MICROTRAC
PARTICLE CHARACTERIZATION

PRODUCT OVERVIEW

I PARTICLE SIZE & SHAPE
I STABILITY & SHELF-LIFE
I SURFACE AREA , PORE SIZE AND CATALYSIS

EXPERT IN PARTICLE CHARACTERIZATION

part of VERDER

1974
Microtrac launches the first commercial laser diffraction analyzer, Microtrac Model 7991.

1987
Rollout of the high-precision gas adsorption instrument BELSORP 28 by MicrotracBEL.

1998
Retsch Technology develops the CAMSIZER and its patented dual camera system.

2003
Premiere of the catalysis investigation system BELCAT by MicrotracBEL.

2007
Debut of Microtrac's BLUEWAVE laser diffractor that uses real blue lasers for highest resolution and sensitivity.

2011
Introduction of CAMSIZER XT with optional modules for wet and dry measurement.

2013
MicrotracBEL introduces the multi-sample BET surface area measurement system, BELSORP MR6.

2018
Launch of the Microtrac SYNC: laser diffraction and dynamic image analysis combined in one instrument.

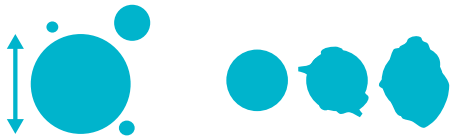
2020
Merging of Retsch Technology, Microtrac & MicrotracBEL into Microtrac under the umbrella of Verder Scientific.

2023
Formulaction, a recognized innovator in the field of Stability & Dispersibility analysis, is integrated into Microtrac.

Three Centers of Excellence

MICROTRAC: A SINGLE-SOURCE SOLUTION PROVIDER FOR PARTICLE CHARACTERIZATION

PARTICLE SIZE & SHAPE FOR PARTICLE ANALYSIS



Size & Distribution | Shape

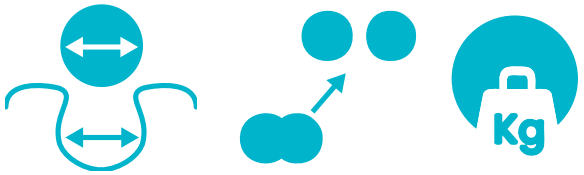
Our expertise in particle size distribution and shape analysis ensures optimal product quality control and supports advanced research efforts. At the core of our technology are **Dynamic Image Analysis (DIA) used on the Camsizer** and a combination of **Laser Diffraction (LD) and Dynamic Image Analysis used on the SYNC** systems. These two technologies cover all your needs for particle size analysis, ranging from 10 nm to 135 mm, whether for dry or wet samples. Our unique size & shape analysis technology utilizes advanced light scattering, state-of-the-art cameras, and sophisticated computational software to deliver outstanding accuracy and repeatability.

COLLOIDS AND FORMULATIONS CHARACTERIZATION

Particle size | Zeta potential | Stability & Shelf-Life

When working with colloids or formulations, the three main parameters to consider are **particle size, zeta potential and stability/shelf-life**. At Microtrac, we address all these needs with our comprehensive technology platforms: **NANOTRAC, STABINO, and TURBISCAN**. Our solutions analyze these critical factors to ensure rapid R&D and quality control for the highest product quality. Utilizing **Dynamic Light Scattering (DLS), Static Multiple Light Scattering (SMLS), and Zeta Potential (ZP)**, our systems offer unique features such as non-dilution, high accuracy, and fast measurement—enabling you to make fast decisions based on reliable data.

GAS ADSORPTION FOR MATERIALS CHARACTERIZATION



Surface Area & Pore size | Catalysis | Density

We offer advanced solutions for measuring surface area, porosity, and catalytic properties of materials. The MICROTRAC analyzers, celebrated for their precision in **gas and vapor adsorption measurements,** determine BET surface area and pore size distribution for both porous and non-porous materials. These analyzers employ cutting-edge gas adsorption technology and are widely used in various sectors, including Research and Development, Quality Control, and Quality Assurance. These tools are trusted worldwide, reflecting the renowned craftsmanship and quality of Japanese engineering, with comprehensive support provided by our competence centers in Japan (Osaka), Germany (Haan), USA (Newtown, PA) and France (TOULOUSE). The **BELSORP** and **BELPORE** analyzers are essential for achieving accurate gas and vapor adsorption analysis.

PARTICLE SIZE & SHAPE

Laser Diffraction

LASER DIFFRACTION (LD) is a leading technique for analyzing particle size in both research and industry settings. It is renowned for its precision, versatility and its broad range of applications measuring particle sizes from 10 nanometers to 4 millimeters. The particle size is measured by detecting the angular intensity of the scattered light. Small particles scatter light at large angles, while large particles scatter light at small angles relative to the laser beam.

The SYNC uses a state of the art laser diffraction architecture with a unique Tri-Laser arrangement. The scattered light can be measured at various angles up to 163 degrees and with up to 151 channels. All data is collected continuously throughout the measurement and analyzed using MICROTRAC's innovative modified Mie algorithms for high precision and accurate particle size distribution. While the Laser Diffraction measurement is taking place, a high-speed camera is also taking live images of the sample. This patented synchronous measurement of the same sample, in the same sample cell at the same time is unique to the SYNC.

0.01 µm – 4 mm

SYNC

- laser diffraction & dynamic image analysis combined in one analyzer
- synchronous size and shape analysis from 0.01 to 4,000 µm
- dispersion modules enable fast switch between wet & dry measurements
- easy-to-use operating software
- advanced design for optimized sample dispersion

0.01 µm – 2 mm

FLOWSYNC

- wet dispersion unit
- resistant to organic solvents
- integrated ultrasonic probe
- self-cleaning mechanism
- fully automatic operation

0.2 µm – 4 mm

TURBOSYNC

- dry dispersion unit
- sample volumes as small as 0.1 cc
- consistent control of aspiration
- measurement time of 10 seconds with TURBOSYNC autoscan

0.5 µm – 2 mm

AEROTRAC II

- analyzer for droplets, spray particles, powder, mist, etc.
- accurate particle analyses at short intervals (0.02 ~ 500 msec)
- equipped with a semi-conductor laser
- different measurement modes to support various applications
- including multiple scattered light correction software as a standard

measurement range *for dry samples* *for wet samples* *add-on for existing instrument*

PARTICLE SIZE & SHAPE

Dynamic Image Analysis

0.8 µm – 5 mm

CAMSIZER X2

(with X-DRY module & X-JET cartrigde)

- unique dual camera system
- for wet & dry samples
- efficient high-pressure dispersion for particles as small as 1 µm

10 µm – 8 mm

X-FALL CARTRIDGE

(for X-DRY module)

- contact-free dispersion of free-flowing, non-agglomerated particles
- complete sample recovery
- no contamination

0.8 µm – 1 mm

X-FLOW MODULE

- X-Change module for suspensions & emulsions
- integrated ultrasonic module
- resistant to organic solvents
- automatic fill and rinse
- liquid volume 200 ml to 700 ml

20 µm – 30 mm

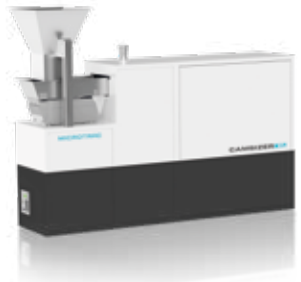
CAMSIZER 3D

- dynamic image analyzer for granulates & bulk material
- proven dual camera technology
- patented 3D measurement
- alternative to sieve analysis

30 µm – 5 mm

CAMSIZER S1

- 12 Mpixel camera for efficient analysis: high-resolution, excellent repeatability
- easy operation for QC requirements with high sample throughput
- cost-efficient alternative to sieve analysis



160 µm – 135 mm

CAMSIZER XL

- non-contact measurement of large particles
- more than 40 morphological parameters (incl. 3D)
- customizable sample introduction

product is CE certified *new product*

Information about particle size & shape is an important aspect of process and quality control. All DYNAMIC IMAGE ANALYSIS (DIA) systems by Microtrac determine the particle shape of the sample material in a detailed and representative manner.

Due to its superior capability, dynamic image analysis is often used as an alternative to conventional methods such as sieve analysis.

The unique dual camera measuring setup of the CAMSIZER 3D / X2 makes it possible to measure an extremely wide dynamic size range accurately, without having to switch measuring ranges or making hardware adjustments. The sample is transported to the measurement field by a vibratory feeder. During the measurement the basic camera records large particles, while the zoom camera records the small ones.

The CAMSIZER 3D detects particles in free fall several times in different orientations (particle tracking) so that the shape of the particles can be determined with the highest accuracy.

The MICROTRAC solutions cover a wide range of APPLICATIONS. Our analysis systems for particle size & shape are used in numerous industry segments, including the agricultural industry, geology, for catalysts, coal & carbon black, building materials, glass, metal powders, plastics, as well as in the chemical, pharmaceutical and food industries.

PARTICLE SIZE & SHAPE

Applications

COATINGS
Paint, inks, pigments...

CONSTRUCTION MATERIAL
Sand, gravel, cements, glass and glass beads, wood chips...

PHARMACEUTICALS
Pills and pellets, active ingredients...

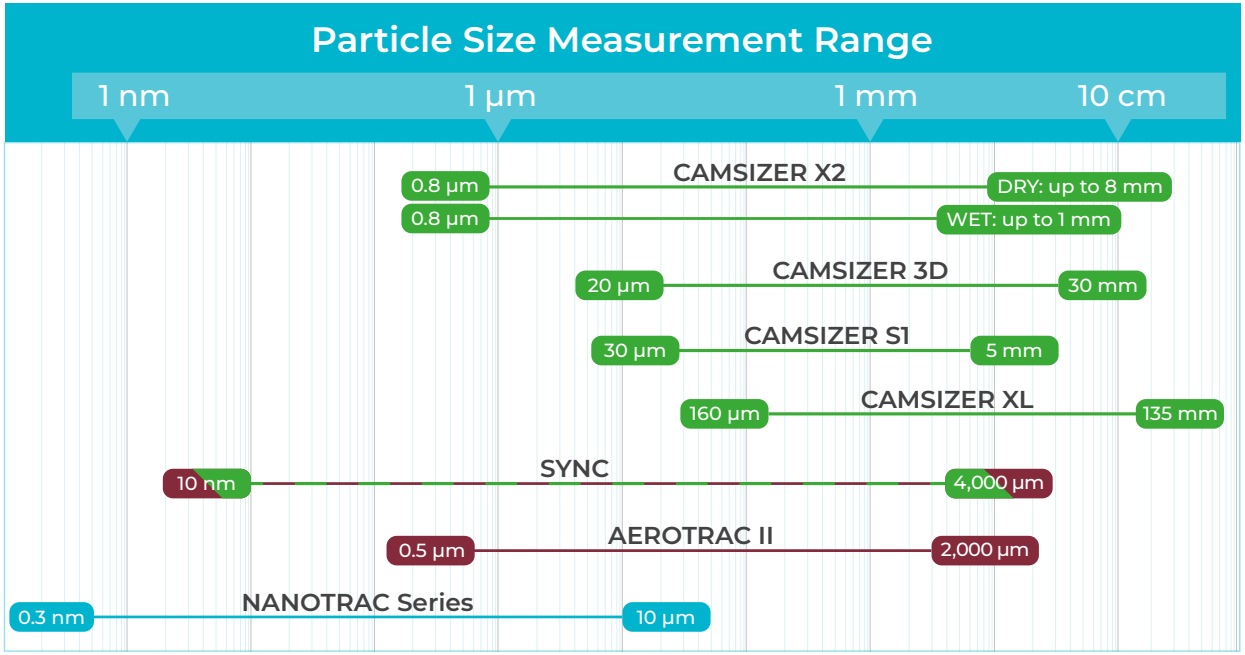
ENERGY
Battery materials, coal & coke...

CHEMICALS
Activated carbon, catalysts, metals powders, polymers, superabsorbent, refractory products, supporting agents, minerals ...

FOOD
Salt and sugar, powder, coffee, milk, beverages ...

ADDITIVE MATERIALS
3D printing, metal powders, plastics, ...

OTHERS
Abrasives, ceramics, extrudates, seeds, fertilizers...



COLLOIDS AND FORMULATIONS

Particle Size & Zeta Potential

0.3 nm – 10 µm

NANOTRAC FLEX

- external “dip-in” probe with 180° backscatter
- allows for turning any vessel into a sample cell
- small volume, as little as one drop of liquid
- universal solvent compatibility
- wide concentration range from ppm to 40 vol %

STABINO ZETA

- zeta and streaming potential in one measurement
- integrated titrator
- suitable for particles from 0.3 nm to 300 µm
- wide concentration range from 0.01 to 40 vol %
- can be combined with NANOTRAC FLEX for particle size analysis

0.3 nm – 10 µm

NANOTRAC WAVE II

- particle size with fixed optics and removable sample cell (Teflon or stainless steel).
- zeta potential via electrophoresis
- reference beating and 180° backscatter

for wet samples *product is CE certified*

Microtrac's innovative approach on DYNAMIC LIGHT SCATTERING (DLS) is based on a unique probe design. By focusing the laser probe at the material interface, the benefits of a short path length are combined with Reference Beating and 180° back-scatter, delivering excellent accuracy, resolution and sensitivity. The DLS signal is evaluated by using a Fast Fourier Transformation.

COLLOIDS AND FORMULATIONS

Stability and Shelf-Life

TURBISCAN offers the ability to investigate the dispersion state, the stability and the shelf-life of liquid dispersions (emulsions & suspensions) and formulations without any dilution, even on highly concentrated samples (up to 95% v/v).

Static Multiple Light Scattering (SMLS) is based on measuring the transmission and backscattering intensities versus the sample's height and aging time. It offers an extraordinary resolution to detect size and concentration variation. Therefore, particle diameter evolution (like aggregation, flocculation, coalescence) and concentration change (like sedimentation, creaming, phase separation) can easily be detected and monitored, up to 1,000 times faster than visual observation.

SMLS is in perfect agreement with ISO/TR 13097's recommendation regarding shelf-life and stability measurement as a direct optical method that does not require sample preparation (such as dilution) and is the leading technology to measure **stability** and **shelf-life.**

1 sample – RT to 60°C

TURBISCAN LAB

- From 1nm up to 1mm, conc. up to 95%
- temperature range from RT to 60°C
- fast destabilization detection
- Turbiscan Stability Index (TSI), mean particle size kinetic and particle size distribution

3 sample – 20°C to 60°C

TURBISCAN TRILAB

- From 1nm up to 1mm, conc. up to 95%
- temperature range from 20°C to 60°C
- fast destabilization detection
- Turbiscan Stability Index (TSI), mean particle size kinetic and particle size distribution

6 sample – 4°C to 60°C

TURBISCAN TOWER

- From 1nm up to 1mm, conc. up to 95%
- temperature range from 4°C to 80°C
- fast destabilization detection
- Turbiscan Stability Index (TSI), mean particle size kinetic and particle size distribution

54 sample – RT to 60°C

TURBISCAN AGS

- From 1nm up to 1mm, conc. up to 95%
- 3 independent storage racks from RT to 60°C
- fast destabilization detection
- Turbiscan Stability Index (TSI), mean particle size kinetic and particle size distribution

1 sample – RT to 60°C – mixing

TURBISCAN DNS

- From 1nm up to 1mm, conc. up to 95%
- stability and dispersibility via mixing and circulating function
- temperature range from RT to 60°C
- Turbiscan Stability Index (TSI), online particle sizing and particle size distribution

measurement range *for wet samples* *new product* *online analyzer for process loops* *product is CE certified*

COLLOIDS AND FORMULATIONS

Applications

CHEMICALS & POLYMERS

Surfactants, stabilizers, polymers and biopolymers, fillers, pigments, latexes, solvents, ...

PHARMACEUTICALS

Injectables, parenterals, vaccines, drug delivery systems, skin treatments, inhalers, cough syrups, ophthalmic suspensions, ...

COATINGS, PAINTS & INKS

Water-based, solvent-based, resins, varnishes, inks, primers, protective and special coatings, ...

BATTERY & ELECTRONICS

Anode & cathode slurries, CMP slurries, multilayer capacitors, LCD and LED display

FOOD & BEVERAGES

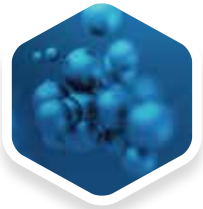
Flavor emulsions, beverages, milk and dairy products, vegetable drinks, plant protein, wine & beers, additives, gums and stabilizers, ...

HOME & PERSONAL CARE

Creams & lotions, moisturizers, sunscreens, detergents, fragranced formulations, cleansers, foundations, makeup, nail polishes, ...

OIL & LUBRICANTS

Water-in-oil demulsification, enhanced oil recovery, drilling fluids, crude oils, heavy fuels, fuel & oil additives, metal-working fluids, lubricating agents, ...



AND MANY MORE

Agrochemicals, building materials, colloidal suspensions, nanoparticles...

TURBISCAN SMART ANALYSIS

TURBISCAN Stability Index (TSI)

The TSI is a Turbiscan-specific parameter designed for formulators to compare and characterize the physical stability of various formulations with a single click and a single, comparable and reproducible number. It enables the quantification of any type of destabilization, thanks to a one-click calculation that is a robust and completely user-independent tool.

Microtrac's STABILITY AND DISPERSIBILITY instruments can analyze a very wide variety of samples: opaque or clear, highly concentrated and very diluted, from nanoparticles to large floccs (mm), emulsions, suspensions, colloids, foams, ...

VISIT OUR APPLICATIONS DATABASE

Interested to hear more about applications in each industry, visit the Microtrac website

START EXPLORING!

www.microtrac.com/applications

MATERIALS CHARACTERIZATION

Surface Area & Pore Size Distribution

The SPECIFIC SURFACE AREA is calculated via BET theory. This theoretical model can be applied to either single point or multi-point adsorption measurements. The single-point BET is often used for quality control applications. More accurate data can be obtained by multi-point BET.

The PORE SIZE DISTRIBUTION via gas adsorption is measured through N_2, Ar or CO_2 isotherms as a standard, enabling analysis of the pore size from several hundred nanometers down to the molecular size range.

The following methods can be utilized for CATALYST EVALUATION: fully automated catalyst analyzer (TPD / TPR / TPO), Pulse chemisorption, single-point BET and breakthrough curve measurement available.

∅ 0.7 nm – 500 nm (opt. 0.35 ~)
0.01 m²/g or more

BELSORP MINI X

- simultaneous measurement of up to 4 samples
- short-time measurement by “Gas Dosing Optimization” function
- high reproducibility with Advanced Free Space Measurement (AFSM™) and AFSM™2

∅ 0.35 nm – 500 nm
0.0005 m²/g or more

BELSORP MAX G

- micro- / meso- / macropore measurement (BET) with 1 sample port
- measurement without He gas via the new Advanced Free Space Measurement 2 (AFSM2™)
- high-performance PSD analysis

∅ 0.35 nm – 500 nm
0.0005 m²/g or more

BELSORP MAX X

- highest throughput with simultaneous measurement of up to 4 samples
- Advanced Free Space Measurement: AFSM™ and AFSM2™ (Helium-free)
- low specific surface area evaluation by Kr adsorption at 77.4 K
- chemisorption option
- special models: MAX X HT; MAX X HP

0.01 m²/g or more

BELSORP MR1

- fast & precise single-point BET via flow adsorption method
- auto zero function with highly sensitive thermal conductivity detector (TCD)
- calibration valve, Dewar elevator & cooling fan

measurement range *pore size diameter* *uses gases* *uses vapors*

MATERIALS CHARACTERIZATION

Catalyst Evaluation & High-Pressure Gas Adsorption

BELCAT II

- fully automated catalyst analyzer (TPD / TPR / TPO / Pulse), breakthrough curve measurement available
- precise gas control by 3 high-performance mass flow controllers
- automatic gas injection system for calibration
- measurable gas/vapor: H_2, O_2, CO, CO_2, NO, N_2O, NH_3, H_2O, VOC, etc.
- measurement temperature: -120°C – 1100°C

BELSORP HP

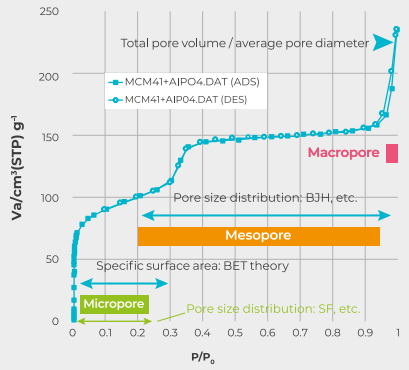
- high-pressure gas adsorption analyzer
- maximum pressure: 13.5 MPa
- compact design, easy-to-use interface
- operating temperature range: -10°C to 800°C optional -196°C
- H_2, CO_2, O_2, N_2, non-corrosive gas

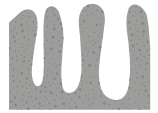
1 amu – 200 amu

BELMASS II

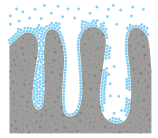
- mass spectrometer for both qualitative and quantitative gas analyses
- heated hose enables the analysis of vapors
- built-in vacuum pump
- provides information on desorbed gases of gas / vapor mixtures and their breakthrough curves when combined with BELCAT II

ADSORPTION / DESORPTION ISOTHERM

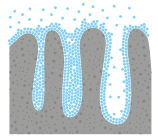




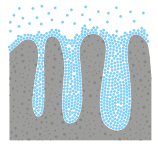
BEFORE ADSORPTION



MONOLAYER FORMATION / MICROPORE FILLING



MULTILAYER FORMATION / CAPILLARY CONDENSATION



FILLING ALL PORES / ADSORPTION INTO VOIDS

new product *product is CE certified*

MATERIALS CHARACTERIZATION

Density Measurement & Sample Preparation

The gas displacement method is used for the DENSITY MEASUREMENT. An inert gas, such as nitrogen or helium, is used as the displacement medium. The gas is directed to the closed sample compartment and then expands into an empty compartment with a defined volume. The pressure difference allows to determine the exact sample volume. The sample density can be calculated from the measured sample volume and the mass.

Microtrac provides optional systems for SAMPLE PREPARATION. All models guarantee a high reproducibility of the sample's condition.
The sample pretreatment can be done independently of the measurements.

BELPYCNO

- quick & reliable true density measurements via gas displacement
- highly precise measurement with variable cell volumes (1 cm^3 - 10 cm^3)
- sample cell cap without grease
- convenient one-hand operation via touch screen
- measurable gas: He, N_2 or other inert gases

BELPYCNO L

- fully automated density & volume measurement of powders, granulates, porous materials, mixtures, pastes and liquids
- multi-volume capability for easy choice of best configuration
- built-in accurate ATC (Automatic Temperature Control)
- variable sample volume (4 cm^3 - 150 cm^3)

BELPREP VAC III

- vacuum / heat degassing pretreatment device for specific surface area & pore distribution analysis (flow / heat optional)
- can be operated independently to perform pre-processing parallel to the measurement
- 6 pretreatment ports

BELPREP VAC II

- vacuum / heat degassing pretreatment device for specific surface area & pore distribution analysis
- can be operated independently to perform pre-processing parallel to the measurement
- 3 pretreatment ports

uses gases *product is CE certified*

MATERIALS CHARACTERIZATION

Mercury Porosimetry

Hg CE

∅ 330 µm – 15 µm, 3000 µm with ultramacropore dilatometer ∅ 180 µm – 3.8 µm, 1000 µm with ultramacropore dilatometer

BELPORE LP

- automatic sample degassing & vertical mercury filling, maximum pressure: 400 kPa
- 5 dilatometer models for various sample dimensions & shapes
- particle size can be determined automatically by second intrusion
- measurement of wet possible
- avoids any risk of powder elutriation via special proportional valve

Hg CE

∅ 40 µm – 0.01 µm ∅ 15 µm – 0.0036 µm

BELPORE HP

- operates up to a maximum pressure of 414 MPa
- particularly suited for ceramics, sintered metals, very hard materials, and solids with porosity in the macro- and mesopore range
- highly recommended for R&D and QC labs
- high accuracy and reproducibility via PASCAL method

Hg CE

∅ 40 µm – 0.015 µm ∅ 15 µm – 0.0065 µm

BELPORE MP

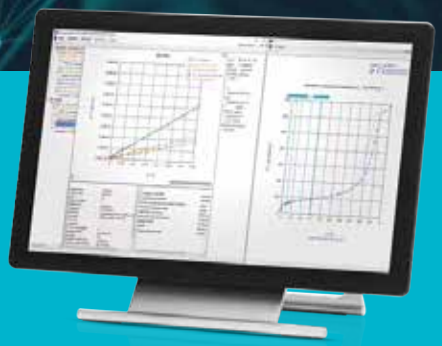
- operates up to a maximum pressure of 228 MPa
- automatic autoclave opening / closing simplifies operation
- different dilatometer sizes to cover all materials & sample types
- for hetero- & homogeneous material with low as well as high porosity

∅ *particle size diameter* ∅ *pore size diameter* Hg *uses mercury porosimetry*

MERCURY POROSIMETRY is the most widely used method for determining the pore size distribution of solids in the range of macro- and mesopores. This technique provides reliable information about the pore size distribution, sample volume and the apparent density of most porous materials, regardless of their type and shape.

The method is based on the intrusion of mercury into a porous system under applied pressure. Using the Washburn equation, the corresponding pore size can be calculated from the pressure.

Microtrac's BELPORE series uses the PASCAL method for pressure build-up control. With this method an optimized speed of the pressure build-up is set and controlled automatically. This allows for shorter measuring times with guaranteed equilibrium conditions.



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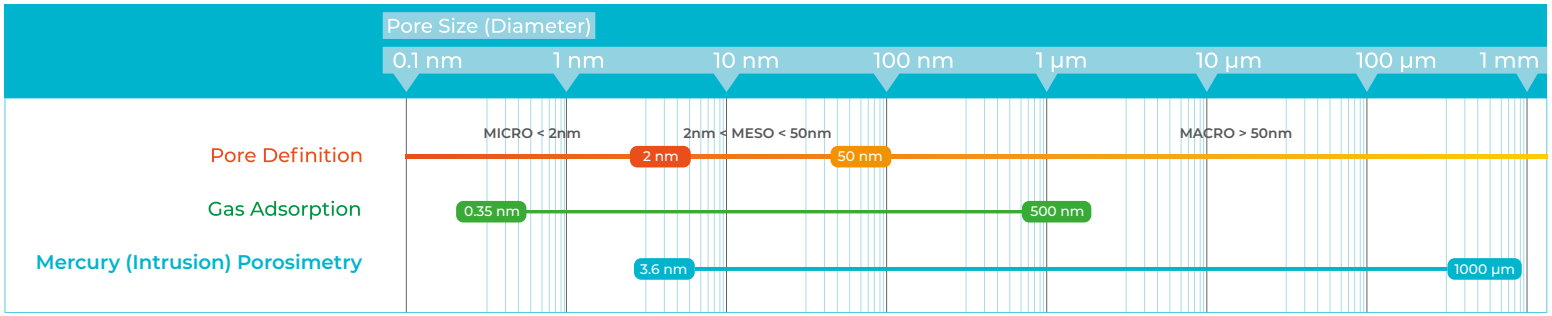
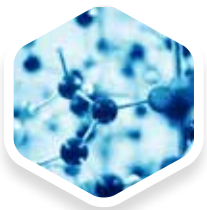
MATERIALS CHARACTERIZATION

Applications



CATALYSTS

BATTERIES



CARBON

PHARMACEUTICALS

COSMETICS

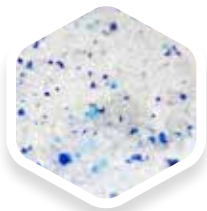
CEMENT

TONER

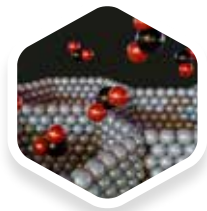
PIGMENTS

CERAMICS

SEMICONDUCTORS



ADSORBENTS



MOFS / PCPS

VERDER – ENABLING PROGRESS

Microtrac is part of Verder, the scientific division of the Verder Group. Five more companies are part of the scientific division; Retsch, Carbolite Gero, QATM, Eltra and Erweka. Together we set new standards in the development and manufacturing of lab and analysis equipment, as well as sample preparation tools, which are used in areas such as quality control, research and development.

For more details about the extensive Microtrac product portfolio please visit our website: **www.microtrac.com**

MICROTRAC
PARTICLE CHARACTERIZATION

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VERDER

ENABLING PROGRESS

Verder Scientific is composed of leading laboratory equipment companies active in sample preparation and analysis for quality control as well as research & development purposes.

As trusted solution partner, Verder Scientific enables thousands of companies to ensure economic, technological and environmental progress by mastering their scientific applications. Together, we make the world a healthier, safer and more sustainable place.

CARBOLITE GERO
ELTRA
Retsch
QATM
MICROTRAC
ERWEKA