ALBERTA INNOVATES

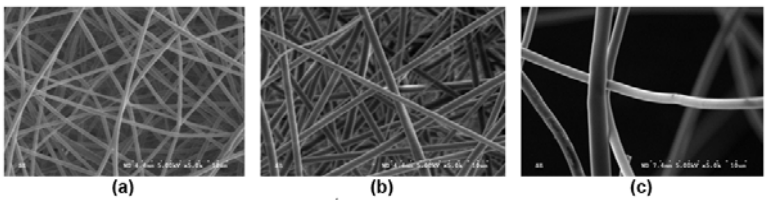
CLEAN RESOURCES

BIOINDUSTRIAL INNOVATION

BIOMATERIALS

Development of Ultralight and Highly Flexible 99% Lignin-Based Fibrous Sponges and Insulation Materials

West Fraser, a forest products company, is seeking commercial applications and market opportunities for their trademarked LignoForce Amalin™ lignin (Amalin lignin), a value-added product from lignin, a fibrous residual from the pulp and paper production process. Amalin lignin is comprised of large molecules which readily entangle to form fibres. These properties suggest potential to use in sponge absorbents and thermal insulation materials, as a sustainable alternative to non-renewable and toxic chemicals. A team lead by Dr. Scott Renneckar set out to develop three-dimensional, ultralight, flexible, fibrous bulk materials from 99% lignin-based nanofibres through optimizing formation of materials and evaluating performance as an oil absorbent and a thermal insulating material.



(a) (b) (c)

Figure 3. Scanning Electron Microscope images of lignin nanofibers spun from various solution concentration (a) 25 wt% (b) 27 wt% and (c) 30 wt%.(Scale bar = 10 um).

FUNDING DETAILS

RECIPIENT:
University of British Columbia

PARTNERS:
West Fraser, Advanced Renewable Materials Innovation Fund

TOTAL BUDGET:
$64,566

AI FUNDING:
$15,625

PROJECT DATES:
SEP 2018 - DEC 2019

PROJECT TRL:
Start: 3
End: 4

APPLICATION

The sponge-like lignin material developed during this Project has a variety of potential applications. The material's lightweight and highly porous structure makes it ideal for separating oil contaminants from water in environmental remediation, such as in oil sands tailing ponds or oil spill cleanup. As a sound and thermal insulator in buildings, the material's ultra-lightweight properties, compressibility, and shape memory allow the material to be compressed, shipped, and unrolled. These properties also suggest potential use of this material in performance clothing where weight is a key parameter. Beyond the scope of this Project, the material's potential for supercapacitor applications in energy storage is known.

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PROJECT GOALS

- Analyze and optimize electrospinning methods to create uniform lignin-based nanofibers from Amalin lignin with less than 1% additive materials.
- Form flexible 3-D structures through freeze-drying fibers with post-heat treatment.
- Determine influence of heat treatment on structure and mechanical properties of these bulk materials, optimizing heating rates and hold times.
- Conduct laboratory trials of using these bulk materials for oil absorption.
- Complete creation of an innovative bioproduct- 99% lignin based flexible sponge.
- Conduct market analysis for at least two applications of lignin sponge material, including oil absorption and building insulation.

BENEFITS TO ALBERTA

- Increase sustainability of West Fraser mill operations by leveraging their Amalin™ lignin technology to commercialize use of lignin residue in developing value-added materials for new domestic and export markets.
- Sustain, diversify and expand future employment and economic opportunities in rural Alberta.
- Deliver a new Alberta-based lignin nanofiber products that are sustainable, ultralight, flexible and compressible.
- Provide an alternative, sustainable remediation technology for treating oil-contaminated water.
- Deliver new sustainable, lignin-based materials for use in sound and thermal insulation products in buildings, and other applications such as performance clothing.

4 Students Trained

2 New Products

CURRENT STATUS

JAN 2020

The Project is complete and achieved the following results in developing and evaluating a lignin-based material: (a) spun uniform fibre with addition of only 1% polyethylene oxide by weight; (b) optimized formation of uniform, lightweight, highly porous sponge-like materials; (c) demonstrated oil-water separation properties; and (d) confirmed potential suitability as building insulation. Further technology development is required to advance commercialization and market development. Publication of research is pending.