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THE EARLY STAGES OF LATEX FILM FORMATION

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The early stages of coalescence and polymer diffusion in latex films based on poly(butyl acrylate-*co*-methyl methacrylate) were examined by fluorescence resonance energy transfer (FRET). These experiments were carried out using a novel device that allowed us to arrest the drying of the wet film, and to carry out fluorescence decay measurements with position control through low magnification microscope optics. Most latex films dry as a moving front. When water evaporation is arrested, the movement of the drying front ceases. This feature of the experiment allowed us to carry out FRET measurements, and to monitor the extent of polymer diffusion, at various distances across the sample from the edge of the drying front. Individual experiments were performed at 23 °C and fixed humidity.

We found that relative humidity plays an important role in latex particle coalescence and in the subsequent polymer diffusion step. An increase of relative humidity delays the onset of polymer interdiffusion adjacent to the drying front. This fact shows that coalescence and diffusion do not necessary occur with the passing of the drying front. We can explain our results by considering that after the drying front has passed, there is still a thin film of water between the packed latex particles that blocks the on-set of polymer interdiffusion.

In this particular latex polymer, once the film is “dry”, the rate of polymer diffusion is strongly enhanced by an increase in relative humidity. This result indicates that water molecules act as a plasticizer to promote the rate of polymer diffusion.