Mechanical & Industrial Engineering
UNIVERSITY OF TORONTO

FACULTY OF APPLIED SCIENCE & ENGINEERING

Seminars in Mechanical & Industrial Engineering

Invited Lecture

Friday, November 27 · 2:10PM · Room MC102
5 King's College Road

Sedimentation Equilibrium of Suspensions in Centrifugal Field: The Colloidal State Equation

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Abstract. The impact of molecular interactions on phase behavior can be experimentally studied by using colloidal suspensions as models. In these models the particle-particle interactions mimic the molecular interactions. These interactions can be tuned by altering the properties of the medium in which the particles are suspended. This can lead to colloidal phase transitions. Although, these transitions mimic the PVT phase transitions, we should describe them in the $\pi\varphi aT$ phase space where π is osmotic pressure, φ volume fraction, a activity of the additive in the medium, and T temperature. Considering the constancy of the total potential (i.e. external field and chemical potential) in thermodynamic equilibrium, we established a theoretical relationship between the osmotic pressure of a colloidal dispersion and its concentration distribution in a gravitational or centrifugal force field. A thin-layer analytical ultracentrifugation technique was developed to measure the concentration distribution of colloids during rotation. Colloidal phase transitions were also observed in polystyrene suspensions for which the phase diagram was established.

The phase behavior of reservoir fluids is the single most important property for reservoir management. Based on PVT studies, we gained much understanding of the gas/ liquid, liquid/ liquid, and liquid/ solid phase transitions in reservoir fluids. However, the colloidal phase transitions have been completely left out of the scope of the oil industry. The colloidal properties of asphaltenes has been a focus of interest since O. C. Mullins and co-workers showed that the self-association of low molecular mass building blocks could lead to high molar mass aggregates. These associated species form colloidal suspensions in reservoir fluids. The sedimentation of these colloids results in a concentration gradient in reservoirs, which has recently been considered in reservoir descriptions. According to colloidal theory a concentration threshold could be reached, where a phase separation occurs. In the light of our findings we discuss implications on reservoir compartmentalization studies.

All visitors are welcome!

To receive seminar invitations please send an email to seminars@mie.utoronto.ca The next seminar will take place on Dec 4 at 2:10pm in MC102. Professor Andrew K.S. Jardine from the University of Toronto will give a presentation with the title "On the Optimization of Condition – Based Maintenance (CBM) Decisions".