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PROPERTY ENHANCEMENT IN UNSATURATED POLYESTER NANOCOMPOSITES BY USING A REACTIVE INTERCALANT FOR CLAY MODIFICATION

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Summary: Most common thermoset polymers used in polymer nanocomposites include phenol resins [1], epoxy resins [2] and unsaturated polyester (UPE) resins [3-4]. Among them, UPE resin exhibits relatively poor mechanical and thermal properties, which restricts its use in advanced composite systems. In order to enhance the performance of UPE resin, it has been reinforced with nano-sized clays by in situ intercalative polymerization method in which polymer resin, dissolved in a polymerizable monomer such as styrene, is intercalated between clay layers via simultaneous mixing and then followed by crosslinking reaction. In the literature, UPE nanocomposites have been prepared by both simultaneous and sequential mixing of UPE, styrene, and organophilic montmorillonite (MMT) clays. Those nanocomposites were found to have partially exfoliated nanocomposite structures with a decreasing trend in static and dynamic mechanical properties as well as a lower glass transition temperaturevalue with increasing clay concentration [3-4]. These results were attributed to insertion of relatively smaller styrene molecules in between MMT layers at high levels which lowers possibility of crosslinking reaction with reactive double bonds of UPE.
In this study, unlike conventional ammonium salts, incorporation of an ammonium salt containing a reactive double bond for modification of MMT clay is thought to be an original solution to the drawback mentioned above. UPE nanocomposites were prepared by in-situ free-radical polymerization method. The MMT clay was rendered organophilic with a quaternary salt of coco amine having a styryl part as the reactive group for crosslinking reaction. The cocoamine salt is expected to intercalate between the clay layers via ionic interactions and participate in polymerization reaction via its reactive double bond. The resultant nanocomposites were characterized via X-ray diffraction (XRD) and transmission electron microscopy (TEM). All the nanocomposites were found to have improved thermal and mechanical properties as compared with neat UPE matrix, resulting from the contribution of nanolayer connected intercalant-to-crosslinker which allows a crosslinking reaction. It was found that the partially exfoliated nanocomposite structure with an exfoliation dominant morphology was achieved when the MMT loading was 1 wt.%. This nanocomposite exhibited the highest thermal stability, the best dynamic mechanical performance and the highest crosslinking density, most probably due to more homogeneous dispersion and optimum amount of styrene monomer molecules inside and outside the MMT layers at 1 wt. % loading [5].

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