THE INFLUENCE OF LIMING THE RANKER SOIL TYPE WITH FLY-ASH OF KOSOVO POWERPLANTS, ON CHEMICAL AND PHYSICAL PROPERTIES

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Abstract: *Increased acidity is very often a limiting factor for decreased soil fertility and unfavorable chemical and physical soil properties. Various materials can be used for liming the acidic soils such as natural ones (ground limestone or slag lime) as well as industrial waste (i.e. saturation silt). Fly-ash from Kosovo power-plants appears as a waste material after burning in the reactors. The material itself causes serious environmental consequences, especially because it is hardly remediated, due to its chemical and physical properties. Since 1963, Kosovo power plants have formed huge fly-ash dumps of very poor remediation ability, with over than 200.000mt of fly-ash. But, despite of its low remediation ability, the material has properties to be used in liming of acidic soils. The fact that fly-ash from Kosovo power-plants is alkaline, with a relatively high content of CaO and CaCO3, it is recommended as a material which can be successfully used in melioration of acidic soils. In our experiment we used the soil type Ranker, as a typical acidic soil from the mountain regions of Kosovo. Quantities of applied material for liming were 1, 3, and 5 mtha-1, calculated on volume of experimental pots of 4 liters. The obtained results recommend the applied liming material as the proper material for use in liming the Ranker soil type. Significant improvements of pH and other chemical properties have been reached, after the experiment, as well as better stability of soil structure.*

Keywords: *Fly-ash, Ranker, liming, acid soil*

Introduction

Fly-ash (Electrofilters ash, EF ash) occurs as a result of coal combustion in power-plants poses a serious environmental problem. On the one hand, the ash landfill is deposited on agricultural land, which excludes them from agricultural production, and on the other hand EF ash is subject to eolation, which affects the quality of the environment kilometers around (Resulović, 1988.).

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Coal burning in Kosovo's power plants has been carried out since 1963 with the opening of the thermal power plant, Kosovo „A“ power 449 MW, which was particularly intensified by the opening of another power plant Kosovo „B“ power 580 MW in 1980. During all the operations of Kosovo's thermal power-plants, ash dumps have been formed, which involve 2,000 hectares of arable land. Moreover, in EF ash the dust fraction prevails, which allows its eolation, thus adversely affecting the environment and agricultural crops. According to the recurrability of ash deposits, they are hardly recurrable (Cairney, 1987.), and therefore pose an additional problem in the living environment of the area. (Šmit, 1988). The cause of poor recurrence lies also in the chemical properties of EF ash, both in terms of high alkalinity and in terms of cementation of the surface layer of landfills (Đikić et al., 1995.).

However, the fact that EF is an alkaline reaction with a very high content of CaO, it is recommended to research its application in alkaline acid calcification.

The calculation is a pedomeliorative measure of repair of acidic soils and the materials to which it is made may be different: CaO, CaCO3, dolomit, saturation sludge and others. This study recommends EF ash as a calibration material, given its chemical and physical properties.

The available amount of ash is quite sufficient to consider its commercial use in the future.

Materials and Methods

The research used the pedological map of the AP of Kosovo and Metohija (Institut „Jaroslav Černi“, 1974.), as well as the soil type Ranker from Lesak county on the Kopaonik mountain - Serbia. The chemical properties of ash were analyzed by standard methods (Black et al. 1965.). The experiment was carried out as an indoor one, in experimental pots of volume of 4 dm^3. Soil moisture was maintained on the level of retention capacity (33kPa).

The characteristics of the EF ash are presented in table 2, as well as the properties of the soil used in the experiment (table 1). The use of EF ash was 10 $mtha^{-1}$ (dosage 1), 30 $mtha^{-1}$ (dosage 2) and 50 $mtha^{-1}$ (dosage 3), with control without the use of calcification agent. Compost is used as an additional fertilizer, for the purpose of achieving better solubility of the calcification agent (Banasova, 1989, Flaig, 1981). The culture of cultivation in this regard was grass mixture. Grass mixture was chosen as the typical culture of a given area.

The results were presented in Table 3. Statistic analyze was done accordingly, and presented as well.

Results of research and discussion

The soil used in the survey was taken in Lesak k.r. on the Kopaonik mountain in Serbia and by type belongs to humic-silicate soil type -Ranker. The chemical properties of the soil treated in the sample are shown in the table 1.

Table 1. Chemical properties of soil in the experiment

Depth	pH_{H2O}	pH_{KCl}	Humus (%)	N (%)	P2O5 (mg/100g)	K2O (mg/100g)	CaCO3	T-S (meq/100g)
0-10	4,7	4,1	8,2	0,41	5,5	27	0,7	32,5
10-22	5,0	4,3	6,5	0,35	2,4	25	1,0	40,2
23-56	5,2	4,2	4,0	0,21	2,0	28	1,0	38,4

As seen from the table shown, the soil in the experiment is very acidic with high humus content, with a somewhat higher amount of phosphorus than expected because it was agricultural land. The content of potassium is moderate. Hydrolytic acidity, shows levels of necessity of liming the soil.

The characteristics of EF ash are shown in the table 2.

Table 2. Chemical properties of fly-ash from Kosovo powerplants

Depth	pH_{H2O}	pH_{KCl}	CaO (%)	Na (%)	P2O5 (mg/100g)	K2O (mg/100g)	CaCO3
0-10	10,52	10,0	47,5	1,22	8,5	>40	15,2
11-20	9,11	8,85	41,5	1,14	5,4	>40	18,4
20-30	10,00	9,21	37,2	0,90	3,0	>40	9,2
30-40	9,85	9,45	45,0	1,10	2,0	>40	8,5

The influence of liming material on amelioration of Ranker with fly-ash is statistically analyzed, and the results are presented in Table 3.

Table 3. ANOVA of the obtained results

		Sum of Squares	df	Mean Square	F	Sig.
pH (H2O)	Between Groups	,996	2	,498	32,000	,001
	Within Groups	,093	6	,016		
	Total	1,089	8			
pH (KCl)	Between Groups	,667	2	,333	27,273	,001
	Within Groups	,073	6	,012		
	Total	,740	8			
Humus (%)	Between Groups	,336	2	,168	5,393	,046
	Within Groups	,187	6	,031		
	Total	,522	8			
N (%)	Between Groups	,002	2	,001	3,207	,113
	Within Groups	,002	6	,000		
	Total	,004	8			
P2O5 (mg/100g)	Between Groups	,016	2	,008	,084	,920
	Within Groups	,553	6	,092		
	Total	,569	8			
K2O (mg/100g)	Between Groups	27,556	2	13,778	3,351	,105
	Within Groups	24,667	6	4,111		
	Total	52,222	8			
CaCO3	Between Groups	1,313	2	,657	72,148	,000
	Within Groups	,055	6	,009		

	Total	1,368	8			
T- S (meq /100g)	Between Groups	27,042	2	13,521	52,453	,000
	Within Groups	1,547	6	,258		
	Total	28,589	8			

In the ANOVA analysis (table 3), the significance of the F-test show that there is a statistically significant difference at parameters pH_{H2O}, pH_{KCl}, humus, $CaCO_3$ and T-S depending on dosages. In order to determine among which dosages there exist significant differences of these parameters, a LSD test was done.

Table 4. Multiple Comparisons – LSD test

Dependent Variable	(I) Dosage	(J) Dosage	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
pH (H2O)	dosage 1	dosage 2	-,53333*	,10184	,002	-,7825	-,2842
		dosage 3	-,80000*	,10184	,000	-1,0492	-,5508
	dosage 2	dosage 1	,53333*	,10184	,002	,2842	,7825
		dosage 3	-,26667*	,10184	,040	-,5158	-,0175
	dosage 3	dosage 1	,80000*	,10184	,000	,5508	1,0492
		dosage 2	,26667*	,10184	,040	,0175	,5158
pH (KCl)	dosage 1	dosage 2	-,33333*	,09027	,010	-,5542	-,1125
		dosage 3	-,66667*	,09027	,000	-,8875	-,4458
	dosage 2	dosage 1	,33333*	,09027	,010	,1125	,5542
		dosage 3	-,33333*	,09027	,010	-,5542	-,1125
	dosage 3	dosage 1	,66667*	,09027	,000	,4458	,8875
		dosage 2	,33333*	,09027	,010	,1125	,5542
Humus (%)	dosage 1	dosage 2	-,30000	,14402	,082	-,6524	,0524
		dosage 3	-,46667*	,14402	,018	-,8191	-,1143
	dosage 2	dosage 1	,30000	,14402	,082	-,0524	,6524
		dosage 3	-,16667	,14402	,291	-,5191	,1857
	dosage 3	dosage 1	,46667*	,14402	,018	,1143	,8191
		dosage 2	,16667	,14402	,291	-,1857	,5191
CaCO3	dosage 1	dosage 2	-,64333*	,07789	,000	-,8339	-,4527
		dosage 3	-,91000*	,07789	,000	-1,1006	-,7194
	dosage 2	dosage 1	,64333*	,07789	,000	,4527	,8339
		dosage 3	-,26667*	,07789	,014	-,4573	-,0761
	dosage 3	dosage 1	,91000*	,07789	,000	,7194	1,1006
		dosage 2	,26667*	,07789	,014	,0761	,4573
T- S (meq /100g)	dosage 1	dosage 2	1,83333*	,41455	,004	,8190	2,8477
		dosage 3	4,23333*	,41455	,000	3,2190	5,2477
	dosage 2	dosage 1	-1,83333*	,41455	,004	-2,8477	-,8190
		dosage 3	2,40000*	,41455	,001	1,3856	3,4144
		dosage 1	-4,23333*	,41455	,000	-5,2477	-3,2190

dosage 3	dosage 2	-2,40000*	,41455	,001	-3,4144	-1,3856

*. The mean difference is significant at the 0.05 level.

Based on this test it can be clearly concluded that the mean values of pH_{H2O}, as well as the values of pH_{KCL} are significantly different within all the dosages, while mean values of humus are significantly different only between the first and third dosage. But this fact does not influence the main goal of the research. Mean values of T-S are also statistically significant among all the applied dosages. This fact is important to the goal of this research.

Based on these results the melioration of Ranker soil type with EF ash from Kosovo's thermal power plants is obvious, and there has been a significant increase in pH. Changing the chemical properties of Ranker enabled better nutritional utilization, better cultivation of the culture (grass mixtures), better quality of the product as well as higher yields.

Conclusion

The results of the study of the impact of EF ashes on the repair of Ranker soil type indicate that EF ash, from the point of view of its chemical properties, is a suitable material for the calcification of acidic soils of the ranker (humic-silicate) type. This is particularly conditioned by the high content of CaO in ash, as well as by absence Na^+ ions.

The performance of the EF ash provided better feedability of the nutrients, which significantly influenced the yield of cultivated culture.

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