ALBERTA INNOVATES

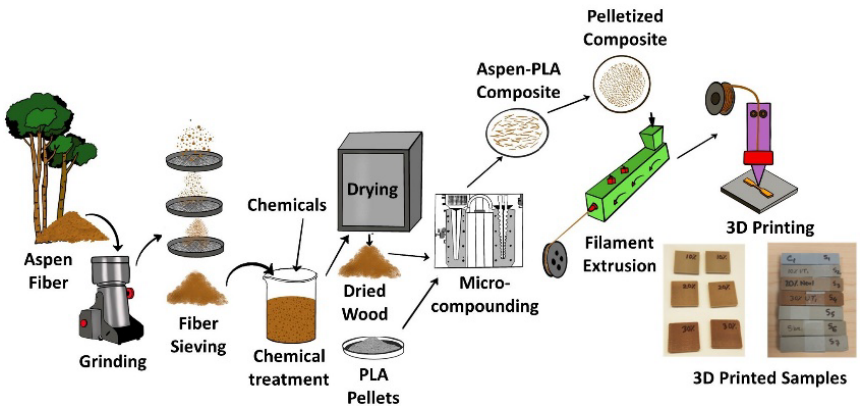
AGRICULTURE AND ENVIRONMENT

BIOINDUSTRIAL AND CIRCULAR INNOVATION

BIOINDUSTRIAL MATERIALS

Additive Manufacturing of Reinforced Hardwood Bio-composites for Structural Applications

This work demonstrates the development of 3D-printed biocomposites, utilizing Alberta's underutilized hardwood and PLA. Our innovative approach, featuring micro-compounding for uniform mixing, yields a versatile filament with 3D printability at a remarkable 30% wood loading. Beyond printability, we've optimized printing parameters to eliminate nozzle clogging, ensuring a smooth production process. We have crafted unique chemical treatment approaches to develop stronger, water-resistant biocomposites for sustainable innovation. But that's not all! We've explored the exciting potential of incorporating carbon fiber reinforcement, paving the way for high-performance biocomposites ideal for demanding structural applications in construction, automotive, and consumer products. While commercialization of these carbon fiber composites requires further development, this study presents a groundbreaking step towards a greener future with stronger, more sustainable materials.



FUNDING DETAILS

RECIPIENT:

Dr. Md Golam Kibria

University of Calgary

PARTNERS:

Innotech Alberta

CarboMat Inc.

TOTAL BUDGET:

AI FUNDING:

$200,000

PROJECT DATES:

Mar 2022 - Feb 2024

PROJECT TRL:

Start: 3

End: 5

APPLICATION

This project aims to produce carbon fiber-reinforced hardwood-derived bio-composites from Alberta's underutilized hardwood for structural applications. The goal of using hardwood as a natural filler and asphaltene-derived carbon fibers for reinforcement is to create lightweight, innovative, and resilient composites. Successful commercialization will enhance the value and productivity of hardwoods, offering a cost-effective solution for various structural applications like building components, furniture, and transportation parts, along with more common applications for bio-composites such as decking, fencing, and automotive interior components.

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PROJECT GOALS

- Green fabrication of composite structures via 3D printing of a reinforced bio-derived thermoplastic matrix (hardwood, carbon fiber, PLA, etc.).
- Tailoring the physicochemical properties (fiber loading, moisture, density, etc.) of the bio-composite components to achieve competitive mechanical performance for structural applications.

BENEFITS TO ALBERTA

- Utilizing underutilized hardwood (about 30%) to create structural materials for building construction, automobile manufacturing, food processing, and more.
- Generating new employment opportunities in a new, environmentally friendly industry, potentially employing over ten thousand people upon commercialization.
- Attracting new investments and providing a fresh revenue stream for the province through the development of the bio-composites sector.
- Diversifying the economy into innovative, green sectors to mitigate the impacts of global warming on the oil and gas industry, potentially leading to a billion-dollar industry.

2 New Products/Services

6 Project Jobs

10000 Future Jobs after

1 conference and 1 journal Publication

Indirect Project GHGs

Future GHGs Reduction 20-30%

CURRENT STATUS

FEB 2024 - Complete

All our objectives for this project have been successfully accomplished. The ongoing advancement includes the investigation on the effect of different fiber treatments and fiber loading on the mechanical properties of hardwood/PLA composite. Moreover, a successful production of a composite, incorporating carbon fiber into hardwood-filled PLA, has been achieved, with a detailed examination of its mechanical performance, thermal stability, and microstructure.