

Development of Novel Composite Material Using Waste Polyethylene Incorporated with Calcium Carbonate Obtained from Sri Lankan Calcite

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Today, there is a great need for the reduction of polyethylene waste to reduce environmental pollution. The main objective of this study is to develop a novel composite material using waste polyethylene reinforced with calcite to make polyethylene/calcite composite. Calcite taken from the Lanka Mineral and Chemicals (Pvt) Ltd. is used as the reinforcement for the composite and low-density polyethylene obtained from waste shopping bags is used as the polymer matrix. Sample series of octadecanoic acid-coated calcite powder and unmodified calcite nanoparticles are used to synthesize the composite. The in-situ deposition is used to synthesize nanoparticles from raw calcite. Calcite is incorporated into low-density polyethylene with different ratios and properties are characterized to obtain the optimum strength. Calcite powder is characterized using particle size analyzer, X-ray diffractometer, and Fourier transforms infrared spectroscopy. The composite is characterized by tensile tests, compression tests, and differential scanning calorimetry tests. Calcite nanoparticles obtained 23.2×10^{-9} m of average particle size after In-situ deposition. Only the polymeric material acquired 64.57×10^6 N m⁻² of tensile strength and 44.62×10^6 N m⁻² of compressive strength. Tensile strength is increased up to 69.87×10^6 N m⁻², 78.98×10^6 N m⁻², 66.41×10^6 N m⁻² and compressive strength is reached to 90.58×10^6 N m⁻², 102.28×10^6 N m⁻², 75.98×10^6 N m⁻² when polyethylene combined with raw calcite powder, calcite nanoparticles, and surface-modified calcite powder (5:3 of polyethylene/calcite ratio) respectively. It provides evidence that the low-density polyethylene with calcite reinforcement attained to better mechanical properties than only the polymeric material.

Keywords: Low-density polyethylene, Nanoparticles, Surface modified, In-situ deposition