
Estimation of the Zeolite Contents of Tuffaceous Samples from the Bigadiç Clinoptilolite Deposit, Western Turkey

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Abstract: Variation of the NH_4^+ -exchange and CO_2 -adsorption capacities with zeolite content was investigated in detail to assess the potential use of these capacities for the estimation of the zeolite contents of the samples taken from the Bigadiç clinoptilolite deposit in western Anatolia, as an alternative to the widely used semi-quantitative X-ray diffraction (XRD) technique. Samples with known clinoptilolite contents taken from 2 different zones with fine- and coarse-grained tuffs of the Bigadiç deposit were used for this purpose. Na-enriched forms of the samples were prepared by repeated ion-exchange with NaCl solutions, and NH_4^+ -forms by repeated Na exchange followed by NH_4^+ exchange with NH_4Cl solutions, which in turn were calcined to obtain the H-forms. NH_4^+ -exchange capacities by Kjeldahl analyses of the NH_4^+ -forms and CO_2 adsorption isotherms in the 0 to 100 kPa range of Na- and H-forms of the samples were determined. Dubinin-Astakhov model parameters were calculated from the isotherm data.

A strong relationship exists between the experimental CO_2 -adsorption capacities at 100 kPa of the Na-forms and the zeolite contents of the samples. Although the Dubinin-Astakhov model represented the isotherm data quite well, the relationships between the amounts of adsorbate at saturation pressure, calculated from the model, and the zeolite contents of the samples were weaker. The strength of the relationship between NH_4^+ exchange capacities and zeolite contents was seen to vary with the zone of origin. There is a very strong relationship between the adsorption and ion-exchange capacities of the samples in their Na-forms taken from the fine-grained zone, indicating that either ion-exchange or adsorption capacity measurements can be used to estimate the zeolite contents of the samples taken from this zone, whereas, significant diffusion hindrance was observed against ion-exchange of hydrated cations from aqueous solutions for some samples from the coarse-grained zone. Inspection of the data pointed to systematic errors in the zeolite contents determined by a semi-quantitative XRD technique. When both zones are considered together, CO_2 -adsorption capacities at 100 kPa of the samples in their Na-forms can be used as a reliable measure of the zeolite content, which in turn is an important index to predict the performance of natural samples in various applications.

Key Words: Clinoptilolite • CO_2 Adsorption • Dubinin-Astakhov Isotherm Model • Natural Zeolites • NH_4^+ -Exchange • Zeolite Content

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