Inspecting Powders - A New Opportunity

Catching Up With The Competition

Advances in powder flow measurement using shear cell technology now make it possible to consider this technique for both incoming inspection and final product acceptance. Why? Shear cells have become affordable devices in recent years, selling for under $20,000. Friendly user interface and repeatable results in test data for powder flowability have given R&D the confidence that this method is more discriminating that traditional practices like flow cup, angle of repose and tap test. The one missing capability for practical use by Quality Control has been speed of test. That has now been solved with quick test times on the order of 10 to 16 minutes per sample.

Shear cells have been used for 50 years, initially for mineral testing, then gradually for powders and bulk solid materials from a range of industries. The pharmaceutical world has been an early adopter of test methods that use the shear cell because stoppages or slow downs due to erratic discharge from a bin during processing are unacceptable. Therefore, it has been worth investing in new test instruments that can serve to mitigate this potential problem.

Figure 1
Brookfield Annular Shear Cell with Powder

Figure 1 shows an example of an annular shear cell. Powder is placed in the annular ring of the trough and leveled with a scraping tool that rotates a blade around the circumference of the cell. The weight of the powder is recorded before initiating the test program. The most frequently used test choice is the Flow Function. This method compresses the powder with a lid that has pockets which become filled with powder as the lid presses down on the sample to achieve a defined pressure. (See Figure 2) The trough then rotates and the instrument measures the amount of force needed to allow the powder particles at the interface plane between trough and lid to slide against one another. The effective measurement is the yield stress between the powder particles needed to allow relative movement. This is also called the "Failure Strength" of the powder.

Figure 2
Vane Lid Used for Flow Function Test

The Flow Function graph in Figure 3 plots powder Failure Strength vs. the Consolidation Stress (compaction pressure). As the Consolidation Stress increases, so does the Failure Strength of the powder, but generally in a ratio that is less than 1 to 1. The initial work performed by R&D to characterize a new formulation may use the more detailed methods associated with the Flow Function test. Time per test may be on the order of 25 minutes or more. Once completed, manufacturing will verify whether the formulation processes successfully at pilot scale. If manufacturing agrees, then the Flow Function curve for that formulation becomes the benchmark for QC when scale up occurs.

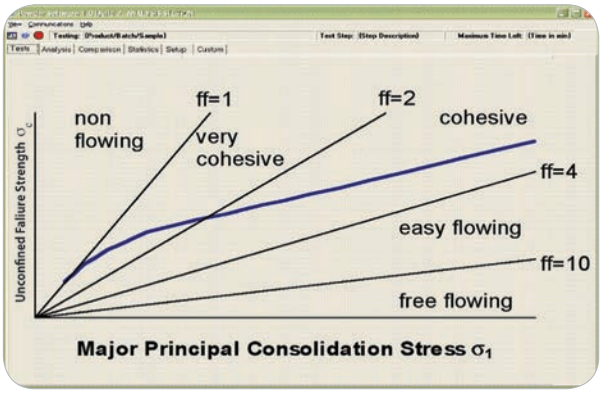

Figure 3
Flow Function Graph

Note that the powder and bulk solids industry has agreed to classify regions on the graph in Figure 3 for different types of flow behavior. "Easy Flowing" is at one extreme while "Non Flowing" lies at the other extreme. Those of greatest concern are typically found in the "Cohesive" and "Very Cohesive" region. These are the powders that can flow acceptably when the bin is full, but can experience a change

During regular production, QC will verify that each batch meets the benchmark by running a quick Flow Function test prior to start of run. The time requirement per test could be as little as 10 minutes.

The objective is to confirm that the Flow Function curve lies below or on the benchmark curve. If it lies above the benchmark curve, then flow difficulty during discharge form hoppers in the process may occur.

Important to note is that QC can use this instrument both for incoming inspection of raw powder material as well as certification of final processed product before shipment to end users. This capability is relatively new in the sense that shortened test times and affordable purchase price for equipment are recent accomplishments by instrumentation manufacturers. If this is new information to you, take the time to talk with users of shear cells and find out directly how they have improved powder processing operations and final product acceptability. It may become an investment that you don't want to miss making.

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