



SAND AND GRAVEL SIZE AND SHAPE WITH DYNAMIC IMAGE ANALYSIS

CONTEXT

The precise characterization of bulk materials such as sand, gravel, and chippings is a central component of quality control in the building materials industry. In addition to the particle size distribution, the particle shape also plays an important role, especially in applications in road and concrete construction. There are other use cases, for example, in the field of foundry or glass sands.

Depending on the application, different requirements are placed on the materials used. A fine-grained plaster mortar is used, for example, to smooth interior walls and prepare them for subsequent coatings (e.g., paint, wallpaper). The demands on the surface are high: it should be even, crack-free, and adhere well.

Fine sand up to 1 mm is therefore preferred, as it allows a smooth surface and is easy to work with. **Sand that is too coarse** may result in a rough surface that requires more rework and can affect the adhesion of coatings. **Sand that is too fine** may increase water demand and can lead to shrinkage cracks as the surface works harder as it dries.

A **well-graded grain size distribution** with a balanced ratio of fine and medium grains ensures good workability (easy mounting and smoothing), low tendency to crack, **good adhesion to the substrate, and even drying.**

The particle size distribution is routinely checked. The aim is to ensure that the sand meets the requirements of DIN EN 13139 (Aggregates for mortars).

With the CAMSIZER series, Microtrac offers high-performance systems for the fast and objective analysis of these materials.

CAMSIZER S1 – Analysis of sand and fine gravel

The CAMSIZER S1 is optimized for the analysis of dry, free-flowing bulk materials in the size range of about 30 µm to 5 mm. Typical materials are sand and fine gravel. The system provides precise information on particle size distribution and grain shape in real time. The measurement is performed dry and non-contact and is significantly faster than classic sieve analyses.

CAMSIZER 3D – Measurement up to 30 mm and advanced shape characterization

For coarser materials such as gravel and chippings, the CAMSIZER 3D is used. It analyzes particle sizes up to 30 mm and captures the particle shape three-dimensionally. This allows a detailed evaluation of shape parameters such as roundness, length-width ratio, and especially flakiness. Flakiness is an important quality parameter in chippings, as platelet-shaped grains can impair mechanical stability.



Figure 1: Measuring principle of CAMSIZER S1 and CAMSIZER 3D. The sample is fed into a funnel and transported to the measuring zone via a vibrating chute. The particles are detected and evaluated as shadow projections in free fall. This design is suitable for free-flowing bulk solids. The two CAMSIZER models differ in their measuring range and camera equipment.

Measurement example 1: Comparison of CAMSIZER S1 with sieve analysis

In this example, seven samples of quartz sand were examined with the CAMSIZER S1. The finest sample has a median of 100 µm, the coarsest one has a median of 1.2 mm, and it contains particles over 2 mm. All samples can be easily measured within a few minutes with the CAMSIZER S1. In addition, a classic sieve analysis was carried out on four of the samples. The results show a very good agreement regarding the grain size distributions. The CAMSIZER S1 thus offers an objective, automated, and time-saving alternative to manual sieving.

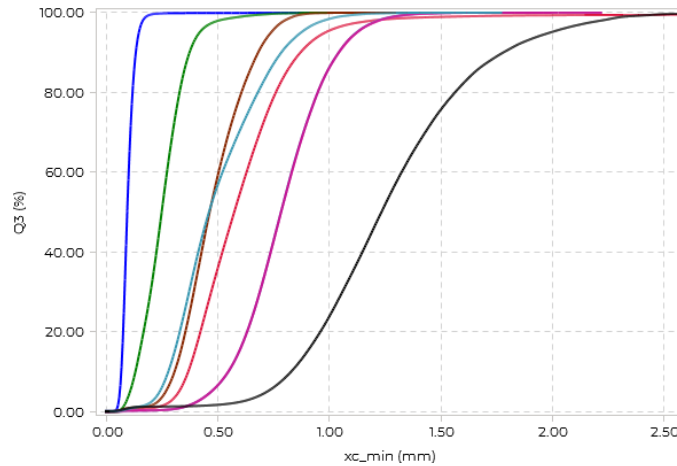


Figure 2: Overview of the size distributions of the seven sand samples examined, measured with the CAMSIZER S1.

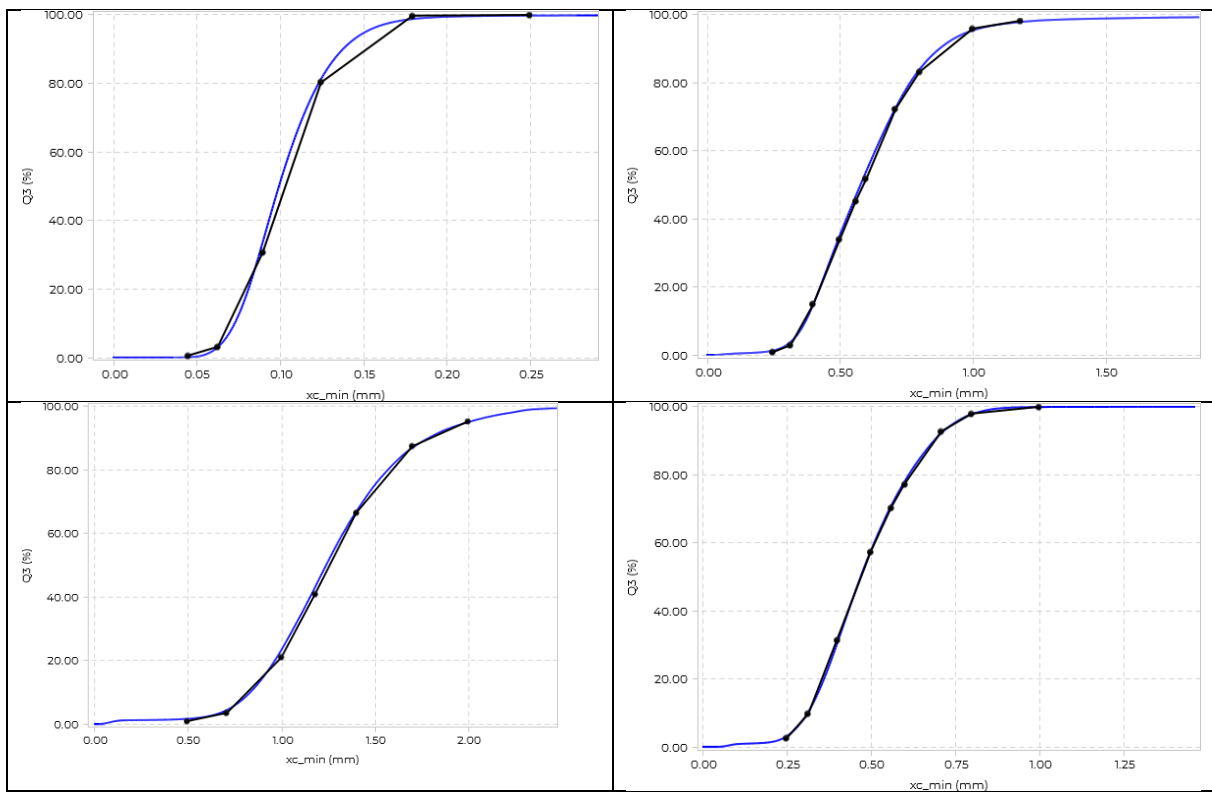


Figure 3: Comparison of CAMSIZER (blue) with sieve analysis (black) for four selected sand samples.

Measurement example 2: Three-dimensional shape analysis of chippings

Chippings are a fractured, angular type of aggregate that plays a central role in concrete and road construction. In contrast to round gravel, chippings offer better interlocking in the structure due to their angular shape, which significantly increases the mechanical stability of concrete and asphalt. Particularly in road construction, chippings are used in base courses, asphalt surface courses, and paving underlays, where high shear strength and load-bearing capacity are required.

In addition to the pure grain size, the **particle shape** is of decisive importance. This directly affects material properties such as packing density, workability, bonding with cement, as well as durability.

The CAMSIZER 3D is particularly suitable for the objective and quick evaluation of these properties. The system analyzes particle sizes up to 30 mm and captures the particle shape three-dimensionally. Not only are classic size parameters such as length, width, and thickness determined, but also shape characteristics such as the **length-width ratio**, **roundness**, and especially **flakiness**. The latter is defined by the minimum ratio of thickness to length and allows a quantitative evaluation of the grain shape according to standard specifications.

The measurement is dry and non-contact, which means that even large sample quantities can be analyzed in a short time. Compared to manual plate determination with slotted screens or special calipers, the CAMSIZER 3D offers significantly higher objectivity, reproducibility, and data diversity. The results can be used directly for quality control, supplier evaluation, or process optimization in rock processing.

To evaluate the grain shape, three samples were analyzed with the CAMSIZER 3D. Three-dimensional image analysis enables the precise determination of flakiness and other shape parameters. This is particularly relevant for road construction applications where the mechanical interlocking of the grains is crucial.

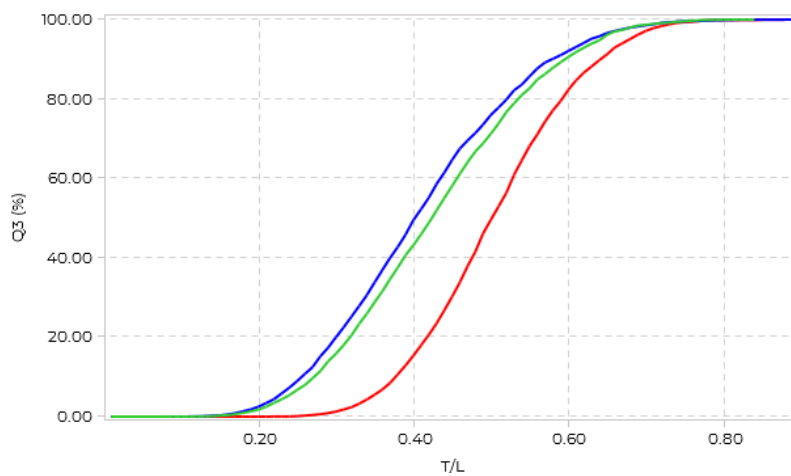


Figure 4: Thickness-to-length ratio of three gravel samples. Lower values indicate flat particles. The particles of sample 1 (red) contain fewer flaky particles than sample 2 (green) and sample 3 (blue). Note that even small shape differences in shape between samples 2 and 3 are detected.

The three-dimensional particle analysis with the CAMSIZER 3D is particularly advantageous whenever accurate shape results are required. In the 3D analysis mode, each particle is tracked as it passes through the measuring zone. The camera detects each particle multiple times because the tumbling particle exhibits different orientations. Thus, the true particle shape is revealed.

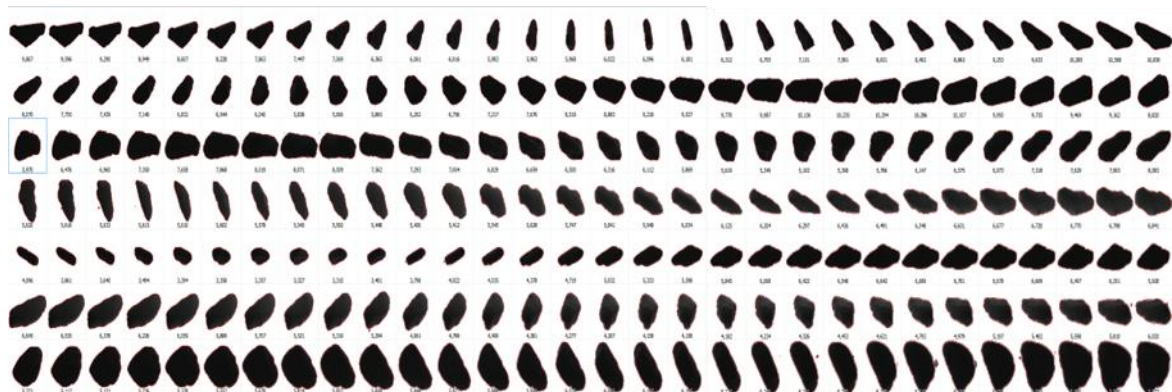


Figure 5: Seven tracked particles (each particle track is aligned from left to right). Every particle shows different orientations; the minimum aspect ratio can easily be found and used for evaluation.

SUMMARY

The CAMSIZER systems from Microtrac offer advanced solutions for the particle characterization of sand, gravel, and chippings used in construction materials. These systems provide fast, automated, and highly accurate measurements of both particle size distribution and shape.

- **CAMSIZER S1** is optimized for fine materials like sand and fine gravel (30 µm to 5 mm), delivering precise size and shape data significantly faster than traditional sieve analysis.
- **CAMSIZER 3D** analyzes coarser materials up to 30 mm and captures particle shape in three dimensions, enabling detailed evaluation of parameters such as roundness, length-width ratio, and flakiness. This is especially important for chippings used in concrete and road construction, where angular particles improve mechanical stability.
- **CAMSIZER XL** extends the measurement range up to 135 mm for very coarse materials. The CAMSIZER XL is also capable of 3D analysis.

The systems support quality control, supplier evaluation, and process optimization by providing reproducible and objective data. Compared to manual methods, CAMSIZER systems offer superior efficiency and insight into both size and shape characteristics, which are critical for the performance of building materials.

- [CAMSIZER S1](#)
- [CAMSIZER 3D](#)
- [CAMSIZER XL](#)

