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Effect of nanographene on mechanical properties and morphology of nanocomposites made of recycled high density polyethylene and fluted pumpkin stem agricultural waste material

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Abstract

Polymer nanotechnology has triggered tremendous proliferation in application of nanographene in development of multifunctional nanocomposites. Polymer nanocomposites are being utilized in packaging, sports equipment, automobile sector and bio-medical applications due to their exceptional property combination and distinctive design feasibility. Nanographene has high aspect ratios than many nanosize fillers such as carbon nanotubes and clays, better mechanical properties than many polymers, so they are favored as a filler material in polymer matrix composites. In this study, the effect of nanographene (NG) on the mechanical properties and morphology of nanocomposites prepared with fluted pumpkin stem flour (FPF) and recycled high density polyethylene (HDPE) were experimentally investigated. Four weight levels of nanographene 0, 0.5, 1.5 and 2.5 wt % were mixed with 65 wt. % HDPE and 35wt. % FPF produced by melt compounding and the extruded nanocomposites was shaped by injection molding machine for the mechanical tests. The mechanical test results showed that when 0.5 wt % of NG was added, flexural strength, flexural modulus and notched impact strength reached their maximum values of 24.77MPa, 1800MPa and 32.61J/m2, compared to the control (without NG) samples), 0 wt % NG addition the flexural strength, flexural modulus and notched impact strength gave lower values: 20.5MPa, 1500MPa and 19.35J/m2 respectively. Although the addition of NG into the polymer matrix effectively improved mechanical properties, these improvements came at proper NG loading of 0.5 wt %. Morphological study confirmed that the samples with 0.5 wt. % of NG showed no fiber pullout/holes, whereas higher contents (1.5-2.5 wt %) of NG showed fiber pullout/holes and were easily agglomerated. This study has shown that fluted pumpkin stem agro-waste material could be used in composite formulation with comparable results to wood-plastic-composites (WPC).

Keywords: Nanographene, Agricultural waste, Nanocomposites, Mechanical, Morphology.

Biography

Ogah Anselm Ogah is a Lecturer in the Department of Polymer Engineering, Faculty of Engineering, Nnamdi Azikiwe University, Nigeria. He was a research scholar (PhD) at the Composite Materials & Engineering Center, Washington State University, USA. He has a PhD Industrial Chemistry with major in Polymer Chemistry & Technology from Ebonyi State University, Abakaliki, Nigeria. He has over 20 publications that have been cited 147 times, and his publication H-index is 7 and has been serving as a reviewer of international reputed journals.

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