

Particle Formation and Growth in Emulsifier-free Emulsion Polymerization under Monomer-Starved Conditions

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Abstract

Particle formation and growth in the monomer-starved emulsifier-free emulsion polymerization of monomers with different water solubility including methyl acrylate (MA), methyl methacrylate (MMA), and vinyl acetate (VA) were studied. The relation of the rate of formation of precursor particles with monomer concentration in the water phase may inspire that the maximum number of particles will be obtained when the water phase is saturated with the monomer. The number of PMA particles showed a maximum at 50 percent of monomer saturation. The number of PVA particles did not show any sensitivity to monomer concentration in the water phase below the saturation concentration of the monomer. More unexpectedly the number of PMMA particles showed a minimum when water phase was just saturated with the monomer. The minimum in the number of PMMA particles was correlated with the enhanced rate of particle growth under monomer-starved conditions. Under monomer-starved conditions, the number of particles produced was in the order of water solubility of monomers; $MA > VA > MMA$. A reverse order was produced under monomer-saturated conditions (high monomer concentration) as particle coagulation became progressively more important for some of the monomers.