World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:19, No:05, 2025

Biobased Toughening Filler for Polylactic Acid from Ultrafine Fully Vulcanized Powder Natural Rubber Grafted with Polymethylmethacrylate

Authors : Panyawutthi Rimdusit, Krittapas Charoensuk, Sarawut Rimdusit

Abstract : A biobased toughening filler for polylactic acid (PLA) based on natural rubber is developed in this work. Deproteinized natural rubber (DPNR) was modified by grafting polymerization with methyl methacrylate monomer (MMA) and further crosslinked by e-beam irradiation and spray drying process to achieve ultrafine full vulcanized powdered natural rubber grafted with polymethylmethacrylate (UFPNRg-PMMA) to solves in the challenges of incompatibility between natural rubber and PLA. Intriguingly, UFPNR-g-PMMA revealed outstanding and unique properties with minimal particle aggregation. The average particle size of rubber powder obtained from UFPNR-g-PMMA at PMMA grafting content of 20 phr reduced to 3.3±1.2 µm, compared to that of neat UFPNR of 5.3±2.3 µm which also showed partial particle aggregation. It is also found that the impact strength of the filled PLA was enhanced to 33.4±5.6 kJ/m2 at PLA/UFPNR-gPMMA 20 wt% compared to neat PLA of 9.6±3 kJ/m2. The thermal degradation temperature of the PLA composites was enhanced with increasing UFPNR-g-PMMA content without affecting the glass transition temperature of the composites. The fracture surface of PLA/ UFPNR-g-PMMA suggested internal cavitation and crazes are the main effects of rubber toughening PLA with substantial interfacial interaction between the filler and the matrix.

Keywords : natural rubber, ultrafine fully vulcanized powder rubber, polylactic acid, polymer composites
Conference Title : ICPC 2025 : International Conference on Polymers and Composites
Conference Location : Istanbul, Türkiye
Conference Dates : May 06-07, 2025