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:

Over the last year, we have focused on understanding the flow of cohesive powders, as their transport in feeders was felt to be of greater importance than of free-flowing powders by IFPRI members. Moreover, constitutive models for cohesive powders are poorly developed.

- Based on earlier observations, we hypothesized that cohesive powders form flow as clusters. We conducted experiments of shear between coaxial cylinders to study clusters statistics. However, imaging limitations prevented us from identification of clusters.
- We conducted DEM simulations of shear between plane parallel plates and coaxial cylinders to study the rheology and kinematics of cohesive powders as a function of the Bond number.
- We have obtained useful statistical information, such as probability distributions of compressive and tensile contact forces and contact time. These statistical features of the micromechanics 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 and other model parameters on cohesion using data from DEM simulations and experiments on simple flows. We will then apply the model to flow in a screw feeder.