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STUDIES AND RESEARCH ON SOIL ANALYSIS IN A DERELICT AREA, WHERE THERE WAS A LANDFILL

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ABSTRACT

In this paper, a study was made regarding the quality of the soil, from a disused area, where there was a garbage dump, which operated illegally. Soil samples were taken from different depths, namely 10, 20, and 30 cm deep, from 3 areas, covering the entire area where was the landfill. In the soil samples taken, the proportion of heavy metals and the pH were determined, thus being able to highlight how the quality of the soil was affected.

KEYWORDS: landfill, heavy metals, soil pollution

1. Introduction

Soil is represented by the surface layer of the earth's crust, made up of mineral particles, organic matter, water, air, and living organisms.

Soil develops and forms on the dry surface, that is, on the upper layer of rocks, on certain parts of the relief, under the action of environmental factors, which generate certain transformations of substances.

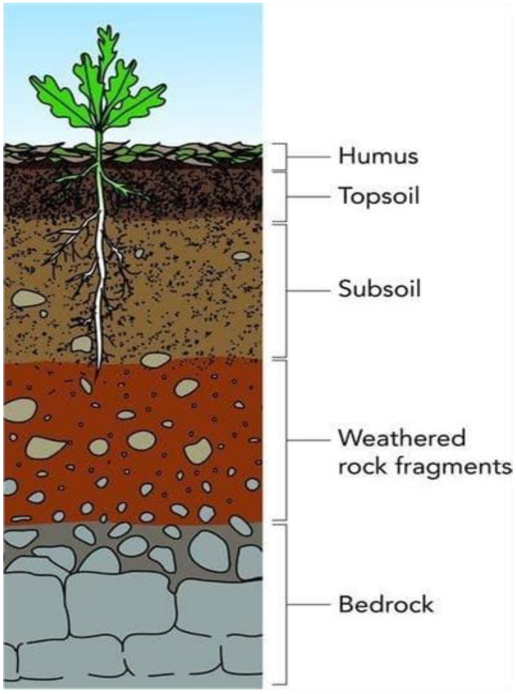

Fig. 1. *Soil horizons*

The process of soil formation is very long and consists of the interaction of several paedogenic factors such as mother-rock, living organisms (animals and microorganisms), climate, vegetation, relief, phreatic and surface water, and geological time [1, 3].

The soils are divided into layers, which depend on the depth. These are called horizons (Fig. 1).

Soil pollution is defined as the presence of toxic substances (pollutants or contaminants) in the soil, in concentrations sufficient to represent a risk to human health and the ecosystem.

2. Experimental research of soil quality

2.1. Establishment of soil analysis areas and research indicators

Soil samples were selected from a disused area, where there was a garbage dump, which operated illegally. Three soil samples were taken, from different depths (Fig. 2).

The investigated perimeters cover large areas, and the evaluation of the soil quality is the foundation of the examination of certain indicators, which measure the properties of the soil.

The criteria that were taken into account, when establishing the soil sampling points, had in mind:

- assessment of the soil situation in the contaminated territory;
- analysis of the elements present in each soil.

The samples were taken from different depths, respectively: 10 cm for sample 1; 20 cm for sample 2, and 30 cm for sample 3.

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From each sample, the pH and heavy metals were analysed. The following devices were used to determine the quality of the soil:

- X-ray fluorescence spectrometer (Innov-X Systems model) Fig. 3;
- the portable multiparameter HQ 40d (Fig. 4);
- analytical balance ALT 220-4NM;
- magnetic stirrer.

Fig. 2. *Landfill area*

Fig. 3. *X-ray fluorescence spectrometer*

Fig. 4. *Portable multiparameter HQ 40d*

2.2. Determination of heavy metals

Heavy metals have a potentially toxic effect on all living organisms, each of them, being dangerous if it exceeds a certain range of values. Thus, plants can accumulate heavy metals directly from the soil. Animals, especially herbivores, take them from the plants they feed on, or directly from the soil they graze on. People are exposed to the action of heavy metals, both through food and through the nature of work in the affected areas [2, 6].

The accumulation of heavy metals by living organisms will occur in different parts of the body, disrupting its proper functioning, at the enzymatic and cellular levels, leading to illness.

The reference values according to the MAPPM Order no. 756/1997 are presented in Table 1.

To determine the level of soil pollutant loading, soil samples were analysed, and the results were centralized in Table 2.

Table 1. *The reference values according to the MAPPM Order no. 756/1997*

Trace of chemical element	Normal values (mg/Kg)	Alert thresholds Types of use		Intervention thresholds Types of use	
		Sensitive	Less sensitive	Sensitive	Less sensitive
Ar	5	15	25	25	50
Co	15	30	100	50	250
Cr	30	100	300	300	600
Cu	20	100	250	200	500
Mn	900	1500	2000	2500	4000
Ni	20	75	200	150	500
Pb	20	50	250	100	1000
Zinc	100	300	700	600	1500

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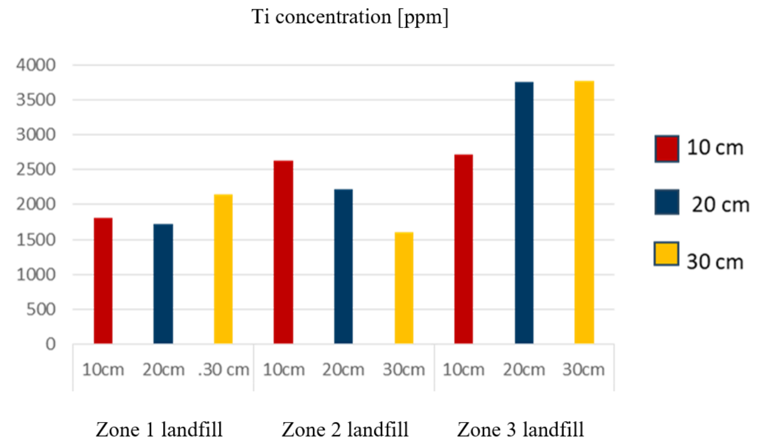
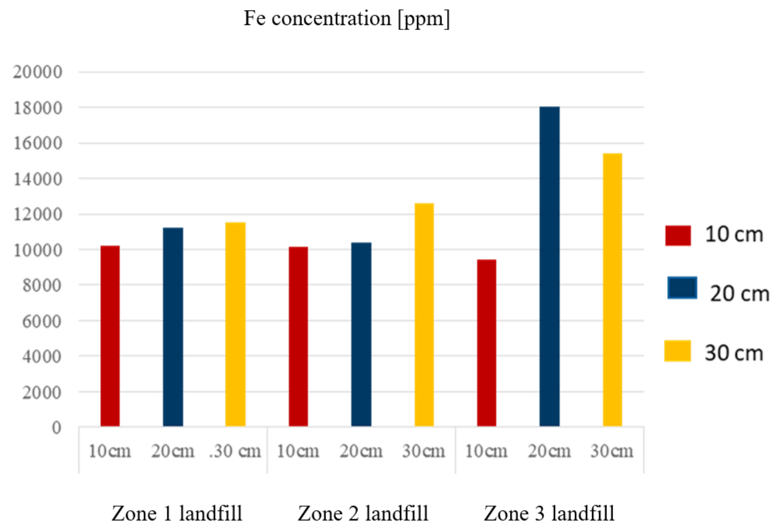
***Table. 2.** The values of heavy metals determined in the soil samples from the landfill area*

Metal	Zone 1 Landfill			Zone 2 Landfill			Zone 3 Landfill		
	10 cm	20 cm	30 cm	10 cm	20 cm	30 cm	10 cm	20 cm	30 cm
TI	1808	1725	2146	2623	2219	1607	2710	3759	3767
Mn	348	367	308	295	352	250	165	471	390
Fe	10239	11209	11499	10165	10383	12597	9428	18059	15398
Ni					38				
Zn	193	52	38	98	256	544	41	67	130
Pb	43	12	10	25	27	110	13	18	21
Cu	28	37	48	34	30	34	43	71	68
Sr	88	36	41	173	75	321	37	102	143
Zr	90	125	104	132	76	174	102	275	296

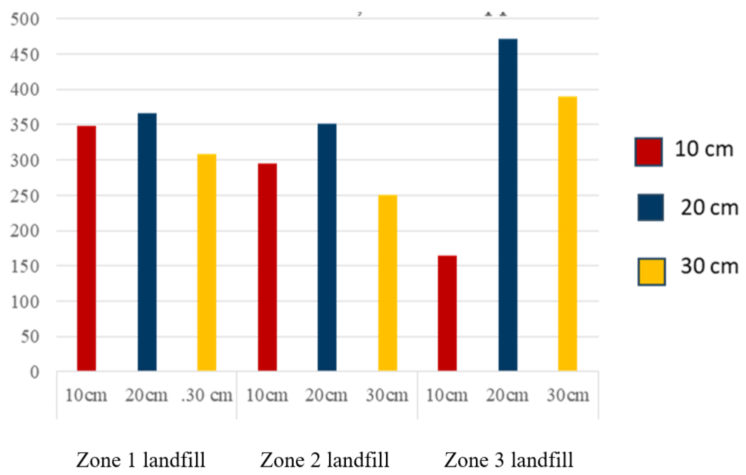


The determinations indicated heavy metals existing in the studied soil, respectively high values of Ti, which has an index of 3767, in zone 3 at a depth of 30 cm. A value that exceeds the allowed limit.



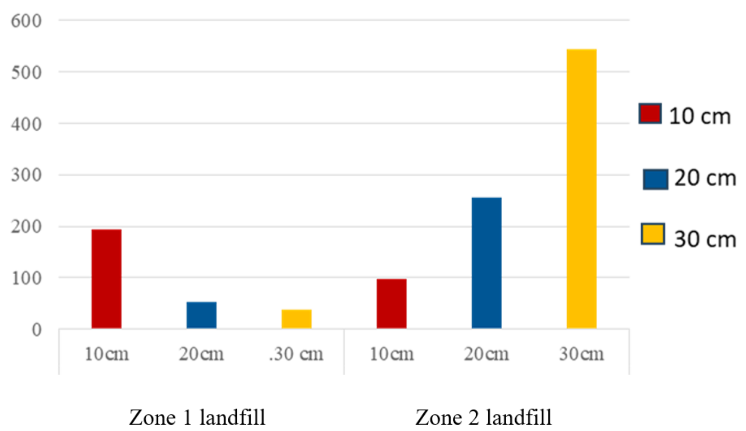
Fe has a very high concentration in all samples. The maximum value being reached, in the sample from the depth of 20 cm, from zone 3, with 15398 ppm.

Mn concentration [ppm]



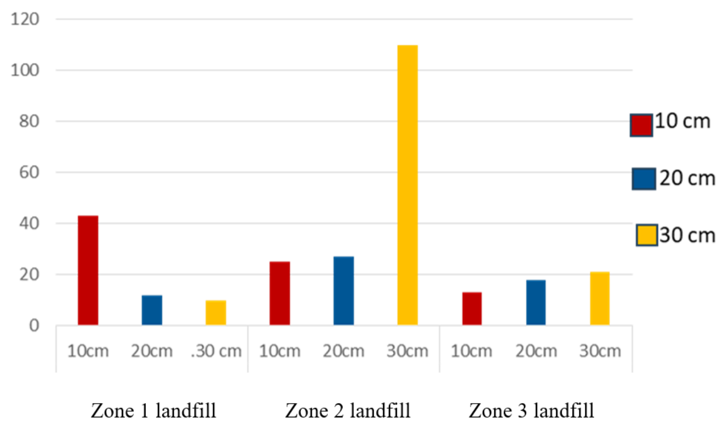
Mn shows a small exceedance of the limit values, for the sample from 20 cm from zone 3, and for the sample from 10 cm from the same zone, the values are within normal limits.

Zn concentration [ppm]



Zn shows values at the maximum limit in the samples taken from areas 1 and 2 and low values in area 3. Nevertheless, these values fall within the allowed limits.

Pb concentration [ppm]



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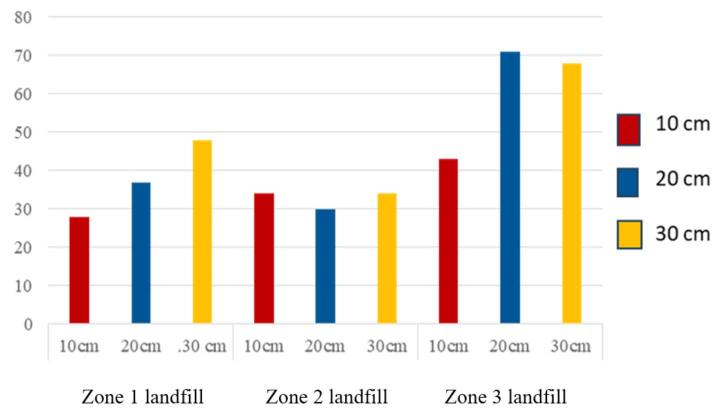
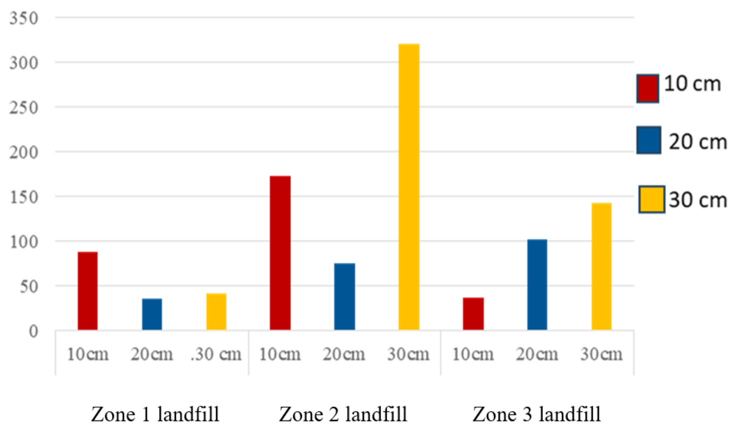
The concentration value of Pb is between 20 and 40 units in zones 1 and 3, and from the sample at 30 cm, from zone 2, the index exceeds the value of 100 ppm.

Cu concentration [ppm]



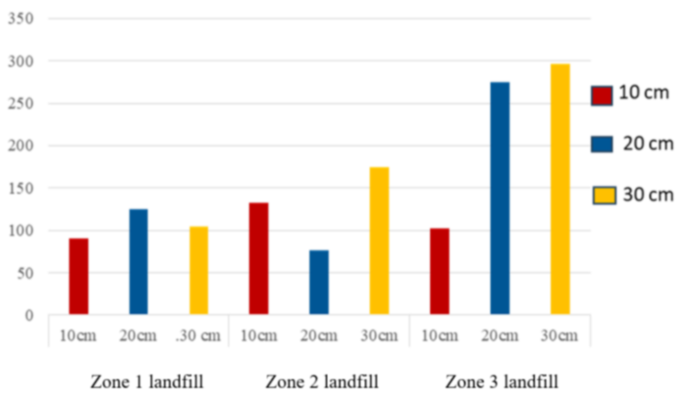
The X-ray spectrometer values for Cu increase in the samples from zone 3, from 20 and 30 cm, while for the other two zones, the values reach no more than 50 ppm.

Sr concentration [ppm]



The determined concentration of Sr, following the analysis, indicates a certain increase in the sample from 30 cm from zone 2, and in zone 1 and 3 the values of the metal are between 20 and 200 units.

Zr concentration [ppm]



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Another element found in all 9 samples is Zr, with a normal limit in zones 1 and 2, and an increase in value in zone 3, from 20 and 30 cm depth.

2.3. Determination of the pH of the soil samples taken from the former landfill

Soil pH refers to the concentration of positively charged hydrogen ions in soil moisture. The pH of the soil is measured on a scale from 0 to 14 (the lower the number, the more acidic the soil is), and this can affect the levels of essential nutrients in the soil. In soils, the pH value is between 3-3.5 and 9-9.5. Knowing the pH value is of great importance because it helps to characterize the salts, and to practice correct agricultural activity [4, 5].

The pH values determined for the soil samples from the 3 areas are centralized in Table 3.

Table 3. *pH values for the soil samples*

Zone 1	**pH**
10 cm	7.86
20 cm	7.16
30 cm	7.13
Zone 2	
10 cm	8.56
20 cm	8.37
30 cm	8.13
Zone 3	
10 cm	7.89
20 cm	7.56
30 cm	7.02

The pH analysis of the soil samples, from the area of the former landfill, shows us that the soil in areas 1 and 3 is weakly alkaline and in area 2 moderately alkaline. Alkaline soils, because they contain soda, can burn the roots of plants or cause the blocking of elements such as zinc, copper, and boron.

3. Conclusions

Soil pollution with heavy metals, from the area of the former landfill, is recognized today as a significant problem, representing a major risk to human health and the environment.

The disused landfill area was identified as one of the polluted areas, due to the long period of time in which the garbage was deposited, negatively affecting the environment and human health.

The concentration of heavy metals in the soil is significant, as a result of the high values of Zn, Fe, and Ti. Excessive amounts of heavy metals in the soil inhibit plant growth and negatively affect nitrogen fixation by microorganisms.

Heavy metal pollution is cumulative, which means that the pollutants accumulate slowly, being the result of permanent and long-term exposure of the soil to the action of these pollutants, without breaking down and without them being able to be removed.

The current state of soil pollution in the affected area is the result of the garbage storage activity carried out over the years.

The result of the analysis of the sampled soil highlights the fact that the studied area is polluted with Zn, Ti, Fe, Ni, and Mn. The analysis of the determinations made regarding Zn and Mn pollution highlights an alarming exceeding of the alert threshold.

The general conclusion indicates heavy metal pollution of the soil at the depth of 0-20 cm, requiring the undertaking of complex remedial activities.

The pH of the soil is within the limits of alkaline values. Alkaline soils, because they contain soda, can burn the roots of plants, or cause the blocking of elements such as zinc, copper, and boron.

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