

## Proppants in hydraulic fracturing

Instrument: CAMSIZER P4

### Application

“Hydraulic fracturing, informally referred to as “fracking,” is an oil and gas well development process that typically involves injecting water, sand (or other proppants), and chemicals under high pressure into a bedrock formation via the well. This process is intended to create new fractures in the rock as well as increase the size, extent, and connectivity of existing fractures. Hydraulic fracturing is a well-stimulation technique used commonly in low-permeability rocks like tight sandstone, shale, and some coal beds to increase oil and/or gas flow to a well from petroleum-bearing rock formations. A similar technique is used to create improved permeability in underground geothermal reservoirs.” (source: US Geological Survey <https://www.usgs.gov/faqs/what-hydraulic-fracturing>).

The task of the proppants in the fracking fluid is to keep the fissures in the rock open and thus to maintain the permeability to oil and gas. Proppants can be sand, resin-coated sand or ceramic beads.

For good permeability, the particle size must be well matched to the size of the cracks and the size distribution must be narrow. Round particles are required because angular material breaks more easily and does not keep the gaps open. Furthermore, the fine fraction arising from breakage can clog the well.

Natural well-rounded quartz sand is the most inexpensive type of proppant material. Resin coated sand brings better performance but is more expensive. The highest quality proppants are ceramic beads, which are used to achieve highest stability and permeability.



**Fig. 1:** Proppants: resin coated sand (left) and ceramic beads (right)

### Customer statement

**“Having the CAMSIZER allows us to move in one tenth or one fifteenth of the time we could without it. All the forward thinking Frac sand companies that are focused on quality are moving to Dynamic Image Analysis. It should become the gold standard.”**

*Jerry McGee, CEO of Cadre Proppants, 2012*

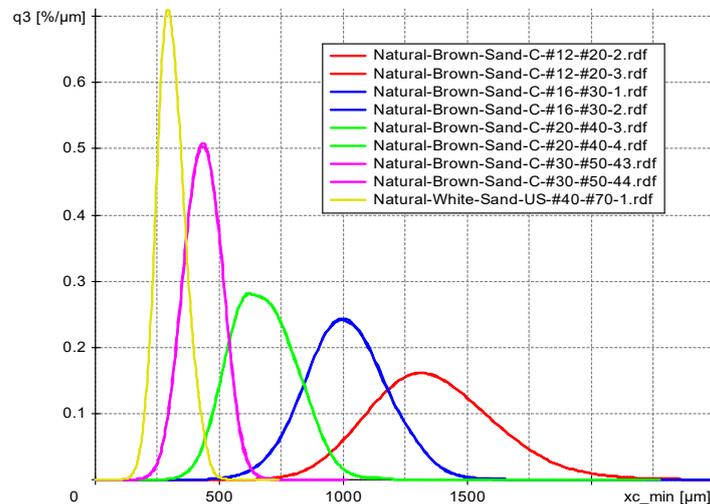
### Demands on quality assurance

The quality control of the proppants is described mainly in ISO 13503-2, which replaces the earlier API standards RP 56, 58 and 60. Among other tests, the standards stipulate the analysis of size, shape and crush resistance. The particle size range is of great importance. Typical proppant sizes are generally #8-#140 mesh (106  $\mu\text{m}$ -2.36 mm), for example, 16-30 mesh (600-1.18 mm), 20-40 mesh (420-840  $\mu\text{m}$ ), 30-50 mesh (300-600  $\mu\text{m}$ ), 40-70 mesh (212-420  $\mu\text{m}$ ) or 70-140 mesh (106-212  $\mu\text{m}$ ). In addition to the size, the shape of the proppants must be controlled as well, especially the roundness. In the past, the roundness has been analyzed using a visual method, i. e. by eye. This method is characterized by greatly differing results, depending on the subjective perception of the operator. The roundness can be analyzed with the CAMSIZER in an objective, comparable and reproducible way, totally independent of the operator.

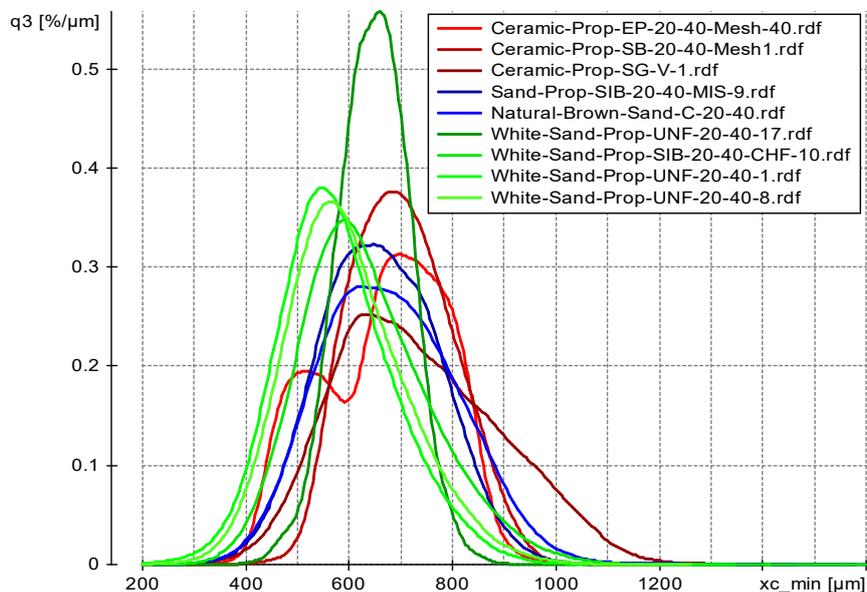
The proppants are an important factor to increase the productivity of an oil well and reduce the drilling costs because of less bore holes and larger distances between the wells. The CAMSIZER P4 can help to establish objective, reproducible quality control criteria, which meet and exceed the requirements described in the API and ISO standards.

## Solution: CAMSIZER P4

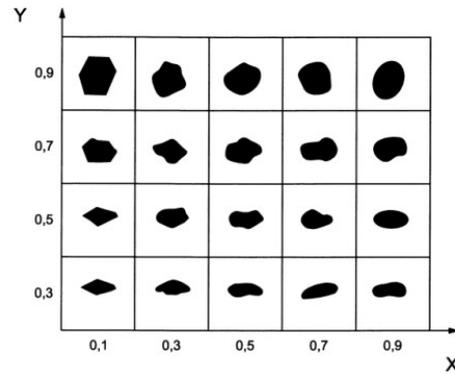
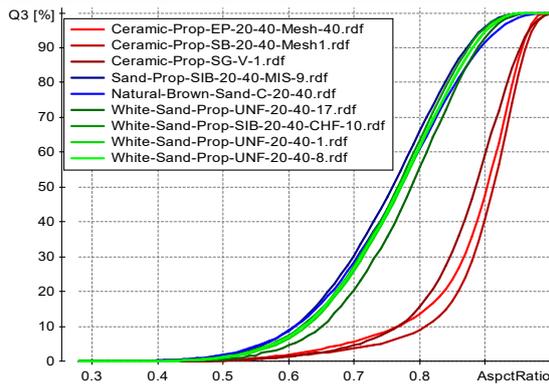
Dynamic Image Analysis with the CAMSIZER P4 offers a contact free, fast and reproducible alternative. The CAMSIZER P4 is much faster than the traditional visual analysis for shape estimation or traditional sieve analysis for size measurement. It saves time and money in the lab, reduces the workload, increases the effectiveness of the lab staff, and finally helps to improve the product quality by allowing for more frequent and faster testing.



**Fig. 2:** Size analysis of 5 different natural sand proppant samples (#12/20, #16/30, #20/40 and #30/50). Each sample was measured twice. The repeatability is excellent. One sample of white sand #40/70 is shown for comparison.



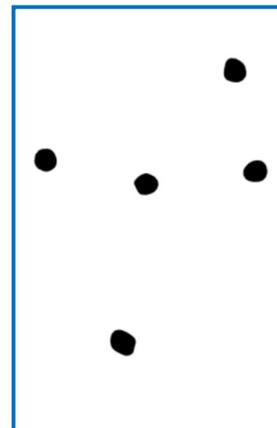
**Fig. 3:** Size analysis of 9 different proppant (sand and ceramics) samples (#20/40). Some have wider, some have more narrow size distributions. One ceramic proppant sample had a bimodal distribution (red "Ceramic-Prop-EP-20-40-Mesh-40").



**Fig. 4:** Shape comparison between natural sand proppants and **ceramic proppants**. There are two different ranges of aspect ratio, which is analogous to Krumbein's Sphericity. Analysis of other shape parameters are possible as well (Convexity, Symmetry, Krumbein's Roundness etc.). Sphericity and roundness used to be determined by visual inspection with the help of "shape charts" (right). Y-axis: "sphericity" and x-axis "roundness". This evaluation strongly depends on the experience of the operator. The CAMSIZER P4 offers objective and meaningful shape analysis.

### CAMSIZER P4: Benefits at a glance

- Analysis time 2-3 minutes
- Measuring range 20  $\mu\text{m}$  – 30mm
- Automated analysis
- Results comparable to sieve analysis
- Autosampler available for further automation
- high sample throughput
- excellent reproducibility
- objective, independent of operator
- shape analysis: length and diameter of particles
- low maintenance, robust design



**Fig. 5:** CAMSIZER P4 dynamic image analysis system (left). Typical CAMSIZER image showing 30-50 ceramic proppants.

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