

Particle Size Analysis of a Mixed Sample of Three Sizes with Equal Log Spacing

Outline

Certified National Institute of Standards and Technology (NIST) traceable polystyrene latex (PSL) size standards made by Thermo Fisher Scientific Inc. (TFS) were used to evaluate the resolution of the centrifugal sedimentation method. Mean diameters of the PSL standards have been calibrated with microscopy methods. Size distribution and uniformity were measured with electrical resistance analysis or optical microscopy. Fig. 1 shows the photograph of PSL particles. They have excellent roundness with a full particle size distribution. A mixed sample of three sizes with log-equal spacing, tri-modal picket fence that was made for the ISO TC24/SC4 WG11 evaluation was measured.

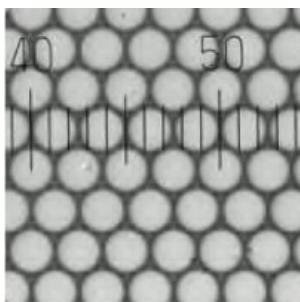


Fig. 1 Photograph of PSL particles that is used with permission from Thermo Fisher Scientific Inc.

Method

Apparatus: HORIBA Partica CENTRIFUGE
 Measurement mode: Line-start
 Sample volume: 10 μL
 Samples: TFS_Tri-Modal Picket Fence Sample Log-Spaced, Monodisperse PSL
 : Mean: 1.587 μm (33.3% by weight), Density: 1,050 kg/m^3
 : Mean: 2.504 μm (33.3% by weight), Density: 1,050 kg/m^3
 : Mean: 4.000 μm (33.3% by weight), Density: 1,050 kg/m^3
 Calibration sample: TFS_No.4100A: PSL/De-ionized water, Nominal size: 1.0 μm , Mean: 1.030 μm , Density: 1,050 kg/m^3
 Particle: PSL (Solid concentration: 0.539%, Refractive index: 1.579, Average density of mixed PSL particles:

1,050 kg/m^3)
 Medium: 2-6% sucrose density gradient solution (Average refractive index: 1.336, Average density: 1,007 kg/m^3)
 Particle size distribution (PSD) base: Volume based
 Calculation setting: Custom mode
 Extinction coefficient correction: ON
 Smoothing: OFF

Results

A 1- μm PSL/water dispersion of 10 μL volume was collected with a micropipette and injected into a cell cap of a cell filled with density gradient liquid for calibration. Thereafter, a Tri-modal PSL/water dispersion sample of 10 μL volume was collected with a micropipette and injected into the cell cap of a cell filled with density gradient liquid and sample measurement was performed by Partica CENTRIFUGE. As shown in Fig. 2, a volume-based PSD of three peaks was obtained. The mode diameter for the peaks as shown are 1.530 μm , 2.429 μm , and 3.844 μm . The horizontal axis is displayed as a log scale, and the three peaks are evenly spaced.

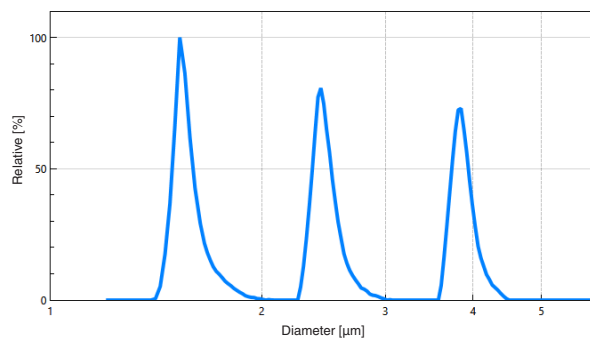


Fig. 2 Volume-based PSD

Conclusion

When a sample containing three size groups of particles arranged at equal log intervals was measured by the line-start method, a PSD of three nicely distributed peaks separated by centrifugal force was observed. Three modes of calculation can be set in the software - QC mode, R&D mode, and Custom mode. Performing extinction correction in custom mode can improve quantitative analysis and the area ratio of a separated peak of a mixture will correspond to its own existing mixing ratio in it. If high resolution is required as in the above case, it is possible to calculate without the smoothing process to increase the resolution. Using this, it is possible to obtain a result matching to an objective by customizing the calculation settings.