MICROTRAC
a VERDER company



PARTICLE ANALYSIS OF BUILDING MATERIALS
AN OVERVIEW

CONTEXT

The particle size distribution is a central feature in the characterization of bulk materials. It significantly influences the physical properties, workability, and final quality of building material products such as concrete, mortar, or plaster. A precise analysis of grain sizes and the grain shape is therefore essential for quality assurance, recipe development, and the optimization of production processes. This overview presents the most important types of building materials and the MICROTRAC solutions available for them.

CLASSIFICATION OF BUILDING MATERIALS

Building materials that exist as bulk materials are loose, granular materials that differ in their particle size, grain shape, and composition. They can be divided into the following main groups:

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Category	Materials	Details
Mineral bulk materials	Sand	Fine-grained material (0.063-2mm), essential for mortar, concrete, and screed.
	Gravel	Coarser than sand (2-63 mm), used as an aggregate in concrete and drainage layers.
	Crushed rock	Angular grain shape, used in road construction and civil engineering.
	Chippings	Crushed gravel (2–32 mm), for paving and asphalt.
	Crushed sand	Fines from rock crushing improve grain gradation and compaction.
Recycled bulk materials	Recycled concrete	Obtained from old concrete, as a substitute for primary gravel.
	Broken bricks	From masonry demolition, for base courses, or as an aggregate.
	Asphalt granules	Recycled material from road surfaces.
Binders (powder)	Cement	Main binder for concrete and mortar, very fine particles (< 100 µm).
	Lime	For mortar, plaster, and soil improvement.
	Gypsum	For interior plaster and drywall.
Special bulk materials	Expanded clay	Lightweight, porous material for insulation and drainage.
	Perlite / Vermiculite	Expanded minerals for thermal insulation and lightweight construction.
	Slag	Industrial by-products, e.g., blast furnace slag in road construction or fly ash.
Organic bulk solids	Bark mulch	For gardening and landscaping.
	Wood chips	For paths, insulation, or energy use.
Finished building material products	Mortar	A mixture of sand, binder (e.g., cement or lime), and water, for walls and plaster.
	Concrete	A mixture of cement, water, sand, and gravel/chippings, for load-bearing components.
	Plaster	Thin-layer covering made of mortar, for surface finishing and protection.

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IMPORTANCE OF PARTICLE SIZE AND SHAPE

The particle size influences:

- Compaction and cohesion of the material
- Water absorption and porosity
- Strength and durability of the product
- Workability (pumpability, flow behavior)
- Reactivity in binders (e.g., cement hydration)

A targeted particle size analysis makes it possible to **optimally adjust the grain size distribution** to the respective application – be it for high-strength concretes, flowable screeds, or heat-insulating lightweight building materials. The particle size distribution is not only a theoretical characteristic value system but also **has a direct impact on the practical processing and performance of building materials**. In construction practice, it determines the quality, cost-effectiveness, and sustainability of products and processes. A central field of application is **quality assurance**. Regular particle size analyses can be used to **detect and correct fluctuations in raw material quality at an early stage**. This is particularly relevant in the production of **concrete**, where the size distribution of the aggregates has a significant influence on compactability, strength, and durability. In **mortar and plaster**, grain size plays a decisive role in the processing properties and surface quality. In **mix design**, targeted control of grain size distribution enables the material properties to be optimized. For example, a better packing density can be achieved by combining different grain sizes, which reduces the need for cement and improves the CO_2 balance. In the case of **lightweight materials** such as expanded clay or perlite, the particle structure can be specifically adapted to influence thermal or acoustic properties.
Particle size analysis is also indispensable in the field of **recycled building materials**. It helps to evaluate the suitability of RC materials for specific applications and to design the mixtures to meet the requirements for load-bearing capacity, frost resistance, or water permeability.

MICROTRAC SOLUTIONS FOR BUILDING MATERIAL ANALYSIS

Microtrac offers a range of **specialized particle analyzers** that are suitable for the needs of the building materials industry. Depending on the type of material, grain size range, and analysis goal, different systems are used. The following are the main devices and their typical applications.

SYNC – Laser Diffraction for Fine Powders

The SYNC system **combines laser diffraction with dynamic image analysis** and is particularly suitable for the analysis of fine **powders** such as **cement and gypsum**. It provides high-resolution particle size distributions in the range of a few nanometers to several hundred micrometers.



***Figure 1**: The SYNC analyzer with the TurboSYNC dispersion module is suitable for powdered bulk solids.*

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CAMSIZER S1 – For fine, free-flowing bulk materials

The CAMSIZER S1 is optimized for the an**alysis of fine, free-flowing bulk materials without cohesive components**. Typical materials are dry sand with grain sizes up to a maximum of 5 mm. The system provides precise information on size distribution and grain shape.

CAMSIZER 3D – For sand and gravel

The CAMSIZER 3D is suitable for the analysis of **coarser, free-flowing building materials such as sand, gravel, and crushed stone**. In addition to the particle size distribution, the grain shape is also recorded three-dimensionally, which enables the evaluation of flatness. This is particularly relevant for quality control in road and concrete construction.



***Figure 2**: CAMSIZER instruments can be used for dry, pourable sand and gravel*

CAMSIZER XL – For very coarse bulk materials

The CAMSIZER XL is designed for the analysis of **very coarse bulk materials with grain sizes up to 135 mm**. Typical areas of application are the characterization of coarse crushed stone, recycled materials, or crushed rock. The system enables fast and non-contact analysis of large particles.

CAMSIZER X2 – For wide distribution and cohesive materials

The CAMSIZER X2 is particularly suitable for **materials with a wide grain size distribution and cohesive proportions**. Typical applications include finished building material products such as mortar mixtures, ground rock, or sand with fines. The system combines image analysis with high resolution and provides reliable data even for complex samples.



***Figure 3**: The CAMSIZER X2 is particularly suitable for mixed materials, containing fine powder and aggregates, like mortar or plaster.*

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The results obtained with all CAMSIZER devices are highly comparable to those obtained with traditional sieve analysis.

Device	Application	Typical materials
SYNC	Laser diffraction for fine powders. Wet or dry measurement	Cement, Gypsum, Clay
CAMSIZER S1	Image analysis for fine, free-flowing bulk materials without cohesive components	Dry sand. Maximum grain size up to 5 mm
CAMSIZER 3D	3D image analysis for coarser bulk materials and shape evaluation	Sand, gravel, gravel; analysis of flakiness
CAMSIZER XL	Analysis of very coarse bulk materials up to 135 mm	Coarse gravel, recycled materials
CAMSIZER X2	Image analysis for wide distributions and cohesive materials	Mortar mixtures, ground rock, sand with silt components

SUMMARY

This overview highlights the **importance of particle size and shape analysis in the building materials industry**. The particle size distribution directly affects the **physical properties, workability, and durability of products** such as concrete, mortar, and plaster. Precise characterization is essential for **quality assurance**, **mix design**, and **process optimization**.

MICROTRAC offers a range of **particle analysis systems tailored to different material types and applications**. These systems provide **fast, non-contact, and highly reproducible measurements**, supporting efficient quality control and sustainable material design. Their results are **highly comparable to traditional sieve analysis**, with added benefits of shape evaluation and automation.

➔ **Application page on Building Materials**



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