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NEWSLINE Forest Products Laboratory

Creating a sustainable, environmentally friendly global economy

Researchers urge use of forest and agriculture materials to reach goals

Four research scientists from the Forest Products Laboratory (FPL) have proposed an approach to meeting global energy needs and creating a sustainable, bio-based economy that would reduce emissions of greenhouse gases, reduce dependence on oil and other fossil fuels, and enhance the health of the world's forests.

The use of forest-based and agricultural residues can help create a sustainable global economy.

Writing in the current issue of *Forest Products Journal*, Jerrold E. Winandy, Alan W. Rudie, R. Sam Williams, and Theodore H. Wegner state that "As society embraces the reality of a global economy, we as a society must commit ourselves to promoting renewable, recyclable, and reusable materials. To do that, we must develop the fundamental and applied science and technology necessary to provide improved value, service life, and utility to meet the needs of consumers." (http://www.forestprod.org/features.htm)

They propose an approach—integrated biomass technologies (IBT)—that provides a roadmap to a bio-based economy founded on the systematic use of renewable forest-based and agricultural resources, including residues, to produce high-value products, including energy, liquid biofuels, chemical feedstocks, advanced biocomposites, and advanced structures.

"This paradigm switch to sustainably meeting user needs for energy and materials will lead to a bio-based society using renewable materials and environmentally benign technologies rather than a society based on the use of nonrenewable, nonsustainable resources," they say.

The IBT approach would also help forest and land managers improve forest health and condition by creating an industrial market demand for low-value biomass to offset the costs associated with managing forestland.

According to the authors, the IBT approach would permit the production of both traditional and new high-value materials with enhanced performance properties from renewable resources. Opportunities are now on the horizon for using forest and agricultural biomass to cost-effectively produce electricity, transportation fuels, chemical feedstocks, nanocrystalline cellulose, and syngas, which in turn can be used to produce hundreds of high-value products.

High-value products, including energy, liquid biofuels, chemical feedstocks, advanced biocomposites, and advanced structures can be produced from bio-based materials that need to be removed to improve forest health.

The IBT framework identifies the needs, opportunities, and research necessary to implement the concept, including the development of new technologies:

- Initial value assessment and sorting procedures during biomass harvesting and collection
- Direct conversion of biomass into energy
- Biorefining some components into bio-based transportation fuels
- Biorefining other components into chemical feedstocks

(continued on pg. 3)

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Check out our website at http://www.fpl.fs.fed.us

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Genome Sequencing of White Rot Fungi to Advance Understanding of Biomass Conversion

A genome sequencing project by Dan Cullen, a microbiologist at FPL, has been included in the U.S. Department of Energy's Joint Genome Institute's (DOE JGI) latest portfolio of DNA sequencing projects that it will undertake in the coming year. The portfolio includes a total of 44 projects, culled from nearly 150 proposals received through the Community Sequencing Program. Sequencing projects are chosen based on scientific merit—judged through independent peer review—and relevance to issues in bioenergy, global carbon cycling, and bioremediation.

The most abundant source of carbon is plant biomass, composed primarily of cellulose, hemicellulose, and lignin. Many microorganisms are capable of utilizing cellulose and hemicellulose as carbon and energy sources, but a much smaller group of filamentous fungi has evolved with the ability to depolymerize lignin, the most recalcitrant component of plant cell walls. Collectively known as white rot fungi, they possess the unique ability to efficiently depolymerize lignin in order to gain access to cell wall carbohydrates for carbon and energy sources.

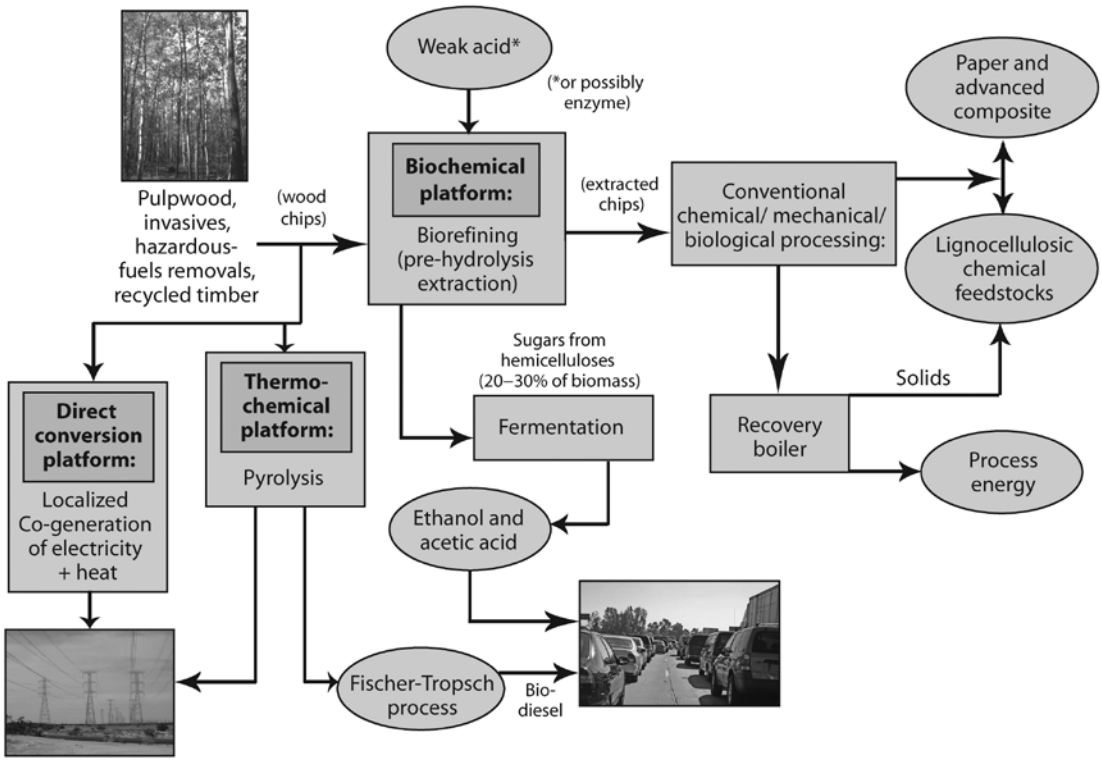
Cullen is focusing on *Ceriporiopsis subvermispora*, which rapidly depolymerizes lignin with relatively little cellulose degradation. The annotated gene set of C. *subvermispora* and comparative analyses with the lignin degraders *P. chrysosporium* and *Pleurotus ostreatus* (both sequenced by DOE JGI) will advance the understanding of these complex oxidative mechanisms involved in lignocellulose conversions.

Visit http://www.jgi.doe.gov/News/news_7_2_08.html for more information on DOE JGI sequencing projects.

Upcoming Events

IUFRO Extension and Technology Transfer Symposium

September 21, 2008— Mattawa and Ottawa, Ontario, Canada Evolving Challenges and Changing Expectations for Forestry Extension and Technology Transfer: Meeting needs of people and forests around the globe. This international symposium is intended to attract presenters and participants from around the world to bring perspectives from their home countries. Registration and abstract submissions available on-line:: www.iufroextension.org. Contact: Guy K.M. Smith; Natural Resources Canada (705) 541-5595; e-mail guy.smith@nrcan.gc.ca.



Hypothetical process chart for a multiple integrated biomass technologies approach intended to diversify product mix, optimize value prior to processing for biomass, and promote a more environmentally benign sustainable biobased economy.

- Processing residuals and other component materials into engineered composites, such as particleboard, fiberboard and strandboard, and paper, paperboard, or advanced composites using various combinations of biomaterials, nanomaterials, inorganic materials, and synthetics

According to the authors, a critical part of the IBT concept is that the mix of new products should be more valuable than the product mix from existing processes. For example, in traditional kraft pulping, lignin and carbohydrates that are not included in the pulp are combusted to produce energy. Redirecting some portion of these two potential chemical feedstock materials to higher value products, such as liquid transportation fuels, pharmaceuticals, plastics, or resins, could improve the profitability of the entire process.

One important tool to develop advanced biocomposites is the new science of nanotechnology to manipulate and control materials and processes. In the near future, nanocrystalline cellulose could likely compete with carbon fiber for use in a variety of innovative, high-strength biocomposite materials. Coincidentally, forest products producers, researchers, and others gathered in St. Louis in June to report on current research involving nanotechnology and forest-based materials.

Another important technology identified by the authors relates to the way buildings and other structures are designed and constructed. "As we move further into the 21st century, the performance demand and complexity of structures are increasing. In the past, structures were designed primarily based on safety issues. Today, structures are designed considering safety along with functionality, environmental impact, service life, ease of maintenance and renovation, and economics and affordability," they write.

The *Forest Products Journal* is a monthly journal containing mostly peer-reviewed articles reporting on research involving forests and forest products. It is published by the Forest Products Society, an international professional membership organization with headquarters in Madison, Wisconsin.

Dividends

FPL Research Papers available to you

We're pleased to announce that the Forest Products Laboratory is re-introducing *Dividends from Wood Research*—our periodic list of recent publications—in a new web-based format! The latest release (for January–June 2007) is now available at www.fpl.fs.fed.us/document-lists/div071.html

If you would like to receive email notification when a new issue of *Dividends* is posted on the web, please send an email to tivoligough@fs.fed.us requesting to be placed on the list.

Below are two samples from our most recent dividends issue.

· Moisture Content and the Properties of Lodgepole Pine Logs in Bending and Compression Parallel to the Grain

Green, David W.; Gorman, Thomas M.; Murphy, Joseph F.; Wheeler, Matthew B. 2007. Research Paper FPL–RP–639. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 11 p. http://www.fpl.fs.fed.us/documnts/fplrp/fpl_rp639.pdf

This study evaluates the effect of moisture content on the properties of 5- to 6-in. diameter lodgepole pine (Pinus contorta) logs that were tested either in bending or in compression parallel to the grain. Lodgepole pine logs were obtained from a dense stand near Seeley Lake, Montana, and sorted into four piles of 30 logs each. Two groups were tested in bending, one green and one dry, and two in compression parallel to the grain. The results of the study provide conservative procedures for estimating compression strength for green logs based on the assigned bending strength and show that modulus of elas-ticity determined by transverse vibration (Etv) on green logs is a conservative estimate of Etv for dry logs. Experimental problems with conditioning the logs tested in bending produced inconsistencies in some property relationships. A more comprehensive study, already in progress, should help resolve these questions.

· Fuels for Schools: Case study in Darby, Montana

Bergman, Richard; Maker, Timothy M. 2007. General Technical Report FPL–GTR–173. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory. 21 p. http://www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr173.pdf

To reduce the risk of catastrophic fires, the USDA Forest Service and its partners are developing practical, economic uses for forest thinnings from National Forests and state and private lands in western states. Because mechanical thinning is costly, developing markets for removed wood as fuel for community energy applications is one way to support the economics of forest management while saving money for communities. By installing a wood heating system in the public schools in Darby, Montana, the Fuels for Schools Program is demonstrating the potential of putting low quality wood residues to practical use in a rural forest-based community. The wood-fired heating system installed in Darby Schools replaced three separate oil-fired systems and saved the school district $24,500 of total fuel costs for the 2003–2004 year. Because of higher fuel oil prices, total fuel cost savings increased to $61,500 in the 2004–2005 heating season. Heating fuel costs were reduced from $0.63 per ft^2 per year (last full oil heating season) to $0.36 and $0.35 per ft^2 per year for the 2003–04 and 2004–05 heating seasons. Adjusting for heating degree days (HDD) for the respective heating seasons, the corresponding seasonal fuel costs in $/thousand ft^2/HDD were reduced from 0.068 in 2002–2003 to 0.040, and to 0.040 in the 2003–2004 and 2004–2005 heating seasons, respectively. In an analysis to show actual costs for a school, we found a payback period of 9.8 years based on 2004–2005 heating fuel values. The project life was for 20 years, and a desired discount rate of 8.0% was specified for determining the before tax net present value.

Ask FPL

We get thousands of inquiries each year. We print what we feel are some of the best questions. Here is one we recently received.

Questions?

Contact us at Forest Products Laboratory,
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http://www.fpl.fs.fed.us or write
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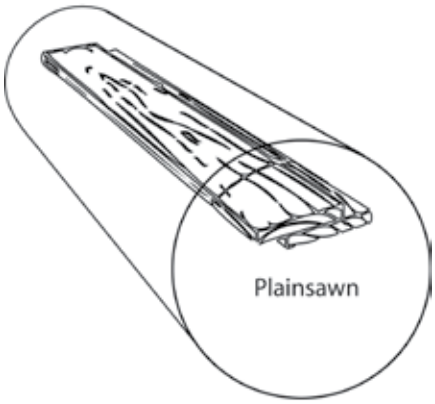
Are there differences between plainsawn and quartersawn lumber other than their appearance?

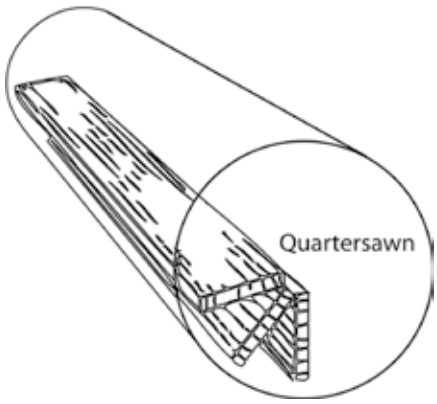
By Rebecca Wallace, Public Affairs Specialist

For many purposes, either plainsawn or quartersawn lumber is satisfactory. Each type has certain advantages that can be important for a particular use:



Plainsawn

- Shrinks and swells less in thickness
- Surface appearance less affected by round or oval knots
- Shakes and pitch pockets (when present) extend through fewer boards
- Figure patterns resulting from annual rings are more prominent
- Is less susceptible to collapse in drying
- Costs less because it is easy to obtain



Quartersawn

- Shrinks and swells less in width
- Cups, surface-checks, and splits less in seasoning and use
- Raised grain caused by separation in annual rings does not become as pronounced
- Figure patterns resulting from pronounced rays, interlocked grain, and wavy grain are more prominent
- Does not allow liquids to pass through readily in some species
- Holds paint better in some species

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Wood you Believe...

- Did you know when leaves appear green, it is because they have an abundance of chlorophyll? In autumn, chlorophyll production is slow due to low light levels. The green color will fade from the leaves and anthocyanin production in leaves will increase making them appear red.
- Did you know the tallest tree species is Californian redwood (*Sequoia sempervirens*)? The tallest known redwood is located in the California Hombodlt Redwood State Park. It's over 378 feet tall!

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