



Uniaxial Powder Tester

Assess and rank the flowability of powders by accurately measuring uniaxial Unconfined Yield Strength (uUYS)

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Uniaxial powder testing

The Uniaxial Powder Tester (UPT) from Freeman Technology is a unique stand-alone uniaxial shear tester for simple, sensitive and cost-effective powder characterisation. The instrument delivers repeatable and reliable measurements, providing a robust 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 (σ_c). 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 bond rather than move easily relative to one another. By contrast, in non-cohesive powders, the tensile forces between particles tend to be much weaker.

Uniaxial testing is a direct and reliable method for measuring the magnitude of this interparticulate strength, in the form of the σ_c and Flow Function (FF).

The UPT's level of automation and low operator input means the instrument delivers highly repeatable data.

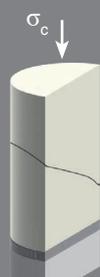
Principles of uniaxial testing



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

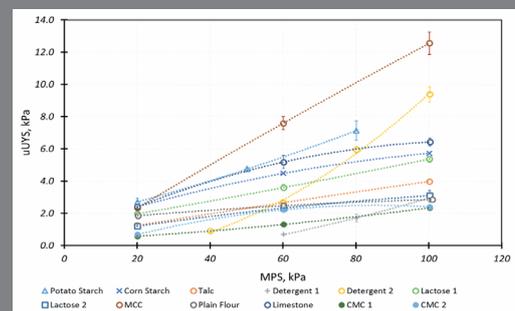


Column is fractured through the application of a compressive stress

Benefits of the UPT:

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

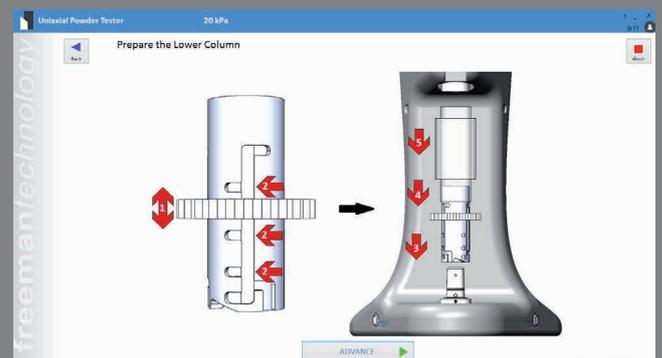
Flow Function Plot



uniaxial Unconfined Yield Strength (σ_c)

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 σ_c is similar to the Unconfined Yield Strength (UYS), a parameter derived from rotational shear testers. However, it should be noted that due to the different consolidation and failure protocols of the uniaxial and rotational testers, it does not always follow that values for σ_c are identical to values of UYS.)



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.

Consolidation Station

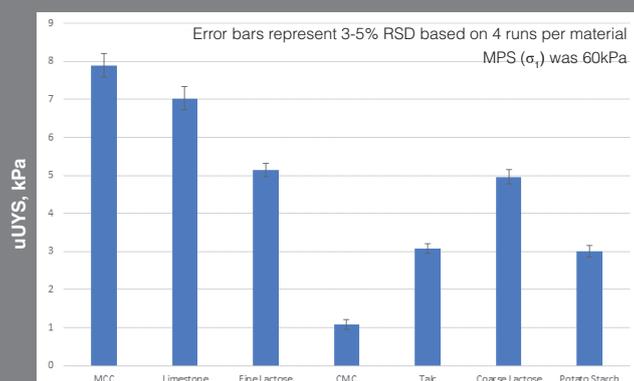
The offline Consolidation Station allows powder samples to be subjected to a range of environmental conditions, such as elevated temperature and humidity for extended periods under the desired MPS. This allows for the simulation of many industrial processes without occupying instruments for long time periods.

Temperature Range	-20°C to +70°C
Humidity Range	0 to 100% RH
MPS Range	5kPa to 100kPa in 5kPa increments



Applications

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



Specification

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

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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