Electrical Conductivity and the Surface Characteristics of Kaolinitic Clays and Clay-Humic Acid Complexes

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Abstract: The conductivites of the Na and H ion-exchanged forms of kaolinitic clay rejects from sand-washing operations, both purified and as found naturally as a complex with soil organic matter, were examined. The two Na-clays showed linear conductivity-concentration characteristics, each having two regions with different slopes intersecting at $\sim 3.3\%$ by weight of clay, which probably reflect a structural change from sol to gel. In the gel region, only the Na-counterions conducted, the reduction in conductivity with concentration being due to a smaller proportion of these ions in the Gouy layer and/or a decrease in their mobilities. In the sol, an additional, concentration-dependent conductivity arose from the electrophoretic motion of clusters of clay particles which gradually broke down on dilution. The two acid clays showed curved conductivity-concentration characteristics consistent with a weak acid dissociation equilibrium; the pK_a values of 6.37 to 6.56 are close to those determined independently from titration with alkali. A stronger acid species detected in the titrations was not seen in the conductivity. The MOH₂⁺/MOH/MO⁻ model of the clay-surface species and one set of the predicted concentrations of each species (see preceding paper) are consistent with the observed conductivities. The MOH₂⁺ species probably bridged the edges and faces of clay particles so that the H atoms were identical, but became different when alkali was added.

Key Words: Electrical conductivity • Electrophoresis • Humic acid • Kaolinite • Surface properties

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