Effect of Salt on the Flocculation Behavior of Nano Particles in Oil Sands Fine Tailings

L. S. Kotylar[1], B. D. Sparks[1] and R. Schutte[2]

[1] Institute for Environmental Research and Technology, National Research Council of Canada, Ottawa, Ontario, Canada, K1A 0R6
[2] Syncrude Canada Limited, Edmonton, Alberta, Canada, T6P 1V8

Abstract: Currently, two commercial plants, operating in the Athabasca region of Alberta, produce approximately 20 percent of Canada's petroleum requirements from oil sands. Surface mined oil sand is treated in a water based separation process that yields large volumes of clay tailings with poor settling and compaction characteristics. Clay particles, suspended in the pond water, interact with salts, dissolved from the oil sands ore, to produce mature fine tailings (MFT) containing only 20 to 50 w/w% solids. As a result, large sedimentation ponds are required to produce enough process water to recycle for the plant. Tailings pond dykes can only be constructed during a short summer season. Consequently, the capability to predict production rate and final volume of MFT is essential for mine planning and tailings disposal operations.

Previous research has demonstrated that a small fraction of nano sized clay particles (20 to 300 nm) effectively controls the bulk properties of MFT. These particles are present in the original ore and become mobilized into the water phase during the oil separation process. In this work, the nano sized particles have been separated from the bulk tailings and subjected to a fundamental study of their flocculation behavior in model tailings water.

Photon correlation spectroscopy and a deuterium NMR method were used to follow particle flocculation and gelation processes. These results were correlated with particle settling data measured under the same conditions. It was determined that the nano particles form fractal flocs that eventually interact to give a thixotropic gel. The ultimate sediment volume produced is almost entirely dependent on the original concentration of nano particles while the rate of water release is governed primarily by electrolyte concentration.

Key Words: Fine Tailings • Flocculation • Gelation • ^{2}H NMR • Nano Particles • Oil Sands

Clays and Clay Minerals; February 1996 v. 44; no. 1; p. 121-131; DOI: 10.1346/CCMN.1996.0440111

Clay Minerals Society (www.clays.org)