INLINE AND OFFLINE PARTICLE SIZE ANALYSIS IN EMULSION POLYMERIZATION PROCESSES

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Particle size and particle size distribution are important properties of polymer latexes because they strongly affect the film formation and the rheology of the latexes. Thus, controlling the particle size and the particle size distribution is of paramount importance during the production of waterborne polymeric dispersions. Advanced control strategies (feedback control) require inline/online measurements of the particle size to be able to track optimal trajectories or to modify them as a function of the online/inline measurements.

PDW spectroscopy, based on photon transport theory (incorporating multiple scattering), Mie theory and theory of time dependent light scattering, determines the absorption and scattering properties of highly turbid samples, what allows a dilution free real-time inline particle size analysis [1]. In the present work, the ability of PDW to inline monitor particle size in diverse polymer synthesis processes such as an all acrylic emulsion polymerization process and a two step process for the synthesis of a waterborne polyurethane dispersion will be discussed.

Turbidity (τ) is the measure of the relative clarity of a liquid that can be measured by the attenuation of a light beam when passing through the sample. This is related to the amount, size and the color of the material dispersed in the fluid and it is quantified by measuring the light transmitted through a given volume of the fluid [2]. Turbidity Spectroscopy is based on UV-Vis spectroscopy and it requires different mathematical treatment methods to determine the particle size and particle size distribution from the experimentally measured turbidity value. In the present work, those methods to retrieve the particle size of waterborne polymer dispersions will be revised aiming to online monitor emulsion polymerizations using a dilution system that is under development.

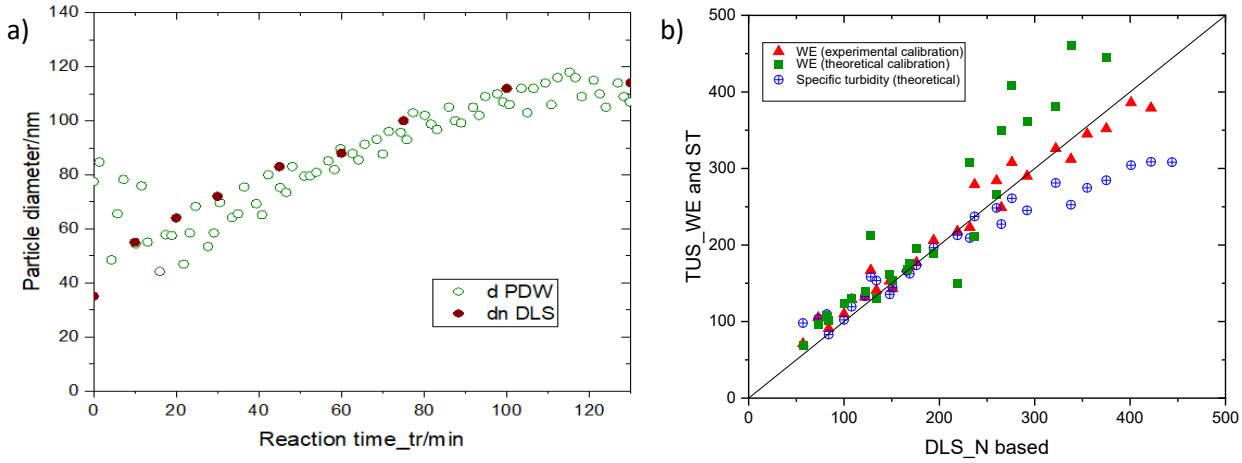

Figure 1 – Example of PDW spectroscopy and TUS analysis of polyacrylate latex synthesis: a) Particle diameter evolution as measured inline by PDW and offline by DLS, b) Comparison of the results obtained by TUS with different calibration methods and the results obtained by DLS.

[1] Bressel, L., Hass, R., Reich, O. (2013). Journal of Quantitative Spectroscopy & Radiative Transfer. 126, 122-129.

[2] Turbidimetry in Particle Size Analysis. Kourti, T. 2000, Encyclopedia of Analytical Chemistry