IFPRI Research Project Brief

Precision powder feeding: Theoretical understanding and predictive model to link material properties to
performance of twin screw feeders

The International Fine Particle Research Institute (IFPRI) wishes to fund a project to develop a theoretical
understanding and predictive model for twin screw feeder performance. The project should encompass
both theoretical and/or computational model development and validation. The model should predict
feeder performance – mean mass flow rate and variability – and consider:

- The dependence of feeder performance on measurable powder properties and feeder geometry
  and configuration
- Powder density and other variations at the feeder inlet, e.g. due to hopper refill events
- Normal and shear stresses and powder densification in the screws (i.e. evolution of material
  state in the feeder),
- Predict cleaving/tensile breakage of consolidated powder at feeder outlet.

The model should identify and include critical material properties that impact feeder performance and
identify any relevant scaling of the controlling physics across feeders of varying sizes (i.e. screw auger
diameter) operating near the lower mass flow rate limit (i.e. slow screw auger rotation speeds), thus
forming the basis for scaling to larger feeders. Ideally, the model will be amenable to use in a real-time
feeder control scheme in the future.

Finally, the model should be tested/broken/validated with experiments with diverse powders. Of
particular interest are "difficult" powders, i.e. fine, cohesive, and aeratable. Diverse mechanical
properties should be examined, for example brittle, ductile, and elastoplastic materials. IFPRI members
may be able to provide materials on interest and access to feeders of different scales and design.

Exclusive use of multi-variate approaches (e.g. PLS) is out of scope, as are multi-component systems,
systems with significant particle damage during feeding, liquid pastes, and extrusion.