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Dynamic Mechanical Analysis of Carbon Fibre Composites

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Keywords: Dynamic mechanical analysis, Short carbon fiber, Thermoplastic natural rubber, Composite, Surface treatment.

Abstract. Thermo-mechanical properties of thermoplastic natural rubber (TPNR) reinforced short carbon fiber (CF) was investigated by means of dynamic mechanical analysis. Blend of natural rubber (NR) / polypropylene (PP) and liquid natural rubber (LNR) was carried out by melt blending in Haake internal mixer at 180 °C processing temperature, 50 r.p.m. rotation of rotor speed and 12 min mixing time. Treated and untreated carbon fibre of 0, 10, 20 and 30 Vf % was added as reinforcement in TPNR matrix. Samples in the form of 3 mm thickness were prepared by hydraulic hot press compression moulding. It was found that the peak of tan δ, E” and midpoint of E’ versus temperature curves almost coincide with one another for TPNR matrix. Contrary to TPNR, tan δ, E” and E’ were not coincide in the case of reinforced TPNR composites. The presence of CF in the TPNR had increased the tan δ and E” surface treatment employed on CF increased the Tg value indicates on better fiber-matrix interaction.

Introduction
Dynamic mechanical analysis (DMA) is a sensitive technique that characterizes the mechanical responses of materials by monitoring property changes in a material with regard to the temperature and frequencies. DMA separates the dynamic response of materials into and elastic part, E’ (storage modulus) and viscous or damping component, E” (loss modulus). The elastic process described the energy stored in the system, whereas the viscous component describes the energy dissipated during the process.

In short fibre reinforced thermoplastics, both the storage modulus and damping are governed by polymer matrices as well as the fillers. Studies by Akay [1] on carbon fibre reinforced epoxy revealed that tan δ occurs at a higher temperature than the loss modulus peak. The temperature interval between peaks varies depending on the fibre orientation with respect to direction of applied load. The glass transition temperature (Tg) consistent with the extent of the stress shielding of the matrix by fibres in composites. Tg also indicates at which composite suffers significant loss of stiffness.

This chapter presented the effect of fibre loading and sulphuric acid treated on dynamic mechanical behaviour of carbon fibre reinforced TPNR composites. Storage modulus, loss modulus and tan δ of reinforced and unreinforced TPNR composites are presented in this paper.

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