

Consortium de recherche sur les panneaux composites à base de bois





Developing innovative bioadhesives from undervalued byproducts obtained from industrial processes

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Corepan-Bois: A mission to sustainable biosolutions

The Consortium on wood composite panels (Corepan-Bois) is a partnership between industrial and academic professionals which aims to contribute to the production of innovative bio-based materials for the wood composite panels' industry. Research interests and goals include:

> Promoting the transition to sustainable and ecological biosolutions, with better environmental footprints.

- > Developing bioadhesives from natural waste byproducts arising from various industrial transformation processes across Canada.
- > Four areas of research on **bioadhesives including byproducts**: lignin, tannins, saccharides and proteins.

Adhesives currently used in the manufacture of wood composite panels include petrosourced like urea-formaldehyde (UF), of which the emitted gas can trigger irritations, allergies and cancers. With recent health and environmental regulations on hazardous substances, designing new processes for the reduction of formaldehyde emissions has become essential and one of the main focuses when designing new bio-based materials.

Project 1. Lignin

One of the most abundant components in the biomass's organic matter. As a byproduct, large amounts are available from wood transformation activities in paper industry.

Lignin is chemically modified to develop an adhesive resin by:

- > Converting kraft and hydroxymethylated lignins into nano-lignin particles.
- > Using nano-lignin to **crosslink industrial petroleum-based resins** (e.g. UF).



Main challenges related to adhesives from lignin are:



Found in industrial byproducts of the food industry, like dairy product transformation.

- > Dairy byproducts (e.g. lactose permeate) are a stable, saccharide-rich waste stream supply (~160Mt/year), offering a valuable source of raw materials.
- > Objective: formulating saccharide-based bioadhesives with improved water **resistance and durability** of the wood product.

Modifications of lactose include:

> Hydroxylated interaction of saccharides with crosslinking agents, like glyoxal, to generate a crosslinked adhesive resin.



> Poor reactivity of lignin specific groups to achieve efficient crosslinking.

Extracted Kraft lignin

Project 2. Tannins

Polyphenols are found in wood bark. Underexploited species like white spruce and black spruce are widely present in Quebec, so bark is a stable and valuable source obtained from tree sawing activities.

Two types of tannins can be used in the manufacturing process of bioadhesives from tannins:

- > Condensed tannins: make up the highest content in the adhesive blend of tannins
- > Hydrolysed tannins: added in little amounts.

Objective: optimising the extraction steps to yield higher recovery percentage from the barks.

Advantages: resistance to heat, and wet woods and fast curing during formulation.







l black spruce barks (top) and extracted ondensed and hydrolysed tannins (bottom)

Dehydrated lactose (disaccharide

Project 4. Proteins

Project 3. Saccharides

Contribute to many biological mechanisms in organic matter, like animal and plant sources obtained from industrial byproducts in Quebec (e.g. food processing).

- Resources providing a stable source of proteins are:
- Fish, crab and meat carcass's byproducts
- Coffee grounds
- > Contaminated crop products

Objective: selecting green chemical reactions, and methods for cutting the protein chains to modify proteins into nonviscous bioadhesives.

Advantages: food waste reduction, strong bonding to wood, resistance to shearing or elasticity.



ctracted protein (bottom

Impacts of Corepan-Bois's biosolutions

- > Bio-based adhesives opens up a new insight to non-toxic, low gas emitting products, thus meeting legislations and customer's expectations for environmentally friendly sustainable solutions.
- > Lignin, tannins, saccharides and proteins offer durable, accessible, sustainable and fossil fuel-independent solutions for designing innovative bio-based materials.
- > They will contribute to the reduction of undervalued byproducts, currently poorly exploited, and will promote the era of **bio-responsibility through** science, product manufacturing and consumption.



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