

IFPRI Research Project Brief

A Systems Engineering Approach to Dry-Milling with Grinding Aid Additives

The International Fine Particle Research Institute (IFPRI) wishes to fund a project in a systems approach to particle size reduction via dry-milling with grinding aids. Typical IFPRI projects run for 3 years, with an opportunity to renew for an additional three years, totaling 6 years.

The systems approach should consider scale-up and productivity of dry-milling processes where product flow and process energy are critical to the product quality and process efficiency. Please address differences between small batch testing versus continuous processing circuits, the latter with systems integration of unit operations (e.g., mill, classifier, recycle, conveying and handling). The approach should be supported using functional breakage models (i.e., in high-stress zone), unit operation models including flow into breakage zones and residence time distributions for process optimization and scale-up, and systems-level modelling (e.g., flow sheets) for process integration.

The industrial process objective is throughput rate and energy efficiency; and the product objective is to achieve target size and sharpness (i.e., narrow distribution) of the product. The research objective is to develop a fundamental understanding of various process and material parameters using a combination of modeling and lab-scale testing, toward the systematic manipulation of same to meet process objectives in an integrated system.

The use of grinding aids should be considered toward the productive manipulation of material and process parameters. The preferred scope, at least during the first three-year grant, may be selected from:

- Dry milled materials such as inorganic minerals, cements, ceramics, pigments, etc.
- Dry milling processes, including media mills, jet mills, hammer mills, high-speed pin mills, etc.
- Grinding aids, preferably in class of liquid additives that may affect surface energy and flowability relative to other particles, milling media or other in-process surfaces, e.g., glycols, organic acids, alcohol amines, surfactants...

As an extension of this scope, please consider how to re-apply the above systematic approach using grinding aids to other classes of materials, e.g., dried organic materials, that are commonly processed in dry-milling. This extended scope may be addressed in parallel or sequentially (e.g., years 4-6) to the main proposal.