59b Morphology of Fatty Acid-Based Vinyl Esters

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One method of reducing styrene emissions from vinyl ester resins is to replace some or all of the styrene with fatty acid-based monomers. Methacrylated fatty acid (MFA) monomers are ideal candidates because they are inexpensive, have low volatilities, and promote global sustainability because they are derived from renewable resources. Interestingly, the morphology of fatty acid-based vinyl esters was very much dependent on whether methacrylated VE (VEM) monomers or acrylated VE (VEA) monomers were used. DMA traces showed that VEM resins had a much broader glass transition than VEA resins. Furthermore, certain ternary blends of vinyl esters, MFA, and styrene showed the presence of two transitions, one at ~70 ºC and another above 100 ºC for VEM resins. However, only one transition was observed for VEA-based ternary blends, intermediate of the two transitions for VEM resins. FTIR reactivity ratio measurements showed that VEA monomers would prefer to react with MFA monomers and MFA monomers would prefer to react with themselves, while the components of VEM resins react randomly. This indicates that microgel domains are more likely to occur in VEM polymers, explaining the presence of multiple phases in VEM polymers. AFM analysis confirmed the presence and relative sizes of these microgels. Furthermore, the particular fatty acid monomer used has a large effect on the morphology. For example, methacrylated linoleic acid monomers formed macro-scale phase separated domains in VE resins, while methacrylated oleic acid monomers and methacrylated fatty acids with saturated residues formed homogeneous polymers on the macro-scale.