Influence of Pore Fluid Composition on Volume of Sediments in Kaolinite Suspensions

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Abstract: Reported in this paper is a study of the influence of pore fluid composition on sediment volume of kaolinite suspensions. Laboratory tests have been conducted with kaolinite in water with NaCl, $CaCl_2$ and $AlCl_3$ of different concentrations and in 10 types of organic liquids of varying values of static dielectric constant. The types of tests performed include regular suspension tests and leaching and cyclic leaching tests on kaolinite sediments. In the leaching tests, sediments formed during the regular suspension tests in water of low salt concentration were subsequently leached with water of high salt concentration. In the cyclic leaching tests, the salt concentration was increased and then decreased. The purpose of the leaching and cyclic leaching tests was to study the change in existing equilibrium fabric caused by subsequent changes in the concentration of salt in pore fluid. Results of the suspension tests indicate that sediment volume of a water suspension decreases with increase in ion concentration and increase in valence of cation. Leaching and cyclic leaching tests indicate that substantial change in salt concentration is required to change the existing fabric. The effect of dielectric constant of pore fluid on sediment volume is somewhat complex. As the dielectric constant increases from 1.9 for heptane to 110 for formamide, sediment volume first decreases, assuming a minimum at 24 for ethanol, increases with a maximum at 80 for water, and decreases again until 110 for formamide. An approximate physico-chemical analysis model is used to interpret some of the data in a quantitative manner. In the analysis model, recently developed theories of double-layer repulsive and van der Waals attractive forces are combined to simulate the behavior of suspensions.

Key Words: Dielectric Constant • Ion Concentration • Kaolinite • Leached • Mixed • Sediment • Suspension • Valence of Cation • Volume

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