Letters to the Editor

Contact ion-exchange interactions in systems involving zeolites

V. L. Bogatyrev,[*a] I. A. Belitskii,[b] G. V. Villeval'd,[a] I. S. Terekhova,[a] V. V. Lisitsa,[a] and S. V. Vasil'eva[a]*

[a]*Institute of Inorganic Chemistry, Siberian Branch of the Russian Academy of Sciences,*
3 prosp. Akad. Lavrent'eva, 630090 Novosibirsk, Russian Federation.
Fax: +7 (383) 235 5960
[b]*Institute of Mineralogy and Petrography, Siberian Branch of the Russian Academy of Sciences*

It has been found that direct contact between granules of zeolite and organic ionite in deionized water results in contact ion-exchange interactions between them. This can be shown using the system of granules of KU-2×8 sulfopolystyrene cationite in the Cs-form (RCs) and granules of zeolite from the Voznesenskii deposit in the H-form (rH), which is related in its elemental composition (according to D. Brek) to high-silicon crystalline aluminosilicates of the heulandite type. When an equilibrium distribution of H^+ and Cs^+ ions between the components according to the reaction

$$\mathrm{RCs} + \mathrm{rH} \xrightleftharpoons{T} \mathrm{RH} + \mathrm{rCs}$$

was achieved, the zeolite was separated from KU by a sieve method, and their compositions were analyzed. The contact time in the experiment was 27 days, which considerably exceeded the time required to achieve equilibrium.

It turned out that the concentration constant of the equilibrium of the contact exchange calculated by the equation

$$T_{\mathrm{RCs}}^{\mathrm{rH}} = \frac{C_{\mathrm{RH}} \cdot C_{\mathrm{rCs}}}{C_{\mathrm{RCs}} \cdot C_{\mathrm{rH}}} ,$$

retained a constant value of 0.038 (the average of five determinations for the initial rH : RCs ratios by capacity from 1 : 1.2 to 1 : 10.7) with a deviation of no more than 10 %. The obtained value of $T_{\mathrm{RCs}}{}^{\mathrm{rH}}$ reflects the higher affinity of the zeolite for the proton than for a metal ion, which agrees well with the selectivity series known for zeolites. The kinetics of the contact interactions is determined by the dimensions of the granules of the contacting components, by the nature of the latter, by the types of exchanging ions, *etc.*, and will be studied in the future.

It is easy to show that

$$T_{\mathrm{RCs}}^{\mathrm{rH}} = K_{\mathrm{RCs}}^{\mathrm{H^+}} \cdot K_{\mathrm{rH}}^{\mathrm{Cs^+}} ,$$

where K_j^i are the corresponding exchange constants for the Cs-sulfocationite with H^+ and for the H-zeolite with Cs^+ ions in solution. Then the degree of exchange achieved in the contact interaction of an organic ionite and zeolite can be estimated from the known solution equilibrium constants or the exchange constant for another component in the solution can be calculated from the known value of T_j^i and one of the K_j^i values.

The phenomenon observed is of interest as a primary model for describing various real systems involving zeolites, including models for the elucidation of deactivation mechanisms of contaminated soils, for studies of plant nutrition in artificial soils, etc.

Received March 4, 1994;
in revised form June 9, 1994

Translated from *Izvestiya Akademii Nauk. Seriya Khimicheskaya,* No. 8, pp. 1505—1506, August, 1994.

1066-5285/94/4308-1427 $12.50