APPLICATION SOLUTIONS

LABORATORY & ANALYSIS EQUIPMENT

RECYCLING & SUSTAINABILITY

BATTERY

SPACE & DEFENCE

FOOD & BEVERAGE

MINING & GEOLOGY

PHARMACEUTICAL

ENABLING PROGRESS

1300
EMPLOYEES

300
MIO. € SALES

22
SALES OFFICES

11
MANUFACTURING SITES

ENABLING PROGRESS

VERDER SCIENTIFIC IS A GLOBAL, RELIABLE MANUFACTURER OF LABORATORY AND ANALYSIS EQUIPMENT.

FIELDS APPLICATION

RECYCLING .... p. 4

BATTERY TECHNOLOGY .... p. 14

SPACE & DEFENCE .... p. 20

FOOD .... p. 30

MINING & GEOLOGY .... p. 40

PHARMACEUTICAL .... p. 48

VERDER

RECYCLING & SUSTAINABILITY

FROM CO_2 CAPTURE TO BATTERIES, BIOCHAR AND GREEN CEMENT, THE HARD PART IS PROVING PERFORMANCE AT SCALE

DISCOVER MORE

STOP GUESSING. GAS, THERMAL AND PARTICLE ANALYTICS TURN GREEN PROCESSES INTO NUMBERS YOU CAN COUNT ON

BIOMASS & BIOCHAR

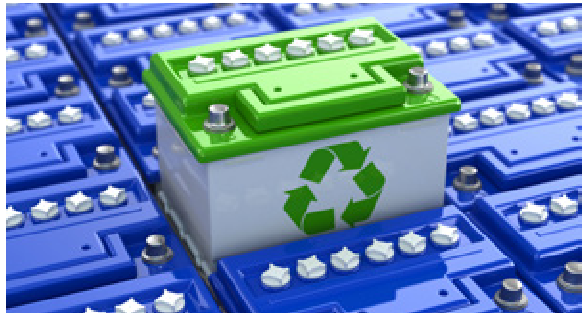
Control oxygen-free pyrolysis to turn wood and residues into stable biochar, creating a reusable carbon product.

CARBON CAPTURE

Test CO_2 capture under humid conditions to reveal competitive adsorption, so performance matches real-world gas streams.

GREEN CEMENT

Quantify C/H/S to optimize the performance of true calorific value and performance of alternative fuels, balancing kiln energy, emissions, and product quality.



BATTERY RECYCLING

Shred and sieve battery materials to unlock black mass and separate polymers and metals, boosting downstream recovery and purity.

BIOMASS TO BIOCHAR: PYROLYSIS YOU CAN CONTROL

How do you turn variable biomass into consistent biochar without drifting in yield, carbonization, or performance?

Pyrolysis needs tight control of temperature, heating rate, residence time, and an inert atmosphere to avoid "half-converted" batches and unstable properties.

OUR CIRCULAR FORMULA

Biochar quality is built in the furnace. By running biomass under inert gas (typically nitrogen) with controlled heating rate and residence time, you drive full conversion to biochar. Then you tune performance via steam or CO_2 activation at elevated temperature to boost surface area and micro/mesoporosity, targeting reliable properties for downstream use (including battery materials).

CARBOLITE
a VERDER company

TS SPLIT TUBE FURNACE

PARAMETER MEASURED:
Temperature, heating rate, residence time, atmosphere (N_2), gas flow, steam/CO_2 conditions.

- ✔ CONTROLLED CONVERSION
- ✔ TUNABLE POROSITY
- ✔ REPEATABLE PERFORMANCE

BIOCHAR PARTICLE SIZE: MILLING YOU CAN CONTROL

How do you get a controlled particle size distribution from brittle, dusty biochar without overheating, overgrinding, or contaminating the sample?

Biochar needs a two-step comminution route: robust pre-cutting for heterogeneous feeds, then high-energy fine grinding when sub-micron (or "nano") performance is required.

OUR CIRCULAR FORMULA

Start with cutting and shearing to create a defined, traceable feed fraction, then switch to planetary ball milling to drive the material to analytical fineness (down to sub-micron, and even nano range). This route supports "nano-biochar" approaches where ball milling can increase accessible surface and improve sorption behaviour for environmental applications.

Retsch
a VERDER company

BALL MILL MM 500 NANO

PARAMETER CONTROLLED:
Bottom sieve aperture (0.25–20 mm), rotor speed, residence time, temperature tendency, final fineness target (<1 µm; colloidal <0.1 µm).

- ✔ DEFINED FINAL FINENESS VIA BOTTOM SIEVES
- ✔ SUB-MICRON TO NANO RANGE GRINDING CAPABILITY
- ✔ IN-JAR PROCESS DATA FOR METHOD TRANSFER AND CONTROL

CARBON CAPTURE

CO_2 vs H_2O: BREAKTHROUGH CURVES THAT DECIDE

How do you predict CO_2 capture performance when water vapor is present, not just in "dry lab gas"?

In real streams, humidity competes for adsorption sites and can shift capacity, selectivity, and regeneration behaviour, so single-gas tests can mislead material screening.

OUR CIRCULAR FORMULA

Test adsorbents the way they actually work: Run dynamic breakthrough curves on CO_2 + H_2O mixtures, track both components, then quantify what was captured and what can be recovered via purge and thermal desorption (TPD). That gives you realistic working capacity and a clearer go/no-go for CCUS materials and operating windows.

MICROTRAC a VERDER company

BELCAT II

PARAMETER MEASURED:
Breakthrough curve (CO_2 and H_2O),
TPD, TPO, TPR

- ✔ TRUE MULTI-COMPONENT BREAKTHROUGH
- ✔ HUMIDITY IS A CONTROLLED VARIABLE
- ✔ ONE CHAINED METHOD: ADSORPTION - DESORPTION MEASUREMENT

CO_2 SORBENTS: PARTICLE SIZE YOU CAN CONTROL

How do you balance fast CO_2 uptake with practical packed-bed operation, without turning your sorbent into "too fine to run"?

Smaller particles can improve kinetics and reduce internal mass-transfer limits, but they can also raise pressure drop and create operability limits in contactors.

OUR CIRCULAR FORMULA

Treat particle engineering as part of capture performance. First, set and verify PSD and morphology (not just "average size"). Then classify into defined fractions for realistic bed packing. This matters across sorbents, and it's especially visible with MOFs, where powders often must be shaped/pelletized for PSA/TSA columns and the shaping step can affect adsorption performance.

MICROTRAC a VERDER company

CAMSIZER X2+

PARAMETER MEASURED:
PSD: D10 / D50 / D90, span, fines/oversize fraction.
Shape: Aspect ratio/sphericity.

- ✔ DYNAMIC IMAGE ANALYSIS
- ✔ MOF-READY APPROACH
- ✔ MEASURED SIZE + SHAPE

GREEN CEMENT

GRINDING REACTIVITY INTO CLAYS: LOW-CO_2 SCMS

How do you activate natural clays for low-CO_2 cement without relying on high-temperature calcination?

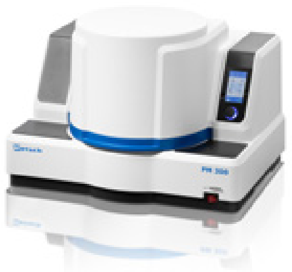
Mechanochemical activation uses intensive grinding to disorder and partially amorphize clay minerals, increasing their pozzolanic reactivity for use as supplementary cementitious materials (SCMs).

OUR CIRCULAR FORMULA

Use high-energy planetary milling to push clays into a more reactive state through mechanical induced amorphization and mechano-chemical dehydroxylation, while simultaneously reducing particle size. This can unlock reactivity in clays that are difficult to activate thermally, helping cut clinker content with a process powered mainly by electricity rather than fuel.

Retsch® a VERDER company

PLANETARY MILL PM 300



PARAMETER CONTROLLED:
Speed, time, ball-to-powder ratio, jar/ball material (contamination control), optional: Temperature and pressure trends during activation.

- ✔ MECHANOCHEMICAL DIHYDROXYLATION + AMORPHIZATION
- ✔ HIGH-ENERGY, REPRODUCIBLE PLANETARY MILLING
- ✔ IN-JAR TEMPERATURE/PRESSURE LOGGING

CARBON & SULFUR: THE HIDDEN LEVERS IN GREEN CEMENT

How do you qualify green cement materials when both raw mix and secondary fuels can swing carbon and sulfur, and one bad level can damage performance?

In cement QC, reliable C/S values are mandatory to prevent issues from excess sulfur and to keep the process in spec.

OUR CIRCULAR FORMULA

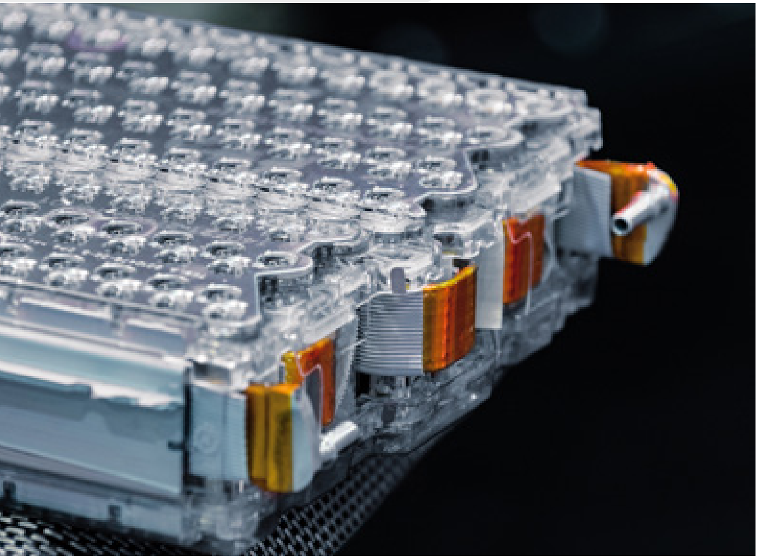
Run C/S analysis across the whole green-cement landscape: Inorganic construction materials (raw meal, clinker, SCMs) plus combustible matrices (coal, coke, secondary fuels). Dual-furnace combustion gives fast, quantitative C and S results that complement XRF, so decisions are based on actual carbon and sulfur content.

ELTRA® a VERDER company

ELEMENTRAC CS-d

PARAMETER MEASURED:
Unique combination of induction and resistance furnace in one instrument. Induction furnace (>2,000°C) plus resistance furnace (up to 1,550°C).

- ✔ INDUCTION + RESISTANCE FURNACE
- ✔ LOW-TO-HIGH CONCENTRATIONS IN ONE RUN
- ✔ ACCURACY ON ANY KIND OF SAMPLES



SILICON NITRIDE IN BATTERIES: O/N THAT DEFINE QUALITY

How do you verify silicon nitride purity after processing or recycling, when oxygen pickup can shift in electrical properties and nitrogen indicates purity?

In lithium-based batteries, nitrogen is used as a purity marker for silicon nitride, while oxygen is used to assess electrical-relevant properties.

OUR CIRCULAR FORMULA

Treat O/N as a *key indicator* for the ceramic battery components. Run bulk oxygen and nitrogen on representative powders, not just surface signals, so to optimize the product performance.

ELTRA a VERDER company

ELEMENTRAC ONH-p

PARAMETER MEASURED:
Oxygen content, Nitrogen content, Hydrogen content.

- ✔ BULK ANALYSIS, NOT SURFACE-ONLY
- ✔ POWERFUL IMPULSE FURNACE FOR HIGH TEMPERATURE ANALYSIS
- ✔ SUITABLE FOR POWDERS AND SOLIDS

FROM CELLS TO FRACTIONS: SHREDDING AND SIEVING

How do you separate black mass from foils and polymers, then prepare each fraction so the chemistry you measure is actually representative?

Battery recycling streams are heterogeneous, so shredding and fractionation are only step one. You still need reliable homogenization battery materials before sampling and analysis.

OUR CIRCULAR FORMULA

Homogenize different fractions to a defined fineness so purity checks, recovery efficiency, and “black mass value” is based on meaningful samples, not random chunks.

Retsch a VERDER company

SIEVE SHAKER AS 200 CONTROL

PARAMETER CONTROLLED:
Amplitude, time, interval; Stored SOP programs.

- ✔ DIGITALLY CONTROLLED SIEVING
- ✔ REPRODUCIBLE RESULTS WITH STORED SOPS
- ✔ EFFICIENT FRACTION SEPARATION

VERDER

BATTERY TECHNOLOGY

COMPLEX CELL ASSEMBLY TURNS MINOR DEFECTS INTO PERFORMANCE DRIFT AND SAFETY CONCERNS

DISCOVER MORE

END-TO-END BATTERY ANALYTICS ALIGN EVERY STAGE, EXPOSING DEFECTS EARLY AND PREVENTING PERFORMANCE DRIFT

BASIC MATERIALS

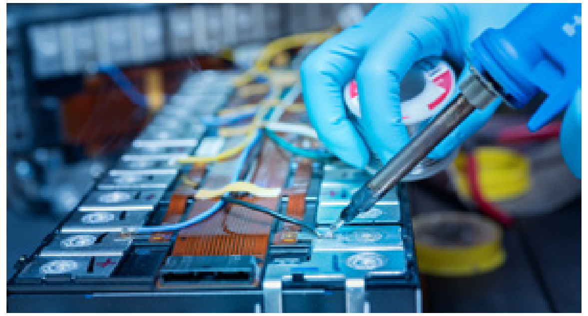
Nitrogen & oxygen analysis: Measuring N and O in silicon nitride verifies purity and predicts electrical behaviour by detecting ppm-to-% shifts in composition.

ASSEMBLY

Battery Cross-Sections: Precision cutting and polishing exposes cell interfaces and hidden defects, so microscopy tells the true story before decisions.

COMPONENTS

Graphitization: High-temperature treatment under inert gas tunes carbon into graphite by controlling heat history, purity and performance.



RECYCLING

Recycling fraction homogenization: Milling black mass, foils, and polymers creates representative samples for purity and value checks while minimizing cross-contamination.

JELLY-ROLL OUT. EVIDENCE INTACT.

How do you cut a Li-ion cell without tearing foils, smearing coatings, or losing the real interfaces?

LIB cutting changes with the goal: you may need to open the casing to extract the whole jelly roll, cut the full battery (casing + electrodes), or section only electrode foils. Each route risks distortions that make microstructure results questionable.

THE BATTERY SLICE FORMULA

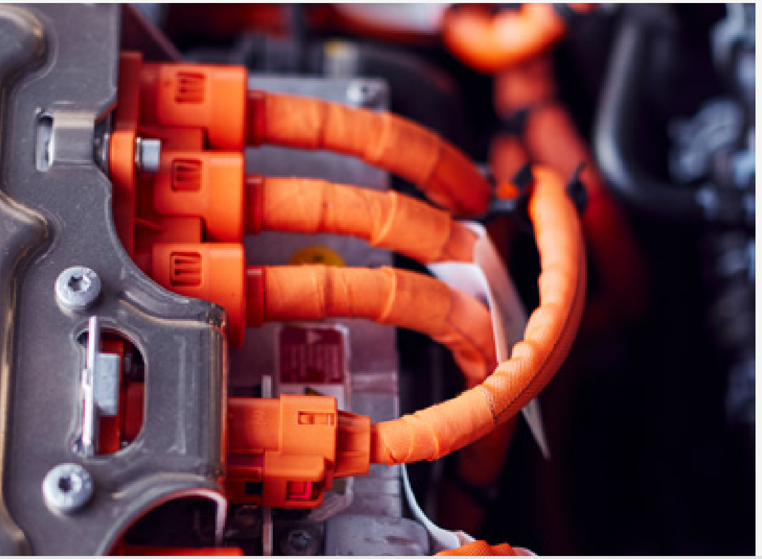
Lock the cell, control the cut, keep the structure: Use a rotating clamping tool to open the casing and remove the jelly roll, and rely on the wet cut-off sectioning with dedicated clamping tools when the entire battery must be cut. This section is applyable only to not-loaded cells and empty houses.

QATM a VERDER company

QCUT 350 A

PARAMETER MEASURED:
Preserved electrode interfaces, clean casing cross-sections, distortion-free geometry for microscopy.

- ✔ SAFE SECTIONING
- ✔ INTERFACE TRUTH
- ✔ REPRODUCIBLE TEARDOWN



TWO METHODS. ONE TRUTH.

How do you keep electrode performance predictable when both PSD and shape drive kinetics?

For LIB materials like NMC/Lithium cathodes and graphite anodes, particle size distribution and shape directly influence reactivity and diffusion, impacting power density, anode porosity, and discharge rate. Typical electrode particle size is around 6 microns, so small shifts matter fast.

THE BATTERY SLICE FORMULA

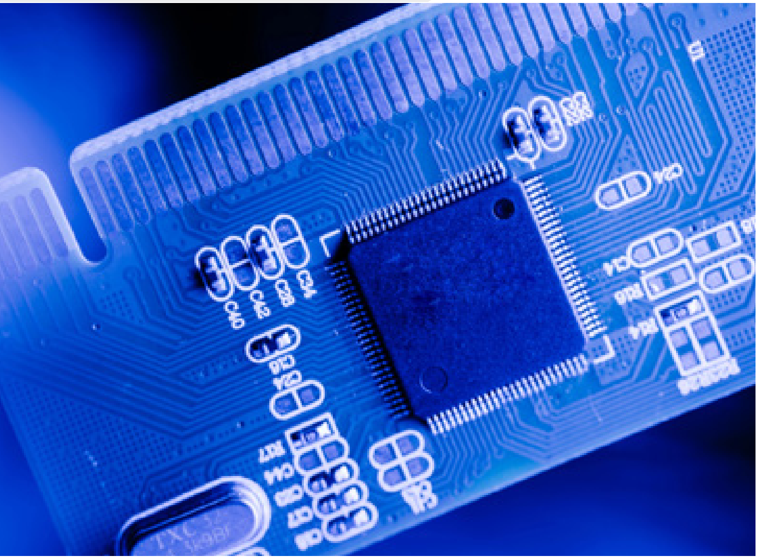
Verify PSD and morphology together by combining Laser Diffraction (fast, robust PSD) with Dynamic Image Analysis (shape and dispersion reality-check) on the same material.

MICROTRAC a VERDER company

SYNC

PARAMETER MEASURED:
D10/D50/D90 (PSD), oversize/undersize fractions, sphericity/aspect ratio, dispersion quality indicators.

- ✔ PSD + SHAPE IN ONE RUN
- ✔ 6 μM WINDOW CONTROL
- ✔ QC-READY VALIDATION



MAKE SILICON BATTERY-GRADE

How do you tune silicon anode powder without overheating it or drifting outside the target size window?

Silicon is a high-capacity semiconductor, but particle size strongly influences surface area, SEI growth, cycle stability, and swelling. Too coarse slows lithiation; too fine accelerates side reactions. The process window is narrow, so milling must be energetic without letting temperature or PSD drift.

THE BATTERY SLICE FORMULA

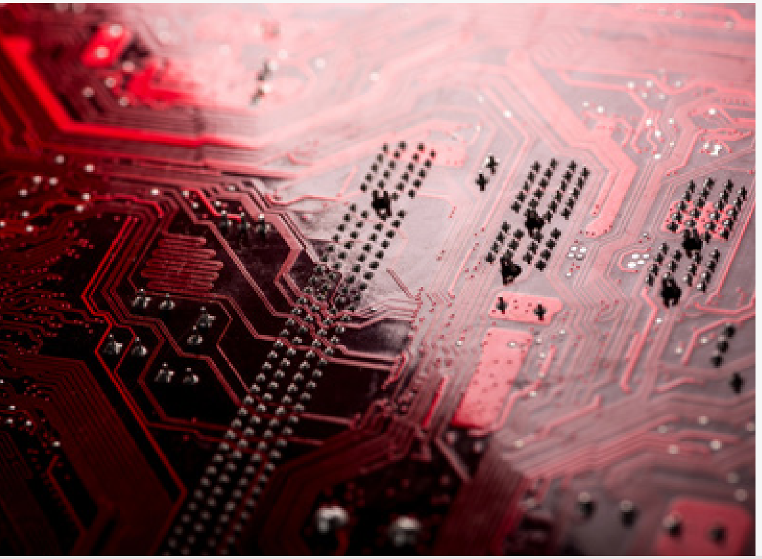
Use high-energy ball milling with temperature control to reduce silicon to a reproducible battery-grade PSD. With wet grinding and zirconia media, the Emax can produce finer, narrower distributions while limiting overheating, making it suitable for silicon feedstock preparation before slurrymaking or Si/C composite design.

Retsch®
a VERDER company

EMAX

PARAMETER CONTROLLED:
Final d90 / PSD window, process temperature, grinding time.

- ✔ SUB-MICRON SILICON
- ✔ TEMPERATURE UNDER
- ✔ REPRODUCIBLE PSD WINDOW



BUILD STABLE SI/C ANODES

How do you turn silicon precursors into stable Si/C anodes without oxygen pickup, uneven carbonization, or batch drift?

Pure silicon offers major capacity but expands dramatically during cycling. Si/C architectures buffer that expansion, preserve conductivity, and moderate interphase growth, but only when pyrolysis is repeatable. Small shifts in heat history or gas handling change carbon structure, coating quality, and electrochemical behavior fast.

THE BATTERY SLICE FORMULA

Use a split tube furnace with a controlled inert atmosphere (e.g., Ar or N2) and precisely defined thermal profiles to perform pyrolysis and, where applicable, sintering. Controlled heating enables removal of binders and residual solvents, facilitates carbonization of precursors into conductive coatings, and promotes the formation of uniform Si/C composite architectures suitable for electrochemical characterization and cell development.

CARBOLITE®
a VERDER company

FST SPLIT TUBE FURNACE

PARAMETER CONTROLLED:
Temperature profile, residence time, gas atmosphere, gas flow.

- ✔ CONTROLLED PYROLYSIS
- ✔ UNIFORM SI/C STRUCTURES
- ✔ REPEATABLE GAS FLOW

VERDER

SPACE & DEFENCE

SMALL VARIATIONS IN MATERIAL PROPERTIES AND PROCESS CONDITIONS CAN TURN INTO BIG FAILURES IN EXTREME ENVIRONMENTS

DISCOVER MORE

PREVENT FAILURE IN EXTREME CONDITIONS BY CONTROLLING AND VALIDATING MATERIALS ACROSS THE FULL PROCESS CHAIN

METAL & ALLOYS

Elemental analysis preserves alloy integrity by controlling C, S, O, N, and H levels to prevent cracking and embrittlement.

CERAMICS & C/C COMPOSITES

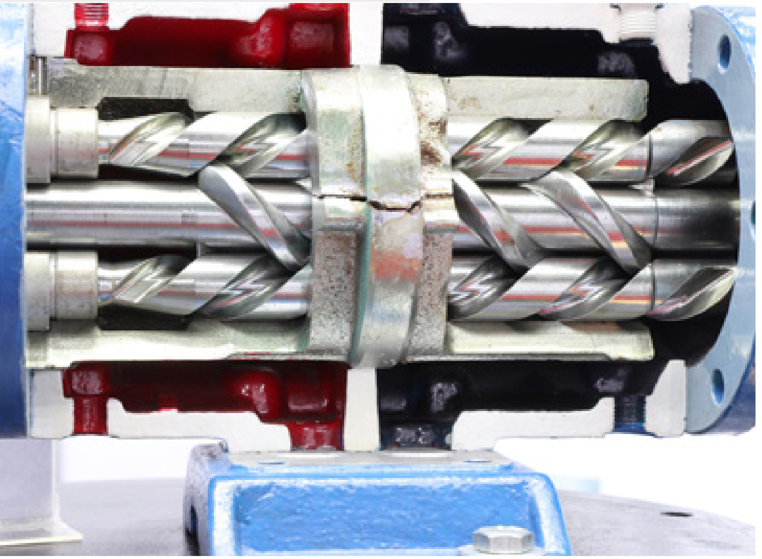
Thermal processing control protects ceramics and C/C performance by preventing microstructural damage during high-temperature steps.

R&D / QUALITY CONTROL

Metallography ensures reliable Powder Metallurgy (PM) Additive Manufacturing (AM) qualification by revealing the true microstructure and hardness without artifacts that hide porosity.

PROPULSIVE & PROPELLANTS

Particle size and shape control ensure safe HMX handling and performance by avoiding fines, oversize particles, and agglomerates that affect burn rate and stability.



TRACE CHEMISTRY, MAJOR CONSEQUENCES

How can ppm-level chemistry be controlled to prevent embrittlement and delayed cracking?

In high-performance steels and titanium alloys, reliability can be lost through trace chemistry drift. Even ppm-level oxygen and nitrogen have effects on metal characteristics, while hydrogen can initiate delayed cracking. Under extreme stress and temperature, tiny deviations can become critical.

HOW OUR EXPERTISE BECOMES ACTION

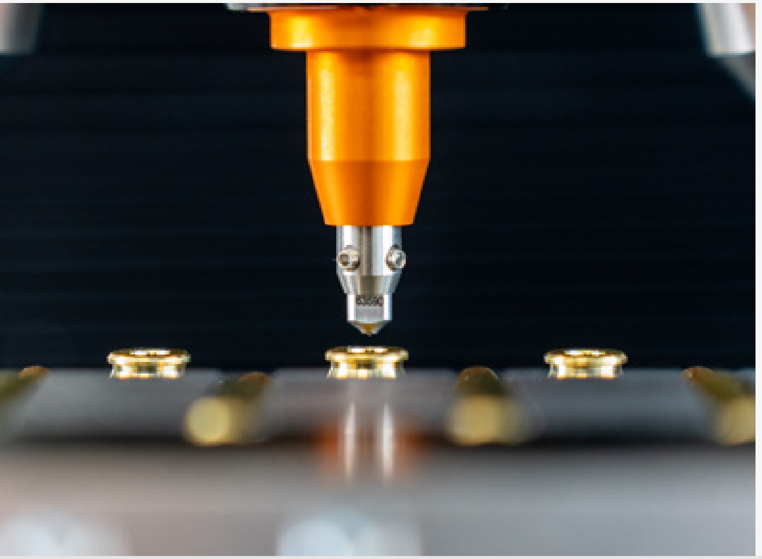
To implement robust control against embrittlement and delayed cracking, qualification requires verifying C/S as well as O/N/H concentrations. These measurements support batch release, supplier validation and process control for metals, typically aligned to ASTM E1019, ASTM E1409 and ASTM E1447.

ELTRA® a VERDER company

ELEMENTRAC ONH-p/CS-i

PARAMETER MEASURED:
Carbon and sulfur concentration (CS-i), oxygen/nitrogen/hydrogen concentrations (ONH).

- ✔ C/S CONTENT
- ✔ O/N/H CONTENT
- ✔ INTERNATIONAL STANDARD COMPLIANCE



SEE THE TRUTH, NOT THE ARTIFACTS

How can metallographic evidence be trusted for PM and AM qualification?

Quality decisions become risky when the metallographic preparation is inconsistent. Artifacts such as deformation, pull-out and smearing can mimic defects or hide real porosity, leading to wrong conclusions on process stability, part integrity and compliance in powder-metallurgy or additively manufactured components.

HOW OUR EXPERTISE BECOMES ACTION

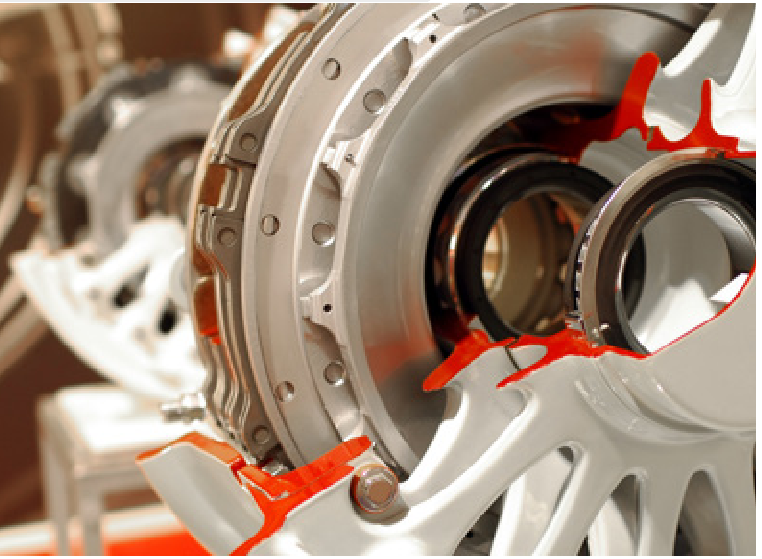
to ensure a defensible qualification, verification relies on true microstructure metrics and hardness results: porosity/voids, phase distribution, grain size and inclusions, plus hardness values or mapping. Standardized preparation, microscopy and hardness testing deliver comparable, auditable outcomes for QC and failure analysis, aligned with ASTM E3, ASTM E407, ASTM E112, ASTM E18/ISO 6508-1 and ASTM E384/ISO 6507-1.

QATM a VERDER company

QNESS 10/60 A+

PARAMETER MEASURED:
Microstructural preparation systems: cutting, mounting, grinding/polishing and hardness test (Vickers / Knoop / Brinell / Rockwell).

- ✔ REDUCTION OPERATOR VARIABILITY
- ✔ AUTOMATION AND REPEATABILITY
- ✔ NO PREPARATION ARTIFACTS



THERMAL CYCLES, MISSION SURVIVAL

How can extreme-heat ceramic and C/C components be protected from thermal processing failures?

Ceramics and C/C composites can fail when debinding, pyrolysis and graphitization are not tightly controlled. Residual binder, microcracks and off-spec carbon structure reduces strength and ablation resistance in parts exposed to severe thermal and mechanical loads.

HOW OUR EXPERTISE BECOMES ACTION

To secure repeatable performance, qualification depends on controlled atmosphere (inert gas or vacuum), defined ramp/soak profiles and verified temperature uniformity across debinding (~800˚C), carbonization and graphitization (up to 2500–3000˚C). These conditions enable polymer-to-ceramic conversion and densification of C/C and UHTC matrices for nozzle inserts, brake discs and hypersonic surfaces.

CARBOLITE®
a VERDER company

LHTG 200-300

PARAMETER MEASURED:
Atmosphere: inert gas and/or vacuum processing, temperature capability: up to 3000˚C in argon, and high-temperature vacuum operation.

- ✔ ULTRA-HIGH TEMPERATURE UP TO 3000˚C
- ✔ VACUUM/INERT ATMOSPHERE
- ✔ UNIFORMITY

AGGLOMERATES HIDE THE TRUTH

How can particle size data be trusted when advanced powders agglomerate and are non-spherical?

Advanced ceramic and carbon powders often form agglomerates due to surface forces and rarely behave as perfect spheres. Without controlled dispersion and shape-aware measurement, PSD can describe clusters instead of primary particles, masking fines and oversize and making sintering behaviour and final microstructure hard to predict.

HOW OUR EXPERTISE BECOMES ACTION

To generate meaningful, comparable results, qualification focuses on PSD (D10/D50/D90), agglomerate or oversize fraction, and shape metrics such as aspect ratio and sphericity. Since laser diffraction (ISO 13320) reports an equivalent sphere distribution, pairing it with dynamic image analysis (ISO 13322-2) confirms true shape and dispersion, separating primary particles from clusters.

MICROTRAC
a VERDER company

SYNC

PARAMETER MEASURED:
PSD + particle shape, plus direct insight into dispersion quality via simultaneous imaging of the same particle stream/sample.

- ✔ PARTICLE SIZE AND SHAPE
- ✔ OPTIMAL DISPERSION/NO AGGLOMERATES
- ✔ ELEVATED THROUGHPUT

PASS. RETAIN. PERFORM.

How can propellant-grade aluminium powder be kept within specification to ensure stable burn behaviour?

For rocket-propellant aluminium powder, particle size drift can change packing and burn behaviour. Without a repeatable sieve method, plants cannot prove cut-off specs such as “90% passing 150 µm and retained on 50 µm”, increasing the risk of batch rejection, instability, and safety concerns.

HOW OUR EXPERTISE BECOMES ACTION

To secure auditable quality control, verification focuses on mass % retained per sieve and cumulative % passing/retained to confirm tight cut-offs (e.g., pass 150 µm, retain 50 µm). Dry sieving remains the standard route for metal powders, commonly aligned to ASTM B214 and ISO 4497, using calibrated test sieves per ISO 3310 to ensure the results are comparable and defensible.

Retsch® a VERDER company

SIEVE SHAKER AS 200

PARAMETER CONTROLLED:
% passing/retained at defined mesh sizes (e.g., 150 µm and 50 µm) plus full retained mass distribution across the sieve stack.

- ✔ UP TO 22 FRACTIONS
- ✔ VERIFIED SIZE SEPARATION
- ✔ GLOBALLY COMPARABLE RESULTS

SURFACE AREA SETS THE PACE

How can burn behaviour and adsorption performance be kept stable when porous materials change over time?

Porous solids and powders used in space & defence can burn or react unpredictably when specific surface area or pore structure drifts. Batch variation or storage-driven changes can alter burn rate, sensitivity, or adsorption performance, creating safety risk and out-of-spec lots.

HOW OUR EXPERTISE BECOMES ACTION

To verify stability and release batches with confidence, QC measures BET specific surface area (m^2/g) from adsorption isotherms and, when required, pore-size distribution (micro/mesopores) using BJH/DFT methods. These metrics correlate with burn behaviour of porous grains and adsorption capacity of protective carbons, and are routinely reported to ISO 9277 and ISO 15901-2.

MICROTRAC a VERDER company

BELSORP MAX X

PARAMETER MEASURED:
BET specific surface area (m^2/g) and pore-size distribution (micro/mesopores) from adsorption isotherm.

- ✔ BET/POROSITY ACCORDING TO ISO 9277
- ✔ ADSORPTION ISOTHERMS DOWN TO VERY LOW PRESSURES
- ✔ BATCH-TO-BATCH CONSISTENCY

MICRONS DECIDE SAFETY

How can HMX particle characteristics be controlled to ensure safe, stable, energetic performance?

Energetic formulations using HMX are highly sensitive to particle size and morphology. Small shifts in fines, oversize or agglomeration can change packing, burn behaviour and stability, increasing safety risk and batch rejection.

HOW OUR EXPERTISE BECOMES ACTION

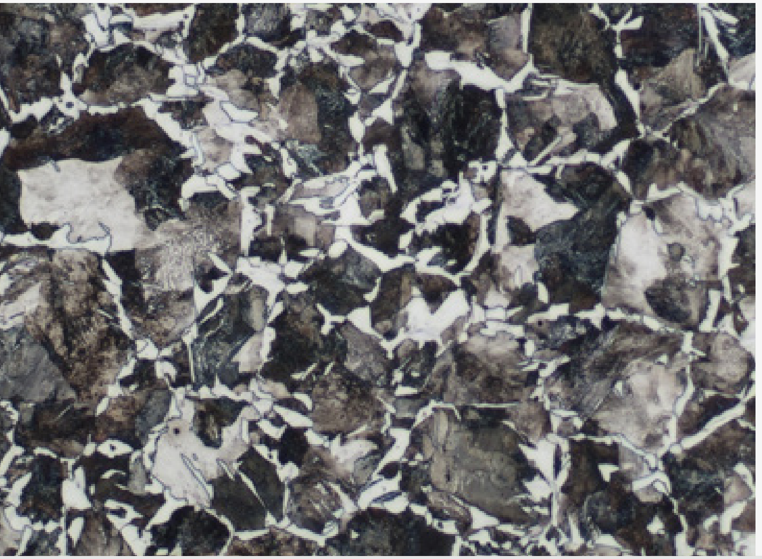
To demonstrate compliance and reduce variability, qualification verifies PSD (D10/D50/D90), %fines/%oversize and shape metrics (aspect ratio, sphericity) across HMX grades for castable, pressed or ultrafine formulations. Programs typically require narrow distributions and low agglomeration (e.g., MIL-DTL-45444), because PSD influences burning characteristics and phase behaviour.

MICROTRAC
a VERDER company

SYNC

PARAMETER MEASURED:
Particle Size Distribution + Dynamic Image Analysis. Fines, oversize, agglomeration and non-ideal shapes particles.

- ✔ PARTICLE SIZE AND SHAPE
- ✔ FINES AND OVERSIZE CONTROL
- ✔ ELEVATED THROUGHPUT



SURFACE QUALITY, RELIABLE DECISIONS

How can QC labs produce evidence that truly supports accept/reject decisions for critical metal parts?

In production and QC labs qualifying critical metal parts, inconsistent sectioning and polishing can create unreliable evidence. Operator-dependent surfaces may hide real porosity or cracks, distort coating interfaces, and drive wrong release decisions, rework, or in-service risk.

HOW OUR EXPERTISE BECOMES ACTION

To make microscopy and verification trustworthy, metallographic preparation must deliver flat, clean, deformation-minimized surfaces that reveal true microstructure, defects, coatings, and interfaces in PM/AM and conventionally processed metals. This standardization keeps results comparable across operators, batches, and audits, strengthening process control and release decisions.

QATM
a VERDER company

QPRESS 40

PARAMETER MEASURED:
Artifact-minimized prepared surface quality (flatness + low deformation/smearing) suitable for true microstructure and defect evaluation.

- ✔ AUTOMATION AND REPEATABILITY
- ✔ ARTIFACT-FREE SURFACE
- ✔ OPERATOR INDEPENDENT

FOOD & BEVERAGE

INGREDIENT VARIABILITY AND COMPLEX MATRICES CAN SHIFT TEXTURE, STABILITY AND SPECS, PUTTING QUALITY AND SAFETY AT RISK

DISCOVER MORE

MAKE COMPLEX FOOD MATRICES BEHAVE: CONSISTENT SAMPLE PREP + RELIABLE PARAMETERS = STABLE TEXTURE, CLARITY AND SHELF LIFE

COFFEE & BEVERAGES

Control particle size and shape so each brew method gets the right grind, keeping flow, extraction and taste consistent.

DAIRY PRODUCT & CHOCOLATE

Rapid CN and TGA methods confirm protein, moisture and ash fast, supporting stable specs and label confidence.

MEAT & FISH

Cryogenic milling keeps samples brittle and cool, preventing fat smearing and volatile loss for representative analysis.

FRUIT AND VEGETABLES

Plant proteins: Combine stability kinetics and droplet sizing to turn the variable plant proteins into stable, scalable emulsions.

GRIND MAKES THE BREW

What causes espresso performance to shift between shots, even with the same beans and recipe?

Because coffee powder is not “just powder”. Small shifts in fines vs coarse particles change the flow through the puck or filter, extraction speed, and what ends up in the cup. Different methods (espresso, filter, AeroPress) need different grind profiles, so controlling the full particle size distribution is the backbone of repeatable aroma and taste.

OUR RECIPE

The practical fix is to define a “recipe window” for each brew method and keep it stable: monitor the distribution (not only an average) and watch the fractions that matter most, especially fines (risk of clogging and over-extraction) and coarse particles (risk of under-extraction and weak body). Reliable control needs a method that captures the very wide size range of coffee powder in one measurement, without biasing results by switching optics or missing one end of the distribution.

MICROTRAC
a VERDER company

CAMSIZER X2+

PARAMETER MEASURED:
Particle size distribution across a broad range and particle shape metrics.

- ✔ TWO CAMERAS - WIDE RANGE SIZE
- ✔ SIZE + SHAPE TOGETHER
- ✔ FAST MEASUREMENT AND EFFICIENT DISPERSION

CLEAR DRINKS, CLEAN PROCESS

Why does clarification sometimes feel like chasing a moving target, with extra filtration cycles and “haze surprises”?

Because beverage (wine, beer, etc) stability depends on how fast and how well particles actually migrate, flocculate, and settle. Protein fining efficiency can change with dose, temperature can shift clarification kinetics, and natural stabilizers can vary, so the same recipe does not always behave the same in the tank.

OUR RECIPE

Don’t judge clarity by eye. Quantify it: compare fining agents and doses by sedimentation onset and sediment growth, track how temperature changes clarification speed, and use charge measurements to understand particle interactions. In beer, this also predicts gushing: gushing-positive samples contain ultra-fine nanoparticles (~1–10 nm, often ~1–2 nm) absent in gushing-negative beers. Detect them by 180° heterodyne DLS and confirm via flow potential/ charge titration. Gushing-positive samples consume more than 0.001 N P-DADMAC due to the higher total surface area of many tiny particles.

MICROTRAC
a VERDER company

NANOTRAC/ STABINO ZETA

PARAMETER MEASURED:
Migration/sedimentation rate, Zeta potential (ζ) / streaming (flow) potential signal, particle total charge via charge titration.

- ✔ SAMPLE STABILITY NO DILUTION REQUIRED
- ✔ FAST DOSE SCREENING
- ✔ CHARGE TITRATION

PROTEIN IN A PINCH

Why does milk protein testing still take so long, get messy, and create last-minute release stress?

Because time-consuming and chemical-heavy methods made routine QC and fast release decision harder than it needs to be.

THE VERDER RECIPE

Use standard compliance Dumas combustion method: burn the sample in oxygen, reduce nitrogen oxides to elemental nitrogen (N_2), remove H_2O/CO_2, then quantify nitrogen with a thermal conductivity detector. Convert %nitrogen to %protein using the matrix-specific factor.

ELTRA® a VERDER company

ELEMENTRAC CN-r

PARAMETER MEASURED:
Nitrogen content (%) (TCD Detector).

- ✔ RESULTS IN 2:30 MINUTES
- ✔ NO HAZARDOUS CHEMICALS
- ✔ HIGH-THROUGHPUT AUTOSAMPLER

ONE RUN, FULL DAIRY PROFILE

Why do milk and cheese checks sometimes turn into a slow relay race between drying, ashing, and "Did we reach constant weight yet?"

Because dairy is a complex matrix: moisture and volatiles (incl. fat-related losses) come off in stages, and ash needs high temperature. Doing these steps separately adds time, handling, and variability.

THE VERDER RECIPE

Use thermogravimetric analysis (TGA) to track mass change at defined in a controlled program. With user-defined temperatures and atmospheres (e.g., inert or oxidative), you can run sequential steps to quantify moisture, volatiles, and finish with ash/content.

ELTRA® a VERDER company

TGA THERMOSTEP

PARAMETER MEASURED:
Mass (weight) vs temperature/time, moisture, volatiles, ash at user-defined steps/atmospheres.

- ✔ 19 SAMPLES PARALLEL
- ✔ MOISTURE VOLATILES ASH
- ✔ PROGRAMMABLE ATMOSPHERES

COLD GRINDS, HOT RESULTS

Why do meat and fish samples turn into paste, smear fat everywhere, or "lose the aroma" before you can even measure anything?

Because wet, sticky, fatty matrices warm up during grinding. That heat makes fats soften, causes clogging and material loss, and can let volatile ingredients escape, so the sample you analyze is no longer the sample you started with.

THE VERDER RECIPE

Make the sample brittle before you grind it. Cryogenic grinding (with dry ice or liquid nitrogen used correctly) keeps the temperature low, improves breakage, and enables true pulverization of soft, tough or fatty foods. Choose the right mill for the job (knife, mixer, rotor/ultra-centrifugal, cutting), use steel where recommended, avoid trapping LN_2 in closed jars (pressure risk), and keep grinding times short or use systems with controlled cooling for longer runs.

Retsch® a VERDER company

CRYOMILL

PARAMETER CONTROLLED:
Target particle size, Temperature-controlled sample preparation.

- ✔ CONTROLLED GRINDING AT CONSTANT -196˚C
- ✔ NO CONTRACT TO HAZARDOUS LN2
- ✔ PARAMETER SETTING AND SOPS

ASH TELLS THE TRUTH

Why can "ash content" turn into a rework party, with smoky runs, incomplete burn-off, and numbers that won't match between labs?

Because ashing is simple on paper, but picky in real life: You must fully oxidize the organic matrix and leave only the inorganic residue, under tightly controlled temperature and airflow, or you risk under-ashing (too high results) or losses/contamination (too low results).

THE VERDER RECIPE

Ashing = heat the prepared sample in air until organics combust and only mineral residue remains, then calculate ash from mass before vs after. For meat products, labs often follow standardized methods such as ISO 936 (total ash), for fish and fishery products, protocols commonly ash around 550 ˚C after charring/drying steps.

CARBOLITE® a VERDER company

AAF / ABF

PARAMETER MEASURED:
Ash residue mass (g) Total ash content (%) = (ash residue mass / initial sample mass) × 100.

- ✔ PREHEATED AIRFLOW
- ✔ CLEANER COMBUSTION
- ✔ AFTERBURNER OPTION

MYCOTOXINS HATE SHORTCUTS

Why can mycotoxin results jump around, even when the lab method is solid?

Because mycotoxins are often patchy in cereals and legumes, so the real challenge is getting a truly representative, well-homogenized sample before the analysis even starts.

THE VERDER RECIPE

Use a two-step grinding workflow for large volumes: First, reduce a representative bulk sample to a manageable, uniform pre-grind. Second, fine-grind to a consistent powder so the test portion actually reflects the lot, while keeping preparation neutral to analysis (no matrix changes from overheating or smearing).

Retsch®
a **VERDER** company

ULTRA CENTRIFUGAL MILL ZM 300

PARAMETER CONTROLLED:
Fine grinding (0.08 to 10 mm), speed 6000-23000 rpm, temperature.

- ✔ REPRESENTATIVE HOMOGENIZATION
- ✔ TWO-STEP WORKFLOW
- ✔ SIEVE-DEFINED FINENESS

PLANT PROTEINS, STABLE EMULSIONS

How do you keep emulsions smooth and stable while moving away from animal proteins and toward more ethical, plant-based formulations?

Because plant proteins (often coming from variable crops or side streams) can behave differently from batch to batch, and emulsions fail when you don't control stability kinetics and droplet size. The result is creaming, separation, and inconsistent texture, exactly where consumers notice first.

THE VERDER RECIPE

Treat emulsification like a measurable process: Quantify global dispersion stability and stability kinetics (how separation develops over time) and measure droplet size distribution to connect formulation and processing to real stability. Use the data to screen plant-protein types and concentrations and pick the most robust "vegan-stable" window.

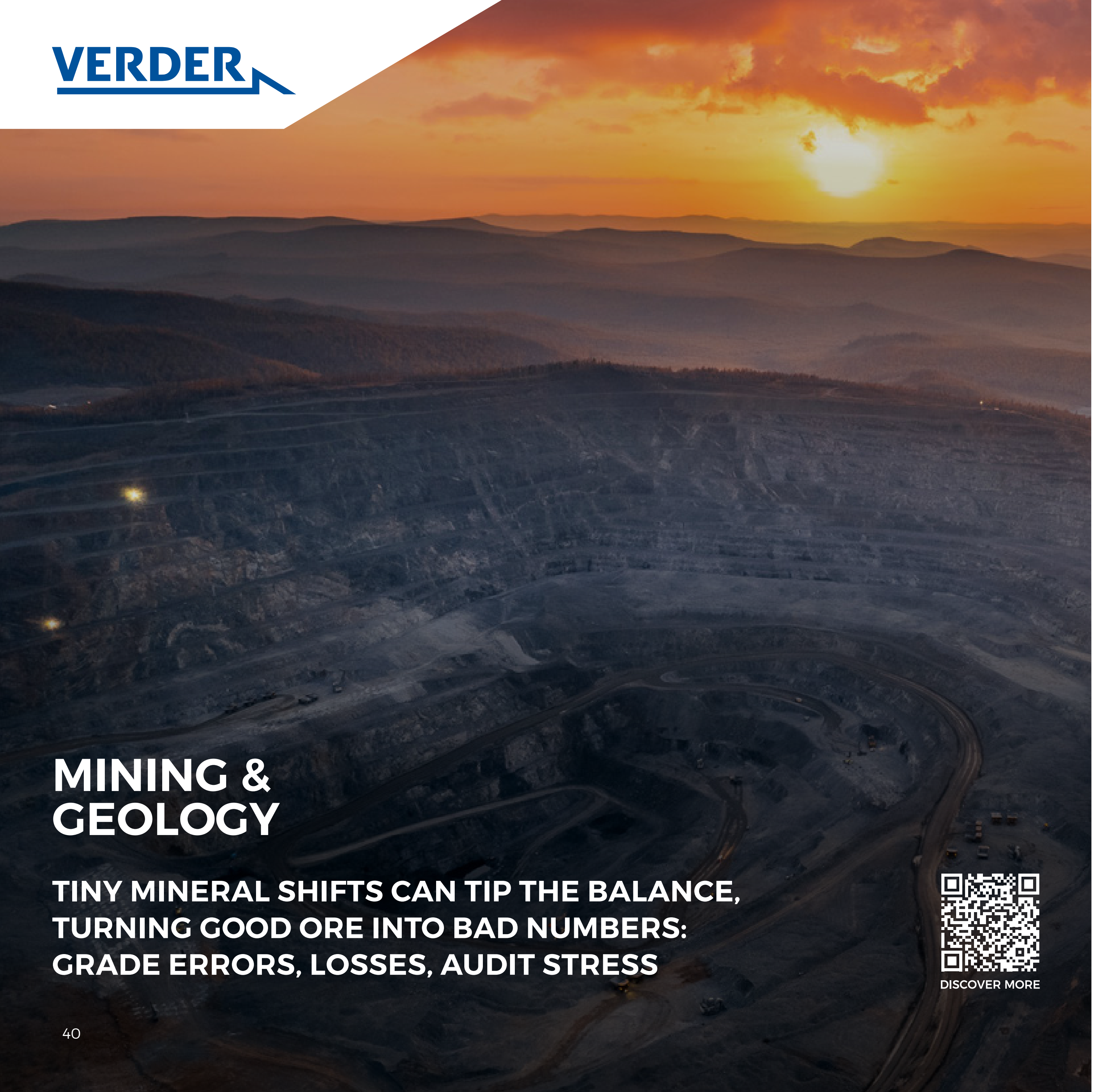
MICROTRAC
a **VERDER** company

TURBISCAN

PARAMETER MEASURED:
Transmission (T) and Backscattering (BS), Zeta potential (ζ) and charge titration signal.

- ✔ CREAMING/SEDIMENT QUANTIFICATION
- ✔ DROPLET PSD
- ✔ SURFACE CHARGE MAPPING

VERDER



MINING & GEOLOGY

TINY MINERAL SHIFTS CAN TIP THE BALANCE, TURNING GOOD ORE INTO BAD NUMBERS: GRADE ERRORS, LOSSES, AUDIT STRESS

DISCOVER MORE

TRACK IT END-TO-END: STANDARDIZED WORKFLOWS AND VERIFIED RESULTS KEEP GRADES TRUE, RECOVERY HIGH, COMPLIANCE SIMPLE

EXPLORATION & CHARACTERIZATION

Dynamic Image Analysis measure wollastonite length, thickness and aspect ratio from real particle images, controlling morphology beyond “equivalent size”.

PRECIOUS METAL RECOVERY

Proximate / LOI (Macro-TGA): Quantify moisture, volatiles and ash (plus LOI) fast with standard-aligned, repeatable workflows for coal, coke, ores and residues.

SAMPLE PREPARATION & PROCESS OPTIMIZATION

Thin Sections: Reveal mineralogy, textures and ore–gangue locking to predict liberation and steer grinding and separation decisions.

QUALITY CONTROL & ENVIRONMENTAL MONITORING

Ash Fusibility: Track IDT/ST/HT/FT to predict slagging under real atmospheres, protecting boilers/gasifiers and cutting unplanned downtime.

PROXIMATE CONTROL FOR STABLE COAL PERFORMANCE

How do you keep moisture, volatile matter, and ash results are comparable across shifts and sites when coal, coke, and ore matrices are inherently variable and prep or furnace conditions can introduce drift?

Proximate data drives fuel handling and heating value (moisture), combustion behavior and rank classification (volatiles), and impurity burden and pricing (ash).

FROM CORE TO CONTROL

Macro-TGA proximate analysis locks the workflow into a controlled temperature and atmosphere program to sequentially quantify moisture, volatiles, and ash, and calculate fixed carbon from the same run, minimizing operator influence.
The same approach extends to mining and geology via loss on ignition (LOI), where step temperatures (commonly around 550˚C for organic carbon proxies and 950˚C for inorganic carbon/carbonates) help characterize ores, sediments, tailings, and residues.

ELTRA a VERDER company

TGA THERMOSTEP

PARAMETER MEASURED:
Moisture (%), Volatile matter (%), Ash (%), Fixed carbon, LOI.

- ✔ HIGH-THROUGHPUT PROXIMATE AUTOMATION
- ✔ REPRODUCIBLE RESULTS ACROSS SHIFTS
- ✔ MOISTURE–VOLATILES–ASH IN ONE CYCLE

WOLLASTONITE MORPHOLOGY CONTROL

How do you control wollastonite's real reinforcing effect when conventional sizing (sieves or laser diffraction) reports only "equivalent spherical diameter" and misses needle-like morphology?

Wollastonite's acicular crystal habit and aspect ratios are what drive performance in plastics, paints, ceramics, and friction products, so "size only" is not enough for comminution control and final QC.

FROM CORE TO CONTROL

Dynamic Image Analysis (DIA) quantifies length and width and calculates the aspect ratio (width/length) to distinguish acicular particles from equant grains, turning morphology into a reproducible control parameter.
Because DIA evaluates very large particle populations and stores real particle images, results become statistically robust and easy to verify, document, and defend in QC.

MICROTRAC a VERDER company

CAMSIZER X2+

PARAMETER MEASURED:
Particle length and width, Aspect ratio (width/length), Shape descriptors, Size distribution alongside morphology.

- ✔ TRUE ACICULAR CONTROL: LENGTH + WIDTH (NOT "ESD")
- ✔ HIGH STATISTICS IN MINUTES
- ✔ REAL PARTICLE IMAGES FOR QC PROOF AND DOCUMENTATION

THIN SECTIONS THAT REVEAL MINERAL LOCKING

How do you produce thin and polished sections that truly represent ore textures when brittle or porous samples crack, pull out grains, or trap bubbles that distort microscopy and automated mineralogy?

If thickness, planarity, or bonding quality drifts, mineral intergrowth (locking) and fine textures can be misread, leading to wrong grind and separation decisions.

FROM CORE TO CONTROL

Thin-section reliability starts by stabilizing the sample: vacuum impregnation removes trapped air so that low-viscosity epoxy can penetrate pores and cracks and reinforce friable material before cutting and grinding.
Then the workflow keeps the sections plane-parallel and bubble-free: precision pre-thinning, controlled grinding to 20–30 µm, and pressing the sample onto the slide with a thin section press to avoid detachment or bubbles

QATM a VERDER company

QCUT 200 A

PARAMETER MEASURED:
Thin section final thickness: 20–30 µm, mineral locking and texture visibility.

- REPRODUCIBLE 20-30 µM THIN SECTIONS
- VACUUM IMPREGNATION OF POROUS, FRIABLE SAMPLES
- BUBBLE-FREE SLIDE BONDING + DEFINED GLASS THICKNESS

GRINDABILITY TESTING FOR RELIABLE MILL SIZING

How do you generate a defensible Bond Work Index when ore characteristics change over time and grindability data must stand up in design reviews, feasibility work, and plant optimization?

Bond Work Index testing is widely used to translate laboratory grindability into specific energy (kWh/t) and support comminution equipment selection and circuit design assumptions.

FROM CORE TO CONTROL

Bond testing turns "ore hardness" into a comparable number by simulating a controlled grinding circuit and linking the measured index to energy calculations that use the chosen feed and product sizes (F80/P80).
RETSCH supports this with a dedicated platform for Bond Index Testing where both ball mill and rod mill modules can be used to match the required grindability range for mining materials.

Retsch® a VERDER company

DRUM MILL TM 300

PARAMETER CONTROLLED:
Bond Work Index (BWI), kWh/t, Rod Mill Work Index range, Ball Mill Work Index range, Target product size sensitivity.

- BALL + ROD BOND TESTING ON ONE PLATFORM
- LARGE, REPRESENTATIVE SAMPLE MASS (15–20 KG)
- VARIABLE SPEED + OVERLOAD PROTECTION

ASH FUSIBILITY DATA THAT PREVENTS SLAGGING

How do you predict slagging risk before it reaches the boiler or gasifier, when ash melting behaviour depends on the inorganic mineral mix and must be reported as standard characteristic temperatures (IDT/ST/HT/FT)?

Ash fusibility testing tracks the shape changes of an ash cone as temperature rises and reports the defined transformation points used to assess melting behavior and slagging tendency.

FROM CORE TO CONTROL

Run a controlled ash-fusion program in the required test atmosphere and let continuous optical monitoring capture each endpoint, so IDT, ST, HT, and FT are determined consistently and documented for QA and reporting.
For real-process relevance, the method is commonly performed in a reducing atmosphere, with additional insight possible from an oxidising run, depending on your application and standard.

CARBOLITE®
a **VERDER** company

CAF G5 ASH FUSIBILITY

PARAMETER MEASURED:
IDT (Initial Deformation Temperature),
ST (Sphere/Softening stage), HT (Hemispherical Temperature), FT (Fluid/Flow Temperature).

- ✔ AUTOMATIC IMAGE CAPTURE + ENDPOINT ANALYSIS
- ✔ REDUCING OR OXIDISING GAS MODES TO MATCH
- ✔ MULTI-STANDARD COMPLIANCE (ISO 540, ASTM D1857/D1857M, DIN 51730)

FROM ISOTHERMS TO RESERVES

How do you quantify how much methane or CO_2 a coal or shale can store under reservoir-like pressure, with data solid enough for resource evaluation, enhanced recovery concepts, and sequestration screening?

Coalbed methane capacity is commonly assessed from adsorption behaviour, where different parameters are used to describe storage capacity and pressure response.

FROM CORE TO CONTROL

High-pressure gas adsorption measures an adsorption isotherm: Uptake as a function of pressure at constant temperature, so you can translate solid gas interaction into a comparable capacity and model inputs.
With a high-pressure volumetric system you can reproduce field-relevant conditions (CH_4/CO_2, controlled temperature), generate adsorption/desorption isotherms, and, when needed, add kinetic insight (rates and diffusion indicators) for screening and process assumptions.

MICROTRAC
a **VERDER** company

BELSORP HP

PARAMETER MEASURED:
Adsorption capacities at various temperatures and pressures.

- ✔ UP TO 0.9 MPA: RESERVOIR-RELEVANT CH_4/CO_2 ISOTHERMS
- ✔ WIDE TEMPERATURE RANGE FROM CRYOGENIC TO 400 °C
- ✔ ONE PLATFORM FOR UPTAKE CAPACITY + KINETICS

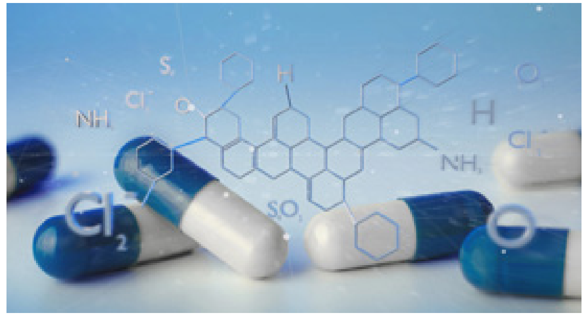
VERDER

PHARMACEUTICAL

FROM INCOMING MATERIALS TO FINISHED PACKS, PHYSICAL TESTING KEEPS SPECIFICATIONS UNDER CONTROL

DISCOVER MORE

RELEASE WITH CONFIDENCE: USP-COMPLIANT TESTING + INTEGRITY CHECKS, EVERY BATCH BACKED BY REPEATABLE PROOF

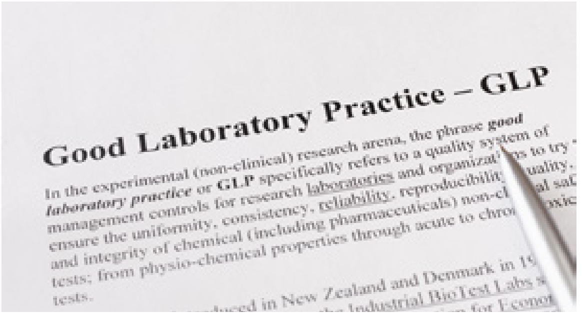


R&D

Particle Size & Shape Insight: Combine size and shape to spot agglomerates and morphology shifts that simple sizing misses, protecting manufacturability.

RAW MATERIALS

Representative sampling: Sample dividers split bulk powders into representative sub-samples, preserving composition across fractions.



QUALITY CONTROL

5-in-1 Tablet Checks: One routine captures hardness, dimensions and weight together, strengthening batch decisions with faster, cleaner data.

PRODUCT INTEGRITY

Static multiple light scattering (SMLS): Tracks backscattering/transmission vs height and time to quantify destabilization and rank shelf-life, without dilution.

QUALITY CONTROL

WHO. WHAT. WHEN. WHY.

How can dissolution results stay defensible when records are fully digital?

In regulated QC, dissolution data support release and stability decisions, so every action around a test must be traceable. Without a validated audit trail, controlled access, and locked methods, investigations and audits quickly turn into "unknown operator, unknown change, unknown reason."

DRUG RELEASE TESTING DONE RIGHT

The DT 950 sets the standard for dissolution testing of tablets, capsules, and other solid dosage forms — delivering precise, reproducible results throughout development and QC. Fully USP, EP, and JP compliant, it ensures your release testing meets the most stringent regulatory demands every time.

ERWEKA
a VERDER company

DT 950 SERIES

PARAMETER MEASURED:
Guided testing with TestAssist,
Advanced method & user management.

- ✔ 21 CFR PART 11
- ✔ TAMPER-PROOF AUDIT TRAIL
- ✔ METHOD CONTROL

SIEVE. WEIGH. VALIDATE.

How do you get reliable PSD on fine, cohesive powders without transfer errors or missed steps?

Fine powders need dry sieving + deagglomeration with tight control and documentation. If you move samples between devices or rely on manual steps, precision and traceability suffer.

THE GMP SIEVING SCRIPT

Run sieving, weighing, and evaluation in one device, with guided workflows and in-process checks (e.g., weighing assistance, tolerances, trend monitoring) to keep results consistent and audit-friendly.

Retsch®
a VERDER company

AS 200 JET PHARMA

PARAMETER CONTROLLED:
Particle size distribution (sieve fractions), % oversize/undersize, percentiles/span, trend/limit monitoring.

- ✔ GMP-READY PSD
- ✔ NO TRANSFER ERRORS
- ✔ GUIDED, TRACEABLE WORKFLOW

PHARMACEUTICAL

SAME D50. DIFFERENT POWDER.

How can QC detect morphology risks when "particle size" looks identical?

In pharma powders (APIs + excipients), two materials can share the same d50 yet behave differently because shape is different (example: two starches with identical d50 but very different aspect ratio b/l, compact vs fibrous). Agglomerated APIs also make sieving unreliable, and laser diffraction can't separate length vs width, so key differences get blurred.

THE PARTICLE PORTRAIT CHECK

Use Dynamic Image Analysis to capture real particle images and calculate size + shape together: choose the right size definition (e.g., xc min = width, xFe max = length), quantify aspect ratio/roundness/circularity, and disperse sticky/agglomerated powders with controlled air pressure (venturi nozzle 20–460 kPa) to reveal what traditional methods hide.

MICROTRAC
a VERDER company

CAMSIZER X2+

PARAMETER MEASURED:
d10/d50/d90 with selectable size models, aspect ratio (b/l) + roundness/circularity, oversize / agglomerates sensitivity + repeatability.

- ✔ SIZE + SHAPE, TOGETHER
- ✔ AGGLOMERATES EXPOSED
- ✔ FAST QC THROUGHPUT

TABLETS NEED MORE THAN HARDNESS.

How can batch release rely on one consistent check instead of scattered measurements and manual transcription?

Batch release decisions can't rely on a single value. If hardness, dimensions, and weight are measured with different routines or recorded manually, variability and documentation gaps creep in and investigations follow.

THE 5-IN-1 RELEASE CHECK

Measure the five key properties in one routine with guided testing (TestAssist) and controlled test management, so every operator follows the same path.

ERWEKA
a VERDER company

TBH II

PARAMETER MEASURED:
Hardness, thickness, width, diameter/length, weight.

- ✔ 5 PARAMETERS, ONE WORKFLOW
- ✔ REPEATABLE MANUAL QC
- ✔ GUIDED TESTING + MANAGEMENT

VERDER

EXPLORE MORE APPLICATIONS

ADDITIVE MANUFACTURING

For MIM parts, CARBOLITE combines catalytic or thermal debinding with final sintering in one workflow.

MICROTRAC qualifies AM metal powders through particle size and shape analysis before printing.

ELTRA tracks carbon in steel powders and oxygen or hydrogen after sintering to avoid hardness shifts.

AEROSPACE/ AUTOMOTIVE

Gas pycnometry and porosity analysis qualify aerospace AM powders and C/C composites before part production.

ELTRA measures diffusible and total hydrogen in titanium and nickel alloys to detect embrittlement risks early.

QATM reveals grain size and phases in 3D-printed titanium and Inconel for aerospace qualification.

STEEL

QATM prepares heat-treated steel samples for microstructure and hardness checks.

CARBOLITE anneals stainless tubes and tempers strip steel under controlled atmospheres.

ELTRA tracks carbon and sulfur from raw iron to stainless steel, where ppm-level shifts affect hardness and quality.

TECHNICAL CERAMICS

CARBOLITE combines debinding and sintering of oxidized technical ceramics in one HTF furnace up to 1800 °C.

Surface area and porosity of alumina or zirconia powders help predict densification and final microstructure.

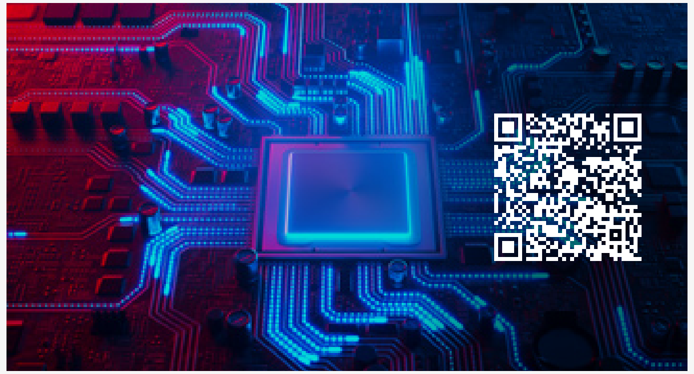
QATM prepares medical ceramic parts for microstructure and hardness checks..

GREEN BUILDING MATERIALS

RETSCH activates fly ash and slag by mechanochemical milling to improve SCM reactivity before green cement blending..

MICROTRAC links particle size and shape in fly ash and slag to hydration and cement durability.

ELTRA measures carbon, sulfur and hydrogen in SCM feedstocks and secondary waste for green cement control.



MICROELECTRONICS

MICROTRAC tracks oversize particles, particle size and zeta potential in CMP slurries to reduce scratches and defects

QATM exposes vias, thin films and solder joints with minimal smearing for failure analysis.

CARBOLITE supports CVD and annealing studies in microelectronics through uniform temperature and atmosphere control.

GLOBAL REACH, LOCAL EXPERTISE

HEAT TREATMENT

ELEMENTAL ANALYSIS

MATERIALOGRAPHY & HARDNESS TESTING

MILLING & SIEVING

PARTICLE CHARACTERIZATION

PHARMACEUTICAL TESTING

verder.com