Neutron Diffraction from Clay-Water Systems

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Abstract: The use of neutron diffraction to determine some of the structural properties of montmorillonite-water systems at low water concentrations is described. The samples were prepared by compression or suction to give clay samples with between one and three molecular layers of water between the plates.

About 10% of the platelets in the clay are randomly oriented. The remainder are partially oriented in the plane of the sample, with an angular spread of 40 ° about the mean orientation. It is suggested that these oriented domains are formed from the larger platelets present in the system. The Bragg diffraction pattern is better explained by a disordered lattice model rather than by a mixture model with small particles having a well-defined lattice spacing. We have fitted both the intensities of (00*l*) reflections and the shape of the (001) reflection quantitatively to a model which allows for a Gaussian spread of platelet spacing about a mean value. The half width of the spread is about 10% of the lattice spacing.

No significant structural differences are found between Li, Na, K, and Cs montmorillonites. The method of preparation has no effect on the structural properties of the large platelet particles but does affect the randomly oriented fraction. The lattice spacing of the latter appears to be better defined for samples prepared by compression.

Experiments on the variation of lattice spacing with humidity indicate that the structural model we have used is adequate except at humidities where the system is changing over from one to two, or two to three water layers.

Key Words: Humidity • Montmorillonite • Neutron • Quasielastic

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