

RESEARCHES REGARDING THE MAIN PHYSICAL PROPERTIES OF THE LAND FROM FORMER BAUXITE QUARRY FROM ZECE HOTARE, BIHOR AND THE SOIL FROM LIMITROPHE BEECH TREE FOREST

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Abstract

*The researches carried out in a former bauxite quarry from Zece Hotare. The exploitation of the bauxite ended in 1998 and very large melioration works were started in 2004. In order to determine the physical properties 4 profiles were made, on the levelled area on the high area (667 m altitude), on the low area (665 m altitude) on the hillside with 10% slope (672 m altitude) on with spruce was planted without mattress and in the beech tree (*Fagus silvatica*) forest at 50 m distance from the edge. The soil samples for determination of the bulk density, penetration resistance and hydraulic conductivity were taken in a natural layout using the cylinders of 100 cm³. There area a very different of the land granulometric composition in the former bauxite quarry in comparison with the soil from limitrophe beech tree (*Fagus silvatica*) forest; the highest differences were registered in the colloidal clay content. The values of the bulk density, penetration resistance and hydraulic conductivity of the land from bauxite quarry are the worse than the values of the soil from limitrophe beech tree (*Fagus silvatica*) forest.*

Key words: texture, bulk density, porosity, hydraulic conductivity, former bauxite quarry.

INTRODUCTION

The degraded soils through social-economical activities can be cropped after applying a complex system of measures: technical-mining, hydro-melioration, soil management. These activities will rehabilitate the fertility of the degraded soil and will create a land shaft proper for agriculture, forestry and other socio-economical activities (1, 2). The complexity of the processes involved in the soil remediation leads to the proposal that the recultivation should be part of a scientific discipline called "ecocreology" (9). The paper analyses the differences between the physical properties (texture, bulk density, total porosity, hydraulic conductivity) from a former bauxite quarry from Pădurea Craiului Mountains and the physical properties of the soil from a limitrophe beech tree (*Fagus silvatica*) forest 7 years after the melioration works.

MATERIAL AND METHODS

The Pădurea Craiului Mountains represent the area between the Crișul Repede River and the Crișul Negru River from the Apuseni Mountains. The researches were carried out at a bauxite quarry located in

Zece Hotare, Bihor County; the bauxite from Zece Hotare has the following chemical composition: $\text{SiO}_2 = 4,2\%$; $\text{TiO}_2 = 2,5\%$; $\text{Al}_2\text{O}_3 = 58\%$; $\text{Fe}_2\text{O}_3 = 22,8\%$; $\text{H}_2\text{O} = 11,7\%$.

The exploitation of bauxite ended in 1998 and in 2004 - 2005 very large melioration works were started: setting up, leveling, plan tiny, and fertilization.

In 2010, in order to determine the physical properties of the land from former bauxite quarry and the properties of the soil from the limitrophe beech tree (*Fagus silvatica*) forest (682 m altitude), 4 soil profiles were placed on the leveled area, on the high area (667 m altitude), on the low area (665 m altitude) and on the hillside quarry (10% slope, 672 m altitude). The profile from limitrophe beech tree (*Fagus silvatica*) is situated at 50 m distance from the edge.

The physical properties were determined in the laboratory of the Agricultural Research and Development Station Oradea. The bulk density and hydraulic conductivity were determined on the soil samples taken in natural layout using the cylinder of 100 cm^3 ($\text{Ø} = 50 \text{ mm}$; $h = 51 \text{ mm}$) in 5 repetitions (7). The texture elements were determined by Kacinski method (3). The research data were calculated by variance analysis method (7).

RESULTS AND DISCUSSION

Differences between texture elements

Regarding the coarse sand, fine sand and silt the biggest values were determined in the profile from the limitrophe beech tree (*Fagus silvatica*) forest in all the 4 depths studied: 0-17 cm; 17-30 cm; 30-40 cm; 40-60 cm. In the 3 profiles from former bauxite quarry the values are lower. The differences, in comparison with the values determined in the profile from the limitrophe beech tree (*Fagus silvatica*) forest, are very statistically significant; the smallest differences were registered in terms of coarse sand (Table 1, 2, 3).

Table 1

Analysis of the coarse sand of the land in the former bauxite quarry in comparison with the content of the soil from limitrophe beech tree (*Fagus silvatica*) forest, Zece Hotare, Bihor

Profile	Depth, cm				
	0-17	17-30	30-40	40-60	0-60
1	3.3	3.7	2.8	2.6	3.1
2	2.3	2.6	2.0	1.8	2.2
3	2.9	2.8	2.0	1.8	2.38
4	2.2	2.1	1.7	1.8	1.95
LSD 5%	0.51	0.31	0.28	0.26	0.29
LSD 1%	0.64	0.54	0.49	0.40	0.40
LSD 0.1%	0.97	0.82	0.71	0.69	0.66

Profile 1 = limitrophe beech tree (*Fagus silvatica*) forest

Profile 2 = high leveled area from former bauxite quarry

Profile 3 = low leveled area from former bauxite quarry

Table 2

Analysis of the fine and coarse sand of the land in the former bauxite quarry in comparison with the content of the soil from limitrophe beech tree (*Fagus silvatica*) forest, Zece Hotare, Bihor

Profile	Drepth, cm				
	0-17	17-30	30-40	40-60	0-60
1	28.1	21.8	25.9	18.1	23.5
2	12.6	13.0	13.7	14.4	13.4
3	11.9	11.5	12.6	14.0	12.5
4	11.3	10.9	10.2	10.1	10.63
LSD 5%	2.1	2.7	2.5	1.4	2.9
LSD 1%	3.9	4.0	3.7	2.9	4.2
LSD 0.1%	6.4	7.6	6.8	4.2	6.9

Profile 1 = limitrophe beach tree (*Fagus silvatica*) forest

Profile 2 = high leveled area from former bauxite quarry

Profile 3 = low leveled area from former bauxite quarry

Profile 4 = hill side area from former bauxite quarry

Table 3

Analysis of the content silt of the land in the former bauxite quarry and the clay content of the soil from limitrophe beech tree (*Fagus silvatica*) forest, Zece Hotare, Bihor

Profile	Depth, cm				
	0-17	17-30	30-40	40-60	0-60
1	33.9	32.0	32.3	41.0	34.8
2	19.5	22.9	21.4	15.7	19.8
3	19.8	21.5	20.6	15.6	19.22
4	15.6	14.9	14.7	13.2	14.6
LSD 5%	3.6	2.9	3.3	3.7	3.4
LSD 1%	5.4	5.1	5.6	6.3	5.7
LSD 0.1%	8.2	7.3	8.0	9.2	8.6

Profile 1 = limitrophe beech tree (*Fagus silvatica*) forest

Profile 2 = high leveled area from former bauxite quarry

Profile 3 = low leveled area from former bauxite quarry

Profile 4 = hill side area from former bauxite quarry

There is a different situation regarding the clay content because in the profile from the former bauxite quarry it is bigger than the soil clay content from all the depths of the profile placed in the limitrophe beech tree (*Fagus silvatica*) forest. The differences are very statistically significant in every case (Table 4).

Table 4

Analysis of the clay content of the land in the former bauxite quarry and the clay content of the soil from limitrophe beech tree (*Fagus silvatica*) forest, Zece Hotare, Bihor

Profile	Drepth, cm				
	0-17	17-30	30-40	40-60	0-60
1	34.7	42.5	39.0	38.3	38.5
2	65.6	61.5	63.2	68.0	64.6
3	65.4	64.2	64.8	69.2	65.9
4	70.9	72.4	73.4	74.9	72.82
LSD 5%	2.9	3.0	3.2	3.3	3.2
LSD 1%	4.7	5.1	5.4	5.7	5.3
LSD 0.1%	7.4	9.2	9.6	10.1	9.5

Profile 1 = limitrophe beech tree (*Fagus silvatica*) forest

Profile 2 = high leveled area from former bauxite quarry

Profile 3 = law leveled area from former bauxite quarry

Profile 4 = hill side area from former bauxite quarry

Bulk density

The values of the bulk density in the leveled area are lower than the values determined in the limitrophe beech tree (*Fagus silvatica*) forest. The values determined in the profile from the hillside of the previous bauxite quarry are the highest. On the 0-60 cm the differences in comparison with the value determined in the profile from the limitrophe beech tree (*Fagus silvatica*) forest are statistically significant and the differences determined in the profile from the hillside are very statistically significant (Table 5).

Table 5

Analysis of the bulk density values of the land from former bauxite quarry in comparison with the values determined in the soil from limitrophe beech tree (*Fagus silvatica*) forest, Zece Hotare, Bihor

Profile	Drepth, cm				
	0-17	17-30	30-40	40-60	0-60
1	1.28	1.30	1.27	1.32	1.29
2	1.13	1.10	1.20	1.21	1.16
3	0.96	1.09	1.13	1.16	1.09
4	1.36	1.59	1.65	1.86	1.62
LSD 5%	0.09	0.11	0.10	0.12	0.10
LSD 1%	0.17	0.20	0.18	0.23	0.19
LSD 0.1%	0.28	0.31	0.29	0.36	0.32

Total porosity

The values of the total porosity determined in the leveled area of the former bauxite quarry are higher than the values registered in the soil profile from the limitrophe beech tree (*Fagus silvatica*) forest. The lowest values of the total porosity were registered on the hillside. The differences registered (statistically assured) in the former bauxite quarry in comparison with the values of the total porosity of the soil from limitrophe beech tree (*Fagus silvatica*) forest are in opposite meaning in comparison with the values of the bulk density (table 6).

Table 6

Analysis of the total porosity values of the land from former bauxite quarry in comparison with the values determined in the soil from limitrophe beech tree (*Fagus silvatica*) forest, Zece Hotare, Bihor

Profile	Drepth, cm				
	0-17	17-30	30-40	40-60	0-60
1	52	51	53	51	53.5
2	58	59	55	55	56.75
3	64	59	58	57	59.5
4	49	40	38	30	39.25
LSD 5%	1.7	2.2	2.3	2.7	2.1
LSD 1%	3.1	4.0	4.9	5.4	3.6
LSD 0.1%	6.2	6.9	8.1	9.3	8.5

Hydraulic conductivity

In comparison with the hydraulic conductivity values within the soil profile from the limitrophe beech tree (*Fagus silvatica*) forest, positive differences ranging from 15% to 33% were registered in the profile from the hill leveled area, from 66% to 153 % in the profile from low leveled area. In the profile located on the hillside of the former bauxite quarry the differences are negative, from -7% to -55%. Compared to the soil from the limitrophe beech tree (*Fagus silvatica*) forest at the 0-60 cm depth, the hydraulic conductivity increased significantly in the high leveled area, distinctively statistically significant in the low leveled area and lower and without any statistical significance on the hillside of the former bauxite quarry (Table 7).

Table 7

Analysis of the hydraulic conductivity values of the land from bauxite quarry in comparison with the values determined in the soil from limitrophe beach tree (*Fagus silvatica*) forest, Zece Hotare, Bihor

Profile	Drepth, cm				
	0-17	17-30	30-40	40-60	0-60
1	6.4	4.7	1.9	1.5	3.63
2	7.6	5.4	2.5	2.0	4.38
3	10.6	8.1	4.7	3.8	6.8
4	4.5	2.1	1.3	1.4	2.33
LSD 5%	0.8	0.7	0.6	0.3	0.5
LSD 1%	1.9	1.5	1.3	0.8	1.3
LSD 0.1%	3.9	2.5	2.2	1.9	3.7

CONCLUSIONS

The paper based on the researches was carried out in 2010 in a former bauxite quarry (the bauxite exploitation ended in 1998) located in Zece Hotare, Pădurea Craiului Mountain led to the conclusions:

- In comparison with the soil profile from limitrophe beech tree (*Fagus silvatica*) forest the values of the coarse sand, fine sand and those

registered in the profiles located on the hillside of the former bauxite quarry are smaller, the differences being statistically assured; the clay content was bigger in all the 3 profiles of the former bauxite quarry, the differences were statistically significant in all the cases.

▪ The values of the bulk density determined in the low and high leveled area were smaller than the values determined in the profile placed on the limitrophe beech tree (*Fagus silvatica*) forest; the values of bulk density from the profile placed on the hillside are bigger and statistically significant. The same situations but with opposite meaning were obtained regarding the total porosity values.

▪ Hydraulic conductivity has the biggest values in the profile from the hillside of the former bauxite quarry. The values of the hydraulic conductivity registered in the soil profile from limitrophe beech tree (*Fagus silvatica*) forest are smaller than the values registered in the leveled area of the former bauxite quarry and bigger than the values registered in the profile placed on the hillside.

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