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The Impact of Acid Activation on Ion Exchange Properties of Kosova Bentonite

Luljeta Pula Beqiri, Mehush Aliu*, Milaim Sadiku, Sadija Kadriu, Mensur Kelmendi

Mitrovica University "Isa Boletini", Food Engineering Faculty, PIM Trepça, 40 000 Mitrovicë, KOSOVË

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Abstract: Experimental researches are conducted on samples of the two characteristic regions deposits of bentonite-Kamenica and Vitia. Potentiometric titration method is used to determine the ion exchange capacity of natural bentonite and activated with acid. Within the paper is researched the impact of the degree of acid activation in ion exchanger capacity of Kabashi bentonite. They used three different concentrations of acid solution: 10 % HCl, 20 % HCl and 30 % HCl. The natural bentonite of Karaçeva has shown greater capacity of ion exchange than natural bentonite of Gushicë and Kabash. The ion exchange capacity of Kabashi bentonite increase after acid activation compared with ion exhange of natural bentonite.

Keywords: *bentonite, ion exchange properties, natural sample, acid activation, potentiometric activation.*

Introduction

Kosovo has large reserves of bentonite. Like other types of clay, also bentonite clays have sedimentary origin. They were created as a result of chemical and bacteriological impacts on feldspat and other natural materials with volcanic origin, such as granit, porfit, etc. (Grim, 1962; Stoch, 1974). Besides uses in drilling and in areas dealing with adsorptive skills, clays has found wide industrial application for ion exchange, such as their use for cleaning wastewater, but also in agriculture to improve the quality of land. (EUBA, 2006; Amorim et al., 2004). Ion exchange capacity represents one of the basic properties of clay minerals. There are two factors that enable ion exchange. (Amman, 2003). One is isomorphic substitution in the tetrahedral or octahedral subsoil of clay mineral. The second source is considered to be the dissociation of aluminum hydroxyl groups in structural edges (Lagaly, 1981).

Material and Methods

Potentiometric titration

Acid activation is carried out with boiling of bentonite in solution of HCl with certain concentration, during three hours. (Kola, 1986). The device for activation has been so prepared that prevented the harmful effect of HCl. The potentiometric method is based on comparing of the two titration curves of added acid and base, constructed on the basis of measurements conducted in the presence and absence of clay. The value changes of abscissa of titration curves in the presence and absence of bentonite clay, for the same pH of solution, responds the equivalent amount of cations exchanged between bentonite clay and solution (Danglia, 1976). Experimental method of potentiometric titration can be accomplished in continual or discontinuous way. Continuous titration method uses the 0.1 N solution of NaCl as the initial solution. Certain quantity of such solution, usually volume of 100 cm^3, within the time intervals of 20 to 30 minutes, added 1 cm^3 of solution of HCl 0,1N, respectively the solution of NaOH 0,2N by the measured of corresponding value of pH of the solution at the end of any interval of time expired. Respective dependence of pH from volume of acid or base used, represent the titration curve in absence of bentonite clay. Experimental measurements of the pH value of the solutions are made by conventional pH meter.

Results and Discussion

Figure 1 illustrates the pH dependence of the added volume of NaOH (0,1N) and HCl (0,1N) into distilled water and natural bentonite clay of Gushica. Experimental dependence of potentiometric titration is illustrated in Figure 2, in the case of bentonite clay of Kabash.

*Corresponding: E-mail: amehush@yahoo.com; Tel: +37744-633-263,

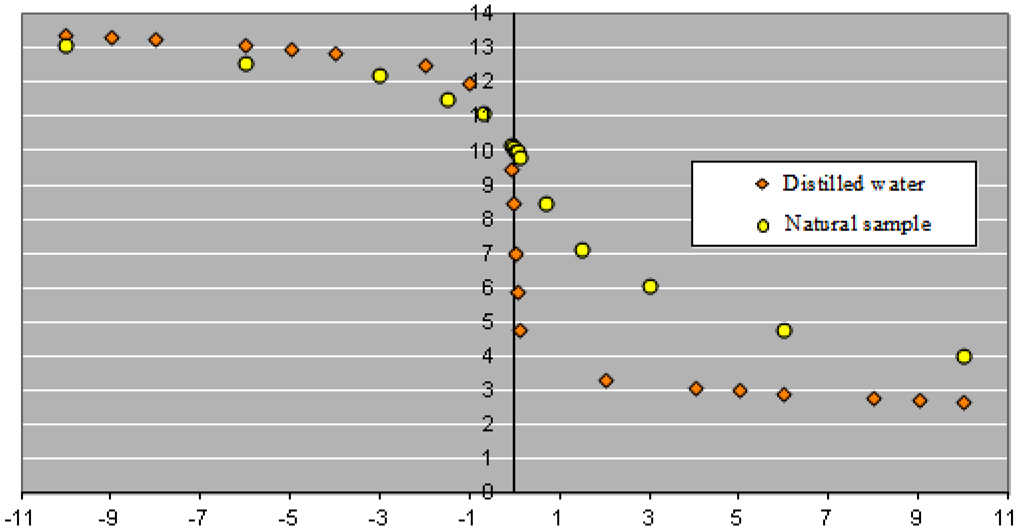

Figure 1. Dependence of pH by adding the volume of NaOH (0,1N) and HCl (0,1N) in distilled water and in natural bentonite clay of Gushica.

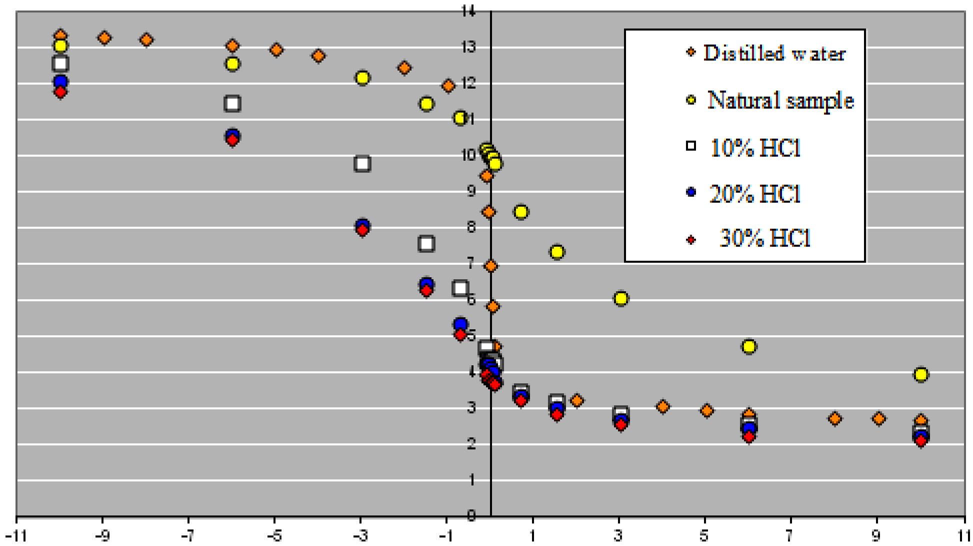

Figure 2. Dependence of pH by adding the volume of NaOH (0,2N) and HCl (0,1N) in distilled water and in natural and acid activation bentonite clay of Kabash.

The measurements results are shown in Table 1.

Table 1. Results of potentiometric titration of natural and activated sample of bentonite clay of deposit Kabash

Volume (ml)		**pH**				
		Sample				
0,1N NaOH	**0,1N HCl**	**D.U.**	**Natural sample**	**Activated sample with 10% HCl**	**Activated sample with 20% HCl**	**Activated sample with 30% HCl**
10		13.4	13.1	12.6	12.1	11.8
9		13.32				
8		13.25				
6		13.1	12.6	11.5	10.6	10.5
5		13.0				
4		12.85				

3			12.2	9.8	8.1	8.0
2		12.5				
1.5			11.5	7.6	6.5	6.35
1		12.0				
0.7			11.1	6.4	5.4	5.1
0.5						
0.3						
0.1		9.5	10.2	4,7	4,3	3,98
0,05		8.5	10,1	4,42	4,25	3,85
0	0	7,0	10,0	4,4	4,15	3.8
	0.05	5.9	9.98	4.38	4.05	3.78
	0.1	4.8	9.8	4.3	3.8	3.7
	0.2					
	0.4					
	0.5					
	0.7		8.5	3.5	3.4	3.25
	1.5		7.1	3.2	3.05	2.9
	2	3.3				
	3		6.1	2.9	2.7	2.6
	4	3.1				
	5	3.0				
	6	2.9	4.8	2.6	2.5	2.3
	8	2.8				
	9	2.75				
	10	2.7	4.0	2.4	2.3	2.18

Based on this methodology, the graphical relevant definitions of differences (n-no) of natural clay samples of Kosovo and for acid activated samples of the Kabash deposit are presented in Table 2.
Ion exchange capacity (CEC^+) are presented in Table 3. These values of ion exchange capacity of Kosovo bentonites are comparable to values encountered in the literature-see table 4.

Table 2. Differences ($n-n_o$) of potentiometric measurements for natural bentonites of Kosova and for samples of Kabashi deposit activated with HCl.

	Natural bentonit	**Activated bentonit**		
		10% HCl	**20% HCl**	**30% HCl**
Kabash	1.80	1.25*	1.95*	2.1*
Gushicë	2.05	-	-	-
Karaçevë	4.35			

Table 3. Ion exchange capacity of natural bentonites of Kosova and samples of Kabashi deposit activated with HCl.

	Natural bentonit	**Activated bentonit**		
		10% HCl	**20% HCl**	**30% HCl**
Gushicë	41.0	-	-	-
Kabash	36.0	50.0	78.0	82.0
Karaçevë	87.0	-	-	-

Table 4. Ion exchange capacity of different clay minerals (Grim, 1953)

Mineral	CEC^{+} (meq/100 g)
Kaolinite	3-15
Gaulazit $2H_20$	5-10
Gaulazit $4H_20$	10-40
Montmorillonit	80-150
Ilit	10-40
Vermikulit	100-150
Chlorite	10-40

Comparison of tables 3 and 4 leads to the conclusion that the largest ion exchange ability of natural bentonite of Karaçeva to natural bentonite of Gushica and Kabash is a result of the most content of montmorillonit, and the greater presence of ilit in bentonite of Gushica and Kabash.

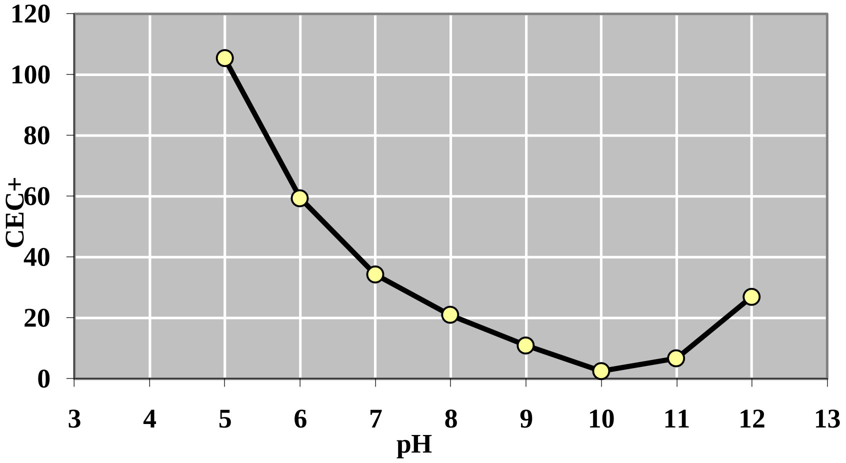

Figure 3. Dependence of ion exchange capacity CEC^{+} (meq/100 g) from pH for natural bentonit of Kabash.

Results of experimental potentiometric measurement also show that ion exchange skills changing by the pH of the solution. This phenomenon is illustrated in figure 3, where are presented the approximate values of ion exchange depending on the pH of natural bentonite of Kabash and showing how ion exchange capacity varies depending on the pH of the environment. The results of the relevant calculations of ion exchange capacities are shown in Table 3. As this table shows, the ion exchange capacity of Kabash bentonite increase after acid activation compared with the ion exchange capacity of natural bentonite- see Figure 4.

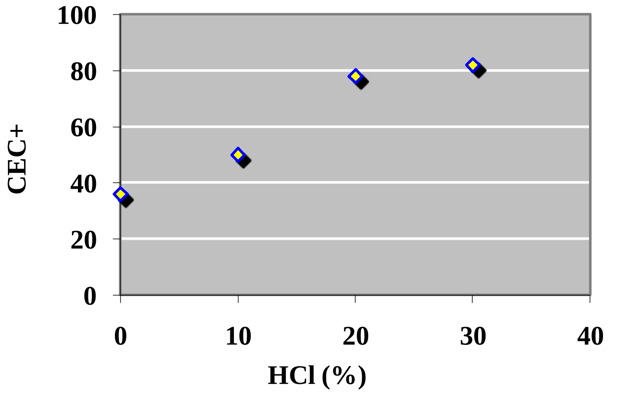

Figure 4. Impact of the level of acid activation on ion exchange capacity CEC^{+} (meq/100 g) of natural bentonite of Kabash.

Conclusions

- The values of ion exchange capacity of Kosova bentonite determined by potentiometric titration shown comparable with values encountered in literature.
- Natural bentonite of Karaçeva it has shown greater ion exchange capacity than natural bentonite of Gushica and Kabash, such a phenomen has been correlated with greater content of montmorillonit, as well as greater presence of ilit in the bentonite of Gushica and Kabash.
- The results of potentiometric experimental measurements shown that the ion exchange capacity change with pH of solution.
- Ion exchange capacity of Kabashi bentonite increase after acid activation comparable with ion exchange capacity of natural bentonite.

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