



The Evolution Powder Tester compared to Shear Testers

The Evolution Powder Tester is used to compare the behavior of materials under consolidated load. The only other instruments available for this type of test are powder shear testers. The Evolution was designed specifically as an alternative to shear testers for the following reasons:

Shear testers are slow

A typical unconfined yield strength shear test takes 45 minutes. A flow function takes hours. Aside from waiting for data, the slow test time gives the sample material time to change due to environmental conditions i.e. moisture loss or temperature change. The Evolution requires 3 minutes for an unconfined yield strength test and 15 minutes for a 5 point flow function.

Shear testers subject the sample to mechanical stress that causes sample breakdown

The original shear testers used fresh material for every point on the yield locus to ensure that the repeated testing did not change the material. Modern instruments use the same material over and over because they are impractical if fresh sample is used each time. This can cause inaccurate strength data due to attrition and preferred particle orientation in the shear zone. This may occur to different degrees in different samples. In addition, a sample should never be exposed to more than one stress level i.e. run a flow function on the same sample. In our experience this causes the flow function to be inaccurate in roughly 80 percent of tested samples. The Evolution uses fresh sample for every test.

Shear testers cannot control the stress level on the sample

To compare the unconfined yield strength of samples, it is essential to subject them to exactly the same conditions. This does not happen in shear testers. The major consolidation stress is controlled by the normal load and the shear forces in the sample. The normal load is controlled but the shear stress depends on the sample. This means that flow indexes calculated by shear testers are not performed at the same stress level. This can actually create artificial differences in the measurements between samples. In addition, if one sample tests faster than another, it is exposed to much less mechanical



stress. With the Evolution, the stress on the sample is completely controlled and is the same for every sample tested.

Time tests are expensive and difficult if impossible with shear testers

Shear test cells are complex which makes them expensive. In addition, they usually have a large lid area which means large forces are needed to keep the sample under pressure for any length of time. These two factors typically preclude time measurements. Some manufacturers claim to run time test by leaving the sample in the instrument for long periods of time. However, this is not practical for two reasons: 1) the instrument cannot be used for other tests during this period; and 2) the sample is not under controlled conditions (unless the whole instrument is put in a glove box - but then temperature and humidity conditions are severely limited). The Evolution was designed for time tests with inexpensive test cells, small lid areas requiring lower forces, and standard weights included. Test time after removal from ovens or humidity chambers is 20 seconds giving the sample no time to change.

No accepted shear cell procedure

Shear tester manufacturers say that they are following a standard test for powder strength measurements. However, this is not the case. There are no universally accepted methods or procedures to follow to measure the true strength of materials. In addition, shear cell designs are not uniform and their geometries affect the results due to differences in stress paths, non-uniformity of shear stresses, undefined shear zones, etc. Accepted procedures are only for each specific shear cell from each specific manufacturer.

Evolution gets the correct values for Limestone standard faster and easier than shear cells.

Shear tester manufacturers say that their instruments get the correct strength for the only recognized powder flow standard. This flow standard is BCR limestone. This limestone is a sample that was tested in a round robin method at several European powder flow laboratories using the original Jenike linear shear cell. The average results of all of the laboratories has become the "standard" value. The Evolution measures the correct values for the limestone standard under all test conditions. It also makes these measurements faster, easier, and less expensively than shear testers.



Evolution Powder Tester Overview

The Evolution Powder Tester (EPT) is an economical and easy to use powder flow tester that measures the unconfined yield strength of a material (a critical flow property) at pressures up to 500kPa. The unconfined yield strength can be measured at one pressure or at many different pressures in order to create a flow function. The flow function presents the material's gain in strength as more pressure is applied to it. The Evolution Powder Tester is the perfect powder tester for measuring the flowability and compressibility of materials in low to high stress situations such as silos and storage containers. The system also measures how materials react to the storage conditions over time.

The Evolution Powder Tester (EPT) offers many advantages over traditional shear and other uni-axial testers. The EPT is a standalone instrument designed just for powder testing and is not an accessory to a general purpose instrument. This allows the design to be cost effective, easy to operate and suitable to any laboratory or manufacturing environment. In addition, it takes approximately 3 minutes for a user to test one sample. This is significantly less testing time than other shear or uni-axial testers.

With the EPT, time consolidation tests can be performed with sample cells and weights that allow a material to be subjected to various pressures over long periods of time. The EPT time cells are designed so that they can be easily placed in ovens or humidity chambers to study their effects on materials in storage situations. Studying the effects of humidity and pressure over long periods of time are difficult with traditional shear testers and uni-axial testers. The analysis cells for many these instruments are very expensive and do not include the means of applying pressure for significant periods of time.

The Evolution Powder Analyzer uses uni-axial compression to assess the flowability of powders. The operator begins the flowability test by filling the analysis cell with either 25 cc or 75cc of sample. The cell is then placed in the Evolution and the material is compressed to a predefined pressure. This pressure is referred to as the major consolidation stress. This stress can also be applied using weights over a long period of time to measure the effects of time, humidity, and temperature.

After compression, the Evolution removes the sample from the cell and applies force to the material until it breaks. The pressure required to break the sample is the unconfined yield strength. The unconfined yield strength represents the force required to make the material flow. A flow factor can be calculated by dividing the major consolidation strength by the unconfined yield strength. The greater the value of the flow factor the better the material will flow at any given pressure. A plot of the unconfined yield strength versus the major consolidation stress is referred to as a flow function and represents the material's flowability under a wide range of pressures.