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Production of wood-based low-carbon and environment-friendly materials

Ton-That, Minh Tan; Li, Hongbo; Faye, Adrien; Saeidlou, Sajjad; Maillard, Damien

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Production of Wood-Based Low-Carbon and Environment-Friendly Materials

Minh Tan Ton-That, Hongbo Li, Adrien Faye, Sajjad Saeidlou and Damien Maillard

Climate and clean tech policies: opportunities and challenges for the transformation of the Canadian forest sector

Biofor 2023 Conference

February 6, 2023

WWW.PAPERWEEK.CA

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PAPTAC

Plastic Waste in Canada

- Plastic industry is an important sector in Canada: $35 billion/yr sales, 1,932 establishments & 93,000 jobs
- Plastics production: energy & chemical intensive
- **Total volume: 4.7 MT/yr**
- Recycling: 0.8 MT/yr (9%)
- Landfills: 2.8 MT/yr (86%)
- The main plastic waste generators
  - Packaging: 47%
  - Automotive: 9%
  - Textiles: 7%
  - Electrical & electronic equipment: 7%

https://www.cbc.ca/news/business/plastic-waste-grocery-stores-recycling-1.4969379

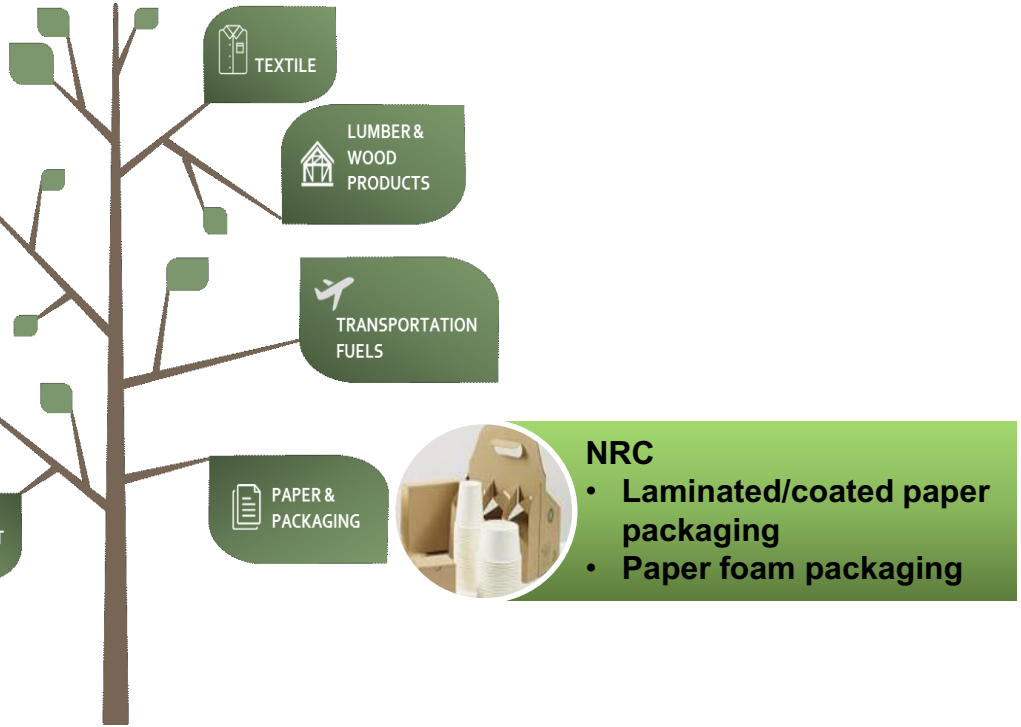
Forest biomass could be used to reduce plastic pollutions and plastic waste crisis while opening new markets for pulp products

* Source: Economic Study of the Canadian Plastic industry, Market and Waste, Deloitte, Feb. 2019

Forest Bioeconomy & NRC Contributions

NRC
- **Lignin thermoplastics**
- **Biocomposites**

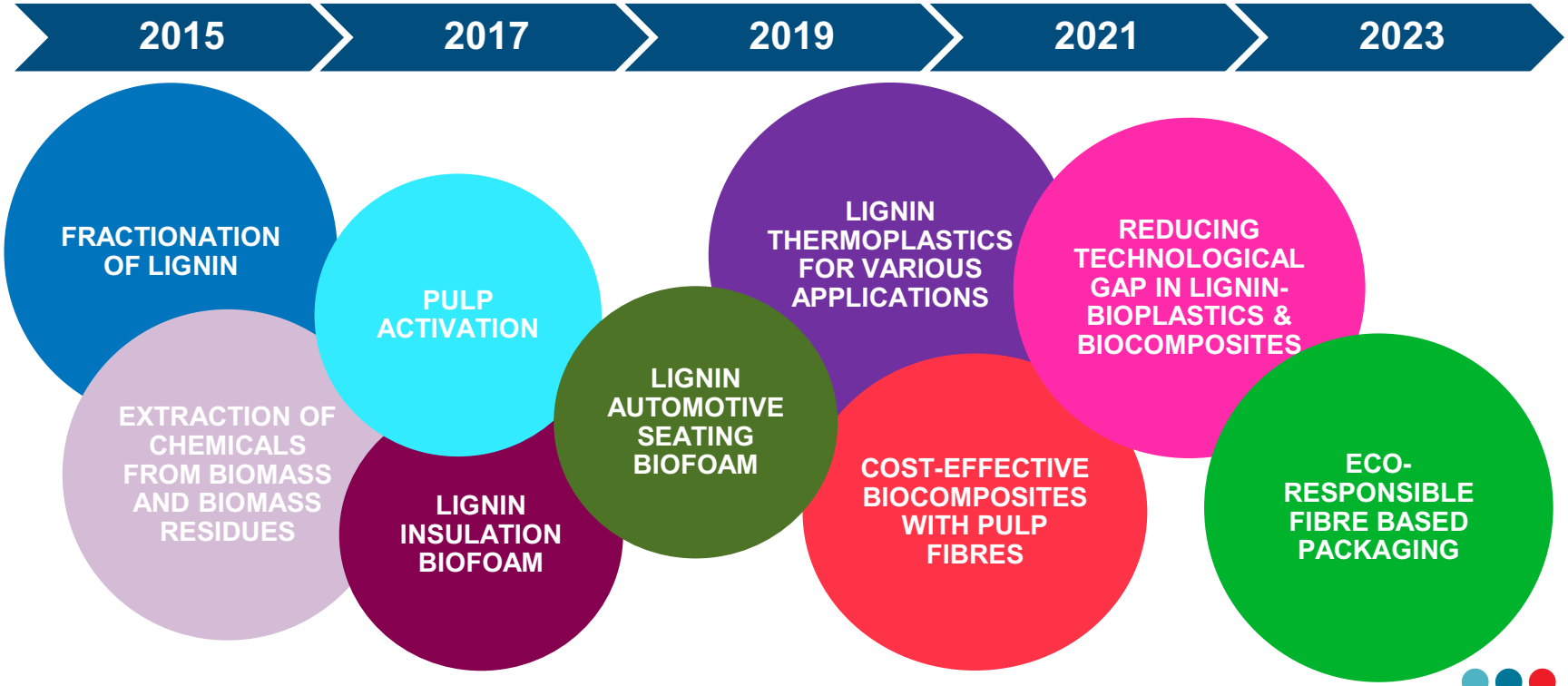
NRC
- **Greener extraction**
- **New applications**



NRC
- **Laminated/coated paper packaging**
- **Paper foam packaging**

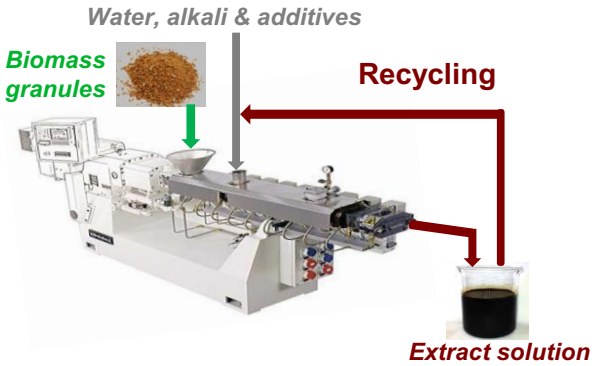
Source: Anne-Helene Mathey, Room to grow: The forest bioeconomy in Canada, NRCan-CFS, 2019

Main Activities Ton Support Forest Innovations



Lignocellulosic Biomass Extraction

***Continuous extraction* of biomass and its residues to produce renewable materials**



- ✓ *Low capital investment*
- ✓ *High efficiency (< 2 min extraction time)*
- ✓ *Saving energy (**50%**), water (**70%**) & chemicals (**30%**)*

Value added materials

Lignin (20 - 40%)

Tannin (2 - 20%)

Cellulose (30 - 50%)

Industrial applications

Flexible biofoam

Rigid biofoam

Biocomposites

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Natural Resources Canada / Ressources naturelles Canada Canada

CanmetÉNERGIE VARENNES CanmetENERGY

Innofibre Centre d'innovation des produits cellulosiques

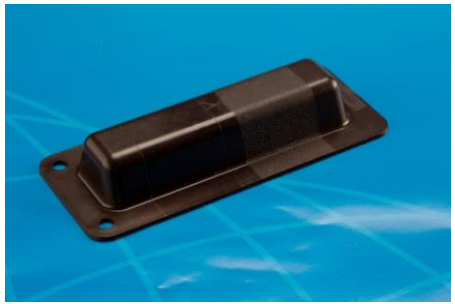
Université de Sherbrooke

Cost-effective Biocomposites from Wood Fibres

Fibre treatment integrated into pulp mill for biocomposites production

Fibre treatment

Pulp sheet making



Molded biocomposites

- ✓ ***NRC-Domtar Joint IP WO2019110868A1***
- ✓ ***No additional step***
- ✓ ***No capital investment***
- ✓ ***Highly efficient***

Domtar

CANPLEX LTÉE *Gage de Confiance!*

InnoFibre Centre d'innovation des produits cellulosiques

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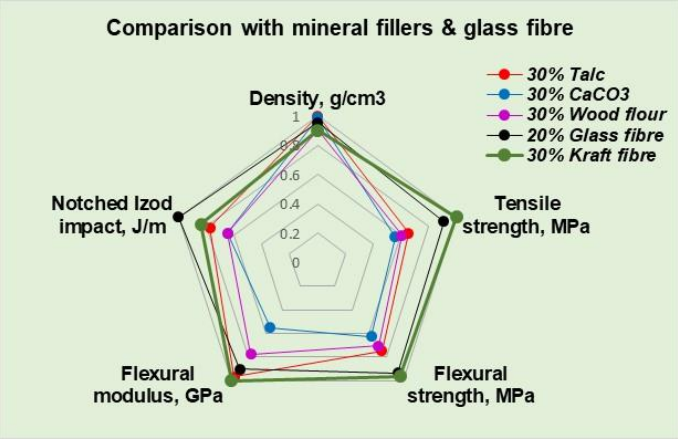
CRIBIQ Consortium de recherche et innovations en bioprocédés industriels au Québec

Cost-effective Biocomposites from Wood Fibres



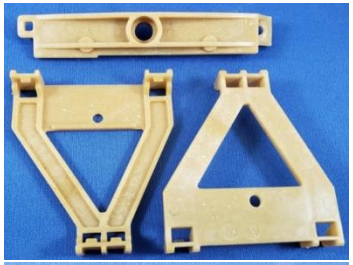
Potential savings: 6% in weight and 4% in cost as compared to 20 wt% glass fibre composite

Automotive Prototypes

Similar cycle time as conventional 30% talc filled PP

PROTOPLAST INC.
PRECISION TOOLING, PLASTIC PARTS & ASSEMBLIES

Natural color



Black color

PLASTIQUE AGE

Lignin Thermoplastics

From concept development to demonstration plant for the transformation into lignin pellets and thermoplastic products

- ***NRC-Domtar Joint IP WO 2018/035598 A1***
- ***Up to 40% lignin in final products***

Profile extrusion at Canplex

TRL1 >> TRL7

Lignin/PE agriculture film performs superior than commercial film

Domtar

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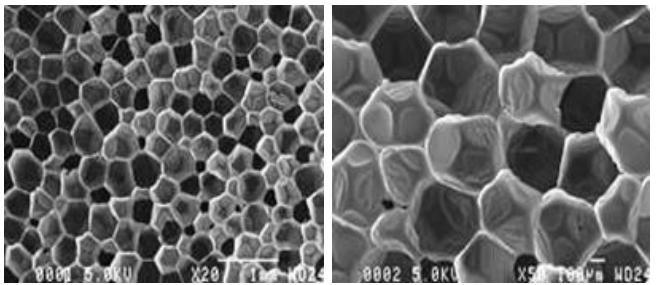
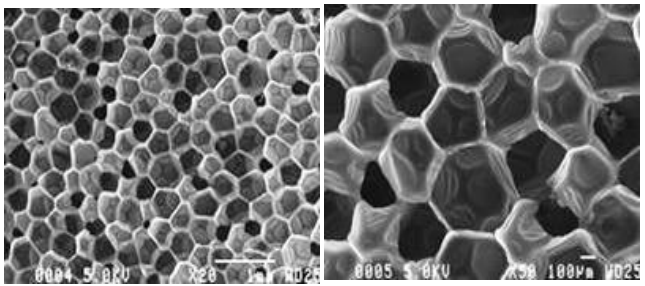
Rigid Biofoam from Lignin for Insulation

Rigid PU Biofoam from Lignin

Lignin incorporated as filler or multifunctional polyol for PU rigid foam fabrication



Reference foam



Biofoam with 20% lignin in polyol

- ✓ *Renewable content up to 30%*
- ✓ *Cost competitive*
- ✓ *Maintain insulation performance*
- ✓ *Enhance mechanical properties*

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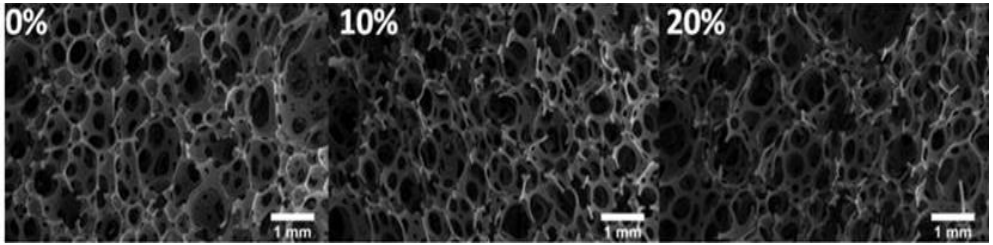
Flexible Biofoam from Lignin for Automotive Seating

Flexible PU Biofoam from Lignin

Lignin incorporated as filler or multifunctional polyol for PU flexible foam fabrication

- ✓ *Up to 20% lignin*
- ✓ *Cost competitive*
- ✓ *Improved elastic properties*



NRC Invention #2020-060

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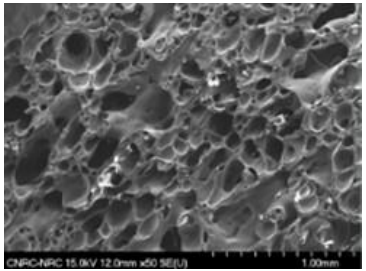
Active Biochar Foam from Lignin

For VOC and Odor Absorption

Lignin

Carbonization and activation

Active biochar foam with very high porosity

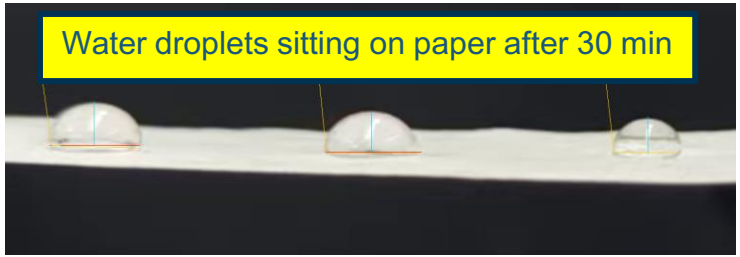


Lignin thermoplastics without odor

Paper Coating for Food Packaging

Novel coating solution for fiber-based packaging

- 100% renewable content
- Highly enhanced moisture and water resistance
- Integrating in paper making process
- Being recyclable

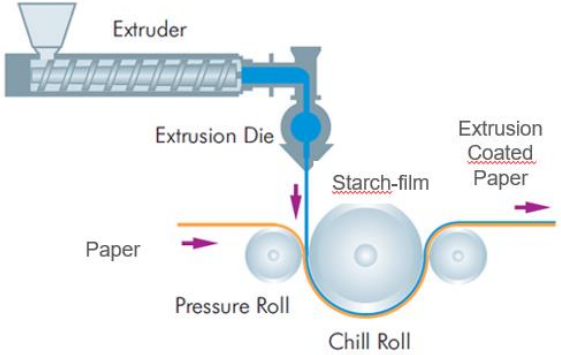


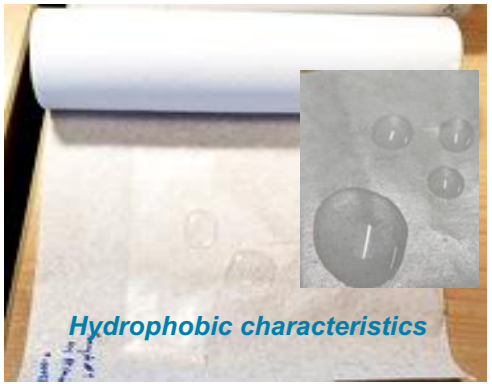
Hydrophobic characteristics

Coated paper

Lamination Coating on Paper

- **Novel starch based-plastic lamination coating solution for fiber-based packaging** (*NRC's Patented Thermoplastic Starch Blending Technology, US 9,045,625)*
  - Highly enhanced moisture and water resistance
  - Starch: low cost and widely available in Canada
    → cost-effective
  - 100% renewable
  - Performing in existing industrial equipment
    → facilitating commercialization
  - Being compostable





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co:alia

Conclusions

- **NRC has great capabilities:**
  - Providing R&D services to develop innovative solutions to transform forest biomass into sustainable valued-added bioproducts for the manufacturing industry
  - Beside renewable materials, recycling and enabling a circular economy are a growing focus for NRC
- **NRC work closely with NRCan with OGDs, consortia, companies and academia to maximize innovation outputs for the forest and manufacturing industry**

Acknowledgements

NRC

- Éric Patenaude
- Karen Stoeffler
- Nathalie Legros

NRCan

- Jean-François Lavasseur
- Matthew Schacker
- Allan Ding
- Marzouk Benali
- Bruno Gagnon

THANK YOU / MERCI

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