



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

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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 and validate particle contact models based on van der Waals (vdW) force approximations and explain the role of nano-sized flow aids. Experimentally assess cohesion reduction due to the imparted nano-scale surface roughness, followed by developing predictive models, validated through data from a wide range of test materials.

Recent Results:

Detailed testing of dozens of industry relevant fine powders included systematic variation of silica amounts targeting theoretical surface area coverage (SAC) values of 25 %, 50 %, and 100 % and flow testing before and after dry coating. Silica amount model based on normalization through SAC was found to be valid and indicated that amounts higher than 50 % theoretical SAC were not necessary. Cases involving macro-rough surfaces were investigated for improving the multi-asperity contact model. As a major finding, it was found that the flowability of powders dry coated with nano-sized flow aid materials was governed by the imparted nanoscale surface roughness. In contrast, flowability of uncoated powders was governed by their natural surface asperity sizes, which also follows the multi-asperity contact model. Experiments and analysis indicated that nano-sized flow aid tends to aggregate of the cohesive powder surface and the model to account for aggregation effect on cohesion reduction is ongoing. Investigation of the dry coating of one constituent, at low to medium loading, indicated positive synergistic effect on blend flowability and content uniformity, which could be predicted through measuring the extent of powder agglomeration of both the dry coated constituent and its blend.

Next Steps:

Work is ongoing to test and refine the contact models for accounting for surface roughness, particle shape, aggregation of flow aid, and linking particle scale to bulk scale properties. We will continue building of bulk property database and seek enhanced interactions with the IFPRI members.
