

## BEHAVIOR OF ALKALI-SOLUBLE RESIN AND ACRYLIC LATEX BLENDS

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Emulsion polymers are widely used as film-forming materials for coatings, adhesives, and printing inks. Surfactants are commonly employed to stabilize the polymer particles.

Alkali-soluble resins (ASRs) are a special type of polymeric surfactants containing both hydrophobic moieties and carboxylic acid functional groups. Upon neutralization, they function as stabilizers and process aids in the production of emulsion polymers, providing electrosteric stabilization to the particles.<sup>1, 2, 3, 4</sup> Conventional surfactants (anionic and/or nonionic) can thus be reduced or even eliminated while the latex stability is maintained or improved.<sup>5, 6</sup> The ASR-stabilized emulsion polymers have shown performance advantages for a wide range of industrial applications.<sup>5, 6, 7, 8</sup>

The ASRs are generally utilized at high concentrations (> 20%) to modify the film-forming polymers.<sup>5, 6, 7, 8</sup> The inclusion of ASR at such high levels is expected to alter the film formation characteristics of the emulsion polymers. Its impact on film formation has been reported for poly(n-butyl methacrylate) (PBMA) latex systems.<sup>9, 10, 11, 12, 13</sup> Film formation kinetics and

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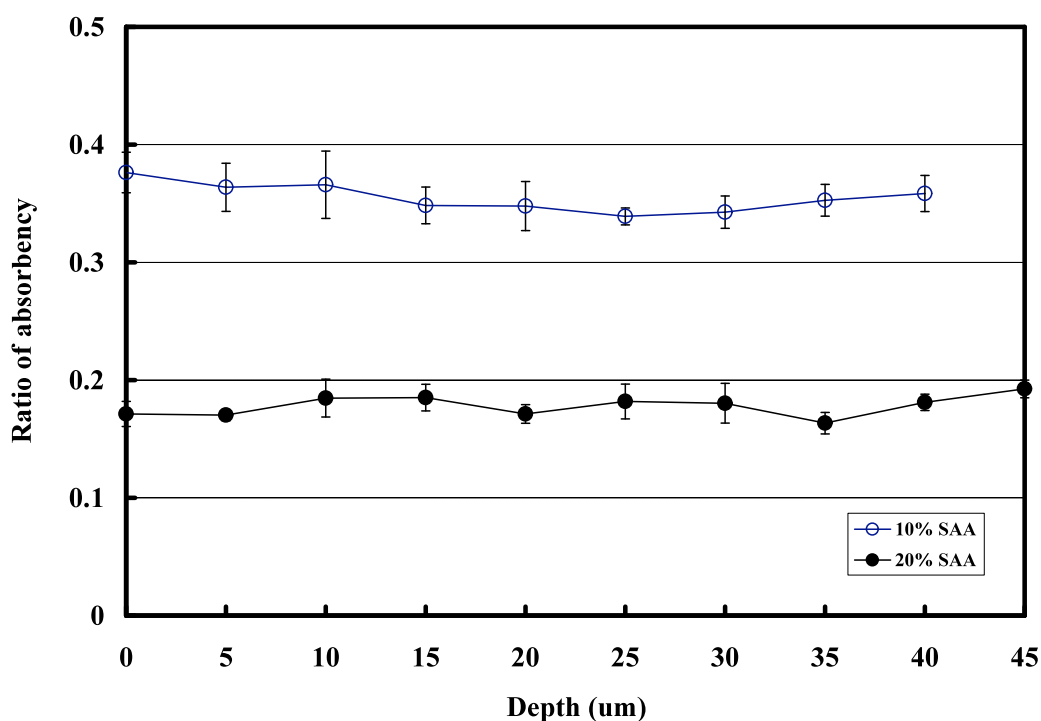
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morphology of surfactant-free PBMA latex were examined in the presence of poly(styrene/alpha-methylstyrene/acrylic acid) or SAA.

A large disparity between the calculated solubility parameters predicted theoretically that PBMA and poly(styrene/alpha-methylstyrene/acrylic acid) or SAA are completely immiscible. Dynamic mechanical analyses (DMA) of the blends indeed show two distinct relaxations corresponding to those of PBMA and SAA resin in the phase-separated state.<sup>13</sup> The immiscibility of the polymer pair caused SAA to form a separate phase in the interparticle spaces and to preferentially accumulate at the film surface. The images from atomic force microscopy (AFM) revealed interesting film morphology. The high  $T_g$  SAA in the interparticle spaces hinders interdiffusion between the PBMA core particles during film formation and at the same time preserves the particle domains in underneath matrix phase.<sup>9, 10</sup>

The distribution of ASRs in other latex-cast films is not well understood and is believed to have a significant impact on the performance properties of paint products. In this study, a mid-range molecular weight SAA is added to a soft acrylic latex with a practical monomer composition consisting of butyl acrylate, methyl methacrylate, methacrylic acid, and a wet adhesion monomer. The latex has the low glass transition temperature (around 0 °C) typical of acrylic polymers for low-VOC waterborne coatings. Since the acrylic base polymer has no aromatic interferences, the concentration of SAA throughout the latex film can be mapped using confocal Raman microscopy (CRM). Various other techniques, including AFM, DMA, contact angle analysis, and differential scanning calorimetry (DSC), were used to characterize ASR distributions.

Surprisingly, only single glass transition corresponding to the soft acrylic latex was detected by both DSC and DMA even when the SAA concentration is as high as 20% based on polymer solids. Figure 1 is the CRM depth profiling of the acrylic polymer in the presence of different levels of SAA. The AFM images indicate that spacing of soft acrylic particles increases with increasing SAA concentration in the blend. These results suggest that the SAA is uniformly distributed in the latex films.



**Figure 1.** Depth profiling of SAA distribution in the acrylic latex film

In addition to different surface morphology, the water-soluble, high  $T_g$  SAA significantly changes the adhesion and mechanical properties of acrylic polymer films. Typical paint performance properties such as scrub resistance, wet adhesion and block resistance were also evaluated. Results provide new insights on the structure and surface morphology of latex-cast

paint films containing ASRs as well as their impact on mechanical and performance properties. The information also cast new light on the mechanism involved in ASR distribution during film formation.

## References

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