Video instead of snapshot: how 3D particle measurement improves image analysis

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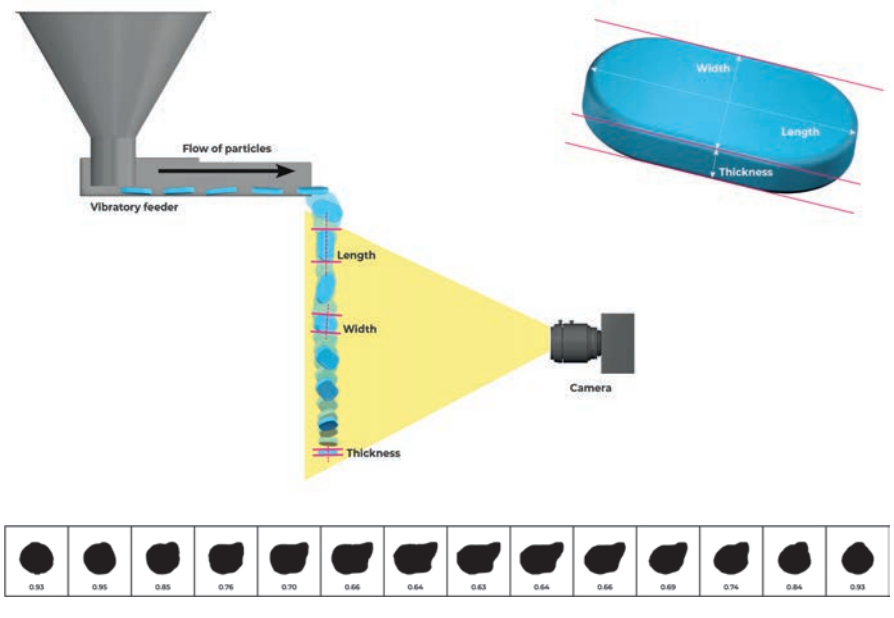
Image analysis is the clearest and most direct method for measuring particle size and shape. Modern sample delivery and camera systems produce high-quality images of large sample volumes in a short time, the analysis of which provides a wealth of size and shape information. However, to analyse the morphology of a particle as accurately as possible, it must be recorded and measured in multiple directions. This is exactly what Microtrac MRB's new CAMSIZER 3D image analyser does.

Traditional 2D image analysis systems capture particles in random orientation, which may leave crucial morphological features unrevealed, for example:

- A small particle ('satellite') adhering to a large particle points away from the camera during imaging and is thus not detected.
- The length of an elongated particle can only be measured correctly if the longitudinal axis is oriented exactly parallel to the camera chip.
- Objects with the three main axes length, width and thickness (e. g. 'almond-shaped' particles) typically show only two of the three main directions, often even only a mixed value.



Functional principle of 3D measurement with the CAMSIZER 3D. Particles are tracked by the camera, creating 3D tracks with multiple views of the same object. Only those individual images are evaluated that show the particle in a desired orientation.

- The minimum aspect ratio can only be measured correctly with the corresponding orientation.

How does the 3D particle measurement work?

Recording particle images from different directions with multiple cameras is not practical. Therefore, a particle stream is passed between an area light source and a fixed camera system. Up to 250 frames/second are produced, with each particle captured up to 30 times in different random orientations. This results in a video file containing "3D tracks" generated for each individual particle. Of these 3D tracks, those frames that contain the relevant information are evaluated.

Which additional measurement parameters does 3D analysis offer?

Traditional 2D image analysis calculates size distributions based on width or length of random particle projections. Shape parameters such as aspect ratio, circularity, convexity, roundness, symmetry, etc. are also determined on the same particle images. 3D image analysis acquires length and width at each frame of the 3D track and provides unique size distributions by using only specific projections:

- 3D length: the largest length value of the 3D track.
- 3D width: the largest width value of the 3D track
- 3D thickness: the smallest width value of the 3D track.

The procedure is similar for the shape parameters: the smallest or largest shape value of the 3D track can be used for result calculation, or the average particle shape, or the shape value that the particle projection has, at which length, width, or thickness was determined.

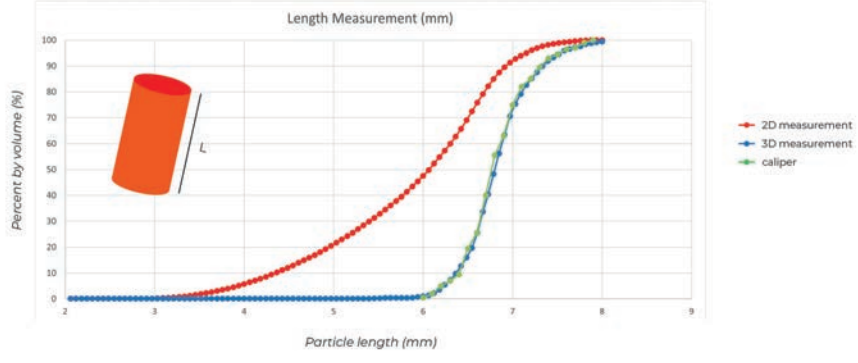
Typical applications of 3D analysis

The 3D method is particularly interesting for particles that are to be produced in a specific morphology or have a specific shape. Until now, many such samples had to be measured laboriously with calipers, or with elaborate microscopic methods in which the particles were photographed oriented on a carrier. These measurement tasks can now be solved with the CAMSIZER 3D in less time and with higher sample throughput, e. g. for the analysis of:

- extrudates
- catalyst rods
- abrasives
- glass beads
- granulated pellets
- fertilisers
- foodstuffs (almonds, coffee beans, rice...)
- building materials

Is 2D particle analysis now obsolete?

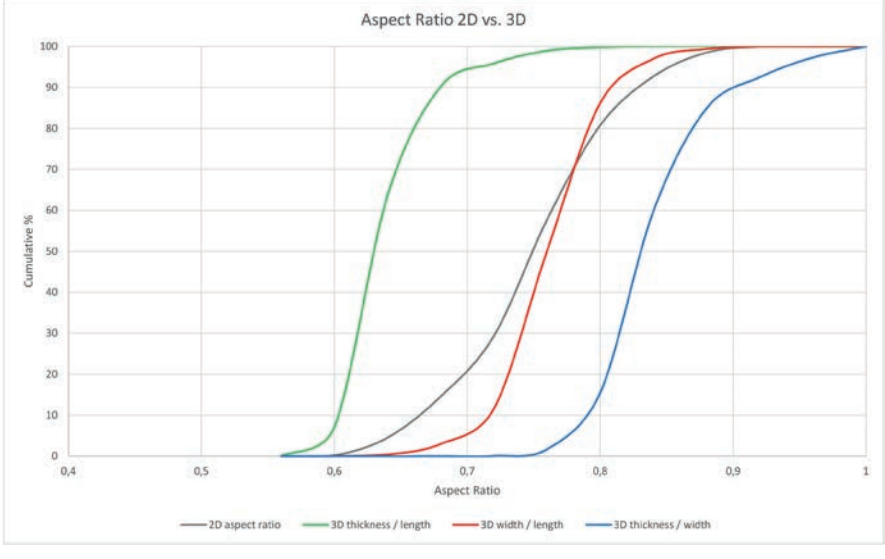
3D particle analysis is a useful complement to traditional 2D image analysis, which has been used successfully for over 20 years to characterise bulk materials. The CAMSIZER 3D also offers the possibility of 2D measurement, which, thanks to the two-camera measuring principle, covers a wider size range and provides robust and reliable values for many routine analysis and quality



Length measurement of cylindrical extrudates. CAMSIZER 3D length (blue, approx. 20000 particles, 2 min measuring time), manual measurement with caliper (green, 200 particles, approx. 1 hour measuring time), conventional 2D image analysis (red). The 3D method determines exactly the TRUE length, the result of the 2D measurement is 'too short'.

control tasks. 2D analysis is also excellent for replacing time-consuming sieve analysis with a fast, automated process.

Learn more: www.microtrac.com/camsizer3d



Better shape analysis: 2D measurement of aspect ratio (grey) and 3D measurement of aspect ratio thickness/width (blue), width/length (red) and thickness/length (green).