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Development of Nanocomposite Coatings by Radiation Curing

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Kencana Fibercomposite is a manufacturer producing high performance fiber composite derived from a revolutionary green technology. These composites are alternative to wood and used in building construction. At present, these materials are ready to be used without coating or painting, however they are vulnerable to scratch and abrasion during handling and transportation. Therefore, Kencana Fibercomposite and Nuclear Malaysia have collaborated to develop scratch and abrasion resistant nanocomposite coating materials. The most appropriate process to cure the materials is using radiation curing technology. The technology offers several advantages such as fast curing, improved productivity and product performance, curing at room temperature and elimination of volatile organic compound (VOC).

In this research work, the incorporation of silica nanoparticles into radiation curable resins is to enhance scratch and abrasion properties of the coating materials while retaining transparency and glossiness. Radiation curable nanomaterials can be prepared using heterogeneous hydrolytic condensation technique. Composite materials that exhibit a change in structure and composition over nanometer length scale have been proven in imparting remarkable property enhancement with respect to stiffness and strength. The technique is also capable of overcoming several major issues related to compatibility between the matrix and the nanoscale component, and also agglomeration of nanosized component during processing. This will produce a homogeneous distribution of nanosilica in the radiation curable nanomaterials. Silico-organic nanoparticles have relatively large surface areas compared to microparticles, therefore modification effects from the polymerization activity should have a great influence on the properties of the composites.

During curing process, electron beam (EB) radiation and ultraviolet (UV) light were used to initiate radical polymerization. These polymerization active nanoparticles were obtained from heterogeneous hydrolytic condensation of the silane to the silanol groups of the silica particles. The above reaction could be verified by the application of FT-Raman spectroscopy (intensity measurement of the C=C vibration band at 1640 cm-1) and gel permeation chromatography to show the impact of polymerization activity of the nanoparticles on the silico/acrylate dispersion. In the curing process, the nanoparticles form crosslinkages to produce radiation cured polymeric composite with improved scratch and abrasion resistance. From Taber abrasion, it can be observed that the weight losses of radiation cured materials are significantly reduced when the amount of silica particles (SiO2) increases. The nanoparticles added into the coating materials significantly improved the scratch property.

Finally, it can be concluded that polymerization active silico-organic nanoparticles could be prepared by in situ reaction. Formulations useful for technical coating process could be prepared and cured using the low energy electron beam (EB) and ultraviolet (UV) light. The composite materials showed highly improved mechanical properties. These polymeric nanocomposites show excellent resistances toward abrasion and scratch properties when compared to pure materials without nanoparticles.

Country/Organization invited to participate

Malaysia

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