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REACTION BUFFERING CAPACITY OF SOILS IN THE ZLATNA AREA

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Abstract

This paper presents studies concerning the soil reaction buffering capacity within affected areas by emissions from the non-ferrous metallurgical industry in the Zlatna city (the emissions into air of huge amounts of sulphur oxides and dust loaded with heavy metals).

The soil reaction buffering capacity is estimated of been very low and low for Preluvosols and Districambosols and reduced and very high for Eutricambosols, Aluviosols and Regosols.

Within the Zlatna area low and very low soil reaction buffering capacity correlated with the high and moderate soil vulnerability to the impact of the acid rains and heavy metal pollution and very high and reduced soil reaction buffering capacity correlated with low soil vulnerability.

INTRODUCTION

The results were based on the field investigations carried out in the Zlatna areas. Soil samples have been collected within the areas affected by emissions of the S.C. Ampellum S.A. Zlatna located on 41 km length (east-west) and 25 km width (north-south).

The research performed by means of the 60 soil profile analysis and the surface affected by pollution was estimated by 55,664 hectares.

The objectives of the paper are the evaluation of the soil reaction buffering capacity from Zlatna industrial areas, the correlation between this and heavy metals mobility and the comparison between the soil reaction buffering capacity and the soil vulnerability to the impact of the acid rains and heavy metal pollution.

MATERIAL AND METHODS

To characterize the soils and to evaluate the soil reaction buffering capacity, the main soil physical and chemical properties have been determinate: particle-size distribution, soil reaction (pH), hydrolitical acidity (Ah), sum of exchangeable bases (SEB), cation exchange capacity (CEC), saturation degree (V), reaction buffering capacity of soil (RBCS) and the mobile contents of heavy metals. Mobile forms have been extracted by EDTA – CH_3COONH_4 solution at 7.0 pH and have been dosaged by means of atomic absorption spectrometry [5].

Using two indicators of reaction buffering capacity of soils (I-RBCS), proposed by Borlan [1] the soils have been characterized and classified from the reaction buffering capacity's point of view.

Indicators of reaction buffering capacity of soils: I-RBCS^{SEB} - in term of sum of exchangeable bases and I-RBCS^{CEC} - in term of cationic exchange capacity formula and definition as follow:

$$I-RBCS^{SEB} = \lg\frac{[SEB]}{(H^+)};\quad I-RBCS^{CEC} = \lg\frac{[CEC]}{(H^+)};$$

in which:

SEB = sum of exchangeable bases; [SEB] = equivalents·kg^{-1}·0,4;
CEC = cation exchange capacity; [CEC] = equivalents·kg^{-1}·0,4;
H = proton activity in the soil solution; (H^+) = moles·liter^{-1}.

Using the indicators I-RBCS values we have been evaluated the reaction buffering capacity of soil according to the table 1.

Table 1

Border values for conventional interpretation of I-RBCS as well as the reaction buffering capacity of soil [1]

Values domains		Soil reaction buffering capacity
I-RBCS^{SEB}	I-RBCS^{CEC}	
> 5.6	> 5.6	very high
5.1 - 5.6	5.2 - 5.6	high
4.5 - 5.1	4.7 - 5.2	moderate
3.9 - 4.5	4.1 - 4.7	reduced
3.1 - 3.9	3.5 - 4.1	low
< 3.1	< 3.5	very low

RESULTS AND DISCUSSION

In the Zlatna areas acid rains affected the soils through progressive acidification, which determinated soil reaction decrease, depletion of bases and base saturation degree decrease [4].

We evaluated the reaction buffering capacity of soil from 29 soils from this area. Table 2 presented main physical and chemical properties (A horizon) since few soil types within areas influenced by emissions from non-ferrous metallurgical industry in the Zlatna area.

Acid soils are represented by Districambosols and Preluvosols and slightly acid to slightly alkaline soils is represented by Eutricambols, Aluviosols and Regosols.

The class of Cambisols is predominant (83.74% of the total area), the soils types including: Eumesobasic Brown soils (19.36% of the total area) and Acid Brown soils (64.36%) [2].

The soil reaction buffering capacity is estimated of been very low and low for Preluvosols and Districambosols and reduced and very high for Eutricambosols, Aluviosols and Regosols.

Table 2

Main physical and chemical properties (A horizon) within areas influenced by emissions from non-ferrous metallurgical industry in the Zlatna

Profile no.	Soil type SRTS*/FAO-UNESCO	pH	V** (%)	OM*** (%)	Texture	I - RBCS^{CEC}	Soil reaction buffering capacity	Vulnera-bility
18	Preluvosol/ Haplic Luvisol	4.3	33	4.7	medium	3.20	very low	high
24		4.6	27	2.9	medium	3.49	very low	high
9		4.8	47	6.4	medium	3.56	low	high
19		4.9	25	1.1	medium	3.60	low	excessive
42		5.1	62	5.0	medium	4.00	low	moderate
47		5.6	73	5.7	fine	4.54	reduced	low
34		5.5	76	5.5	fine	4.53	reduced	low
20		5.9	79	3.0	medium	4.73	moderate	medium
46	Luvosol/ Luvisol	6.8	92	7.7	fine	5.83	very low	low
45		5.6	65	4.9	medium	4.44	reduced	low
6	Districambosol/ Dystric Cambisol	5.0	54	6.0	medium	3.99	low	moderate
1		4.9	46	7.0	medium	3.76	low	high
41		4.9	32	10.3	medium	3.80	low	high
2		4.7	36	8.6	medium	3.59	low	high
8	Faeoziom/ Phaeozem	5.5	82	5.5	fine	4.62	reduced	low
10	Eutricambosol/Eutric Cambisol	7.1	96	2.7	medium	6.07	very high	low
11		6.9	92	3.4	medium	5.83	very high	low
4		5.5	70	2.9	medium	4.26	reduced	moderate
40	Aluviosol/ Fluvisol	7.1	93	3.5	medium	5.98	very high	low
3		5.4	72	6.7	medium	4.34	reduced	moderate
7		5.1	60	4.3	coarse	3.84	low	moderate
37	Regosol/ Regosol	7.1	96	3.3	medium	6.19	very high	low
22		6.6	93	8.7	medium	5.78	very high	low
28		5.5	81	4.7	fine	4.49	reduced	low
36		5.3	5,4	5.4	medium	4.05	low	moderate
32	Erodosol	5.4	67	4.6	fine	4.34	reduced	low
39		5.6	74	5.4	fine	4.59	reduced	low

*SRTS - Romanian Soil Classification System; **V - Base saturation degree; ***OM - Organic matter

The soil of second group being practically non vulnerable to the impact of acid rains and heavy metal pollution, because base saturation degree, organic matter content and texture of these soils induce an increasing degree of resistance to the action of deteriorating factors.

The soil reaction buffering capacity has been compared with soil vulnerability to the impact of the acid rains and heavy metal pollution, which were evaluated by Lacatusu [2] in terms of soil reactions, organic matter content and texture.

Within the Zlatna areas low and very low soil reaction buffering capacity correlated with the high soil vulnerability, and very high soil reaction buffering capacity correlated with low soil vulnerability.

On the basis of the soil reaction buffering capacity, the vulnerability indicated that 68 per cent represent soils with high soil vulnerability, 22 per cent represent soils with moderate soil vulnerability and 10 per cent represent soils with low vulnerability.

Into surface horizon, when were the biggest impact to acid rains and the accumulation of the heavy metals, soil acidification process determinate the decrease of the soil reaction and soil bases depletion, and the soil reaction buffering capacity decreased. If the soil reaction buffering capacity I-RBCS^{CEC} (in term of cationic exchange capacity) and I-RBCS^{SEB} (in term of sum of exchangeable bases) increased into soil profile**,** his mobile contents of the heavy metals decreased (figure 1, 2 and 3).

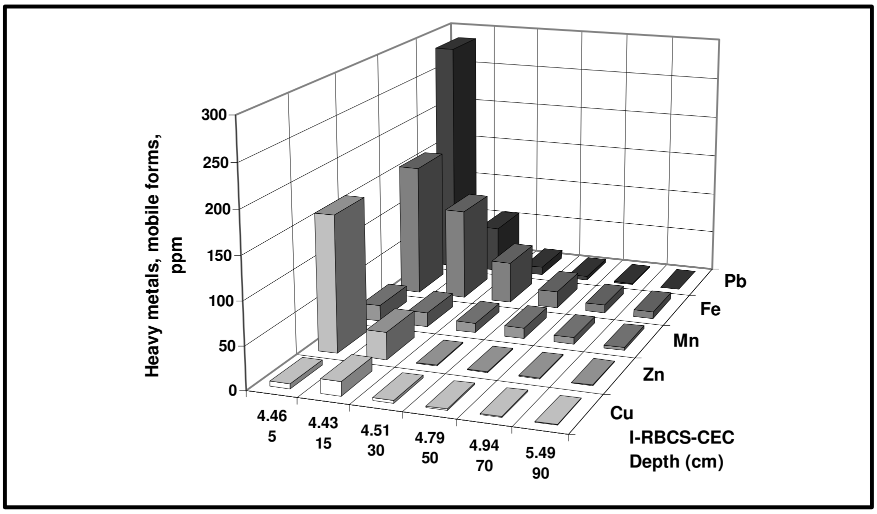

Fig. 1. The correlation between soil reaction buffering capacity I-RBCS^{CEC} (in term of cationic exchange capacity) and heavy metals content in profile no. 45 (Disticambosol, Galati)

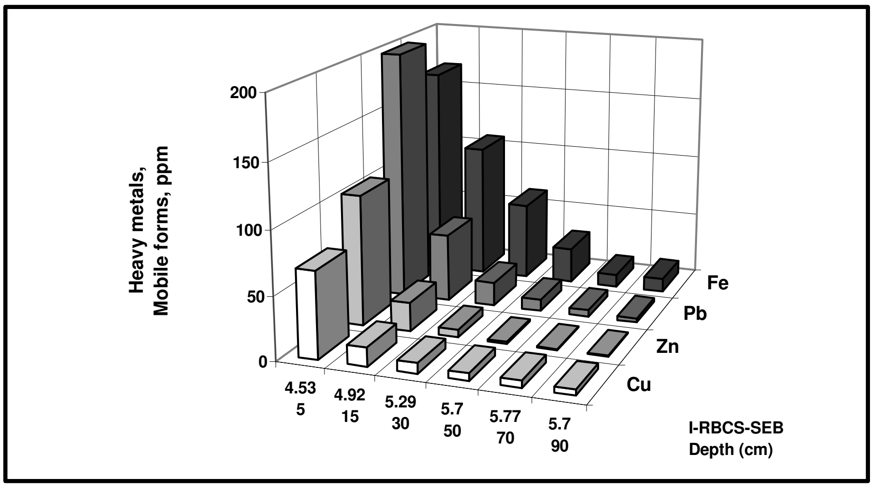

Fig. 2. The correlation between soil reaction buffering capacity I-RBCS^{SEB} (in term of sum of exchangeable bases) and heavy metals content in profile no. 8 (Cambic Faeoziom, Zlatna)

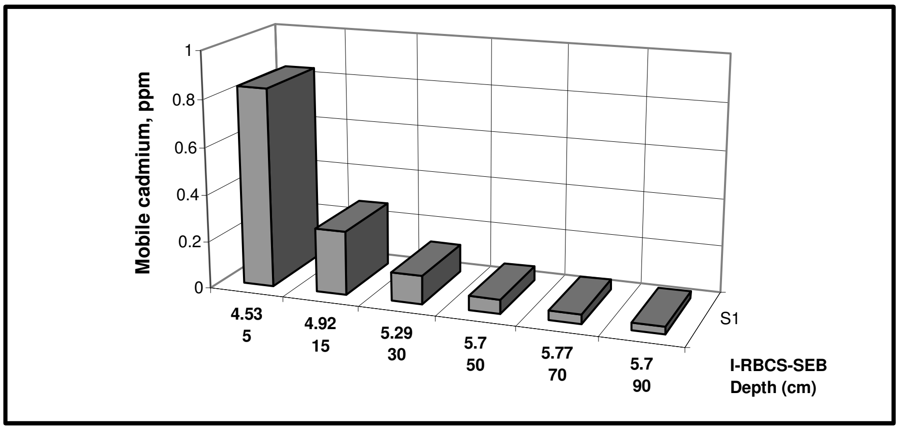

Fig. 3. The correlation between soil reaction buffering capacity I-RBCS^{SEB} (in term of sum of exchangeable bases) and mobile cadmium content in profile no. 8 (Cambic Faeoziom, Zlatna)

For 29 soil profiles analyzed in this paper were obtained inverse correlations between the soil reaction buffering capacity (I-RBCS) and mobile content of heavy metals: very significant for Fe, significant for Mn and no significant for Cd, Pb, Zn and Cu.

CONCLUSIONS

1. In Zlatna, areas acid soils are represented by Districambosols and Preluvosols and slightly acid to slightly alkaline soils are represented by Eutricambols, Aluviosols and Regosols; the class of Cambisols is predominant.
2. The soil reaction buffering capacity was estimated of been very low and low for Preluvosols and Districambosols and reduced and very high for Eutricambosols, Aluviosols and Regosols.
3. In the Zlatna areas, low and very low soil reaction buffering capacity was correlated with the high soil vulnerability, and very high soil reaction buffering capacity was correlated with low soil vulnerability.
4. On the basis of the soil reaction buffering capacity, the vulnerability indicated that 68 per cent represent soils with high soil vulnerability, 22 per cent represent soils with moderate soil vulnerability and 10 per cent represent soils with low vulnerability.
5. Into surface horizon, when was the biggest impact to acid rains and accumulation of the heavy metals, soil acidification process determined the decrease of the soil reaction and soil bases depletion, and the soil reaction buffering capacity decreased.
6. For 29 soil profiles analyzed in this paper were obtained inverse correlations between the soil reaction buffering capacity (I-RBCS) and mobile content of heavy metals: very significant for Fe, significant for Mn and no significant for Cd, Pb, Zn and Cu.

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