Stable Micro Systems

innovation • education • application

quantify
powder
flow
properties

• Food
• Pharmaceutical
• Chemical
• Medical
• Industrial

PowderFlow
Analyser

Why measure the flow properties of powders?

It is estimated that over 50% of all materials used in all industries are, at some stage, in powder form.

A vast range of powders = a wide range of problems. All types of powder need to flow!

The Powder Flow Analyser provides an objective measure of powder and granule flow, which can:

- Avoid extensive costs and time involved in unloading powders that will not flow out of storage containers
- Help achieve the best product formulation with the properties to suit the requirements
- Improve the quality and consistency of the product
- Save costs by optimising storage, packing, handling and transportation

EMPLOY YOUR POWDER FLOW ANALYSER TO:

Powder production should not be a stop-go business

- Measure flow properties to ensure correct formulation and optimise key process stages for full control and reliability of the whole production cycle

Substitution – is it really "the same"?

- Investigate the potential effects of ingredient substitution to confirm whether apparently more economical ingredients behave acceptably in existing systems

You don't even want a spoonful of trouble

- Rapidly assess samples by batch and source on delivery to avoid significant flow variation problems during storage, handling and processing

Learn how to handle your powders

- Characterise powders with a 'fingerprint' containing information on cohesion, caking and flow speed and investigate many variable parameters

Do the powder properties match the optimum end performance requirements?

- Optimise mixing and addition of flow aids and relate powder mix properties to processing systems and required end product features

Don't let your flow properties control your fill weight

- Ensure compliance with all external authority requirements relating to controlled product standards, weights and measures

For foods, pharmaceuticals, cosmetics or paints, the Powder Flow Analyser can have a big impact in making production processes more reliable

The Powder Flow Analyser – Controlled Flow

A flexible system to suit your laboratory's needs

Stable Micro Systems use the test frame and vertical drive system provided by a universal Texture Analyser, and add the additional rotational drive and software functionality to form the Powder Flow Analyser – an accurate and reliable method of measuring the flow characteristics of powders.

Powder Flow Analysers can be purchased as completely new working systems, or you can take your existing Texture Analyser and attach the Powder Flow Analyser to extend your range of testing solutions from powders to end products.

A patented helically machined rotor can be programmed to move through a powder column in different ways depending upon the characteristic that is to be measured. Due to the unique precision profile of the rotor's blade the sample can be physically displaced in many different ways. *The Test Settings* of blade path angle and tip speed determine the mode of Controlled Flow achieved within a sample column.

A typical tests starts with conditioning the powder column to remove operator loading differences. Depending upon the programmed rotation of the blade in terms of path angle, blade direction and tip speed the powder column can be displaced in a number of different ways to suit the process and properties to be measured.

During the test, axial force, time and distance are measured by a sensitive transducer and data is displayed and analysed in real time by *Exponent* software. Sample results can be ranked and compared to assess the impact of external conditions including humidity and moisture content, surface properties, electrostatic charge and particle or granule size, shape and distribution.

Once programmed, the optimised test can provide identical controlled flow conditions when completing the same test programme. *Test Settings* can be optimised to show the maximum differentiation between similar products, or to imitate the process or storage handling conditions, experienced by the product.

The Powder Flow Analyser is supplied with library tests, so operators can start testing quickly and conveniently after straightforward installation and calibration. Users can, however, fully program the instrument to carry out slicing, shearing, compressing, compacting and aerating cycles in any combination.

The Powder Flow Analyser with Controlled Flow* provides:

- User programmable tests that displace the sample by slicing, shearing, compressing, compacting, mixing, and aerating; in any combination, and in any sequence
- Exact repetition of the test sequence best suited to your need, time after time
- Independence from variable sample loading by pre-conditioning at the start of the test
- Extremely gentle through to aggressive displacements
- Measurement and analysis of force, time, and distance; parameters that define the sample behaviour during the programmed **Controlled Flow***
- Objective, numeric, automated analysis, characterising of the flow behaviour of the sample during **Controlled Flow***.
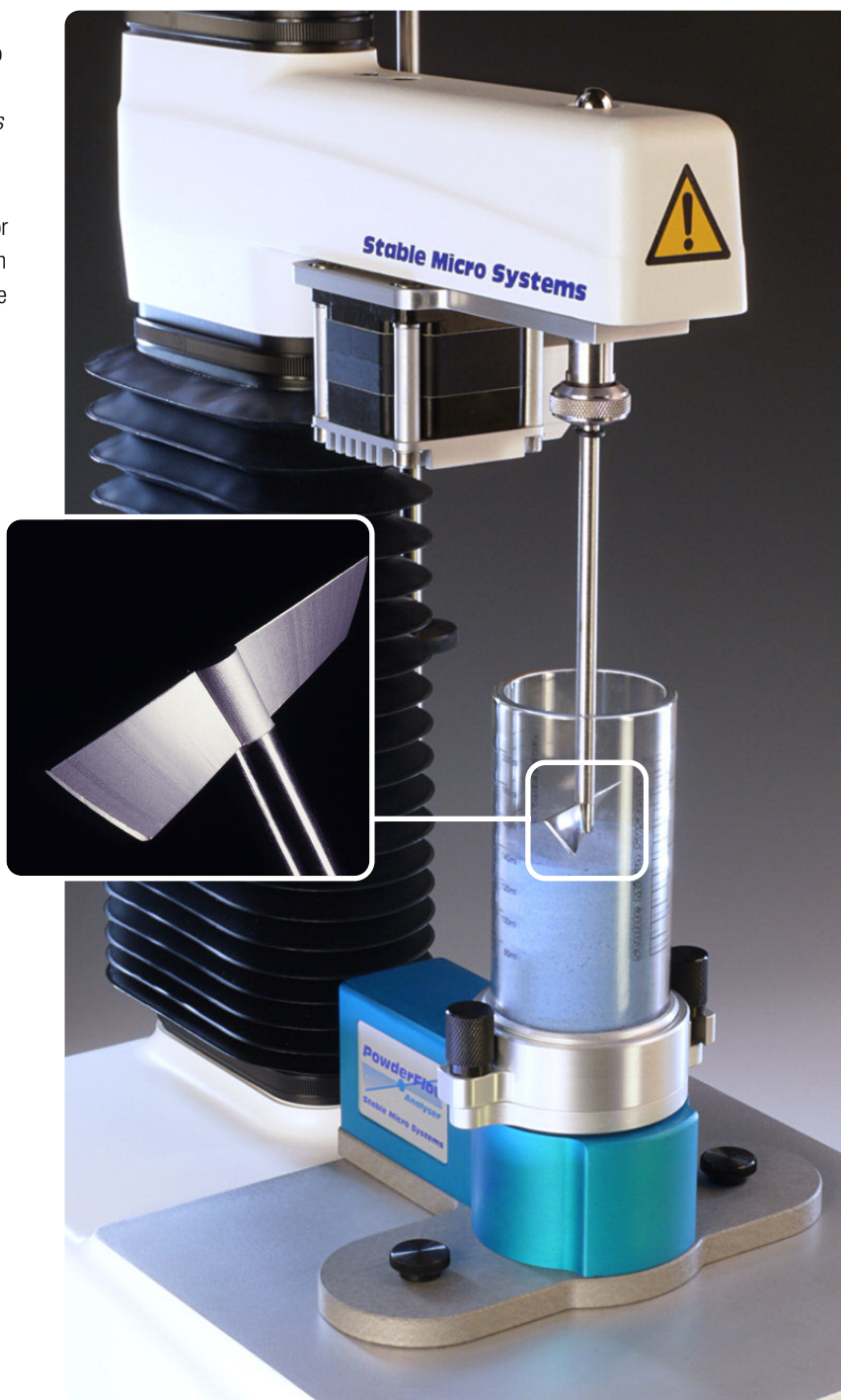
The Powder Flow Analyser unit may be attached to or removed from the TA.XTplus Texture Analyser within minutes

The most important tool for powder flow measurement is provided by a patented* precision blade (inset)

Operation, data analysis & presentation of results

Software functionality – a summary of the highlights

Exponent is the software package which drives the TA.XT*plus* and TA.HD*plus* Texture Analysers on which the Powder Flow Analyser is located. The software provides a flexible graphical user interface to choose test settings and acquire test data in a real-time graphical display. Macro and spreadsheet facilities are built-in to aid automated data collection and analysis with a wide range of data presentation formats.

The following presents some highlights of the software, which can only be fully appreciated by a live demonstration...
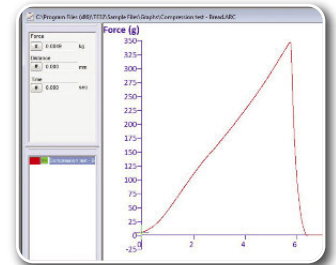
CALIBRATION: two simple calibrations and you're ready to go

Calibration of both force and distance is carried out in-house at the end of the manufacturing process.

Customers can easily re-calibrate the instrument in their laboratories, depending upon their good laboratory practice.

The instrument's accuracy can easily be checked in terms of speed, distance and force measurements to meet the more demanding regulations of certain industries.

As with all good instruments, calibration and verification are standard practice

TEST SET-UP AND DESIGN

Testing starts with your choice of settings. This will depend on the type of test you wish to perform. *Exponent* provides you with a wide range of possibilities depending on sample volume, and the properties you wish to investigate. At the click of a button, your chosen project automatically transfers the required test settings to the instrument and loads the associated macro, spreadsheet and report ready to analyse and display the results once the test is performed.

Experienced users may wish to modify the test projects that are provided or design their own test protocol. Three test interface options are available, depending upon whether you wish to use the provided projects with recommended settings, make small changes to the test parameters with a 'Configure Your Own' project, or design a completely new test sequence step by step.
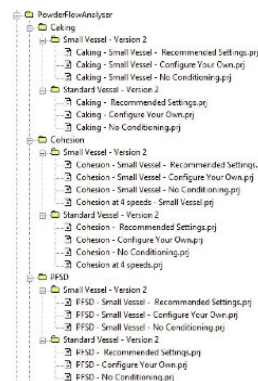

ANALYSIS AND PRESENTATION

Graphs

A graph is produced from testing of the sample. Graph files can include photos of the sample that was tested and can also be exported as .bmp or .jpg.

Macros

Macros automatically calculate the important parameters and annotate the areas of interest on each test curve. A set of instructions are listed and executed which automatically collect data from the graph. Tests can be automated with either intricate or simple macros which is ideally suited to a production environment.

Test Settings and analysis macro routines can be optimised to suit your particular applications and if routinely required they can then be saved as user-specific *Projects.*
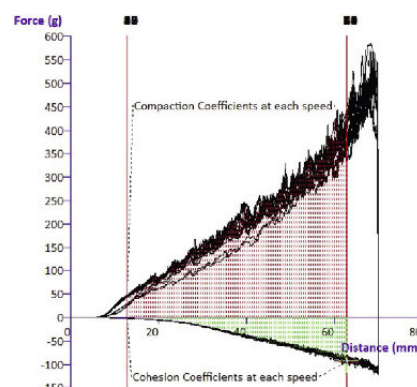
A macro is applied to analyse the relevant portions of the graph

the Powder Flow Analyser

RESULTS FILES

Data collected from macros is displayed in a spreadsheet and if necessary further calculations are made by the addition of more columns to product other parameters.

From here charts in a multitude of formats can be automatically displayed or designed to suit your data comparison needs.

At the click on a button your test data is automatically composed into a *Report.*

Data from the results file can be displayed in a multitude of chart forms for easier comparison and interpretation.

EXPORTING DATA

Spreadsheets, text or images can be exported to other Windows applications for further specific manipulation/presentation if required.

HELP: within the software and online, we always try to help

Help files guide you through your testing and analysis and provide the background support material you need to get the best from your instrument.

Each test explanation includes videos of each test stage.

Read about other people's experiences and their data.

An extensive database of videos, on a wide range of powder samples, is included on DVD.

Language Editor: One software version has all language options available. Choose your preferred language at the *User* window.
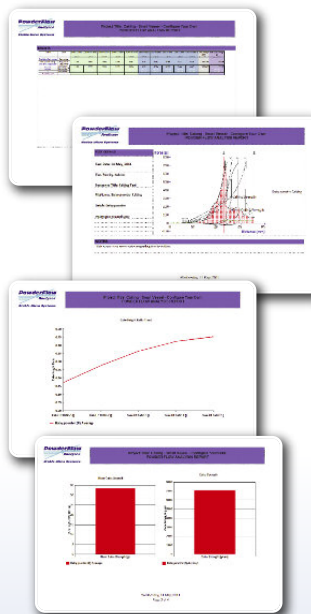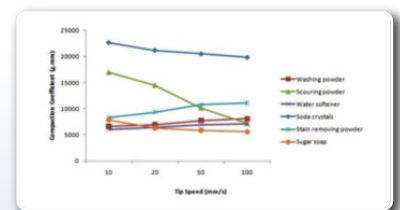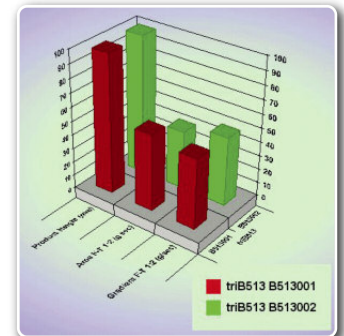
Report formats

Chart formats

The graphic output of Exponent software enables easy interpretation of results by users with any level of experience

The Help file menu panel guides the user through full information sections on the Powder Flow Analyser, test and analysis procedures and troubleshooting

The animated Test explanations ensure that the user has full confidence in their own understanding of the principles and procedures involved in each test sequence

Papers on the use of the Powder Flow Analyser can inform your test planning and give valuable insights into the capabilities of the instrument

Recordings of each test are provided to further illustrate the Help file instructions

The whole Help package is unsurpassed in its comprehensive scope and attention to detail, and complements the capability of Exponent to deliver rapid, accurate and repeatable results

Test Types: a vast range of powders – and parameters

Sample Conditioning

To remove any user loading variation and to normalise the powder column after filling and prior to testing, test protocols include a conditioning process. Data is not captured during this process, but it ensures that each sample starts after the same influence and hence provides outstanding reproducibility. Once your full range of tests is performed, the collection of parameters you have obtained can be collated into a 'fingerprint' of each sample.

ASSESSMENT OF COHESION

Cohesiveness is the tendency for particles of powder to cling together and agglomerate (form larger clusters of particles). The PFA measures this cohesion characteristic by moving the blade in such a way as to lift the powder. A more cohesive powder will cling to itself and to the blade, so reducing the force exerted on the base of the vessel. This is shown in the plotted data by a large negative force. A change in the cohesive properties of a powder may have an important affect on production processes such as die filling that could impair production efficiency and product quality.

How the Cohesion Test works

The powder blade moves down through the powder column using a "cutting" action to minimise compaction. The upward part of the cycle then lifts the powder and the force of the powder on the vessel base is recorded.

Measured Parameters

• Cohesion Coefficient
• Cohesion Index

Application of Data

The cohesion index is a useful quality control measure as changes in powder specification (formulation, particle size distribution, particle shape etc.), storage conditions and test environment can all influence the tendency of a powder to agglomerate.

This quick analysis allows repeatable quantification of the cohesiveness of a bulk solid. Test results enable comparison of the test sample with previously analysed product, to assess if it is more cohesive or more free flowing.

ASSESSMENT OF CAKING

Caking is the tendency of a powder to form large agglomerates during storage and transportation. The tendency of a powder to cake is closely related to its cohesiveness and generally a powder that is cohesive will also form a cake during the caking test. The strength of the cake will depend on a number of factors such as packing efficiency, particle to particle interactions and moisture content i.e. humidity. Understanding the caking properties of a powder are important as most powders will be stored in hoppers or silos, or transported at some point in the production process. A powder that cakes easily and forms a strong cake may not discharge easily from a silo when required. However the caking process can be intentional and a desired result such as in a granulation process or when required to form a 'cake'.

How the Caking Test works

The blade levels the top of the powder column and measures its height. The blade then moves down through the column and compacts the powder to a pre-defined force (usually 750g). When it reaches this force it measures the height of the cake and slices up through the powder. This compaction cycle is repeated four more times. The fifth time the target force is reached, the blade slices through the compacted cake of powder formed at the bottom of the vessel.

Measured Parameters

• Column and Cake Height Ratios
• Cake Strength Work
• Mean Cake Strength Force

Application of Data

The tendency of a powder to cake can give important data about the properties of the powder after storage and transportation. The formation of strong, high height cakes may lead to issues with discharge of powders from storage hoppers or silos. Product settlement and cake formation may also impact on customer perception of products, as it may appear that the product is less voluminous than stated. Proper understanding of the caking characteristics of powder may assist manufacturers in minimising issues after storage or transportation.

ASSESSMENT OF POWDER FLOW SPEED DEPENDENCE (PFSD)

Powder flow properties may change with increasing or decreasing flow speeds. For example, a powder may become more resistant to flow as it is forced to flow faster or indeed it may become more free flowing as the flow speed increases. This issue can lead to under/filling, for example, as a result of process changes to meet increase output demand. The PFA measures this characteristic by assessing the work needed to move the blade though the powder at increasing speeds. An evaluation of the flow stability of the powder is also made by comparing the work needed to move the blade though the powder at the start of the test compared to the work required to move the powder at the same speed at the end of the test.

How the PFSD Test works

The powder flow speed dependency (PFSD) test provides 5 sets of 2 cycles at increasing speeds. The downward parts of the cycles compact the powder and the upward stroke of the cycle uses a lifting action.

The test measures resistance of a powder sample as controlled flow is imposed at different speeds. Powders that flow freely will transfer very little resistance through the powder column in either a downward or an upward direction. Conversely, poorly flowing powders exhibit substantial amounts of force in either direction.

Measured Parameters

• Compaction Coefficients at each speed
• Cohesion Coefficient
• Flow Stability

Application of Data

PFSD gives important information about the speed flow properties of a powder and this can be of interest in a production environment. It may be necessary to convey a powder through plant at a certain speed to meet production volume requirements. The PFSD test can assess the suitability of a powder for different conveying speeds or test a powder for variations in speed flow properties from batch to batch. PFSD can also give important data on the attrition characteristics of the powder.

# Not only Powder Flow – the complete solution

Physical characterisation – from start to finish!

When coupled with a Powder Flow Analyser, the Texture Analyser gives you a complete range of testing solutions for both your powders and end-products.

Alternative powder flow measurements do not provide such a comprehensive range of testing possibilities.

Used in conjunction with the TA.XT*plus* Texture Analyser, users can experience an extensive range of well established testing possibilities such as uniaxial compression with the Powder Compaction Rig, diametral tablet compression using cylinder probes and granule compressibility using a Granule Compaction Rig. Single particle mechanical strength and progressive swelling/disintegration of granules and pellets also expand the myriad of tests available for samples from powder to finished product.

We don't just sell equipment – we pride ourselves in providing solutions to measuring your products physical properties to help you solve your quality control, formulation or processing problems.

Relate powder measures to process and end product features
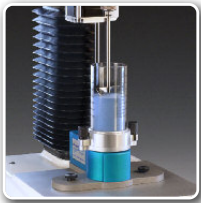
Powder Flow Analyser[§]
For assessment of typical powder issues, e.g. batch and source variation in ingredients, caking during storage/transportation, or problems with discharging from hoppers or bins.
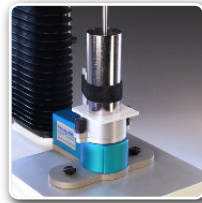
High Tolerance Powder Compaction Rig*
Suited to high force applications where the punch/die clearance is critical for the assessment of powder compaction properties.
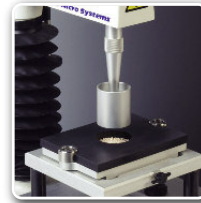
Low Tolerance Powder Compaction Rig*
Suited to powder compaction applications where the punch/die clearance is less critical.

Powder Caking and Consolidation Rig
Allows the assessment of the sample's caking behaviour, after consolidation using the supplied weight.

Granule Compaction Rig*
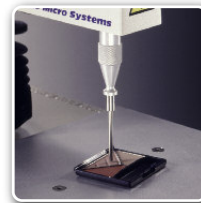This test allows the granule hardness/compressibility to be assessed.

Cylinder Probes
Enable measurement of single particle mechanical strength or of progressive swelling of granules/pellets.

[§]*Patents granted and applied for*   **Community Registered Design*

One instrument – endless testing possibilities!

Do the powder properties match the optimum end performance requirements?

Beneath your Powder Flow Analyser lies a Texture Analyser – extending your testing possibilities dramatically

The ability to plug-in peripheral instruments is present in the instrument design to provide multi-channel data acquisition. This allows for many other measuring devices to be used in conjunction with the Powder Flow Analyser and their data simultaneously collected, such as acoustic emission, temperature, humidity.

Instrument specification: measurement & control

Feature	Value	Note
Force Down	5kg (50N) max.	± 0.05%
Force Up	5kg (50N) max.	± 0.05%
Force Zero Hysteresis	< ± 0.1g	
Rotor Blade (48mm dia.) Tip Speed	Dependent on Test Angle	0°: 0-754mm/sec (limit of 300rpm)
		90°: 0-40mm/sec
Rotor Blade (23mm dia.) Tip Speed	Dependent on Test Angle	0°: 0-360mm/sec
		90°: 0-40mm/sec
Rotor Blade Speed Control Accuracy	Better than 0.05%	
Data Acquisition	Force, Distance, Time	Up to 500 data points per sec per channel (16 bit accuracy)
Operating Temperature	0-40°C	
Operating Conditions	Dust and splash resistant	
Power Supply	90V - 264V AC, 47Hz - 63 Hz	

PowderFlow Analyser

Accessories

Test Vessels: *3 vessels included with PFA*

Precision tube in borosilicate glass with removable acetal base attachment ring for easy cleaning.

Vertical alignment and radial tolerance better than ± 0.05mm. Special materials and sizes on request.

Vessels are available in 2 sizes and are supplied individually or in sets of 3:

1) Typical sample volume 100-200ml: 50mm internal diameter: 130mm total height
2) Typical sample volume 20-35ml: 255mm internal diameter: 80mm total height

Rotors: *1 rotor included with PFA*

Shafts: 6mm diameter 316 Stainless Steel

Blades: Precision machined to optimise blade form.

   Over Anodised (Clear) Aluminium Alloy or 316 Stainless Steel as standard.

Special materials and sizes on request.

Rotor blades are available in 2 sizes:

1) 23 mm diameter: 10mm height
2) 48mm diameter: 10mm height

Customer Support

Distributed in the UK by our own sales force, Stable Micro Systems' Powder Flow Analysers are marketed on every continent through a network of hand-picked distributors and agents, who have been trained in all major areas of both powder flow and texture analysis applications.

Exponent software is written in-house, giving us the ability to quickly update and add required features suggested by our users — indeed, we offer unmatched continuously enhanced software. We constantly strive for improvement and pride ourselves on the quality of our customer support throughout the world.
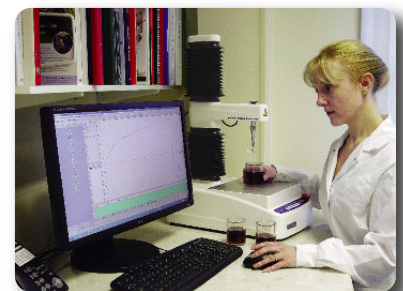
*Patents granted and applied for: US 7201040; EU 1448973; HK 1071429; JP 4322676;
   US 6481267; AU 774211; JP 2000-351017; NZ 508253

FREE technical support throughout the life of your instrument

---