

## Cross-linking during the Film Formation of an Acrylic Latex

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There is a trend in the coatings industry to replace organic solvent-based systems with equivalent-performing, environmentally-benign products. Waterborne systems, in particular colloidal polymers (*i.e.* latex), represent a promising alternative. Other researchers have reported the design of latexes that, upon film formation, impart the desired levels of mechanical strength and resistance properties. The development of these properties is often enhanced by the incorporation of a chemical cross-linking agent that creates a three-dimensional network in the final coating. If cross-linking occurs *prior* to particle coalescence, however, the network will not be continuous throughout the film, and a weaker product will result. Therefore, an understanding of the relative rates of polymer inter-diffusion and cross-linking is imperative.

The overall objective of this research is to explore the competition between these two dominant processes in an acrylic, core-shell latex, containing acrylamide functionality that exploits the "keto-hydrazide" cross-linking reaction. Gel fraction and swelling measurements, utilising gravimetric and spectroscopic ellipsometry techniques, are used to probe the evolution of the cross-link density in coatings over time. Partitioning of cross-linker between the polymer particles and the latex serum is studied using direct injection HPLC/MS of the serum, enabling the monitoring of the cross-linker's location during the various stages of film formation. The cross-linking reaction is favoured in an acidic environment, according to current understanding of the reaction mechanisms. Measurement of the latex pH relative to polymer mass fraction during film formation clarifies the expected point of onset for cross-linking in relation to the amount of particle packing and the film formation stages. It is found that a high gel fraction is achieved shortly after casting a film but that the cross-link density increases more slowly over time.