

Quantitative Data on Microorganisms and Heavy Metals in Middle Albania Soil.

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Abstract – In this above scientific work, data are given on the presence of microorganisms (main bacteria) and heavy metals present in the underground layers of the Elbasan city, located in Middle Albania. From the data obtained, we can reach an important conclusion, if the presence of bacteria and heavy metals is present at such levels that they can be considered as soil pollution factors.

The primary purpose of undertaking this work was to present the possible connection between microbial and chemical soil pollution, pollution which has a serious impact on the population's health.

To complete this goal, five soil samples that were taken up to a depth of 0.5 m, in April 2023, were served. We emphasize the fact that Elbasan city has been considered over the years as an area with significant atmospheric chemical and microbiological pollution.

From the statistical processing of the data, we obtained results that present data on chemical elements that can be considered as a possible factor of soil pollution.

In conclusion, starting from the qualitative analysis of the results by comparing them with the allowed pollution rates from the EU, we find a chemical pollution of the soil from the element nickel, which is present in an amount about 2.5 times more than the standards defined by the Regulatory Acts of EU.

We are of the opinion that the ascertained pollution of the Elbasani soil is mainly dedicated to the activity of agricultural farmers in the misuse of organic and chemical fertilizers, the mismanagement of wastewater by the relevant city authorities, and mainly to the abusive activity of light and heavy industries that operate in the city.

Keywords –Microorganisms, Heavy Metal, Soil Pollution, Nickel, Industries, Elbasan City.

I. INTRODUCTION

Heavy metal contamination in soil surrounding industrial areas has proved devastating for both agricultural land, forests, and pastures.

Heavy metal study contamination in Elbasan industrial facilities, mines and enrichment plants has been and continues to be the research subject for a wide range of researchers from academic institutions and research centers in the country.

Accumulations of Cu, Ni, Zn, Pb, Co, Cd, Cd and Arsenic in forest ecosystems and agricultural land near industrial sites have drastically changed the plant community.

Heavy metals are natural components of the Earth's crust. Examples of heavy metals include Lead (Pb), Mercury (Hg), Cadmium (Cd), Arsenic (As), Chromium (Cr), Selenium (Se), Nickel (Ni).

Like trace elements, some heavy metals (e.g., copper, selenium, zinc) are essential to maintain the metabolism of the human body, support living life [1], [2].

Heavy metals are toxic at low concentrations. They cannot be degraded or destroyed. In small quantities they pass through the body through food, drinking water and air, leading to toxic effects on living organisms [3]-[5].

At high concentrations, above recommended rates the presence of heavy metals can lead to poisoning.

Heavy metals are dangerous because they tend to bio-accumulate [6].

Various diseases such as tuberculosis, typhoid, influenza and various fungal diseases of plants or animals are easily spread through the air [6],[7].

Bioaccumulation is an increase in the concentration of chemical elements in a biological organism over time, as opposed to its concentration in the environment [6], [8].

In the natural environment, their concentration is low. Whereas high concentrations of heavy metals in the case of contaminated environments result in environmental and public health impacts [5], [8].

Heavy metals damage the cell membrane of plants, inhibit the normal development of roots and shoots, reduce CO₂ plants assimilation, and reduce stomatal conductance and transpiration [5], [8].

In general, industrial processes, in addition to primary production, also produce secondary products, solid, liquid, and gaseous, in the surrounding environment for which there must be continuous control and monitoring [5], [8].

The concentration of metals in the soil depends on parameters such as pH, redox potential, organic matter, and total metal content in the soil [9], [10].

This paper gives important information about the soil pollution in some areas of the Elbasan city during April 2023 period.

For the analysis of the microbial and heavy metal level pollution in Elbasan, 5 monitoring points

have been determined in the north, east and southwest direction of the industrial facility.

One point is taken about 80 m from the facility while another has about 2100 m.

The analysed data showed that the concentrations of zinc, arsenic, cadmium, chromium, cobalt, copper, and lead are below the critical EU-determined values, except for nickel only at levels 2.5 times higher than the defined criteria.

All the soils sampled are planted with crops. They are mainly cultivated with fodder products, wheat, maize, and fruit trees [6].

Our scientific research through the survey of the bacteria and heavy metal's presence taken on analysed soil samples of Elbasani town, attempts to provide preliminary information on possible impacts and factors that have led to soil pollution.

II. MATERIALS AND METHOD

Five soil samples are taken at a 0.25 to 0.5 m of depth during March 2023 period in Elbasan area. For the speciation analysis, determinations in water soil extracts were carried out by applying the colorimetric method diphenyl carbazide [5], [11].

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

After centrifugation for 10 min at 3500 rpm, the water was filtered through a 0.45 µm Millipore filter [9]. Instantly after extraction, the sample was acidified with a drop of concentrated ultrapure HNO₃ to bring the pH < 2. 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 [11].

Various studies showed that the soils sediments consisted of more than 90% of silt to sand fraction. The clay fraction was about 8%.

The analysis of the grain size performed by taking 10 g of sample were treated first with HCl to remove the calcareous material, then oxalic acid for iron release and H₂O₂ for organic release.

III. RESULTS

After laboratory analyses and statistical and analytical processing, it is found that the soil samples taken during the period of April 2023 in the Elbasan area show that there is a significant microbial presence, but soil pollution above the allowed rates is observed only in the nickel element. The data of each of the five samples are

grouped together, to correctly judge soil pollution progress, always compared to the basic rates.

Table 1 shows the soil microorganisms presence of *Enterococci* and Coliform bacteria presence.

Table 1. Summary microbial analysis for the five stations.

No.	Microbiological index	Average (100 g of dry soil weight)	Total %
1	<i>Enterococci</i>	17108	22
2	Coliform bacteria - minus <i>E. coli</i>	49820	65
	<i>E. coli</i>	10332	
Total groups of Bacteria		77260	100%

Table 2 shows the presence of heavy metals in March analysed for the five stations, as well as the recommended content.

Table 2. Average value of soil heavy metals for five stations.

No.	Heavy metals	Recommended content (mg/kg)	Average (mg/kg)
1	Cadmium (Cd)	3	1.35
2	Arsenic (As)	30	0.8
3	Cobalt (Co)	75	31
4	Nickel (Ni)	75	194
5	Copper (Cu)	140	42
6	Chromium (Cr)	200	54
7	Lead (Pb)	300	58
8	Zinc (Zn)	300	72

Except for nickel which appears in values much higher than the allowed rate, all other elements are below the allowed norm.

Cadmium (Cd) in the amount of 0.1 mg/kg is included in the normal soil content while for 3-8 mg/kg the soil is called toxic; it is in the value of 1.35 mg/kg of 3 mg/kg constituting the limit permitted by the EU, so its presence can be considered almost *normal*.

Arsenic (As) for 5 mg/kg quantifies normal soil type and for 20-40 mg/kg soil is classified as toxic, currently it is measured at 0.8 mg/kg from 30 mg/kg constituting the permissible limit of European directives, so its presence can be *normal*.

Cobalt (Co) for of 10 mg/kg is included in the normal soil content while for 40 mg/kg the soil is called toxic; it is in the value of 31 mg/kg of 75 mg/kg constituting the limit permitted by the EU, so its presence can be considered almost *normal*.

Copper (Cu) for 2mg/kg quantifies normal soil type and for 60-125 mg/kg soil is classified as toxic, currently it is measured at 42 mg/kg from 140 mg/kg constituting the permissible limit of European directives, so its presence can be *normal*.

Chromium (Cr) for 5 mg/kg is included in normal soil content and for the presence of 75-100 mg/kg the soil is considered toxic, currently it is present in the value of 54 mg/kg out of 200 mg/kg which constitutes the limit permitted by the Directives. European, so its presence can be considered quite closes but still *below the permitted limit*.

Lead (Pb) in the amount of 10 mg/kg is included in the normal soil content while for 100 mg/kg the soil is called toxic, namely it is in the value of 58 mg/kg of 300 mg/kg which constitutes the limit permitted by the EU, so its presence is *normal*.

Zinc (Zn), for 10 mg/kg is introduced into the normal soil contents and for 100 mg/kg the soil is called toxic, in our case it is in the value of 72 mg/kg of 300 mg/kg constituting the limit permitted by European directives, so its presence can be considered *normal*.

Nickel (Ni) for 10 mg/kg is introduced into the normal soil content while for 70-400 mg/kg the soil is called toxic. It is present at a value of 194 mg/kg of 75 mg/kg which constitutes the limit permitted by the European Directives; it is *2.5 times higher than the European Union standard*.

IV. DISCUSSION

The soil can be polluted by bacterial factors, due to the discharge of sewage, while from the content of heavy metals, due to the dumping of industrial wastes on the ground. 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], [10].

Heavy metals are released into the environment from technological processes, the smelting and refining industries, metal scrap, the plastics and rubber industry, various consumer products and from the burning of waste containing these elements. They can reach the food chain through potable water supply, air suction and food consumption [12].

High levels of heavy metals in the environment result in heavy exposure of humans and animals to these toxic elements through the food chain, inhaling dust, or direct ingestion.

Feeding animals can get a feed contaminated with heavy metals, and the remainder is excreted from the soil when it is fertilized with organic manure, which comes from animal excrement [9].

Elbasan city has been ranked one of the most polluted cities in Albania. We are mainly of the opinion that among the main reasons for this pollution we can list high concentration of population, multiple buildings, loaded traffic, infrastructure, absence of green areas and above all the development of heavy industrial production activity and poor management regarding the technical control carried out by the Albanian state, in disrespect of environmental pollution measures.

Meanwhile, it is well known that environmental pollution from nickel comes from traffic [5], [13], [14], but mainly from emissions from refineries and industrial waste.

We think that this excessive presence of nickel is also influenced by the lithology of the terrain and serves as a fact that nickel pollution is the result of the natural distribution of nickel in the area under study [5], [15], [16].

Elbasan area soil along the analysis period results to be polluted by Nickel.

V. CONCLUSION

- All heavy metal components are found in almost acceptable conditions.
- Elbasan area soil has in its composition heavy metals elements, where we find that only nickel shows contamination in values about 2.5 times above the EU standards.
- Elbasan, starting from the high level of nickel, is considered a city with soil pollution, where we think the main factor is the deposit of raw materials from the production activities carried out by the light and heavy industries operating in the city.

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