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BUTYL ACRYLATE AND VINYL ACETATE SEMICONTINUOUS EMULSION COPOLYMERIZATION: INFLUENCE OF ACRYLIC ACID

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The enhanced colloidal stability resulting from the presence of carboxylic groups on the outer surface of the latex particles justifies the use of small amounts of carboxylic monomers in industrial recipes [1] with high solids content. To maintain control over the particle size and latex stability in emulsion polymerization reactions, it is very important to understand the relationship between several different but interdependent phenomena, including particle nucleation, kinetics, particle coalescence, monomer type, solids content [2] and the role of the carboxylic monomer. In this work, the kinetics and stabilization performance of semicontinuous vinyl acetate (VA) and butyl acrylate (BuA) (80/20 weight ratio) emulsion copolymerization reactions with high solids content (55%) are studied under different reaction temperatures and acrylic acid (AA) concentrations (see Table 1). Conversion was measured by gravimetry. Particle size was measured by dynamic light scattering using a Malvern ZetaSizer apparatus. Feed streams 1 and 2 were continuously fed during 120 minutes in all reactions. Figure 1 shows that reactions performed with different amounts of AA (0.46% and 0.92%) at 60ºC were virtually equal, presenting the same behavior for conversion and particle size. Nevertheless, the reaction performed without AA lead to coagulation just after the end of monomer feeding period when a high solids content was reached in the reactor. Higher reaction temperatures lead to a different behavior for different AA amounts with higher stability for higher amounts of AA. Stability decreases with increasing reaction temperature for small amounts of AA (0,46%) and the coalescence of polymer particles, induced by reactor agitation, increases strongly after reaching 55% solids content.

Table 1 - Formulation of the reactions.

	VA (g)	BuA (g)	AA (wt %)[a]	Water (g)	SLS (g)	$Na_2S_2O_8$ (g)	Na_2CO_3 (g)
Initial charge	—	—	—	190.10	9.442	—	1.336
Feed stream 1	217.00	54.25	0/0.46/0.92	—	—	—	—
Feed stream 2	—	—	—	39.90	—	1.312	—

[a] weight % in relation to total VA and BuA mass.

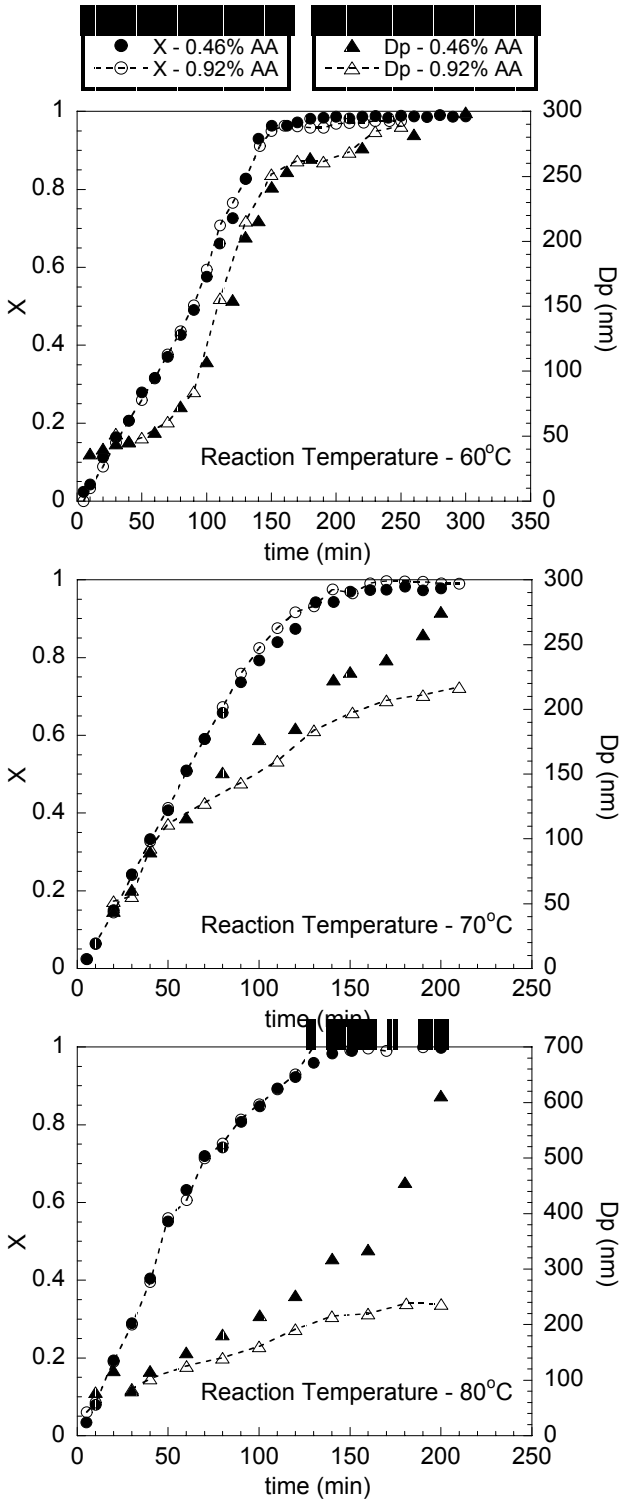

Figure 1: Evolution of global conversion (X) and average particle diameter (Dp) at different reaction temperatures (60ºC, 70ºC and 80ºC) and different amounts of Acrylic Acid (0.46% and 0.92% in relation to total Vinyl Acetate and Butyl Acrylate mass).

AA seems to have no influence on polymerization kinetics as the evolution of the conversion of all reactions at the same temperature were the same with 0.46% or 0.92% of AA. It is also interesting to observe that, apparently, AA has no significant effect on particle nucleation as at the beginning of all reactions the number of polymer particles was the same at the same temperature (same Dp at the same X). Only when the solids content increased in the reactor, at 70ºC and 80ºC, the particle diameter and, consequently, the number of polymer particles presented a different behavior for different amounts of AA.

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