
Effect of Saturating Cation, pH, and Aluminum and Iron Oxide on the Flocculation of Kaolinite and Montmorillonite

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Abstract: The effect of pH on the flocculation-dispersion behavior of noncrystalline aluminum and iron oxides, kaolinite, montmorillonite, and various mixtures of these materials was investigated. The clays were Na- or Ca-saturated and freeze-dried before use. Critical coagulation concentrations (CCC) of all materials and mixtures were found to be pH dependent. The Al oxide was flocculated at pH >9.5 and the iron oxide was flocculated between pH 6.0 and 8.2; i.e., flocculation occurred at pHs near the point of zero charge (PZC). The CCC of both the Na- and Ca-clay systems increased with increasing pH. The effect of pH was greater for the Na-kaolinite (flocculated at pH 5.8 and having a CCC of 55 meq/liter at pH 9.1) than the Na-montmorillonite system (having a CCC of 14 meq/liter at pH 6.4 and a CCC of 28 meq/liter at pH 9.4). A 50/50 mixture of Na-kaolinite and Na-montmorillonite behaved more like montmorillonite (having CCCs of 13 and 33 meq/liter at pH 6.2 and pH 9.0, respectively). The presence of either noncrystalline oxide decreased the CCC over that of the clay(s) alone; the decrease occurred at pHs >7 for Al oxide and at pHs >6.5 for Fe oxide. Aluminum oxide produced a greater decrease in CCC than Fe oxide, especially at pHs >8. The effect of each oxide on CCC was greatest near the PZC, 9.5 and 7.2 for Al and Fe oxide, respectively.

Key Words: Aggregation • Aluminum oxide • Critical coagulation concentration • Dispersion • Flocculation • Iron oxide • Kaolinite • Montmorillonite

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