CPS

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Application Note

Measuring Polymer Dispersions with the CPS Disc Centrifuge

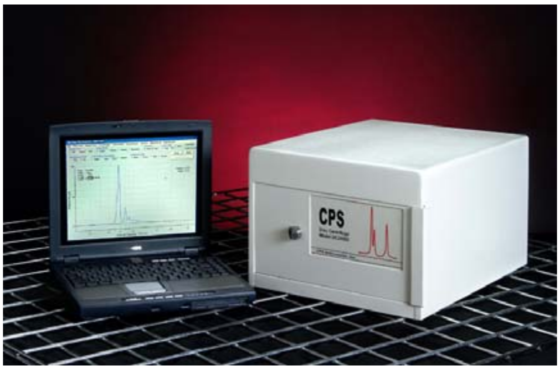
Polymer dispersions are stabilized dispersions of polymer particles in a continuous phase (normally water). These products are generally produced using four different methods:

1) classic emulsion polymerization;
2) homogenization of monomers (also called “microsuspension”), followed by polymerization using an oil soluble polymerization initiator;
3) chemical emulsification of monomer(s) using “liposomes” followed by polymerization;
4) a combination of the other three methods.

Polymer dispersion particles generally range from ~6 microns to ~0.03 micron diameter, although there are some products that contain particles outside this range. Polymer dispersions are used in water based paints and coatings, inks, water based adhesives, solvent-free “urethane” coatings, polyvinyl chloride “plastisol” latexes (PVC particles that will be ultimately dispersed in plasticizer), and in many other applications.

In most polymer latex applications, the particle size distribution is very important, and control of particle size is a critical quality control issue. The CPS Disc Centrifuge is often used to characterize polymer latexes, because it offers excellent particle size resolution, high sensitivity, and rapid analyses (for most samples). Compared to other particles sizing methods, the CPS Disc Centrifuge has 2 to 6 times better size resolution (minimum difference between two narrow peaks that allows complete separation), with typical analysis times under 15 minutes. Samples with active weight of a few micrograms (or less) can be accurately characterized for most materials. The CPS Disc Centrifuge operates at up to 24,000 RPM (maximum g-force >25,000), so all analyses are at least 3 times faster than with other disc centrifuges. When the particle size distribution is broad, the CPS Disc Centrifuge is normally 4 to 6 times faster than other disc centrifuges.

The CPS Disc Centrifuge is used for both research/development and for quality control in polymer dispersion applications. In research and development, the high sensitivity and superb resolution offer advantages compared to other particle sizing methods. In quality control, simple operation and the (optional) autosampler reduce labor costs, while at the same time providing very consistent, reliable analyses. Run to run variation in reported particle size is usually well under 0.5%, even when the runs are separated in time by weeks or months. This excellent consistency comes from use of a known calibration standard to calibrate the instrument each time it is used. Calibration can be done as often as each sample run or as little as each 10 sample runs.



Polymers of any particle density can be routinely measured, even those that are neutrally buoyant in water. Low density or neutrally buoyant particles are measured in a fluid of density higher than water, where they float, such as sucrose in water or deuterium oxide. Low density analyses are done using CPS Instrument’s patented low density method (US patent 5,786,898). All analyses are carried out with a net difference in density between the particles and surrounding fluid of at least 0.06 g/ml, which insures consistent results for all samples.

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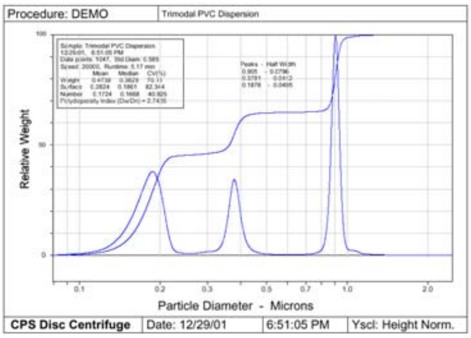
The table below shows the practical size range[1] for several kinds of polymer dispersions.

Polymer	Maximum Size	Minimum Size	Run Time to 0.06u
Acrylic Adhesive	35 microns	0.030 micron	35 minutes
PVC	25 microns	0.020 micron	15 minutes
Polyvinylidene Chloride	20 microns	0.015 micron	10 minutes
Paint Latex	30 microns	0.025 micron	30 minutes
Polyurethane	20 microns	0.015 micron	35 minutes
Styrene/BD	30 microns	0.025 micron	35 minutes

Conclusion

Virtually any type of polymer dispersion can be accurately characterized using the CPS Disc Centrifuge, even those that are equal to or lower in density than water. The resolution, sensitivity, and run-to-run repeatability are unmathced by other particle sizing instruments.



[1] The minimum practical size is the size where noise in the signal becomes more than ~10% of the signal. The maximum practical size is the size where it is not possible collect consistent data run to run.