Sustainable mining of natural resources is a cornerstone of our standard of living and prosperity. With a wide range of applications, mined materials play a critical role in various segments of our lives, including construction and power generation, and are used as commodities for industrial applications and luxury goods. They also contribute to current green technologies – like wind turbines, solar panels, and electric vehicles – and are an integral aspect of the effort to counter climate change. Exploring new exploitable deposits and recycling raw materials have to be done responsibly for mining to have a sustainable economic role in society. Mined metals and minerals must be extracted, transported, stored, and processed according to quality control processes that deliver safe and high-quality products. We have a wide array of instruments that contribute to every step of this development and production chain.

Responsible and Sustainable Production for High-Quality Products

Optimize the mining process and plan downstream processing requirements

Discover possible recovery losses ahead of time

Increase efficiency and stabilize plant conditions

Reduce the costs and environmental impact of ore processing

Evaluate groundwater movement and pollution

Prevent energy waste on unnecessary grinding

Raw ores and drilling fluids analysis

Powders and slurries analysis

Processed ore and tailings analysis

EXPLORATION 4–5

ORE TRANSPORT AND PROCESSING 6–7

QUALITY CONTROL 8–9

www.anton-paar.com/apb-mining-solutions
Several instruments from our portfolio help you optimize your exploration process.

**X-ray diffraction:**
XRDynamic 500, an automated multipurpose powder X-ray diffractometer

**Mercury intrusion porosimetry:**
PoreMaster, a mercury intrusion pore size analyzer

**Gas pycnometry:**
Ultrapyc, the most versatile single-station gas pycnometer

**Microwave acid digestion:**
Multiwave GO Plus, 5000, and 7000, modern microwave digestion systems

**Laser diffraction:**
The PSA series, determines the particle size distribution of liquid dispersions and dry powders

**Rheometry:**
The MCR series, the world’s most versatile and trusted rheometer brand

**Viscometry:**
ViscoQC and RheolabQC, rotational viscometers

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<table>
<thead>
<tr>
<th>CHALLENGE</th>
<th>BENEFIT</th>
<th>TECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identifying and quantifying high-value deposits and other types of minerals at an exploration site</td>
<td>Optimize the mining process and effectively plan downstream processing requirements</td>
<td>X-ray diffraction</td>
</tr>
<tr>
<td>Identifying non-extractable ore forms for yield estimates that can’t be done via chemical analysis alone</td>
<td>Discover possible recovery losses ahead of time to optimize the extraction process</td>
<td>X-ray diffraction</td>
</tr>
<tr>
<td>Quantifying rock porosity and pore size</td>
<td>Measure porosity and pore size distribution for a full site evaluation for groundwater movement and pollution, which has both safety and environmental concerns</td>
<td>Mercury intrusion porosimetry, Gas pycnometry</td>
</tr>
<tr>
<td>Obtaining optimum mud density for hydrostatic pressure and circulation (i.e., density ideal for bringing cuttings to the surface)</td>
<td>Measure the density of both dry solids and formulations for accurate fine-tuning of density from individual values and blends of cuttings, barite, clays, and other solids to minimize cost while preventing blow-out</td>
<td>Gas pycnometry</td>
</tr>
<tr>
<td>Ensuring reliable characteristics of cement powder and sand (i.e., those fit for well-bore cementing)</td>
<td>Determine the skeletal density and, with this value, calculate the target solid’s percentage with confidence and improve the accuracy of Blaine measurement to produce a cement with proper support and isolation</td>
<td>Gas pycnometry</td>
</tr>
<tr>
<td>Obtaining a precise estimation of the elements that drilling samples/rocks contain</td>
<td>Perform high-temperature microwave digestion with minimum acid consumption to prepare samples for analysis by atomic spectroscopy (ICP-OES, ICP-MS, AAS)</td>
<td>Microwave acid digestion</td>
</tr>
<tr>
<td>Detecting low-gravity solids (LGS) of reused drilling mud as they build up</td>
<td>Monitor the particle size distribution in order to know how long drilling mud can be reused before risking sudden downtimes</td>
<td>Laser diffraction</td>
</tr>
<tr>
<td>Ensuring a smooth fracking process</td>
<td>Predict the flow behavior of fracking fluids at high pressures and various shear rates, and even the possible yield point</td>
<td>Rheometry</td>
</tr>
<tr>
<td>Ensuring proper viscosity of bentonite at rest and during pumping</td>
<td>Smooth processing when drilling mud is transported as well as no sudden downtime</td>
<td>Viscometry</td>
</tr>
</tbody>
</table>
Several instruments from our portfolio help you optimize your ore transport and processing.

**X-ray diffraction:**
XRDyynamic 500, an automated multipurpose powder X-ray diffractometer

**Gas pycnometry:**
Ultrapy, the most versatile single-station gas pycnometer

**Gas adsorption surface area analysis:**
The Nova series, surface area and pore size analyzers

**Laser diffraction:**
The PSA series, determines the particle size distribution of liquid dispersions and dry powders

**Rheometry:**
The MCR series, the world’s most versatile and trusted rheometer brand

**Viscometry:**
ViscoQC and RheolabQC, rotational viscometers

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<td>Delivering consistent mineralogy to the processing plant</td>
<td>Increase efficiency and stabilize plant conditions via optimal grade selection through phase identification of the minerals present in mined ore</td>
<td>X-ray diffraction</td>
</tr>
<tr>
<td>Exploiting ore deposits of lower-ore grades requires frequent monitoring of the mined material</td>
<td>Optimize operational efficiency of the mining process and the beneficiation process of the ore by rapid qualitative and quantitative analysis of the mineral composition</td>
<td>X-ray diffraction</td>
</tr>
<tr>
<td>Difficulties during transport and storage of powder raw materials</td>
<td>Simulate the mechanical transport of solid raw materials in order to avoid issues during transport and storage of powdery materials</td>
<td>Powder rheometry</td>
</tr>
<tr>
<td>The slurry gets stuck while pumping</td>
<td>Analyze the yield point of the ore slurry and lower the yield point so that less force is needed to initiate sample flow, which results in smooth and efficient transportation process during production</td>
<td>Rheometry, Viscometry</td>
</tr>
<tr>
<td>Optimum processing viscosity for processing of metal extracted from slag</td>
<td>Perform temperature-dependent viscosity measurements and thus reduce processing cost by minimized temperatures and reduced wear of container materials</td>
<td>High-temperature rheometry</td>
</tr>
<tr>
<td>Calculating the proper amount of slurry dispersant/stabilizer</td>
<td>Measure true powder surface area so that the minimum particle surface coverage required can be calculated</td>
<td>Gas sorption surface area analysis</td>
</tr>
<tr>
<td>Accurately calculating sedimentation times of tailings/washings</td>
<td>Measure density for more efficient operation and lifecycle management to reduce overall costs and land use</td>
<td>Gas pycnometry</td>
</tr>
<tr>
<td>Optimizing the density of fluids in float-sink tanks for coal washing to meet end-user specifications</td>
<td>Measure density of sink and float fractions to maximize the economics of separating coal from rock and minerals</td>
<td>Gas pycnometry</td>
</tr>
<tr>
<td>Optimizing ore grinding by preventing fine and ultrafine particles, and wastage of energy on unnecessary grinding</td>
<td>Constantly monitor the particle sizes, which leads to lower energy consumption and cost reduction</td>
<td>Laser diffraction</td>
</tr>
<tr>
<td>Producing uniform particle size to prevent ore separation bias</td>
<td>Adapt the ore comminution process based on the resulting particle size distribution and reach a more efficient and faster separation, and higher yields</td>
<td>Laser diffraction</td>
</tr>
</tbody>
</table>
Several instruments from our portfolio help you optimize your quality control.

**X-ray diffraction:**
XRDynamic 500, an automated multipurpose powder X-ray diffractometer

**Gas pycnometry:**
Ultrapyc, the most versatile single-station gas pycnometer

**Automated representative sampling:**
The Micro Rotary Riffler, an automated representative sampler

**Microwave acid digestion:**
Multiwave GO Plus, 5000, and 7000, modern microwave digestion systems

**Hot block digestion:**
Multicube 48, a hot block digestion system

**Laser diffraction:**
The PSA series, determines the particle size distribution of liquid dispersions and dry powders

**Rheometry:**
The MCR series, the world's most versatile and trusted rheometer brand

**Viscometry:**
ViscoQC and RheolabQC, rotational viscometers

### CHALLENGE | BENEFIT | TECHNOLOGY
---|---|---
Continuous monitoring of processed ore quality | Fast phase identification and quantification in order to quickly respond to changes in processed products to ensure optimal quality and reduced wastage | X-ray diffraction
Large quantities of materials with potential reusable value may end up in tailings | Identify compounds of value that can be recovered from tailings and thus reduce wastage and potential environmental damage | X-ray diffraction
Analyzing water and soil for contamination with harmful elements | Digest 48 samples at once, 24/7, at up to 180 °C | Hot block digestion
C askic leaching of bauxite samples to determine available alumina and reactive silica | Highly temperature-dependent extraction process makes elements of interest available for analysis | Microwave acid digestion
Fast acid digestion of process QC samples for elemental composition | Reliable data for process control | Microwave acid digestion
For metal analysis, it's important to take a small aliquot from ground/milled material that has the same composition as the larger sieved sample | Use the most effective representative sampling technique that provides you with eight equivalent aliquots, from a single split, which can be directed towards digestion and/or multiple physical and chemical analytical methods | Automated representative sampling
Assuring correct volume of powdered rock (ore) | Measure density to provide accurate mass calculations for all materials prior to distribution and export | Gas pycnometry
Efficient dilution of tailings to enable pumping while minimizing discarded material | Analyze flowability with variable degrees of dilution to remove a yield point so that sample flow is possible | Rheometry
Coal ash sticks to reactor walls and needs to be mobilized by heating/melting and subsequent removal | Being aware of temperature and composition at which a predefined viscosity (viscosity to flow down the reactor wall) is reached. This ensures smooth operation and long-term running of the plants/gasifiers | High-temperature rheometry
Continuous particle size distribution (PSD) monitoring of processed ore in order to ensure consistent quality of the final product | Measure the PSD for constant quality of the final product, suited for the planned application | Laser diffraction
We're confident in the high quality of our instruments. That's why we provide a full warranty for three years.

All new instruments include repair for three years. You avoid unforeseen costs and can always rely on your instrument. Alongside the warranty, we offer a wide range of additional services and maintenance options.

*Due to the technology they use, some instruments require maintenance according to a maintenance schedule. Compliance with the maintenance schedule is a prerequisite for the three-year warranty.

**SERVICE AND SUPPORT DIRECTLY FROM THE MANUFACTURER**
Our comprehensive service provides you with the best individual coverage for your investment so that maximum uptime is ensured.

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**Anton Paar Instruments**

**XRDynamic 500**
XRDynamic 500 ensures optimized processes at every stage of the mining operation via rapid as well as precise phase identification and quantification of metals and minerals.
- Right out of the box: Best-in-class resolution / signal-to-noise ratio
- TruBeam™ concept: Larger goniometer radius and evacuated beam path
- Full automation: X-ray optics and beam geometry change

**Ultrapyc series**
Measurements with the Ultrapyc gas pycnometers take less than 10 minutes, so they’re perfect for controlling the quality of your solid materials and slurries throughout exploration and processing.
- PowderProtect: Measure fine powders without instrument contamination
- Built-in Peltier temperature control for superior thermal stability
- Accurate results for sample volumes from 4.5 cm³ to 135 cm³

**PSA series**
The PSA instrument has market-leading robustness when it comes to ground vibrations, dusty environments, and abrasive samples.
- Permanently aligned solid-state lasers – durable and resistant to ground vibrations
- No glass in the dry path of the sample and exceptionally robust glass in the liquid path
- Compact 2-in-1 design to conduct both wet and dry measurements in a single setup

**MCR rheometer series**
Your solution for material flow optimization, from designing raw material powder transport to predicting flow behavior of tailings suspensions and optimizing slag processing.
- 15 rheometers and over 200 accessories mean all of your samples and requirements are covered
- A range of smart features do the work so you can do the thinking
- Continuous development of the portfolio in response to customer feedback and new ideas

**ViscoQC, RheolabQC**
For quick and convenient dynamic viscosity measurements, ViscoQC and RheolabQC rotational viscometers ensure the quality of your substance for the best pumpability and workability results.
- Save time with the fast and highly accurate sample temperature control delivered by the Peltier temperature devices PTD 80 and PTD 175
- Unique features provide error-free and efficient operation
- Economical consumption of resources with a small footprint

**Multiwave GO Plus, Multiwave 5000, Multiwave 7000**
Multiwave digestion systems are the perfect sample preparation instrument for the mining industry.
- Budget-friendly disposable vials and inserts for economic sample preparation
- Innovative features (e.g., library with more than 500 methods, hands-free door opener) make microwave digestion easier and more convenient than ever
- Clever instruments and vessel concepts, state-of-the-art sensor technology, and the highest safety standards (ETL and GS safety certificates)

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“Safeguarding your investment”
“Service is global”
“Certified service engineers”
“The shortest response times”
“Anton Paar Certified Service”