

PC09 - Factors Influencing the Exudation of Surfactant in Self-Crosslinking Acrylic Latex

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There is a trend in the coatings industry to replace organic solvent-based systems with equivalently performing, environmentally benign products. Waterborne colloidal polymers represent a promising alternative^{1,2}. Through the years some strange and unusual observations of surfactant "islands" and "blobs" on coating surfaces have gone unexplained and remain mysterious^{3,4}. It is known that the presence of surfactants profoundly influence the mechanical strength, durability, adhesion, blocking, gloss and permeability of the final film⁵⁻¹⁰. The development of mechanical strength and hardness is often enhanced by chemical crosslinking agents that create a three dimensional network¹¹⁻¹⁴. If crosslinking occurs prior to particle coalescence, however, the network will not be continuous throughout the film and a weaker product will result¹⁵. Therefore an understanding of the relative rates of polymer interdiffusion and crosslinking is imperative. The stages and conditions of film formation, crosslinking and the exudation of surfactant are processes that are inter-related and should not be considered in isolation.

We have explored the inter-relationship between interdiffusion and crosslinking processes in an acrylic latex containing carbonyl functionality exploiting the "keto-hydrazide" crosslinking reaction. Gel fraction measurements were used to probe the rate and amount of crosslinking. The precise chemical mechanism has been identified in a model system using complementary spectroscopic techniques. The reaction was found to be acid catalysed and favoured at lower water concentration. Measurement of the latex pH relative to the polymer mass fraction during film formation clarifies the expected point of onset for crosslinking in relation to particle packing. Atomic Force Microscopy was used to follow surface levelling relative to the competing influence of crosslinking. The rate and total amount of surfactant exudation were found to be influenced by crosslinking, properties of the latex particles, such as deformability (as determined by the temperature relative to the polymer glass transition temperature), and the evaporation rate (as controlled by the relative humidity).

References

- (1) Kerhsaw, Y., *Europ Coat J*, 4/98, (1998), 230-232, 234, 235.
- (2) Keddie, JL., Film formation of latex, *Materials Science & Engng Reports*, (1997), R21 (3).
- (3) Tzitzinou, A., Jenneson, PM., Clough, AS., Keddie, JL., Lu, JR., Zhdan, P., Treacher, KE., Satguru, R., *Progress in Organic Coatings*, (1999), 35, 89.
- (4) Belaroui, F., Hirn, MP., Grohens, Y., Marie, P., Holl, Y., *J of Colloid and Interface Sci*, (2003), 261, 336.
- (5) Thorstenson, TA., Urban, MW., *J Applied Polymer Science*, (1993), 47, 1381.
- (6) Hellgren, AC., Weissenborn, P., Holmberg, K., *Progress in Organic Coatings*, (1999), 35, 79.
- (7) Butler, LN., Fellows, CM., Gilbert, RG., *J of Applied Polymer Science*, (2004), 92, 1813.
- (8) Aramendia, E., Barandiaran, MJ., Grade, J., Blease, T., Asua, JM *Langmuir*, (2005), 21, 1428.
- (9) Charmeu, JY., Kientz, E., Holl, Y., *Progress in Organic Coatings*, (1996) ,27, 87.
- (10) Athey, RD., *European Coatings Journal*, (1996), 816.
- (11) Pinenq, P., Winnik, MA., *J Coat Technol*, (2000) ,72 (903), 45.
- (12) Winnik, MA., *J Coat Technol*, (2002), 74 (925), 49.
- (13) Taylor, JW., Winnik, MA., *JCT Research*, (2004) ,1 (3), 163.
- (14) Zosel, A., Ley, G., *Macromol*, (1993), 26, 2222.