

252g Understand Fluid-Bed Coating through Detailed Modeling

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The process analytical technology (PAT) initiative of the FDA emphasizes enhanced understanding of the various unit operations in the pharmaceutical industry. Computational fluid dynamics (CFD) modeling can help engineers make informed choices about the various parameters that affect product variability and quality.

In this work, we illustrate how CFD modeling can be used to understand the flow in a Wurster fluid-bed column. A multi-fluid Eulerian model, used with the kinetic theory for granular solids, can be used with confidence to predict the qualitative and quantitative flow behavior in fluidized beds. We will illustrate the capability of the model to predict the observed flow features using examples.

The model described in this work addresses one of the drawbacks of traditional Eulerian models: they subsume all information at the particle level, providing information at a more-general level. This obliterates particle history. The individual particle paths can be tracked using a Lagrangian framework, but the Lagrangian models are computationally expensive. In this work, we integrate the advantageous features of the Eulerian and Lagrangian frameworks—namely the excellent predictive capabilities of the Eulerian models along with the particle-specific information that can be obtained by the Lagrangian framework. In our approach, massless marker particles are introduced that will move with the particle phase in a time-dependent manner. These particles carry with them information about several useful variables such as particle history. At the end of the process, the variability introduced due to the different histories of the particles can be analyzed.

The approach is useful in understanding the uniformity of coating, spray patterns and fluidization behavior in a Wurster fluid-bed coater.