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Advanced Research about Heavy Metals and Microorganisms Soil Presence, in Central Albania

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Abstract – To successfully carry out this advanced scientific research about soil pollution, we have obtained data that show us the presence of heavy metals and microorganisms in the soil that can be the soil pollution causes.

In this scientific paper, we have presented quantitative data on the presence of some chemical elements (parts of heavy metals) as well as some bacteria present in the soil. Based on the real presence and the maximum criteria that should be, we are able to judge whether we are dealing with contaminated soil.

To carry out this work, we took soil samples at depths of 15-25 cm, in five stations, during the period October-December 2022, in Elbasan area, including the strategic points where the city's light and heavy industry operates.

It is worth mentioning the fact that Elbasan has always been considered one of the areas of the Albanian state with the greatest atmospheric pollution, whereas the main cause we mention the industries operating in the area, which do not take the necessary measures regarding environmental protection.

After processing the data, we reached values above the standards set by the EU Regulation (more than 3 times) of the element nickel (Ni), a fact that leads us to the conclusion that nickel can be the main cause of soil pollution with heavy metals. In addition to industry, soil pollution can also come from activities carried out by humans, where we mention the poor-quality sewage management and the indiscriminate use of organic fertilizers in agriculture.

Keywords – Heavy Metals, Microorganisms, Soil contamination, Nickel, Elbasan.

I. INTRODUCTION

The focus for which this scientific work was undertaken was the fact that the soil is mainly characterized by the microbiological and heavy metal content, having an indisputable influence on the content and quality of the soil, underground water and consequently also on the cultivated plants.

The constant presence of various metals in the subsoil represents a potential risk for the contamination of the surface layer of the soil and necessarily the reserves of drinking water, being in this way a constant risk for human health.

The damage caused to plants and fruit trees by microbiological and heavy metal pollution, adding to the possible soil erosion as well as the poor and poor management of the land by humans, has continuously led to the destruction of natural resources, especially in the centers inhabited near industrial areas [1], [2].

Various diseases such as tuberculosis, typhoid, influenza and various fungal diseases of plants or animals are easily spread through the air [3], [4].

The presence of heavy metals in the soil and because of the food chain in mammals leads to toxic effects on living organisms.

This phenomenon is dedicated to competition and replacement between essential chemical elements, as well as damage to the cell membrane and reactions with phosphate groups [5]-[7].

Heavy metals damage the cell membrane of various plants, inhibit the normal development of roots and shoots, reduce CO_2 assimilation by plants and reduce stomatal conductance and transpiration [8], [9].

The heavy metals present in the subsoil are characterized by a specific pH, and any fluctuation below the predetermined value of this pH leads to a significant increase in their solubility.

Heavy metals are mainly found in the form of ionic and colloid phase particles.

In this paper, data are provided on microbiological and heavy metal pollution of the soil of Elbasan city, during the period August-September 2022, as well as the relationship on the impact on human life is presented. To perform a more accurate analysis of the level of soil pollution for the Elbasani town, we performed microbiological and toxicological analyzes for soil samples taken at four stations.

For this scientific research, focusing on the two types of analysis mentioned above, which were carried out on the soil samples taken in the Elbasan, we tried to present a valid information on the possible impacts on human health and the factors that have led to underground pollution.

II. Materials and Method

Four soil samples are taken at a 25 cm depth during the August-September 2022 period in Elbasani town. For the speciation analysis, determinations in water soil extracts were carried out by applying the colorimetric method diphenyl carbazide [10].

So, 2.5 g soil samples were shaken with 25 ml of demineralized water for 2.5 hours.

After centrifugation for 10 min at 3500 rpm, the water was filtered through a 0.45 μm Millipore filters [11].

Instantly after extraction, the sample was acidified with a drop of concentrated ultrapure HNO_3 to bring the pH < 2. Afterward the sample was kept in a refrigerator until analysis.

Soil pH (after standard calibration at pH 4-7) in a suspension of 10 g of soil in 25 ml demineralized water, after magnetic stirring for 30 min, followed by 5 min sediment settling.

Various studies showed that the soils sediments consisted of more than 90% of silt to sand fraction. The clay fraction was about 10%.

The analysis of the grain size performed by taking 10 g of sample were treated first with 1 M HCl to remove the calcareous material, then oxalic acid for iron release and H_2O_2 for organic release.

Crown it all the samples were treated with peptizing for 1 h on hot plates.

III. Results

The analysed soil samples were taken during the period August-September 2022 in four different and strategic points of Elbasan.

The data obtained for each of the two months and for the four stations are grouped together, this was done with the aim of having a more realistic conception of the progress of soil pollution compared to the basic parameters.

Table 1 shows the microbiological presence in soil samples, where data on the number of Enterococci and Coliform bacteria are given.

Table 1. Summary table of microbial analysis (average and percentage values) for all four stations.

No.	**Microbiological index**		**Average per 100 g *of dry soil weight***		**Total %**	
1	Total Coliform bacteria *(group)*	Coliform bacteria - *without E. coli*	51065	**62355**	62	**76**
		E. coli - Part of Coliform Bacteria	11290		14	
2	Enterococci *(genus)*		**17650**		**24**	
Total groups of Bacteria			**80005**		/	

Table 2.Summary table of soilheavy metals with average values for all four stations.

No.	**Heavy metals**	**Recommended content (mg/kg)**	**Average(mg/kg)**
1	Arsenic (As)	30	0.6
2	Cadmium (Cd)	3	1.4
3	Chromium (Cr)	200	52
4	Cobalt (Co)	75	31
5	Copper (Cu)	140	28
6	Lead (Pb)	300	55
7	Nickel (Ni)	75	**232**
8	Zinc (Zn)	300	74

Analysis of soil microbial populations in contaminated areas have shown a significant presence of aerobic bacteria, actinomycetes, fungi

and nitrogen-fixing agents and various microbial groups [2], [4], [12].

Table 2 shows the presence of chemical elements in the two months analysed for the four stations, as well as the recommended content.

From the data in table 2, we see that except for Nickel (Ni) which appears in values much higher than the allowed rate, becoming a key factor in the pollution of underground deposits, other heavy metals are within the norm.

IV. DISCUSSION

The soil can be contaminated by bacteriological factors, due to the discharge of sewage, while from the content of heavy metals, due to the dumping of industrial wastes on the ground.

From the processing of the obtained data, it appears that the underground of Elbasan city is polluted, mainly from the underground water that comes because of the discharge of raw industrial water from the heavy industries operating in Elbasan.

We believe that the heavy metals that cause soil pollution are mainly released into the environment by smelting and refining industries, technological industries, scrap metal, the plastic industry and by burning waste containing these elements. Heavy metals can then easily reach the food chain through drinking water supply, air inhalation and food consumption [13]. Also, the fact that Elbasan town is considered one of the most polluted cities in Albania is indisputable.

We think that among the main reasons for this pollution may be high population concentration, busy traffic, infrastructure, lack of green surfaces and above all the development of heavy industrial production activity and poor management in relation to technical control of carried out by the Albanian state, mainly in non-compliance with measures for environmental pollution.

Besides animals can absorb for their own needs a food contaminated with heavy metals, the rest is excreted from the soil through the organic manure that we obtain from animal excrement [14].

We are of the opinion that there is a negative correlation between heavy metals and microorganisms, a phenomenon dedicated to the fact that the presence of heavy metals in the soil helps to reduce the number of gastrointestinal bacteria. From the results obtained in this paper, the presence of nickel above the norm in the surface layer of the soil is clearly seen.

This phenomenon depends on the lithology of the terrain and is a proof that in the studied area the nickel pollution is the result of the natural distribution of nickel [2].

Also, environmental pollution from Ni is mainly caused by refinery discharges and industrial waste, as well as traffic [15], [16].

In conclusion: the soil of Elbasan city throughout the analysed period turns out to be contaminated by the heavy metal nickel.

V. CONCLUSION

•From the results obtained and analysed from this study, we conclude that: Heavy metals are present in optimal conditions, except nickel.

• Heavy metals elements are present in the soil of Elbasan, most of which do not present a level of pollution except for the nickel component, which is at levels around 3 times higher, compared to the standards of EU.

•We think that the underground pollution of Elbasan is dedicated not only to human processes to agriculture, the poor treatment of wastewater, but also to the deposits of raw materials on the ground from the production activities carried out by the heavy industries located in the Elbasan area.

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