

Effects of clay wettability and process variables on separation of diluted bitumen emulsion

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Stable water-in-oil emulsions persist in diluted bitumen from the surface mining process of Athabasca oil sands because of asphaltenes and clay solids. When the bitumen is diluted with naphtha to reduce its viscosity and density, almost complete separation can be obtained with demulsifier PR₅ in the absence of clay solids. However, a “rag layer” persists between the oil and free water layers when clay solids are present.

Effects of naphtha/bitumen (N/B) ratio, demulsifier selection, and silicate dosage on rag layer formation and product quality have been studied. Emulsion with N/B ratio 0.7 is more stable than that with naphtha/bitumen ratio 4.0. This can be partially attributed to the difference in viscosity and density affecting the sedimentation velocity.

The residual water and solid contents in the oil layer decreases with addition of silicate. This is attributed to the effect of silicate on clay wettability. Clay solid has toluene-soluble organic content: in oil layer > in rag layer > at bottom layer. This could be used to interpret the wettability difference of solids in different layers. In the same layer, sample with N/B ratio 0.7 has higher toluene-soluble organic content in solids than that with N/B ratio 4.0. This is in contrast to expectation of more asphaltene precipitation with addition of naphtha.

Emulsions at 80° C with N/B ratio 4.0, adding 200 ppm PR₆ and 4×10⁻⁴ M sodium meta-silicate had 0.3%-1.5% water and 0.9% solids in the oil layer.