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Green composites based on cork residues for additive manufacturing

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Statement of the Problem: An important stage of materials development is the validation of its mechanical performance prior to the manufacturing step. In composite materials, mechanical properties are highly dependent on the interaction between polymer matrix and the filler1-3. Cork-polymer composites (CPC) based on biodegradable matrices for fused filament fabrication (FFF) technique were prepared. FFF, an additive manufacturing (AM), is an extrusion-based technique, in which a thermoplastic filament is melted and selectively extruded via nozzle, deposited layer by layer4. Cork is the outer bark of Quercus Suber L. oak tree and possesses an unique combination of properties: low density, viscoelasticity, high recovery capacity after impact, among others5. Biodegradable polymers as neat polylactic acid (PLA) and PLA/Polyhydroxyalkanoate (PHA) blend were used as matrices in composites formulation. The selection of an elastomeric blend, PLA/PHA, was based on the compatibility of the elastic behavior of cork and to print a more flexible product. In order to evaluate the adhesion between cork and the polymeric matrices, morphological, chemical and mechanical analyses were performed.

Methodology: CPC were prepared using cork powder residues from industrial stoppers production. Both PLA/PHA blend and CPC were prepared by melt compounding. Morphological analyses were made by scanning electron microscopy (SEM); chemical analyses by Fourier Transform Infra-Red (FTIR); and, mechanical tests (tensile, flexural and impact).

Findings: Morphological and chemical analyses revealed a good adhesion of cork to the biodegradable matrices. When cork was incorporated in neat PLA, led to a more flexible material. Conclusion: The incorporation of cork powder residues into biodegradable matrices results on the development of sustainable green composites. AM techniques can add value to these green composites by employing them as filaments for FFF. Combining FFF with the unique cork properties and aesthetics, can potential new design freedom solutions and products.

Biography

Sara P. Magalhães da Silva has a Master in Chemical Engineering and she is a PhD student of Materials Science and Engineering at University of Aveiro, Portugal. Her field of research is related to the development and characterization of thermoplastic composites for injection molding applications; development of new materials formulations for additive manufacturing; lignocellulosic residues valorization. This work is part of her PhD thesis entitled "Cork-polymer composites – A sustainable solution in injection molding and additive manufacturing".

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