Seminar über Fragen der Mechanik

zu folgendem Vortrag wird herzlich eingeladen

Mittwoch, 05.10.2011, 13:30 Uhr, Egerlandstr. 5, Raum 0.044

Flow modeling in tumbling mills

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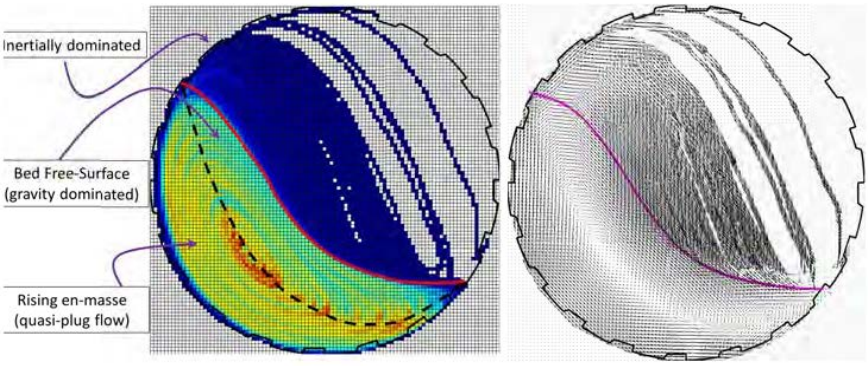
Analogous to potential difference in Ohm's law, the fundamental driver of flow through dynamic, unconsolidated granular systems is pressure gradients. However, just as a current is a more useful quantity to monitor in practical implementations of Ohm's law, so to, the velocity in engineering flow systems becomes the important physical driver.

Regarding the pressure gradient, a new modeling approach to slurry transport in dynamic beds based upon combining space and time-averaged Navier-Stokes equations with a new type of cell model is described. The resulting Ergun-like equation is used to correlate pressure drop with time-averaged distributions of the porosity, superficial fluid velocity and solids velocity for data derived from positron emission particle tracking (PEPT) experiments in a scaled industrial tumbling mill fitted with lifter bars, pulp lifters and a discharge grate and run with particles and re-circulating slurry.

Regarding the velocity field, a continuum based granular flow model of charge motion that combines the inherent frictional nature of particles with its distinct fluid-like structure is presented. Starting with Newton's 2^{nd} Law on a volume element of charge, we derive the velocity field in the bed free-surface and the rising *en-masse* region as illustrated below. Invoking flux conservation within the two regimes of interest then yields a (simple) differential equation for the free-surface of the charge body. Combining the velocity field equations with a suitable (empirical) choice for the shear stress completes the picture with a description of the in-situ rate of shear energy dissipation in tumbling mill – a key ingredient driving the production of fines in a tumbling mill. Again, direct comparisons with PEPT measurements are made for validation purposes.



Measured (via PEPT) time-averaged velocity field, probability distribution, and delineation of flow field into (dominant) distinct zones

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