Metal Powders
Particle size and shape analysis of metal powders

Application

Metal powders and ores are used in many different industries and research fields, ranging from mining and steel production to aerospace or defense. The powders are used for example as coatings, catalysts, battery electrodes or as raw materials for powder metallurgy (PM). PM produces highly engineered, sophisticated parts like special gears and motor parts for the automotive industry, manifolds for oil rigs, medical scissors etc.

Fig. 1   precision parts made of metal powder

Demands of quality assurance

Quality control on shape and size has to be carried out on the respective metal powder or ore, since both affect the material properties. A basic requirement for most applications is that the particles have a defined particle size distribution. In addition, the shape influences the flow and transport behaviour, reactivity, electrical properties (for electrodes) or coating process parameters.
The CAMSIZER® can reliably and accurately measure both, on the one hand samples with a wide size distribution like ores, and on the other hand samples with a narrow size distributionlike zinc for batteries.

Solution

Some manufacturers use sieve analysis for their measurements which has some disadvantages like long sieving times and limited resolution of the sieving results (especially for very fine particles). The CAMSIZER® can easily replace sieve analysis. Both narrow and broad size distributions, and especially oversized particles, can be measured fast, with excellent reproducibility, and even fully automatically if desired.

Fig. 2   Different grades of Aluminum (left to right: coarse [approx. 10 mm], medium [approx. 3 mm] fine [approx. 500 µm])
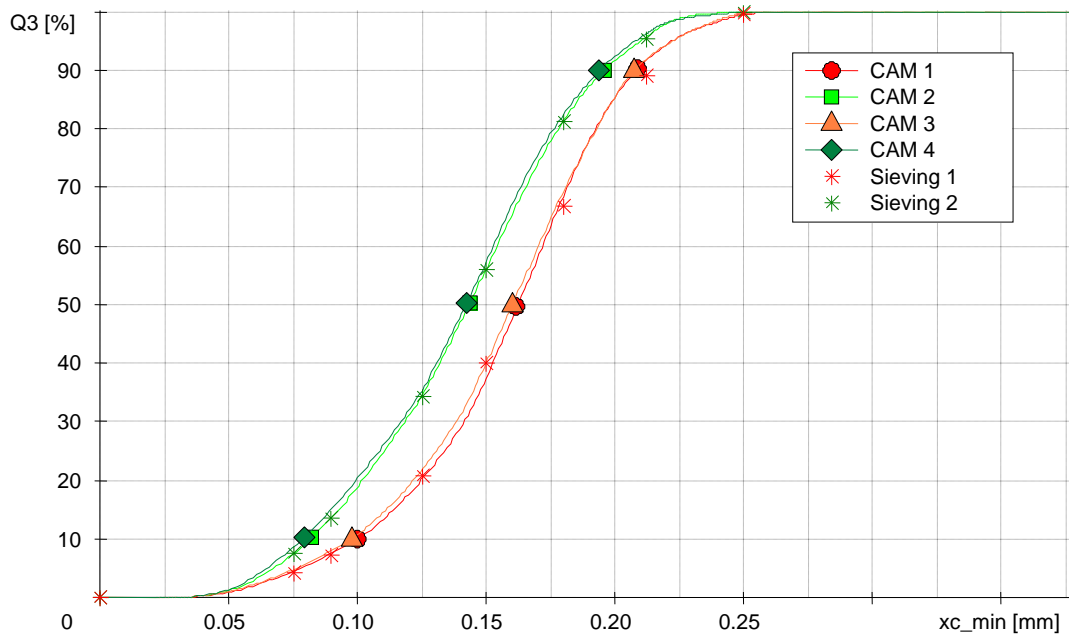
Fig. 3   Comparison between sieve results (dots) and CAMSIZER results (curves) of four different zinc samples, two from each batch. There are big differences between the two batches. Minor differences are visible between samples from the same batch, due to sampling effects. The CAMSIZER data match the sieve data nicely.

The particle shape and surface area of the sample are important parameters for many applications, as for example the flow behavior of the particles depends on the shape, and the reactivity depends on the surface area. The production process sometimes is optimized for a certain shape and size, for example the tin-silver droplets are supposed to be round, whereas the zinc for batteries can be quite elongated (needles).
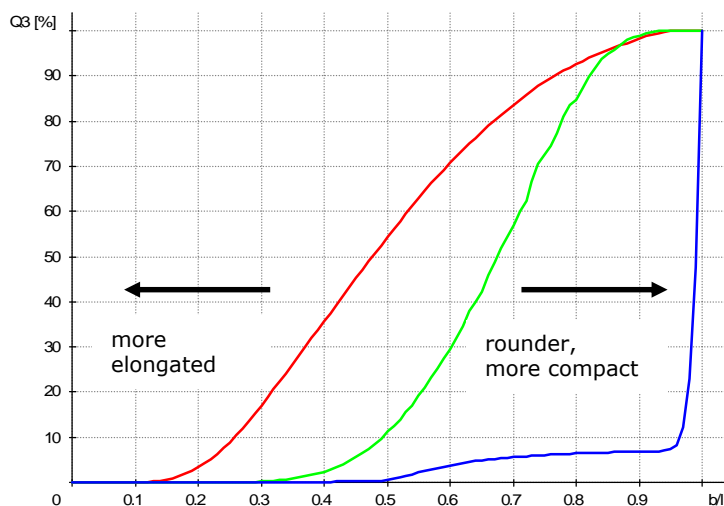

Fig. 4   Shape comparison of 3 different metal powders: Zinc (red), Zirconium (green), and Tin Silver (blue).

A wide range of metal powders has been analyzed with the CAMSIZER in recent years, for example:
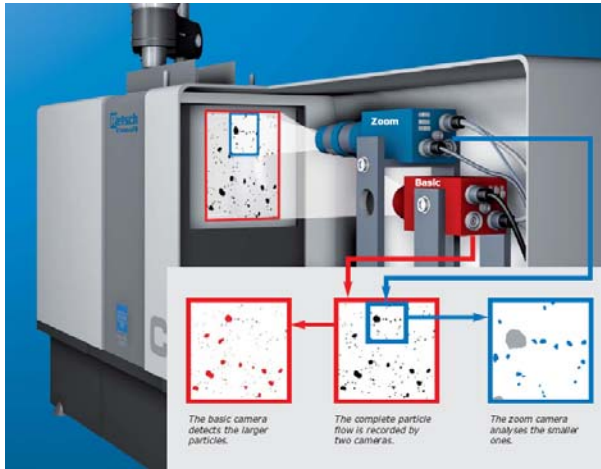
- Zn (Zinc) for batteries
- FeSi (Ferro Silicon) and pure silicon (Si) for solar cells
- Ni (Nickel), NiAl (Nickel Aluminum), Ni-C (Nickel Graphite Mixture) for coating
- SnAg (Tin Silver) droplets
- Fe (Iron) and Mn (Manganese) ores for steel manufacturers
- Zr (Zirconium),
- Hf (Hafnium),
- Al (Aluminum), and respective alloys sintered WC (Tungsten Carbide)
- stainless steel

CAMSIZER® - Benefits at a glance

- Patented two camera system: measurement of broad particles distributions in one analysis, without readjustment
- Reduction in workload. Working with the CAMSIZER requires less than 3 minutes operator time for each analysis. Sieving: Typically more than 20 minutes per analysis.
- Faster availability of the results in 10 minutes or less after sample taking instead of more than 1 h (sieving) allows faster adjustment of production parameters, less waste production.
- Perfect matching of sieve results, i.e. identical product specifications
- More information on each sample (i.e. size and shape, higher resolution etc.)
- Higher resolution of the size distribution → more precise adjustment of the process parameters → higher output (less recycling)
- Results are available in higher frequency and faster - also in the night time → less junk/cull and time effort
- Results saved in 1,000 size classes → ability to simulate any sieve stack configuration
- The CAMSIZER software allows for export of an EXCEL readable file to provide the results of the at-line and lab analysis to the quality computer system (LIMS).
- More frequent and better calibration
- Identical and accurate results at different locations in the plant or group, independent of individual operators.

RETSCH TECHNOLOGY

Measuring Principle

The basic camera detects the larger particles.

The complete particle flow is recorded by two cameras.

The zoom camera analyses the smaller ones.

The patented measuring setup of the CAMSIZER – two digital cameras as an adaptive measuring unit – improves and optimises particle analysis by digital image processing. Therefore, it is possible to measure a wide range of particles from 30 µm to 30 mm with extreme accuracy, **without having to switch measuring ranges or make adjustments**. The sample is fed in from the feed channel so that all particles fall through the measurement field. During the measurement procedure the two digital cameras (CCD) perform different tasks. The basic camera (CCD-B) records large particles, the zoom camera (CCD-Z) records the small ones. The contact-free optical measurement is carried out in real time and simultaneously obtains all the required information about particle size and particle shape. A modularly configurable online version of the instrument has been developed to allow automated measurements to be conducted continuously.

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