ASPHALT RIDGE TAR SANDS - FLOTATION BEHAVIOR AND PROCESS DESIGN

by

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ABSTRACT

Tar sand deposits in Utah represent more than 25 billion barrels of in-place bitumen, 96% of the known U.S. reserves. Although dwarfed by the size of the well known Canadian tar sand deposits, the Utah tar sands may provide a new domestic source of synthetic crude oil.

The hot water process for Utah tar sands differs significantly from the commercially practiced hot water process for Athabasca (Canadian) tar sands. The process strategy differences reflect the inherent differences in the respective bitumen physical and chemical characteristics and the nature of the bitumen-sand association. In a six year research program the criteria have been identified that are necessary to achieve satisfactory phase disengagement in digestion. The focus of this report is to present findings on the conditions which achieve the best phase separation of bitumen from sand in the flotation of Asphalt Ridge tar sand following digestion.

Although contact angle measurements of feed material and pure bitumen indicated slight and moderate hydrophobicity respectively, air bubble attachment to a bitumen concentrate was not possible. This surprising result suggests that the flotation separation is dependent on air bubble entrapment rather than on attachment due to surface hydrophobicity. The occlusion of air bubbles in the bitumen was apparent from the visual examination of the nature and behavior of the concentrate.

A factorial design of the major operating variables in the flotation separation indicates that the quality of phase separation is significantly dependent on flotation temperature and to a lesser extent on the degree of agitation. Under the best flotation condition recoveries of 96% and concentrate grades of 60% bitumen were realized. The improved separation at higher flotation temperatures is due to the decreased bitumen viscosity resulting in more effective rejection of coarse sand from the bitumen.

The addition of a small amount of sodium carbonate in flotation is needed to prevent the concentrate from being excessively sticky. The small addition also slightly improves the quality of separation. At sodium carbonate additions greater than 0.075M the system develops a voluminous unmanageable froth.

Diluent additions to flotation did not increase the quality of separation or appear to alter the hydrophobicity of the bitumen surface.

Study of the percent solids in flotation was not conclusive but indicated that reasonable separations can be obtained at up to 40 percent solids.

Preliminary settling tests resulted in the development of a flocculant addition schedule which gives rapid settling and a clear supernatant. Water recycling tests using water from which the suspended solids were removed by polymeric flocculants did not show any detrimental effects due to residual polymers and/or soluble organics. Results from liquid-solid separation tests and water recycling are preliminary in nature.

Finally, based on the experience and results compiled over the life of this research program a flowsheet is proposed for the pilot plant production of 2,000 barrels per day of synthetic crude oil. The preliminary costs estimate indicates a total capital expenditure of $5,228,500 $\pm$ 30 percent would be required for the hot water processing portion of such a plant.

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