Electro-Optic Investigation of the Permanent and Induced Dipoles of Montmorillonite as Affected by Electrolyte Concentration

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Abstract: An electro-optic birefringence technique was employed to study the orientation mechanism of montmorillonite in an electric field. The instantaneous reversal of the field polarity produced evidence of a low voltage permanent dipole and a high voltage induced dipole. This technique was used to study the effect of electrolyte concentration on the rotational diffusion coefficient, a measure of the rate at which the particles rotate or relax, within the solution, from a preferred orientation. Thus, a measure of the immediate environment of the particles was obtained that is not an average effect for the whole system, yet allows for the full development of the clay-cation-water interactions under the experimental conditions. It was found that particle rotation could be accounted for using the measured particle size and normal water viscosity only when the double layer was fully developed, with no free ions or other perturbations. As soon as perturbations were applied, either by adding salts or applying an electric field, the measured particle size and normal viscosity would not account for the data. Either the rotating moiety has to be larger, that is, be a particle plus a water hull, or the viscosity greater, or in some cases both.

Clays and Clay Minerals; June 1974 v. 22; no. 3; p. 213-221; DOI: 10.1346/CCMN.1974.0220303

Clay Minerals Society (www.clays.org)