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The effect of feeding profile in the distribution of chains composition and mechanical performance of styrene/butyl acrylate emulsion copolymers

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Semi continuous seeded emulsion co-polymerizations, using 5 different types of feeding profiles of co-monomers (styrene/butyl acrylate, S/BA) were carried out, to vary in a gradual manner the composition of the copolymer chains formed throughout the reactions (gradient composition copolymer, GCC). For comparison, equivalent core-shell type polymeric materials were synthesized in two stages (TS). In all reactions, the S/BA global mass ratio was: 70/30. To estimate the weight composition distribution (WCD) of the copolymer chains, the cumulative styrene content in the polymer mass was followed throughout the reaction (¹H-NMR). Average molecular weights were determined using SEC. The differences in mechanical performance were established, carrying out a mechanodynamic (DMA) and mechanostatic characterization (stress-strain at several temperatures and, Izod testing). The area under the loss modulus curve (LA) was correlated with Izod impact strength, showing the damping superiority of the GCCs over the T-S material. At all tested temperatures (between 25°C and 70°C), the GCC materials exhibited yielding and plastic deformation, while the T-S material presented brittle fracture in that temperature interval. The WCDs were used to elucidate the differences in mechanical behavior among GCC materials. The feeding profile variation in combination with the WCD analysis represents a novel methodology to produce tailor made copolymers.

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