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### **Thermoset biocomposites for industrial applications**

Ton-That, Minh Tan; Legros, Nathalie; James, Byron; Slaski, Jan; Duckett, Mike; Graham, Lori-Jo

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# World Congress on Industrial Biotechnology

July 19-22, 2015 Montréal

BioProducts AgSci Cluster  
***Thermoset Biocomposites For  
Industrial Applications***

Session 5: Generating More Value from  
Canadian Biomass and Waste Streams

NRC: **Minh Tan Ton-That**, Nathalie Legros  
AITF: Byron James, Jan Slaski  
Stemia: Mike Duckett  
AAF: Lori-Jo Graham



# Introduction

- This project belongs to the BioProducts AgSci Cluster managed by Bioindustrial Innovation Canada (BIC)



- Initial budget: \$350k
- It is partly funded by Agriculture Agri-Food Canada (AAFC)



Agriculture and  
Agri-Food Canada

Agriculture et  
Agroalimentaire Canada

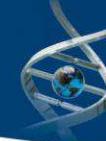
- Cash and in-kind contribution from Stemia and AITF
- Duration: Sep 2015 – March 2018



## Project objective

Develop high performance and cost-effective thermoset biocomposites from Canadian hemp (or flax) fibre showing good mechanical properties and improved fire and humidity resistance for the industry such as transportation, construction and oil field.





# Project partners

- NRC: Industrial Biomaterial Flagship Program

- Minh Tan Ton-That
  - Nathalie Legros



National Research  
Council Canada

Conseil national  
de recherches Canada

- Stemia Group Ltd, Alberta

- Mike Duckett, CEO



- Alberta Innovate-Technology Future (AITF), Alberta

- Jan Slaski
  - Byron James
  - Anthony Anyia



- Alberta Agriculture and Forestry (AAF), Alberta

- Lori-Jo Graham



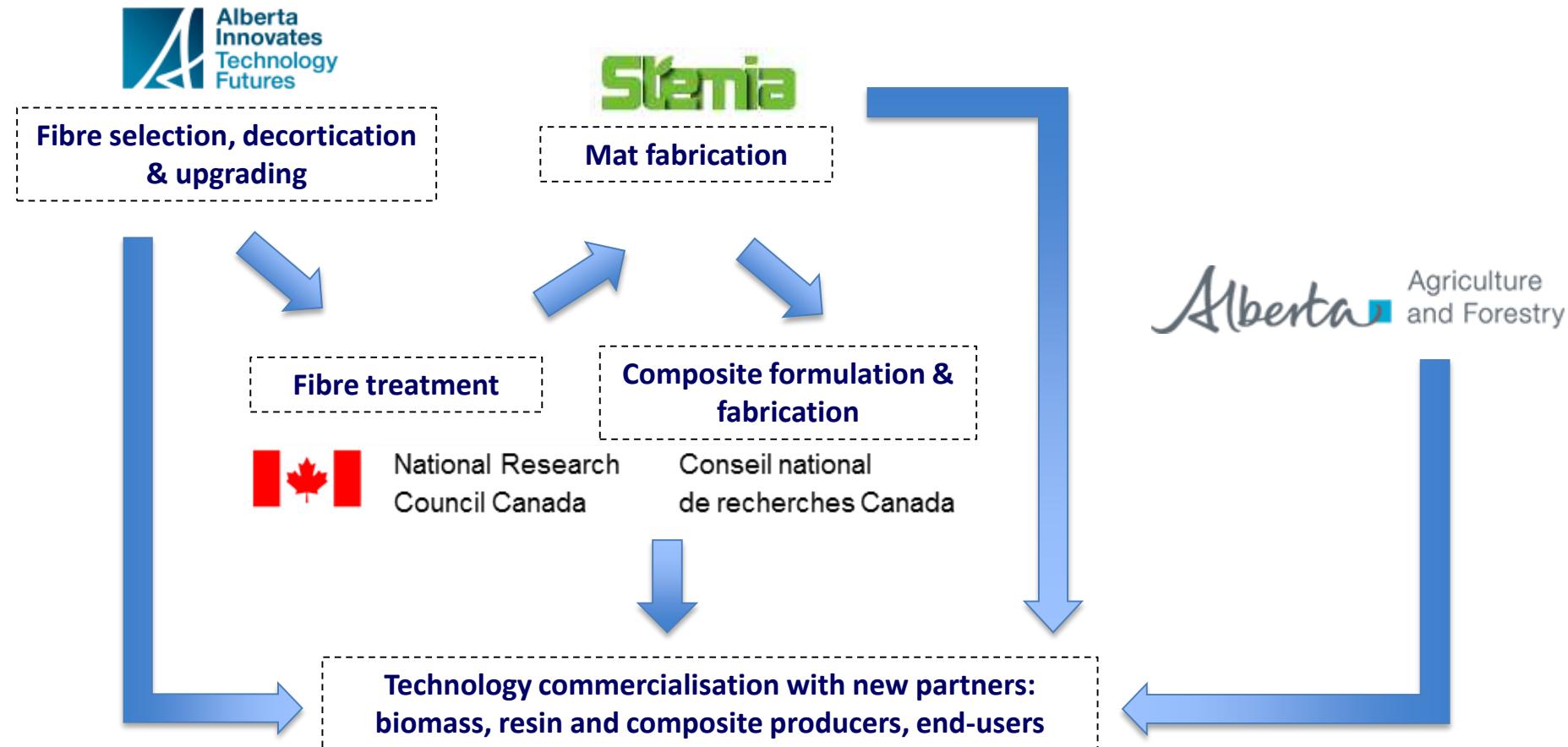


## Project activities

- Process for flax fibre post-harvest handling and mat making (AITF, Stemia)
- Fibre treatment process to improve the fibre resistance to humidity and fire (NRC, AITF, Stemia)
- Biocomposite formulation with adequate processing performance (NRC)
- Preparation of technology commercialization (NRC, AITF, Stemia, AAF)



# Project activities





# AITF with unique expertise and facilities in flax and hemp production research and development

- AITF in Vegreville, Alberta runs agronomy and demonstration field trials of hemp and flax



# AITF with unique expertise and facilities in cellulosic fibre decortication and upgrading

## AITF pilot scale decortication system in Vegreville, AB

- Decorticate hemp or flax fiber using a hammer mill type decortication system
- Long bast fiber at the end of the process is >95% clean and is between 50 - 200 mm inches in length
- Short fiber (hurd or shiv) is also produced
- Dust is removed using this system

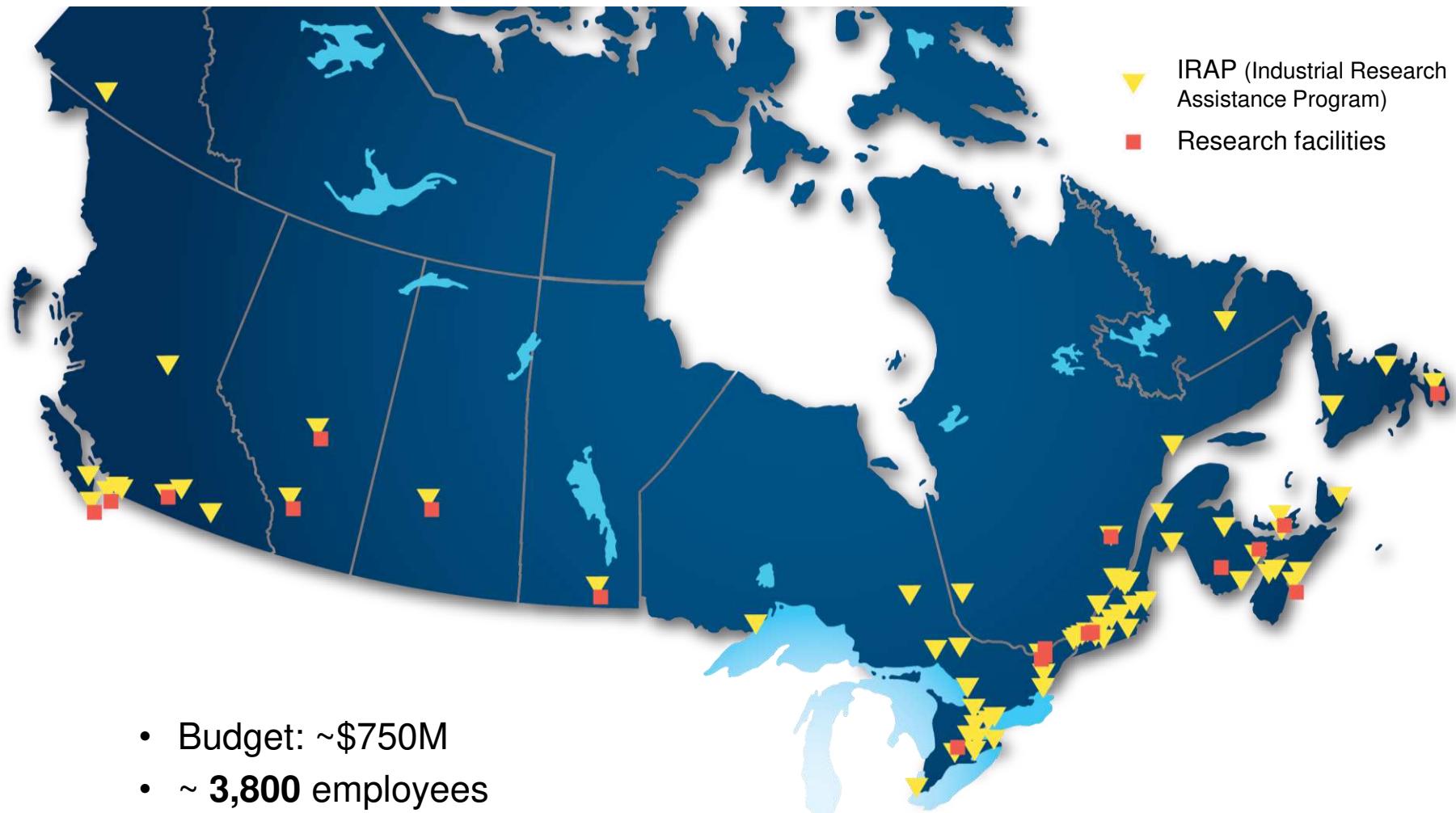




## Stemia's use of unique patent protected state-of-the-art mat forming line

- Flexibility of production allows the manufacture of a wide range of products from 150 – 8000 g/m<sup>2</sup>
- Patented addition system allows efficient in line treatment of fibres
- Production capacity is maintained across the product range
- Cost effective process
- The ability to utilise a wide range of input fibres in the length range 1 – 100 mm

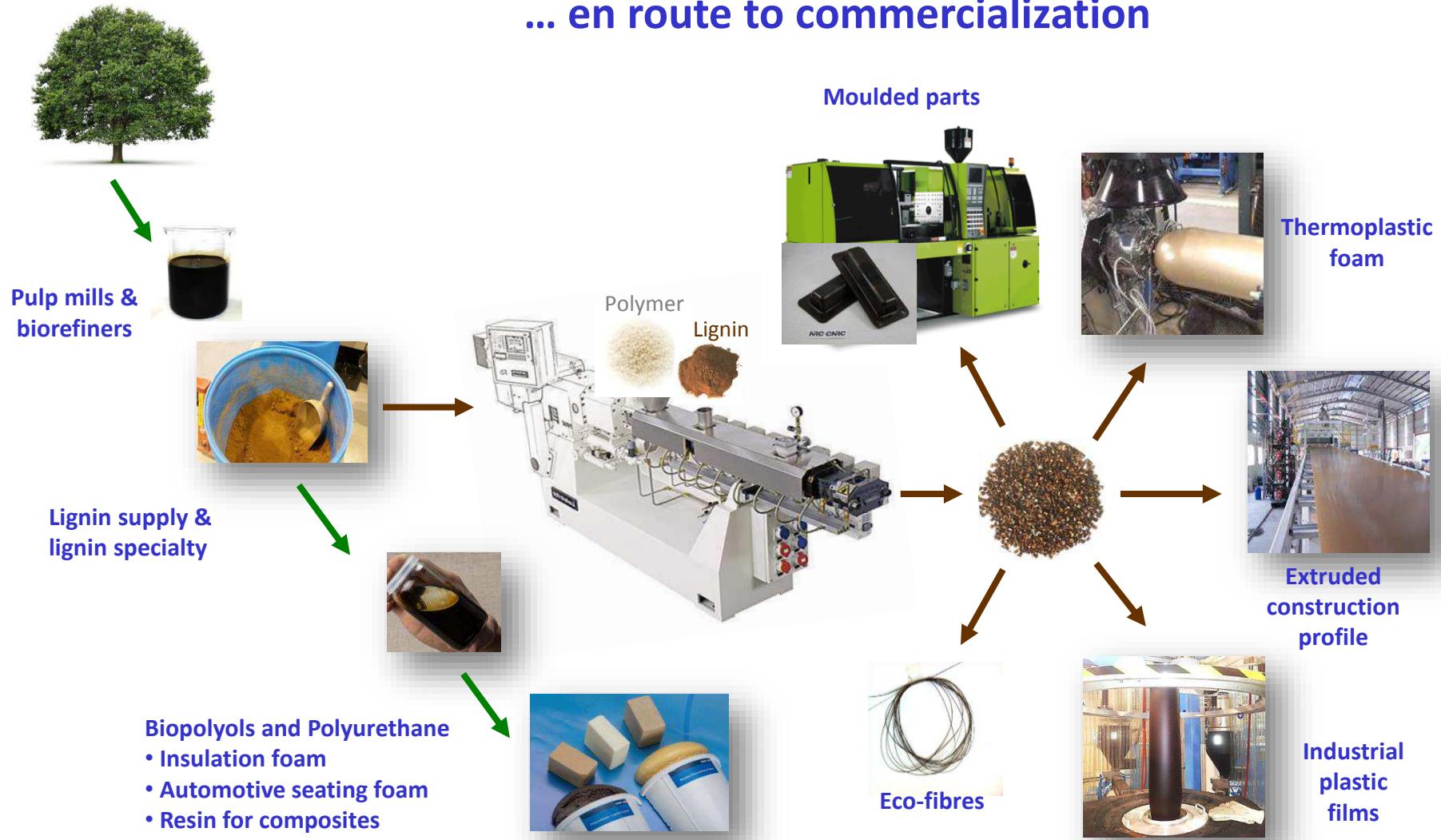
# NRC: R&T organization



- Budget: ~\$750M
- ~ **3,800** employees
- Wide variety of disciplines and broad array of services and assistance for industry

# Example of NRC's lignin technologies

... en route to commercialization





# Example of NRC's biocomposites technologies

...from short to long and continuous fibres, mats and fabrics



1- Green and low cost compounding and processing



Extruded panels



2- Lightweight advanced composites and cost-efficient biocomposites for automotive products



Magna-NRC Composites Centre of Excellence

Bio-based C-Pillar Cover

Formulation: NRC, Acknowledgements: CRIBE, Alberta Innovates Bio-Solutions, Magna

3- Fire resistant and hydrophobic fibres for high performance biocomposites



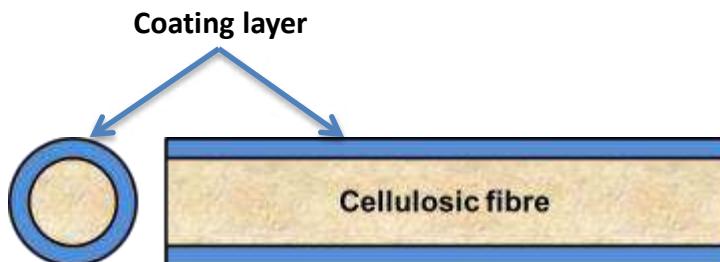
Self extinguished cellulosic fibre composites



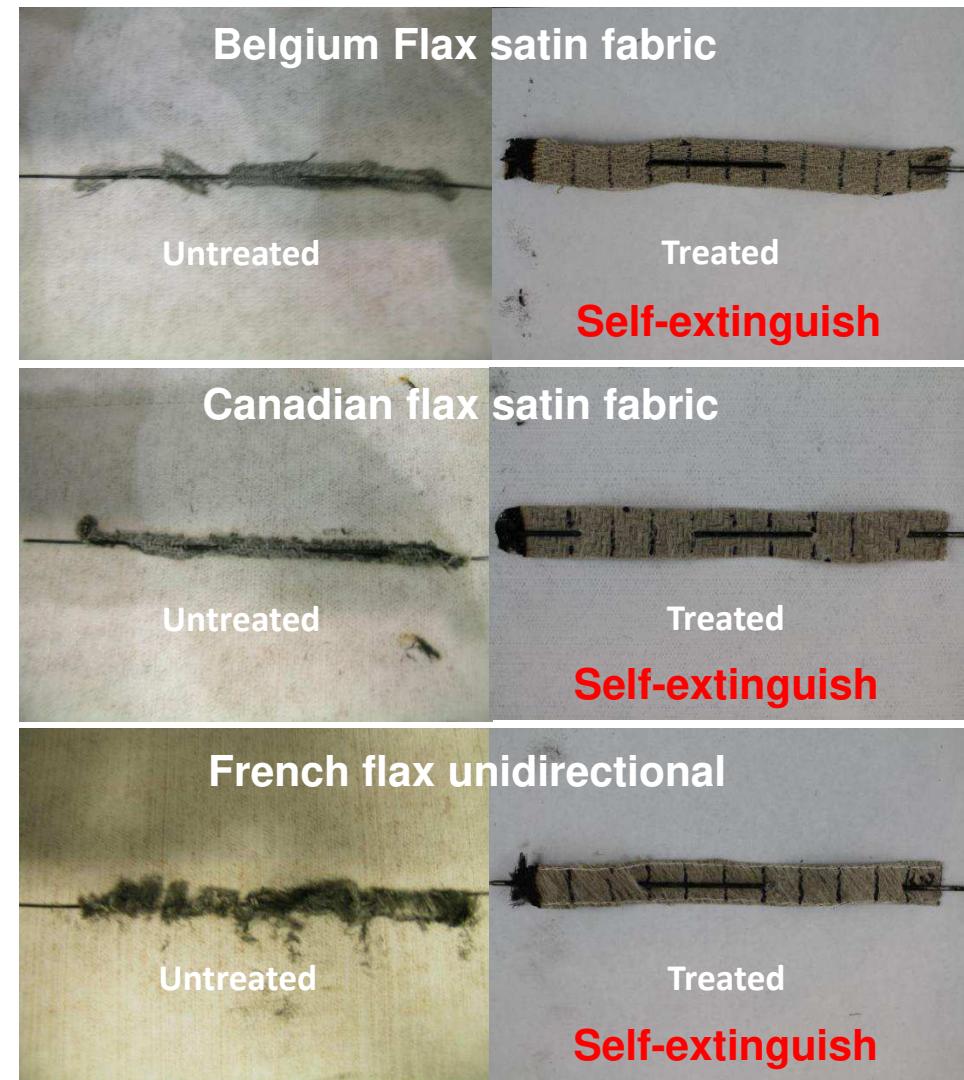


# NRC's technology: self extinguish cellulosic fibres

- Coating the cellulosic surface by a layer of inexpensive, non-toxic and non-halogenated compounds to protect cellulosic fibres from fire or from moisture without affecting the mechanical properties



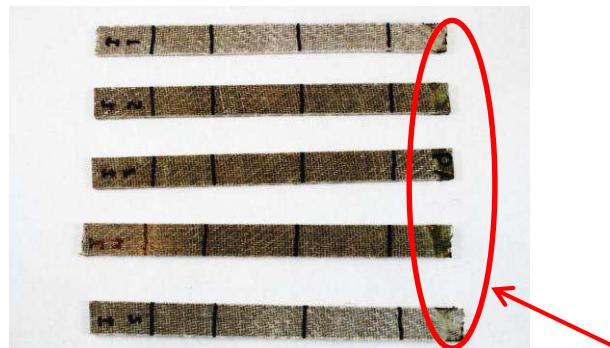
*NRC patent pending*  
PCT/CA2012/000631





# NRC's technology: self extinguish cellulosic fibres

Sample	Tensile stress (MPa)	Energy to break (J)
Epo-C2	117.7 ± 4.0	33.7±2.0
Epo-C2-34/P1	106.4 ± 1.0	36.7±2.6



UPE-flax fiber composite



PF-flax fiber composite



Ignition zone

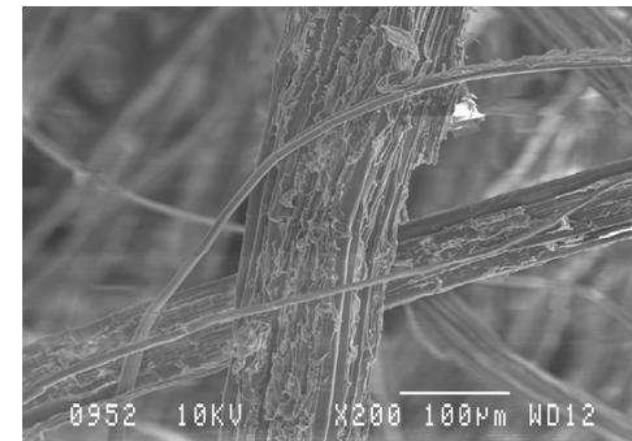
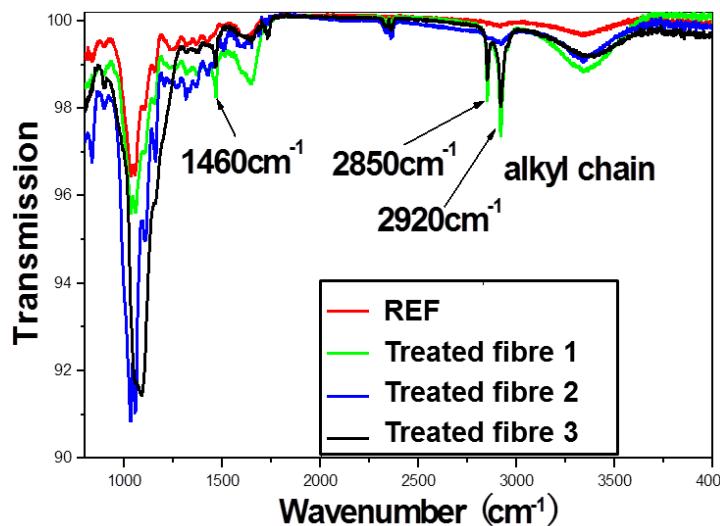


Epoxy-flax fiber composite



# NRC's technology: hydrophobic cellulosic fibres

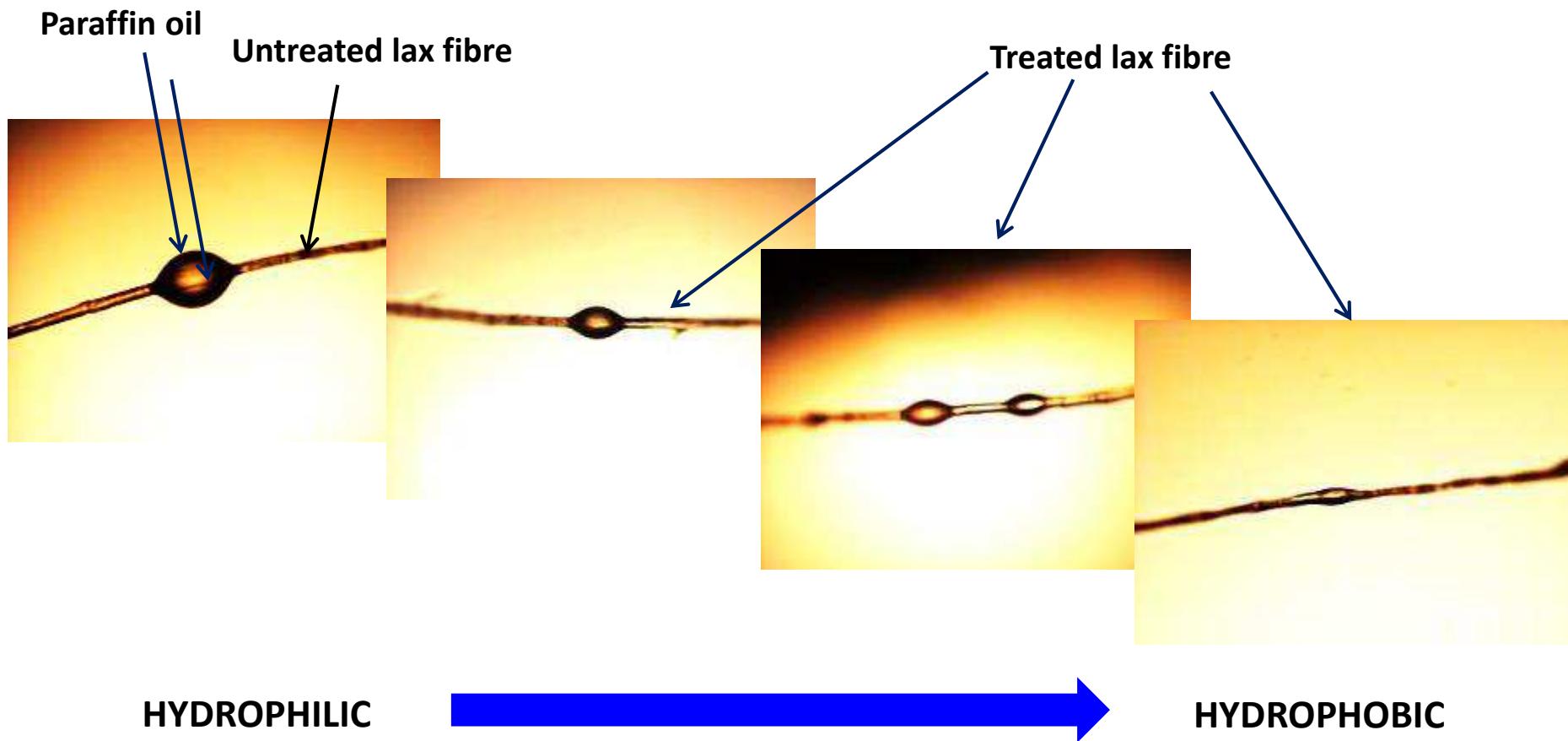
- Change the hydrophilic nature of natural fiber surface into hydrophobic using bio-based chemicals (fatty acid) for reducing moisture absorption



NRC invention



# NRC's technology: hydrophobic cellulosic fibres



*NRC invention*



# Preparation for commercialisation

- Open to collaborate with other companies who are biomass suppliers, resin and composite producers and end-users
  - Partnership can taken any time during the course of the project (2015-2018) and beyond
  - Different stages of product and application development: prototype, pilot scale, performance evaluation, technology transfer
  - Flexible business models: one-on-one or multipartners



# Thank you!

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