Manufacturing VS. R&D: ROUND 2

Obtaining Tablet Powder Data for "Flowability"

Tablet production depends on steady flow of powder from a feed hopper to the tablet machine. Hang ups are unwelcome because they interrupt production and necessitate a costly restart. Testing the powder for flowability before manufacturing start up is a must in order to prevent this type of problem.

R&D has always used a popular method like the Tap Test because it's quick, easy to perform, and the data may give a picture of potential flow problems. However, this particular test is more an indicator of compaction density for the powder and not flowability in gravity discharge from a hopper.

Shear cells (see Figure 1), a popular tool for characterizing powder flow behavior, actually create a density curve as part of the standard Flow Function test. This standard test involves compaction of a powder sample in the shear cell and measuring the sliding friction between particles when the trough rotates relative to the lid. At each compaction pressure, the reduced volume of powder sample is measured and a corresponding density value is calculated. The graph in Figure 2 shows an example of density vs. consolidating stress. This particular piece of information has given R&D the ability to convince manufacturing that shear cells actually do a better all around job. Interestingly enough, the pharmaceutical industry has become a major practioner of the shear cell method.

Figure 1: Shear Cell Used with Brookfield Powder Flow Tester

Trough with Powder and Vane Lid

Flow Function is the primary test performed by shear cells. The objective is to measure the strength of the powder and determine how much stress is required to overcome its ability to hold together and resist movement when stored in a bin. Figure 3 shows an example of a graph that illustrates powder failure strength vs. consolidating stress. Industry has agreed to define regions of flow behavior as indicated on the graph. Powders that exhibit "highly cohesive" or " non-flowing" behavior are obviously going to cause problems during processing.

Given the valuable information that comes out of the Flow Function test, what will bring this methodology to Quality Control? Comparatively, the shear cell method requires a much longer test time to perform the full Flow Function test, perhaps as much as 45 minutes, vs. the 5 to 10 minutes needed for the Tap Test.

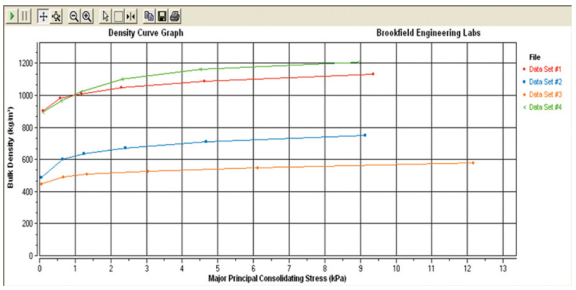

Figure 2: Density Graphs Shows Density vs. Consolidating for Different Powders

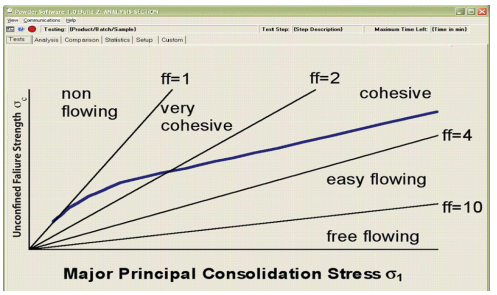

Figure 3: Graph Shows Standard Flow Function Test Data and Regions of Flow Behavior

Recent efforts to shorten the Flow Function test have produced the so-called "Quick" versions of this test. Before describing them, it's important to understand the "Standard" Test. The basic approach in the standard Flow Function calls for testing the powder at five increasing consolidating stress values and measuring the powder failure strength at each one. What takes so long is the need to replicate the test at each consolidating stress to confirm that the powder is sufficiently consolidated and that the value for failure strength is repeatable. Therefore, the test steps at each individual consolidating stress may take up to 8 minutes.

New versions of the "Quick" test mimic the full Flow Function and execute in 10 to 16 minutes. The shortest method applies the first and last (fifth) consolidating stresses on the powder, measures the failure strength at both, and creates a Flow Function curve based on those two data points (see the red curve in Figure 4). The longer "short" method applies all five consolidating stress, but confirms the repeatability of powder failure strength much earlier in the cycle than the normal 8 minutes. Either "Quick" method may work acceptably, provided comparative analysis is performed relative to the standard Flow Function test (see the blue curve in Figure 4) and the data looks reasonably consistent.

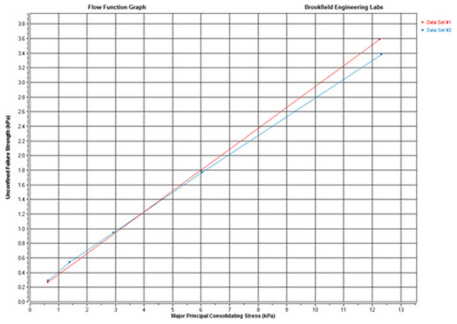

Figure 4: Graph for Quick Flow Function Test (Two Points) vs. Standard Flow Function Test (5 Points)

Now with these methods that take less time, R&D is in a good position to convince Manufacturing that a shear cell test can be quickly performed before each production run. With this assurance, unwanted powder flow problems can be identified before they occur and appropriate corrective action taken. If you are not familiar with theses improvements that have taken place, ask R&D to have your instrument supplier run test samples and illustrate the potential for using this "Quick" test method in your operation.

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