# UNDERSTANDING SHEAR-INDUCED COAGULATION IN EMULSION POLYMERIZATION SYSTEMS

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**Abstract**

Coagulation in emulsion polymerizations can range from small amounts of coagulum that gradually built up on an impeller, through to catastrophic coagulation that can shut down a 50-tonne reactor. Shear is a common factor in this coagulation. Particle imaging velocimetry was used to map out the shear field in actual laboratory reactor configurations, with different impeller speeds and so on. It was found that this detailed and complex shear field could be adequately predicted using appropriate computational fluid dynamics. Various means of measuring the coagulation rate in these reactor configuations of a latex chosen to be unstable to shear were then implemented, including a new laser-turbidimetry technique for determining the stability ratio. A range of theories were then applied to these data. It was found that relative amounts of rates of coagulum formation could be adequately predicted for zero shear using DLVO theory, but the established method of including shear (by adding the shear kinetic energy to the integrand in the conventional DLVO integral) cannot reproduce the data on the effect of shear. A new simulation technique is devised to enable trajectory calculations to be carried out to yield the coagulation rate coefficient, which takes full and simultaneous account of Brownian motion, DLVO-type interparticle interaction, shear, hydrodynamic interaction and secondary-minimum coagulation. The results from these simulations are used to test the validity of various approximate treatments for these effects in the literature, and compared with the observed shear effect from the data.

**Keywords:** emulsion polymerization, coagulation, shear