THE INFLUENCE OF AN INDUSTRIAL SLAG ON THE MACROELEMENTS CONTENT IN THE SOIL

EUGENIA GAMENT[1], MARIANA MARINESCU[1], VERA CARABULEA[1], GEORGIANA PLOPEANU[1], ILDIKO ANGER[2]

[1]National Research Institute for Soil Science, Agrochemistry and Environmental Protection, Bucharest, Romania, Email: eugeniagament@yahoo.com

[2]National Research Institute for Non-Ferrous and Rare Metals, Bucharest, Romania

Keywords: industrial slag, macroelements, soil

ABSTRACT

To maintain the quality of the soil it is required its use according the characteristics it has. This implies the inclusion on the appropriate use of any kind of waste, nutrients and pesticides management; improve physical and chemical characteristics, to avoid pollution. The ability of steel slag to improve the characteristics of acidic soils may be explained by the high content of calcium and magnesium. The paper describes the changes that occurred with regard to existing macroelements in soil as a result of using different doses of steel slag (0%; 0.1%; 0.2%; 0.3%; 0.4%; 0.5%) for the purpose of amending the soil. Macroelements such as nitrogen, phosphorus and potassium, as well as organic carbon content are presented. Changes in the total nitrogen content and soluble potassium content were strongly influenced as a result of treatment.

INTRODUCTION

Any change in soil ability to function (soil quality) can be reflected in soil properties with the corresponding consequences for fertility, economic efficiency and environmental state. [Florea &Rizea, 2008]

Data on soil composition and their chemical and physical characteristics are of great importance in evaluating soils, being basics limitations as concern the suitability for different uses and how to exploit the soils, technology.

The reaction of an acid soil can be corrected by adding substances containing Ca, Mg, referred to as amendment, to neutralize the acidity of the soil. [NSA]

Changes in the soil pH and other chemical indicators such as cation exchange properties were strongly influenced as a result of treatment. [Gament et. al., 2014]

MATERIAL AND METHOD

Using steel slag as a product applied in agriculture began in PNCDI II no. 122 project in the form of tests to study not only in terms of improving acid soil properties, but also to know the speed with which this slag will react faster with acid soil.

Reaction or soil's capacity to maintain a specific solution hydrogen ion activity is a result of saturation with bases of adsorptive clay-humic complex and of the content of salts in the soil. Therefore, changes in soil reaction occur due to changes of level of base saturation and the content of salts in the soil.

Soil material subject of the experiment was sampled from Moara Domneasca, near Bucharest.

In 1 kg soil pots, with 6 rates of steel slag LF (0%; 0.1%; 0.2%; 0.3%; 0.4%; 0.5%), 3 replicates and no mineral or organic fertilizers used, the treatment has been applied to study not only the changes in soil pH and Cation Exchange Properties, but also to observe the effect of treatment on the macroelements (total Nitrogen, soluble Phosphorus, soluble Potassium) content as well as organic Carbon content in the soil.

The chemical characteristics of the steel slag and the soil material used in the experiment were presented in the last studies. [Gament et. al. 2014]

Steel slag LF had an alkaline reaction (pH=11.96), a very high soluble salts contents (717mg/kg soil – conductometric residue) and a very high calcium and magnesium oxides contents.

The soil used in the experiment belongs of the silt-loam medium texture group class (silt-loam subclass-SL) according to Soil Taxonomy Romanian System (SRTS).

RESULTS AND DISCUSSIONS

The Cation Exchange Properties and some chemical characteristics (pH, C_{org}, N_t, P_{AL}, K_{AL}) of the soil material are shown in Table1.

Table1

Cation Exchange Properties and some chemical characteristics of the soil material (n=5)

	V^*_{Ca2+} % from CEC*	V^*_{Mg2+} % from CEC	V % from CEC	pH (H_2O)	Corg %	Nt %	P_{AL} $mg \cdot kg^{-1}$	K_{AL} $mg \cdot kg^{-1}$
X (mean)	54.5	17.3	73.5	5.62	1.03	0.182	62	337

*Cation Exchange Capacity - CEC; Calciun Range in Percent Saturation - V_{Ca}^{2+}; Magnezium Range in Percent Saturation - V_{Mg}^{2+}

Under the treatment, the Cation Exchange Properties have been statistically favorable influenced. Base Cation Saturation Ratio (V%) very significant increased for all doses, between 73.5% (V_0-control) and 96.9% (V_5). [Gament et. al., 2014]

Concerning the influence of steel slag on the macroelements and also on the organic carbon content of the soil, the results are presented bellow.

As regards the variation of macronutrients such as nitrogen, phosphorus and potassium, as well as organic carbon content, Fig.1, Fig.2, Fig.3 and Fig.4 show their changes according to treatment.

Total nitrogen (Fig.1) very significant decreased starting even with variant V_1 (0.1%), from 0.256% at V_0 (control) to 0.205 % at variant V_1 (0.1%) and dropped to 0.168% in the case of variant V_5 with 0.5% treatment.

The **soluble phosphorus** values (P_{AL}) were not significantly changed. (Fig. 2)

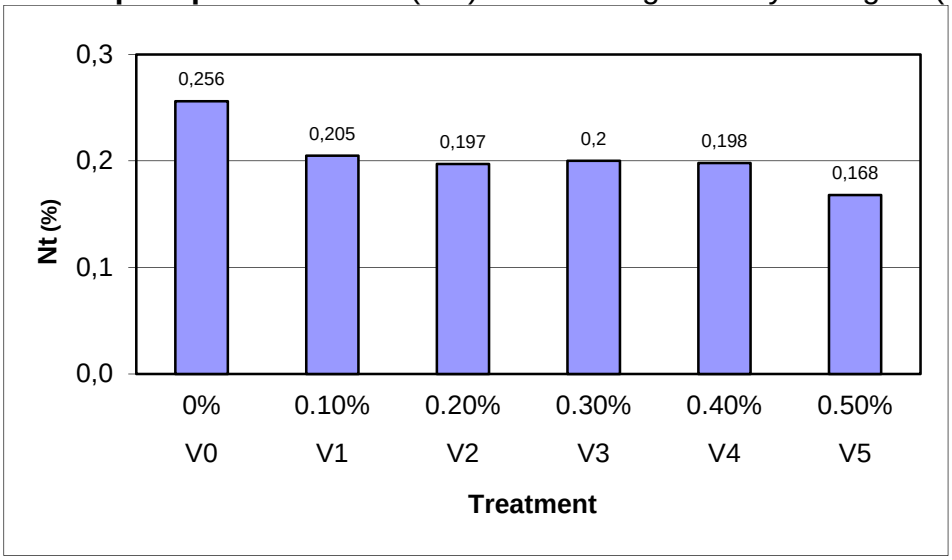

Figure 1. Effect of steel slag on the total nitrogen content in the soil

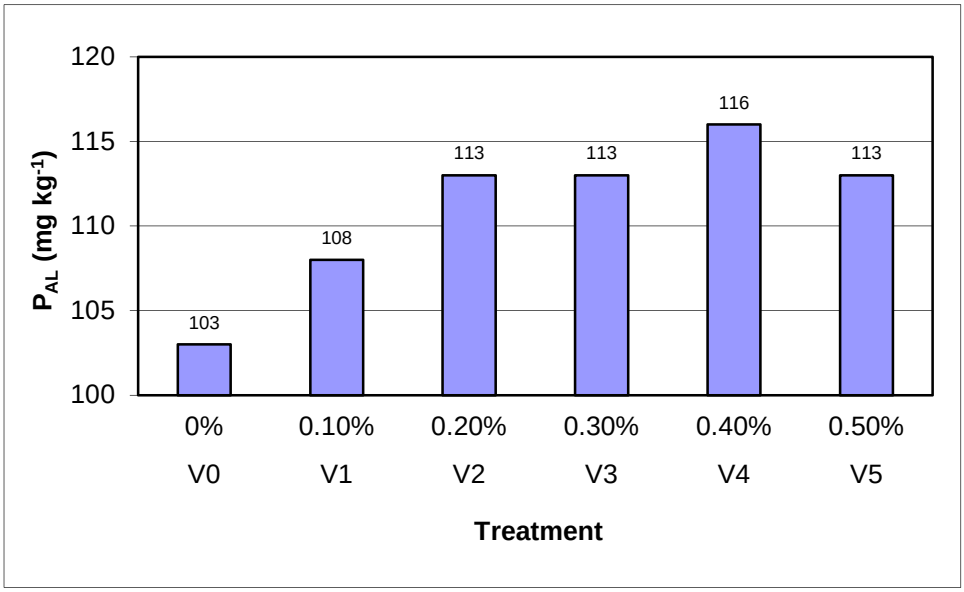

Figure 2. Effect of steel slag on the soluble phosphorus content in the soil

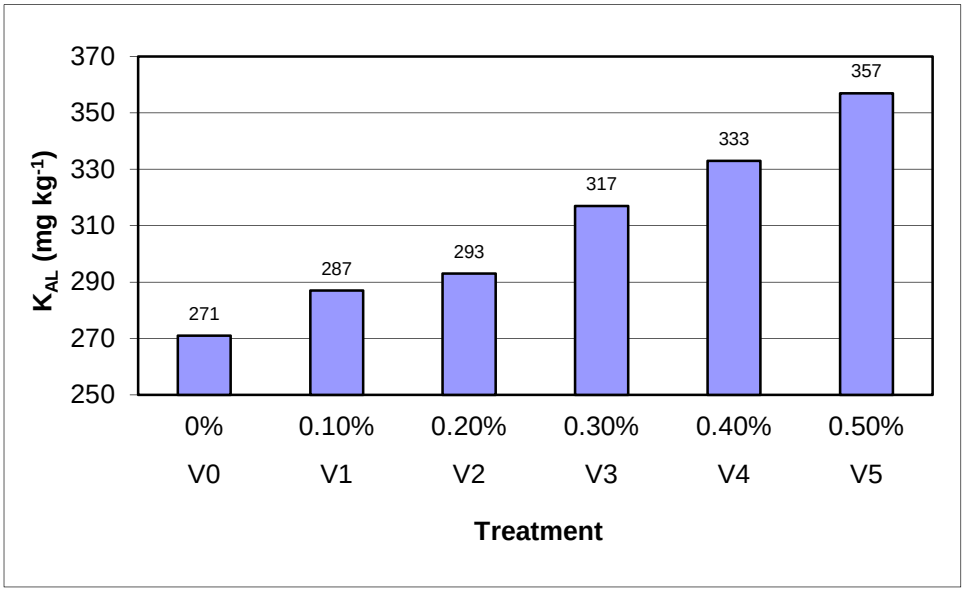

Figure 3. Effect of steel slag on the soluble potassium content in the soil

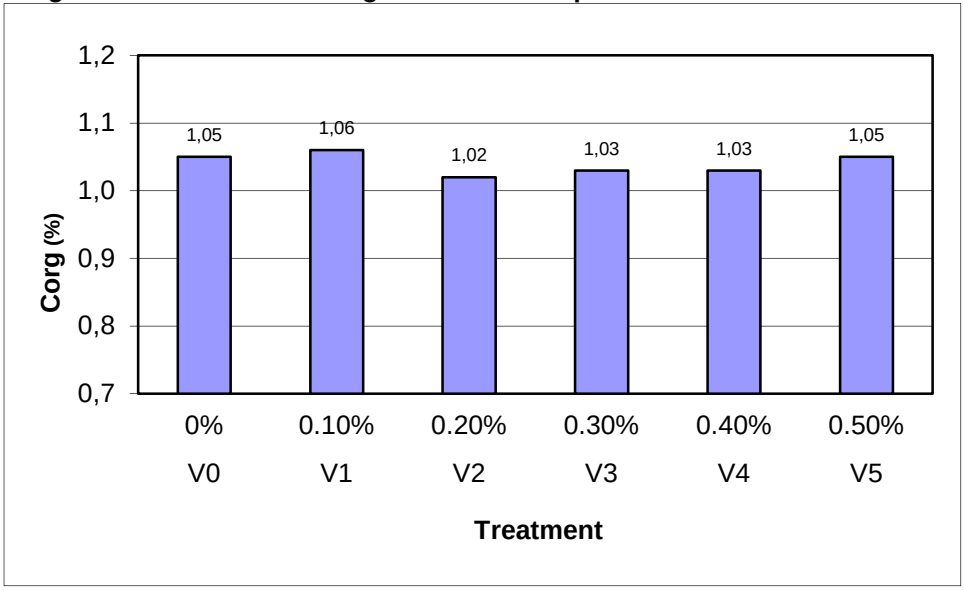

Figure 4. Effect of steel slag on the organic carbon content in the soil

The **soluble potassium** does not change significant considering the variants V_1 (0.1%) and V_2 (0.2%), but it significant increased at doses 0.3% (V_3) and 0.4% (V_4) and very significant increased at 0.5%. (Fig.3)

The **organic carbon** values were not significantly changed. (Fig. 4)

CONCLUSIONS

- Insignificant changes of soluble phosphorus and organic carbon, the significant decrease of total nitrogen values, can lead to some recommendations in terms of field experiments;
- To improve the soil quality, we recommend using in the field experiment the steel slag as amendment together with a nitrogen fertilizer and/or with organic fertilizer.

ACKNOWLEDGMENT

The financial support provided by the UEFISCDI – Executive Unit for Financing Education Higher Research Development and Innovative – project no. 122 – Acid Soil Amelioration Using a Metallurgical Waste.

REFERENCES

1. **Florea, N., Nineta Rizea,** 2008 - *Insusirile chimice ale solului, Component essential al mediului*, Bucuresti, ISBN 978-973-0-06021-8;

2. **Gament Eugenia, Mariana Marinescu, Ildiko Anger, Mihalache, M., Ilie, L., Stoiciu, Fl.,** 2014 - *Effect of Steel Slag LF Application on Soil Chemical Properties,* Annals of the University of Craiova – Agriculture, Montanology, Cadastre Series, Vol. XLIV, ISSN CD-ROM 2066-950x, pp. 110-115;

3. **NSA** – *National Slag Association, A Guide for the Use of Steel Slag in Agriculture and for Reclamation of Acidic Lands*, P.O. Box 1197, Pleasant Grove, UT81062;

4. **Sistemul Roman de Taxonomie a Solurilor SRTS**, 2003, ICPA, Ed. ESTFALIA, Bucuresti, ISBN 973-85841-7-5.