

High Toughening Effects of Polybenzoxazine Filled with Ultrafine Fully Vulcanized Powder Natural Rubber Grafted with Varied Monomers

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Abstract : Varied types and content of ultrafine vulcanized powdered natural rubbers (UFPNR) as toughening fillers of polybenzoxazine composite are investigated in this work. Four types of UFPNR were prepared by graft polymerization of acrylonitrile monomer (AN), styrene monomer (ST), styrene-acrylonitrile copolymer (ST/AN), and styrene-methyl methacrylate copolymer (ST/MMA) onto deproteinized natural rubber (DPNR). The solid UFPNR powders with different types of grafting were finally obtained by electron beam vulcanization and a spray-drying technique. Additionally, effects of various UFPNR contents (0, 5, 10, 15, 20, and 25 wt%) on toughness of polybenzoxazine composites were studied. It was observed that the UFPNR grafted with the styrene-methyl methacrylate copolymer (UFPNR-g-(PS-co-PMMA)) exhibited the most effective toughening agent for polybenzoxazine, whereas the rubber powder content of 25 wt% was found to be the optimal filler loading in enhancing the toughness of the resulting composite. The experimental results revealed an increase of 86% in toughness and 56% in impact strength at the above UFPNR-g- (PS-co-PMMA powdered rubber content. Interestingly, the utilization of the UFPNR-g-(PS-co-PMMA as toughening agent was found to increase thermal stability (degradation temperature at 5wt.% (Td5) and glass transition temperature (Tg) of the composite i.e. an increase of 8°C and 6 °C has been observed for the Td5 and Tg, respectively.

Keywords : natural rubber, ultrafine fully vulcanized powder rubber, polybenzoxazine, polymer composite, toughening

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