INFLUNCE OF SOIL ACIDIFICATION ON SOME SOIL PHYSICAL PROPERTIES (WATER STABLE AGGREGATES AND DISPERSION)

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Abstract

During non-ferrous metallurgical plant from Zlatna were emitted into the air both sulfur dioxide and powder of metal sulphides and metal oxides. Dioxide and trioxide sulfur in contact with rain water converts to sulfuric acid that leading to the formation of acid precipitation, which in contact with soils lead to its acidification. Acid soils have less favorable physical properties including poorly formed or damaged structure. In this paper is studied the influence of soil acidification on some physical properties as water stable aggregates and dispersion. In the reserached area, the water stable aggregates of soils range in the field of small-very large values, with median belongs to moderate class values and only 10% had values that belong to high and very high classes. In the soils investigated from Zlatna area, the water stable aggregates is significant, respectively, very significantly influenced by the soil physical and chemical properties as: clay, content of humus, Ca^{2+} ions, percentage of base saturation, sum of exchangeable bases, soil reaction, and cation exchange capacity. Lowest correlation was established with soil reaction (r=0.338*) and the strongest correlation was with total cation exchange capacity (r=0.756***). Dispersion ranges in the field of low-very high values and over 75% of the values belong to classes of high-very high values.

Key words: soil, Zlatna, water stable agregates, dispersion

In Zlatna area, because of Ampellum S.A activity, as shown by Rauta et al., 1998, and Smejkal, 1982, were issued large quantities of SO2, SO3, heavy metal oxides and sulfates.

Dioxide and trioxide sulfur in contact with rain water converts to sulfuric acid that leading to the formation of acid precipitation. Gaseous emissions (SO_2, NO_X) and fall-out of particles enriched in Pb, Zn, Cu and Cd cause acid precipitation and heavy metal contamination (Bartok, 1982, quoted by Williamson et al.).

The mean pH of rainfall in the very heavily polluted area was around Zlatna and was 4.81, while the minimum pH reached was 2.67 (Smejkal, 1982). Acid rain leads to increase the total soil acidity. Lacatusu et al., 1999 shown a decrease of soil reaction in Zlatna area by 1-2 pH units.

Acid soils with clay-humus complex heavily saturated with hydrogen ions, presents less favorable physical properties: poorly formed or damaged structure, low porosity, usually less permeability (Puiu et al., 1983).

Degradation of soil structure by physic-chemical processes occurs as a result of cation exchange. Calcium cation adsorption complex, in certain circumstances, be replaced by hydrogen ions and in this case and the colloids that playing the role of cement in soil structure are dispersed and aggregates lose their structural stability (Oanea &Radu, 2003**)**.

Excessive decrease of Ca content in soil associated with low soil humus determines soil destructuring (Dumitru et al., 1997, Fenn et al., 2006). The decline in soil structural stability is considered one of the most serious forms of degradation of agricultural soils (Dumitru et al., 1999).

In this paper is studied the influence of soil acidification on some physical properties as water stable aggregates (AH, %) and dispersion (D, %).

MATERIAL AND METHOD

In order to assess the structure was determined water stable aggregates and dispersion. It was also tried to establish correlations with some physical and chemical properties of soils.

Soil samples were collected from the whole investigated area on the following depth: 0-10 cm and 10-20 cm. The soil samples were analyzed:

-soil reaction (pH) was determined potentiometric method, in water suspension (1:2,5);

-the values of the percentage base saturation ($V_{8,3}$, %) were determined through calculation, sum of exchangeable bases (SB, me/100 g soil) and hydrolytic acidity (HA) by

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Kappen procedure, and the total cationic exchange capacity through calculation;

-the Ca^{2+} was determined by Schollenberger, Dreibelbis, Cernescu method;

-total humus was determined by wet oxidation, Walkley-Black method modified by Gogoasa;

-particle size distribution by wet and dry sieving, sedimentation procedure, pipette sampling chemical treatment with different dispersant agents (H_2O_2, HCl, $Na_4P_2O_7.10H_2$) according to organic matter and carbonate content;

-water stable aggregates (AH,%) and dispersion (D, %) by wet sieving, sedimentation procedure and pipette sampling;

Interpretation of results concerning the water stable aggregates and dispersion were done according to Canarache, 1990 (table 2).

RESULTS AND DISCUSSIONS

Calcium ions promote the formation of a stable soil structure by saturation humus and formation of calcium humat, colloid coagulation and increasing cohesion of structural aggregates. A proportion of 50-80% of Ca^{2+} ions from T ensures the soil fertility, a soil stable structure and a favorable regime for water and air (Lixandru et al., 1990).

In soils from Zlatna area, on the depth of

0-20 cm, 75% of the values have values of Ca^{2+}/T ratio below 43% and only 10% of the soil samples have values higher than 50 % Ca^{2+} ions from T (table 1).

Soil structural stability is compromised when the report $Ca2^{+}/(K^{+} + Na^{+} + Mg^{2+})$ has values less than 5.33 (Blaga et al., 2005). The study of this report on 56 samples from the studied area showed a range of variation of this ratio between 0.54 and 5.64 and 90% of the values have values of this ratio below 3.82 (table 1).

Table 1

The ratio of Ca^{2+}/T and the ratio of $Ca^{2+}/(K^{+}+Na^{+}+Mg^{2})$

Statistical parameters	Ca^{2+} / T	$Ca^{2+}/(K^{+}+Na^{+}+Mg^{2})$
Number of samples	59	58
Minimum	1,36	0,54
25th percentile	6,44	1,25
Median	21,97	1,87
Mean	25,5	2,18
75th percentile	42,95	2,78
90th percentile	57,33	3,82
Maximum	64,3	5,64
Coefficient of variation	79	59

The assessment of the soil structural stability also was done in the laboratory by determining the indicators such as water stable aggregate and dispersion. Water stable aggregate is a highly suggestive physical characteristic of the soil structure capacity, its vulnerability to degradation or soil destructuring in relation to soil formation processes and human intervention (Dumitru şi colab., 2009).

In the studied area, water stable aggregate range in the field of small-very large values, with value of median (17) in the middle class and only 10% of values belong to large and very large classes (table 2).

Table 2

Statistical parameters of water stable agregates and dispersion

Statistical parameters	Water stable aggregates > 0,25% mm (%)	Dispersion (%)
Number of samples	49	49
Minimum	4	3
25th percentile	7	7
Median	17	9
Mean	21,1	8,5
75th percentile	29	10
90th percentile	45	11,2
Maximum	72	15
Coefficient of variation	80	28

In the investigated soils from Zlanta area, the water stable aggregates are significantly influenced by soil reaction (r =0.338*) and type of correlation is exponential.

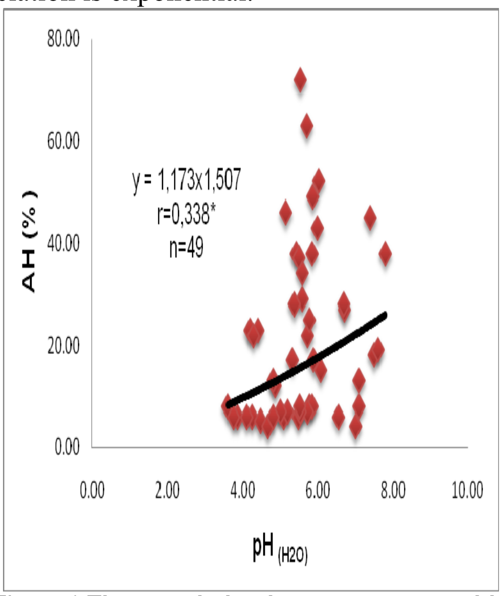

Figure 1 **The correlation between water stable agregates (AH, %) and soil reaction (pH_{H2O})**

Very significant and distinctly significant correlations were established with degree of base saturation (r=0.568***), cation exchange capacity (r=0.568***) and degree of base saturation (r=0.416**) and the type of correlations are linear and, respectively, logarithmic (fig. 2, 3, 4).

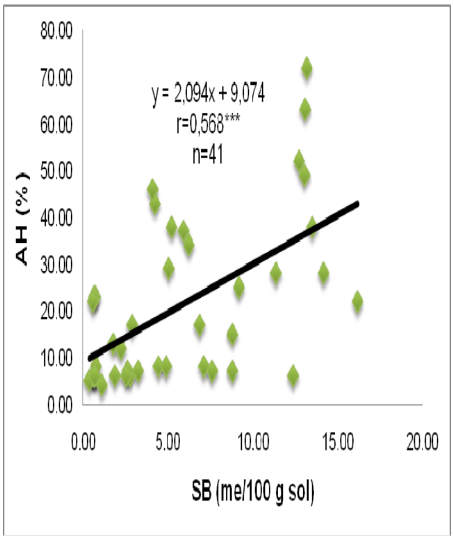

Figure 2 **The correlation between water stable agregates (AH, %) and sum of exchangeable (SB, %)**

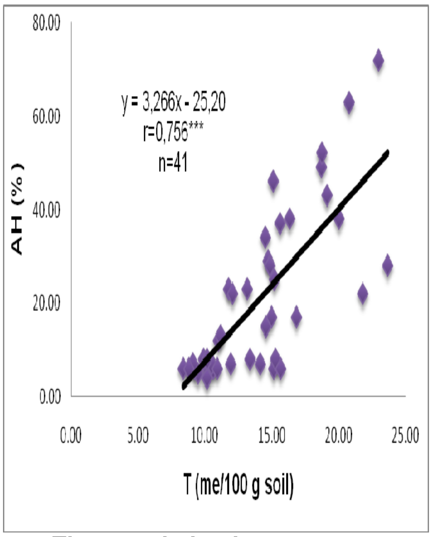

Figure 4 **The correlation between water stable agregates (AH, %) and total cations exchange capacity (T,me/100 g soil)**

Fenn et al., 2006, considers that the soil structure, macro-and microfauna, the rate of decomposition, nitrogen metabolism is important processes are significantly influenced by the content of calcium in the soil. Between Ca^{2+} content in researched soils and soil water stable aggregates there is a linear and very significant correlation (fig. 5).

In case of strong acid soils in addition there is a loss of soil structure due to loss of fine clay. This type of degradation occurs in soils that reach a very low pH and the pH is maintained for at least 10 years (Slattery et al., 1998), conditions that have been met in soils from Zlatna area.

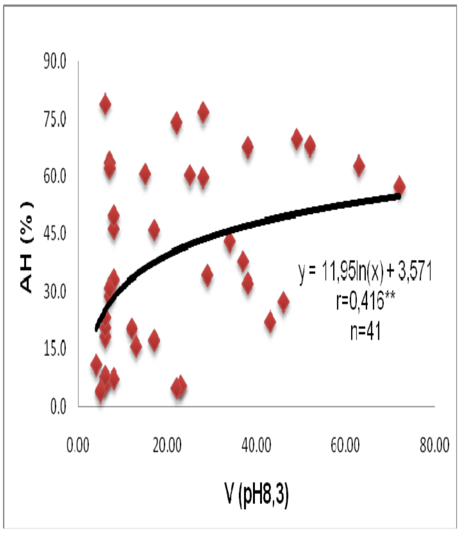

Figure 3 **The correlation between water stable agregates (AH, %) and percentage of base saturation ($V_{pH8.3}$,%,)**

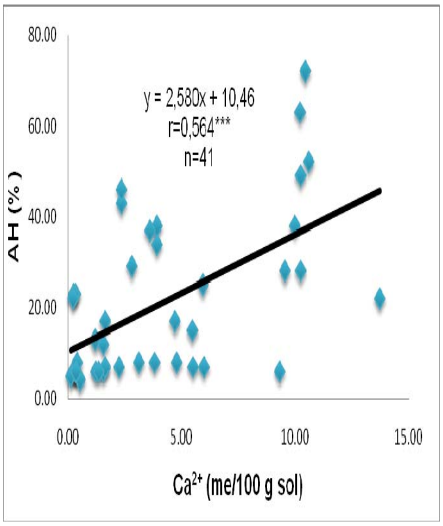

Figure 5 **The correlation between water stable agregates (AH, %) and content of Ca^{2+}**

Also, the water stable aggregates are highly significant, respectively, significantly influenced by humus and clay contents (fig. 6, fig. 7). Similar results have been reported by Dumitru, 1998.

Dispersion (D,%) range in the field of low-very high values and over 75% of the values belongs to classes of high-very high values (table 2). Between values of dispersion have been not established correlations with chemical and physical soil characteristics.

As was shown by Rauta et al., 1998, the decrease of Ca^{2+} content associated with low content of humus and clay determined the soil destructuring in most of the samples belong to A horizon from heavily polluted area.

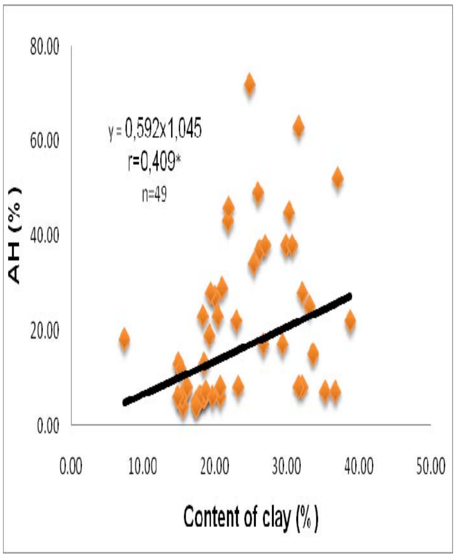

Figure 6 **The correlation between water stable agregates (AH, %) and content of clay (%)**

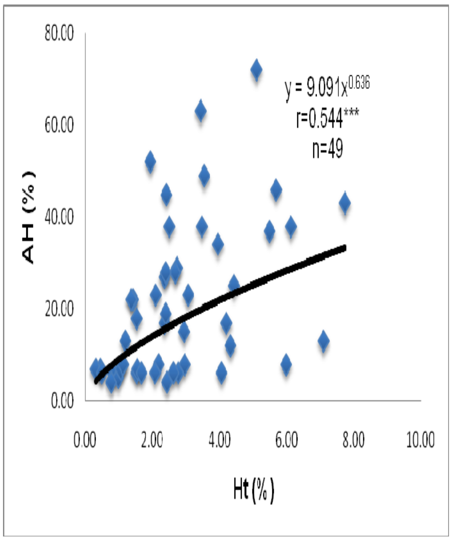

Figure 7 **The correlation between water stable agregates (AH, %) and total humus (Ht, %)**

CONCLUSSIONS

In the studied area, water stable aggregate range in the field of small-very large values, with value of median (17) in the middle class and only 10% of values belong to large and very large classes. Dispersion range in the field of low-very high values and over 75% of the values belong to classes of high-very high values.

The water stable aggregates is significant, respectively, very significantly influenced by the soil physical and chemical properties as: clay, content of humus, Ca^{2+} ions, percentage of base saturation, sum of exchangeable bases, soil reaction, cation exchange capacity.

Lowest correlation was established with soil reaction (r=0.338*) and the strongest correlation was with cation exchange capacity.

These results confirm the influence of soil acidification on the soil destructuring.

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