Structure of Alkyd/Acrylic Nanocomposite Films

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Alkyd resins are used to make coatings that can be crosslinked to achieve hardness, but there are problems with yellowing and brittleness. Acrylics are less brittle but are also less water resistant. Films made from blends of alkyd emulsions and acrylic dispersions have attractive properties that are useful for coatings. However, previous work has revealed that phase separation can occur upon film formation and there can be a long drying (alkyd cross-linking) time.(1) Waterborne nanocomposite films of alkyd resin and acrylic polymers have attractive properties useful for coatings. Miniemulsion polymerisation (2) has been proven to be an effective way to create nanocomposite particles of acrylics and alkyd resin, (3) but questions remain about the phase distribution in the final film. Our aim in this work is to use fluorescent confocal microscopy to determine the level of heterogeneity in nanocomposite films, as it is affected by the interdiffusion of miscible acrylic phases and the phase separation of immiscible alkyd and acrylic phases. A fluorescently-labelled acrylic monomer, (4) that is not prone to photo-bleaching, was used in the miniemulsion polymerization of acrylic nanoparticles and also alkyd/acrylic nanocomposite particles. Confocal microscopy was used to determine the acrylic distribution in films made from various combinations of particles. The continuous phase is made up of either acrylic or alkyd/acrylic particles, whereas either acrylic or alkyd/acrylic particles are dispersed as a minority phase. Analysis of the intensity distribution across a confocal image allows us to determine the heterogeneity of the acrylic and alkyd phases in nanocomposite films in comparison to films made from blends of particles. The fluorescent and normal acrylic particles were found to be miscible, as there was no evidence for phase separation. When acrylic nanocomposite particles are blended with nanocomposite particles, the amount of heterogeneity is increased as the concentration of alkyd in the matrix is increased. When acrylic latex is physically blended with alkyd emulsion there is evidence for phase separation as large drops of alkyd are present in the bulk of film. Thus, nanocomposite films are more homogeneous than physical blends of alkyd and acrylic, and thus the mechanical properties and performance as a coating are likewise expected to be different.

This work was funded by the EC Framework 6 Integrated Project, "NAnostructured waterborne POLymEr films with OutstaNding properties (NAPOLEON)" under Contract No. IP 011844-2. and by the Basque Country, (becas para la formación de investigadores, gobierno Vasco-Eusko Jaurlaritza).

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