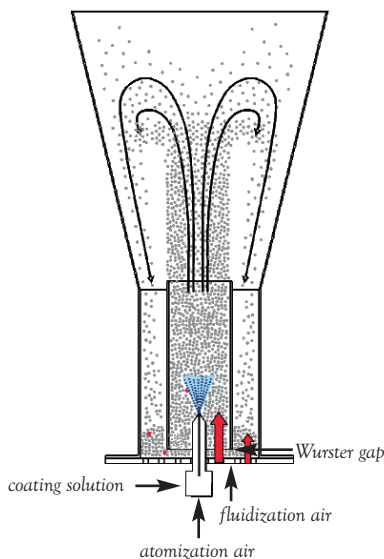
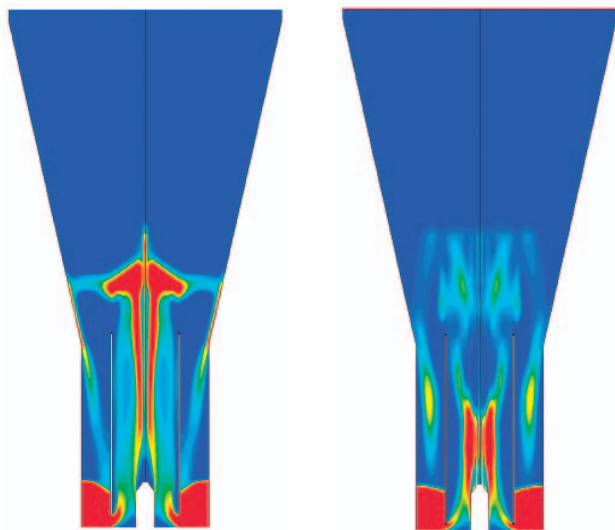


Understanding Fluid-Bed Coating

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Schematic illustration of a process stream in a bottom-spray Wurster fluidized bed coater



Contours of particle volume fraction for two different Wurster gap designs: wide (left) and narrow (right), for a similar air flow rate

DURING THE PAST DECADE, the use of fluidized bed systems for coating has developed to a point where this equipment is now used for applications in industries ranging from chemical to pharmaceutical to agriculture. The appeal of fluidized beds for coating is due to the high energy and mass transfer rates that are available in such a system. There are three types of fluidized beds that are typically used for this purpose: top-spray, tangential-spray, and bottom-spray. In a recent joint project involving engineers at Bend Research and Fluent, a fluidized bed with a bottom-spray of the Wurster type was studied.

Fluid bed coaters are used to obtain controlled release or delayed release particles in pharmaceutical and agricultural applications. For these types of coatings, it is important to have control of both coating quality and coating uniformity. Typically, this process is run in batch mode with particles circulating through the coating zone multiple times in order to achieve the desired coating level. In this process, the particles are entrained in a high velocity gas, they pass through the Wurster column where coating is applied via a two-fluid atomizer, they then dry in the expansion chamber and fall back down to the bed to repeat the process. FLUENT has been used to help understand the process, design process conditions that yield products within an acceptable variation, and understand the effect of various parameters on product variability and quality.

Accounting for the presence of a secondary phase within CFD software is well established. Some of the more recent advances enable simulations of flows with very high solid loading, such as hoppers and chutes; flows with large particles, such as particle milling machines; gas-solid flows with particle size variation, such as polymerization reactors; and flows where the effects of particle shapes and particle mechanics are important. For the Wurster bed simulation, the Eulerian granular model in FLUENT was used. The results have led to a better understanding of the uniformity of coating, spray patterns, and fluidization behavior. Parameters that control the process efficiency and coating uniformity were studied. These included the equipment geometry, air flow rate, and other spray-related characteristics.

Of particular importance for the equipment geometry is the Wurster gap, a small passage at the base of the unit between the inner and outer (annular) columns. During operation, the particles in the bed are fluidized and coated primarily in the inner column, where the fluidization velocity is highest. As a result, a steady fountain of solid particles is produced, and after reaching the upper region of the device, these particles stream down the walls of the outer section prior to being entrained through the gap and re-entering the primary fluidization region.

The results indicated that there is a steady solids flux through the larger gap, but in the case of the smaller gap, the flow of solids through the gap is choked periodically and the bed does not maintain a steady fountain. This creates a non-uniform solids flux in the spray region, which could lead to problems with coating uniformity. ■