Environmental Applications Of Modified Natural Zeolites

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The field of environmental applications of natural zeolites is quite well investigated. The chemical modification of the zeolites considerably extends their application possibilities and increases their effectiveness providing them with specific properties. Because of this reason, the investigations in this direction are of particular interest. A number of reports concerning the chemical modification of an inorganic carriers with compounds of different nature has already appeared in the literature /1-3/. This contribution presents a classification of the zeolite modification methods as well as some applications of the resulting in modified zeolites based on literature data.

The following techniques were used for the chemical modification of the natural zeolites:

1. Treatment of natural zeolites with organic substances.

Water soluble polyelectrolytes with aminogroups - polyhexamethyleneguanidine and polyethylenimine were selected for this purpose /4/. As a results, the sorbents , retaining the cation-exchange properties of the initial zeolite - carriers (cation-exchange capacity 1,2 - 1,3 meq/ml) were obtained. The materials additionally acquired anion-exchange properties (anion-exchange capacity 0,2 - 0,6 meq/ml) and the bactericidal activity. The selectivity to oxygen-containing anions (CrO_4^{2-}, AsO_4^{2-}, PO_4^{3-}, etc.) is the characteristic property of these organozeolites.

Examples of applications of these sorbents to the decontamination and desinfection of solutions of different composition and surface waters are presented in this contribution.

2. Treatment of the natural zeolites with a inorganic substances.

2.1 The clinoptilolite-rich tuffs were treated with a hot suspension of freshly precipitated magnetite /5/. This leads to the preparation of sorbents possessing magnetic properties. The sorbent obtained is characterized by magnetic susceptibility of (5-6) x 10^{-3} CGSM units. The cation-exchange capacity of the initial zeolite and the selectivity to Sr, Cs and heavy metals was retained. The radionuclides and heavy metals recovery from soils and silts was investigated using different soil and ferromagnetic zeolite weight ratios and contact times. Different soils and sorbent of varying capacities were used for these investigations. As example, the recovery ^{137}Cs and ^{85}Sr from soils of different nature is presented in Table 1.

The specific properties of the materials obtained and the experimental data, suggest that these materials can be used for the decontamination of soils, silts and highly turbid solutions from cationic contaminants using magnetic field for the subsequent separation of phases.

2.2 Treatment of natural zeolites with Fe-containing solutions or Fe-containing natural waters. The filtration of these solutions through clinoptilolite-rich tuffs makes leads to preparation of materials possessing high selectivity to PO_4^{3-} - ions . For example, this sorbent removes up to 2,5 meq/g of PO_4^{3-} - ions at pH 10 - 11,5.
The properties of these sorbents can be utilized for the PO_4^{3-} - decontamination of waters (e.g. waste waters) and for the subsequent use of these materials in agriculture as fertilizers.

References cited

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Table 1: Removal of radioactive Cs- and Sr-isotopes from various soils by ferromagnetic natural clinoptilolite-rich tuff *)

W_1/W_2	Recovery, %			
	Soddy podzolic Soil		Chernozem	
	Sr	Cs	Sr	Cs
1.5	95	56	71	40
3.0	90	43	63	20
5.0	82	20	61	8
10.0	66	20	33	7
15.0	60	18	29	4
20.0	50	-	25	-
25.0	45	13	21	-

*) W_1/W_2: $wt_{Soil}/wt_{zeolite}$, Contact time: 24 days