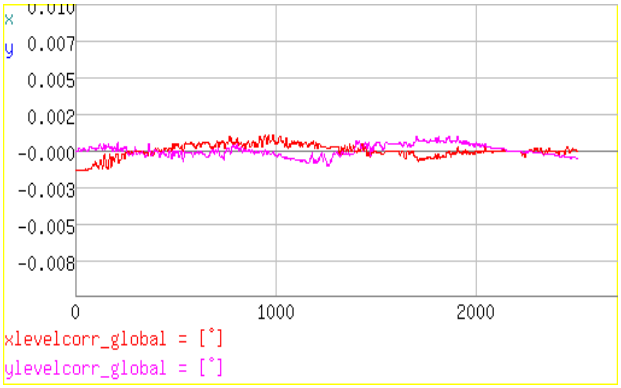

Figure 3. Detected tilting changes between two low encoder positions (< 0.007○)

This type of scanner has also a dynamic compensation, which is designed to provide position corrections so that the instrument does not suffer any offset during measurements (Figure 3). The position of the laser scanner has been constantly corrected, so that the maximum offsets do not exceed ± 2°, resulting in very high accuracy holds.

To determine the points coordinates, the scanner uses the time-shift principle, making it ideal for lens scanning due to the speed of the scan and the higher resolution compared to the scanners based on the time-of-flight method. The maximum scanning speed is 1,016,000 dots per second.

Furthermore, operating this type of laser to retrieve dots was found safer for the users, which made the scanner more appropriate for the objective within this field test, due to the relative high number of participants that were present during the scanning process.

The time-shift method is often used in wave measurements. This method is used in both total stations using the laser function for distance measurements and in active laser scans. It involves the measurement of a phase difference between transmitted and received waves.

Paper targets also served as landmarks outside the area of influence of the explosion. These paper targets are made of two black triangles attached to the center of the paper, which is the representative point to be considered at the processing stage.

It was observed that site planning for scan stations and targets has a key role in optimizing and rationalizing the field measurement phase, particularly in static ground scanning.

In the case of the measurements within these field tests, the static ground scanning method

was used to ensure a higher accuracy and to obtain a point cloud of relatively small size so that the data processing is more facile.
To determine the optimal position of the stations, it is important to consider the range of the scanner, the maximum distance to which the scanner ensures maximum accuracy and coverage. With a view to optimize the number of stations, the distance between the stations should not be too short, as it would result in a very high percentage of repetitive information (the same points seen from several stations) which would be useless and inefficient.
It is also necessary to determine the positions that are providing the largest possible coverage area of interest, without any obstruction on the laser beam path. The position of the scanner was chosen so that the emitted laser beam intersects the scanned surface in a perpendicular direction, as the scanned surfaces diffuses light reflectance, so that if the angle of intersection is too sharp, the accuracy of determining the point would decrease considerably.
The scanning equipment was placed in a stable area, protected from unfavourable weather (e.g., strong wind, blizzard), vibrations, or other external factors that could cause unwanted movement of the scanner during data acquisition. Another important element was the positioning height of the device, depending on the purpose of the scan. In this case, the positioning was done to be able to observe as many targets as possible.
In addition, it was observed that the positioning of the paper targets played an essential role in achieving the alignment of the obtained point clouds after consecutive scans, but also to be able to define the same coordinate system of the scanned objective before and after the explosion. It is essential that their positioning is done so that there are at least 3 common targets between pre-explosion scanning stations and post-explosion scanning stations. Determining the location of these targets proved to be very difficult, as the targets located too far away did not provide satisfactory accuracy, and the targets located near the blast were destroyed or their position has changed, so that, they were classified as unusable.
During the monitoring of the panels at INSEMEX Petroșani, a series of scans were performed before and after the explosion. Each scan series consisted of two separate scans, carried out to capture all the details of the panels. The initial scan was used to capture the undeformed shape of the envelope panels and the second one was performed to determine the deformations after the explosion (Figure 4).

Figure 4. After-blast footage of the deformed panels

Also, 7 paper targets were placed, at distances between 20 and 70 meters from the two scanning stations, to collect several common points to be able to perform data processing in the dedicated software. Although the positioning of the targets was made so that they were at a safe distance from the blast, 3 targets suffered positional changes due to the shock wave caused by the explosion, and one target turned out to be too far away to provide a satisfactory accuracy.
The first step of the processing consisted in exporting the data acquired from the scan.
The Z+F Laser control program was used for data processing and after some intermediate steps, the point clouds were gained. In accordance with the obtained point clouds, a 3D model of the façade systems was acquired.

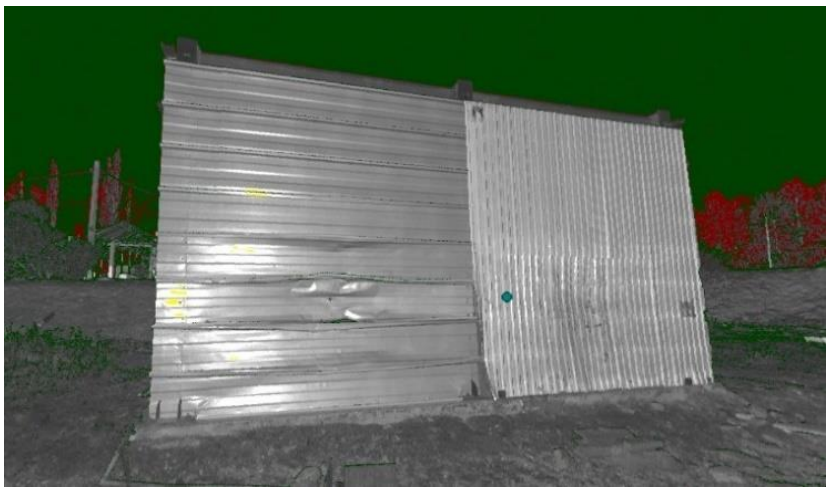

Figure 5. Initial monochrome point cloud

Initially, the point cloud is grayscale (Figure 5), but during the process, each point is coloured by using panoramic images which are taken by the camera incorporated into the laser scanner.

A significant process involves the alignment of the scan stations using paper targets.

The centre point of each paper target will be selected and named in the same manner in each scan.

To achieve the highest accuracy, the distance between the scanner and the paper targets should be in the range 3-10m.

A particularity observed within this case study was that the paper targets placed at a short distance from the panels were destroyed during the explosion.

Theoretically, the most ideal positioning of the targets during the scanning process, is perpendicular to the direction of the laser wave. Nevertheless, in practice, it is difficult or almost impossible to replicate this ideal case, but very sharp or obtuse angles must be avoided at any cost, during the placement of the paper targets.

The existence of a minimum of three common points between the consecutive laser scanning stations is compulsory. If this condition is not fulfilled, the achieved point cloud will be rotated in a particular direction and the obtained image is distorted.

Based on three paper targets, the alignment of the point clouds, obtained during the two scans which were taken before the explosion and the two scans taken after the explosion, was performed.

The accuracy obtained in the alignment of the scan is very high and showed an average error of only 1.7 millimetres.

During the measurement phase, a series of points were collected.

However, some of the acquired points were classified as redundant because they contained unnecessary information regarding the object of interest (e.g., trees, bushes, terrain) (Figures 6 and 7). This data is not relevant for this case study and makes it difficult to process the information using the large amount of data.

With the purpose to remove the ineffectual data and obtain the final results, the point cloud was cleaned using the CloudCompare program (Figures 8 and 9).

RESULTS AND DISCUSSIONS

As mentioned previously, to obtain consistent results, it is mandatory that the scans taken before and after the explosion have the same system of coordinates, this step being achieved during the initial processing within the Z+F LaserControl software. For this scope, the coordinates of the paper targets used in the scans taken before the explosion are the baseline data for the post-blast coordinates of the paper targets. The average error in alignment of the point clouds was only 4.3 millimetres.

Processing using CloudCompare software reduced the number of points from 2.7 million points to 300,000 points. This step was essential to reduce the thickness of the point cloud and to obtain the final results in terms of deflections. The deformations were already visible in the CloudCompare software (Figure 10), but due to the limitations of the software, the reduced point cloud was exported in DXF format, and with the

aim to obtain the final results, the AutoCAD software was used instead (Figures 11 and 12).

Figure 6. Uncleaned point cloud of the panels before the explosion

Figure 7. Uncleaned point cloud of the panels after the explosion

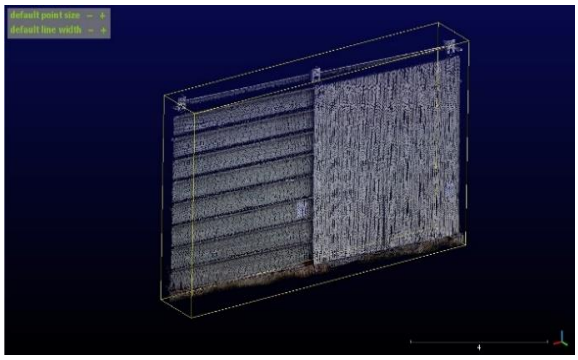

Figure 8. Cleaned point cloud of the panels before the explosion

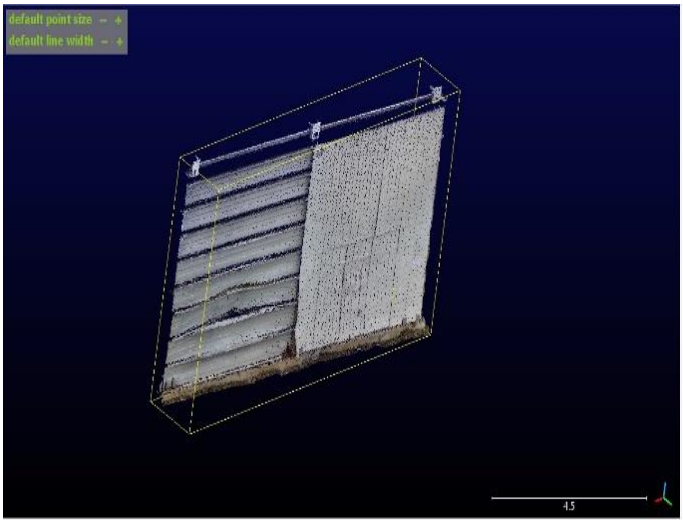

Figure 9. Cleaned point cloud of the panels after the explosion

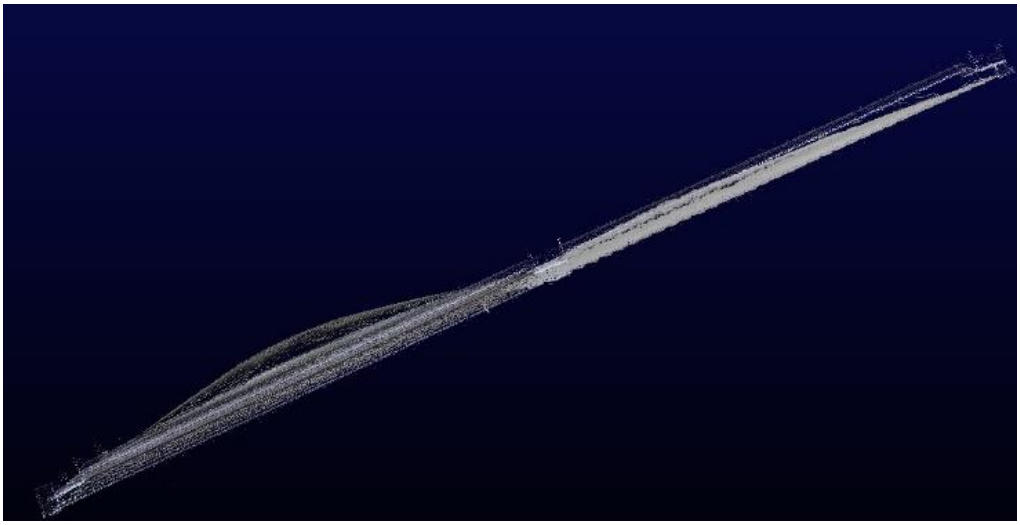

Figure 10. Top view of the cleaned point cloud of the deformed shape

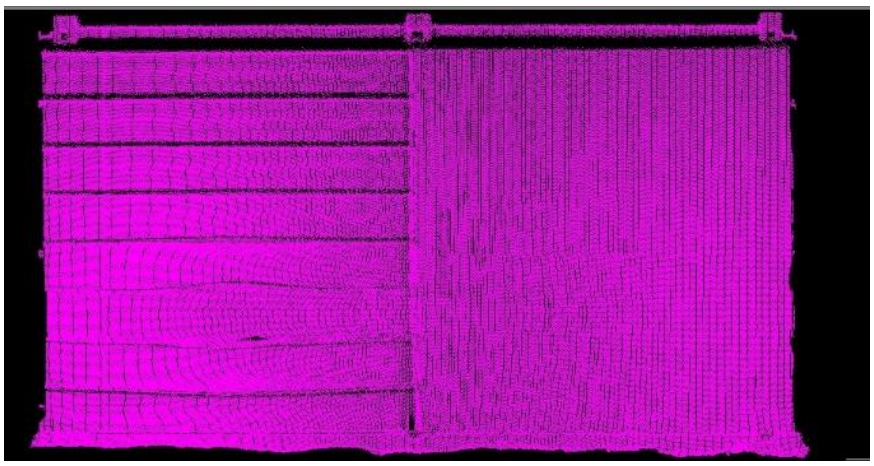

Figure 11. Final point cloud of the deflected shape in AutoCAD

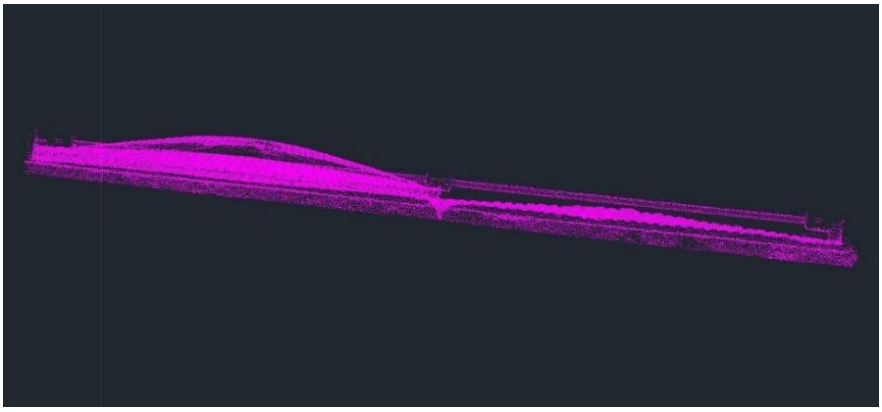

Figure 12. Final point cloud of the deflected shape in AutoCAD – top view

During the field tests, it was observed that the dynamic response of the two façade systems is beneficial for mitigating explosive effects and very similar, due to fact that, both are lighter and more flexible systems and possess enough ductility to avoid a brittle failure mode. The two systems suffered comparable permanent damages but absorbed enough energy through deformation to transfer lower forces into the connections and then into the supporting elements of the structure. In the case of the steel cassette, the failure occurred in the connections between the panel and column (failure of the fastener), moreover large deformations appeared in the interior zones. In the case of the sandwich panel the failure mode is comparable but larger deformations occurred only on the exterior sheet of this system; showed also a higher ultimate strength capacity and a superior blast response reduction capability.

Basically, the foam core absorbed the energy during the blast, dissipated kinetic energy, and as a result, lower impulse was transferred to the structure.

Both panel systems underwent inelastic deformation and very small tearing but failed in a ductile mode such as flexure rather than a brittle mode such as shear and showed a membrane/catenary like behaviour that indicates enough robustness to reduce hazards associated with fragmentation.

Following the processing of the measurements in AutoCAD, it resulted that the maximum deflection of the sandwich panel was just 13.90 centimetres, while the deflection of the cassette panel was 35.72 centimetres (Figure 13).

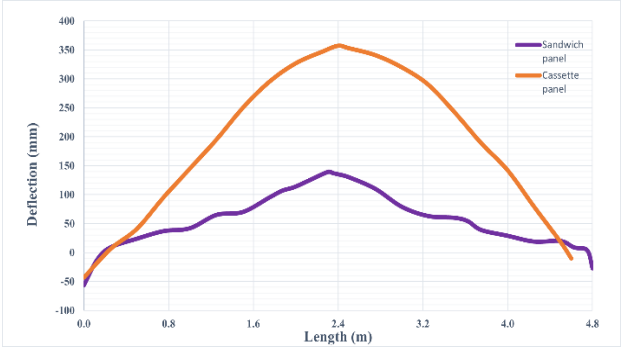

Figure 13. Deflection comparison between the two façade systems

CONCLUSIONS

The use of the Terrestrial Laser Scanning in measuring panel deformations has proved to be significant since the displacement sensors located on the panel have been destroyed during the blast tests, making it impossible to accurately determine the deformations using traditional methods.

Moreover, after the explosion it was established that, the maximum deflection of the cassette panel occurred above the area where the displacement measuring sensor was installed. This was subsequently confirmed by the analysis of the point cloud obtained from the terrestrial laser scanning.

Terrestrial laser scanning represents a new effective method that can be used to evaluate the behaviour of more suitable materials and systems used in blast response reduction for building envelopes. Reducing the potential of hazards that endanger the structural integrity of the building means to design the exterior envelopes of high-risk buildings to be more robust during these exceptional situations since they constitute the critical line of defense for protecting the structural elements and more important the occupants.

In conclusion, Terrestrial Laser Scanning is an innovative technology capable of providing more accurate and comprehensive results compared to traditional measurement methods in terms of monitoring a steel structure even in exceptional situations.

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Z+F IMAGER® 5010C user manual

SECTION 04
CADASTRE

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CADASTRAL FOR UTILITIES IN MUNICIPAL AREA MOȘNIȚA NOUĂ

Stana-Elisabetina DRĂGULESCU-ANDREI, Sabrina-Emanuela GRIGORE, Sebastian-Constantin HNATIUC, Razvan-Claudiu MOȚ

Scientific Coordinators: Senior Lect. PhD Eng. Anca-Maria MOSCOVICI Senior Lect. PhD Eng. Clara-Beatrice VÎLCEANU

Politehnica University Timisoara, Civil Engineering Faculty, Department of Overland Communication Ways, Foundation and Cadastral Survey, Traian Lalescu Street, no.2, 300223, Timisoara, Romania, Phone: +40256.40.40.00, Fax: + 40256.40.40.10
Corresponding author email: sebastianc.hnatiuc@gmail.com

Abstract

In the following paper we aim to present the importance and necessity of a municipal cadastral plan because it serves as a starting point for many projects, especially in the field of architecture and civil engineering, for example obtaining building authorisation. By municipal cadastre we refer to the management of the municipal networks that serve the development of a city, networks such as the potable water supply, the sewage, the natural gas, the heating, the electric cable, the telecommunications, or other types of municipal networks. In this project, we have also included a presentation of the methods and stages used for the execution of such a project realized in a district of Mosnita Nouă, Timiș county.

Key words*: Cadastre, GIS, Mapping, Municipal networks Orthophoto*

INTRODUCTION

Definition of municipal cadastre

Urban networks represent technical utilities serving buildings, social and cultural complexes, institutions, economic agents, as well as technical industrial networks in urban areas, and can be located both above and below ground. A specific information system must be set up for municipalities to systematically record the technical and qualitative aspects of underground and above-ground facilities in the perimeter of the urban area. It must be constantly maintained and updated in line with the actual situation. The work presented represents a project of building cadastral survey realized during our courses at the University, having as study area ATU MOSNITA NOUA (Figure 1).

The importance of the municipal cadastre in ATU (administrative territorial unit)

The purpose of the information system for building networks is to provide real and quality information, to manage localities efficiently by using an informational system based on cadastral data for decisions, to create a standard content for network plans, road maps and centralized statements, to establish single criteria for the evaluation, verification and acceptance of works and products concerning the building network fund.

Figure 1. The area under study

Linking the building cadastre with the informational system

The building network informational system should be linked to the real estate fund informational interview system because there is a better management and coordination of activities that lead to a high standard of living in a locality (Manea, 2007).

The general cadastre deals with the technical aspect and refers to the recording of real estate belonging to this field in order to establish by measurements the shape, position and configuration of the properties for registration in the cadastral documents and in the Land Registry, obtaining digital cadastral plans.
The component of the specialist evidence is made up of elements belonging to the quality aspect as well as other technical characteristics:

- the recording and inventory of building networks by type of network (Figure 2 and Figure 3);
- determination of the position in the plan and the layout of the main and distribution network routes;
- planimetric determination of buildings and technical installations;
- determination of the dimensions of significant elements or points (manhole covers, gratings, ducts in a manhole, etc.).
- information sheets (road sheets, single sheets, standard sheets);
- information on the nature of the materials of construction of the pipes and their diameters;
- information on the condition of the networks;
- information on flow rates, capacities.

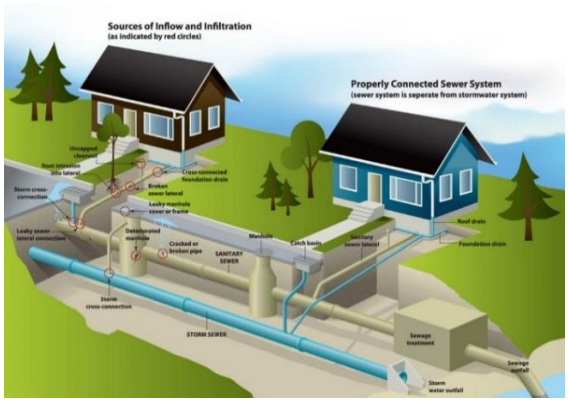

Figure 2. Sewerage Network

Figure 3. Water Supply & Distribution System

Classification
Building networks are structured by levels (roads, building elements, landscaped areas) as follows: drinking water supply network, sewerage network, natural gas network, district heating network, electric cable network, telecommunications network, or other types of building networks (Musat, 2022).

MATERIALS AND METHODS

RENNS

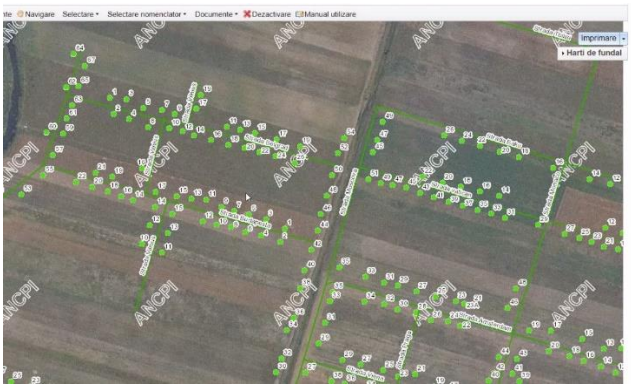

Figure 4. Street nomenclature of Mosnita Noua

The RENNS (Figure 4) is used to manage the street nomenclature, streets and administrative addresses, as well as their geometry. The management of streets and addresses is done through flows defined in the system. Only users with the proper roles can manage streets and administrative numbers. RENNS is available to users in municipalities, local councils and allocation commission members.
The RENNS product provides information about the project as well as its related modules, which can be accessed as application links for managing, validating, administrating and publishing street classification content. The RENNS portal and the public access module of the street nomenclature were used to consult information related to the ATU Moșnița Nouă.
The public component materializes in a web portal and allows users to consult and use information about "Streets", "Address numbers" and additional address information managed by the system, as well as a series of functionalities made available within the application. The RENNS portal is addressed to a wide range of users such as: - The general public, through web interfaces accessible from common browsers; - IT systems in other public institutions, based on

standard web services; - Local public authorities (RENNS, 2022).
Even though RENNS is a useful software, it needs to be updated frequently, which is why it was also necessary to collect data on field and consult other platforms (eTerra, NACLR).

NACLR and eTerra

The National Agency of Cadastre and Land Registry (NACLR) is a Romanian governmental organization with legal personality, subordinated to the Ministry of Regional Development and Public Administration.
ETerra is a national property registration system and manages information on properties and their owners, optimising the collection of building data for the urban cadastre.
We consulted the Eterra website to collect the necessary data to identify the height regime, the properties and the geometry of the buildings for the Mosnita project (Figure 5 and Figure 6).

Figure 5. Eterra Mosnita Noua interface

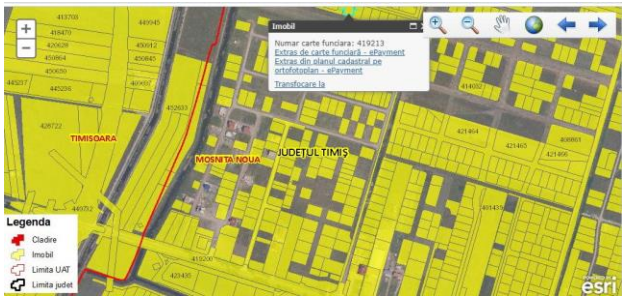

Figure 6. Geoportal NACLR

GNSS

A satellite navigation system, also called Global Navigation Satellite System (GNSS), is a stand-alone system that calculates the geospatial position of objects on the ground or in space using signals received from navigation satellites or so-called pseudosatellite (ground-based relays with similar functionality). Such a system also helps to orient or guide vehicles, ships in the open ocean, rockets etc.

To define a position, the receiver must receive signals (position and time) from at least 4 satellites simultaneously. Small differences between the signals are then used to determine the receiver's position.
The GNSS determinations realized for our project in Mosnita Noua, took place over a period of 3 days and for a more accurate positioning we stationed 1minute at each point, with continuous measurements (Figure 7).

Figure 7. GNSS determinations in Mosnita Noua

Position determinations refers to obtaining the coordinates (absolute or relative) of certain interest points in a specified reference system from satellite observations (measurements). Satellite observations consist of various types of measurements made between the satellite receiver on the ground or near the ground and one or more satellites in circum-Earth orbits.
The satellites play an active role by sending out signals that are received by specialised instruments (receivers) that decode this signal. After decoding the signal, the information needed to determine the receiver's position is extracted from it (Herban et al., 2012).
Global Navigation Satellite Systems (GNSS) are systems that enable highly accurate determination of position in a geocentric reference system at any point on, near or beyond

the Earth's surface using artificial Earth satellites.

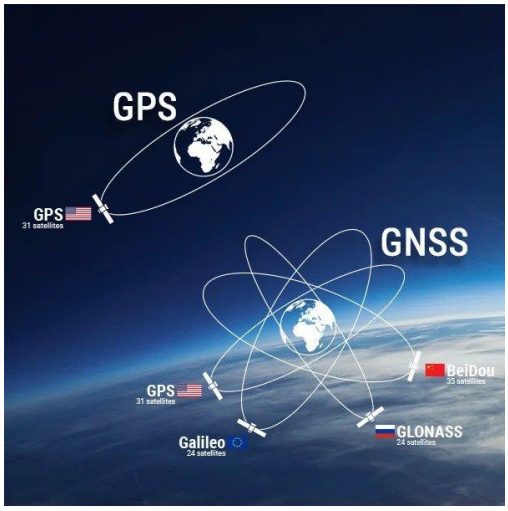

Figure 8. GNSS System

Currently the most popular GNSS systems are NAVSTAR GPS (USA), GLONASS (Russia), Galileo (European Union), BeiDou (China), NavIC (India) and QZSS (Japan). There are no major differences between these GNSS systems in terms of operating principles and technology. Each system includes three segments: the space segment (satellites), the control segment (monitoring and control stations) and the user segment. (Figure 8)
ROMPOS® uses Galileo, NAVSTAR GPS and GLONASS global positioning systems.

Galileo
The Galileo system has 22 operational satellites on 3 orbital planes inclined at 56°. This system was launched in 2011, becoming operational in 2016 and completed in 2020.
GALILEO is inter-operable with NAVSTAR GPS and GLONASS. The reference and coordinate system used is the ETRS (European Terrestrial Reference System).

NAVigation Satellites with Time And Ranging – Global Positioning System (NAVSTAR – GPS)
The GPS space segment consists of 32 satellites in 6 orbital planes inclined at 55° at an altitude of 20230 km. The revolution period of the satellites is 11hours and 56minutes. The positioning accuracy for the civil segment has been increased from about 100m to 13m by suspending the SA (Selective Availability) technique. The reference system used is WGS84 (World Geodetic System 1984).

GLObal NAvigation Satellite System (GLONASS)
The GLONASS space segment comprises a total of 24 satellites in 3 orbital planes inclined at 64.8° at an altitude of 19100 km. The revolution period of the satellites is 11 hours and 16 minutes. From the 24 satellites projected, 16 satellites are currently operating. Each satellite has an atomic clock that generates a frequency from which the two carrier waves are formed. The transmitted signals are similar to the GPS system. The level of accuracy of the Russian GLONASS system is comparable to that of the NAVSTAR GPS system. In Romania, GLONASS can be used to complete the GPS constellation. The reference system used is PZ90.

Figure 9. Drone overflight

Workflow
The field works, after the realization of the geodetic and elevation networks, consist in collecting the necessary elements to survey the components of the urban networks, which appear on the surface, using the method of the polygonal traversing survey. and drone survey.
In case there are topographic or cadastral plans at scale 1:500 or 1:1000 for the elaboration of the complete technical building plan, the elements of planimetry concerning the street layout, plots with cadastral number and main beneficiaries will be taken from them. (Figure 9)
In case there are no such plans, the above-mentioned plan elements will be collected by measurements on the ground at the same time as the urban network elements are surveyed.

For manholes, the planimetric position of the centre of the manhole cover, its elevation and the elevation of the invert, as well as the manhole relief and its diameter shall be determined using a plotting compass, and the dimensions and diameters of the pipes leading into the manhole shall be determined using a wooden triangle mounted at the end of a wooden graded stake or stud.
The routes of the urban networks, in plan, are obtained by joining the covers of the manholes, or of the cable draw pit chambers, with conventional lines. The routes of the building networks, in the vertical plane, are obtained in the longitudinal profile using the manhole covers.
There are two methods for obtaining urban network routes, in plan and in elevation: the direct method and the indirect method. The direct method - consists of surveying the position of the network during its survey (before the trench is filled).
It allows high working speed and accuracy to be achieved. The planimetric and altimetric position of the characteristic points (covers, vents, valves, pipes, etc.) is determined from the points of the planimetric and geometric levelling paths of the order V.

Objectives
The objective of the urban network information system is the following: to provide real and quality information; to manage the localities efficiently using an information system based on cadastral data for decisions; to create a standard content for urban network plans, road maps (unique and standard) and central statements; to define unique criteria for the evaluation, verification and acceptance of works and products concerning the urban network fund.

RESULTS AND DISCUSSIONS

Implication/Benefits
Direct management of cadastre functions will allow local authorities: improve the integration of the technical and administrative functions of the cadastre;

- improve knowledge of land and buildings and therefore optimise the taxation process;
- to improve the process of alignment between cadastral and urban data;
- provide the public with a more user-friendly, functional and efficient service because it is physically delivered locally.

Orthofotoplan

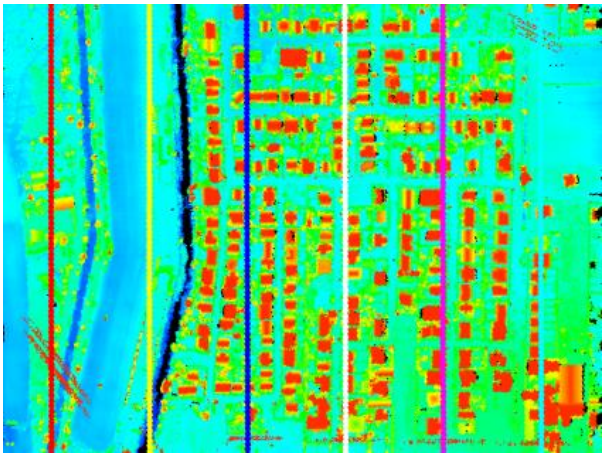

Figure 10. Orthophotoplan top view of Mosnita Noua

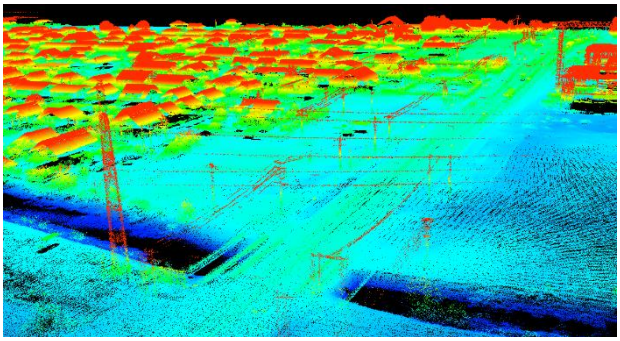

Figure 11. Orthophotoplan 3D view of Mosnita Noua

An orthophoto is an aerial photograph or satellite imagery geometrically corrected ("orthorectified") such that the scale is uniform: the photo or image follows a given map projection. Unlike an uncorrected aerial photograph, an orthophoto can be used to measure true distances, because it is an accurate representation of the Earth's surface, having been adjusted for topographic relief, lens distortion, and camera tilt (Figure 10) (Figure 11), (Moscovici et al., 2019).

Situation plan / Urban plan
Following the steps listed above, the result is a site plan, which shows the exact information and details of the building network.
We realized this plan for ATU Mosnita Noua in AutoDesk AutoCad (Figure 12).

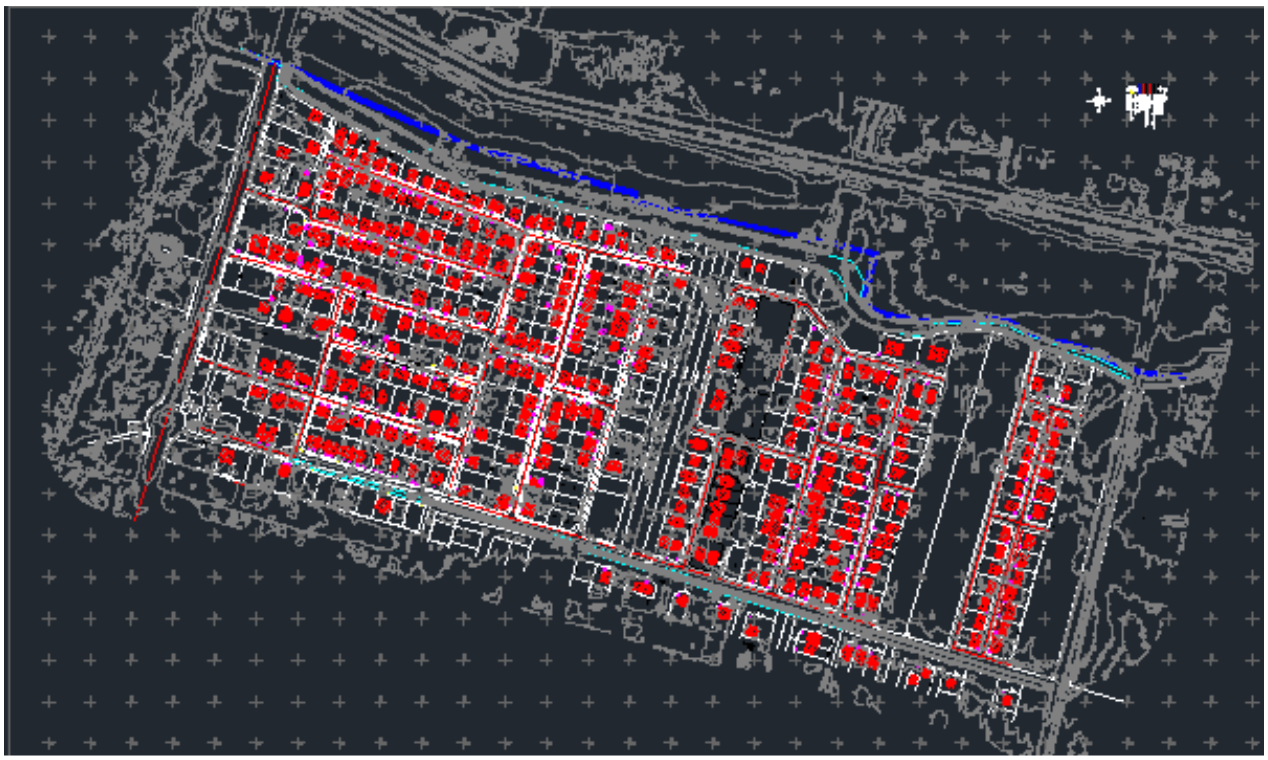

Figure 12. Urban Network Plan of Mosnita Noua

Parallel to Iceland – Saskatoon

The City of Saskatoon has visions of heated sidewalks, while they're a reality in Reykjavik. Imagine a city with snow-free sidewalks all winter long without having to be plowed or shovelled. This isn't a magical land it's Iceland, and the City of Saskatoon is looking towards it and a few other Scandinavian countries for inspiration (Figure 13), (Cbc, 2022).

The City of Saskatoon has visions of heated sidewalks, while they're a reality in Reykjavik.

Saskatoon's City Centre Plan proposes heated sidewalks in the downtown area. Not only would it make walking easier and avoid back aches from shovelling, it would also save the wintry city money (Orkustofnun).

On the volcanic island of Iceland, ground water from the earth's crust is used to heat Reykjavik homes. The water is between 100º and 300ºC.

The runoff water, which is about 30ºC, is then piped into plastic tubing inside the city's streets and sidewalks. Although there aren't any volcanoes on the Canadian prairies, Hjalmarsson said it's still possible to develop heated sidewalks in the city (Figure 14).

The city's plan says that sidewalks could be heated through connections with nearby public buildings or through the recapture of waste energy. It says that warmed pavement could also be incorporated with existing sidewalk infrastructure and they would be located in "strategic locations," such as City Hall Square.

Figure 13. Heated Sidewalks in Saskatoon

Figure 14. Heated Sidewalks in Saskatoon

Case study Italy, Florence (Lombardy)

The underground infrastructure network consists of street lighting, electricity, water, gas, sewerage (Figure 15) (Figure 16).

In order not to end up with problems, which may affect the city's building networks, for example: irrational use (Figure 17) excavation incidents, unauthorized construction, management of interferences, increased pollution, random occupancy, the following criteria will be addressed: directive Arrangement of technological systems underground, Application of law 26 (Management of local services of public interest, Rules on waste management, energy, use of underground resources and water resources) and Inspire Directive (Infrastructure for Spatial Information in Europe) (E. Falcomatà, 2022).

Figure 15. Organisation of infrastructure networks in Florence - Italy

A project coordinated by the Lombardy Regional Authority has been implemented in this city to address the issues listed above and will be carried out in the following stages: feasibility study, cost assessment and model testing.

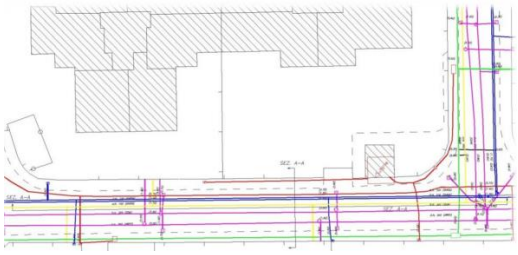

Figure 16. Urban Network plan in a part of Florence

Figure 17. Irrational use in middle of a street from Florence - Italy

In this application different mapping methods will be used (digital slit-plotting (Figure 18), GPR - Ground-penetrating radar standard or 3d complex), where the obtained data will be processed and 2d-3d WebGIS will be used.

-ground scanning

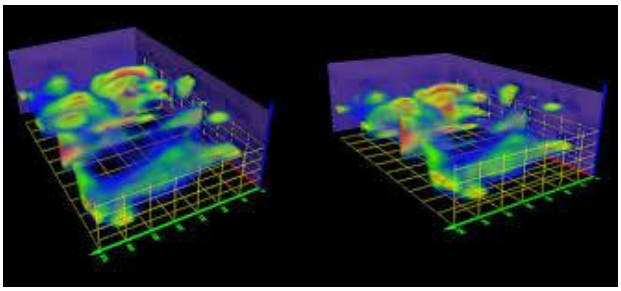

Figure 18. Ground penetrating radar

Eventually, a public portal will be obtained, containing all data sets for information exchange between utilities and authorities.

-WebGIS 2d and 3d portal (Figure 19).

Figure 19. WebGIS 2d interface

CONCLUSIONS

In conclusion, we can say that such a plan is very important, first of all for identifying the municipal network when building permissions are needed in areas where there are no buildings already in existence, and also where changes are made to the network or certain unpleasant situations arise. These plans help specialists in different fields, such as architecture, civil engineering, construction, to more easily identify problems in case of unexpected situations.

The need for a utility networks database in order to manage more efficiently the problems that may occur (cracks, blockages, leaks, power cuts, wire breaks) and for new utility connections for future constructions in the area is also answered by such an approach such the one presented.

At present, the building cadastre is under development in our country, and the authorities should keep track of their regular updates.

The implementation of the building cadastre in every ATU and the introduction of these data in a national GIS is a necessity for their recording, management and monitoring.

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TECHNICAL AND LEGAL ASPECTS REGARDING FOREST RETURNS IN POIANA MĂRULUI

Simona Ioana PÎȘEU

Scientific Coordinator: Assoc. Prof. PhD Eng. Cornel Cristian TEREŞNEU

Transilvania University of Brasov, Faculty of Silviculture and Forest Engineering, 1 Sirul Beethoven Street, 500123 Brasov, Romania, Phone /Fax: +40-268-418600 / +40-268-475705

Corresponding author email: simona.piseu@student.unitbv.com

Abstract

The paper presents the technical aspects but also the legal ones regarding the issue of restitutions of areas covered with forest in a locality of Braşov county. An area of 393.43ha was considered to be measured using two Trimble Pro XT and Pro XH receivers. The measured areas were correlated with the areas registered in the property titles or with the data held by the mayor's office (requests and validations). Accuracy of point coordinates was calculated with GPS equipment in two situations: at the boundary between forestry and agriculture and within forest areas. Very good accuracies were obtained, accuracies that fell within the range 0.2… 0.4m at the border with the agricultural and 0.5… 0.8m inside the forest areas. Also, all the property titles and the record of vesting of possession were synchronized with the concrete land situation, managing to draw up the parcelling plans in order to submit them for approval to OCPI Braşov. However, there are also some situations in dispute, these being the subject of discussions between the owners, the representatives of the mayor's office and the company that carries out the tabulation work.

Key words*: forest, measurements, Poiana Mărului, property titles.*

INTRODUCTION

The work is being carried out for a part of the forests in Poiana Mărului, forests that have been returned according to the property laws. First image partially shows the area considered.

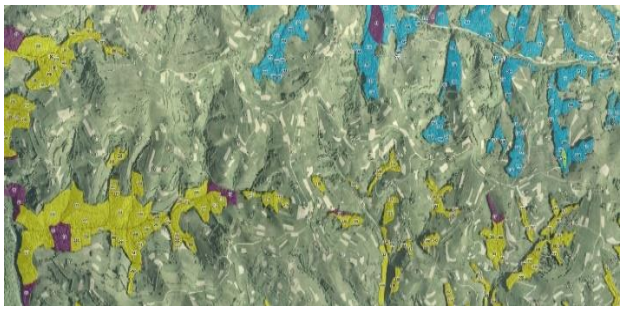

Figure.1 Map with the location of the measured forest areas (partially)

For the beginning, all the property titles were gathered and the Poiana Mărului City Hall was asked for all the lists with the forest validations in order to return them. The second situation resulted from field measurements. Obviously, there were some differences as the forest areas were returned with different property laws, some of them, as it is known, not taking into account the initial physical location (Law 18/1991). Because all these forests are isolated bodies inside Poiana Mărului, it is clear that they are developed behind the households of those who requested them. For this reason, the land measurements took into account what the owners showed, supported (of course) by the neighbors. In the end, these two situations were correlated and a unitary situation was achieved.

MATERIALS AND METHODS

The materials used to solve this work were:
two Trimble PRO XT and Trimble PRO XH dual frequency GPS receivers through which the point coordinates were determined;
the cadastral plans equipped with forest boundaries and the orthophotoplan corresponding to the area;
forest descriptions (so-called parcelling description) taken from the forestry authority.
The research methods used were:

- method of the study of documents in order to visualize the correctness of the titles and the record of vesting of possession or of the validations based on the certificate;
- method of direct topographic measurements - by using the Stop & go method and post-processing the data with the help of data received from a permanent station;

methods of mathematical statistics for the analysis of the accuracy of determining the coordinates of the points with the help of GPS equipment (Dogan et al., 2014; Janez et al., 2004; Ordonaez Galan et al., 2011, 2013; Tereşneu and Vasilescu, 2015, 2019; Tereşneu et al., 2014).

RESULTS AND DISCUSSIONS

Following the field measurements, a table was drawn up to highlight the forest area actually used by each of the forest owners (Table 1).

Table 1. Field measurements and technical and legal problems encountered (extract)

Nr. Crt.	GIS OBJECT	UP	UA	Name	Measured area (ha)	Observations
1	397	XI	69	CORCA TEODORA	1.1176	
2	398	XI	69	BOBEIU IOAN	2.2728	
3	399	XI	69	TOGOE ALEXANDRU COMANICI GHEORGHE	0.2668	
4	400	XI	69	CORCA IOAN	0.0822	
5	401	XI	69	LAZAROIU GHEORGHE	0.9509	
6	402	XI	69	GUIMAN PARASCHIVA	0.4332	
7	403	XI	68	GUIMAN PARASCHIVA	0.0362	
8	404	XI	68	PISEU AUREL	0.7003	
9	406	XI	68	PISEU AUREL	0.3309	
10	407	XI	68	PISEU AUREL	3.2325	
11	408	XI	68	PISEU AUREL/ ADAM ION	0.2648	
12	409	XI	68	TOGOE ION	0.1032	
13	410	XI	68	PISEU AUREL/ADAM ION	0.1255	
14	411	XI	70	PISEU MARIA	0.8378	
15	412	XI	70	ENESCU ELVIRA	0.7048	
16	413	XI	70	PASOIU (RASOIU) ANA	1.6487	
17	414	XI	70	LIHACIU ANA (ANA STAN PERSOIU)	0.7370	
18	415	XI	70	TITILINCU ARON	0.6157	
19	416	XI	70	BALAU IOAN	2.2786	OVERLAY SERVER
20	417	XI	70	TITILINCI ION	0.4397	
21	418	XI	70	PERSOIU IANCU PERSOIU EMIL	0.7538	
22	420	XI	70	ORZAN ION	0.2470	OVERLAY SERVER
23	422	XI	70	ORZAN GHEORGHE	0.5309	OVERLAY SERVER
24	423	XI	71	TITILINCU ARON GURAN ARON	0.3964	
25	424	XI	71	POPA IOAN DRAGOI MARIA	2.4997	
26	434	XI	72 - 76	DOBRESCU ILIE	6.0628	
27	435	XI	72A	CEAPA NECULAI	2.7239	
291	770	XI	122	NITU ILIE	0.4834	NITU ILIE PROBLEMS WITH PRODAN

Several types of problems have been reported, each requiring a specific approach to address. Regarding the issue of overlaps with cadastral works performed by various individuals authorized to perform cadastral works, they have been contacted and the action of verifying topographic measurements and preparation of repositioning documentation is underway. With regard to the disputed issues, where two owners claim the same forest area, a commission has

been set up at the town hall level to find a compromise solution by which each party will receive the requested part of the forest as area.
All the field data as well as the written ones were introduced in the GIS project, which is a very efficient way to manage such a situation. At the level of such a project, in addition to the synthetic situation at the level of the entire measured surface (Figure
2), it was possible to highlight the surfaces with problems such as litigation (Figure 2), or the overlaps with buildings registered in the integrated system of cadastre and land registry (Figure 3).

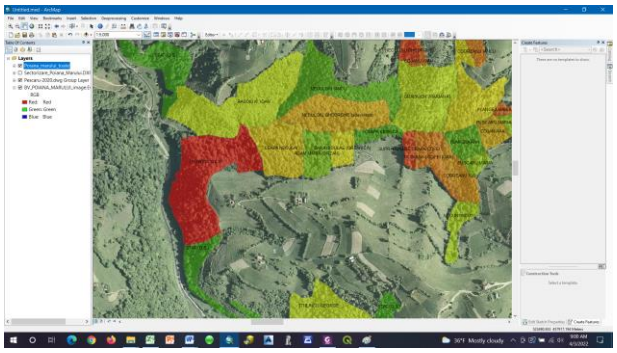

Figure 2. GIS Project overlapping over ortophotoplan

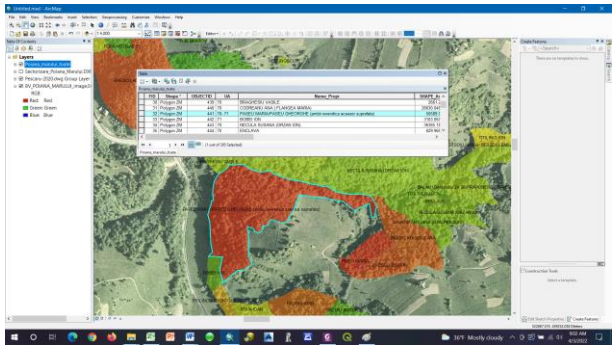

Figure 3. GIS project – Litigations highlighting

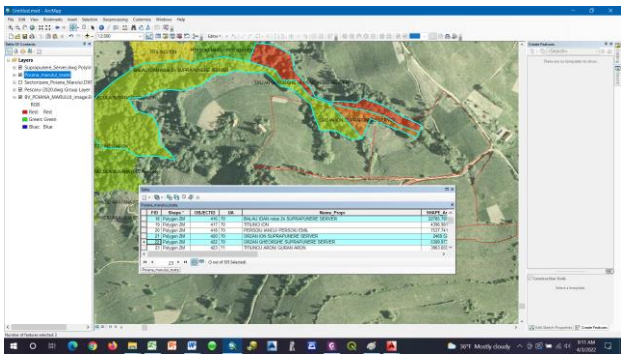

Figure 4. GIS Project – overlays highlighting

The situation shown in Figure 4 is a special case as the owner chose to update his cadastre for the entire area recorded in the land registry, even if part of it overlapped over the forest that was the subject of property laws. In order to solve this situation, it was proposed to the owner to restore the geometry of the buildings registered in E-Terra, in the sense of surface rectification and thus omitting the forested perimeter, and then to draw up the parcelling plan to be submitted for approval to OCPI.

CONCLUSIONS

The problem of tabulating forest areas that have been returned with property laws is a very thorny one and requires both technical skills to solve field measurements and preparation of documentation, as well as legal knowledge to find legal solutions and agreed by beneficiaries. The corresponding areas were measured, the correspondence with the forest parcelling and the existing scripts at the town hall were identified and the corresponding parcelling plans were drawn up. Where the situation is unclear due to overlaps with other agricultural buildings or where several owners request the same forest area, repositioning and / or surface rectification works are carried out and the owners' acceptance is expected regarding the solutions proposed by the designated commission.

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SOLAR CADASTER - A SOLUTION FOR ROMANIA'S SOLAR ENERGY

Ioana-Alexandra POPA

Scientific Coordinator: Assist. Prof. PhD Alexandru-Iulian ILIESCU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: + 4021.318.25.67, Email: iliescualexfifim@gmail.com

Corresponding author email: ioana_popa99@yahoo.com

Abstract

Green energy is a topical issue as there is a move towards more and more energy consumption, be it in transport (through the development of electric cars and other mobility devices), for domestic use (heating and cooling homes) or in industry. There is a target in the Paris Agreement to increase renewable energy consumption by up to 65% by 2050. One solution for obtaining electricity in urban areas where space is limited is to install solar installations on the roofs of buildings. By implementing a solar cadaster, the potential of these areas can be highlighted and calculated. Geodetic engineers can be involved in all necessary steps of solar map development, implementation and updating.

Key words: *cadaster, GIS, Romania, solar cadaster*

INTRODUCTION

Green energy is an energy produced from renewable sources that doesn't generate contaminated substances or greenhouse gases, that help to protect biodiversity and the people as much as possible. Green energy, which is generated from natural resources and renewable sources, it is more looked into by a population that is preoccupied by the environment and to take part in protecting and to upkeep the planet.
The nature has a set of characteristics that can be converted into electrical energy. Main sources of renewable energy are: **Sun** - solar energy is produced by using solar panels that are capable to convert sun's natural energy in two types of energy:

- Photovoltaic solar energy: the solar rays from the solar panels that are converted into electrical energy by the photovoltaic cells that compose them
- Thermic solar energy: the solar panels concentrate the light and the heat from the sun converting them into electricity. Solar energy is the most abundant energetic resource from Earth - 173.000 terawatts of solar energy hit the earth constantly. This is 10.000 times greater than the total energy consumption on the entire world. (source:https://www.endesa.pt)

Other sources of renewable energy are: wind, tides, water, biomass, earth's heat.
Advantages of green energy are very significant and they are:

- Renewable: unlike fossil fuel (coal or natural gases), the sun, wind and earth's heat are replenishable and durable that can be renewable in a natural and regular way. This fact dictates the ending of the worries about the deficit of resources.
- Sustainable: because it has a renewable and clean origin, green energy is a big contribution to protection of the environment, protection and durability of the planet Earth.
- 100% green: energy is generated from renewable source, which means that it doesn't have a negative impact on the environment, like greenhouse gases, soil, air and water contamination.
- Less electrical dependence from other countries: reducing the need to import fossil fuel, like coal or natural gases, exported from other countries.

- Reducing the up keeping and exploiting costs: Renewable energy continues to go towards a more efficient future from an economic standpoint. Nowadays the up keeping costs are smaller than the costs associated with the combustion of fossil fuel.
- Minor risks: The risk associated with the production of energy from renewable sources is significantly less than the unrenewable one.
- Improving the public health: fossil fuel energy production is responsible for a big part of the air, water and soil pollution, affecting the air we're breathing, the water we drink and the food we are growing, collecting and consuming. On a long term, the risks to live in polluted areas include respiratory problems, heart attacks, neuronal problems and other serious complications. An engagement towards green energy will eliminate all these problems and will contribute to improving the health of our community.

MATERIALS AND METHODS

For the creation of solar maps it is necessary to acquire data from the field with Lidar measurements or from digital elevation models. From these 3D models we can extract the necessary data for the creation of solar maps such as: geometry and area of buildings, area and slope of roofs, geographical orientation etc. These elements can be entered into a GIS, then we can estimate the solar potential of the building. The important thing is the roof area of the building and its orientation.

A very important tool for solar cadastre is represented by 3D cadastre, namely by introducing the third dimension, different situations regarding the built areas can be better illustrated. Also, the introduction of the third dimension and the management of information in a GIS environment for both 3D cadastre and solar cadastre contributes to the clarification of energy consumption and for the development of photovoltaic panel infrastructure (Moscovici et al, 2019).

RESULTS AND DISCUSSIONS

To a national and European level, in the past 20 to 25 years, the environment pollution problems were beginning to be taken more and more into consideration. Therefore, a series of measures have been taken, especially in maintaining the air quality department, the proper management of waste and the ways of obtaining electrical energy.

In Romania, for production and promoting the production of renewable electrical energy, starting with 2003, the primal laws that represent the base of this activity had begun to be created. Green energy regulation to a European level tally with the entry of environmental problems to a larger scale in public debates. First laws were adopted in 1997, when it was settled that until the year of 2010, 22.1% of the consumption of electricity has to come from renewable sources. In 2001, the objective specific to each country of the European union have been settled. Because through these measures the wanted results weren't obtained, subsequently a much better define legislative framework has been crated. (source: https://stratos.ro)

At european level in the future, one of the most recent developments in this domain is the one that came after the Paris Conference in 2015 regarding the climate, through which it has been settled that the percentage of energy from renewable sources need to be 27% from the total consumption until 2030 in the European union.

It was pursued that until 2030, 32% of Europe's energy to become green, with the mention that until 2023, the percentage will be revised, depending on the progress made until then.

In 2020, the percentage it has gone up once again to 55%, even 60%, a very big number, but it was considered fitting after signing the Pact for Green Europe and the announcement of the strategy plan by the European Commission von der Leyen.

To a European level one of the most important perspectives is the creation of an Energy Union, that will reassure the total integration of the national markets in energy.

Cities that host more than half of the population of the earth, consume the biggest majority of energy from the entire world. To become more resilient for the future, cities have to start to make their own energy not just to reduce the necessary of it. One way to generate renewable energy in an urban environment is to utilize the solar energy. It is important to obtain a bigger image, more detailed, of the quantity of energy that we can produce with solar panels on the roofs of existing buildings. One way to analyze the potential of the existing environment is through solar maps.

A solar map or a solar cadaster it's a GIS system that shows the annual solar radiations on the surface of the existing buildings, most of the times it comes with the solar energy production, thermic or photovoltaic systems and connection to a website. Many municipal administrations already have solar maps and they serve mainly two purposes: as a frontal platform to inform citizens for the potential of their own roof and as a back-end instrument for city administration that they can depend on for energy related decisions.

The actual solar maps have different levels: the delivered information quality can differ a lot for each user. Sometimes, solar maps are a component of bigger programs to obtain more renewable energy productions in cities and to offer users direct access to information about solar system providers. Other solar maps offer the users just the solar radiations, without any other information. Plus, all the solar maps until now only cover the solar radiations to the roofs and not to other walls.

The principal accent of all solar cadaster applications is based on the following aspects:

- Annual solar radiations (KWh/m)
- Applications considered
- (photovoltaic, thermic)
- Total power per roof (KWh/area)
- Assumed efficiency of technologies
- Patrimony limitations (buildings with cultural patrimony are marked)
- Step value per category (KWA/m)
- Minimal surface of the solar system (m).
- Solar Maps can generate data about:
- The potential of building photovoltaic panels
- Solar-thermic potential
- Solar radiation potential analyses

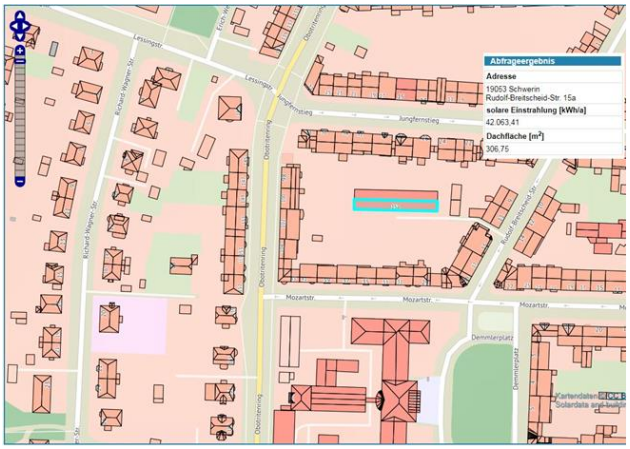

Figure 1. Solar potential map for the city of Schwerin from Germany – Data about address and annual solar radiation per surface (source: http://solar.geocontent.de/schwerin/)

Different types of solar maps are already developed in cities across Europe.

Figure 2. Solar radiation potential map for the city of Schwerin from Germany (source: http://solar.geocontent.de/schwerin/)

CONCLUSIONS

- Romania, at the current moment doesn't have any solar map and this concept is not developed or proposed for implementation;
- There is a target to increase renewable energy consumption by up to 65% by 2050;
- It is our duty to bring this new concept into the attention of the public, because engineers are directly involved in every step of the developing of solar maps, from the field data purchase, which can be done through LIDAR, or trough digital model generations of the terrain, and data manufacturing in the coordinate system with dedicated programs and creations of

a GIS. Also the updating of the maps it's an important element

- The implementation of the solar cadaster and creations of solar maps for urban zones as fast as possible is strictly important, considering that the Romanian Government finances the 'Green House' program for installing photovoltaic systems
- Through the implementing of the solar cadaster program 'Green House' it could finance with priority being the areas with the most solar potential, and with the help of the date delivered buy the application it could request a selection criteria.

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SECTION 05
FUNDAMENTAL SCIENCES

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DEPRESSION ON TEENAGERS BEFORE AND DURING THE COVID-19 PANDEMIC AND NATURAL TREATMENTS

Serena-Andreea BUCUR, Marius BUICA

Scientific Coordinator: Assoc. Prof. PhD Alina ORȚAN

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: + 4021.318.25.67,

Corresponding author email: serenabucurjvh@gmail.com

Abstract

Depression is a mental disorder that affects more than 300 million people worldwide, which makes it one of the most common mental disorders. At the moment, psychological distress among teenagers looks to be on an increasing scale. Adolescence is a developmental phase of adaption to diversity and life problems, and so, adolescents are more likely to develop mental disorders. Also, stressful, and unwanted situations, such as the Covid-19 outbreak increase the risk of mental illnesses appearing. Based on a poll conducted by UNICEF in 2020 on 8444 adolescents, 46% reported symptoms of depression such as less motivation for activities they usually enjoyed, or less motivation to do regular chores that was reported by 36% of them. And especially because this life period involves so many changes in teenagers, natural treatment is a recommended way to treat depression, without affecting other anatomical processes inside the body. Studies have shown that there is a lot of natural, plant-based medication that has high efficiency in curing depression. Also, recent research shows that there is an increased interest in finding and developing natural and efficient treatments for depression and other associated diseases, especially for teenagers.
This paper aims to provide an overview of the Covid 19 pandemic, and also of the measures that were adopted by the authorities worldwide to limit the spread of infection, which can be possible causes of the increased number of teenagers affected by depression, and also the assessment of the possibilities of using plant-based medication for the treatment of this disease.

Key words*: Covid-19, depression, natural treatment, teenagers.*

INTRODUCTION

Depression affects over 300 million people worldwide, and this makes it one of the most common mental illnesses. Even though there is a big variety of first-line treatment options, 30% of adults with depression report they have difficulty with work, home, or social activities due to their depression. The present Covid-19 pandemic has further emphasized the need for addressing anxiety and depression on a global scale and increasing remote access to treatment.

MATERIALS AND METHODS

To characterize the evolution of depression cases, their causes, potential treatment, and their increase due to the pandemic situation, there were used scientific articles about depression, statistics made by UNICEF, and also scientific articles about natural, plant-based treatment. The period analyzed in this study was specially represented by the Covid-19 pandemic and the post-pandemic period.

RESULTS AND DISCUSSIONS

On March 11, 2020, the World Health Organization (WHO) declared the spread of Covid-19 a global pandemic. So, on March 12, Norwegian authorities, as in other countries worldwide, decided to shut down large parts of society as an efficient way to limit the spread of infection. Measures taken by the government comprised quarantine and social distancing in the first place. That also meant closing schools at all levels for a good two months during the spring of 2020. The situation has led to serious concerns about how child and adolescent mental health and well-being may have been impacted.
According to a poll conducted by UNICEF on 8444 adolescents, 46% reported symptoms of depression such as less motivation to do things they usually enjoyed or less motivation to do

regular chores, which was reported by 36% of them.

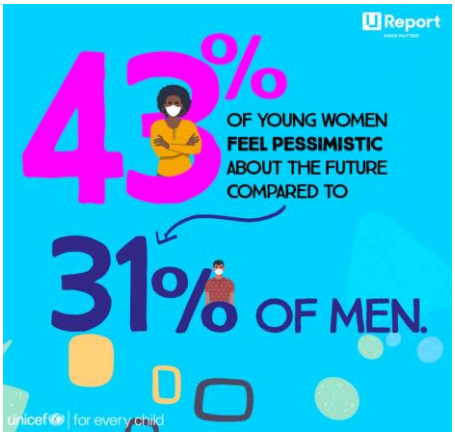

Figure 1. UNICEF poll percentages

The isolation from friends over time, uncertainty about the future both short- and long-term, as well as a continuous state of fear, have all been evidenced to pose a risk for developing psychopathology in youth (Hafstad et. al., 2021). Family stressors pertinent to the pandemic outbreak, such as parental job loss and financial insecurity, may affect adolescents in general, and in particular, those living in families with increased levels of psychosocial disadvantage. The perception of the future has also been negatively affected, particularly in the case of young women who have and are facing particular difficulties. 43% of the women feel pessimistic about the future compared to 31% of the male participants.

Figure 2. UNICEF poll statistics about motivation in teenagers

Adolescence represents a developmental phase of adaptation, exploration, and resilience towards adversity. At the same time, adolescents are at a vulnerable stage of development, with the majority of mental disorders peaking during this period. Studies have shown that about two-thirds of mental health problems in the adult population were reported to emerge during adolescence. Currently, rates of psychological distress among adolescents seem to be on a rising trend. Cross-sectional data from affected areas worldwide indicate that adolescents have shown high rates of psychological health problems during the Covid-19 outbreak. Adolescent girls are at particularly high risk for experiencing anxiety and depression during times of elevated stress. Although many may experience transitory distress, there is reason to believe that some groups of the adolescent population may be disproportionately affected (Hafstad et. al., 2021).

For instance, adolescents with pre-existing vulnerabilities may be at particular risk during a pandemic. Hence, there is a need to understand what characterizes adolescents at the greatest risk of developing psychopathology during a pandemic outbreak such as the current one.

Loneliness and pandemic-related worries during the outbreak were both related to symptoms of anxiety and depression in June 2020, accounting for all other risk factors. Additionally, the finding may have a strong practical impact in that, as noted by Holmes and collaborators reducing a sustained feeling of loneliness and promoting belongingness are central mechanisms in protecting against mental health problems.

The causes of this condition include both biological and social and psychological factors, including depressed family or personal history, trauma, stress, or major adverse changes, but also certain medical conditions and medications.

NATURAL TREATMENT

Studies have shown that there are a lot of natural, plant-based drugs that have high efficiency in treating depression and recent research shows that there is an increased interest in finding and developing natural and efficient treatments for depression and other associated diseases, especially for teenagers.

PLANTS

ST. JOHN'S WORT-*Hypericum Perforatum*-Specialists attribute it to beneficial effects in cases with the low or medium difficulty of

anxiety, depression, chronic stress, and chronic fatigue. St. John's wort supplement balances the chemical processes in the brain and stimulates the release of hormones that induce our well-being.

Figure 3. Hypericum Perforatum plant

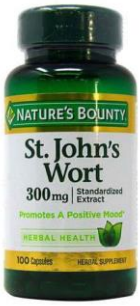

Figure 4. *H. Perforatum* supplement

Lavender has been used as a natural treatment since ancient times, and its actions are well known both internally and externally as well as the valerian, whose effects are noticeable due to its interaction with gamma-aminobutyric acid (GABA), a central inhibitory neurotransmitter that helps regulate nerve impulses in the brain and nervous system. Researchers have shown that low levels of GABA are associated with chronic stress, anxiety, and sleep problems.

Other plants that have also been found to have positive effects on depression are as well *Withania Somnifera* (Ashwagandha), Tilia (Linden), and *Taraxacum Officinale* (Dandelion).

Another efficient plant is curcumin. Curcumin has shown promising efficacy in studies of major depression. Being one of the most powerful natural antioxidants - according to medical research - and the most powerful natural anti-inflammatory, curcumin can reduce DNA damage in the brain and counteract the effects of stress and depression. Although the mechanism of the antidepressant effect of curcumin is not fully understood, there is a hypothesis that it works by inhibiting the enzyme monoamine oxidase. In addition, scientists believe that the success of the antidepressant activity of Curcumin is because it would cause a natural increase in the levels of serotonin, norepinephrine, and dopamine in the brain.

Figure 5. Curcumin plant and powder

CHINESE HERBAL FORMULA FOR DEPRESSION

Traditional Chinese medicine (TCM) conceptualizes the xin ‘heart’ as the “master” of the body, as the center for mental activities, as well as the seat of intellectual activity and emotional activity (Wang, 2020).

Figure 6 graphic representation of the connection between brain and heart

Given that depression is a high-risk factor for Coronary Heart Disease and is associated with poor cardiac outcomes, it is clear that Coronary Heart Disease patients require both mental health care and cardiac treatment, also known as psycho-cardiology therapy (Wang, 2020).

Because conventional antidepression therapies have reported lower effect sizes in Coronary Heart Disease patients, a group of Chinese researchers developed a plant-based formula, composed of 7 herbs (Wang, 2020).

The clinical study was performed over 8 weeks and eligible patients were randomly assigned

(1:1) to receive antidepressant treatment or herbal formulation treatment.
The results showed that the effect of the herbal formula was at least as effective as the antidepressant treatment.

CONCLUSIONS

Due to the alarming increase in the number of persons affected by depression, especially adolescents, as a result of the Covid-19 pandemic, there is an interest in finding and developing natural and efficient treatments for depression and other associated diseases, because the sooner the depression is treated, the sooner the life can take a turn for the better.

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GRIGORE MOISIL – LIFE, SCIENTIFIC WORK AND WORDS OF WIT

Elena - Georgiana ZLOTEA, Ștefania-Cristina PANĂ

Scientific Coordinator: Lect. PhD Cosmin - Constantin NIȚU

University of Agronomic Sciences and Veterinary Medicine of Bucharest, 59 Mărăşti Blvd, District 1, 011464, Bucharest, Romania, Phone: +4021.318.25.64, Fax: + 4021.318.25.67

Email: elenazlotea23@gmail.com, panastefania7@gmail.com

Figure 1. Grigore C. Moisil (1906-1973)

Abstract

The mathematician and computer scientist Grigore Moisil, member of the Romanian Academy, was one of the most prominent personalities in the history of Romanian science. Starting this year, January the 10th was declared in Romania the National Day of Mathematics, Informatics and Sciences, in honor of Mosil, this being exactly his birthday. Moisil is the "father" of Romanian computer science. He also distinguished himself by a very broad mathematical horizon, being the author of a vast scientific work. Last but not least, Grigore Moisil was a charismatic person, being the author of some memorable words of wit that remained famous, and he had a permanent dialogue with the press, popularizing mathematics, computer science and science in general. In this article we propose a foray into the life and work of academician Grigore Moisil.

Key words*: computer science, Grigore Moisil, mathematics, scientific work, words of wit*

INTRODUCTION

The mathematician and informatician Grigore Moisil was born on the 10th of January 1906 in Tulcea, Romania. He is considered the founder of Romanian computer science, following the invention of tristable electronic circuits, and due to his contributions in the professional training of the first computer scientists in Romania.

“Together with Simion Stoilow, Miron Nicolescu and Gheorghe Vrănceanu, Gr.C. Moisil was one of the many great professors of mathematics that the University of Bucharest has enjoyed since the fifth decade of the past century; those distinguished teachers who, together with some brilliant predecessors, were to become the great heads of the Romanian school of mathematics.

Gr. C. Moisil formed not one school, but several schools (including one on mechanics, one on mathematical logic, and one on the algebraic theory of automatic mechanisms). This is explained by the fruitfulness of his ideas, by the mastery with which he knew how to present not a "ready-made" mathematics, but one that was built in the presence of the audience and in which open problems, aspects that could be improved were always emphasized. His thinking was essentially open, according to the remark he made so strongly somewhere: <<No problem has borders. Every answer has many>>”. (Marcus S., 1975). Starting this year, in honor of Moisil, January the 10th, the date of his birthday, was declared in Romania the National Day of Mathematics, Informatics and Sciences.

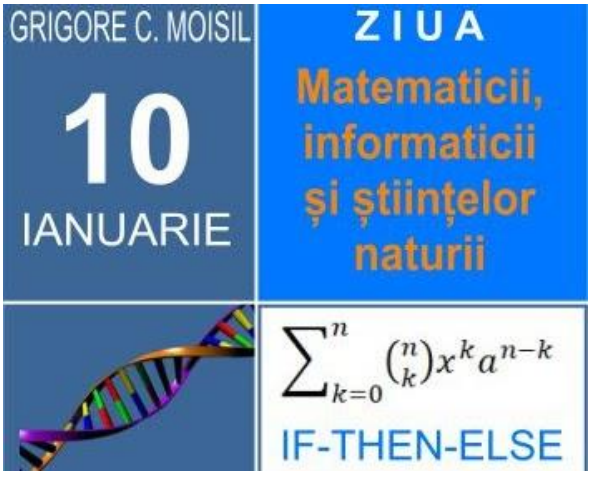

Figure 2. January the 10th, the date of his birthday, was declared in Romania the National Day of Mathematics, Informatics and Sciences.

HE "INVENTED" THE SIMPLE RULE OF THREE

Grigore Moisil's upbringing, "Grigri," (Greygrey) as his mother caressed him, and as he remained all his life for relatives and friends, has been bizarre since the early years. Twisted, he learns, for example, to count and only later to read. "A long, long time ago I was very young. I didn't know my mother had been very young. She didn't start with teaching me to read or write, but to count. She wanted to make me stop being afraid of math. After she taught me to count from 1 to 10, she jumped. (…) The simple rule of three she knew how to make me invent it. Then the mental calculation began ", Grigore Moisil said in an interview in the “Woman" magazine, in 1954.

STUDIES

He attended primary school in Bucharest, and high school in Vaslui (“Mihail Kogălniceanu” Theoretical High School) and Bucharest (“Spiru Haret” High School) between 1916-1922.

In 1923 he entered the Faculty of Mathematics at the University of Bucharest. His parents considered that a person with his mathematical skills must necessarily become an engineer. In 1924 he began his studies at the University POLITEHNICA of Bucharest, at the construction department, although a stronger call was maintained by the Faculty of Mathematics, where his teachers were Dimitrie Pompeiu, his mentor, Gheorghe Țițeica, Traian Lalescu, Anton Davidoglu. Thus Grigore C. Moisil was at the same time a student of the Polytechnic and the University of Bucharest. The interest in mathematics became a priority, so in 1929 he left the Polytechnic, although he had already passed all the exams in the first three years. But in the same year he defended his doctoral thesis in mathematics, “Analytical mechanics of continuous systems”, in front of a commission led by Gheorghe Țițeica. This thesis was also published in 1929 by Gauthier-Villars in Paris.

In 1930 he left for Paris, where he studied at Sorbonne with great mathematicians. In 1931 he took the teaching exam, with the work “Sur une classe de systèmes d'équations aux dérivées partielles de la Physique mathématique. Afterwards, he went to Rome with a Rockefeller scholarship, and studied between 1931 and 1932 with the mathematician Vito Volterra.

UNIVERSITY CAREER

In 1932 he returned to the country, where he became a full professor at the University of Iasi in 1932, then an Associate Professor in 1935, and a University Professor in 1939. He taught the first modern algebra course in Romania, "Logic and Demonstration Theory", at the University of Iasi. In parallel, he began a series of works on the logics of the Polish mathematician Jan Łukasiewicz. His research in logic was the basis of a strong school of mathematics in the country and abroad (Argentina, Yugoslavia, Czechoslovakia, Hungary). During the Iasi period he also published works in the fields of mechanics, mathematical analysis, geometry, algebra and mathematical logic. He extended in n dimensions Pompeiu's areolar derivative and studied the monogenic functions of a hypercomplex variable with applications to mechanics, he introduced trivalent and polyvalent algebras called Łukasiewicz (now called Łukasiewicz-Moisil algebras) and used them in and in the study and the logic of switching circuits. He developed new methods of analysis and synthesis of finite automata and had valuable contributions in the field of algebraic theory of automated mechanisms.

In 1941, a university professor position became available at the University of Bucharest. Four remarkable Romanian mathematicians entered the competition: Gheorghe Vrănceanu, Dan Barbilian, Miron Nicolescu and Grigore Moisil. Although only Vrănceanu, the oldest of them, was initially selected, Moisil convinced the Minister of Education that it had a rare opportunity to develop mathematical research in Romania. Consequently, the Ministry of Education created four teaching positions at the University of Bucharest, and hired all four. Moisil received his position in the academic year 1941-1942.

In the years 1940-1950 he published intensively in the field of electronic circuits.

Between 1946-1948 he was appointed Ambassador of Romania to Ankara. While stationed in Turkey, he gave a series of mathematics lectures at Istanbul University and Istanbul Technical University. In 1948, he returned to the University of Bucharest.

In the 1950's he became passionate about computer science. At the time, the official philosophy dictionary, translated from Russian and published in 1953, described the field of cybernetics as "a reactionary bourgeois science directed against the working class."

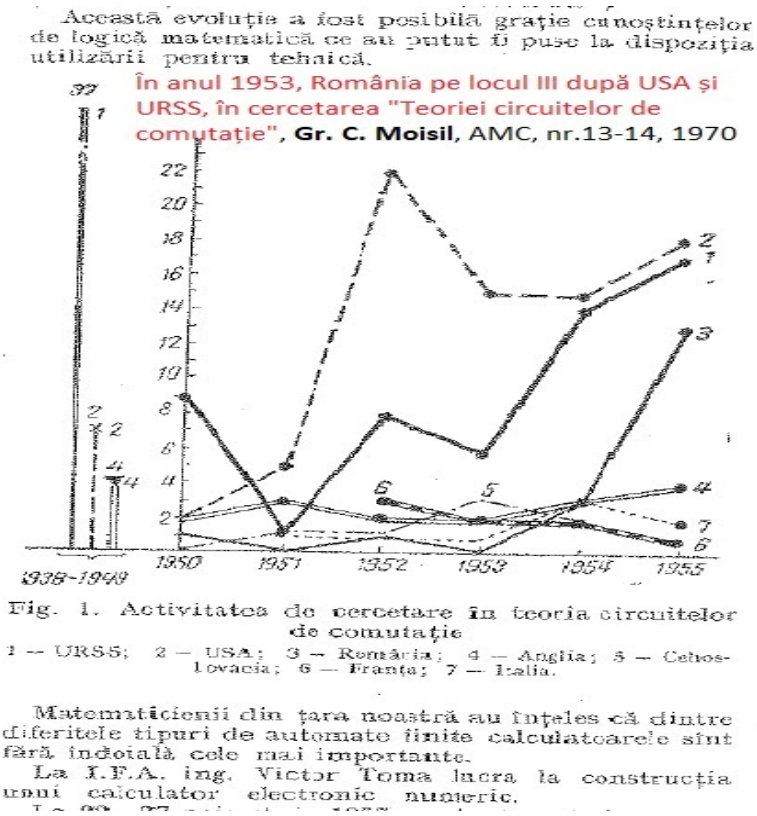

Figure 3. World research activity in the theory of commutation circuits in 1953

THE ACTIVITY OF THE COMPUTING CENTER OF THE UNIVERSITY OF BUCHAREST

In Annexes I and II of the article "Activity of the Computer Center of the University of Bucharest", one can see the diversity of courses and institutions on the activity of using electronic computers. For example, the courses took place at the headquarters of the following institutions, in the period 1963-1969, when Gr. C. Moisil was director of CCUB: Computing Center of the University of Bucharest (CCUB), Institute of Mathematics of the Romanian Academy, Energy Institute of Romanian Academy, Astronomical Observatory of the Romanian Academy, Institute of Fluid Mechanics of the Romanian Academy, Aerodynamic Research Center, Ministry of Petroleum and Chemistry, Ministry of Machine Building, Ministry of Railways, Ministry of Armed Forces, Military Academy of Bucharest, Bucharest, Polytechnic Institute, Bucharest Construction Institute, Faculty of Mathematics of Iași, Institute of Design, ISPE, IPROMET, ISCAS, CEPECA, IPACH, CSCAS.

In 1953, Romania was ranked third after the USA and the USSR, in the field of research on "Theory of switching circuits", regarding the number of published scientific articles. From the chart below, it can be seen that between 1938 and 1949, the USSR had 37 articles, the USA had 8 articles, and England had 4 published articles. "This evolution was possible thanks to the knowledge of mathematical logic that could be made available for use in technology" Gr. C. Moisil.

SCIENTIFIC ACTIVITY

- He published scientific papers in the fields of mathematical analysis, algebra, mathematical logic, geometry, mechanics;
- Particularly valuable are the contributions made by Grigore Moisil in the field of algebraic theory of automatic mechanisms. He developed new methods for the analysis and synthesis of finite automata, as well as a structural theory of them.
- He extended in the space with several dimensions the areolar derivative of D. Pompeiu. Areolar velocity in physics is a vector quantity that represents the area swept in the unit of time by the vector radius of a moving material point on a

curvilinear trajectory. The definition formula is given by the expression:

$$\vec{\Omega} = \frac{d\vec{A}}{dt}$$

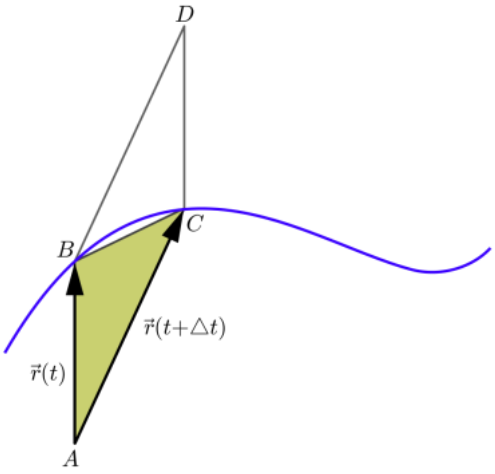

Figure 4. The areolar derivative

- •He studied the monogenic functions of a hypercomplex variable, with applications to mechanics. A complex function $f: A \subset \mathbb{C} \to \mathbb{C}$ is called monogenic at a point $\zeta \in A$ if there exists and it is finite the derivative

$$f'(\zeta) = \lim_{z \to \zeta} \frac{f(z) - f(\zeta)}{z - \zeta}$$

- •He introduced algebras called trivial and polyvalent lukasiewiczien and used them in logic and in the study of commutation circuits. Moisil has made a significant contribution to the introduction and use of the first electronic computing machines in our country.
- •He wrote many scientific articles and 17 books, of which we mention: "La mecanique analytique des systemes continuus" (1929), "Logique modale" (1942), "Introducere in algebra" (1954), "Teoria algebrica a mecanismelor automate" (1959), "Circuite cu transistori" (2 volumes, 1961- 1962).

PROMOTING MATHEMATICS AND THE USE OF COMPUTERS. SCIENTIFIC, DIDACTIC CONCERNS AND INITIATIVES OF GRIGORE C. MOISIL

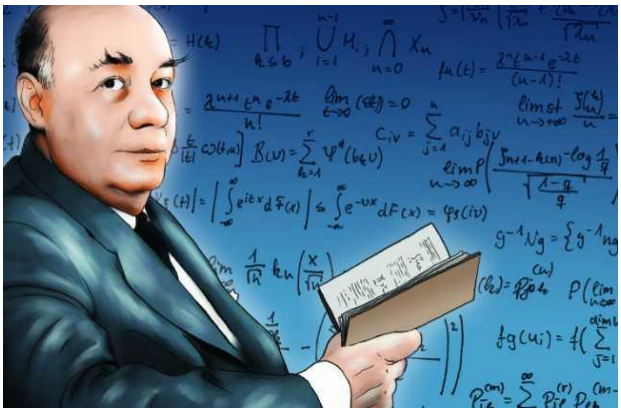

Figure 5. Grigore C. Moisil

In 1962, Grigore C. Moisil founded the Center for Computing of the University (CCUB), where he was honorary director until 1969, the "gray eminence", as he amused himself. The first machine used was the digital one by Victor I. Toma "CIFA 1", replaced in 1968 by an IBM /360 computer. Here he learned the programming languages and the underlying disciplines, abstract algebra, mathematical logic, Boolean algebras, the first educational team to teach computer science today at the Faculty of Mathematics in Bucharest, or at other educational centers: Prof. Constantin P. Popovici, Sergiu Rudeanu, Leon Livovschi, etc. . As a result of the growing interest of non-mathematicians in mathematics, Grigore Moisil began in 1970 a series of lessons in Mathematics for the Humanities at the semiotics laboratory of the Faculty of Philology in Bucharest.

In 1971 he left the position of Algebraic Theory of Automatic Mechanisms, which he had held since 1967 at the Faculty of Mathematics and became a professor at the Faculty of Philosophy and Law. At the age of 65, he began a series of completely new and original courses in Fundamentals of Mathematics, Sentence Logic, Operational Research. He is the one who introduced computer science education at the Faculty of Mathematics in Bucharest.

Secondary education has not been left out of its sphere of interest either. As president of the Romanian Mathematical Society, he was in contact with high school teachers. In 1965 he proposed the establishment of special mathematics classes, in 1968 he held an experimental course in mathematical logic at the

"Petru Groza" High School in Bucharest; also in 1968 he opened the first postgraduate courses in computer science.
In 1970 Gr. Moisil opened the column "Science and Humanism" in the magazine "Contemporanul", which he continued until his death.

A HUMOROUS MATHEMATICIAN

Grigore Moisil, however, was not the kind of mathematician to delve into his studies. Instead, he enjoyed teaching math to those around him.
In principle, mathematics is not a branch of science that is appreciated by many pupils or students. It is difficult, it requires strength of concentration and long study, but Moisil managed to make his students learn with pleasure. How did this work? Because he had a lot of humor and used this quality to relax his students during class.
Among his famous jokes are those about women, such as: "Every man needs a mistress! The wife thinks he is with his mistress, the mistress thinks he is with his wife and so he can sit quietly in the library to read. " Ironically, an adaptation of this joke to modern times would probably require the man to play on the computer.
However, he also joked about the lack of intelligence of some of his peers: "The laws of the country do not forbid anyone to be an idiot."

GRIGORE MOISIL'S PASSION FOR LITERATURE AND WRITING IS LESS WELL KNOWN

From his literary essays we selected the lyrics:

„Pe vârfuri de zăpadă, când soarele apune,
Ca pietre nestemate sunt boabele de gheată.
Lucesc şi-a lor sclipire ne pare o minune.
Bătrânul munte râde de-astă frumoasă fată."

("On snowy peaks, when the sun goes down,
Ice grains are like precious stones.
They shine and their sparkle seems like a miracle,
The old mountain laughs at this beautiful girl.")

PASSING AWAY TO ETERNITY

He died in Ottawa, Canada, on the evening of May the 21st , 1973. Inevitably, the news spread out to all continents: reaching out to colleagues in Japan, teachers in Paris, and family at home.
Despite the sudden death, family and friends were barely talking about this moment.
"Whenever he didn't feel well, he did math, and also whenever he was happy he did math. It's rigour matched his logical spirit. <<What are you passionate about outside of your profession?>> an editor once asked. He answered: Mathematics" (Mosil V., 2002). This is another declaration of love for mathematics. Because, no matter how obsessive mathematics may seem in a teacher's life, practiced "when you brush your teeth and when you don't brush your teeth", this was his great joy.

MORE WORDS OF WIT (THE SO CALLED "MOISILISMS")

For more interesting aspects see Moisil V., 1989 and Moisil V., 1998.
•"*Explozivul cel mai puternic nu este toluenul, nici bomba atomica, ci ideea omeneasca.*"
("The most powerful explosive is not the toluene or the atomic bomb, but the human idea.")

•"*Spre deosebire de vin, stiinta nu trebuie lasata sa se invecheasca.*"
("Unlike wine, science must not be allowed to age.")

•Explicand principiul recursivitatii:
"*-Esti de acord ca orice om are dreptul la un pahar de vin?*
-Da.
-Bei paharul, ıl pui jos. Esti alt om. Si cum orice om are dreptul la un pahar de vin … si asa mai departe."
(Explaining the principle of recursion:
"-Do you agree that everyone has the right to a glass of wine?
- Yes.
- Drink the glass, put it down. You are a different man. And how everyone has the right to a glass of wine … and so on.")
•

$$1^1 = 1,\ 1^2 = 1, 1^3 = 1 \ldots$$
$$2^1 = 1,\ 2^2 = 2, 2^3 = 8 \ldots$$
$$0^1 = 0,\ 0^2 = 0, 0^3 = 0 \ldots$$

Concluzii: "*unde-i unul, nu-I putere; unde-s doi, puterea creşte; o nulitate ridicată la putere tot*

nulitate rămâne" (ultima cu referire la regimul Ceaușescu).
(Conclusions: "where there is one, there is no power; where there are two, the power increases; a nullity raised to power remains a nullity" (the last one referring to Ceausescu's regime)).

•"*Căsătoria este singura scăpare pentru un bărbat fără succes și pentru o femeie cu prea multe*."
("Marriage is the only escape for a man without success and for a woman with too many.")

•"*Dușmanii sunt recrutați dintre prieteni."*
("Enemies are recruited among friends.")

• "*Problema morții este vie (la o anumită vârstă)."*
("The problem of death is alive (at a certain age).")

• "*Nu este greu să ai dreptate; e greu sa-i convingi pe altii*."
("It's not hard to be right; it's hard to convince others.")

• *Se știe că o idee începe cu un paradox, continuă cu o banalitate și ajunge să fie o prejudecată*.
(It is known that an idea begins with a paradox, continues with a banality and ends up being a prejudice)

• "*Ce este un pesimist? Un optimist bine informat."*
(What is a pessimist? A well-informed optimist.)

• "*Nu e de părerea ta cel care te aprobă, ci acela care te imită.*"
("It is not of your opinion the one who approves you, but the one who imitates you.")

• *Desigur, nu tot ceea ce iese din comun are o valoare, dar tot ceea ce are o valoare reală este – în mod necesar – ieșit din comun*.
(• Of course, not everything out of the ordinary has a value, but everything of real value is - necessarily - out of the ordinary.)

• În ședința Consiliului Profesoral pentru titularizare, prof. Ștefan Procopiu a votat împotriva numirii lui Moisil, „candidatul fiind prea tânăr pentru a ocupa funcția de profesor".
„*Este un defect pe care îl corectez în fiecare zi*", a răspuns Moisil.
(At the meeting of the Teachers' Council for the tenure, Prof. Stefan Procopiu voted against the appointment of Moisil, "the candidate being too young to hold the position of professor": "It's a defect that I correct every day," Moisil replied.)

• "*— Matematica asta pe care o predici, m-am săturat de ea.*
Moisil: Dar matematica se face de sus!"
("This math you're preaching, I'm tired of it.
Moisil: But math is done from the top up!")

• "*— Domnule profesor, credeți în vise?*
- Sigur, dragă! Vedeți, cu ceva timp în urmă am visat că am devenit academician, că sunt la clasă și că prezidez o ședință. Și când m-am trezit, eram într-adevăr un academician, eram în clasă și conduceam o ședință."
("Professor, do you believe in dreams?"
- Sure, darling! You see, some time ago I dreamed that I had become an academician, that I was in the classroom, and that I was chairing a meeting. And when I woke up, I was really an academician, I was in the classroom and I was chairing a meeting.)

• La o întâlnire în care factorii politici au discutat despre unificarea diferitelor departamente, profesorul Moisil a vorbit cu vocea sa inconfundabilă:
"- *Este o idee bună. Ca urmare, propun ca geometria să se unească cu geografia și geologia și îl propun pe Geo Barton ca preşedinte*." (Notă: un actor cunoscut la acea vreme.)
(At a meeting in which political factors discussed the unification of various departments, Professor Moisil spoke in his unmistakable voice:
"- It's a good idea. As a result, I propose that geometry unite with geography and geology, and I propose Geo Barton as president." (Note: a well-known actor at the time.)

• "*E bine să cunoşti bine pe cineva. Dacă îl cunoşti foarte bine, e rău".*
("It's good to know someone well. If you know him very well, it's bad.")

• „*Sunt oameni care spun: există şi greşeli fecunde. Nu greşeala e fecundă, ci îndreptarea ei."*
("There are people who say: there exist also fruitful mistakes. It is not the mistake that is fruitful, but its correction.")

• "*Iarna sunt tradiționalist fiindcă port căciula, vara sunt paradoxal fiindcă umblu cu capul gol, primăvara sunt socialist din cauza naturii, toamna sunt burghez din cauza umbrelei."*
("In winter I am a traditionalist because I wear a hat, in summer I am a paradoxical because I walk bareheaded, in spring I am a socialist because of nature, in autumn I am a bourgeois because of my umbrella.")

• "*Aproape toate meseriile pe care cineva le va practica în viitor, de la inginerie la muzicologie, de la fizică atomică la turism, de la istorie la medicină, vor folosi calculatoarele. Calculatoarele nu merg singure, ca să meargă trebuie să aibă oameni pricepuţi să le mâie. Ca să ai oameni pricepuţi, trebuie să îi înveţi: CE?"*
("Almost all the jobs that someone will practice in the future, from engineering to musicology, from atomic physics to tourism, from history to medicine, will use computers. Computers do not work on their own, in order to work, they need skilful people who can handle them. In order to have skilful people, you have to teach them: WHAT?")

• "*Omul trebuie să înveţe logica nu pentru a învăţa să judece corect, ci pentru a învăţa mai repede să judece corect."*
("Man must learn logic not to learn to judge right, but to learn to judge right quicker'')

• *"Matematica va fi limba latina a viitorului, obligatorie pentru toti oamenii de stiinta, tocmai pentru ca matematica permite accelerarea maxima a circulatiei ideilor stiintifice.*"
("Mathematics will be the Latin language of the future, mandatory for all scientists, precisely because mathematics allows the maximum acceleration of the circulation of scientific ideas.")

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