

ADSORPTION OF LANTHANIDES ON Na-MORDENITE

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The adsorption of the lanthanides (except for Pm) on the mordenite was investigated under various solution conditions of nitrate ion concentrations ($[\text{NO}_3^-]$: 0.001-2 mol/dm³) and total lanthanide concentrations 0.0005 mol/dm³. Zeolite CBV 10 A (mordenite) in the form of powder has been delivered by Zeolyst International. Chemical composition of the samples has been reported by the supplier as: Na₂O – w/w 6.6%, SiO₂/Al₂O₃ = 13.

EXPERIMENTAL

The aqueous phases (100 cm³ volume) containing lanthanide nitrates (0.0005 mol/dm³; 99.9% purity, Sigma Aldrich) dissolved in sodium nitrate with concentrations ranging from 0.001 mol/dm³ to 2 mol/dm³ (pure, Sigma Aldrich) were equilibrated through 4h with 100 mg samples of the sodium form of the mordenite in temperature 23±1°C. The aqueous phase was separated from the solid residue by filtration (paper filter Filtrak 390, Polskie Odczynniki Chemiczne) and the concentration of the lanthanides was determined spectrophotometrically using Arsenazo III [1]. The concentration of the lanthanide in the solid phase c_{ze} was found as the difference between the initial concentration c_{in} and the concentration in the equilibrium aqueous phase c_{aq} . The initial and equilibrium pH values were controlled using combined glass electrode (Sigma Chemical Co.) connected to the pH meter (CX-731 type, Elmetron Co.).

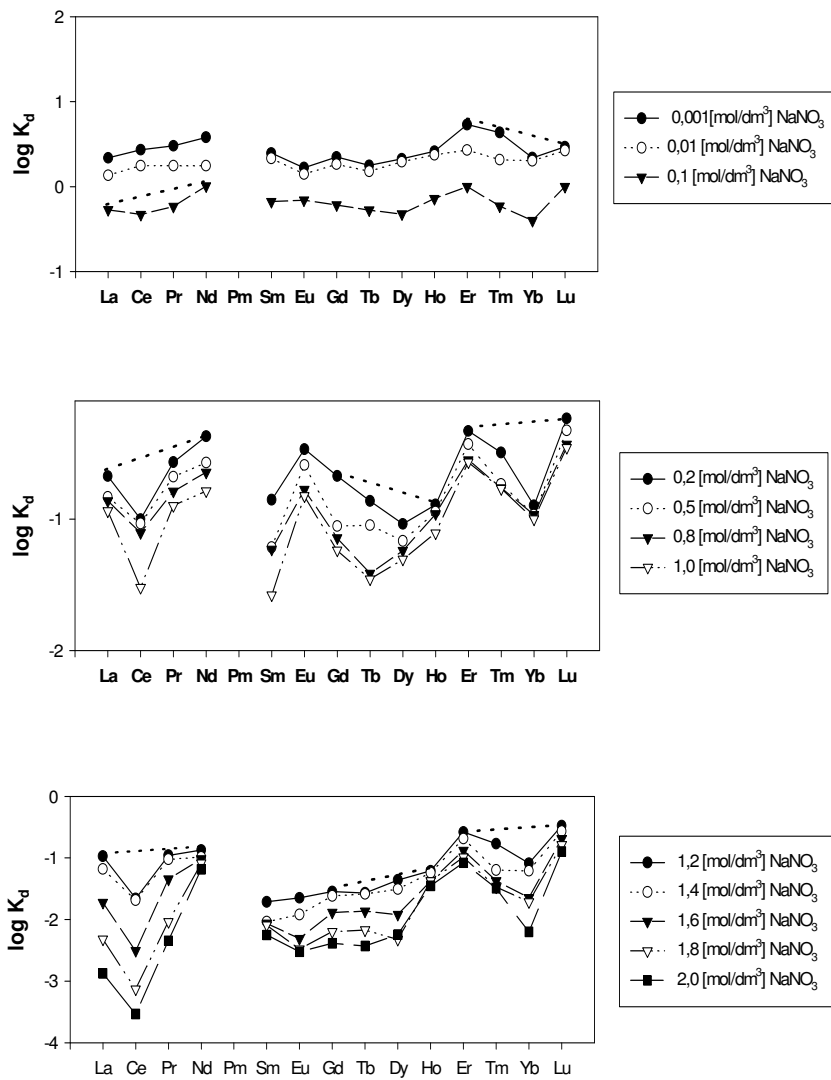
RESULTS AND DISCUSSION

The change of the distribution constants of the lanthanides in the system Ln(NO₃)₃-NaNO₃-mordenite with the nitrates concentrations is given in Figure. The distribution constants K_d are defined as:

$$K_d = (c_{ze}/c_{aq})V/m. \quad (1)$$

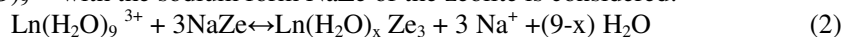
where: V and m denote the volume of aqueous phase and the mass of the adsorbent respectively.

The nonmonotous change of log K_d values with the atomic number of the tripositive lanthanides is evident. For the first tetrad of the lanthanides (La-Nd) the concave deviation from the interpolation straightline in the run of K_d values is observed. Second tetrad (Pm-Gd) was not considered since we do not have the data for Pm. For the third tetrad (Gd-Ho) the negative deviation from the interpolation



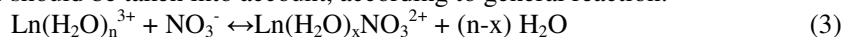
line is noticed. For the fourth tetrad (Er-Lu), similarly as in the case of the first tetrad, concave deviations are evident especially for higher concentrations of nitrates ($0.2 - 2 \text{ mol/dm}^3$). According to Kawabe [2-6], the concave tetrad is observed when the covalency in lanthanide ion-ligand in products of the complexation reaction is Fig.1. The changes of distribution constants (K_d) of the lanthanides in the system $\text{NaNO}_3 - \text{mordenite}$ with nitrate concentrations.

weaker, i.e. Racah parameters are higher, than in the substrates. Therefore for the ions: La^{3+} - Nd^{3+} , when the ion exchange-complexation reaction of the aquoions $\text{Ln}(\text{H}_2\text{O})_9^{3+}$ with the sodium form NaZe of the zeolite is considered:



covalency of the Ln-O bond in the $\text{Ln}(\text{H}_2\text{O})_x \text{Ze}_3$ species is weaker than in aquocomplex $\text{Ln}(\text{H}_2\text{O})_9^{3+}$.

Apart from above mentioned reactions the complexation of the lanthanide ions by nitrates should be taken into account, according to general reaction:



where $n=9$ and 8 for the light and heavy lanthanides [7].

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