SORPTION OF STRONTIUM BY MEXICAN ERIONITE

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The apparent diffusion coefficient of Sr$^{2+}$ in natural Mexican erionite from Sonora at different pH and concentrations were determined. Neutron activation was applied to measure the sorption of strontium. The apparent diffusion coefficient values showed that the mobility of Sr$^{2+}$ through the cavities of the erionite depended on the concentration of strontium and the pH of the solution. As a consequence the sorption of this ion by the erionite was affected by these parameters and the maximum sorption of Sr$^{2+}$ was at pH higher than 3 and 0.0094 mol$^{-1}$1 strontium nitrate solution.

Natural aluminosilicates in the separation of radionuclides from liquid wastes have been used specially for strontium and caesium.$^1$

The sorption properties of $^{238}$U(VI), $^{90}$Sr, $^{134}$Cs, $^{137}$Cs and $^{90}$Sr on clinoptilolite and mordenite have been studied by Xu et al.$^2$ They found that the sorption capacity decreases as follows: clinoptilolite $>$ mordenite $>$ bentonite.

The combination of sorption and chemical precipitation has been studied for $^{60}$Co, $^{90}$Sr and $^{144}$Ce with natural zeolites (clinoptilolite and mordenite). It was found that the decontamination factor was the highest for $^{90}$Sr.$^3$ On the other hand, precipitation and ion exchange using clinoptilolite or vermiculite, or a mixture of both sorbents in the sodium form, greatly increases the degree of decontamination from caesium and strontium.$^4$ Also Komarneni et al.$^5$ proposed strontium erionite as overpack material under hydrothermal conditions, as a procedure for the waste treatment.

The purpose of this paper was to study the sorption and apparent diffusion properties of Sr$^{2+}$ ions in a Mexican erionite at different concentrations and pH.

Experimental

Material: The erionite was from Agua Prieta, Sonora. The natural material contained the following exchangeable cations: 1.96 wt.% Na, 1.60 wt.% Ca, 2.16 wt.% K, 1.12 wt.% Fe, 161 ppm Mn, and 50 ppm of Cu and Ni.$^6$
The zeolite was powdered to less than 250 mesh and treated for 8 days in a 5 mol·l⁻¹ NaCl solution, washed and dried at 100 °C for 5 hours to saturate it with sodium. The sodium content, after the treatment, was determined by neutron activation analysis and it was 2.24 meq Na⁺/g (5.15 wt.%). Analytical grade reagents were used without further purification.

Isotherm: Sodium erionite samples (200 mg) were put in contact with 20 ml of strontium isonormal nitrate solutions for 72 hours. The total concentration of nitrates was 0.1 mol·l⁻¹ and the concentrations of strontium were from 0.002 to 0.2 mol·l⁻¹, finally the solids were separated by centrifugation and washed with deionized water.

The strontium zeolite samples, together with standard samples of strontium and sodium, were irradiated in a TRIGA MARK III nuclear reactor for 30 seconds at a neutron flux of 10¹³ n·cm⁻²·s⁻¹. The radioactivity of ⁸⁵Sr and ²⁴Na was measured with a Ge/hyperpure solid state detector coupled to a 2048 channel pulse-height analyzer. The strontium and sodium determined by this technique, in each sample were used to obtain the isotherm.

Diffusion: Each zeolite sample (150 mg), initially in the sodium form, was converted partially into the strontium form by the addition of 15 ml strontium solutions labeled with ⁸⁵Sr at concentrations 0.0023 mol·l⁻¹ (pH 3.0), 0.0047 mol·l⁻¹ (pH 1.5, 3.0, 5.0 and 7.0), 0.0072 mol·l⁻¹ and 0.0094 mol·l⁻¹ (pH 3). Contact time varied from 3 minutes to 24 hours. The solutions were separated from the solid by centrifugation. The radioactivity of the remaining solutions, as well as the original solution were measured with a Ge/hyperpure detector, from these data the quantities of strontium sorbed by the zeolite at different times were calculated and from them Qₐₙ and Qₜ were determined.

Apparent diffusion coefficient determination: In the crystalline zeolites ion exchange is controlled by diffusion of ions within the aluminosilicate structure. It has been shown