Uniaxial Powder Tester

Assess and rank the flowability of powders by accurately measuring uniaxial unconfined yield strength (uUYS)

freemantechnology

Uniaxial powder testing

The Uniaxial Powder Tester (UPT) from Freeman Technology is a unique stand-alone uniaxial shear tester for simple, sensitive and cost-efficient powder characterisation. The instrument delivers repeatable and reliable measurements, providing a robust, cost-effective alternative to traditional powder testing techniques.

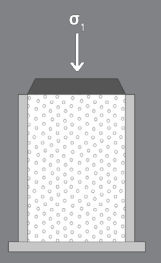
Uniaxial testing first involves the construction of a consolidated powder column. This is then removed from its confining sleeve before being fractured through the application of a vertical stress, directly measuring the uniaxial Unconfined Yield Strength (uUYS). This technique can therefore be used to assess and rank the flowability of powders.

Cohesive powders have relatively strong inter-particulate forces, which encourage the particles to stick together rather than moving easily relative to one another. By contrast, in free-flowing powders, the tensile forces between particles tend to be much weaker.

Uniaxial testing is a direct and reliable method for measuring the uUYS (σ_c) and Flow Function (FF) of powders.

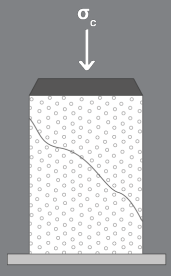
The UPT is available in either a manual or an advanced version. Both deliver the same data with high repeatability, whilst the advanced version also offers the advantage of increased levels of automation and reduced operator input.

Principles of uniaxial testing



Sample is loaded into a cylinder and consolidated with a Major Principal Stress (σ_1) to form a powder column

Major Principal Stress and cylinder are removed to leave a free-standing consolidated powder column



Column is fractured through the application of a compressive stress

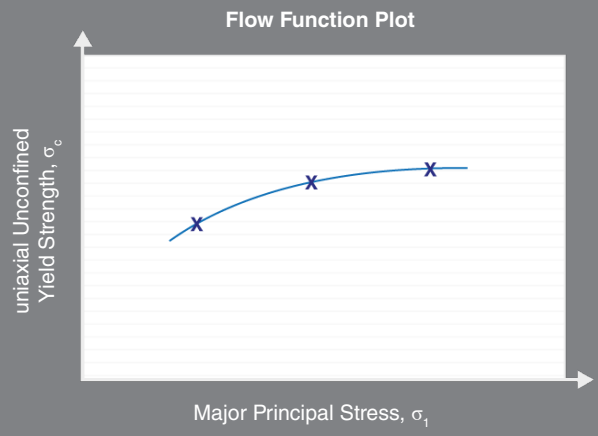
uniaxial Unconfined Yield Strength (uUYS)

The uniaxial Unconfined Yield Strength (σ_c) is a measurement of the stress required to break or fail a previously consolidated, unconfined column of powder.

(Note: The uUYS is similar to the Unconfined Yield Strength (UYS), a parameter derived from biaxial shear testers, but it should be noted that due to the different consolidation and failure protocols of the uniaxial and biaxial testers, it does not always follow that values for uUYS are identical to values of UYS)

Benefits of the UPT:

- Direct uUYS (σ_c) & FF measurements
- Fast
- Repeatable
- Low cost
- Versatile
- Easy to use
- Intuitive, easy to interpret results
- Robust



Consolidation Station

For off-instrument consolidation. The Consolidation Station is available for when a powder needs to be consolidated for an extended period of time or within a controlled environment, for example at a fixed relative humidity or in an oven.

The challenge...

Practical constraints have previously inhibited the exploitation of uniaxial testing. These include:

- Constructing a free-standing powder column
- Ensuring a uniform density and stress throughout the entire powder column
- A practical, easy to use tester that can be used with a wide range of powders

The UPT has overcome these challenges by:

- Developing a sleeve design enabling the creation of a free-standing column of powder
- Using a double-ended consolidation method to ensure uniform density and stress

Comprehensive powder testing

Freeman Technology has developed a range of powder testers to match the requirements of users and their applications.

The UPT is a cost effective and practical solution, offering users the opportunity to quickly quantify a defined set of parameters.

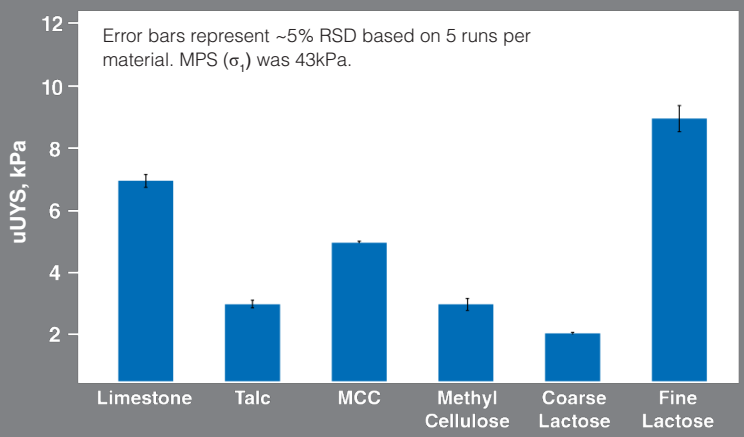
However, the complex nature of powders and the processes in which they are used will often require a more comprehensive understanding of flow properties. This can be achieved with testing carried out on an FT4 Powder Rheometer®, a universal powder tester that measures an extensive range of properties.

Specification	Manual	Advanced
Uniaxial Consolidation Stress Range: 0 -100kPa	✓	✓
Normal Stress - Resolution	10 Pa	0.3 Pa
Double Ended Consolidation	✓	✓
uniaxial Unconfined Yield Strength (uUYS) - Measurement	✓	✓
Real Time Stress Display	✓	✓
Sample Mass - Measurement	✓	✓
Compressibility (%)	Derived*	✓
Height / Diameter Ratio of Consolidated Sample	1.25 - 1.50	1.25 - 1.50
Bulk Density - Poured (g/ml)	Derived*	✓
Bulk Density - Consolidated (g/ml)	Derived*	✓
Off Instrument Consolidation	✓	✓
Automated Stress Control	✗	✓
Automated Speed Control during Consolidation & Failure	✗	✓
Data Logging	✗	✓
Data Export	✗	✓
Report Generation	✗	✓
Instrument Footprint	395 x 321 x 647mm	310 x 321 x 647mm

*Derived - by user through simple calculation

Applications

Uniaxial testing has proven application in many powder processing industries, including Chemicals, Food, Plastics, Cement, Detergents, Ceramics, and Pharmaceuticals.



Freeman Technology has over 15 years' experience in the design of powder characterisation instrumentation for powder processing applications. Working with Freeman Technology means more than simply purchasing an instrument. Thanks to our expertise and know how, we provide users around the world with extensive and ongoing consultation and applications support, based on real-world experience.

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