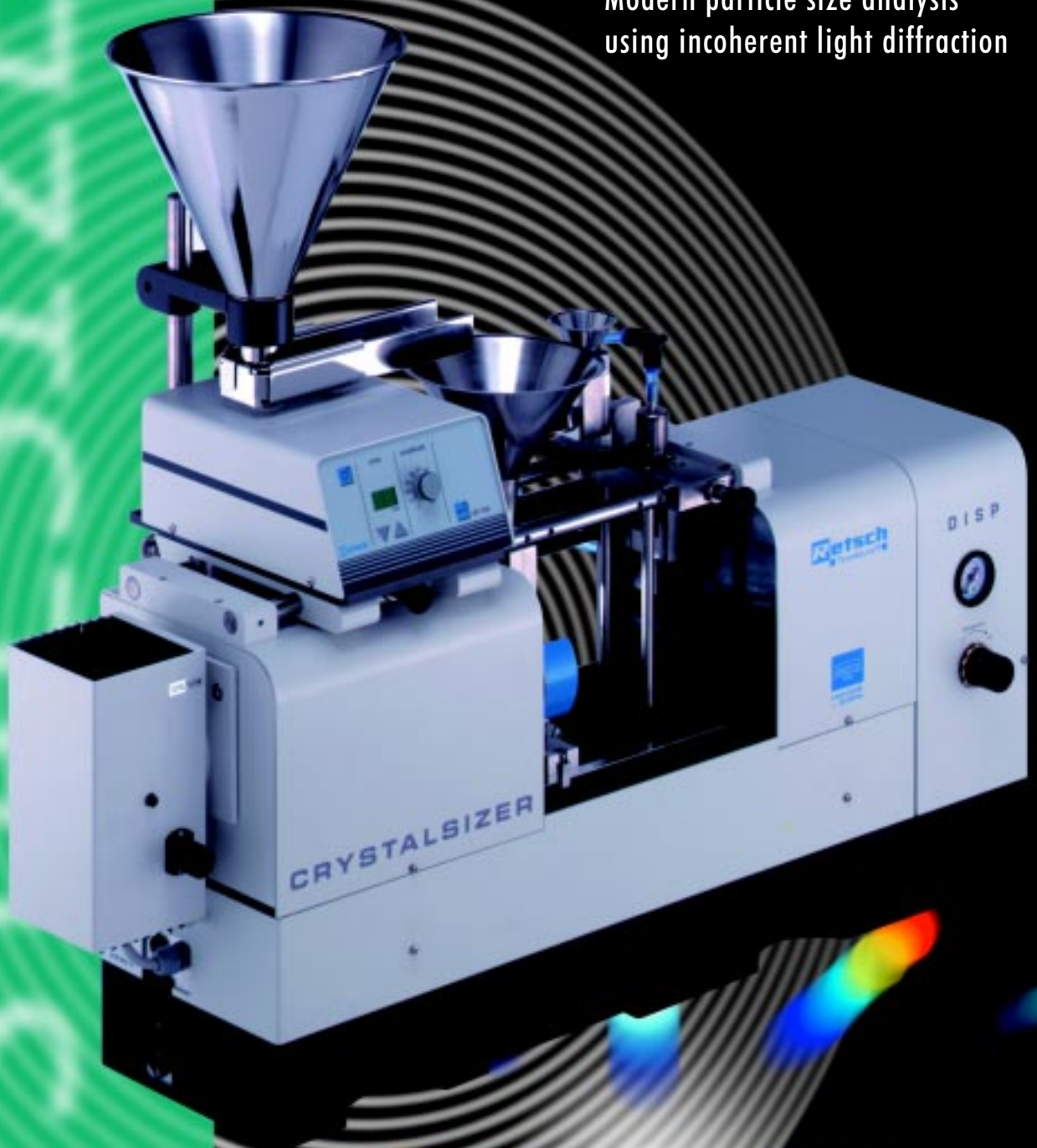


CRYSTALSIZER®

Modern particle size analysis
using incoherent light diffraction



The CRYSTALSIZER[®] system

The innovative system for precise particle size analysis

Quality assurance for your products

When powders and granulates are characterised, the particle size and its distribution are important quality characteristics. In many cases they determine the suitability of raw materials, production processes and products.

The Crystalsizer carries out precise particle size analysis of your products and raw materials, rapidly and reliably. It offers novel opportunities in quality and process monitoring.

The Liquid crystal display

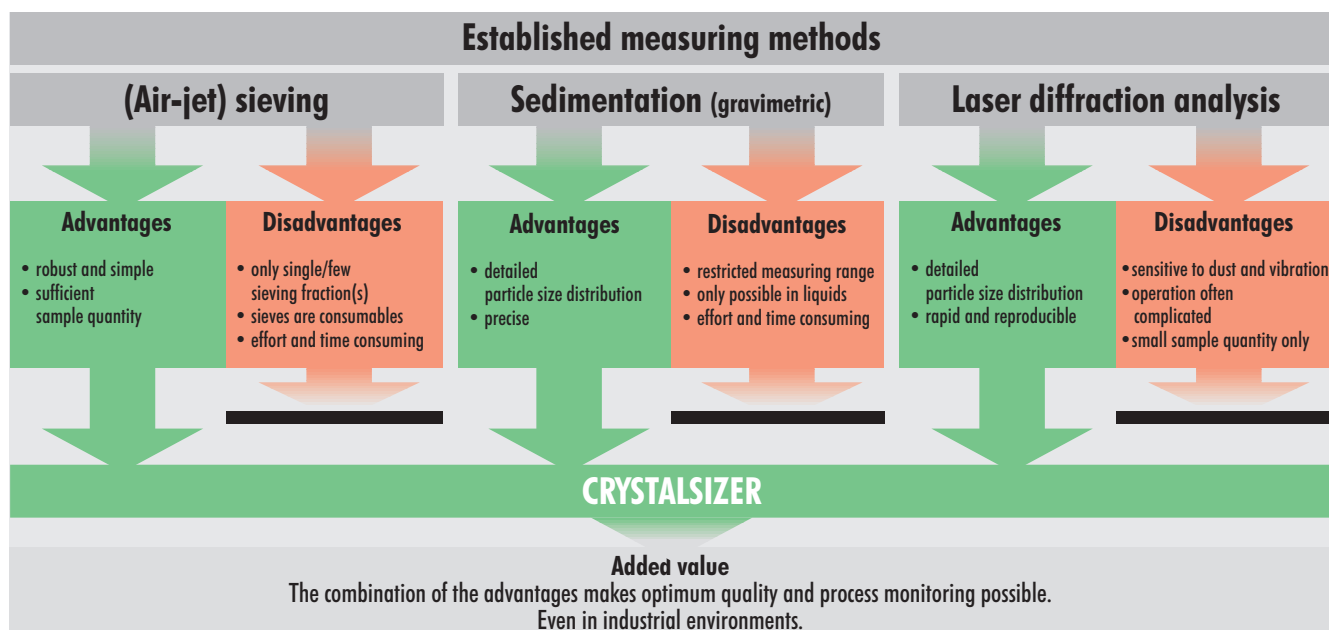
The newly developed Liquid crystal display (LCD) not only provides the name for the Crystalsizer, it is also its innovative core. A high resolution LCD system makes it possible to measure pourable and dry dispersible materials with a particle size between 0.7 µm and 2500 µm. The patented measuring principle using incoherent diffraction analysis allows the Crystalsizer to operate in difficult environmental conditions, to handle large samples and still to come up with precise and reproducible results.

Make use of our advanced technology

The Crystalsizer is the result of a successful alliance in optical particle size measuring technology between Jenoptik Laser, Optik, Systeme GmbH and Retsch GmbH & Co. KG. This innovative instrument is a product of close collaboration between research, development and practical application involving pilot customers. The Crystalsizer possesses striking advantages in its application. Intelligent measuring and analysing software provides all relevant results. An intuitive user surface makes it easy to take advantage of the performance of the system.



The CRYSTALIZER® - The reliable solution for the analysis of your products



High utility

The Crystalsizer is a multi-talented instrument for the determination of particle sizes thanks to the wide range of materials it can test, its precise and rapid analysis and the comfortable and simple operation. In particular it is up to the job in difficult environments due to its insensitivity to dust and vibration. The Crystalsizer can also cope with larger sample batches and provides correspondingly meaningful results.

Reliable analysis

The Crystalsizer was developed for industrial applications. While the suitability of traditional methods for measuring particle sizes under industrial conditions is limited, Crystalsizer offers the specific advantages of established measuring methods without also being encumbered by their disadvantages. Even optically difficult or sensitive materials can now be measured without problem using incoherent diffraction analysis.

Wide application range

All bulk materials in the range between 0.7 μm to 2500 μm which are pourable or dry dispersible can be analysed. Most materials investigated have a particle size below 1250 μm .

Typical sample materials are for example:

- | | |
|-------------------|------------------------------------|
| • sugar | • construction materials/additives |
| • salt | • washing powder |
| • glass | • raw materials for chemicals |
| • flour | • ceramic powders |
| • sand | • polymers |
| • pharmaceuticals | • metal powders |

The measuring period lies between 0.5 and 3 minutes depending on material, feeding mode and desired statistical quality of data. During the measuring period the sample material is continuously fed by an automatic dosing unit.



The unique measuring principle of the CRYSTALSIZER®

Incoherent diffraction using a Liquid crystal display.

High-Technology for practical applications

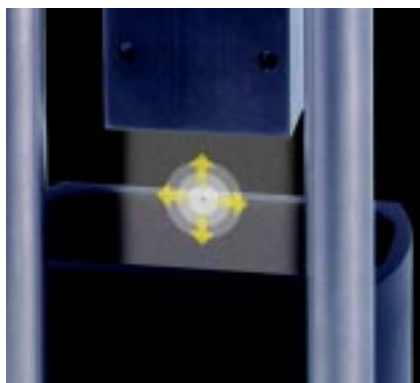
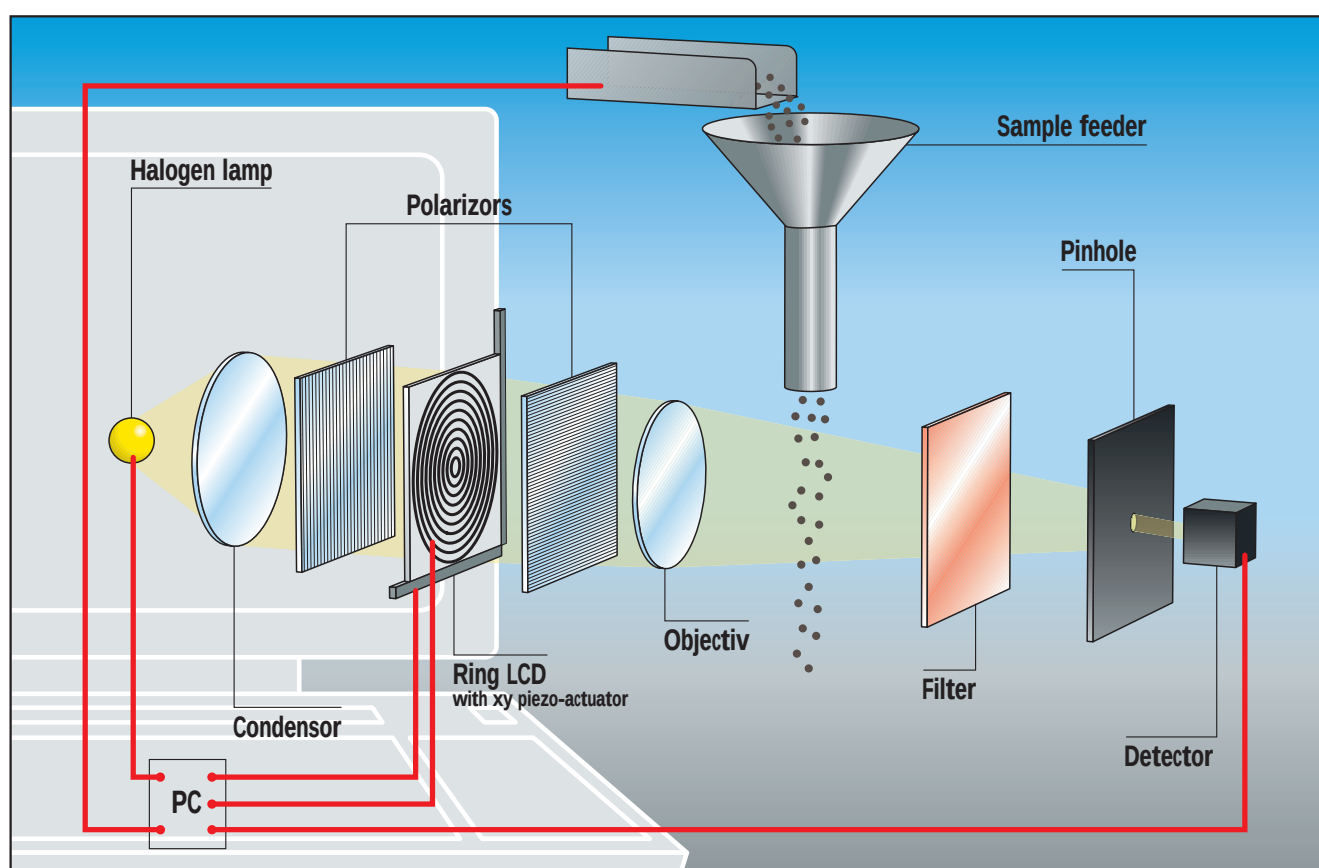
Most particle sizers are either high-tech or suitable for industrial use. The Crystalsizer is both. Its unique measuring principle in conjunction with its robust design, which is the result of the work of experienced specialists, has made it possible to unite the most modern technology with the requirements of today's industry.

Unique measuring set-up

The Crystalsizer is a high value measuring device for determining particle size distributions between $0.7\text{ }\mu\text{m}$ and $2500\text{ }\mu\text{m}$. Its measuring principle is based on the diffraction of incoherent "white" light by the stream of particles. The light source used is a halogen lamp whose light is modulated by a Liquid Crystal Display (LCD).

Incoherent light diffraction

The LCD produces ring-shaped light beams with various diameters. A certain LCD diameter only results in a signal at the detector when particles of the correct matching size are found within the sample. These particles scatter the light at the right angle onto the detector. The term for the underlying physical principle is diffraction.



High frequency measurement

During measuring the individual rings of the liquid crystal display are switched through in rapid succession. Each ring is only active for a few milliseconds at a time. The cycle is repeated until the complete sample has been fed and measured. During the measurement an xy piezo-actuator maintains an optimum state of adjustment and thus a precise optical path.

Optional dispersion unit

Very fine materials tend to agglomerate which then makes it impossible to analyse them without dispersing them. For solving this problem the Crystalsizer is equipped with an efficient compressed air dry disperser unit. It blows the sample to dust immediately before it enters the optical path and that way an optimal analysis of the so-called primary particles is made possible. Inconvenient wet dispersing is not required.

Innovative measuring principle

Many optical measuring devices utilise one specific property of particles: they diffract light to a varying degree depending on particle size. Up to now these devices were all using a point-shaped laser and a planar detector.

The Crystalsizer was designed particularly for industrial applications where simple and convenient operation and low safety risk are important. It is based on the principle of incoherent light diffraction and therefore it works using "normal" halogen light. Here the traditional optical structure is turned back to front. A variable planar light source which is created by a ring-shaped LCD and a point-sized detector are used. Thus the same physical effect is measured as with traditional devices, but without using coherent laser light.

Advantages in the product design

The innovative measuring principle makes it possible for the Crystalsizer to unite the advantages of mechanical and optical measuring devices. It measures larger sample sizes rapidly, precisely and provides detailed information. At the same time it is insensitive to dust and vibrations and easy to use. Therefore the Crystalsizer is not exclusively a laboratory device but is also designed for applications close to or even integrated into production. Essential for achieving these advantages was the development of a high-resolution liquid crystal display which is the central core of the set-up and has provided the name for the device.

Simple, robust and low maintenance

The measuring process in the Crystalsizer is fully automated and prevents random errors. In conjunction with the robust measuring principle, the stiff and compact design and the automated adjustment function provide a very reliable device. All optical components are continually flushed by an air stream and that way are protected from contamination, thus making the device effectively maintenance-free.

Light diffraction

When the light from a ring of the LCD falls onto the particles it is diffracted to a varying degree depending on particle size. The diagram shows small particles resulting in a larger diffraction angle α so that the light of outer LCD rings is diffracted onto the detector. For larger particles the opposite is true: Therefore the following formula applies:

$$d_{\text{LCD}} \sim \frac{1}{x}$$

d_{LCD} = diameter of LCD ring
 x = particle size.

Variation of the LCD diameter

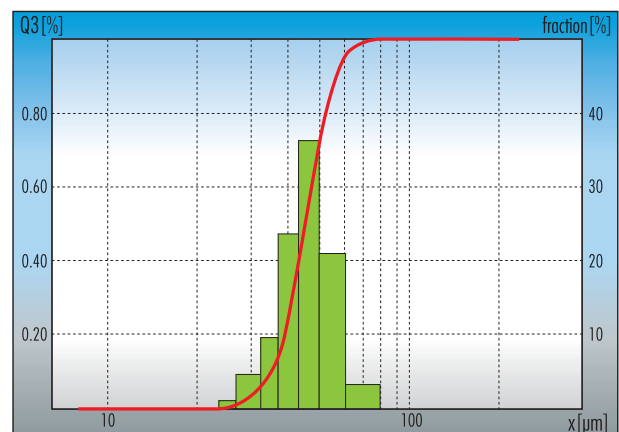
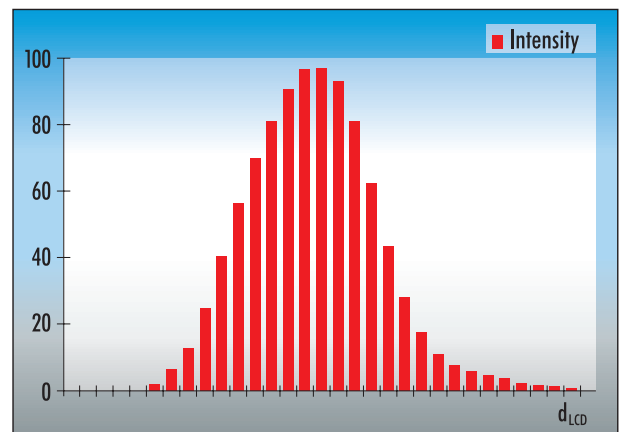
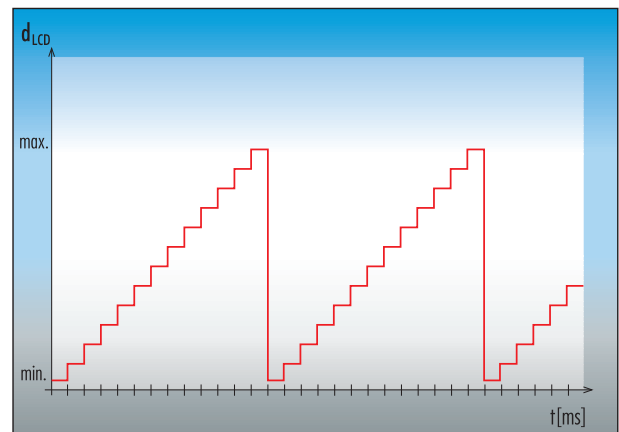
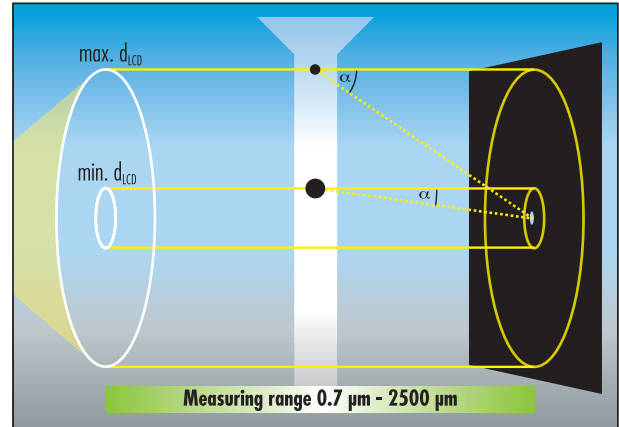
Each ring diameter is directly correlated to a certain particle size. During the measurement the LCD rings are switched through cyclically. This in effect is a search for the particle size distribution of the sample. Each ring diameter is only switched transparent for a few milliseconds at a time, long enough for a precise measured value at the detector.

Intensity distribution

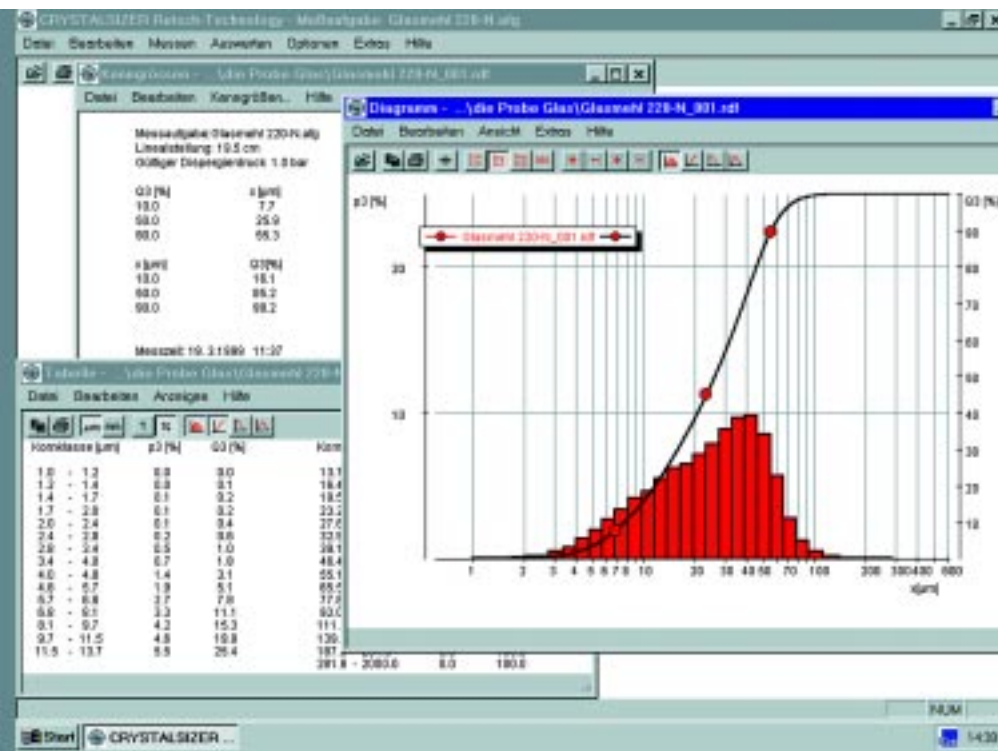
Corresponding to the formula above, the detector receives a certain light intensity for each LCD ring which depends on number and size of the particles in the sample. Many measuring cycles ensure that this intensity is representative for the total sample and thus guarantees a high measuring accuracy. A characteristic intensity distribution is found for each sample.

Measured result

Based on the universal diffraction theory developed by Fraunhofer the software calculates the particle size distribution from the measured intensity distribution. For this calculation no specific parameters are needed. As a defined correlation exists between particle size, LCD diameter and detector signal, the measured result is absolutely trustworthy.



CRYSTALSIZER® - Results and documentation



Clear measuring results

Nowadays precise production monitoring and optimum quality control demand rapid, up-to-date and precise measuring results. For this reason the Crystalsizer allows a graphical display of the result already during the measurement. This makes it possible to immediately check up on raw materials, intermediate and final products at any time and to create a trend analysis of the production process.

At a glance

The Crystalsizer software provides a display of the individual results in the form of tables, diagrams and characteristics. It is also possible to calculate mean values, to compare curves and to monitor freely definable parameters long-term. This shows up variations in production and delivery quality. An easy overview and precision are guaranteed.

Simple and safe operation

Highly developed measuring devices often provide results which in practical operation can neither be used qualitatively nor quantitatively. Therefore measuring and analysis software has been developed for the Crystalsizer which is equally comfortable, of high performance and appropriate in practical applications. The software surface is similar to other well-known Windows™ applications. Its operation is simple and can be learned intuitively. The Crystalsizer software works as standard under Windows™ 95 and 98 and if specifically requested also under Windows™ NT. Users who already work with the Retsch Camsizer will immediately be familiar with the operation as the software layout is identical.

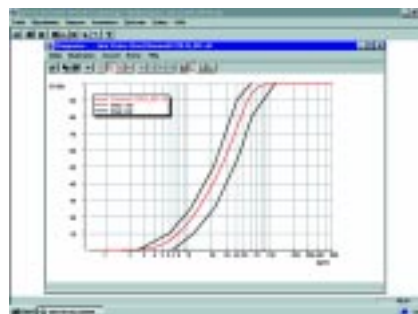
Application orientated software

The Crystalsizer software is intended for daily use. In particular it is possible to change the sample material to be analysed rapidly. The product-specific settings can be defined beforehand and saved in a so-called measuring task. Here the user is supported by a Wizard function which guides him step by step and prevents errors. For switching between recurring measuring tasks only a single operation is required. For preventing manipulation and, subsequently, wrong measurements it is possible to activate password protection. Thus for routine tasks requirements to the operator are kept low.



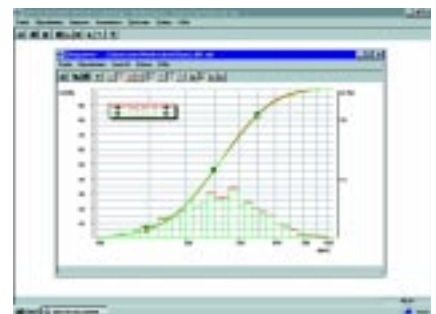
Individual settings

A precondition for convenient operation of the software is that the measuring parameters and measuring classes can be configured and saved individually.



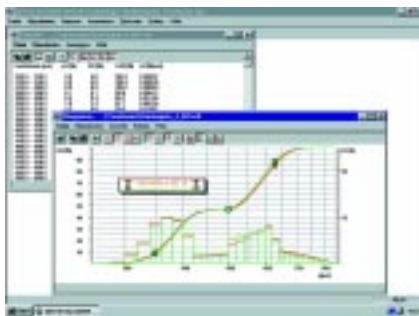
Quality assurance

A comparison of measuring results with specifications or permissible tolerances can already be made while the measurement is being carried out.



Reproducibility

The reproducibility of the analysis is demonstrated by the cumulative volume distribution Q3 (passage curve) and the volume shares p3 (fractions).



Resolution

Even multi-modal particle size distributions can easily be monitored.



Trend analysis

The trend analysis presents quality variations in the supplied or produced materials at a glance.

Easy change-over

Despite all the advantages that the Crystalsizer offers in respect of measuring properties, operation and robustness often further demands are made by industry: it should be possible to continue using existing specifications. The measured results should be comparable to the data gained by the previously used methods. The demands arising from modern methods of testing and monitoring measuring tools must be fulfilled.

We have made a special effort to consider these factors. For example the Crystalsizer software includes a teachable algorithm for matching results to results from other measuring methods. Therefore the specifications not necessarily have to be changed. The communication basis between customer and supplier remains. Several output formats are provided for data export. At any time the system can be calibrated within seconds using a high precision reference system. The measuring record can be structured by the user to common standards (e.g. DIN 66165). This means that Retsch makes it easy for you to decide on replacing an existing method (e.g. air jet sieving) and taking maximum advantage of the Crystalsizer.



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Brief description of the system:

The Crystalsizer® is a compact laboratory device for the particle size analysis of pourable solids. Agglomerating materials can be measured with the help of a dry disperser unit.

Unique advantages are provided by the patented measuring principle of incoherent diffraction. Even in a rough industrial environment precise and reliable sample analysis is possible. Relatively large, representative sample quantities can be measured easily, comfortably and rapidly using the Crystalsizer®.

Scope of supply:

Particle measuring instrument Crystalsizer® with variable LCD light source and photo-multiplier detector; high performance PC of the latest generation incl. operating system, monitor, keyboard and mouse; PC interface cards for hardware communication; modern 32-bit measuring and analysis software ready to run under Windows™ 95/98 (NT optional) with the option of emulating existing analysis methods (e.g. air jet sieving); continuous cleaning by flushing air; optional: dry disperser unit and accessories.

Technical data:

Measuring principle: incoherent light diffraction with liquid crystal display.
Measuring range: 0.7 µm to 2500 µm.
Measuring time: approx. 0.5 to 3 minutes, depending on the required measuring statistics.
Equipment data: Height: approx. 385 (740) mm
Width: approx. 770 (890) mm
Depth: approx. 210 (270) mm
Weight (without PC): approx. 35 kg
Power supply: 230 V / 50 Hz
or 115 V / 60 Hz.

The Crystalsizer® is CE certified and fulfils the applicable guidelines and standards.

Applications:

Purpose: Rapid and precise determination of particle sizes of all pourable and dry dispersible bulk materials, granulates or powders. For an optimum quality assessment of raw materials, products and processes.

Sample materials: Flour, pharmaceuticals, polymers, ceramic powders, sugar, salt, sand, washing power, raw materials for chemical production, metal powders, and many more.

Operating sites: Industrial laboratories, locations close to production, research institutes and universities.

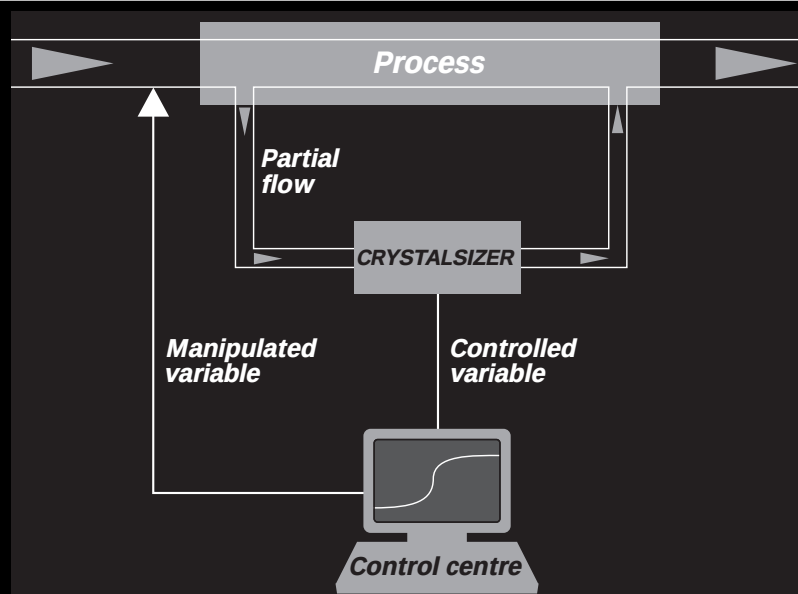
Results:

The Crystalsizer® allows the measurement of particle size distributions with high resolution and accuracy. The results can be presented in graphical form or in tables, both of which can easily be selected and pre-configured. Selected characteristic values are calculated simultaneously. The measuring record can be individually structured to fulfil common standards (e.g. DIN 66165). Furthermore a number of formats are available for exporting the measured results. The software also features analysis options such as mean value calculation and quality trend monitoring.

On-line application

Its innovative measuring principle and its robust construction mean that the Crystalsizer® is suitable for applications integrated in the production line. In such applications, the on-line version of the Crystalsizer® is optimally matched to the specific needs "on site". Usually, this will require some individual adjustments to the design, electronics and software.

Typically, a representative sample of the bulk material is removed from the process for on-line analysis and fed to the Crystalsizer®. Immediately on completion of measurement, the next batch of the product is removed and analysed. This way a precise measured value for the particle size is available at any time. The Crystalsizer® provides continuous quality assurance all day long. Via a control circuit the process parameters can be continuously optimised and that way rejects are efficiently prevented.



Subject to technical modification without notice.

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