Proceedings of the Canadian Society for Mechanical Engineering International Congress 2021
CSME Congress 2021
June 27-30, 2021, Charlottetown, PE, Canada

FDM 3D Printed Wood-fiber Reinforced Architected Composites

E. Estakhrianhaghighi[1], A. Mirabolghasmi[1], Y. Zhang[1,2], L. Lessard[2], A.H. Akbarzadeh[1,2*]
[1]*Department of Bioresource Engineering, McGill University, Island of Montreal, QC, H9X 3V9, Canada*
[2]*Department of Mechanical Engineering, McGill University, Montreal, QC, H3A 0C3, Canada*
[*] *Corresponding author: hamid.akbarzadeh@mcgill.ca*

ABSTRACT

As a renewable source of cellulose, wood chips are transformed in this study to reinforce bio-based thermoplastic filaments for fused deposition modelling (FDM). A new processing method is developed for adding wood-fibers to polylactic acid (PLA) polymers to produce wood-fiber reinforced PLA filaments in order to 3D print high-performance composites. Dogbone samples are 3D printed with the produced filaments to evaluate their elastic and fracture properties as well as internal microstructure, with various weight fractions of wood-fiber. The experimental results demonstrate increased stiffness and ultimate strength and reduced density for composites with optimum wood-fiber content, compared to the pure PLA specimens. Furthermore, following the growing interest in lightweight cellular solids, wood-fiber reinforced PLA filaments are used to 3D print cellular materials with optimized microarchitectures. It was demonstrated that using wood-fiber reinforced composites for FDM 3D printing of advanced materials is a promising approach to not only extend the material properties of biopolymers but also to offer a new class of lightweight and sustainable structural materials. The experimental results on as-built 3D printed cells, compared with the results of a detailed computational analysis on as-designed cells, elicit that the designed architected cellular solids made of wood-fiber PLA composites can exhibit a considerably higher stiffness and ultimate strength than the conventional PLA hexagonal honeycombs.