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Interaction Forces between Goethite and Polymeric Flocculants and their Effect on the Flocculation of Fine Goethite Particles

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Abstract

Goethite is a major component in many mineral processing operations. Its presence can have adverse effects on solid/liquid separations. To understand the interactions between goethite surfaces and their influence on particle flocculation, the anionic polymer flocculants ammonium polyacrylate (NHPA), hydrolysed polyacrylamide (PHPA), and hydroxamic polyacrylamide (HXPA) were studied using a combination of atomic force microscopy (AFM), floc structure analyses, and settling tests. The floc settling velocity related to the different flocculants had the following order: NHPA > HXPA > PHPA. The different floc sizes indicated many small and large sized flocs formed with NHPA and PHPA, while monomodal medium sized flocs formed with HXPA. The mass fractal dimension values showed that more compact flocs were formed with HXPA than the other flocculants. The direct force measurements without flocculants confirmed that the goethite surfaces strongly repel each other in alkaline solutions, which agrees with DLVO theory for similarly charged surfaces. The various interactions measured with different flocculants can be related to their molecular structures and molecular weights. The incubation of NHPA at various pH values resulted in long-range adhesion after surface contact with multiple elastic minima, indicating strong adsorption and an expanded molecular conformation for the adsorbed flocculant. The strong elastic minima and long-range adhesion for HXPA indicated a strong adsorption of

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