

Objective

Silica gels are used for a variety of applications, the most common being as a desiccant found in packages in order to keep the contents dry.

Silica gels are also often used in Chromatography Column packing. Both the size *and* the shape of the silica have an effect on the quality and discrimination of the separation being performed. In this example, two silica gels which had essentially identical particle size distributions were found to have very different levels of effectiveness when used for chromatographic separations. Microscopic examination of the particles showed that one batch was fairly round and smooth in shape, while the other had particles which were less round and rougher on the surface. It was desired to find a method for rapidly and automatically determining the quality of the gels.

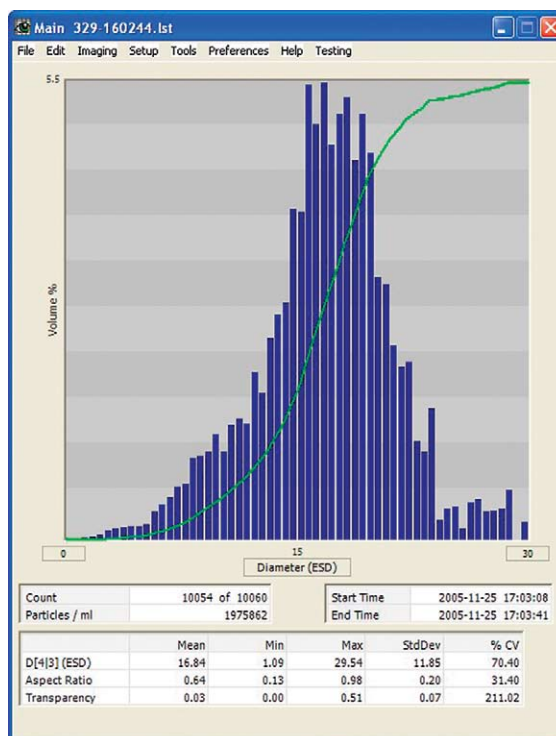
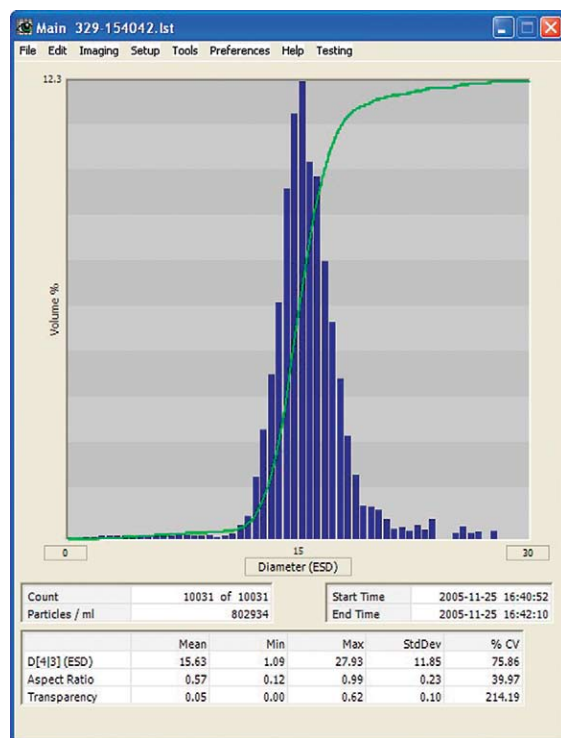
Method

The two dry samples were first each suspended in de-ionized (DI) water until the mixture was dilute enough to separate the particles from each other when passing through the FlowCAM's flow cell. A 10X objective lens (approximately 100X overall magnification) was used with a 100µm (deep) flow cell.

Approximately 10,000 particle images were collected in each run, which took approximately 1 minute per run. Several runs were made with both samples, with the results showing excellent repeatability. By contrast, measuring even 100 of the particles manually through a microscope would take 30 minutes or more. The greatly increased number of particles analyzed using the FlowCAM yields much higher *statistical significance* for the results.

Classification of Silica Gels Using Particle Shape

Results for Silica Gel Sample A, showing data distributions and summary statistics. For 10,031 particles imaged and measured, the mean Equivalent Spherical Diameter (ESD) was measured as 15.63µm.



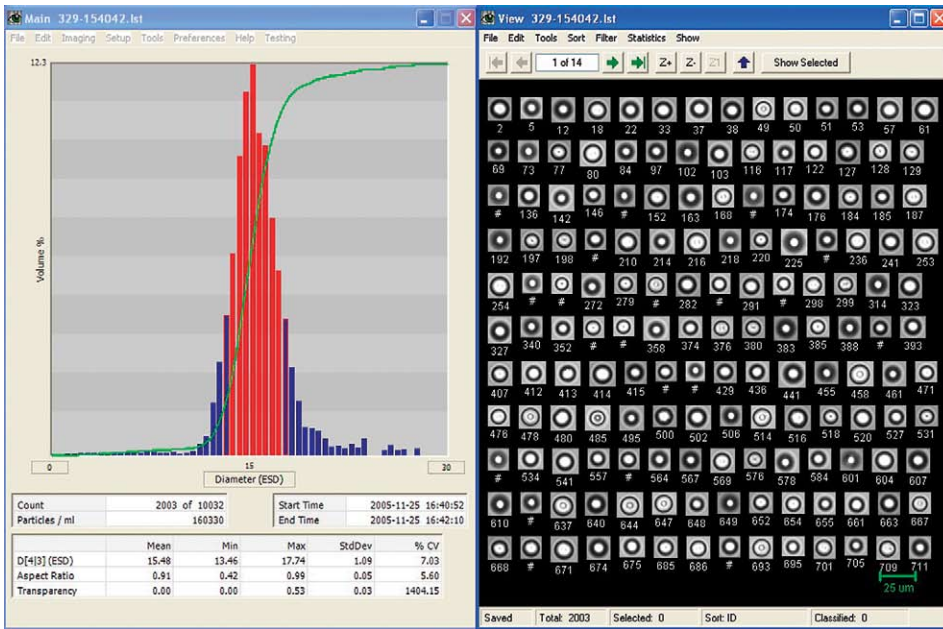
Results for Silica Gel Sample B, showing data distributions and summary statistics. For 10,054 particles imaged and measured, the mean Equivalent Spherical Diameter (ESD) was measured as 16.84µm.

Results and Conclusions

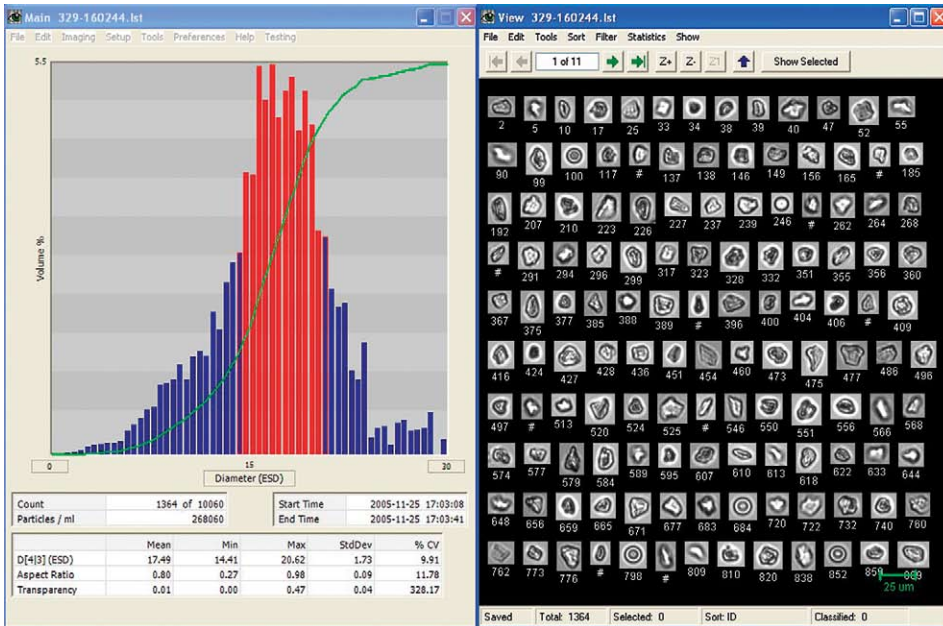
As seen on the previous page, the particle size statistics are very similar for the two samples when comparing Equivalent Spherical Diameter (ESD). However, because the FlowCAM measures many different particle attributes beyond ESD (up to 26 different measurements can be captured per particle), it is easily able to distinguish between the two samples.

The screenshots to the left show the difference between the two samples clearly: notice the difference in aspect ratio (width/length) between them:

Sample	Aspect Ratio (w/l)	Standard Deviation
A	0.91	0.05
B	0.80	0.09



Results from Sample A, showing statistics and sample particle images taken near the mean.



Results from Sample B, showing statistics and sample particle images taken near the mean.

Beyond the statistical differences seen, the FlowCAM is unique in that it can also display the particle images for every particle in the run. This means that the quantitative conclusions found in the particle statistics can easily be verified qualitatively by viewing the images. It is quite clear from looking at the images from both samples that Sample A contains much rounder and uniform particles than does Sample B.

In Summary, aspect ratio alone proves to be sufficient to distinguish between these two samples. However, if the difference between the two samples were even more subtle, a more discriminatory measurement collected by the FlowCAM could have been used called "Roughness". This measurement distinguishes very subtle differences in the irregularity of the particle's surface by comparing the ratio of the perimeter of the particle to its convex perimeter.