UTILIZATION OF THE MAGNESIUM MANUFACTURING INDUSTRY WASTE IN THE FERTILITY IMPROVEMENT OF ACID SOILS

VALORIFICAREA DEȘEURILOR DIN INDUSTRIA OBȚINERII COMPUȘILOR CU MAGNEZIU ÎN AMELIORAREA FERTILITĂȚII SOLURILOR ACIDE

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Abstract: *The paper presents a possible modality of improving the fertility of an acid soil by treating it with alkaline compounds, containing essential and trace elements, resulted in the industrial process of manufacturing magnesium carbonate and oxide from dolomites. The experiment pursueds the effects of soil treatment with 2 waste types applied in different doses. The obtained results show a buffer effect on the acid soil reaction and an increase of the essential and trace elements content of the treated soil. The pH buffering process and the enrichment of essential and trace elements in soil by alkaline waste supplies establishes in soil the enhancement of global soil fertility.*

Rezumat: *Lucrarea prezintă o posibilă modalitate de ameliorare a fertilităţii unui sol acid prin tratarea acestuia cu produşi bazici ce conţin macro şi microelemente, proveniţi din procesul de precipitare a oxidului şi carbonatului de magneziu din dolomite. Experimentul urmăreşte efectul asupra fertilităţii solului datorat tratării acestuia cu două tipuri de deşeu industrial, aplicate în doze diferite. Rezultatele obţinute evidenţiază o tamponare a reacţiei acide a solului şi de asemenea o creştere a conţinutului de macro şi microelemente în solul tratat, determinând astfel creşterea fertilităţii acestuia.*

Key words**:** *alkaline waste supplies, pH buffering, essential and trace elements content*
Cuvinte cheie: *doze de deşeu, tamponarea pH, conţinut de macro şi microelemente*

INTRODUCTION

The industrial process of magnesium carbonate and oxide manufacturing from dolomites generates important amounts of waste (KOHN et al., 1998). The composition of this waste includes precipitated calcium carbonate, as well as a considerable amount of precipitated magnesium carbonate besides impurities from the raw dolomite, namely iron, manganese, copper, zinc, chromium and nickel compounds (TAUBERT, RĂDULESCU, 2006). The crusts deposed on the walls of the equipment represent another source of mineral elements. The mentioned waste, as well as the crusts, could be tested as mineral supplements for the treatment of depreciated soils. The simultaneous presence of the above-mentioned mineral elements in soil and soil solution creates a balance in the uptake process of mineral elements. The interaction of the ions in soil and soil solution influence the root absorption process, creating antagonistic effects between the ion couples. Such ions couples, well-known, are: $Ca^{2+} : Na^{+}$; $Ca^{2+} : Fe^{2+}$; $Mg^{+} : Na^{+}$; $Mg^{2+} : Fe^{2+}$; $Mn^{2+} : Mg^{2+}$; $Mn^{2+} : Fe^{2+}$; $Zn^{2+} : Fe^{2+}$; $Cu^{2+} : Fe^{2+}$; $Cu^{2+} : Mn^{2+}$; $Zn^{2+} : Ca^{2+}$ (AVARVAREI et al., 1997).

The main objective of this study was to present the influence of the soil treatment, with several doses of waste and crusts from the magnesium products industry, on soil reaction and mineral content. The obtained results show changes in the mineral content of luvosoil, as well as in its reaction, proving a bettering of soil fertility.

MATERIALS AND METHOD

Luvosoil, having a pH value of 5.8 and a rather low fertility, was collected, air-dried, crushed, mixed thoroughly and put into pots, each containing 1 kg soil. The soil was treated with 2 types of additions as mineral supplements, namely industrial waste (A) and industrial crusts (B), with the composition presented in table 1.

Table 1

Composition of the industrial waste (A) and crusts (B)

Parameter	Ca	Mg	Fe	Zn	Mn	Cu	Cr	Ni
	(%)		(mg/g)					
waste	28	7	1.93	0.16	0.136	0.042	0.054	-
crusts	19	14	0.88	0.05	0.051	0.051	-	0.0026

The applied waste doses and the experimental alternatives are described in table 2.

Table 2

Added waste amounts and mineral content into the experimental soil alternatives

Parameter	**Experimental alternatives**			
***industrial waste* A**	V_1	V_2	V_3	V_4
Waste amounts, mg/kg	180	360	720	1440
- calcium content, mg/kg	50	100	200	400
- magnesium content, mg/kg	13	25	50	100
- iron content, mg/kg	0.347	0.695	1.390	2.780
- manganese content, mg/kg	0.025	0.050	0.101	0.202
- copper content, mg/kg	0.007	0.015	0.030	0.060
- zinc content, mg/kg	0.029	0.058	0.115	0.230
- chromium content, mg/kg	0.010	0.019	0.039	0.078
***industrial crusts* B**	V_5	V_6	V_7	V_8
Crusts amounts, mg/kg	263	526	1053	2105
- calcium content, mg/kg	50	100	200	400
- magnesium content, mg/kg	37	74	147	295
- iron content, mg/kg	0.23	0.46	0.93	1.85
- manganese content, mg/kg	0.0134	0.0268	0.0536	0.1073
- copper content, mg/kg	0.0134	0.0268	0.0537	0.1074
- zinc content, mg/kg	0.0132	0.0264	0.0526	0.1052
- nickel content, mg/kg	0. 0068	0.0136	0.0273	0.0547

Soil reaction was analysed from water: soil- 5:1 solution by help of a pH-meter. The soil mineral content was analysed as follows: The samples brought in a powder stage were dried at 95°C until a constant weight. Out of the dried sample, it was weighed a sample of approximately 0.2 g, which was introduced into a bomb of raylon, which was heated by microwaves. In this apparatus of BERGHOF B type were previously put 5 ml nitric acid (65%). The disintegration took place at 190°C, this temperature being preserved constant for 10 minutes. After cooling, the obtained solution was brought to a flask of 50 ml and was analysed by means of an atomic emission spectrometer - JOBIN YVON 24 sequential ICP.

The soil samples were collected after a vegetation period on oat of 8 weeks and analysed in comparison with an untreated soil sample (Vo). All the experiments were done in triplicate to have a statistic assurance.

RESULTS AND DISCUSSION

The obtained results of the analysed soil samples are presented in table 3.

Table 3

Soil reaction and mineral content in the experimental alternatives

Parameter		Experimental alternatives								
		control	*industrial waste* (A)				*industrial crusts* (B)			
content	M. U.	V_0	V_1	V_2	V_3	V_4	V_5	V_6	V_7	V_8
pH	pH units	5.80	6.40	6.45	6.66	6.93	6.20	6.30	6.50	6.80
	increase	-	0.60	0.65	0.86	1.13	0.40	0.50	0.70	1.00
calcium	mg/kg	2136	2267	2261	2440	2674	2122	2164	2254	2717
	%	100	106	106	114	125	99	101	106	127
magnesium	mg/kg	327	348	352	400	464	343	361	412	566
	%	100	106	108	122	142	105	110	126	173
iron	mg/g	235	250	245	260	257	233	243	235	254
	%	100	106	104	111	109	99	103	100	108
manganese	mg/g	88	84	80	87	73	76	71	94	93
	%	100	95	91	99	83	86	81	107	106
copper	mg/g	3.40	3.49	3.67	3.46	3.67	3.46	3.36	3.79	3.73
	%	100	103	108	102	108	102	99	111	110
zinc	mg/g	110.4	33.1	31.2	14	12.9	4.42	4.83	4.57	4.43
	%	100	30	28	13	12	4.0	4.4	4.1	4.0
chromium	mg/g	0.1	0.14	0.11	0.14	0.20				
	%	100	140	110	140	200				
nickel	mg/g	1.14					0.94	0.93	1.15	1.27
	%	100					82	81	101	111

For each experimental waste, 4 different doses were applied on the soil. The results were finally compared with an untreated soil sample (Vo).

Taking into account the composition of each waste and the administered doses, the results show an improvement in the mineral content of soil once with the increase of the dose and a buffering effect of the acid soil reaction.

The highest dose of waste (A) generates a calcium increase in soil content of 25% and 42% for magnesium. The increase is also evident for iron (11%), copper (8%) and the highest value registered for chromium (100%). Manganese and zinc in soil content show a decrease of 17% and 88% respectively, because of the antagonistic effects created by high amounts of calcium and magnesium in soil content.

The soil samples treated with crusts (B) show similar results to the treatment with waste (A). The highest dose of crusts (B) generates a calcium increase in soil content of 27% and 73% for magnesium. The magnesium increase in soil can be explained because of the higher magnesium amount in the crusts (B) composition. The increase for other mineral elements is as follows: 8% for iron, 7% for manganese, 10% for copper and 11% for nickel. An evident decrease shows the zinc content in soil, representing 86%, in comparison with the untreated soil. A similar buffering effect of soil reaction was also established, the pH value increase for the highest crusts dose being of 1 pH unit.

CONCLUSIONS

The obtained experimental results confirmed that the two tested waste can be successfully used in agriculture as soil amendment to improve the soil fertility.

Soil treatment with the administered waste doses had a positive effect on the soil quality by raising its content of essential and trace elements and turning the pH reaction to neuter.

The high amounts of calcium and magnesium in soil, as well as the rising amounts of iron and copper from the waste composition creates antagonistic effects, which decrease the concentration of manganese and zinc in soil.

All other mineral elements such as essential elements like calcium and magnesium, as well as trace elements like iron, copper, chromium and nickel improve their concentration in soil by adding the tested doses of industrial waste (A) and crusts (B).

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