THE IMPACT OF METALLURGIC ACTIVITIES ON THE SOIL QUALITY IN DAMBOVIŢA COUNTY

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The dusts resulted from the metallurgic activities have a great impact on the soil, by the high contribution in heavy metals. These elements are accumulated, especially in the superior layer of the soil, from where they are absorbed by plants, and after that the metals overtake in high concentration in the food chain, even in human body. The impact of metallurgic activities on the soils was established by the heavy metals concentration which, in a high range, affects the soil quality. The acquired concentrations have maximum values which get over the alert limit for soils affected by the sedimentable dusts. The concentration level of heavy metals in the soils, influenced by the metallic dusts, range of 89,51-420,86 mg/kg dry soil for Cr; 131,8-600,39 mg/kg dry soil for Cu; 132,79-870,33 mg/kg dry soil for Zn; 71,99-294,28 mg/kg dry soil for Pb, respectively between undetectable limits and 11,2 mg/kg dry soil for Mo.

***Key words**: metallurgic industry, soil, heavy metals, dusts*

On the metallurgic process line, in each stage, are produced controlled and diffuse emissions of pollutant gases, dusts and sedimentable powders with a high content in metals. Near the sedimentable powders, a very important cause of soil pollution is the improper solid wastes deposits [1], especially the slag (*fig. 1*).

In the industrial platform of Targoviste City, the metallurgic activities of the industrial units SC Mechel SA, SC Oţelinox SA and SC Erdemir SRL present a pollution risk by the deposit of the emitted substances reach in metals on the leaves and on the soil, by the improper deposits of the rough material, by the careless handling of materials, by the infiltration of some noxious substances draw into the soil by the precipitation and by the waste waters emission caused by the sewerage system breakage [3].

Figure 1 **Industrial wastes deposit (slag) of SC Mechel SA**

The atmospheric emissions, emanated from the metallurgic activities, are found on soil up to some kilometers distance from the pollution sources. The level of these dusts emission depends on the final metallurgic product type. For example, for cast iron, steel, bronze and brass, the emitted dusts are about 8-12 Kg/tone of product, but, for the aluminum, these emissions increase up to 450 Kg/tone of product [4].

With all of these, according to the Environment Status Rapport in Dambovita County [3], in 2005, the heavy metals contents in the soil are under the alert limit, with a few exceptions, of 10-30% from the analyzed samples, where they exceed the alert limits, but not the intervention limit.

The noxious effect of pollutants in the soil depends on many parameters like period of exposure, dispersion range, the presence or absence of other elements, the way of the toxic element manifestation and the meteorological conditions. The pollutants accumulation in the plants cause them insertion in the food chain where is produced the effect of biological amplification.

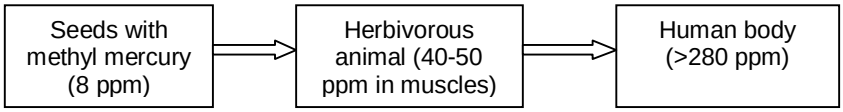


Figure 2 **The biological amplification effect of the mercury concentration [4].**

MATERIAL AND METHOD

To establish the points for soil sampling we take into account the industrial units emplacement, the metallurgic activities of them and the characteristics of climatic regime.

For the analyze of the impact of SC Mechel SA emissions, by the heavy metals concentration in the soils from the industrial area of Targoviste, we follow the predominant wind direction (from NE and E) and we select for sampling areas two plots of land situated in the SW and W of the sedimentable dusts emission sources. The sampling points are about 100 m distance one of each other, and the same distance from the source.

To find out the heavy metals concentration in the soil, polluted by the elements provided by the material and metallurgic product handling and transport, we were sapling the soil inside of the SC Oţelinox SA and SC Erdemir SRL units. From here we select three areas nearby the access and transport ways of the metallurgic product, in the distance of 0 and 3 m.

The soil samples were taken from the surface layer of the soil, down to 5 cm.

The metallic elements content of the soil samples was established by the Inductively Coupled Plasma - Atomic Emission Spectrometry method with the Varian Liberty 110 Spectrometer. This method is an analytical one use in many scientific domains because of its high specificity, multi-element analyzes and low limits of detection. A plasma source is use to dissociate the sample in constitutive atoms or ions, stirring them on a superior energetic level. They will revert to the original form by the emission of a characteristic energy photon. This emission is recorded in an optic spectrometer; the radiation's intensity is proportional with each element concentration in the sample and is intern calculated by a couple of calibration curves to obtain directly

the measured concentration. The concentration resulted are given in mg of metal related with kg of dry soil. The detection limits for the analyzed metal are 0,5 mg/kg for Cr, Cu and Mo, respectively 0,4 mg/kg for Zn and Pb.

To be analyzed by ICP-AES method, for the soil samples were done hot extractions with nitric acid 1:1.

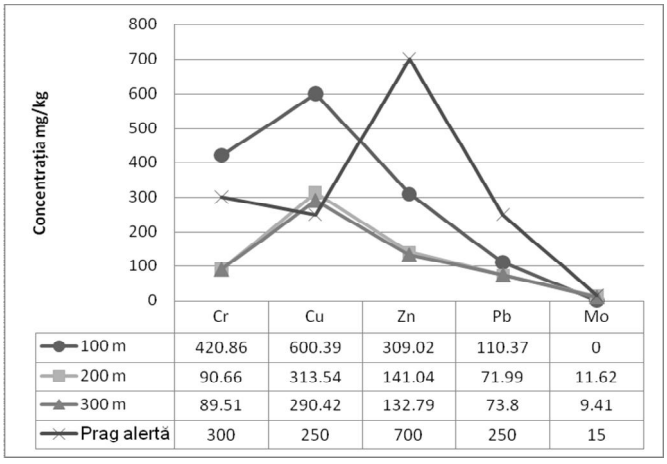
RESULTS AND DISCUSSIONS

The heavy metals are a part of natural environment in normal conditions, but, in high concentration, these elements produce the heavy metals stress condition. The metallic elements don't disintegrate and are accumulating in the living organisms, commanding the urgent intervention actions to reduce the heavy metals concentrations.

The normal values of heavy metals concentrations in the soil are 2 mg/kg for Mo, 20 mg/kg for Cu and Pb, 30 mg/kg for Cr, respectively 100 mg/kg for Zn [2]. In the same normative document are stipulated the levels of concentration, for each noxious element, which are considerate the alert and intervention limits for the soils from the industrial areas (less sensible).

On the industrial platform of Targoviste City, the heavy metals concentrations in soil depends on the pollution sources' type and this is the reason that we analyzed separately the soils polluted by the sedimentable dusts emission and the soils polluted by the metallurgic products handling. In the first case, the values are higher and closer by the alert limits.

The heavy metals concentration level in the soils affected by the metallic dusts emission is analyzed according with the emplacement toward the pollution source. Because the Aeolian regime of Dâmboviţa County is characterized by the NE and E winds, the soils from SW and W side of metallic dusts source of SC Mechel SA will have the highest pollutants concentrations. In the *figures 3* and *4,* are represented the concentrations for some heavy metals, comparing with the values of alert limits for each metallic element, in an industrial areas.



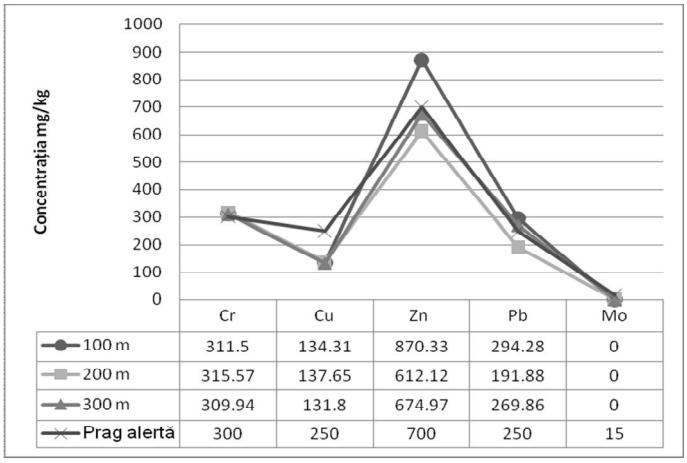
	Cr	Cu	Zn	Pb	Mo
100 m	420.86	600.39	309.02	110.37	0
200 m	90.66	313.54	141.04	71.99	11.62
300 m	89.51	290.42	132.79	73.8	9.41
Prag alertă	300	250	700	250	15

Figure 3 **The heavy metals concentration in the soil emplaced in SW part toward the dust emission source**

Regarding the soil from the SW part of emission source, we can observe that the distance between the sampling point and emission source has matter, meaning that, at 100 m distance, the metals concentrations are few times bigger comparing with the metallic

concentration levels in the soil emplaced more distant. The heavy metals concentrations in the analyzed soils meaningful increase up to 100 m distance, for Cr, Cu and Zn, and between 200 and 300 meters the levels of these metals are almost the same. The alert limit concerning the metallic concentration in the soil is exceeded up to 300 m distance for Cu, and only up to 100 m for Cr. For the other analyzed heavy metals, the concentration in the soils doesn't exceed the alert limit, but exceed the normal values of concentration for those metals in the industrial soils.

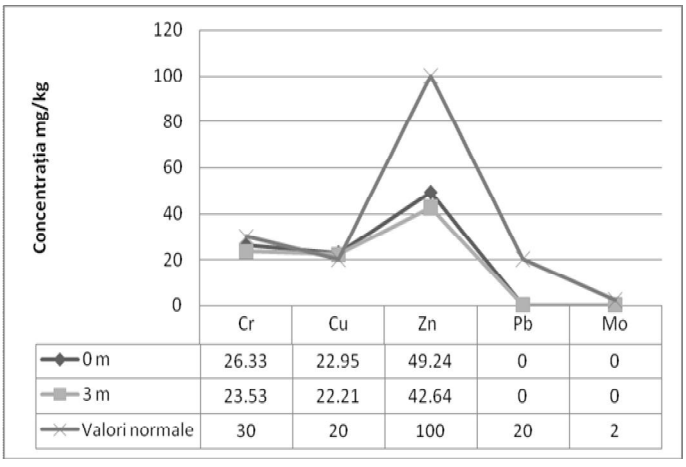
On the west direction, the distance from the pollution source doesn't have a meaningful influence and the concentration levels are more or less equal up to 300 m distance from the emission source. The concentration values doesn't exceed the alert limits for the majority of analyzed metals, only at 100 m, for Zn an Pb, the concentration level slightly exceed this limit. In these analyzed samples of soil all the heavy metals has high concentration, which are more times bigger than the normal values for the metals level in the industrial soil.



	Cr	Cu	Zn	Pb	Mo
100 m	311.5	134.31	870.33	294.28	0
200 m	315.57	137.65	612.12	191.88	0
300 m	309.94	131.8	674.97	269.86	0
Prag alertă	300	250	700	250	15

Figure 4 **The heavy metals concentration in the soil emplaced in west part toward the dust emission source**

In these two graphics, *figure 3 and 4*, we can observe that the impact of the metallic dusts emission is stricken by the point emplacement toward the pollution source, on the SW direction, and the heavy metals concentrations in the soil, for bought direction, have values close with the alert limits, exceeding them in many situation.



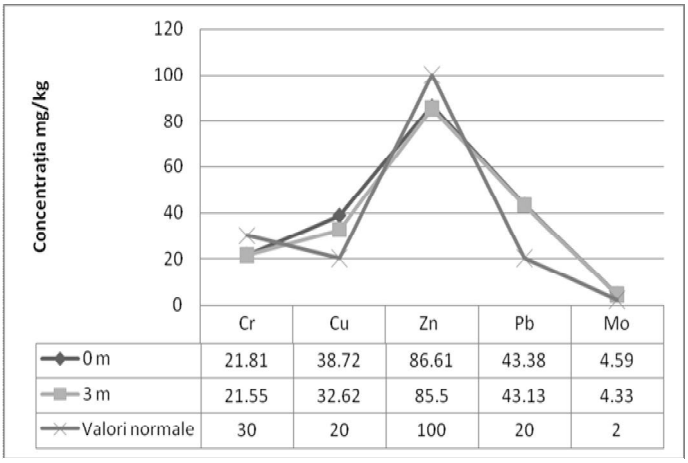
	Cr	Cu	Zn	Pb	Mo
0 m	26.33	22.95	49.24	0	0
3 m	23.53	22.21	42.64	0	0
Valori normale	30	20	100	20	2

Figure 5 **Some heavy metals concentration in the soils inside of SC Oţelinox SA – the entrance in the metallurgic products warehouse**

Heavy metals concentration in the soils, nearby the of access and transport

ways of rough material and metallurgic products is lower than in the sedimentable dusts impact and them values doesn't exceed the normal concentration in the soil. For the soil samples nearby the metallurgic products warehouse of SC Oţelinox SA we observe (*fig. 5*) that the heavy metals concentration levels are close to normal values. For Zn and Pb the concentration levels are meaningful lower than the normal levels and the copper is the only analyzed heavy metal which slightly exceeds the normal limit.

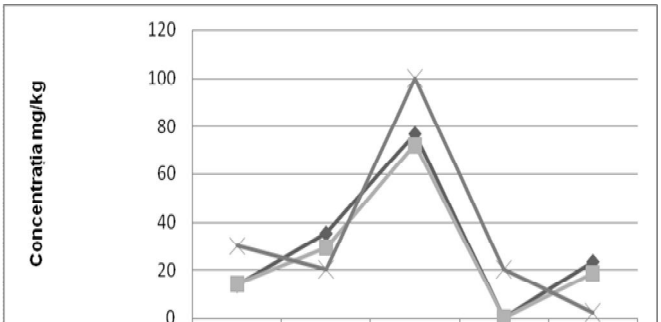
Near the entrance of SC Otelinox SA (*fig. 6*), where the traffic is more intense, the analyzed metallic levels are higher, the concentration of Cu, Pb and Mo exceed the normal values and for Zn and Cr, the values are colse to normal limits. The distance to the access way doesn't influence the concentration level very much, only for Cr, Cu and Zn are petty differences, meaning that, closer with the access ways the concentration levels for these metals are higher that the values for 3 m distance from the access ways.



	Cr	Cu	Zn	Pb	Mo
0 m	21.81	38.72	86.61	43.38	4.59
3 m	21.55	32.62	85.5	43.13	4.33
Valori normale	30	20	100	20	2

Figure 6 **Some heavy metals concentration in the soils inside of SC Oţelinox SA – the entrance in the industrial**

Inside of SC Erdemir SRL, the heavy metals concentrations have low levels (*fig. 7*), exceeding the normal values only for copper and molybdenum. For the other metallic species, the level of the concentration in the analyzed soil is under normal limits. This shows that, the impact of metallurgic products transport and handling is minim in these units.



	Cr	Cu	Zn	Pb	Mo
0 m	13.71	35.37	76.86	0	23.42
3 m	14.04	29.46	72.16	0	18.45
Valori normale	30	20	100	20	2

Figure 7 **Heavy metals concentration in the soils inside of SC Erdemir SRL**

Analyzing the last three graphics we can say that the access ways are not a impact source for the soil concerning the heavy metals pollution inside the metallurgic units, because the metallic elements concentration in the soil

doesn't exceed, in a high range, the normal values of these metals in the industrial soils.

CONCLUSIONS

The impact of metallurgic activities on the soils from the industrial platform is induced by the type and the characteristics of the industrial activities. The sedimentable dusts emission with a high content in heavy metals is the most important parameter of the impact, inducing heavy metals concentrations in the soil up to the alert limits.

For the metallic dusts emissions, the distance between the sampling point and the pollution source is characteristic for the impact. The soils emplaced up to 100 m from the emission source are more affected by the metallic pollutants than the soils from 200 and 300 m distance.

The transport and handling activities of metallurgic products don't have a meaningful impact on the nearby soils, the analyzed heavy metals remaining close to normal limits in the studied emplacements.

For the soil affected by the sedimentable metallic dusts we have to consider necessary to take steps for remediation of soils and for the heavy metals concentration decreasing, with the interest of soil quality increasing, by ecological actions and biotechnologies.

BIBLIOGRAPHY

1. Vişan, S., Angelescu, A., Alpopi C., 2000 – *Mediul înconjurător – poluare şi protecţie*, Ed. Economică, Bucureşti.
2. ***, 1997 - ORDIN nr. 756 din 3 noiembrie pentru aprobarea Reglementarii privind evaluarea poluarii mediului;
3. ***, 2005 - *Raport privind starea mediului în judeţul Dâmboviţa*, Agenţia pentru Protecţia Mediului Dâmboviţa.
4.***- http://www.contabilizat.ro/file/ cursuri_de_perfectionare/ economie_generala/ Tehnologie% 20industriala/cap7.pdf.