

found that KCl and NaCl induced flocculation at lower ionic strength than CaCl₂, while AlCl₃ favored dispersion at all ionic strengths tested. The simple organic ligands promoted flocculation at low concentration, with citrate having a more pronounced effect than salicylate. At higher concentrations, these ligands reversed their effect, inducing a more dispersed state of the oxide. The organic ligand effect on dispersibility was modified by the particular metal cation present, with Ca²⁺ being more conducive to flocculation than K⁺. Soluble humic materials affected goethite flocculation in a qualitatively similar way to that of the simple organic ligands, that is low concentrations favored flocculation while high concentrations induced dispersion. This dispersing effect was partially suppressed by the presence of Ca²⁺, and completely suppressed by Al³⁺. Thus, soluble humic substances at relatively high concentrations appear to have a marked dispersing effect on goethite in the absence of polyvalent cations, and a strongly flocculating effect in their presence.

The results can be explained qualitatively by a simple oxide surface charge model, in which chemisorption of multivalent cations or organic ligands alters the surface charge. Reactions that increase the magnitude of positive or negative surface charge favor dispersion, while those that reduce the magnitude of charge favor flocculation.

Key Words: Citrate • Dispersion • Flocculation • Goethite • Humic Acid • Light Scattering • Salicylate • Soluble Organic Matter

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