The Australian Society Of Rheology, Inc.

2018 Rheology Lecture Series

CAV Reg. No. A0055806E

In 2018 the Australian Society of Rheology is presenting a national series of lectures, which is open to anyone interested in the flow and deformation of matter. The next event in the series will be held in **Melbourne**.

Calendar details

Date:	**Thursday, 25th October 2018**
Time:	6:30 PM to 08:30 PM
Venue:	**RMIT University, Melbourne** *Room details to be announced*

Invited lectures

Professor Ian Frigaard (Departments of Mechanical Engineering and Mathematics, University of British Columbia)

"Stuck in the mud: particles in yield stress fluids, theory and applications"

Mr Sam Skinner (Consultant, Environment and Planning, Aurecon)

"Compressive Rheology of Biofouling: Application to Membrane Bioreactors"

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Lecture 1:

Professor Ian Frigaard (Departments of Mechanical Engineering and Mathematics, University of British Columbia)

"Stuck in the mud: particles in yield stress fluids, theory and applications"

Studying the motion or particles in yield stress fluids has a history dating back to the 1960s, both as a theoretical challenge and due to practical application, stemming initially from the removal of cuttings from a newly drilled oil well using a drilling mud. For a particle of density different to that of the carrier fluid, there is critical ratio of yield stress to buoyancy stress above which the particle will be held static in the fluid. Critical values are known for various particle shapes. We review recent results, the state of knowledge and also explain how the static state is in fact dynamically stable. We move then to yield stress suspensions, where the past decade has seen many advances in pragmatic constitutive modelling. We explore the interesting question of whether multi-particle systems and yield stress suspensions are also dynamically stable for sufficiently large yield stress, reviewing recent results for simplified flow configurations. We close on a pessimistic note. Despite recent advances we remain stuck in the mud: depressingly distant in computational and theoretical terms from solving practical problems in detail with real yield stress suspensions, such those stemming stem from the mining or petroleum industries.

Speaker's biography:

Ian Frigaard is Professor of Mechanical Engineering and Applied Mathematics at the University of British Columbia, where he has been since 2000, having previously enjoyed an industrial career with Schlumberger. His main field of expertise is the flow of viscoplastic fluids, both in terms of rheological and fluid mechanics fundamentals. He leads a group of 10-12 researchers, largely targeting flows that arise on the petroleum industry, using computation, lab-scale experiments and analysis. He has published »180 peer reviewed journal and conference papers. He serves on the editorial boards of Rheological Acta, Journal of Engineering Mathematics, Meccanica and Journal of Non-Newtonian Fluid Mechanics, the latter of which he is currently Editor in Chief.

Lecture 2:

Mr Sam Skinner (Consultant, Environment and Planning, Aurecon)

"Compressive Rheology of Biofouling: Application to Membrane Bioreactors"

The operation of filtration membranes in membrane bioreactors (MBR) is severely affected by the formation of a bio-fouling layer that causes a rapid increase in transmembrane pressure and results in frequent cleaning cycles. The increase in transmembrane pressure is often attributed to particulate fouling within the membrane. However, the fouling layer or filter cake that builds up from wastewater treatment sludge is highly compressible, thus any model of filtration in a MBR must properly account for compression of the suspension network structure within the filter cake. The compressive rheology approach based on the theoretical framework developed by Buscall and White (1987) implicitly accounts for this compression by considering only the local material properties; permeability and compressibility. We examine the compressive rheology of the fouling layer that is external to the filter membrane. A one-dimensional model based on the piston-driven filtration model of Landman et al. (1991) is proposed. The model can be used to predict the rise in transmembrane pressure necessary to maintain constant flux. The fouling layer dewatering properties required for the model were obtained using simple laboratory-based centrifuge and constant pressure filtration tests. The model was compared to data from a pilot-plant developed to treat effluent from a MBR and showed good correlation, without the need to assume fouling within the membrane. Optimisation of cycle times, flux rates, maximum pressures and other operating parameters can be performed using this model.