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The Edge

Slash microsite treatments on south-facing slopes in the Rocky Mountain Foothills of Alberta evaluated

In the summer of 2015, FPInnovations completed a silviculture study as part of a larger project in the Rocky Mountain Foothills of Alberta. The project included concurrent FPInnovations trials that evaluated the fuel efficiency of ground-based harvesting and forestry equipment working on steep slopes.

Chinook winds in this region cause up to 30 per cent tree seedling mortality from winter desiccation on exposed south-facing slopes. Slash was returned to the cutover to provide the planted seedlings protection from exposure. The cost and effectiveness of the slash return techniques, and the impact of slash return on site preparation treatment in terms of achieving a desired density of plantable spots, were evaluated in five different treatments. Generally, returning slash to the cutover is a cost-effective treatment, especially if it increases seedling survival and reduces future fill-planting costs.

The cost of a "hot logging" harvesting treatment that used two processors working together with one skidder was lower than a standard separate-phase harvesting treatment, as long as there were no lengthy unplanned breakdowns or delays. Post-treatment measurements showed that all five treatments provided at least twice the density of slash microsites required to meet minimum stand density objectives. Future research is needed to determine which slash microsites become occupied (natural or planted) and which slash microsites are effective at protecting seedlings from winter desiccation.

For more information, please contact Grant Nishio, Researcher of the Silvicultural Operations department, at grant.nishio@fpinnovations.ca.

Unmanned aerial vehicles (UAVs) to help design and construct steep-slope resource roads

In coastal British Columbia, 56 per cent of harvestable timber volume is located on slopes greater than 35 per cent, and forest companies are increasingly turning to this challenging source of fibre as the more easily accessed timber near valley bottoms is exhausted. As part of its Steep Slopes Initiative, FPInnovations is looking for new approaches and technologies to improve timber harvesting safety and efficiency on steep slopes, while reducing environmental impacts.

To improve accessibility to this resource, FPInnovations' Resource Roads group recently initiated a project aimed at developing practices for steep road design and construction. As part of this project, the group filmed several logging trucks navigating steep switchbacks and road sections from directly overhead using FPInnovations' DJI Inspire 1 unmanned aerial vehicle (UAV). The footage was synchronized with cameras attached to the logging truck; the cameras looked backwards from the truck cab at the trailer, and from the rear

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trailer tires looking forward towards the truck cab. Documenting typical travel paths and actual off-tracking of vehicles will help designers improve geometric designs for various truck configurations and terrain conditions. True travel paths used by different drivers can be compared with design models and help improve and calibrate these predictive models, thus improving overall safety.

FPInnovations also used the UAV to survey several sections of steep road by flying it in a grid pattern at a constant elevation, and taking photos at regular intervals with the camera angled straight down. The data were then used to create a 3D point cloud similar to what could be obtained from LiDAR data. This form of surveying takes considerably less time than conventional surveying, and has a broad range of applications such as auditing road construction progress in real time, conducting as-built surveys, or surveying felled road right-of-ways before road construction occurs. This information can help land managers update plans or identify previously undiscovered environmental concerns.

This project showcases some of the interesting technology FPInnovations is using, and innovative applications for using UAVs in forest operations.

For more information on this project, please contact Alex Forrester, Scientist in the Resource Roads group, at alex.forrester@fpinnovations.ca.

Demonstration buildings validate potential of multifunctional panels

Changes made to energy efficiency requirements in Canada and the U.S. may dramatically affect the wood panel sheathing market.

When work on multifunctional panels was initiated, APA—The Engineered Wood Association, estimated that an eventual substitution of oriented strandboard (OSB) and plywood sheathing by non-wood products could result in a 20 per cent loss of market share, or one billion square feet.

Multifunctional panels were developed in response to the increasingly strict energy efficiency standards for buildings, and to make it possible to simultaneously achieve energy efficiency and structural performance objectives. The panels consist of two thin OSB or plywood panels laminated to a rigid wood fibre or foam insulation core. Developed in collaboration with numerous partners and stakeholders, the multi-functional panels have been subjected to thorough property characterization to gain acceptance by the construction community, and ensure their long-term performance.

Two demonstration buildings have been erected, making it possible to evaluate the panels' performance in real situations, in the humid coastal climate of Vancouver and the cold climate of Edmonton. The 7.62 m x 3.66 m demonstration buildings are sheathed with FPInnovations' new multifunctional panels. These buildings were constructed to demonstrate the in-service performance of the product and may be viewed by members visiting

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FPInnovations in Vancouver or Alberta Innovates-Technology Futures in Edmonton.

These panels promise to offer a lower-cost alternative for the construction industry. Based on cost analysis findings, multifunctional panels offer 6–7 per cent savings compared to the other solutions, to achieve the same insulation values. Construction time would also be reduced by more than one-half day per building, while delivering performance equal or superior to traditional OSB sheathing panels.

For more information on multifunctional panels or to plan a visit to one of the demonstration buildings, please contact Bob Knudson, Research Leader, Engineered Wood Products Manufacturing and Product Development at FPInnovations, at ... bob.knudson@fpinnovations.ca.

AI Bio supports commercial lignin production and downstream research

BY TONY KRYZANOWSKI

Forest company West Fraser Timber has set out to show that lignin can be economically recovered in high volumes from wood fibre and transformed into a valuable and sustainable bioproduct. The company has opened a new lignin recovery plant at its pulp mill in Hinton, Alberta. It is the first commercial-scale facility of its kind in Canada.

Also seeing the potential in lignin, Alberta Innovates Bio Solutions (AI Bio) contributed $3 million to the project's total cost of $30 million. Currently in start-up mode, West Fraser hopes to begin commercial lignin recovery by summer.

"Some of AI Bio's roles are to help strengthen the forest sector and to accelerate growth of the Alberta bioeconomy," says Steve Price, AI Bio's chief executive officer. "We believe that having this innovative facility in the province, which can successfully recover lignin for commercial use, is a significant step forward."

Lignin is one of the most abundant polymers on the planet. It gives trees their strength. One of its properties is its ability to work as an effective, benign adhesive substitute in the production of panel products such as plywood, oriented strandboard (OSB), and laminated veneer lumber (LVL), as well as a binder for wood pellets.

West Fraser says it was motivated to make the lignin recovery plant investment because it has a potential in-house use for the product, considering it operates three plywood plants and an LVL plant. The company has also been working with FPInnovations, Alberta Innovates Technology Futures (AITF), and chemical company Hexion to develop resin formulations that maximize lignin use while meeting or exceeding West Fraser's performance standards as a panelboard adhesive. So far, they have.

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"Our intent was to develop a novel bioproduct as well as add value and diversify our products from our Hinton pulp mill," says Rod Albers, West Fraser's Manager of Energy and Bioproduct Development. "We thought that the opportunity for lignin with our integration with plywood really posed a significant advantage to West Fraser, in terms of being able to develop a lignin-based bioproduct."

West Fraser could also see its potential in the manufacture of other bio-based products, such as packaging, carbon black, activated carbon, epoxy resins, adhesives in foundry resins, thermoplastic composites, surfactants and binders, and polypol in polyurethane foams.

"It is extremely important to have the support of AI Bio in this project," says Albers. "We actually got very quick response from them, and it was really encouraging to feel their support behind the entire program."

Natural Resources Canada also contributed $10 million to the project through its Investments in Forest Industry Transformation (IFIT) program. As well, Sustainable Development Technology Canada, an arm's-length foundation created by the federal government, invested $6 million.

The Hinton plant uses a lignin recovery technology called LignoForce, developed by a consortium involving FPInnovations and B.C.-based NORAM Engineering. It is a one-of-a-kind facility capable of recovering 30 tonnes of lignin per day—a 1000-fold increase in lignin recovery compared to a pilot-scale plant in Thunder Bay, Ontario.

Lignin is recovered from the Hinton pulp mill's black liquor byproduct stream using LignoForce's bolt-on technology, without impacting the flow or quality of the black liquor, which is burned in a recovery boiler.

Under the right circumstances—where a pulp mill has reached its recovery boiler capacity—removal of lignin from the black liquor stream could provide pulp mills with additional boiler capacity and allow them to increase pulp production, while also recovering a portion of the lignin for production of valuable commercial bioproducts.

As part of its agreement with AI Bio to receive financial support for the construction of the lignin recovery plant in Hinton, West Fraser agreed to contribute $1.5 million to AI Bio's lignin research fund. Albers says it is money well spent, as it is helping West Fraser successfully integrate lignin-based resins into its panel production, and also helping the company investigate other potential commercial and industrial uses for this raw material.

Price says the AI Bio lignin research fund will be used to spur development of new applications for lignin. Fund details have yet to be worked out.

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For more information about West Fraser's lignin recovery plant in Hinton, contact Tara Knight, West Fraser, at tara.knight@westfraser.com.

For information about AI Bio and its funding, contact Julia Necheff, Alberta Innovates Bio Solutions, at julia.necheff@albertainnovates.ca.

Making woody biomass more cost effective as a renewable fuel source

BY TONY KRYZANOWSKI

Discovering ways to cost effectively package, transport, and store woody biomass has come a long way over the past five years. Today, end users can access tools and research through the Canadian Wood Fibre Centre (CWFC) to make sound business decisions and fine-tune plans on the best harvesting and transportation methods to deliver this raw material to their manufacturing plants.

Whether it is a plan to use woody biomass to produce bio-fuels or bio-products, CWFC can help end users make informed decisions based on its discoveries related to woody biomass feedstock harvesting, pre-processing and delivery systems. Individuals or companies interested in using woody biomass as a feedstock can also access modeling tools like value simulators and economic feasibility programs tied directly to an end product to map out a feasible game plan.

Tim Keddy, CWFC Wood Fibre Development Specialist, says knowledge related to mid-supply chain management of woody biomass has grown in "leaps and bounds", with CWFC having conducted extensive research at various locations across Canada with industry partners, investigating different woody biomass sources, and field testing various harvesting, packaging, delivery and storage methods. As part of its cost analysis, CWFC has also considered the quality and characteristics of the raw material needed by the end user, and how that influences mid-supply costs, with the goal of providing the end user with a more refined and accurate financial breakdown of woody biomass usage.

One of the biggest challenges related to making a sound business case for greater woody biomass use has been transportation costs, because the raw material typically reaches its volume maximum before reaching its weight maximum when transported by truck. CWFC has investigated various harvesting, gathering, baling and compaction methods in the field that have resulted in the discovery of various methods to increase delivery weights and reduce transportation costs. It can now recommend packaging methods and truck trailer configurations where a loaded truck is much closer to its maximum allowable loaded weight. Keddy says that CWFC has demonstrated that it can increase transported volume by 45 per cent using compacted bales versus loose chips, and continues to investigate trailer and bale configurations to reduce costs even more. What this has done is effectively pushed out the radius of how far an end user could look to source woody biomass material at

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an affordable cost, and also perhaps increase the number of potential sources for woody biomass.

A key objective of CWFC's research has been to connect the most cost-effective ways to harvest, package and deliver woody biomass in bulk with the value of the end product, meaning that mid-supply methods can be customized depending on how the raw material will be used and its required characteristics upon delivery.

End users are strongly encouraged to take advantage of the knowledge acquired by CWFC on the various options available to them. Keddy says they might be surprised by what they discover, and how various methods tested by CWFC can significantly lower the cost of delivering woody biomass to an end user's doorstep.