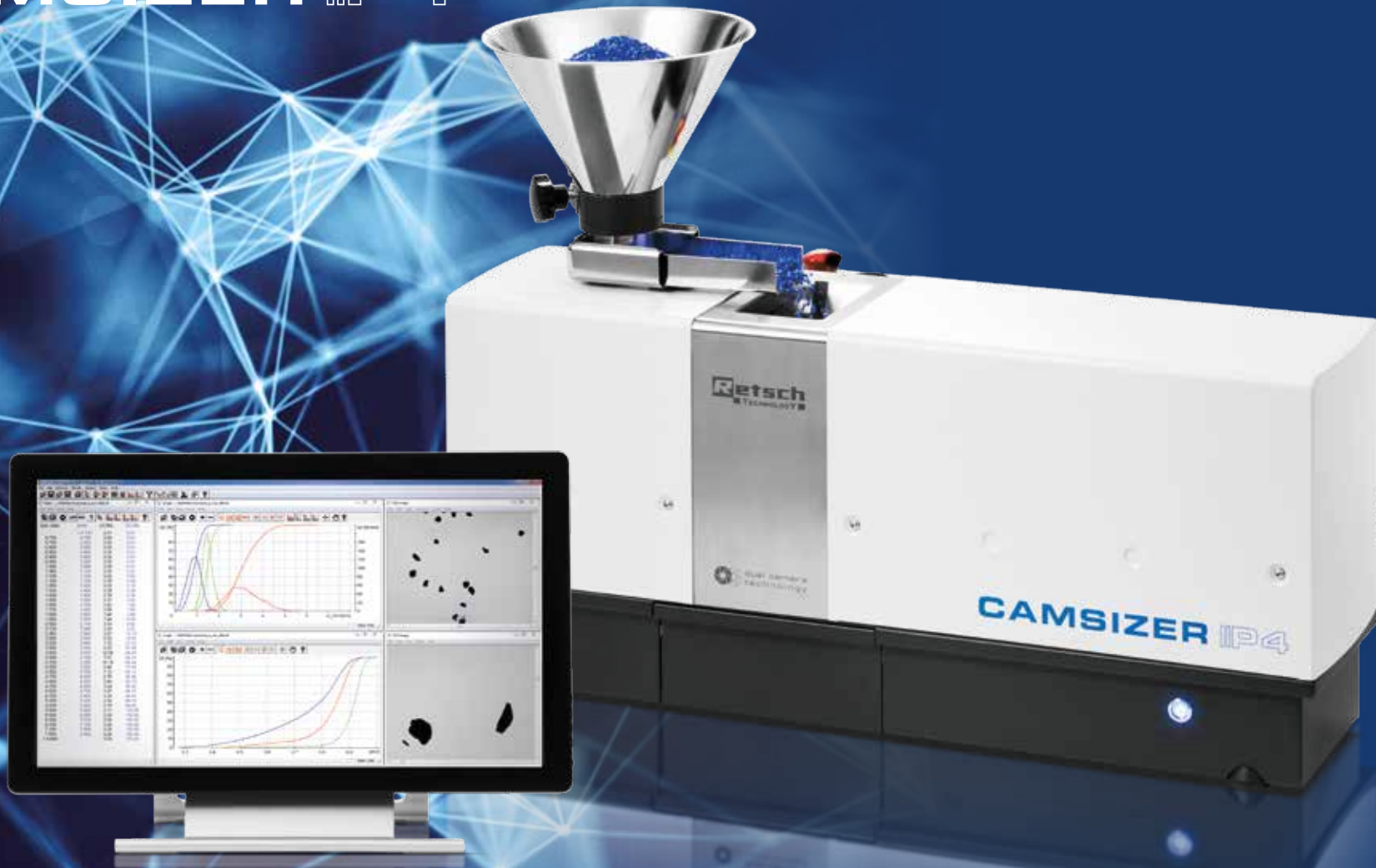


Particle size and shape characterization by
Dynamic Image Analysis



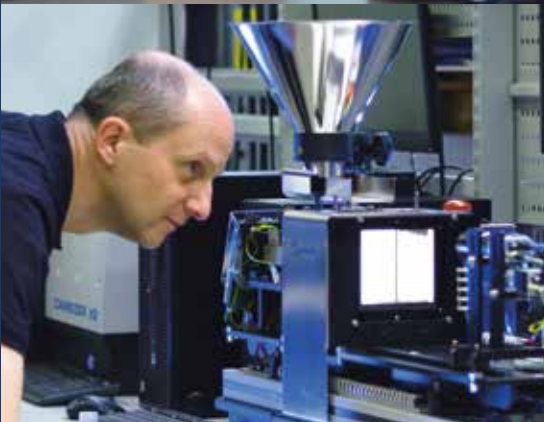
Solutions in Particle Sizing

CAMSIZER IP4



part of **VERDER**
scientific





Retsch Technology – Optical Particle Measurement at Its Best

Quality „made in Germany“ for research and quality control

RETSCH Technology is your superior partner for optical particle characterization. We provide our customers with advanced technologies and comprehensive application expertise to obtain consistently reliable results. The measurement principles used in our particle analyzers are laser diffraction and dynamic image analysis which are suitable for the characterization of a variety of dispersed materials. The analyzers cover a size range from 0.3 nm to 30 mm – from nano particles to pebbles!

Our highly specialized team develops and manufactures the image analyzers at the company's headquarters in Haan near Duesseldorf. Innovation, quality and customer needs are the foundations of our actions. We not only provide first-rate measurement technology but also comprehensive service, thorough application support and hands-on training. As part of the Verder Scientific Division we offer worldwide support through a network of subsidiaries and distributors.

PREMIUM QUALITY



MADE IN GERMANY

CAMSIZER Series

High-resolution dynamic image analysis of particle size and particle shape

With permanently increasing demands for product quality, accurate evaluation from raw materials to intermediate and final products has become indispensable. Automation, high sample throughput and short measurement times make the CAMSIZER system an ideal tool for routine analyses and quality control. A sophisticated evaluation software provides a wealth of valuable information and measurement parameters. Hence the analyzers are frequently employed in research and development applications.

RETSCH Technology has set the standard in dynamic image analysis by inventing the patented dual

camera technology implemented in all instruments of the CAMSIZER series. Unmatched accuracy and reproducibility combined with a wide dynamic measuring range place the CAMSIZER series among the most powerful image analyzers in the world. The product family comprises two models optimized for different application areas:

- ▶ CAMSIZER X2 for fine, agglomerating powders and suspensions
- ▶ CAMSIZER P4 for free flowing bulk materials and granulates





CAMSIZER IP4

Complete Quality Control of Bulk Materials

The CAMSIZER P4 analyzes particle size and shape of dry, free flowing bulk materials in a size range from **20 µm to 30 mm**. The software-controlled feed chute conveys the sample to the measurement zone, ensuring **uniform sample feed** and consistent analysis conditions. The particle stream passes an **ultra-bright planar LED stroboscopic light source**; the resulting shadow projections are captured and evaluated by a camera system. The particles fall freely during analysis, so the procedure is **contact-free and non-destructive**.

The CAMSIZER P4 provides extremely sharp images and determines a variety of different size and shape parameters for each detected particle. Analysis of hundreds of thousands or even millions of individual particles guarantees results with high statistical reliability. The typical measurement time is only **1 to 3 minutes** with **60 images** being evaluated **per second** in real time.



Particle Analyzer CAMSIZER P4

- ▶ Particle size and particle shape analysis from 20 μm to 30 mm without hardware adjustments
- ▶ Broad dynamic range for measuring wide particle size distributions
- ▶ High resolution for narrow mono-modal or multi-modal distributions
- ▶ 100% detection of oversized grains
- ▶ Fully comparable to sieve analysis results
- ▶ A wealth of evaluation options (different size models, a variety of shape parameters, particle library, single frame evaluation, etc.)
- ▶ Outstanding reproducibility
- ▶ Evaluation of 60 images / s in real time
- ▶ Powerful LED light source
- ▶ Virtually maintenance-free

PREMIUM QUALITY



MADE IN GERMANY

Superiority by Design

ADVANTAGE CAMSIZER P4:
The hopper height and the speed of the sample feed are software-controlled which guarantees consistent measurement conditions and outstanding reproducibility.

ADVANTAGE CAMSIZER P4:
The dust-proof housing of the CAMSIZER P4 makes it suitable for use in a production environment. Thanks to its robust construction it is also not sensitive to vibrations.

ADVANTAGE CAMSIZER P4:
Contact-free, non-destructive measurement which permits sample capture and reuse. Variable sample volumes.

ADVANTAGE CAMSIZER P4:
Powerful long-life ultra-bright LED stroboscopic light source ensures high-resolution, distortion-free images.

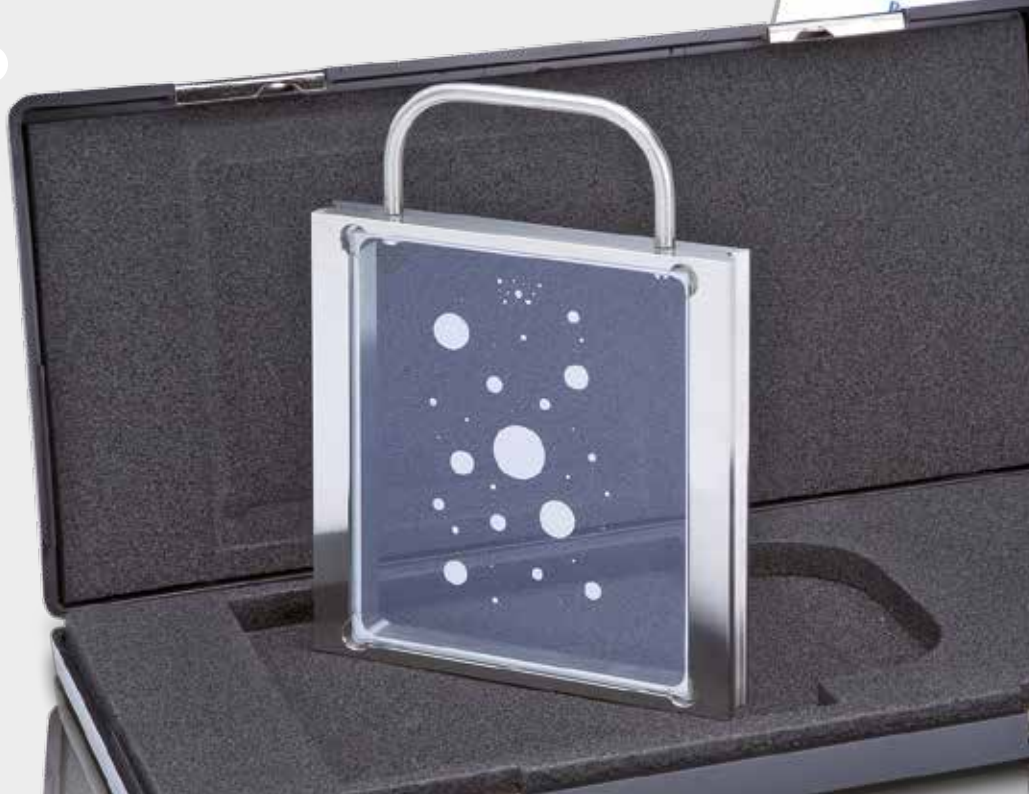


ADVANTAGE CAMSIZER P4:
Compressed-air flushing via Venturi nozzle prevents contamination by dust particles.

ADVANTAGE CAMSIZER P4:
Patented dual camera technology provides highest accuracy over the entire measuring range.



1



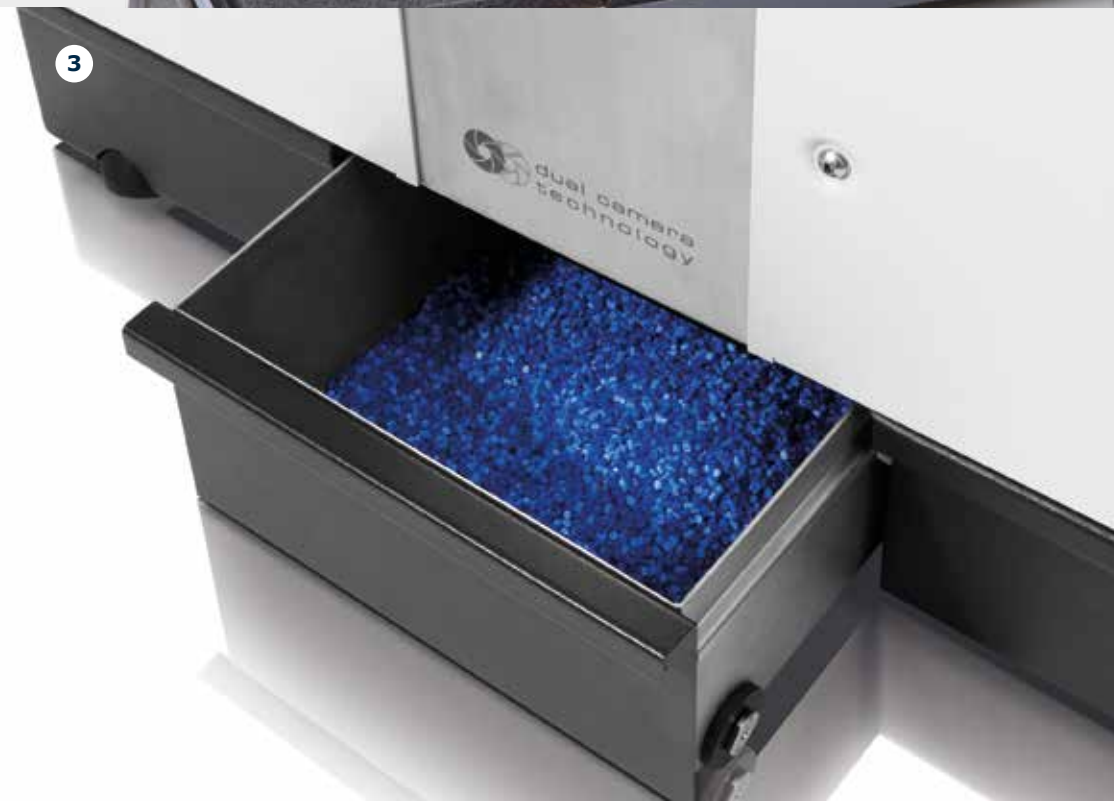
CAMSIZER P4 Highlights

1. Calibration within seconds with a highly precise, certified calibration reticle
2. Typical measurement time of 1 to 3 minutes
3. Excellent statistics thanks to analysis of large particle number

2



3





Patented Dual Camera Technology

The dual camera technology invented and patented by RETSCH Technology is a landmark in the development of image analysis technology. By simultaneously employing two cameras with different magnifications, extremely wide dynamic measuring ranges are obtained. This is accomplished without hardware adjustments or modifications and without compromising accuracy. Each camera is specialized for one measuring range: the ZOOM camera analyzes fine particles with highest precision whereas the BASIC camera detects the larger particles with excellent statistics. A special algorithm combines the information provided by both cameras and delivers the exact

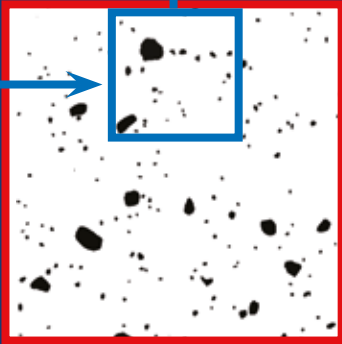
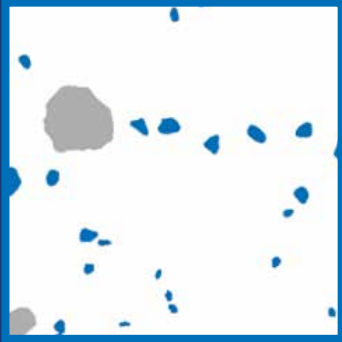
size distribution in a range of more than three decades!

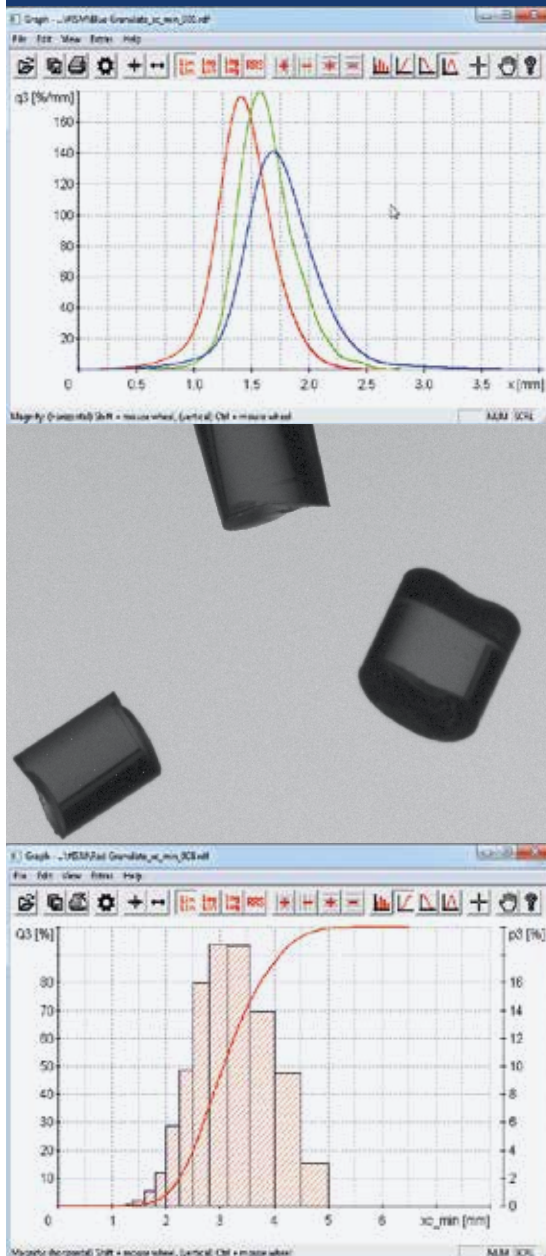
This arrangement resolves a significant drawback of many image analysis systems that employ only one camera, e. g. microscopes. Such instruments either cannot correctly report the fine particles in wide size distributions, or the large particles are not captured due to the small field of view.



Measurement Principle

Two cameras operate during measurement: the BASIC camera (red) analyzes the larger particles, the ZOOM camera (blue) captures the small particles. This procedure ensures optimum measurement conditions for all particle sizes in a distribution.





Powerful Measurement and Evaluation Software

Complex task with a quick and easy solution

All parameters at a glance: Dynamic image analysis provides a wealth of information about the sample material to be analyzed. The high-performance CAMSIZER software measures dozens of parameters from every single particle and presents the results in a clearly structured, standard-compliant measurement report.

Functions like the comprehensive export option and the generation of synoptical tables or trend analyses are routine. Also storage and automatic monitoring of predetermined product specifications are part of the software. Password protection prevents undesired modifications of measurement settings; hence, analyses may also be carried out by non-technical staff.

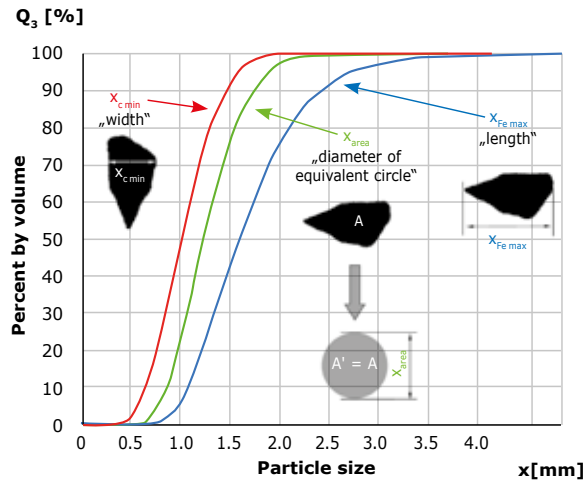
The CAMSIZER software is easily adapted to customer requirements:

- Display of size and shape distributions as graphs or tables
- Up to 3000 freely selectable measurement classes
- Statistic data analysis
- Comparative tables and trend analyses
- Clearly structured measurement protocols
- Different password-protected user levels provided
- LIMS connection standard
- 21 CFR part 11 compliant software version available
- Automatic testing of established threshold values

Particle Size and Particle Shape Parameters

Detailed evaluation – optimum results

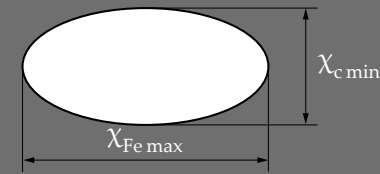
Imaging techniques are the only methods able to detect the various dimensions of irregularly shaped particles. Whereas technologies like laser diffraction or sieve analysis merely ascertain the equivalent spherical diameter, the CAMSIZER P4 additionally measures length and width of every single particle in one analysis. During measurement, each particle projection is scanned in up to 64 directions, thus allowing for shape analysis with high resolution. Shape parameters from ISO 9276-6 include, among others, aspect ratio (width/length), circularity, sphericity, symmetry, compactness, roundness, and convexity.



DIA may use different size definitions

WIDTH / LENGTH RATIO

$$\frac{\chi_{c \min}}{\chi_{Fe \max}}$$



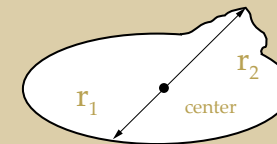
CIRCULARITY

$$\sqrt{\frac{4 \pi A}{U^2}}$$



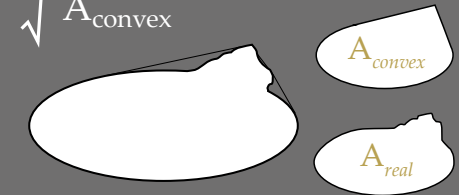
SYMMETRY

$$\frac{1}{2} \left[1 + \min \left(\frac{r_1}{r_2} \right) \right]$$

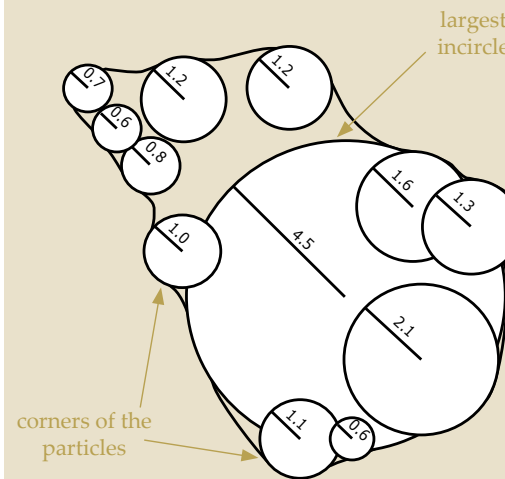


CONVEXITY

$$\sqrt{\frac{A_{\text{real}}}{A_{\text{convex}}}}$$

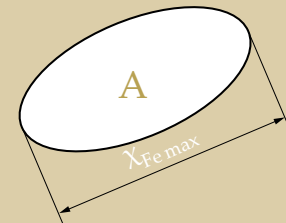


ROUNDNESS



COMPACTNESS

$$\sqrt{\frac{4 A}{\pi \chi_{Fe \max}}}$$

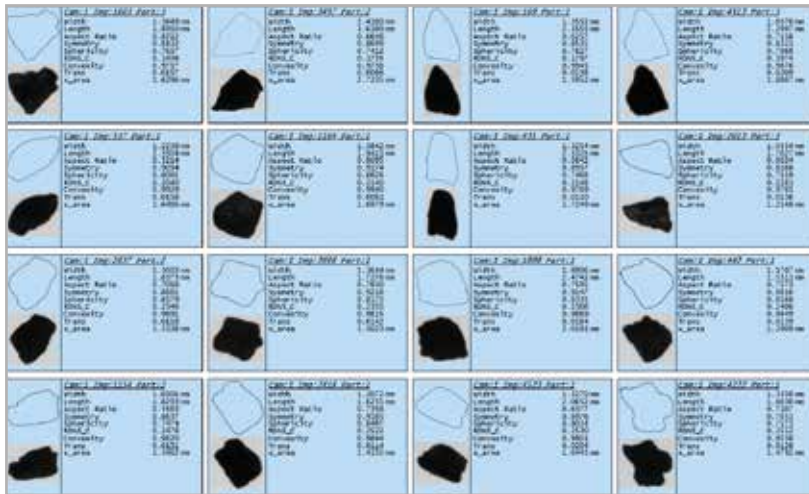


- $\chi_{c \min}$ = width
- $\chi_{Fe \max}$ = length
- A = area
- U = perimeter

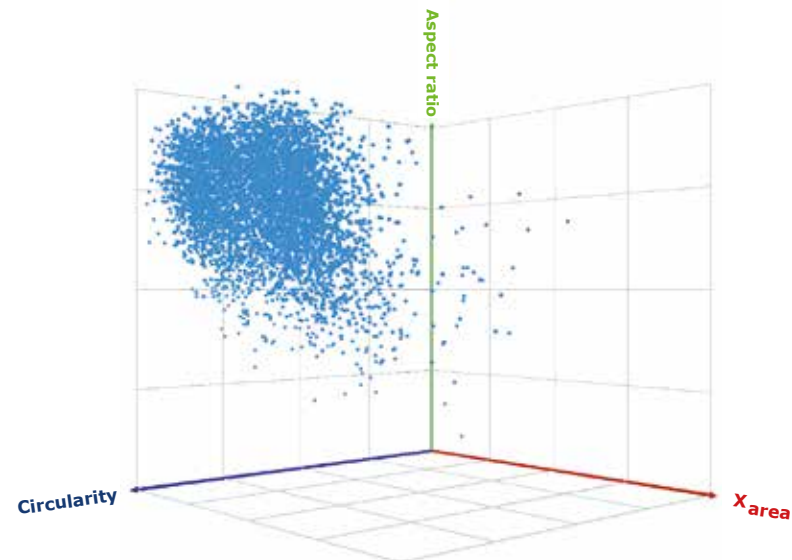
Graphical Presentation of Image Information: Particle X-Plorer

Comprehensive particle database: evaluation of the smallest detail

The results of dynamic image analysis are based on the precise measurement of hundreds of thousands to millions of single particles. The CAMSIZER P4 results provide the highest statistical reliability due to the large representative sample volumes which are analyzed. Moreover, it is possible to save and archive a representative selection of particle images including all measurement parameters from each analysis. The innovative software module Particle X-Plorer imports information on every single particle into the database which allows to find and display particles with specific characteristics or combinations of characteristics. This helps to interpret measurement results, facilitates application development and enhances understanding of the sample material under investigation. Further options of Particle X-Plorer include preparing 3D scattergrams and subsequent filtering and recalculation of the complete data sets.



Evaluation of single particle populations



3D scattergram

Switching from sieve analysis to CAMSIZER P4 is no problem as the analyzer software is equipped with algorithms to correlate to sieve analysis. Thus, it is easily possible to replace time-consuming sieve analysis with CAMSIZER P4 without having to modify trusted quality criteria.



Applications

Optimum solutions for every industry

Many properties of bulk materials, like flowability, solubility, filtration efficiency, reactivity, abrasiveness, and taste, are significantly influenced by particle size. Therefore, particle size determination is commonly used as a part of quality control in many different industries.

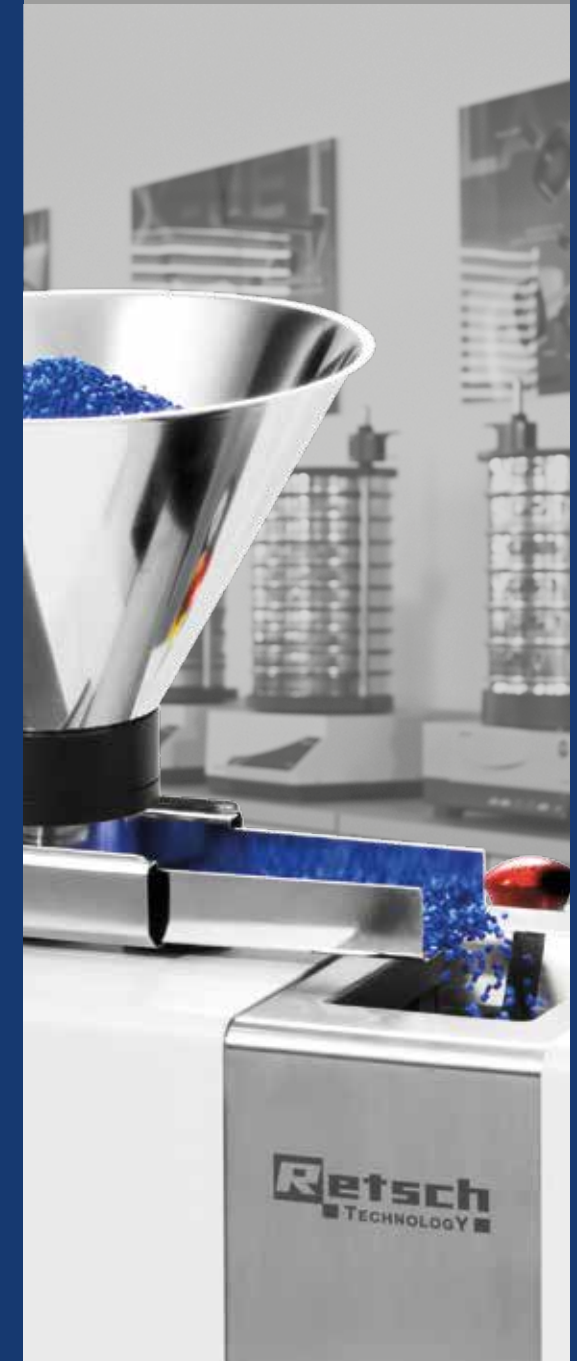
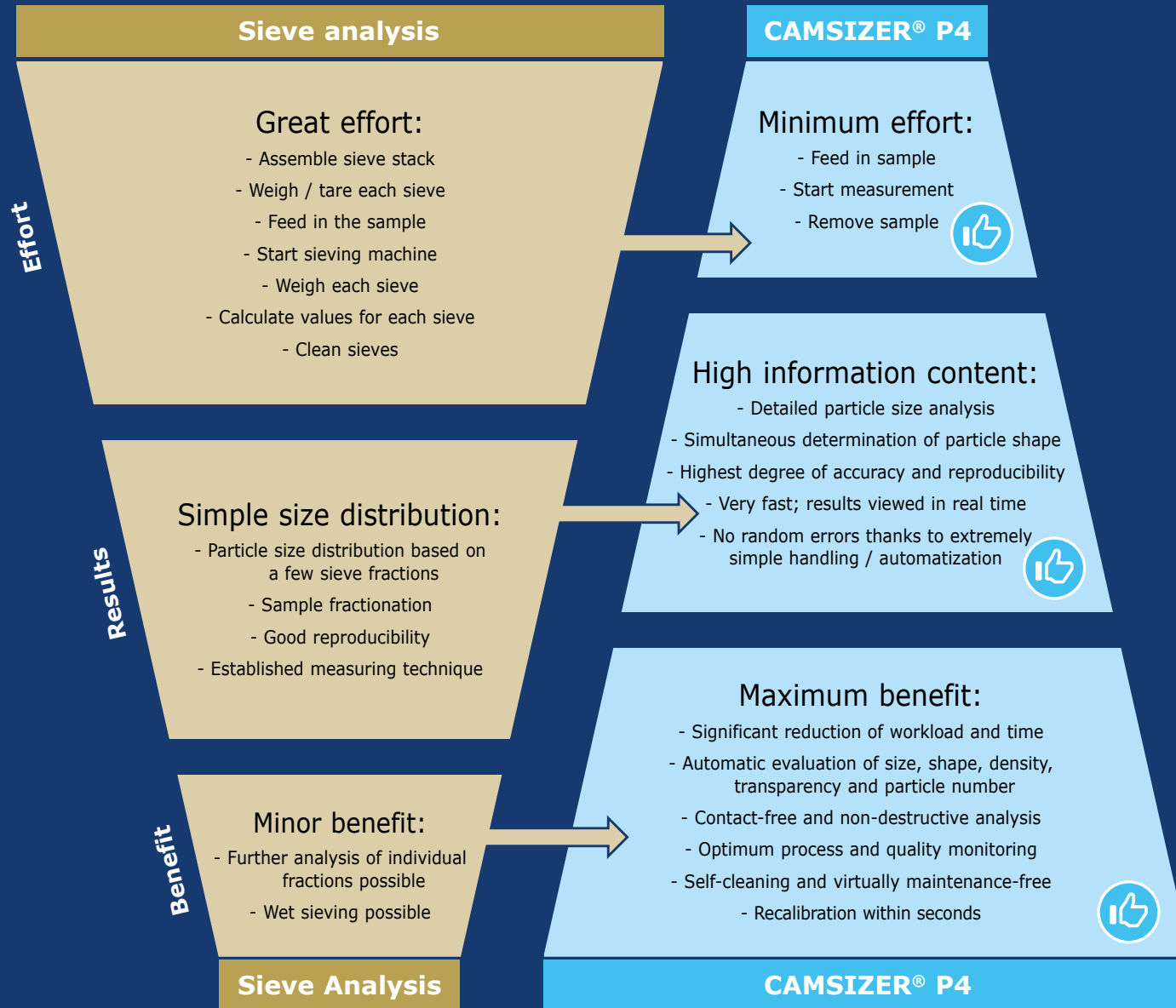
Typical Applications

- Abrasives
- Catalysts
- Chemicals
- Coal/coke
- Coffee
- Construction materials
- Fertilizers
- Food
- EPS
- Extrudates
- Glass / reflective beads
- Pharmaceutical pellets and granules
- Polymers
- Proppants
- Refractory materials
- Salt/sugar
- Sand/gravel
- Superabsorbent
- Wood chips and many more



CAMSIZER® P4 Replaces Sieve Analysis

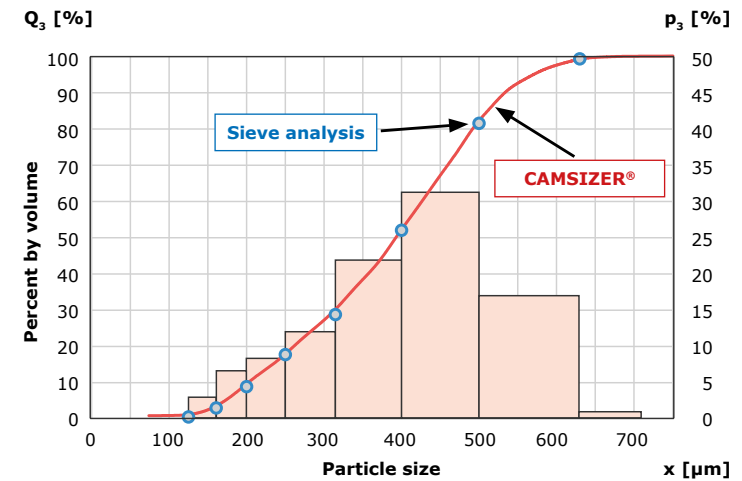
Faster, more precise and additional information



Superabsorbent polymers

CAMSIZER P4 replaces sieve analysis

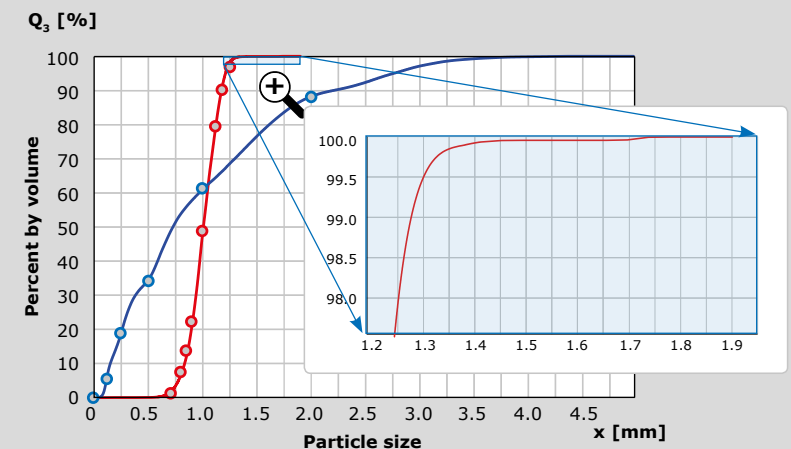
Superabsorbent polymers can absorb large amounts of a liquid relative to their own mass. They are used in granular form, for example in baby diapers as drying agent. Particle size is an essential quality criterion with a distribution that is usually between 100 μm and 1000 μm . Small particle size equals high specific surface area, hence faster liquid absorption. The specifications are typically based on sieve analyses. The CAMSIZER P4 delivers 100% equivalent results and can fully replace this time-consuming and error-prone technique.



Sand

Reliable detection of oversize particles

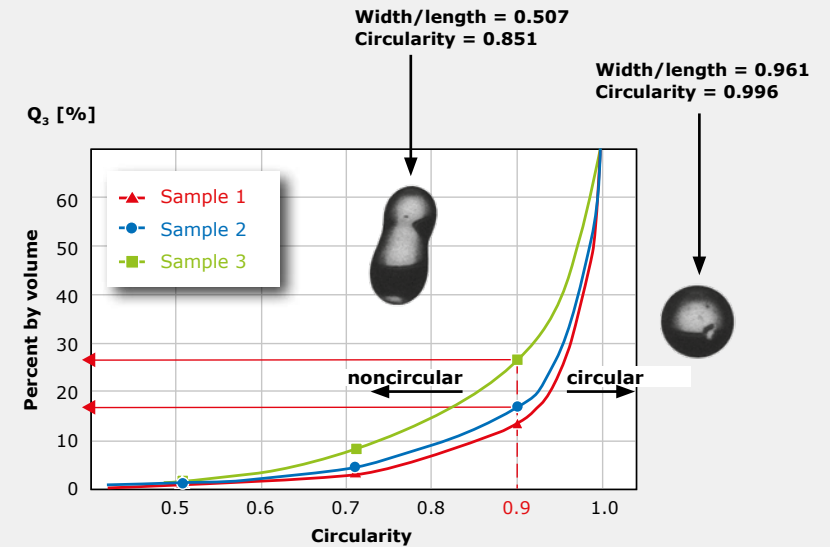
Sand and gravel are among the most important natural resources. The various application fields of sand result in a great variety of requirements with regard to particle size distribution and particle shape. This example shows a sand sample with wide size distribution as well as material with tight fractions and the corresponding sieve analysis results. The results of the two measurement techniques are readily comparable. The sample with narrow distribution contains a few oversized particles which the CAMSIZER P4 reliably detects. This helps to quickly recognize defects or wear of the production sieves.



Glass beads

Shape analysis of reflective beads

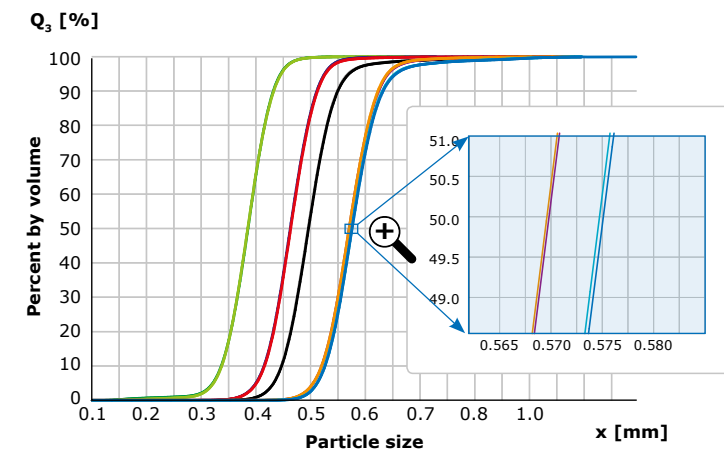
Glass beads are used, for example, in road paints to ensure high retro-reflectivity. Fused or deformed beads reduce the reflectivity and thus harm the product quality. The CAMSIZER P4 is able to measure the percentage of defective beads with highest accuracy. The graphic illustrates the circularity of three different glass bead samples. Sample 1 and 2 have less than 20% of non-round particles (circularity < 0.9) whereas sample 3 contains almost 30%. The image on the right shows a perfectly circular and a noncircular (defective) bead with the corresponding shape parameters.



Pharmaceutical granules and pellets

Reliable process control

The CAMSIZER P4 is ideally suited to characterize the growth of granules and pellets. The results provide information about the thickness and homogeneity of coatings, dust fractions or oversize (agglomerates). This information is the basis for the prediction of such complex parameters as the release rate of an active ingredient from the granule in the human body. The example shows the initial material and four coating steps (two repeated measurements for each). Even the last process step with a coating thickness of only 2.5 μm is reliably detected thanks to the extremely good reproducibility.



The Autosampler

CAMSIZER P4 in continuous operation

The Autosampler is a fully automatic sample feeding system for the CAMSIZER P4 which can be easily retrofitted to existing instruments. It processes up to 14 samples (extendable to 40 samples) in a row without the need for the operator's intervention. The correct measurement settings are read from the barcodes on the sample beaker. The Autosampler is suitable for continuous operation.



Accessories and Options

Optimum configuration for each application

RETSCH Technology offers various sets of feed hoppers and chutes for specific applications. With the help of the feed guides, the sample stream can be oriented in a way that, for example, longish particles like extrudates are always measured in the correct orientation.

Different kinds of sample dividers provide representative sub-samples of powders, granules and many other types of bulk material prior to analysis.



CAMSIZER P4 at a glance

Technical data

CAMSIZER® P4

Measurement principle	Dynamic Image Analysis according to ISO 13322-2	
Measuring range	recommended range 20 µm to 30 mm (with no hardware adjustment)	
Parameters	particle size, shape, density, transparency and number	
Measurement	60 images/s with more than 1,300 pixels each (corresponds to more than 78 million pixels per second)	
Measuring time	approx. 1 to 3 min (depends on required measurement statistics)	
Instrument data	dimensions (H x W x D)	approx. 650 x 850 x 350 mm
	weight (without PC)	approx. 40 kg

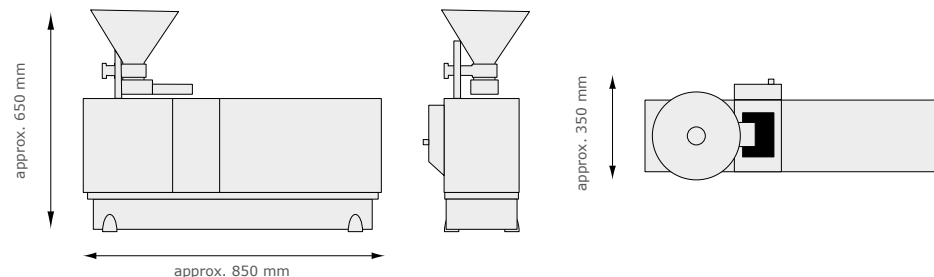
The CAMSIZER P4 is CE-tested and follows the relevant guidelines and standards. It can be supplied with software complying with FDA rule 21 CFR Part 11.

AutoSampler

Compressed air supply	6-8 bar	
Compressed air consumption	max. 10 l/min	
Instrument data	dimensions (H x W x D)	approx. 900 x 1450 x 490 mm
	weight	approx. 60 kg
Sample feed	control of the conveyor belt by light beam interruption during sample container positioning, sample feed by electro-pneumatic robot arm, emergency stop-button	

Fields of application

Scope and purpose	rapid and exact particle size and shape analysis of all dry, flowable bulk materials and powders
Sample material	abrasives, catalysts, chemicals, coffee, construction materials, coal/coke, fertilizer, food granulate, glass/ceramics, metal powders/silicon granulate, pesticides, pharmaceutical pellets, plastic granulate, proppants, refractory products, salt/sugar, sand, washing powder, wood chips and many more



CAMSIZER X2

RETSCH Technology's CAMSIZER X2 is another powerful particle analyzer. This model is also based on the principle of dynamic image analysis and uses the well-proven dual camera technology. Due to an optical system with higher resolution, the CAMSIZER X2 is optimized for analysis of fine particles, powders and suspensions. As these materials tend to agglomerate, different modules for particle dispersion are available for the CAMSIZER X2. These include dispersion by compressed air with variable pressures, wet measurement, and analysis in free fall (like CAMSIZER P4). The measurement range is from 0.8 µm to 8 mm and depends on the dispersion option.

More information at
www.retsch.com/camsizerX2





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