

Predicting Powder Flow Rate Limitations in Pharmaceutical Applications

In the pharmaceutical industry, production rate limitations can develop when tableting/encapsulating *fine powders* (i.e., below 100 micron in average particle size) at high speeds. These feed rate issues are due to the interaction of the material with entrained air.

This interaction can result in adverse *two-phase* (powder: interstitial air) flow effects, such as feed rate limitations, erratic feed, or flooding from a feed hopper into an encapsulator bowl or a press feed frame. These feed rate problems can result in out-of-specification results for tablet/capsule weight, content uniformity, hardness and dissolution.

We can measure the flow properties of a powder and numerically model its behavior in the feed system to assess if feed rate stability is a concern and, if so, provide corrective actions to provide reliable feed. The corrective actions may include recommended changes to the powder properties and/or feed system equipment.

We commonly measure the following flow properties to assess two-phase flow behavior:

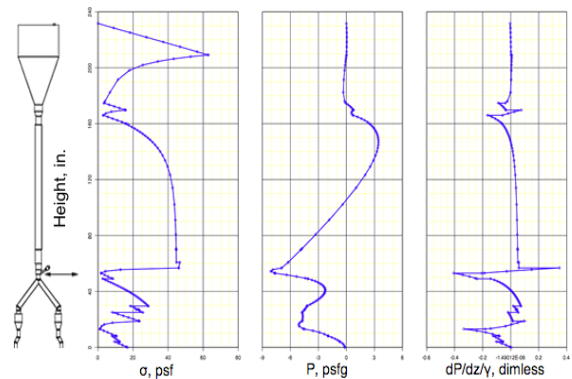
- Particle sizing by dry laser diffraction;
- Cohesive strength and wall friction;
- Compressibility;
- Permeability (described below).

Permeability is measured as a function of bulk density. In the permeability test set-up, air is injected at the bottom of the test cell through a permeable membrane. During the test, the flow rate of air is measured at a pressure drop through a sample of known bulk density. The permeability is then calculated using Darcy's law. A permeability constant is determined from a curve fit of the test results.



Permeability Test Set-up (Left), Example of Fine Powder Tested by J&J (Right)

By inputting the permeability constant along with other material properties into proprietary software, we can model two-phase flow effects and calculate several key parameters throughout the press feed system. These calculated outputs are then used to predict if feed rate problems will occur and if modifications to the powder and/or equipment will be successful in achieving target production rates.



Results of a J&J Press Feed System Analysis

It is common that seemingly minor shifts in the powder properties or feed system equipment can have a significant effect upon achieving target production rates.

Contact us if we can be of assistance in assessing the potential for flow problems, including a production rate limitation.