

A Critical Comparison of Photon Correlation Spectroscopy and Disc Centrifuge Techniques for Characterization of Polymer Latexes

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Photon Correlation Spectroscopy (PCS) and Disc Centrifuge Photosedimentometry (DCP) are two of the most widely used techniques for studying submicron particle size distributions of a diverse range of materials, prominent among which are many polymer colloids. They are both "first principle" techniques and do not rely on empirical calibration. They are equally suited to use with suspensions or emulsions. Being based on completely different principles, however, the two methods have different characteristics which may influence the choice of one rather than the other for a given application.

PCS is a light scattering technique which requires only the viscosity of the suspending medium in order to yield the particle size although further information about the distribution can be gained with knowledge of the optical properties of the sample. The DCP technique requires a knowledge of densities as well as viscosity if absolute rather than relative values of particle size are to be obtained and, again, distribution data (over most of its practical size range) can be enhanced by taking account of refractive indices.

Like other light scattering methods, PCS offers *relatively* low resolution. In practice, it is restricted to diameters of a micron or less but, with sufficient laser power, can go down to a nanometre or two and, to a limited extent, can yield information on diffusion - and hence molecular weights - of polymer molecules in solution. DCP's size range is somewhat density dependent, extending from as little as 7nm for very dense particles to as high as 30+ microns for light materials; in the case of latexes, 50nm to 10-20µm would be more typical. Within that range, it offers very high resolution and is able to distinguish differences of the order of 13% in particle diameter. DCP is therefore very useful in the study of complex, e.g. multimodal, distributions.

This paper sets out to describe the practice of the two techniques and to illustrate their relative performance by reference to several examples. These include analysis of broad and multimodal particle size distributions, studies of factors affecting particle size and the influence of bound layers at the particle surface. In general, the two methods show excellent agreement given their very different founding principles and the choice between them is largely dependent upon the type of information required and the nature of the sample material.