Malvern Panalytical
a spectris company

# Building Materials analytical toolbox

## Measure - Predict - Monitor - Control - Optimize

## Cement and Concrete analysis

As the push for a circular, Net Zero industry drives the use of alternative fuels and clinker replacements, robust elemental and mineralogical analysis is increasingly essential to high-quality cement production. At the same time, particle size analysis remains critical for optimizing grinding efficiency and final cement properties. More than ever, cement manufacturers need tight control of every step in the production process to achieve maximum efficiency, cost-effectiveness, and quality.

To improve their cement's quality and consistency, while also supporting sustainability and reducing production costs, manufacturers need reliable material analysis solutions. Solutions like Malvern Panalytical's world-leading instruments: X-Ray Diffraction for mineralogical analysis, X-Ray Fluorescence and Activated Neutrons Cross Belt analyzers for chemical compositions and our Laser Diffraction solutions for particle sizes distributions. Our cement portfolio provides a one-stop set of solutions for all parts of the production process. The solutions integrate seamlessly into your existing production processes, and come with support that you can count on, anywhere in the world.

| Quarry - Recycling | Fuels | Process Monitoring | | | Quality Control | Environmental check | Research |
|---|---|---|---|---|---|---|---|
| Raw materials | Alternative fuels Recycling – coal | (Pre-blend) stockpile | Raw mix – raw meal – hot meal | Cement additives SCMs - recycling | Cement | Concrete | Research |

**Expertise support:** Tailored consultancy and training services with knowledge of in-house experts

| | Mineralogical composition & crystalline structure | | Elemental composition | | | | | Automated Mineralogical/ Elemental compositions | |
|---|---|---|---|---|---|---|---|---|---|
| |  |  |  |  |  |  |  |  | |
| **Product** | **Aeris Cement** | **Empyrean** | **CNA Range** | **Zetium** | **Axios FAST** | **Epsilon 1** | **Epsilon 4 Cement** | **Twin Zetium/Aeris** | **Product** |
| **Technology used** | X-ray diffraction (XRD) | X-ray diffraction (XRD), Computed tomography (CT) | Pulsed Fast Thermal Neutron Activation (PFTNA) | X-ray fluorescence (XRF) | X-ray fluorescence (XRF) | X-ray fluorescence (XRF) | X-ray fluorescence (XRF) | Combined X-ray fluorescence (XRF) and X-ray diffraction (XRD) | **Technology used** |
| **Where in the process?** | ● ● ● ● ● | ● ● ● | ● ● ● ● | ● ● ● ● ● ● | ● | ● ● ● | ● ● ● | ● ● ● ● ● | **Where in the process?** |
| **What is it used for?** | • Phase identification and quantification. Main focus: the mineralogical composition of clinker, SCMs (e.g., slag, fly ash, pozzolans, and calcined clays), and cement.<br>• Prediction of process parameters related to cement/concrete properties (e.g., compressive strength and setting time). | Main focus: the mineralogical compositions of alternative fuels, clinker, SCMs (e.g., slag, fly ash, pozzolans, and calcined clays), and cement. Also great for:<br>• Phase identification<br>• Phase quantification<br>• Mineral mapping<br>• 2D and 3D imaging<br>• Bulk material characterization<br>• Non-ambient phase changes<br>• In-situ phase changes<br>• Stress and residual strain<br>• Crystallographic texture | • Real-time detection of variation in coal composition<br>• Real-time detection of variation in raw materials composition (e.g., limestone)<br>• Raw material sorting for stockpile management<br>• Accurate clinker ratio monitoring for low CO2 emission cements (LSF) | • Quantification of elements in range Be-Am, with superior lower limit of detection for most elements<br>• Materials in solid, powder, or liquid form<br>• Small spot mapping for all elements across the range | • High-speed process critical elemental analysis during mining and ore processing<br>• High-speed elemental analysis in service laboratories | • Quantification of elements from Na to Am with lowest limits of detection for most elements<br>• Analysis of raw materials directly in the mine<br>• Use in remote container laboratories<br>• At-line process analysis<br>• Environmental check (heavy metals contaminants, compliance to norms)<br>• Elemental analysis of solids, powders and liquids | • Quantification of elements from Na to Am with lowest limits of detection for most elements<br>• analysis of raw materials directly in the mine<br>• Use in remote container laboratories<br>• At-line process analysis<br>• Alternative fuels analysis<br>• Environmental check (heavy metals contaminants, compliance to norms)<br>• Elemental analysis of solids, powders and liquids | Combination of both instruments in an automated environment (includes the conveyor belt) | **What is it used for?** |
| **What's special about this product?** | • Compact X-ray diffractometer designed for the cement industry<br>• Minimal infrastructural requirements<br>• External sample changer<br>• Fully automatable<br>• Intuitive operation accessible to non-experts<br>• Touch-screen user interface makes measurement effortless<br>• Low cost of ownership, with no need for compressed air or external cooling, and low power consumption<br>• X-ray tube has a virtually unlimited lifetime<br>• Speed and Sensitivity pack available<br>• HighScore software or RoboRiet for completely automated data evaluation and easy analysis | • Most versatile an productive XRD system<br>• Highest data and product quality on the market<br>• Widest range of non-ambient and *in-situ* environments<br>• All relevant diffraction geometries (reflection, transmission, capillary, microdiffraction, Debye-Scherrer) with batch automation<br>• Wide selection of components to match every customer need<br>• Cost-effective options for CT configurations<br>• HighScore software | • Ultimate operator safety with on/off neutron tube<br>• Two different designs tailored to raw materials (recycling) or coal<br>• Monitors full material volume on the belt<br>• Accommodates various belt loads and widths<br>• Simple installation, easy maintenance<br>• Intuitive CNA Manager software and UI<br>• Dedicated raw mix and stockpile software, O_blend, enables combination with Zetium to deliver highly accurate data for digital-driven plants | • Combination of ED and WD (SumXcore technology) reduces measurement time by up to 50%<br>• Batch automation<br>• Simple and intuitive SuperQ software with Virtual Analyst for in-house expertise<br>• FastScan Omnian program for standardless analysis<br>• Dust removal device<br>• SST R-mAX tube with CHI-BLUE window coating for increased X-ray tube durability and less drift<br>• Small-volume airlock design for rapid cycling of samples into vacuum, or low He consumption for liquid analysis<br>• Expertise and CRMs for all material types (including in-house-developed standards such as WROXI or Pro-Trace)<br>• Ready for digital-driven plants with the cloud solution Smart Manager | Speed of analysis:<br>• Simultaneous analysis<br>• Up to 28 user-defined elements<br>• Most precise results within short measurement times<br><br>Highest throughput:<br>• Unattended batch analysis<br>• Minimal sample loading time<br>• Maximal operational efficiency:<br>• No need for recalibration<br>• 4 kW SST-mAX X-ray tube with ZETA technology for minimal drift<br>• Easy maintenance<br>• Global support and maintenance network | • All measurements in air, no need for helium or vacuum pump<br>• Can be used with a car battery int he field<br>• Highest analytical performance in its class<br>• Completely X-ray safe operation<br>• Built-in drift monitor for best accuracy and easy operation<br>• Creating unlimited applications<br>• Automatic Program Selection (APS) for easy operation<br>• Supported by expertise and CRMs for all materials types | • Handles wide range of sample sizes, from < 1 g up to larger bulk samples, including irregularly shaped objects<br>• Small footprint<br>• Automatable<br>• Flexible calibration solutions (WROXI)<br>• Close coupling X-ray source-sample-detector for optimized sensitivity<br>• Reduced helium consumption<br>• Online remote support<br>• Multiple software options (e.g., elemental screening with Omnian, pass/fail analysis with Fingerprint)<br>• Automatic built-in drift monitor for best accuracy<br>• Unique combination of 10-position sample changer with spinner<br>• Automatic Program Selection (APS) for easy operation | The performance of each instrument is maintained, plus:<br>• Single software to control both instruments and get optimized, merged results<br>• Easy installation<br>• Global results easily managed within LIMS<br>• Delivers accurate data for digital-driven plants | **What's special about this product?** |

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|---|---|---|---|---|---|---|---|

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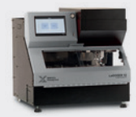
| | Particle size and shape | | | | Sample preparation for XRF and ICP | | | | Industry 4.0 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| |  |  |  |  |  |  |  |  |  |  | |
| **Product** | **Mastersizer 3000+** | **Insitec** | **Morphologi 4-ID** | **Zetasizer** | **LeNeo** | **FORJ** | **Eagon 2** | **LeDoser 12** | **Automation** | **Digital solutions** | **Product** |
| **Technology used** | Laser diffraction | Laser diffraction | Image analysis, Raman spectroscopy | Dynamic Light Scattering, Electrophoretic Light Scattering, Static Light Scattering | Borate fusion and sample oxidation | Automated borate fusion and sample oxidation | Automated borate fusion and sample oxidation | Automation | Combination of multiple sensors | Cloud based software algorythms | **Technology used** |
| **Where in the process?** | ● ● | ● | ● ● | ● ● | ● ● ● | | | | ● | ● ● ● | **Where in the process?** |
| **What is it used for?** | Main focus: Particle size distribution for cement, raw mix, clinker, and SCMs (e.g., calcined clays).<br>• Measuring the size distribution of suspensions, emulsions and dry powders 10 nm-3500 µm<br>• Controlling powder properties such as wettability, bulk density, powder flow and solubility | • On-line continuous particle size analysis<br>• Suitable for process streams from dry powders to hot sticky slurries, sprays and emulsions – whether milligrams or hundreds of tonnes per hour<br>• Achieve correct properties during cement grinding while saving electricity<br>• Particles in the range of 0.1 micron-2.5 mm<br>• High-frequency, representative measurement provides results suitable for process optimization and modeling to target pre-determined properties (AI, ML) | • Size measurement of non-spherical particles, such as needle-shaped crystals, 0.5 µm-1000 µm<br>• Measurement of shape differences<br>• Detection and enumeration of agglomerates, oversized particles, and contaminant particles<br>• Automation of manual methods such as microscopy<br>• Physical characterization of individual components within a mixture<br>• Cross-validation of particle size measurements such as laser diffraction | • Measuring the size of colloids, nanoparticles and molecules in solution from 0.3 nm-15 µm<br>• Monitoring molecular aggregation and particle flocculation processes<br>• Defining optimum composition of charged additives to cement in new formulations | • One fusion position<br>• Automated preparation of glass disks for elemental analysis using XRF<br>• Preparation of peroxide or borate solutions for elemental analysis using ICP<br>• Decrease sample preparation time<br>• Increase user safety | • Six fusion positions (pre-loading of six additional samples with tray loader option)<br>• Automated preparation of glass disks for elemental analysis using XRF<br>• Automated preparation of peroxide or borate solutions for elemental analysis using ICP<br>• Increase user safety<br>• Speed and high throughput with the tray loader<br>• Connectivity and sample monitoring (sample tracking, remote control, LIMS connection) | • Two fusion positions<br>• Can be integrated into automated processes<br>• Automated preparation of glass disks for elemental analysis using XRF<br>• Decrease sample preparation time<br>• Increase user safety | • Automated and standardized dosing of chemical for the preparation of glass disks for XRF and solutions for ICP | • Automated process monitoring<br>• High-througthput analysis<br>• Standardized measuring<br>• Sample - treatment, - transport, - preparation<br>• Result distribution<br>• Container laboratories<br>• Automated process monitoring | • Development of digital solutions for specific applications<br>• Smart Manager gives insight into utilization of equipment, notification of maintenance, and global access to systems<br>• Data fusion to predict process parameters | **What is it used for?** |
| **What's special about this product?** | • World's most popular particle sizing instrument<br>• Class-leading particle sizing performance in a compact footprint<br>• Intuitive software with built-in expertise to ease your workload<br>• Flexible reporting to display your data the way you want it<br>• Rapid and effective wet dispersion<br>• Fast, reliable particle size measurement of fragile and cohesive dry powders<br>SelectScience 2023 PLATINUM Seal of Quality * | • Industrially robust<br>• Technologically proven<br>• Measures particles in the size range 0.1-2500 µm<br>• Delivers real-time monitoring and control<br>• Base model hardware manufactured to GAMP5 standards and compatible with CIP/SIP requirements<br>• Easy-to-use software and fully automated operation<br>• Integration with existing control platforms<br>• High reliability of > 95% with little downtime, minimal maintenance, and maximum ROI | • Measure particle size, shape and chemical identity in one platform<br>• Integrated dry powder dispersion unit<br>• Versatile sample presentation accessories for measuring suspended and filtered samples<br>• Simple SOP operation from sample dispersion through to size, shape, and chemical analysis<br>• Automatic selection, targeting, and chemical classification of thousands of individual particles<br>• Powerful and intuitive software interface | • Patented technologies<br>• Simple operation for minimal training and robust results<br>• High optical quality and temperature control ensures accuracy and repeatability<br>• MPT-3 Autotitrator option and Autosampler option for automated trend measurements and high-throughput testing<br>• Shape/size/composition correlations possible depending on sample | • Patented technologies<br>• Simple operation for minimal training and robust results<br>• High optical quality and temperature control ensures accuracy and repeatability<br>• MPT-3 Autotitrator option and Autosampler option for automated trend measurements and high-throughput testing<br>• Shape/size/composition correlations possible depending on sample | • High productivity with six fusion positions<br>• Withstands heavy workloads and harsh work environments<br>• Three preparation modes in one instrument<br>• Three different layers of refractory materials for maximal heat retention and energy saving<br>• Sample monitoring to prevent losing track of samples and to measure fusion success rate<br>• Lower operational cost: lower maintenance, fewer consumables, lower energy consumption, shorter fusion cycles, and less energy loss | • Absolute safety for the operator<br>• Two fusion positions<br>• Optional exhaust adapter for minimal infrastructure requirements<br>• Casting dish sensors: prevents damage to the instrument from pouring without molds<br>• Non-wetting agent pill injection for optimized fusion method efficiency<br>• Pause and inspect function to visualize the fusion process during the fusion cycle | • Synchronizes sample preparation and readies samples in time for subsequent fusion and analysis<br>• Twelve positions<br>• Saves 90% of labor time in the weighing step<br>• Fully adaptable to standard operating procedure (SOP)<br>• Eliminates data transfer errors as it is LIMS-ready and has sample tracking option<br>• Self-installation | • In-house automation knowledge<br>• In-house sensor development<br>• In-house application expertise<br>• In-house automation software<br>• In-house service and support | • In-house digital experts<br>• In-house sensor development<br>• In-house application expertise<br>• Global support | **What's special about this product?** |

* Select Science 2023 Platinum Seal of Quality awarded to Mastersizer 3000

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# About Malvern Panalytical

We draw on the power of our analytical instruments and services to make the invisible visible and the impossible possible.

Through the chemical, physical and structural analysis of materials, our high precision analytical systems and top-notch services support our customers in creating a better world. We help them improve everything from the energies that power us and the materials we build with, to the medicines that cure us and the foods we enjoy.

We partner with many of the world's biggest companies, universities and research organizations. They value us not only for the power of our solutions, but also for the depth of our expertise, collaboration and integrity.

We are committed to Net Zero in our own operations by 2030 and in our total value chain by 2040. This is woven into the fabric of our business, and we help our employees and customers think about their part in creating a healthier, cleaner, and more productive world.

With over 2300 employees, we serve the world, and we are part of Spectris plc, the world-leading precision measurement group.

**Malvern Panalytical. We're BIG on small™**

# Service & Support

Malvern Panalytical provides the global training, service and support you need to continuously drive your analytical processes at the highest level. We help you increase the return on your investment with us, and ensure that as your laboratory and analytical needs grow, we are there to support you.

Our worldwide team of specialists adds value to your business processes by ensuring applications expertise, rapid response and maximum instrument uptime.

- Local and remote support
- Full and flexible range of support agreements
- Compliance and validation support
- Onsite or classroom-based training courses
- e-Learning training courses and web seminars
- Sample and application consultancy

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