

## Measurement of Particle Size Distribution of a Mixed Sample of Polystyrene Latex Standards of Five Different Sizes

### 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 five sizes of monodispersed PSL was used to evaluate the resolution and quantitative capability of the centrifugal sedimentation method.

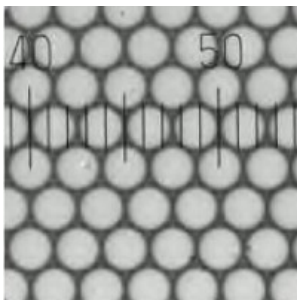


Fig. 1 Photograph of PSL particles was used with permission from Thermo Fisher Scientific Inc.

### Method

Apparatus: HORIBA Partica CENTRIFUGE  
Measurement mode: Line-start  
Sample volume: 10  $\mu\text{L}$   
Samples: TFS\_No.4202A: PSL/De-ionized (DI) water, Nominal size: 2.0  $\mu\text{m}$ , Mean: 2.020  $\mu\text{m}$ , Density: 1,050  $\text{kg}/\text{m}^3$   
: TFS\_No.4018A: PSL/DI water, Nominal size: 1.8  $\mu\text{m}$ , Mean: 1.745  $\mu\text{m}$ , Density: 1,050  $\text{kg}/\text{m}^3$   
: TFS\_No.4016A: PSL/DI water, Nominal size: 1.6  $\mu\text{m}$ , Mean: 1.592  $\mu\text{m}$ , Density: 1,050  $\text{kg}/\text{m}^3$   
: TFS\_No.4013A: PSL/DI water, Nominal size: 1.3  $\mu\text{m}$ , Mean: 1.361  $\mu\text{m}$ , Density: 1,050  $\text{kg}/\text{m}^3$   
: TFS\_No.4011A: PSL/DI water, Nominal size: 1.1  $\mu\text{m}$ , Mean: 1.101  $\mu\text{m}$ , Density: 1,050  $\text{kg}/\text{m}^3$   
Calibration sample: TFS\_No.4100A: PSL/DI water, Nominal size: 1.0  $\mu\text{m}$ , Mean: 1.030  $\mu\text{m}$ , Density: 1,050  $\text{kg}/\text{m}^3$   
Particle: PSL (Solid concentration: 1%, Refractive index:

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

### Results

A 1- $\mu\text{m}$  PSL/water dispersion of 10  $\mu\text{L}$  volume was collected with a micropipette and injected into a cell cap of a cell filled with density gradient liquid for calibration. Thereafter, one drop each of the five PSL/DI water dispersions having different sizes (almost equal volume) was mixed well together. A 10  $\mu\text{L}$  volume was collected from this mixture with a micropipette, injected into a 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 five peaks was obtained.

The mode diameter for the five peaks: 1.079  $\mu\text{m}$ , 1.312  $\mu\text{m}$ , 1.535  $\mu\text{m}$ , 1.686  $\mu\text{m}$ , and 1.946  $\mu\text{m}$ .

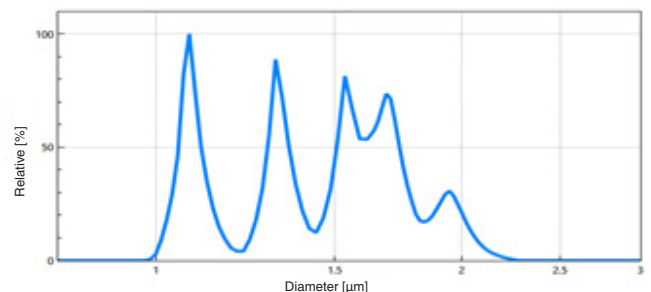


Fig. 2 Volume-based PSD

### Conclusion

When a mixed sample produced from five particle size standards between 1  $\mu\text{m}$  and 2  $\mu\text{m}$  was measured by the line-start method, a PSD with five nice peaks classified by the 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.