

MD-CT-2

RESIDUAL MONOMER CONTENT IN VINYL ACETATE / BUTYL ACRYLATE EMULSION COPOLYMERIZATIONS. EFFECT OF REACTION CONDITIONS

Pedro H. H. Araújo, Claudia Sayer, Reinaldo Giudici*

University of São Paulo, Department of Chemical Engineering, 05508-900 - São Paulo - SP, Brazil,
email: paraujo@lscp.pqi.ep.usp.br, csayer@lscp.pqi.ep.usp.br, rgiudici@usp.br

Reducing the residual monomer content is a desire of every polymer producer, as a product with no, or very low levels of residual monomer would have a different commercial appeal ^[1, 2, 3, 4]. The presence of residual monomer may create hazards to workers due to long term exposure during polymer processing and sometimes even to customers.

This work studies the effect of copolymer composition and reaction temperature on the decrease rate of VA and BuA contents and on the final VA and BuA residual contents in batch VA/BuA emulsion copolymerization reactions. The basic formulation is presented in Table 1. All analyses were performed using a headspace gas chromatograph equipped with a mass spectrometer (HS-GCMS Shimadzu). Figure 1 shows the effect of copolymer composition, that was varied by the mass fraction of monomers in the initial charge (85/15, 50/50 and 15/85 wt/wt), and reaction temperature (50, 55 and 60°C) on the decrease rate of the residual VA content during VA/BuA emulsion copolymerization reactions.

Table 1 - Formulation of the reactions.

VA + BuA (g)	Water (g)	SLS (g)	Na ₂ S ₂ O ₈ (g)	Na ₂ CO ₃ (g)
105.168	454.832	1.344	1.624	0.392

Table 2 - Effect of composition on the residual monomer content. T = 50 °C.

VA/BuA = 85/15			VA/BuA = 50/50			VA/BuA = 15/85		
t (min)	VA (ppm)	BuA (ppm)	t (min)	VA (ppm)	BuA (ppm)	t (min)	VA (ppm)	BuA (ppm)
110	3705	64	110	48195	133	110	5648	508
170	639	24	170	30040	46	150	7432	151
300	-	-	300	1508	21	210	6534	22
						330	3555	15

Table 3 - Effect of reaction temperature on the residual monomer content. VA/BuA = 85/15 wt/wt.

T = 50 °C			T = 55 °C			T = 60 °C		
t (min)	VA (ppm)	BuA (ppm)	t (min)	VA (ppm)	BuA (ppm)	t (min)	VA (ppm)	BuA (ppm)
110	3705	64	111	644	37	50	253	17
170	639	24	190	209	-	90	-	-
300	-	-	300	70	-	180	-	-

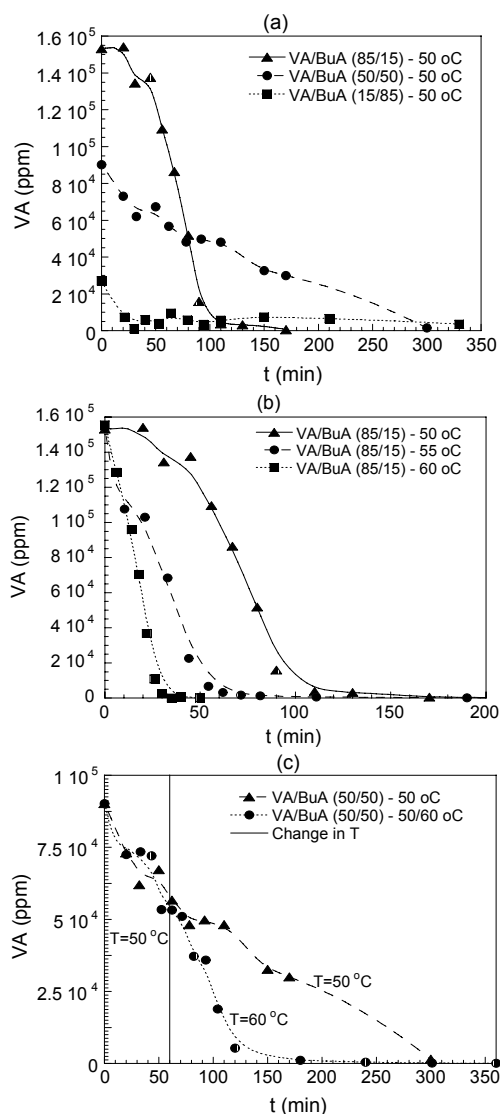


Figure 1 - Effect of reaction temperature and composition on the residual VA content in VA/BuA copolymerizations.

Table 4 - Effect of changes in reaction temperatures on the residual monomer content. VA/BuA = 50/50 wt/wt.

T = 50 °C			T = 50 / 60 °C (after t = 60 minutes)		
t (min)	VA (ppm)	BuA (ppm)	t (min)	VA (ppm)	BuA (ppm)
110	48195	133	104	18929	110
170	30040	46	180	5291	-
			240	472	29
300	1508	21	300	193	-
			360	85	26

Due to the significant difference in the copolymerization reactivity ratios of those two monomers, the BuA polymerizes first, the higher the mass fraction of BuA the slower is the decrease of the residual VA content (Figure 1a) and the higher is the final residual VA content (Table 2). According to the results presented in Figure 1b and Table 3 higher reaction temperatures enhance the residual VA decrease rate but do not affect the final residual VA and BuA contents. On the other hand, increasing the reaction temperature after 60 minutes, not only enhances residual VA decrease rate (Figure 1c) but also diminishes significantly the final residual VA content (Table 4). The residual BuA content was not affected significantly by reaction temperature or by the mass fraction of BuA in the initial reactor charge.

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