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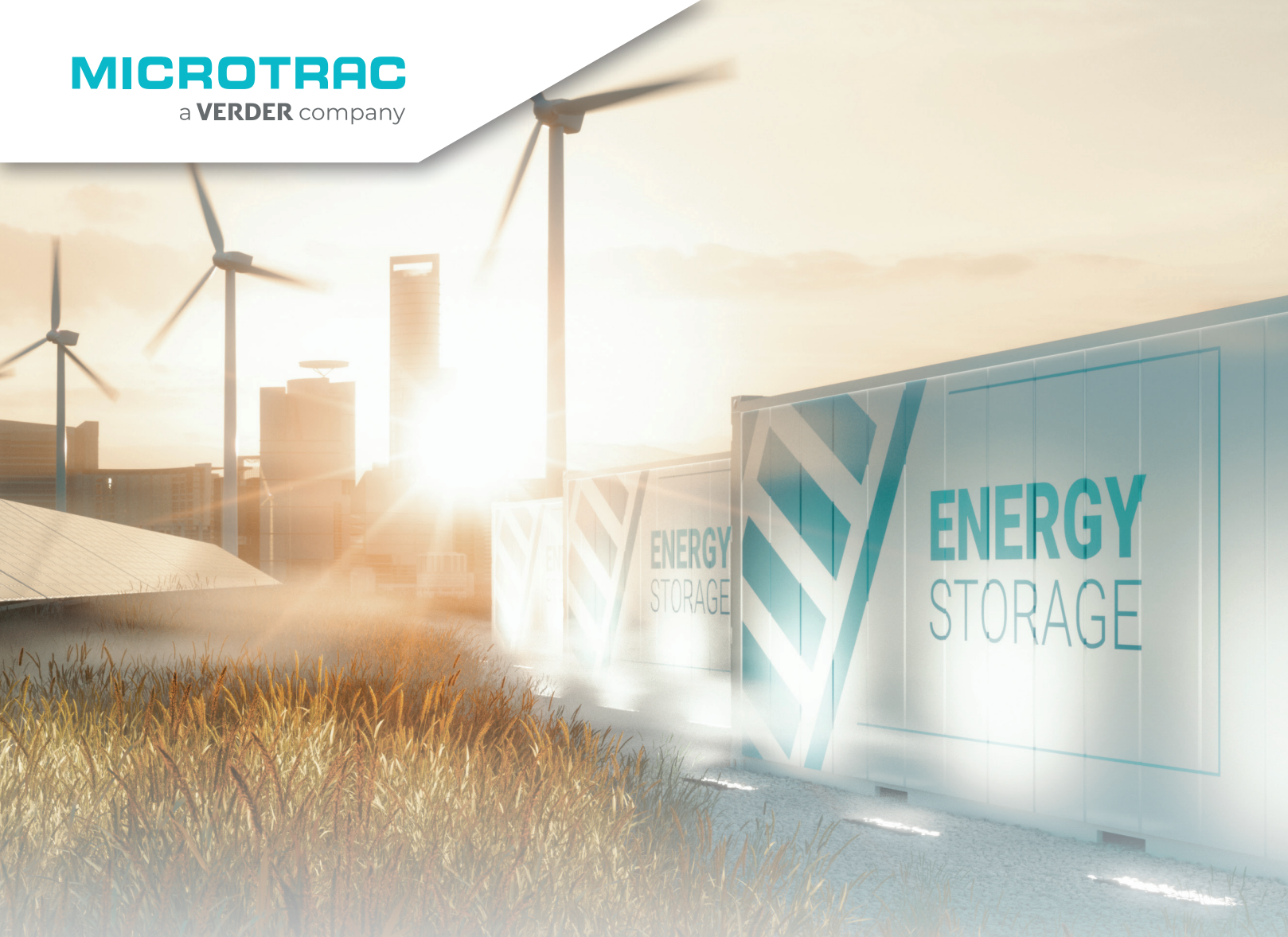

APPLICATIONS FOR

BATTERY TECHNOLOGY

- BASIC MATERIALS
- COMPONENTS
- ASSEMBLY
- RECYCLING

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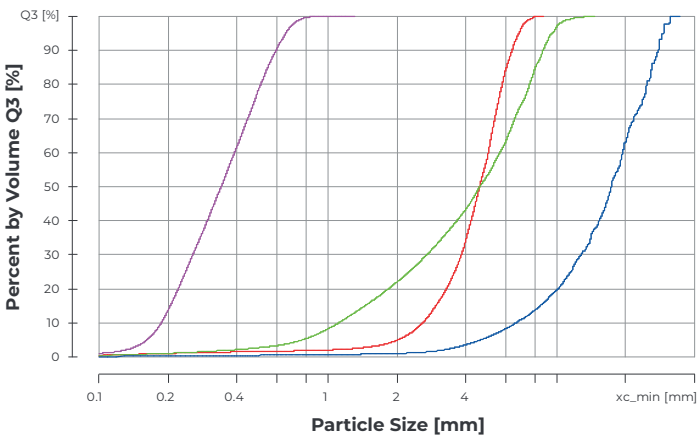
PARTICLE SIZE & SHAPE ANALYSIS

PROCESS-RELATED PARTICLE MEASUREMENT

Monitoring the particle size distribution of crushed ore material is important to control the following process steps. For this purpose, a complete recording of important size parameters is crucial. The CAMSIZER 3D provides relevant size and shape parameters within a very short time and can be used in harsh production environments. This means that deviations in the processes can be detected, and adjustments can be made almost immediately. The CAMSIZER 3D is also available in a version for online measurement and in an XL version for particle sizes up to 135 mm.



CAMSIZER 3D analysis of different grades of an ore sample
(note the logarithmic scaling of the x-axis)

PARTICLE SIZE & SHAPE ANALYZER CAMSIZER 3D

SHORT FACTS
- Dynamic Image Analysis for particle size & shape analysis
- 3-dimensional characterization of particles

FIELD OF USE
- Research & Quality Control

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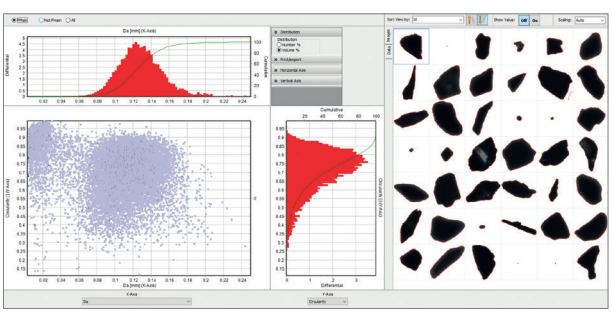
PARTICLE SIZE & SHAPE ANALYSIS

LASER DIFFRACTION AND DYNAMIC IMAGE ANALYSIS TO MEASURE THE PARTICLE SIZE AND SHAPE OF ELECTRODE MATERIALS, ELECTROLYTES AND SEPERATORS

NMC (Nickel Manganese Cobalt) and Lithium are the main active cathode components in LIB (Lithium Ion Batteries), while graphite is a typical material for the anode. Both the particle size distribution and the shape of the electrode materials are important criteria for battery quality. Size and shape can affect the kinetics and reactivity of the battery materials, determining the diffusion rate, power density, anode layer porosity and the discharge rate. A typical particle size for electrode materials is approximately 6 microns. Particle size distribution and shape are reliably measured using a combination of Laser Diffraction and Dynamic Image Analysis.



Scatter Diagram of Area Equivalent Diameter and Sphericity of the Anode Material

PARTICLE SIZE AND SHAPE ANALYZER SYNC

SHORT FACTS
- Laser Diffraction and Dynamic Image Analysis for particle size analysis
- Particle size distribution and shape of active battery materials

FIELD OF USE
- Research & Quality Control

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DENSITY MEASUREMENT

GAS PYCNOMETERS TO MEASURE THE DENSITY OF ELECTRODE MATERIALS

The main active cathode components in a Lithium Ion Battery (LIB) are nickel, manganese, cobalt (NMC) and lithium, while graphite is commonly used as the anode material.

The density (g/cm³) is a crucial factor in characterizing and evaluating battery active materials. A gas pycnometer determines the density of electrode materials by measuring the amount of displaced gas (helium).

Graphite powder measured with BELPYCNO L, density = 2.223g/cm³

GAS PYCNOMETER BELPYCNO L

SHORT FACTS
- Temperature-controlled gas pycnometer for density measurement
- Characterization of the skeletal density of battery active material
- Standard method for R&D and QC

FIELD OF USE
- Research & Quality Control

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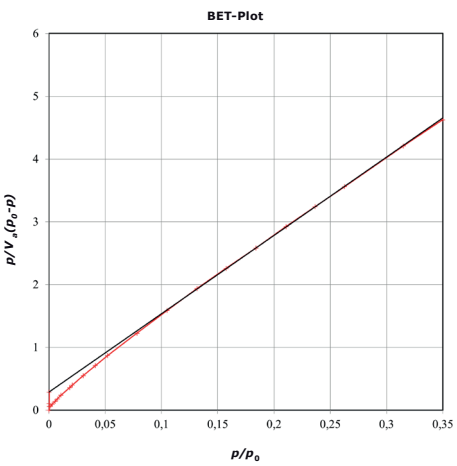
GAS ADSORPTION MEASUREMENT

GAS ADSORPTION TO SPECIFY THE SURFACE AREA AND PORE SIZE DISTRIBUTION OF ELECTRODE MATERIALS

The specific surface area and a pore size distribution of electrode materials can be derived from the measured gas sorption isotherm. The surface area related to the mass as specific surface area (m²/g) is an important parameter in the characterization and evaluation of battery active materials, as their morphology has a direct impact on the battery performance.



BET Specific Surface Area (SSA) of NMC with 0.34m²/g derived with gas adsorption devices Belsorp Mini X

SURFACE AREA & PORE SIZE DISTRIBUTION ANALYZER BELSORP MINI X

SHORT FACTS
- Gas sorption to characterize the specific surface area and pore size distribution (<1nm up to >300nm)
- Characterization of the porosity of battery active material
- Standard method for R&D and QC

FIELD OF USE
- Research & Quality Control

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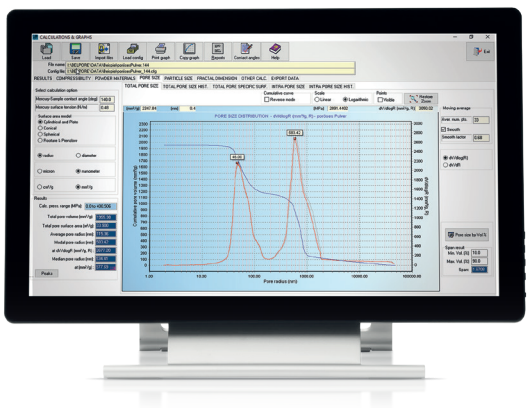
POROSIMETRY

MERCURY POROSIMETRY TO DETERMINE THE POROSITY OF ELECTRODE AND SEPARATOR MATERIALS

Mercury Intrusion Porosimetry (MIP) is used to assess the porosity of electrode and separator materials. Graphite is commonly used as the anode material, while variations of porous polymers form the basis of separators. The pore volume and distribution of pore size are crucial parameters in characterizing and evaluating batteries. Other obtainable results include the specific surface area, bulk and apparent density, and bulk modulus of electrodes.



BELPORE pore size distribution of a bimodal separator membrane

MERCURY POROSIMETER BELPORE SERIES

SHORT FACTS
- Mercury intrusion for porosity measurement in a range from 3.6 nm to more than 1 mm
- Characterization of porosity of electrodes and porous separators
- Standard method for R&D and QC

FIELD OF USE
- Research & Quality Control

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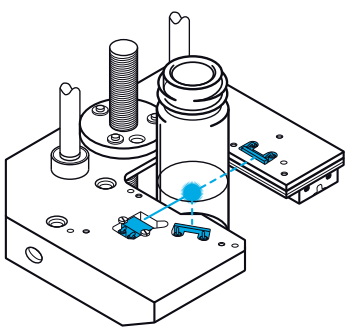
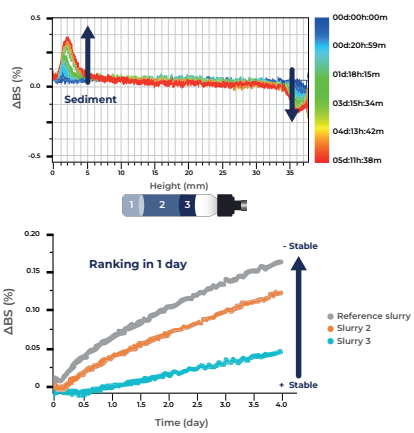
STABILITY AND SHELF-LIFE

ELECTRODE SLURRY STABILITY & HOMOGENEITY ANALYSIS

During battery manufacturing, electrode slurry formulation is key to coating uniformity and final performance. Slurries of active material, binder, and conductive additives may face sedimentation, aggregation, or clarification, causing uneven coatings and lower efficiency. **TURBISCAN** applies **Static Multiple Light Scattering (SMLS)** to scan the full sample height, detecting instability within hours—well before visual signs appear. This accelerates formulation and process optimization, shortens development, and ensures quality in R&D and production.

- Detects sedimentation, aggregation, and clarification phenomena
- Sensitivity to early changes for faster formulation decisions (<1 day possible)
- Quantitative ranking of slurry stability for material or binder comparisons
- Supports transition to water-based binder systems by assessing compatibility





DISPERSIBILITY & STABILITY TURBISCAN TOWER

SHORT FACTS
- Static Multiple Light Scattering (SMLS) for slurry stability analysis
- Early detection and quantification of sedimentation, aggregation, and clarification

FIELD OF USE
- R&D & Quality Control

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