

IFPRI Project Brief
Model-Based Control of Granule Porosity

Binder granulation is widely used size enlargement process in powder processing. The primary objective of the process is to produce a powder with improved performance and handling properties, primarily through reducing fines and increasing the mean particle size of a feed powder through agglomeration of primary particles into granules. The literature is replete with empirical and physical models of granule growth, and process monitoring and control of granule size is widely practiced. However, granule porosity and pore size (distribution) are often equally or more important than granule size, and these granule properties are less frequently included explicitly in kinetic models and is typically absent in process control applications.

The objective of this project is to develop a process control system for control of pore structure: total porosity and (as a stretch goal) pore size distribution. The focus is on *process control*, not process or physical modeling. The successful project will include all elements of a model-based control system and its demonstration. These elements include a control model, sensing method(s), tuning methodology, and validation. The scalability of the system should be demonstrated. (It's not necessary to demonstrate the control system at manufacturing scale, only that it is possible to do so.)

Either high-shear (mixer) or fluid bed granulation may be considered, although we suggest that one or the other be selected to maintain project focus. Batch or continuous operation are in scope. In batch operation, it would be interesting to consider trajectory control in addition to end-point control. In continuous granulation, start-up strategies and process dynamics should be investigated.

Measurement of granule porosity and pore structure are critical to this project. We do not place restrictions on the analytical method(s), including whether the measurements are in-line, at-line, or off-line. Soft sensor methods are in scope.

Finally, there is no restriction on the materials that are processed. To demonstrate the generality of the control system, we suggest that at least two formulations with significantly different granulation behavior be included in the project.