



Research Project Brief

Drying Wet Powders With Shear to Prevent Agglomerate Formation

The International Fine Particle Research Institute (IFPRI) wishes to fund a research project on elucidating how the method of drying, and more specifically the intensity of shear in a dryer, affects the state of agglomeration of the dried product and its redispersibility.

IFPRI has supported strong work on spray drying in recent years which has provided insight into the mechanisms of atomisation (affects granule PSD) as well as the dewatering modes of the droplets (drying outside-in vs inside out) and how they affect the granule strength and porosity. However, industrially, drying is diverse, with tray and belt dryers at low/no shear, fluid bed and rotary dryers at medium shear, and flash and agitated dryers at high shear - with diverse mechanisms of heat exchange. The choice of the right dryer for a given situation is multifactorial - it can be driven by cost (capex/energy efficiency), by the delicacy of the material, or by the resulting bulk density, flowability or dustiness of the product.

The state of agglomeration of the dried powder, and the ability to redisperse the powder later is also very important. For many fine materials, drying results in unavoidable agglomeration, sometimes this is beneficial, sometimes it presents problems. The degree and nature of this agglomeration is influenced by the particle's surface chemistry and morphology (size and shape) but is also strongly influenced by the type of dryer used, as well as the presence or absence of solutes in the water. The intensity of shear in the dryer clearly is a key variable that influences both agglomeration and granule attrition in conjunction with the time-temperature history of the powder and understanding interplay between these variables in controlling the ultimate particle structure of the *dried* powder is the general objective of this project.

While we expect this project to be largely experimental, we place no restriction on the approach. For example, development of a regime map in terms of fundamental variables (e.g., time, temperature, moisture content, shear stress) would be acceptable, as would be a focused study on drying of particle clusters under appropriate mechanical stresses. IFPRI is interested in drying of both organic and inorganic powders, so the primary restriction of material system is that the powders be fine (volume mean particle size smaller than 100 microns) and hydrophilic. Drying in the presence of soluble species is in-scope as well.