Aggregation of Silica Particles in Non-Aqueous Media

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A major challenge to any “solvent-based” oil sands extraction method is the removal of suspended fine solids from the hydrocarbon media (i.e. diluted bitumen). In this study, we examined how colloidal solids could be made to aggregate in a hydrocarbon medium and thus be removed by gravity settling. The model solids employed in this study were micron-sized “bitumen-treated” silica particles; the oil phase was comprised of bitumen diluted in an organic solvent of variable aromaticity. On the macroscopic scale, the experiments involved quantifying the settling rates of the silica solids as the aromaticity of the solvent was varied (by applying different volume ratios of toluene and heptane). Our results indicated that there was an optimal (non-zero) aromaticity at which the solids settling rate was the highest. On the microscopic scale, adhesive forces between individual glass spheres, which are playing the same role as silica particles in settling tests, were directly measured using the microcantilever technique (again in non-aqueous medium). It was found that, for treated silica spheres, there was a correlation between the settling rate and particle-particle adhesion. This finding shows that, besides asphaltene precipitation, the inter-particle force is partly responsible for particles aggregation in non-aqueous media.