IFPRI Project Abstract

Modeling of screw feeder performance

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Project Objective:

The main objective of the project is to develop a theoretical understanding and predictive model for screw feeder performance. The model should predict the dependence of feeder performance on powder properties and feeder geometry, and consider complicating factors such as feed rate variations. The model predictions should be tested against experiments on diverse powders.

Approach:

A continuum model for slow granular flow will be applied to screw feeders. An experimental setup will be constructed to measure the mean flow rate, the detailed velocity field and the stress field to test the predictions of the model. DEM simulations will be used to validate and refine the theoretical studies and guide experimental measurements.

Recent Results:

- The non-local rheological model developed by us was applied to the problem of shear in a cylindrical Couette device. The model predicts accurately the secondary vortex flow that was reported in our earlier study. The prediction of this complex dilatancy-driven flow establishes the model's capability of capturing the coupling between the density and velocity fields.
- We had earlier studied the feeding of some cohesive powders used in the pharmaceutical industry, but their cohesion was uncontrolled. Over the last year, we have synthesized powders of controlled cohesion by mixing dry glass beads with small amount of glycerol.
- Our experiments using the above-mentioned powders of controlled cohesion have yielded useful information on flow fluctuations and their temporal and spatial correlations. These statistical features will be used to build a rheological model for cohesive powders.

Next Steps:

We propose to extend the non-local model to cohesive powders by establishing the dependence of the fluidity on cohesion and agglomeration using DEM simulations and experiments on simple flows. We will then apply the model to flow in a horizontal rotating drum and in a screw feeder.