





# Low-density OSB. Pilot plant study and techno-economic analysis

<https://library.fpinnovations.ca/en/permalink/fpipub7709>

Author: Groves, C. Kevin  
MacFarlane, Alan  
Feng, Martin

Date: March 2020

Edition: 52986

Material Type: Research report

Physical Description: 30 p.

Sector: Wood Products

Field: Wood Manufacturing & Digitalization

Research Area: Advanced Wood Manufacturing

Subject: Testing  
Strandboards  
Oriented strandboard (OSB)  
Gluing  
Glue  
Pilot Plant  
Markets

Location: Vancouver, British Columbia

Language: English

Abstract: In this project, the main objective was to evaluate the “best bet” experimental mat structure design previously identified by FPInnovations in 2018/19. This mat structure was comprised of three strand size classes incorporated into six equal weight mat layers. Both experimental and control panels were prepared at 39lb/ft<sup>3</sup> and 35lb/ft<sup>3</sup> densities and tested for dry static bending, single cycle bending (D4), concentrated static load, thickness swell, and internal bond strength.

## Documents



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**Hybrid Profiled Decking  
Innovation Engine 2019-  
2020**

Hybrid Profiled Decking  
Innovation Engine 2019-  
2020

# Hybrid profiled decking innovation engine 2019 - 2020

<https://library.fpinnovations.ca/en/permalink/fpipub52926>

Author: Wong, Daniel  
Stirling, Rod

Date: March 2020

Material Type: Research report

Physical Description: 19 p.

Sector: Wood Products

Field: Wood Manufacturing & Digitalization

Research Area: Advanced Wood Manufacturing

Subject: Decking  
Preservatives  
Testing

Location: Vancouver, British Columbia

Language: English

Abstract: Decking markets in Canada lack options of hybrid designs and are generally limited to smooth 5/4" or 2x6" of either pressure treated wood, cedar, tropical hardwoods or wood plastic composites. Profiled decking has been unsuccessful in entering the Canadian market on a large scale even though globally it is more prevalent. This report looks to leverage FPInnovations' expertise to identify opportunities to improve the stability, durability, performance and competitiveness of wood decking by combining profiling and treatment with additional non-wood materials. This information will be used to develop prototypes of novel wood-based decking products that would suit the needs of Canadian consumers as well as maintaining or expanding the solid wood decking market for Canadian producers. Six hybrid decking models were conceptualized to address market concerns about wood decking.

## Documents



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Drying of balsam and subalpine fir: for a better



# understanding

<https://library.fpinnovations.ca/en/permalink/fpipub52906>

Author: Lavoie, Vincent  
Date: November 2019  
Material Type: Research report  
Physical Description: 4 p.  
Sector: Wood Products  
Field: Wood Manufacturing & Digitalization  
Research Area: Advanced Wood Manufacturing  
Subject: Air drying  
Balsam  
Drying  
Fir  
Logs  
Lumber  
Moisture content  
Performance  
Sawmills  
Subalpine fir  
Wet pockets  
Wood yards

Series Number: FPI WP 2019

Language: English

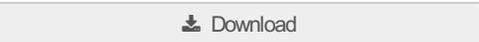
Abstract: The findings of recent studies from both eastern and western Canada have shown that the drying behaviour of subalpine fir (*A. lasiocarpa*) and balsam fir (*A. balsamea*) is similar, which allows common solutions to be applied based on research conducted on one species of fir or the other. This article summarizes previous research findings and good practices that can be adopted in the short term to improve the drying of fir.

## Documents



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# Séchage du sapin baumier et subalpin: pour une meilleur compréhension

<https://library.fpinnovations.ca/en/permalink/fpipub52907>

Author: Lavoie, Vincent  
Date: November 2019  
Material Type: Research report  
Physical Description: 4 p.  
Sector: Wood Products  
Field: Wood Manufacturing & Digitalization  
Research Area: Advanced Wood Manufacturing  
Subject: Air drying

Balsam  
Drying  
Fir  
Logs  
Lumber  
Moisture content  
Performance  
Sawmills  
Subalpine fir  
Wet pockets  
Wood yards

Series Number: FPI WP 2019

Language: French

Abstract: Des travaux récents tant dans l'est que dans l'ouest du Canada ont montré que le comportement au séchage du sapin subalpin (*A. lasiocarpa*) et du sapin baumier (*A. balsamea*) est similaire, ce qui permet une application de solutions communes à partir de travaux effectués sur l'une ou l'autre variété de sapin. Le présent document se veut une revue sommaire de résultats de travaux antérieurs et de bonnes pratiques pouvant être adoptées à court terme pour améliorer le séchage de cette essence.

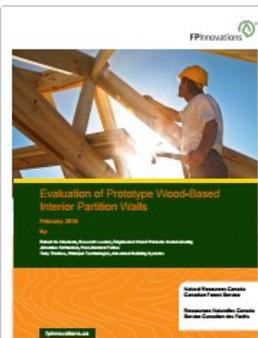
## Documents



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## Evaluation of prototype wood-based interior partition walls

<https://library.fpinnovations.ca/en/permalink/fpipub7508>

**Author:** Knudson, Robert M.  
Schneider, Johannes  
Thomas, Tony

**Contributor:** Natural Resources Canada. Canadian Forest Service

**Date:** February 2018

**Edition:** 49823

**Material Type:** Research report

**Physical Description:** 20 p.

**Sector:** Wood Products

**Field:** Wood Manufacturing & Digitalization

**Research Area:** Advanced Wood Manufacturing

**Subject:** Wood  
Walls  
Residential construction  
Prototypes  
Design

**Series Number:** Transformative Technology ; TT 2018

**Language:** English

**Abstract:** Interior partition walls for non-residential and high-rise residential construction are an US\$8 billion market opportunity in Canada and the United States (Crespell and Poon, 2014). They represent 1.6 billion ft<sup>2</sup> (150 million m<sup>2</sup>) of wall area where wood currently has less than 10% market share. To approach this market a new system would be needed to compete against the incumbent system (wood/steel stud plus gypsum). The system would need to have an installed cost before finishing of approximately US\$5 per ft<sup>2</sup> or lower. The system would also need to meet several code requirements for strength, sound transmission and fire resistance (flame spread and burn through). Crespell and Poon further concluded that to be truly transformative, the system would also need to address major trends impacting the building industry including reducing labor, reducing skilled labor, reducing onsite waste, reducing call-backs, and easily recyclable with low environmental impact. A likely market entry point for wood-based interior partition systems may be in taller and larger wood buildings.

Work described in this report investigated the fabrication, installation, acoustic and combustion properties of prototype interior partition wall designs.

Two types of non-structural prototype interior wall panels designated Type A and Type C were installed between two offices in the FPInnovations Vancouver laboratory. Wood sill plates for mounting the prototype panels were fastened to the concrete floor, sides and top of the opening between the two offices to produce a frame for mounting the test panels. Panels were fastened to the frame using dry wall screws. This same

method of installation is envisioned in practice. The installation method makes it easy and fast to both install and remove the wall panels.

Acoustic tests showed the difference in ASTC rating measured between a double wall composed of Type A and Type C prototype panels compared with a double wood stud wall with gypsum board faces was approximately 6 ASTC points. A 6 point difference would be clearly noticeable. Although the results of this study are largely qualitative, they suggest that the prototype interior partition panels would have an acoustic advantage compared to stud wall designs.

In a related study summarized in this report, the combustion properties of three prototype interior panel constructions, including Types A and C evaluated in this report, indicated that any of the three types of partition constructions could be used in combustible construction in accordance with Division B of the National Building Code of Canada.

A second related study, also summarized in this report, estimated an installed cost of US\$4.07 per ft<sup>2</sup> including overhead and profit for unfinished panel partitions comparable to panel construction Type C (gypsum/OSB/wood fibre insulation) as evaluated in this study. Thus, there would appear to be potential installed and finished cost advantages for the wood-based panel partitions compared to steel or wood stud walls with gypsum faces.

Other potential advantages of the prototype interior partition panels compared with the most common, currently-used systems (wood/steel stud plus gypsum) include ease and speed of installation, ease and speed of removal, design flexibility, prefabrication including pre-finishing, and easy installation of services.

Based on the positive results of these exploratory studies, further development of wood-based interior partition systems including design, fabrication, installation and in-service performance would appear justified. Knowledge of the products and testing methods developed in these studies would be expected to speed further development.

## Documents

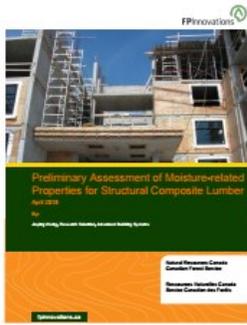
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# Preliminary assessment of moisture-related properties for structural composite lumber

<https://library.fpinnovations.ca/en/permalink/fpipub49831>

Author: Wang, Jieying  
Contributor: Natural Resources Canada. Canadian Forest Service  
Date: April 2018  
Material Type: Research report  
Physical Description: 37 p.  
Sector: Wood Products  
Field: Wood Manufacturing & Digitalization  
Research Area: Advanced Wood Manufacturing  
Subject: Wetting  
Drying  
Performance  
Water repellents

Series Number: Transformative Technology ; TT 2018  
Language: English  
Abstract: Fifteen structural composite lumber (SCL) products including laminated-veneer lumber (LVL), laminated strand lumber (LSL), oriented strand lumber (OSL), and parallel strand lumber (PSL) provided by Boise Cascade, LP, West Fraser, and Weyerhaeuser were tested for moisture-related properties in this study, also covering four reference materials: 16-mm Oriented Strand Board (OSB), 19-mm Canadian Softwood Plywood (plywood), 38-mm Douglas-fir and lodgepole pine solid wood. Water absorption, vapour permeance, vapour sorption, and dimensional stability were measured with limited replication by following relevant standards for a purpose of assisting in improving building design and construction, such as hygrothermal modelling of building envelope assemblies, design for vertical differential movement, and on-site moisture management.

## Documents

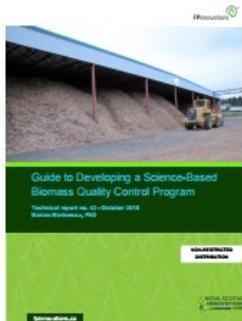
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# Guide to developing a science-based biomass quality control program

<https://library.fpinnovations.ca/en/permalink/fpipub52656>

Author: Marinescu, Marian  
Contributor: Nova Scotia Innovation Hub  
Date: October 2018  
Material Type: Guide  
Research report  
Physical Description: 26 p.  
Sector: Forest Operations  
Field: Wood Manufacturing & Digitalization  
Research Area: Advanced Wood Manufacturing  
Subject: Biomass  
Quality control  
Sampling  
FOP Technical Report  
FPITR  
Series Number: Technical Report ; TR 2018 n.42  
Language: English

Abstract: To support the implementation of biomass procurement practices, a formal, rigorous, consistent, science-based biomass quality control (QC) program is needed. This program should be designed to determine customer needs, the sources of product variation, and ways of eliminating or minimizing product variation as soon as it occurs. The program should also include a well-designed QC plan and sampling protocol, statistical process control methodologies and tools, formal QC teams, and regular training.

This report describes various statistical QC tools and demonstrates those using examples of biomass moisture content data. These tools can be developed in-house or be purchased, but their integration with existing databases (e.g., LIMS) is recommended. FPInnovations experts can assist in developing customized QC programs for companies and for specific biomass products, and can train QC teams to develop and use the tools presented here.

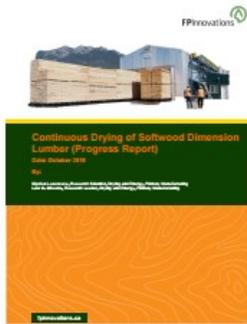
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## Documents



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## Continuous drying of softwood dimension lumber (progress report)

<https://library.fpinnovations.ca/en/permalink/fpipub52785>

Author: Lazarescu, Ciprian  
Oliveira, Luiz C.

Date: October 2018

Material Type: Research report

Physical Description: 22 p.

Sector: Wood Products

Field: Wood Manufacturing & Digitalization

Research Area: Advanced Wood Manufacturing

Subject: Drying  
Lumber  
Softwoods  
Testing  
Simulation

Location: Vancouver, British Columbia

Language: English

Abstract:

Continuous drying is still in its relatively early stages and mills are currently dealing with process adjustments to obtain desired throughput and quality of the final product. Field measurement carried out in 2015-16 illustrated a number of opportunities for process optimization involving each of the three main stages of current continuous kilns. Simulations of industrial continuous drying at laboratory level performed in 2016-17 were successful and allowed the evaluation of each of the drying stages to be fully characterized (lumber temperatures, drying schedule conditions of dry and wet bulb temperatures). Thus, different drying schedules provided an excellent opportunity to examine the impact of schedule conditions on drying defects, drying rates and kiln residence times.

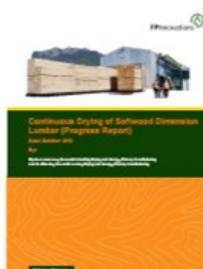
The main objectives of the project for 2017-18 were to simulate continuous drying in laboratory conditions for different products, products mix, species and green sort groups. In addition, a detailed evaluation of potential technologies was carried out to explore the concept of dynamically adjusting speed (push rates), based on drying rates and moisture content.

Piecewise regression was used to identify the optimum push rate and suggest design modifications of continuous kilns. This method proved to be efficient in identifying potential reductions in drying time for different sorts of spruce/pine (SP) lumber without compromising the quality of the final product. Simulations also allowed identifying the push rate of 2 feet/h to satisfactorily dry green hem-fir 2-inch lumber.

Initial tests showed that mid-sort sub-alpine (moisture content below approximately 70%) could not be mixed with wet sort SP in a continuous kiln operating at push rate of 4.2 feet/hr because only 73% of the sub-alpine sort dried below 21%. Decreases in push rate will reduce the percentage of sub-alpine fir wets but will also increase the amount of over-dried lumber. Changes in kiln configuration may reduce the drying time but increase the percentage of over-dried lumber.

The results indicated that additional laboratory tests are required to develop drying schedules and temperature profiles in the main drying zone of continuous kilns, drying times and final moisture content distribution.

Documents



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## Phytosanitary issues, relevant codes, standard work and research in 2016/2017

<https://library.fpinnovations.ca/en/permalink/fpipub49452>

Author: Uzunovic, Adnan  
Contributor: Canadian Forest Service  
Date: April 2017  
Material Type: Research report  
Physical Description: 29 p.  
Sector: Wood Products  
Field: Wood Manufacturing & Digitalization  
Research Area: Advanced Wood Manufacturing  
Subject: Standards  
Research  
Canada  
Specification  
Regulations

Language: English

Abstract: This report covers our involvement in phytosanitary-related issues and research in the financial year 2016/17. It addresses actions planned in the 2016/17 project statement of the CFS-funded project entitled: Phytosanitary Measures and deliverables for Codes and Standards work related to phytosanitary issues. It captures our ongoing engagement with CFS, CFIA, and industry, and participation in the key phytosanitary forums including the International Forestry Quarantine Research Group (IFQRG) and the Canadian Forest Phytosanitary Working Group (CFPWG) as these two forums provide guidance to our research in the area.

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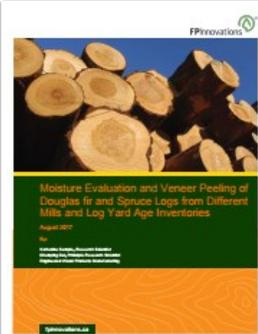
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## Moisture evaluation and veneer peeling of douglas fir and spruce logs from different mills and log yard age inventories

<https://library.fpinnovations.ca/en/permalink/fpipub49466>

Author: Semple, Katherine  
Dai, Chunping

Date: August 2017

Material Type: Research report

Physical Description: 69 p.

Sector: Wood Products

Field: Wood Manufacturing & Digitalization

Research Area: Advanced Wood Manufacturing

Subject: Moisture content  
Veneer  
Fir  
Spruce  
Storing

Language: English

Abstract:

A total of 48 peeler blocks and 256 mini-billets were sampled from mills to investigate the effects of yard storage time, and artificial yard drying and sprinkling on residual moisture contents (MCs) and veneer quality. MC in fresh and stored log inventories varied greatly across mills according to geographic location of their wood supply zones, bark damage and loss, and storage time and conditions. The main findings were as follows:

1. DF logs supplied by three BC mills from the Cariboo, Thompson Okanagan, or Kootenay regions were highly variable in wood MC.
2. Winter-cut DF logs with high sapwood MC stored had good bark retention and high moisture retention over 6 and 9 winter-spring months. No effects on veneer peeling roughness from longer-term winter storage up to 9 months.
3. Summer-cut logs had little or no residual bark, or the bark slipped off very easily during debarking. Exposed, bark-free summer-cut logs can dry and crack on edges and ends very quickly, within a few weeks.
4. A marked decline in veneer quality with piling time in Summer for spruce and DF, suggesting an optimum window of processing of such exposed logs of about two weeks. Veneer quality and recovery suffered markedly once the logs had fully air dried mainly because of edge splits creating natural fragmentation of the ribbon.
5. Mills receiving dry-zone logs with much lower MC have a very limited storage window, especially over winter. As little as 2-3 weeks if bark is damaged or missing.
6. Veneer quality could not be definitively tied to log residual MC. Under the controlled laboratory conditions used here it was observed that peeling quality could still be good at low sapwood MC (35-40%) and or very high (MC>100%). Whether this is still the case in mill production is unknown.
7. Logs must never be allowed to fall below FSP and develop edge-checks or deep end checks.
8. Wax emulsion end sealants were effective at hampering drying and end checking on high MC logs, but not effective on low MC logs.
9. Sprinkling retained log freshness and peel quality in high MC DF for several months and prevented log drying and end splitting as well as inner log staining. Ends absorbed considerable extra moisture. Some variability in peel quality was noted.
10. The prototype EM1000 Ground Penetrating Radar could only be reliably used in log edge mode in DF. The unit would also require re-calibration for the very high sapwood MC in spruce and wet-zone DF logs.

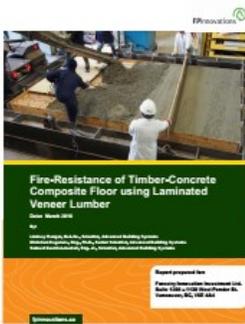
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## Fire-resistance of timber-concrete composite floor using laminated veneer lumber

<https://library.fpinnovations.ca/en/permalink/fpipub40133>

Author: Ranger, Lindsay  
Dagenais, Christian  
Cuerrier-Auclair, Samuel

Contributor: Forestry Innovation Investment

Date: April 2016

Material Type: Research report

Physical Description: 28 p.

Sector: Wood Products

Field: Wood Manufacturing & Digitalization

Research Area: Advanced Wood Manufacturing

Subject: Fire  
Resistance  
Structural composites  
Wood  
Concrete  
Laminate product  
Veneer  
Floors

Series Number: E-4960

Location: Québec, Québec

Language: English

Abstract: There is a need to demonstrate how novel timber-concrete composite floors can span long distances and be a practical alternative to other traditional structural systems. Better understanding of the fire behaviour of these hybrid systems is essential. To achieve this, the fire-resistance of a timber-concrete composite floor assembly, using BC wood products, will be evaluated in accordance with CAN/ULC-S101 [2]. A 2 hr fire resistance rating will be targeted, as this is the current requirement in high-rise buildings for floor separations between occupancies. The structural behaviour of this type of system will also be assessed from conducting pull-out tests of the shear connectors. In conjunction with previous test data, the results of this test will be used to develop an analytical model to assess the structural and fire-resistance of timber-concrete composite floors. 301010618

### Documents

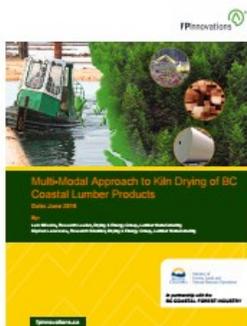
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## Multi-modal approach to kiln drying of BC coastal lumber products

<https://library.fpinnovations.ca/en/permalink/fpipub52669>

Author: Oliveira, Luiz C.  
Lazarescu, Ciprian

Contributor: BC Coastal Forest Industry

Date: June 2016

Material Type: Research report

Physical Description: 31 p.

Sector: Wood Products

Field: Wood Manufacturing & Digitalization

Research Area: Advanced Wood Manufacturing

Subject: Drying  
Lumber  
Kilns  
Productivity  
Costs

Location: Vancouver, British Columbia

Language: English

Abstract:

BC Coastal mills will need to diversify the drying technologies currently used and consider new approaches in order to improve productivity, reduce drying costs, regain competitiveness and continue to play a significant role in the increasingly stringent quality market for forest products. New demands for drying are related to energy efficiency, low environmental impact and of course, quality of the final product. The specific objectives of the project were: (1) to improve the conventional drying of 4.5" x 4.5" Douglas-fir lumber, (2) to evaluate the superheated steam/vacuum (SS/V) drying of 4.5" x 4.5" Douglas-fir lumber, (3) to develop a green sorting strategy for hem-fir lumber and (4) to determine the time required to reach 56°C in the core of 5¼ x 5¼ lumber using the requirements of CFIA PI-07 Heat Treatment schedule Option D - Generic Phytosanitary Heat Treatment Schedule, Heat Treatment with Moisture Reduction.

The results showed that the drying time in conventional drying of 4.5" x 4.5" Douglas-fir lumber can be reduced by up to 25% without compromising the quality of the lumber. This can be achieved by increasing the temperature in the final drying stages and using lower relative humidity at the beginning of the drying process. In addition, final moisture content (MC) variation was reduced from 6.2% to 3.9%. Reductions of drying times from 26% to 41% were observed when drying 4.5" x 4.5" Douglas-fir under SS/V drying. Quality of the lumber at the end of drying was better when compared to the quality of the lumber at the end of conventional drying. In addition, specimens exhibited less final MC variation.

Based on drying rate measurements of green hem-fir lumber dried to 9.0% MC, a new database was developed which in turn was incorporated into OASiS 2.0 software to evaluate different pre-sorting scenarios. Pre-sorting simulations allow end users to estimate the impact of kiln productivity, final MC distribution and drying degrade. The results showed that different correlations between the time to reach 19.0% MC and initial weight or initial MC could be established. The best correlation with an R square of 0.77 was made between initial weight and MC. After performing several simulations with the new database an optimum cut-off point of 65% yielded the best results in terms of potential increase of productivity and quality of the final product.

Wood heating rate test results showed that CFIA Option D may be extended for 5¼ x 5¼ lumber as long as the dry-bulb = 71°C (= 160°F) for 36 hours at the end of the heat treatment. Total heat treatment time required, including the time required to reach 71°C (160°F), is 72 hours.

Documents

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## Le contrôle des moisissures avant et après séchage

<https://library.fpinnovations.ca/en/permalink/fpipub49652>

Author: Gignac, Manon  
Date: 2016  
Material Type: Research report  
Physical Description: 36 p.  
Sector: Wood Products  
Field: Wood Manufacturing & Digitalization  
Research Area: Advanced Wood Manufacturing  
Subject: Fungi  
Wood  
Wood fungi  
Forestry  
Drying  
Prevention

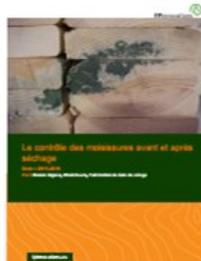
Location: Québec, Québec

Language: French

Abstract: Pour différentes raisons, les moisissures représentent un défi constant lors de la production de bois résineux et feuillus : santé, environnement, qualité et stratégies de production. Elles sont aussi une préoccupation constante pour les consommateurs et à l'origine de réclamations qui peuvent être très coûteuses pour les producteurs. Un sondage en 2014 dans l'Est du Canada révélait qu'en moyenne les coûts annuels liés à la détérioration biologique étaient de 60 000 \$ par usine. Dans le cas d'une usine intégrée, spécialisée en transformation primaire et secondaire de feuillus et résineux, ces coûts avaient atteint près de 475 000 \$ pour cette même année. Ces coûts sont liés à un ensemble de facteurs : modification du procédé, perte de productivité, réclamations, pertes de ventes (Gignac, 2015).

Plusieurs facteurs peuvent contribuer au développement de moisissures dont la teneur en humidité du bois, les conditions climatiques et la durabilité naturelle propre à l'essence de bois. Avec les années, FPInnovations a acquis beaucoup de connaissances, accumulé beaucoup d'information, de données et de savoir-faire à travers ses projets de recherche et son soutien technique à l'industrie. En combinaison avec d'autres données disponibles dans la communauté scientifique, nous proposons de résumer l'information pertinente pour l'industrie et de la présenter sous forme de document de vulgarisation. Ce document se veut un outil simple et pratique pour le personnel de l'industrie de la transformation du bois afin de les soutenir dans la prise de décision concernant les stratégies d'entreposage, de séchage à l'air, séchage au séchoir, gestion du bois sec et transport jusqu'à sa destination finale, le consommateur. Ce document de référence regroupe les connaissances générales en lien avec les problématiques de moisissures.

Documents



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## Development of bio-modified of chitosan-based adhesives for wood composites

<https://library.fpinnovations.ca/en/permalink/fpipub5798>

Author: Wang, Xiang-Ming

Yang, D.-Q.

Zhang, Yaolin

Feng, Martin

Huang, Z.

He, G.

Date: February 2016

Edition: 40114

Material Type: Research report

Physical Description: 36 p.

Sector: Wood Products

Field: Wood Manufacturing & Digitalization

Research Area: Advanced Wood Manufacturing

Subject: Adhesives

Environment

Wood composites

Series Number: Transformative Technologies - Development of "Green" Wood Adhesives for Wood Composite Products

Project no.301006168

E-4956

Location: Québec, Québec

Language: English

Abstract:

Chitosan is an amino polysaccharide obtained from the deacetylation of chitin, which is naturally occurring in the shells of a large number of marine crustaceans. Chitosan is soluble in weakly acidic aqueous solutions and possesses adhesive properties. Chitosan has received much attention for medical and industrial applications; however, only limited studies have been conducted on the application of chitosan as a wood adhesive, because its bonding properties on wood are poor. To improve the adhesive quality of chitosan resin, an innovative study on chitosan adhesives has been conducted to use selected fungal species to modify chitosan and improve its bonding properties, to synthesize non-formaldehyde resins with the fungus-modified chitosan, and to enhance urea-formaldehyde (UF) and phenol-formaldehyde (PF) resin performance with the fungus-modified chitosan.

The bonding properties of wood composites made with these chitosan-based green wood adhesives were significantly improved, in terms of lap-shear strength. Unmodified chitosan solution was not compatible with ammonium lignosulfonate, liquid PF resin, soybean resin, powder PF resin, or soybean flour, but was compatible with UF resin, polyvinyl acetate (PVA) resin, and phenol. With the addition of chitosan in UF and PVA resins, both the dry and wet shear strengths of plywood panels were improved, compared with those of panels bonded with the control UF and PVA resins, i.e. without chitosan. A number of chitosan and chitosan-reinforced UF resins were prepared as a binder for particleboard panel manufacturing. Six (6) types of particleboard panels with different levels of resin loadings and press conditions were manufactured. The resulting boards were tested to evaluate the bond quality of the chitosan and chitosan-reinforced UF resins. The test results showed that particleboard panels with good visual quality could be produced with all formulations of chitosan-UF adhesives, even with resin systems made with 1% of chitosan resin only. All chitosan resins used alone or added to UF resins yielded panels with better internal bond (IB) strength than those made with the UF control resin. The panels made with 1% chitosan resin plus 66% UF resin in a 1:1 ratio yielded panels with the highest IB strength and the best overall mechanical properties.

Documents

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# Évaluation de nouvelles approches pour réduire la courbure des rangs du haut des chargements de séchoirs

<https://library.fpinnovations.ca/en/permalink/fpipub5808>

Author: Savard, Marc  
Gignac, Manon  
Labrecque, Guy

Date: March 2016

Edition: 40213

Material Type: Research report

Physical Description: 16 p.

Sector: Wood Products

Field: Wood Manufacturing & Digitalization

Research Area: Advanced Wood Manufacturing

Subject: Lumber drying  
Kilns  
Lumber defects

Series Number: 301010408  
E-4978

Location: Québec, Québec

Language: French

Abstract:

Des pièces de bois sont régulièrement rejetées à l'entrée de la raboteuse en raison de courbures excessives. Elles proviennent en majorité des rangs du haut des chargements de séchoirs. À cet endroit, les pièces ne sont pas contraintes, et les conditions de séchage sont souvent plus sévères. Dans une étude antérieure de Forintek Canada Corp., Garrahan (1997) a démontré l'impact du poids de chacune des rangées sur le déclassement du bois en fonction de la hauteur du chargement. La figure 1 montre que les pertes en valeur diminuent du haut du chargement jusqu'au bas. Le poids exercé par les rangées supérieures est de plus en plus important et permet de contraindre le bois en place en cours de séchage.

## Documents



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# Développement d'un prototype industriel de reséchage par haute fréquence en continu

<https://library.fpinnovations.ca/en/permalink/fpipub5818>

**Author:** Lavoie, Vincent  
Tanguay, F.  
Kendall, J.

**Date:** April 2016

**Edition:** 40274

**Material Type:** Research report

**Physical Description:** 23 p.

**Sector:** Wood Products

**Field:** Wood Manufacturing & Digitalization

**Research Area:** Advanced Wood Manufacturing

**Subject:** Drying  
Kilns  
Seasoning high frequency

**Series Number:** E-4981

**Location:** Québec, Québec

**Language:** French

**Abstract:** La technologie de séchage par haute fréquence en continu développée par FPInnovations et Hydro-Québec a récemment été démontrée à l'échelle semi-industrielle (précommerciale) (Lavoie et al. 2015). Les essais de séchage ont porté principalement sur des applications de produits à valeur ajoutée. La technologie est viable techniquement et peut répondre à des besoins de séchage de précision pour des applications spécifiques. La technologie a également le potentiel de resécher des pièces demeurées humides (volontairement ou involontairement) lors de la production de bois d'œuvre.

## Documents

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# Dynamic properties of tall mass timber buildings under wind-induced vibration

<https://library.fpinnovations.ca/en/permalink/fpipub53027>

**Author:** Cuerrier-Auclair, Samuel  
**Contributor:** Forestry Innovation Investment  
**Date:** April 2016  
**Material Type:** Research report  
**Physical Description:** 2 p.  
**Sector:** Wood Products  
**Field:** Wood Manufacturing & Digitalization  
**Research Area:** Advanced Wood Manufacturing  
**Subject:** Structural composites  
Wood  
Laminate product  
Veneer  
Floors  
**Series Number:** E-4960  
**Location:** Québec, Québec  
**Language:** English  
**Abstract:** FPInnovations launched a multi-year research project to measure mid- to high-rise wood buildings' natural frequencies and damping ratios to expand the database and validate or adapt the existing equations to estimate the natural frequencies. Two high-rise wood buildings equipped with an anemometer and accelerometers are also being constantly monitored to study how the wind excites the building.

## Documents



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# Performance of borate-treated glulam and LVL after eight years in an accelerated above-ground field test

<https://library.fpinnovations.ca/en/permalink/fpipub40029>

Author: Ingram, Janet K.  
Morris, Paul I.

Contributor: Natural Resources Canada. Canadian Forest Service

Date: June 2015

Material Type: Research report

Physical Description: 58 p.

Sector: Wood Products

Field: Wood Manufacturing & Digitalization

Research Area: Advanced Wood Manufacturing

Subject: Composites  
Laminate product  
Preservatives  
Preservatives boron

Series Number: Field Performance of Durable Wood Products

Language: English

Abstract: Glulam and laminated veneer lumber protected by a combination of treatment with borate by two processes, and a film-forming coating, were exposed outdoors in an above-ground field test using a modified post and rail test design. After eight years' exposure, early to moderate decay was found in untreated test units, while those which were borate-treated by either method were generally sound up to six years and showed greatly reduced decay at eight years.

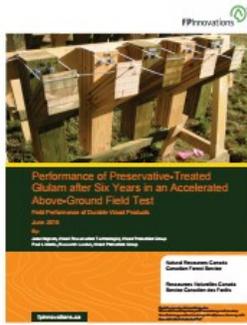
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# Performance of preservative-treated glulam after six years in an accelerated above-ground field test

<https://library.fpinnovations.ca/en/permalink/fpipub40036>

Author: Ingram, Janet K.  
Morris, Paul I.

Contributor: Natural Resources Canada. Canadian Forest Service

Date: June 2015

Material Type: Research report

Physical Description: 23 p.

Sector: Wood Products

Field: Wood Manufacturing & Digitalization

Research Area: Advanced Wood Manufacturing

Subject: Composites  
Laminate product  
Preservatives tests

Series Number: W3214

Language: English

Abstract: Glulam manufactured from laminating stock of three species pre-treated with ACQ-D or CA was exposed outdoors in an above-ground field test using a modified post and rail test design. After six years' exposure, early to moderate decay was found in untreated test units, while those which were preservative-treated were completely sound.

## Documents

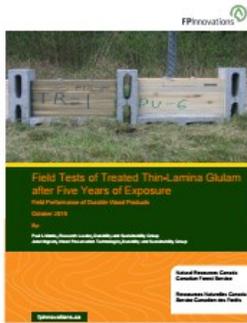
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# Field tests of treated thin-lamina glulam after five years of exposure

<https://library.fpinnovations.ca/en/permalink/fpipub40062>

**Author:** Morris, Paul I.  
Ingram, Janet K.

**Contributor:** Natural Resources Canada. Canadian Forest Service

**Date:** October 2015

**Material Type:** Research report

**Physical Description:** 21 p.

**Sector:** Wood Products

**Field:** Wood Manufacturing & Digitalization

**Research Area:** Advanced Wood Manufacturing

**Subject:** Composites  
Laminate product  
Preservatives tests

**Series Number:** Field Performance of Durable Wood Products  
W3260

**Language:** English

**Abstract:** Field tests of untreated and preservative-treated glulam beams in outdoor exposure, in ground contact and above ground, were inspected for decay after five years. Copper azole and ACQ-D-treated material was in excellent condition, while moderate to severe decay was present in untreated non-durable material. Early stages of decay were also noted in yellow cedar glulam in the above-ground test. Using galvanized rather than stainless steel fasteners appeared to have a protective effect against decay in untreated material, supporting the hypothesis that zinc from the sacrificial coating on galvanized bolts inhibits germination of basidiospores.

## Documents

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