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EVALUATION OF LAND POLLUTION WITH HEAVY METALS FROM PERI-URBAN PANTELIMON AREA

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Abstract

Toxic metals can affect the biosphere for long periods of time and their movement through the soil and contaminate groundwater. Using plants as food contaminated with heavy metals is a high risk to human health and animals (Wang et al., 2003).
The research was conducted in 2010-2011 in the Neferal-Acumulatorul area to identify pollution with heavy metals as a result of industrial activity in the area.
To determine the degree of pollution were performed research on physic and chemical characteristics of the soil in the area and retention degree of heavy metals in the upper soil profile especially zinc, copper and lead.
This paper presents the correlation between retention of heavy metals and main physical and chemical properties of soil in the study area.

Key words: *soil, pollution, heavy metals.*

INTRODUCTION

Environmental contamination with heavy metals has become a worldwide problem affecting crops, soil biomass and fertility, contributing to their accumulation in the food chain.
Heavy metals such as lead affect adversely the biological activity of soil because it blocks yeast (especially dehydrogenase and urease) by reducing the intensity of carbon dioxide elimination, by reducing the number of microorganisms.
Lead causes disturbances in metabolism of microorganisms, particularly affecting the breathing process, the cells multiplication.
Copper has a low mobility in soils rich in organic matter and clay. Pollutant effect of copper occurs mainly on physical and chemical properties of soil, soils contaminated with copper have a lower percentage of aggregate stability, leading to increased susceptibility to erosion and compaction. Increasing the concentration of copper in the soil causes increased mobile fraction of soil, changing composition of humus, increases of hydrolytic acidity and reduction of basic cations.
Copper ion inhibits enzymatic reactions by complexing substrate, by combining with active enzyme groups or by reactions with enzyme-substrate complex. Toxic action of copper on plants depends especially on the adsorption capacity and soil reaction.
Hani and Gupta (1983) appreciated that trace elements from soil can be grouped into 5 groups: (1) water soluble, (2) exchangeable, (3) adsorbed, chelated or complexed and precipitated, (4) secondary clay minerals and metal oxides with poor solubility, and (5) primary minerals. The first three groups are in balance and are the most important in ensuring microelements for plants during the growing season.
Zinc excess causes changes in physical and physic-chemical properties of soil, reducing soil biological activity. Zinc acts on organisms directly and indirectly, disturbing transformation processes of organic matter in the soil. Toxic action of zinc excess on microorganisms is slow physiological processes. Borlan and Hera (1973) estimated that in arable horizon of reddish brown forest soils (Chromic Luvisols) that do not suffer from the influence of emissions, varies between

50 and 100 mg/kg and appreciated that normal values of copper in these soils are 20 mg/kg.
Among the micronutrients, copper forms the most stable links with organic matter is largely bioaccumulation in upper soil horizon, it can be linked up to 50% of total copper. It is accepted that this form with carboxylic and phenolic groups of organic substances, as the humic, most stable compounds.

MATERIALS AND METHODS

The research was conducted in 2010-2011 in the Neferal - Acumulatorul area to track lead, copper and zinc pollution. For this aim were collected from 15 profiles 30 soil samples on the N, S, SE and V direction (Figure 1). Soil samples were collected at 0-20 cm and 20-40 cm depth and were made the following determinations: soil reaction with field pH meter HACH HQ 40D, organic carbon content - wet oxidation and titrimetric dosing (after Walkley Bleack - Gogoașă change), the content of Pb, Zn and Cu using X-met device, were determined in the surface horizon and soil texture (particle size analysis pre-treatment followed by granulometric fractions separation by sieving and pipetting) to track how the main soil characteristics influence retention of heavy metals.

Figure 1. Distribution of soil profile

Also was made a soil profile of the unpolluted area to identify the soil type. Soils in the investigated area is from Luvisols class, Chromic Luvisols is the dominant soil type, in depression areas with moisture excess the soil type is Stagnic Luvisols. Also on concentrations of heavy metals from soil were conducted directions of pollution load in horizons surface of the investigated area.

RESULTS AND DISCUSSIONS

Elements concentration in the upper horizon investigated show that their movement toward depth is reduced as ionic form and occurs only like clay-humic complexes. Research has shown that heavy metals are strongly retained especially soil surface where they are bound by chelating with soil organic matter and their mobility is conditioned of soil texture and its reaction (Gâță et al., 2006).
The Bt horizon at a depth of 40 cm proportion soluble is obviously reduced and most elements are included in the network minerals in the soil and probably less leaching. However, chelated proportion of organic material cannot be neglected while concentrating trace elements from the soil surface is unlikely their leaching.
Soil reaction ranges from 5.34 to 6.59 (moderately acid to weak acid). In the event of soils with moderate acid reaction heavy metals mobility is generally higher. Organic matter content varies between 2-3.5%, of low to medium content (Table 1).
We mention that the land is rich in plant debris because lately has not been cultivated. Under these conditions at some points high organic matter content is attributed to accumulation of spontaneous crop residues left on the soil surface each year.
Higher content of organic matter causes a strong retention of heavy metals in horizons surface.
The low electrical conductivity values what show that soluble salts and calcium carbonate were removed to depth.
Heavy metal content in the studied area presents very high values above the maximum allowable 20 mg/kg Cu, Pb and 100 mg/kg Zn in most studied points (Figures 2, 3, 4 and 5).
In the area immediately adjacent to the pollution source levels are very high with for lead, copper and zinc.
Increasing distance from the source of pollution shows a decrease in the concentration of these heavy metals in soil.
Soil texture can play a very important role in the migration of heavy metals to the depth. Generally, in the investigated points texture of surface horizon is loamy and to the depth is

medium clay loamy. Higher content of clay in lower horizons leads to a low mobility of these heavy metals in soil profile given great thickness to Bt horizon of Luvisols from this area (Table 2).

A very important aspect is the spread of pollutants, such Pb, on the East direction concentrations vary between 199 and 436 mg/kg, Cu with concentrations from 57-116 mg/kg and Zn from 138-256 mg/kg (Figure 6).

Table 1. Characterization of soil reaction, organic carbon and electrical conductivity

No profile	Depth (cm)	pH	Organic carbon (%)	Electrical conductivity (µS)
1	0-20	6.47	3.5	205
	20-40	6.46	3.2	215
2	0-20	5.72	2.8	105.2
	20-40	5.97	2.2	128.2
3	0-20	5.50	2.7	115
	20-40	5.82	2.3	118
4	0-20	6.00	3.1	129.9
	20-40	6.16	2.5	117.7
5	0-20	5.60	2.9	125
	20-40	5.34	2.4	131
6	0-20	6.57	3.6	145
	20-40	6.59	3.4	130
7	0-20	5.58	3.0	123
	20-40	5.80	2.4	114
8	0-20	5.91	2.9	112
	20-40	5.85	2.4	110
9	0-20	5.97	2.8	131
	20-40	5.92	2.5	120
10	0-20	6.12	3.5	145
	20-40	6.05	2.7	132
11	0-20	5.56	2.8	126
	20-40	5.68	2.1	117
12	0-20	5.78	2.6	112
	20-40	5.96	2.0	125
13	0-20	5.45	2.5	108
	20-40	5.65	2.4	113
14	0-20	5.87	2.8	121
	20-40	5.90	2.4	128
15	0-20	6.12	3.2	146
	20-40	6.14	2.4	132

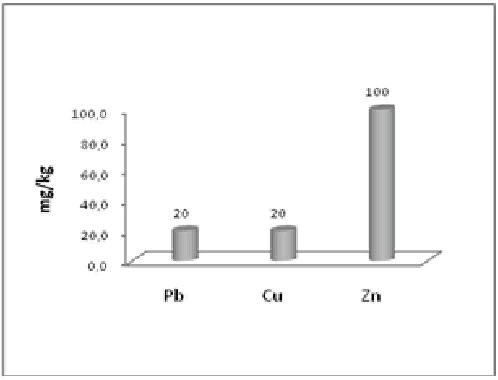

Figure 2. Normal concentration of Pb, Cu and Zn in soil

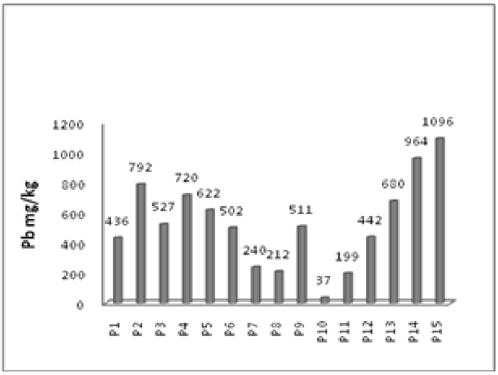

Figure 3. Lead content in soil

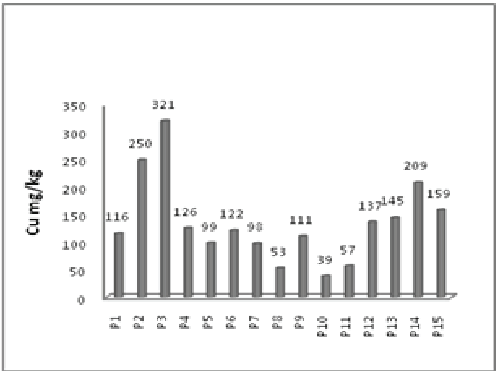

Figure 4. Copper content in soil

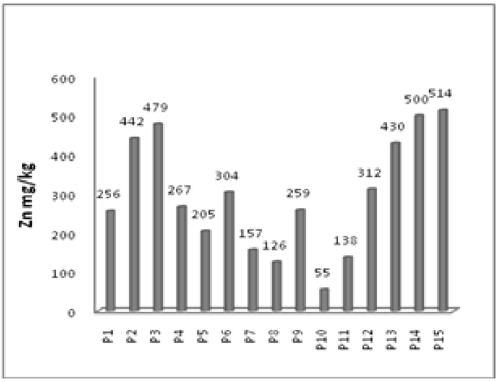

Figure 5. Zinc content in soil

Table 2. The particle size distribution of the Chromic Luvisols

No. profile	Depth (cm)	Soil texture				
		Coarse sand (2.0-0.2 mm)	Fine sand (0.2-0.02 mm)	Loamy (0.02-0.002 mm)	Clay (<0.002 mm)	Clay (<0.001 mm)
1	0-20	1.0	36.0	32.7	30.3	51.1
	20-40	0.9	34.8	32.6	31.7	52.6
2	0-20	0.9	39.2	31.0	28.9	50.7
	20-40	0.9	37.8	30.4	30.9	50.6
3	0-20	1.2	38.7	30.6	29.5	51.4
	20-40	0.9	36.6	29.4	33.1	53.1
4	0-20	1.9	35.6	29.5	33.0	52.0
	20-40	2.0	34.7	30.5	32.8	51.9
5	0-20	1.0	38.7	29.7	30.6	50.7
	20-40	1.0	37.5	30.4	31.1	50.8
6	0-20	0.9	38.4	31.4	29.3	49.4
	20-40	1.0	36.9	32.1	30.0	49.6
7	0-20	1.0	36.1	31.4	31.5	52.6
	20-40	0.9	37.9	29.8	31.4	50.0
8	0-20	0.9	37.9	29.9	31.3	50.2
	20-40	0.9	35.7	32.1	31.3	45.5
9	0-20	1.2	37.5	31.4	29.9	44.1
	20-40	1.0	36.2	31.2	31.6	45.4
10	0-20	0.9	35.2	29.4	34.5	75.9
	20-40	1.1	34.7	29.9	34.3	49.4
11	0-20	1.3	40.3	29.4	29.0	42.7
	20-40	1.2	38.1	29.8	30.9	45.1
12	0-20	1.1	38.1	31.4	29.4	44.4
	20-40	1.0	36.0	33.1	29.9	45.8
13	0-20	2.4	44.6	23.7	29.3	40.9
	20-40	1.9	43.8	25.3	29.0	41.3
14	0-20	8.6	39.6	22.8	29.0	39.8
	20-40	6.5	38.9	24.1	30.5	41.9
15	0-20	1.8	41.5	27.4	29.3	42.7
	20-40	1.6	36.3	24.9	37.2	17.4

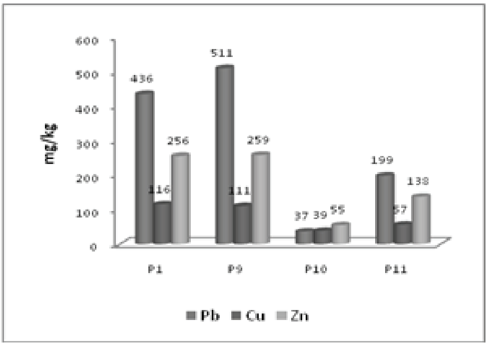

Figure 6. Distribution of heavy metals to the East

Higher concentrations of heavy metals were recorded in a North direction from 792-442 mg/kg Pb, Cu 250-137 mg/kg and from 442 to 312 mg/kg Zn (Figure 7).

In the South direction were found among the lowest concentrations in Pb from 502-212 mg/kg, at Cu from 122-53 mg/kg and 304-126 mg/kg for Zn (Figure 8).

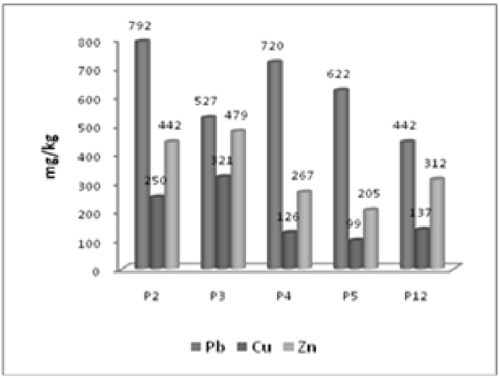

Figure 7. Distribution of heavy metals to the North

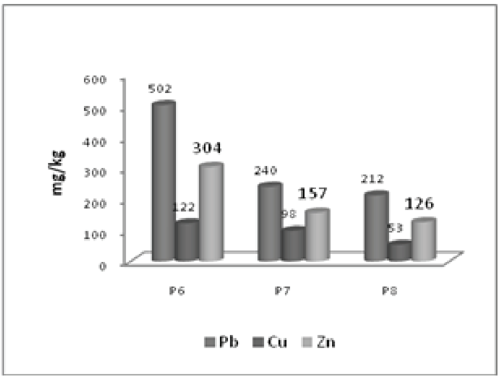

Figure 8. Distribution of heavy metals to the South

High concentrations were recorded in West and North direction. If the majority of points with increasing distance from the source of pollution heavy metal concentrations have decreased on the west concentrations of Pb, Zn and Cu grew to the point farthest from the source of pollution (Figure 9).

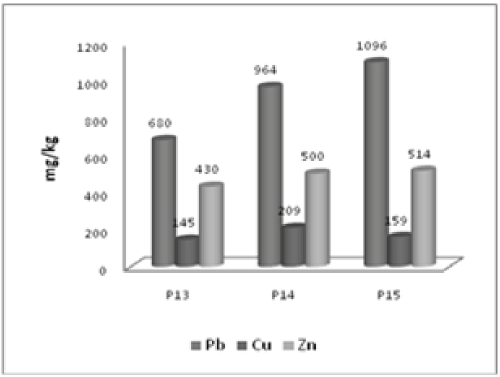

Figure 9. Distribution of heavy metals to the West

This is explained by the dominant wind direction researched area and the fact that pollution is increasing by intense traffic of the area.

CONCLUSIONS

Research conducted in the Neferal - Acumulatorul area revealed concentrations above the maximum limits for lead, copper and zinc.

The highest concentrations are recorded in surface horizons where heavy metals are closely related in particular lead by chelating with organic matter of soil.

Heavy metal mobility on soil profile is influenced by soil texture, is loamy on the surface and the depth is clay-loamy, resulting a retention of heavy metals and their reduced mobility on profile.

High concentrations of lead, copper and zinc were recorded on prevailing wind direction, on the west, where lead values ranged from 680-1096 mg/kg.

In assessing land from area investigated an important aspect is area of pollutants distribution and their concentrations.

From the presented data it can be concluded that most charging lead and copper have soil samples collected in northern of factory and lower have samples from the south.

Among the three, the highest load factor is lead, followed by copper and then zinc.

Heavy metal concentration increased by reducing the distance from pollution source.

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