Dynamic Young's modulus measurement of treated and post-treated tropical wood polymer composites (WPC)

ABSTRACT

By means of dynamic mechanical thermal analysis (DMTA), selected tropical wood species, namely Eugenia spp., Artocarpus rigidus, Artocarpus elesticus, Koompassia malaccensis, and Xylopia spp. have been characterized. The woods were treated with sodium metaperiodate to convert them into wood polymer composites (WPC). After two weeks the WPC were chemically treated with phenyl hydrazine to convert them into secondary wood polymer composites, also called post-treated WPC (PTWPC). The chemical treatment and post-treatment are successful in improving the mechanical properties of the final product. The storage modulus (E') was measured using dynamic mechanical thermal analysis (DMTA), and the dynamic Young's modulus (Ed) was calculated using free-free vibrational testing. The results reveal that the elastic properties i.e. stiffness (Ed) and storage modulus (E') of the composite were dependent on the type of wood species. The E' of WPC and PTWPC were much higher than raw wood, whereas the glass transition temperatures (Tg) of WPC and PTWPC were much lower than those of raw wood. Free-free vibration testing provided rapid information about the quality of the composite material, such as the stiffness (Ed) of the PTWPC compared to the respective WPC and raw woods. The WPC and PTWPC were characterized using Fourier transform infrared (FTIR) spectroscopy and scanning electron microscopy (SEM). FTIR analysis indicated the absorption band of raw wood at 1635 cm-1 due to carbonyl stretching, whereas WPC and PTWPC showed increased absorption bands near 1718 cm-1 and 1604 cm-1, respectively.

Keyword: Tropical wood; Wood polymer composites; Post-treatment; Storage modulus; Elastic properties; Stiffness