IFPRI Project Abstract

Selection of Flow Aids: Model-based Prediction of Flow Properties Enhancements

Principle Investigator: Dr. Rajesh Dave
Affiliation(s): New Jersey Institute of Technology, Newark, USA
Project Start Date: [01 September 2021]
Abstract Date: [15 May 2022]

Project Objective:

Mechanistic prediction of flow properties and its enhancements from particle scale measures, developing a collection of models and decision tools that can be used for flow aid selection while minimizing the extent of experiments needed.

Approach:

Develop particle contact models based on van der Waals (vdW) force approximations and tailor cohesion between micro-sized fine powders by coating them with nano additives. The emphasis is on predicting cohesion reduction through dry coating on reducing the most dominant cohesion forces. Towards that objective, several models are being developed in conjunction with the necessary characterization and test materials.

Recent Results:

Review of existing particle adhesion models was carried out and the deficiencies of those models were outlined. Several of those shortcomings were addressed, such as the particle shape, the assessment of the particle surface roughness and models to account for their effect, the influence of nano-silica agglomeration, etc. Dozens of industry relevant fine powders were considered and tested for key bulk properties before and after dry coating with hydrophobic and hydrophilic silica at various amounts, leading to different levels of theoretical surface area coverage (SAC). Flowability, packing and powder agglomeration were measured before and after dry coating. Applicability of multi-asperity contact model was tested, specific cases where the model need to be advanced were identified. Powder agglomeration effect on drug particles dissolution was assessed. It was found that dry coating significantly reduced powder agglomeration which led to enhanced dissolution even when hydrophobic silica was used. Powder agglomeration was identified as a material sparing screening indicator of powder flowability and processability.

Next Steps:

Work will continue in expending the models for guest-host compatibility, selection of guest amount, accounting for surface roughness and particle shape, and linking particle scale to bulk scale properties. Experimental investigation will include assessment of surface roughness, surface area and powder agglomeration, and building of bulk property database. Enhanced interactions with the IFPRI members and submission of manuscripts covering project advances are planned.