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Abstract

Fused Deposition Modelling (FDM) is a versatile manufacturing technique that utilizes polymer filaments as a raw material. It is appropriate process for integrating recycled biowaste and fibers as reinforcing agents alongside the polymers. This research article delves into the intricate process of fabricating filaments using powder extracted from Electronic Waste (EW), notably Printed Circuit Boards (PCB) and blended with virgin Polylactic Acid (PLA), providing a comprehensive exploration of the methodology involved. The primary pellet in this study was virgin PLA, while flexi PLA F2110 was utilized as a plasticizer. The PCB underwent shredding and grinding into powder particles ≤150 µm, which was subsequently blended with polymer pellets (1 and 3 wt.%) for the experiment. Energy Dispersive X-Ray Spectroscopy (EDAX) was utilized to determine the composition of the segregated EW. Differential Scanning Calorimetry (DSC) and Thermogravimetric Analysis (TGA) were performed on the EW powder to test its thermal stability and determine its capacity to survive the temperatures required for filament extrusion. The filaments were extruded using a single screw extruder with EW-PCB, and the properties of both the extruded filament and filler particles were assessed through tensile, impact and hardness testing. Thermal analysis and morphology examination of the EW-PCB filler particles confirmed their suitability for filament extrusion. The outcomes of the tensile, hardness and impact tests revealed that the composite filament, containing 3 wt.% EW-PCB, demonstrated significantly greater resistance to tensile load, a higher Young's modulus, increased surface hardness and decreased toughness compared to the other composite filaments (0 and 1 wt.%).