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Abstract

Additive Manufacturing of Wood-Based Polymer Composites Fabricated Using Vat Photopolymerization for Design Applications †

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1. Introduction

In the present research work, wood-based composites were prepared by adding different poplar powders within a soybean oil-based resin, choosing liquid crystal display (LCD) as vat photopolymerization (VP) among the additive manufacturing (AM) technologies used for polymer processing. The aim was to combine the advantages of AM with the valorization of poplar wood powder waste from the plywood industry to obtain innovative and more sustainable composite materials as alternatives to classic fossil-based materials for interior design applications.

2. Materials and Methods

Several photocurable formulations were prepared using an acrylate epoxidized soybean oil (AESO) resin as the polymer matrix and isobornyl methacrylate (IBOMA) as a reactive diluent, in the presence of 2 wt.% of phenyl bis(2,4,6-trimethylbenzoyl), with phosphine oxide (BAPO) as the photoinitiator. Bio-based composites were obtained by adding 3 wt.% of different wood poplar powders (P_I and P_{IV}), two by-products from plywood panel production to the AESO formulations, and 3D printing different parts in an LCD 3D printer.

3. Results and Discussion

A comprehensive characterization of the composites fabricated by VP was carried out. Rheological, thermal, morphological, and mechanical measurements were performed to investigate the final properties of the 3D-printed wood-based composites. Several 3D-printed components were fabricated, showing different levels of detail and complexity. The specimens showed enhanced final properties in terms of elastic modulus, glass transition temperature, and storage modulus due to the reinforcing effect induced by the presence of the fillers.

4. Conclusions

This research demonstrates that bio-based components can be successfully 3D-printed via LCD, including objects with potential application in interior design, such as joints

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and connections, highlighting the material's suitability to realize customized and more sustainable elements for design-oriented applications.

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