ALBERTA INNOVATES

CLEAN RESOURCES

BIOINDUSTRIAL INNOVATION

BIOMATERIALS

Odour Reduction of Lignin-Polyolefin Composites Using Carbon Nanomaterials

Lignin is abundant in woody plants as a major structural material. Lignin is a by-product of kraft pulp mills that often combusted for energy. West Fraser developed processes to enable higher value uses for lignin, such as thermoplastics. Volatile organic compounds (VOCs), such as guaiacol and reduced sulfur compounds, are released from lignin during processing. Humans can detect unpleasant odours for these VOCs at very low thresholds, e.g.: 3 to 21 parts per billion (ppb) for guaiacol in water solutions. West Fraser has successfully used activated carbon to reduce odours at storage temperatures. This study, led by Dr. Suong Hoa, examines the potential to reduce VOC odors at higher processing temperatures, in the order of 200°C, using advanced carbon nanomaterials (CN) to absorb odours.

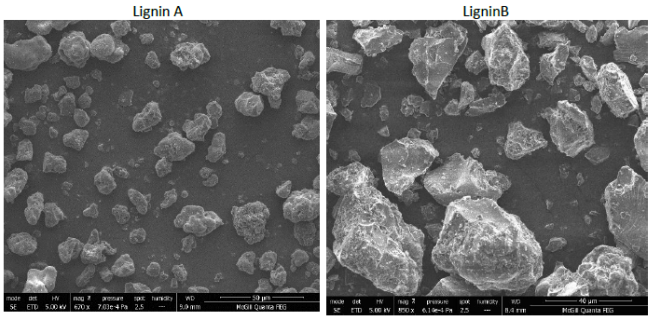

Fig. 10 SEM images of dried lignin samples

FUNDING DETAILS

RECIPIENT:
Concordia University (Quebec)

PARTNERS:
West Fraser; FP Innovations

TOTAL BUDGET:
$30,000

AI FUNDING:
$15,625

PROJECT DATES:
MAY 2018 - MAY 2019

PROJECT TRL:
Start: 3
End: 5

APPLICATION

Elimination of VOCs and odours associated with thermal processing of lignin can enhance working conditions for mill workers who handle the materials and reduce risk of customer concerns about product odour. Addressing these issues can help reduce barriers to production and market growth, while maintaining or enhancing West Fraser's reputation as a producer of sustainable, high quality forest products.

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PROJECT GOALS

The project objectives are as follows:

- Achieve uniform dispersion of carbon nanomaterials into lignin A (kraft pine lignin) and lignin B (lignosulphonate lignin)
- Optimize dispersion of carbon nanomaterial/lignin composites into polypropylene using twin screw extrusion.
- Assess tensile properties of the resulting composites, using neat polypropylene as a benchmark.
- Using human testers, evaluate odour of resulting composites to determine the best carbon-nanomaterial for odor control.
- Determine final loading of the lignin composite product, with a target of up to 20% of lignin and less than 2% of carbon nanomaterial by weight.

BENEFITS TO ALBERTA

- Leverage existing forest industry infrastructure to help diversify Alberta's rural economy and create additional employment opportunities for highly qualified and skilled personnel.
- Advance development of new value-added products from lignin, which is combusted as a component of black liquor to produce heat or electricity in conventional operations.
- Create potential new markets for Alberta-produced carbon nanotubes and graphene.

CURRENT STATUS

MAY 2019

The project is complete. A technique was developed to efficiently disperse carbon nanomaterials into lignin A and B, and CN-lignin composites were successfully dispersed in polypropylene by twin-extrusion. Carbon nanotubes were shown to reinforce the lignin particles as well to create a reinforced lignin/polypropylene interface. Carbon nanomaterial/lignin/polypropylene composites with a 5% loading of carbon nanomaterials failed to efficiently capture VOCs generated during extrusion. However, the researchers suggest that supercritical carbon dioxide could be used to extract most the VOCs present in the lignin samples studied, and thereby increase the odour-reducing efficiency of carbon nanomaterials.

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