IFPRI

International Fine Particle Research Institute

Research Project Brief

Modeling Porosity Development During Drying of Liquids and Slurries

The International Fine Particle Research Institute (IFPRI) wishes to fund a research project on modeling the drying of gas-saturated liquids or slurries, including foams, with focus on the development and evolution of pore structure (porosity and pore size). Pre-saturation or foaming of the feed to a dryer is used by several industries to create porosity in the dried particulate product, in order to tune density (important for subsequent package filling operations), achieve product functionality, or improve drying efficiency.

The development of pore structure is determined by the kinetics of a variety of physical processes: bubble nucleation, growth, and coalescence; water transport in the solid, developing pores, and external to the particle; and phase changes and concomitant changes in physical properties such as viscosity and diffusivity. This implies that the ultimate porosity of the dried particle will be sensitive to the time-temperature-humidity profile of the drying process, i.e., it will be sensitive to the mode of drying.

To create such internal porous structure, gas dissolution in concentrated solutions or slurries is generally applied prior drying to achieve saturated state. Then, during the drying process, because of supersaturation state, gas nucleation and growth is happening, leading to porous particles. However, both processes of drying (inducing viscosity build-up gradient) and formation of bubble (nucleation, growth, coalescence) occurs at the same time with different kinetics which could lead to very different internal pore structure (size and distribution). The objective of this project is to develop a validated drying model that captures these processes and can be used to describe a variety of formulations and dryers, relating the final pore structure to feed properties, effervescent (or foaming) gas properties, and process variables.

There are no restrictions on the materials or drying process, other than a requirement that long and short drying times be investigated (e.g., representing tray drying to spray drying). IFPRI members will be happy to consult on materials selection.

High temperature drying during which the liquid boils and creates vacuoles is out of scope.