Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

The Effect Liquid Loading on the Rheology of Granular Flows
SANKARAN SUNDARESAN, ALI OZEL, YILE GU, Department of Chemical and Biological Engineering, Princeton University, Princeton, New Jersey 08540, USA, STEFAN RADL, Institute for Process and Particle Engineering, Graz University of Technology, Inffeldgasse 13/III, 8010 Graz, Austria, SUNDAR'S GROUP TEAM, CFDEM COLLABORATION — Discrete element simulations of simple shear flows of dense and homogeneous assemblies of uniform, spherical, soft and dry particles reveal three regimes: (i) a quasi-static regime, where the stress is independent of shear rate, (ii) an inertial regime where the stress varies quadratically with shear rate and (iii) an intermediate regime where the stress manifests power-law dependence with n 1/2. Inclusion of inter-particle cohesion due to van der Waals force has been shown to lead to bifurcation of the inertial regime into two regimes: (a) a cohesive rate-independent regime and (b) an inertial regime. In the present study, we perform analogous simulations for wet particles. We account for capillary and viscous interaction forces between particles, which result from the liquid bridges, and allow for liquid transfer between the particles and the liquid bridge. It is found that the bifurcation of the inertial regime observed with van der Waals interaction persists for capillary cohesion and that the span of the cohesive rate-independent regime increases with liquid loading in the pendular regime. A simple model for steady shear rheology is obtained by blending the results in various regimes. The presentation will also discuss the effect liquid viscosity on the flow behavior.

Sankaran Sundaresan
Department of Chemical and Biological Engineering,
Princeton University, Princeton, New Jersey 08540, USA

Date submitted: 14 Nov 2014 Electronic form version 1.4