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Forest Products Laboratory's

Newsline

Summer 2014

In-Place Preservative Treatments for Covered Bridges

By James T. Spartz, Public Affairs Specialist

Most covered bridges are made of wood and can be vulnerable to damage from fungi and insect attack. A recent paper from Forest Products Laboratory forest products technologist Stan Lebow and Oregon State University professor Jeff Morrell, *In-Place Preservative Treatments for Covered Bridges*, describes treatment options that help prevent or slow down biodegradation.

"Controlling exposure to, and protection from, moisture is one of the best ways to prevent biodeterioration in covered bridges," says Lebow. "We have found that regular maintenance and attention to needed repairs is extremely helpful for keeping these bridges in working order." Lebow says that county or local governments charged with maintaining the structural and aesthetic integrity of covered bridges can benefit from the research on in-place preservative treatments.

Deterioration of bridge beams tends to be more common wherever beams contact abutments, are near the ends of bridges subject to wetting from splashing, or are below windows or other openings that allow windblown precipitation access to the interior bridge space.

In-place preservative applications can help limit deterioration when moisture cannot be eliminated. The goal of in-place treatment on a covered bridge is to distribute preservative into areas that may easily get wet from exposure to precipitation. In-place treatments include surface coatings, pastes, rods, gels, and fumigants. Some preservative treatments may cause a color change in

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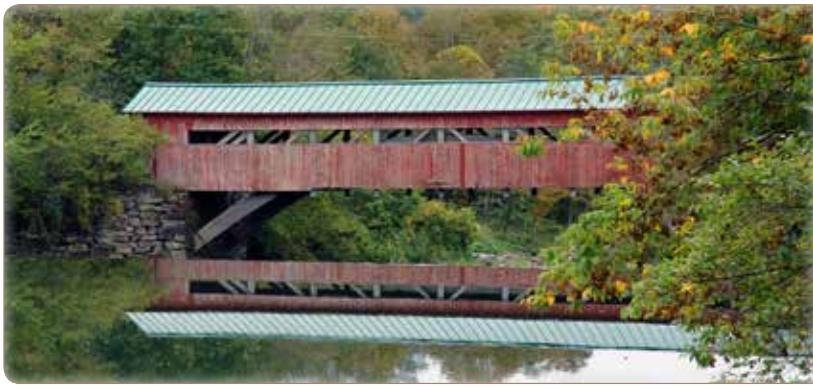

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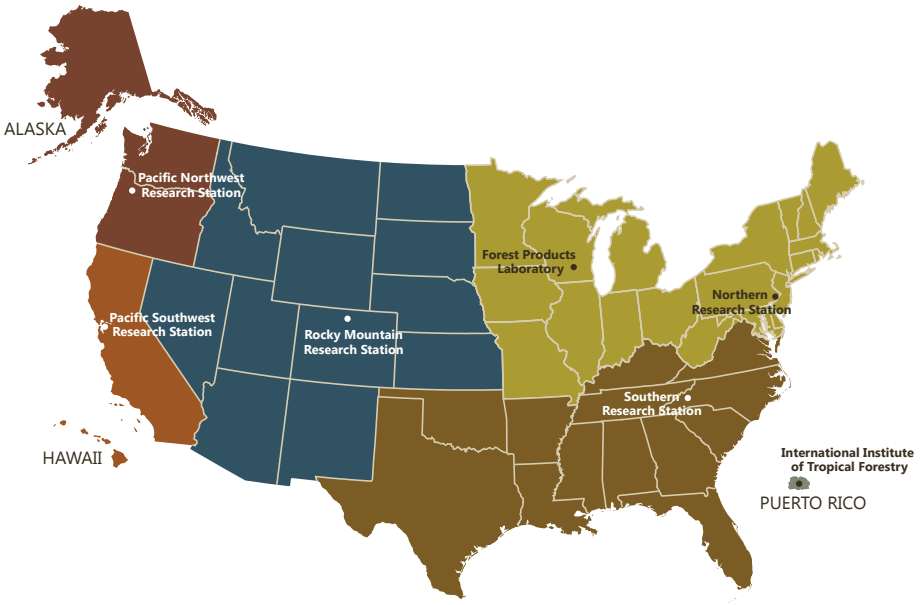
Wood You Believe

The research and development (R&D) arm of the Forest Service, a component of the U.S. Department of Agriculture, works at the forefront of science to improve the health and use of our Nation's forests and grasslands. Research has been part of the Forest Service mission since the agency's inception in 1905.

The organization consists of seven research stations and 80 experimental forests and ranges. Forest Service R&D interacts with national forests in nine regions and with the agency's State and Private Deputy Area throughout the United States.

Today, more than 500 Forest Service researchers work in a range of biological, physical, and social science fields to promote sustainable management of the Nation's diverse forests and rangelands. Their research covers a lot of territory, with programs in all 50 States, U.S. territories, and commonwealths.

This map shows the geographic regions covered by the Forest Service Research Stations and the International Institute of Tropical Foresty. The Forest Products Laboratory—the only national research facility of the Forest Service—is located in Madison, Wisconsin.



Map from "Forest Products Laboratory, 1910–2010, Celebrating a Century of Accomplishments." www.fpl.fs.fed.us/centennial/index.shtml

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Upcoming Events

Third International Conference on Processing Technologies for the Forest and Biobased Products Industries

September 24–26, 2014, Kuchl, Austria

Hosted and organized by the Salzburg University of Applied Sciences at Campus Kuchl and scientifically supported by Cost Action FP1006, Forest Products Society, International Union of Forest Research Organizations (IUFRO), University of Tennessee in Knoxville, University of Natural Resources and Life Sciences, Campus Tulln, and Transilvania University of Brasov. A research and technical gathering of innovative specialists to exchange ideas and information related to processing, engineering, modification, and sustainable uses of wood. The biennial conference provides a forum for discussions and networking opportunities among teaching staff, researchers, and producers of forest and bio-based products and acts as a catalyst for new research and development, and applications for manufacturing industries. Enjoy the combination of practical and scientific experiences of industry leaders in the plenary sessions with additional concurrent sessions by academic and industry researchers.

For more conference information, visit http://ptfbpi2014.fh-salzburg.ac.at/.

19th International Nondestructive Testing and Evaluation of Wood Symposium

September 22–25, 2015, Rio de Janeiro, Brazil

The 19th International Nondestructive Testing and Evaluation of Wood Symposium is a forum for those involved in nondestructive testing and evaluation of wood, wood-based materials and products. It will bring together the international nondestructive testing and evaluation research community, users of various nondestructive testing technologies, equipment development and manufacturing professionals, representatives from various government agencies and other groups to share research findings and new nondestructive testing products and technologies.

For more conference information, visit http://abendieventos.org.br/wood_symposium/.

North American Wood Window and Door Symposium

September 23–25, 2015, Forest Products Laboratory, Madison, Wisconsin, USA

A premier symposium focused on the effective use and optimal performance of wood and wood-based materials in wood window and door manufacturing. The purpose of this conference is to ensure that wood remains a viable option for windows and doors and to educate attendees of the benefits of wooden fenestration, as well provide instruction that will ensure optimal performance of these products. The target audience will consist of manufacturers, architects, contractors, designers, researchers, and policy makers who influence selection of materials for residential and commercial construction.

For more conference information, visit http://www.forestprod.org/wooddoorsymposium/#!/.

Visit Lab Notes!

Have you checked out *Lab Notes*, the FPL's online news feed? Visit www.fpl.fs.fed.us/labnotes for unique, interesting, and quick-hitting stories about FPL research, scientists, and the greater forest products industry.

With Lab Notes, you can easily follow hyperlinks and get to know our researchers, their work, and how it all fits within a larger forestry-sector context.

FPL to Play Key Role in Innovative Biomass Research: $5.8 Million Federal Grant Awarded to Humboldt State University

By Rebecca Wallace, Public Affairs Specialist

Humboldt State University (HSU), along with 15 regional partners including the Forest Products Laboratory (FPL), has received a $5.88 million grant from the U.S. Department of Energy to conduct innovative biomass research.

The grant is part of the Biomass Research and Development Initiative, a collaborative effort between the Department of Energy and the Department of Agriculture that supports renewable energy research in the rural United States.

Under the grant, a team of scholars, industry partners, and forestland managers led by HSU forestry professor Han-Sup Han will build on existing research for converting forest residues into renewable fuel and other valuable biobased products. Forest residues include limbs, treetops, and other materials left on the forest floor after timber harvesting. Often considered waste material and not effectively used, forest residues are an undervalued source of potential bioenergy. Strategic use of woody biomass has the potential to reduce U.S. dependence on foreign oil, lower greenhouse gas emissions, and promote economic development in rural America.

The grant will allow research teams comprising investigators, graduate students, postdoctoral researchers, and private sector partners to address technical challenges and make bioenergy technologies more marketable. The three research areas will be feedstock (processed forest residues) supply, mobile conversion technologies, and economic life-cycle analysis.

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Forest residues can be turned into renewable fuel and other valuable biobased products.

Steve Schmieding, Forest Products Laboratory

> *"It's not enough that the technologies work and produce energy, they also need to be economically viable, socially acceptable, and environmentally sustainable."*
> *~ Ted Bilek*

Ted Bilek, an economist at FPL, will lead the economic life-cycle analysis group. Bilek's team will conduct a life-cycle analysis documenting the economic benefits and other environmental effects related to using forest residues.

"It's not enough that the technologies work and produce energy," Bilek says. "They also need to be economically viable, socially acceptable, and environmentally sustainable. These are the focuses of our group. Our research will also help to highlight areas that offer the greatest potentials to improve returns and to ensure long-term sustainability."

The grant is titled *Waste to Wisdom: Utilizing Forest Residues for the Production of Bioenergy and Bioproducts.* Research partners include Green Diamond Resource Company; the University of Washington; Oregon State University; the Bureau of Land Management; USDA Forest Service; USFS Rocky Mountain Research Station; USFS Forest Products Lab; Redwood Forest Foundation; Forest Concepts, LLC; Steve Morris Logging; Peterson Pacific Corporation; Biochar Solutions, Inc.; Pellet Fuels Institute, and the Forest Business Network, LLC.

USDA Under Secretary for Natural Resources and Environment Visits FPL

By Rebecca Wallace, Public Affairs Specialist

Robert Bonnie, USDA Under Secretary for Natural Resources and Environment, visited FPL in May. Mr. Bonnie addressed national and regional leadership personnel while at FPL and received a comprehensive tour of the FPL facilities.

"It was our great pleasure to host Mr. Bonnie," said Michael T. Rains, Director of the Forest Products Laboratory and Northern Research Station. "We believe deeply in the important work we are doing here at FPL and feel fortunate to have the support of (USDA) Secretary Vilsack and the Under Secretary's office as we collectively strive to advance our contemporary conservation mission."

Supervisory Research Chemist Alan Rudie (left) discusses nanotechnology with FPL Assistant Director Ted Wegner (middle) and Under Secretary Robert Bonnie (right).

Photos on pg. 5: Steve Schmieding, Forest Products Laboratory

Research Materials Engineer Ron Sabo shows engineered wood panel samples to Under Secretary Robert Bonnie.

FPL Director Michael T. Rains (left) and Supervisory Research Chemist Alan Rudie (right) tour Under Secretary Robert Bonnie around FPL's Nanotechnology Pilot Plant.

Supervisory Research General Engineer Bob Ross tours Under Secretary Robert Bonnie around FPL's Engineering Mechanics and Remote Sensing Laboratory.

Research General Engineer Bob Falk discusses tornado safe room research conducted at FPL with Under Secretary Robert Bonnie.

Madison College Students Give Historic FPL Timber New Life

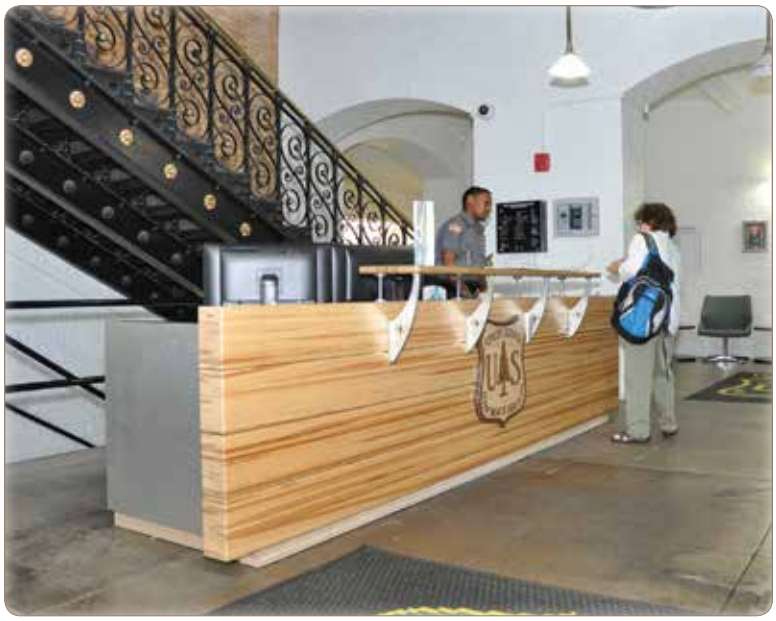
By Rebecca Wallace, Public Affairs Specialist

A reception desk laden with history graces the newly remodeled Sydney Yates building in Washington, D.C., thanks to Madison College cabinet and millwork students and the Forest Products Laboratory (FPL).

The Yates building is home to the U.S. Forest Service headquarters, and the agency wanted its rich history to be incorporated into the modern reconstruction of the space. Combining the skill of Madison College students with materials from FPL research projects resulted in a striking reception desk that acts as a focal point of the Yates building lobby and also as a tribute to more than a century of wood research.

The front of the desk was crafted from glued-laminated timbers that previously stood for 75 years on the FPL campus. Used to construct "Building Two" in 1934, the glulams showcased the latest developments in wood engineering at the time, as this was only the second building in North America to use such materials. Building Two was deconstructed in 2010 during FPL renovations, and all of the original glulam arches were retained and evaluated by researchers, providing a rare opportunity to study the long-term performance of wood structures.

Karl Perry, USDA Forest Service



Completed desk installed in the Sydney Yates building in Washington, D.C.

Patrick Molzahn, Madison College

Patrick Molzahn, Madison College

Madison College cabinet and millwork students designed and crafted the glued-laminated timber desk.

Laminated white oak was used for the transaction counter and work surface of the desk. This material was studied at FPL in the early 1990s when it was used as a critical structural element in the hulls of wooden minesweepers during Operation Desert Storm. Researchers evaluated the performance of connections used in the construction of the boats.

The iconic tree that is part of the Forest Service emblem is inlayed into the counter's surface. The inlay is live oak, a species known for its incredible strength and durability, which was reclaimed during a restoration of the famed warship, the U.S.S. Constitution or "Old Ironsides." FPL researchers used a technique called nondestructive evaluation to determine the condition of the wood in the ship's hull. By measuring the speed of sound waves sent through the wood, researchers could locate areas of decay, damage, or deterioration and pinpoint where repairs were needed.

TAPPI Honors FPL Achievements with 2014 Awards

By Rebecca Wallace, Public Affairs Specialist

Steve Schmieding, Forest Products Laboratory

JunYong Zhu

JunYong Zhu, research general engineer at the Forest Products Laboratory (FPL), is winner of the 2014 Research and Development Technical Award and William H. Aiken Prize by TAPPI's International Research Management Committee (IRMC). This award is given for outstanding accomplishments or contributions advancing the technology of paper and related industries.

By focusing on biomass utilization, mill pulping, and fiber processing technology and processes, Dr. Zhu's work has "made a significant contribution to the industry's fundamental understanding of these areas as well as our ability to use materials commercially," notes Larry N. Montague, president and CEO of TAPPI. "His research spans both laboratory and mill-level studies and this prestigious award recognizes the importance and the impact of this work."

Zhu's work includes developing the kraft pulping process and air emission controls, novel flotation deinking technologies, test methods for pulp and paper analysis, upgrading and pretreating forest residues for biofuel production, and novel methods for production of cellulose nanomaterials. It has also included research on understanding the fundamentals of cellulase enzyme interactions with lignocelluloses for woody biomass bioconversion.

Nancy Ross Sutherland, a supervisory general engineer at FPL, was awarded TAPPI's 2014 Paper and Board Division Leadership & Service Award and Oscar May Prize. This award recognizes outstanding leadership and exceptional service in the Division.

Sutherland's efforts "have provided great benefit to the Paper and Board division and its members for more than two decades," notes Montague. "She's worked tirelessly and enthusiastically in many leadership roles for TAPPI and is simply a great choice for this prestigious award."

The awards were presented in April at PaperCon 2014 in Nashville, Tennessee. TAPPI is the leading association for the worldwide pulp, paper, packaging, tissue, and converting industries and publisher of Paper360°, Tissue360°, and TAPPI Journal.

Considering Wood for Energy? There's an app for that.

By Rebecca Wallace, Public Affairs Specialist

The U.S. Forest Service released a Wood Energy Financial App for use by community and business leaders seeking to replace fossil fuel with wood energy. The app allows users simply and quickly determine if wood energy is a viable alternative for their community or small business.

The app is offered as part of the Community Biomass Handbook eBook. The Community Biomass Handbook walks users through initial states of project scoping and pre-feasibility analysis by providing a variety of information:

- *Guidance*—Matching project motivations and local resources with appropriate technologies and investment pathways
- *Personal stories*—Identifying what has worked in other places with common financial and technical challenges faced
- *Options*—Checklist of possible products with important planning and investment considerations

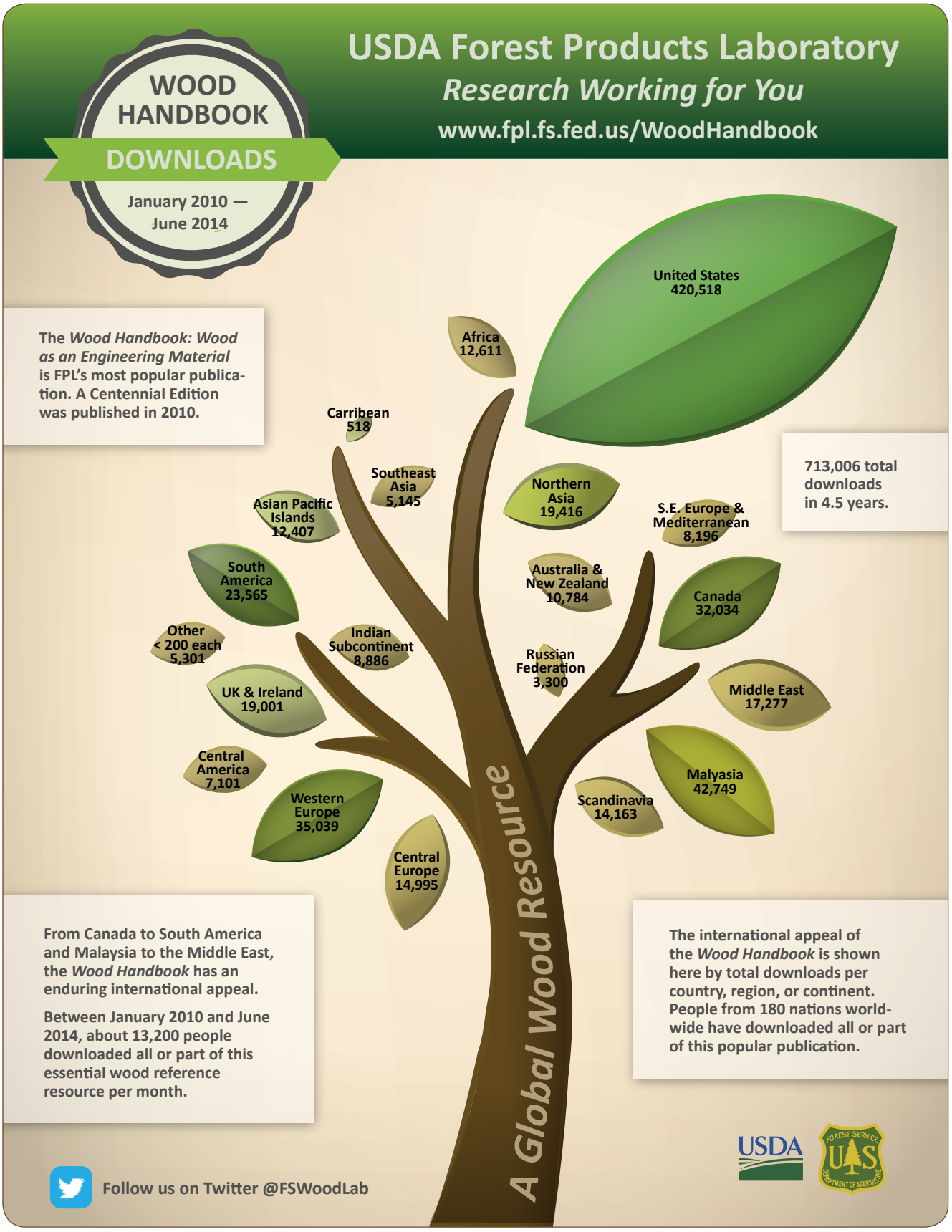
http://woodenergy.umn.edu/

- *Project screening*—Initial financial assessment using the Wood Energy Financial App

The Wood Energy Financial App can be found at http://woodenergy.umn.edu/BiomassCalculator/

The full Community Biomass Handbook can be found at http://www.woodenergy.umn.edu/communityBiomassHandbook.html

Tivoli Gough, Forest Products Laboratory



Wood Wise—*Terms from the World of Wood*

Kiln: A chamber having controlled air-flow, temperature, and relative humidity for drying lumber. The temperature is increased as drying progresses, and the relative humidity is decreased.

Naval Stores: A term applied to the oils, resins, tars, and pitches derived from oleoresin contained in, exuded by, or extracted from trees, chiefly species of pines (genus Pinus). Historically, these were important items in the stores of wood sailing vessels.

Oleoresin: A solution of resin in an essential oil that occurs in or exudes from many plants, especially softwoods. The oleoresin from pine is a solution of pine resin (rosin) in turpentine.

Pitch Pocket: An opening extending parallel to the annual growth rings and containing, or that has contained, pitch, either solid or liquid.

Pitch Streaks: A well-defined accumulation of pitch in a more or less regular streak in the wood of certain conifers.

Seasoning: Removing moisture from green wood to improve its serviceability.

Air-Dried: Dried by exposure to air in a yard or shed, without artificial heat.

Kiln-Dried: Dried in a kiln with the use of artificial heat.

Source: Wood Handbook—Wood as an Engineering Material, General Technical Report FPL–GTR–190, www.fpl.fs.fed.us/woodhandbook

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In-Place Preservative Treatments for Covered Bridges

the treated wood or present safety and handling concerns, or both.

One limitation of all these treatments is that they cannot be forced deeply into the wood as is done in pressure-treatment processes. However, some can be applied into the center of large members via treatment holes and can move through the wood by vaporization or diffusion.

Lebow and Morrell used laboratory and field research to compare the movement of water-diffusible and fumigant treatments. The wood in some covered bridge timbers, they found, may be too dry to promote the effective spread of diffusible preservative treatments. Water diffusible treatments must be applied in locations where moisture accumulation is suspected and fumigants have greater potential for movement in dry bridge timbers and wood species that resist moisture movement.

The paper can be found in full text on the FPL web site: http://www.fpl.fs.fed.us/products/publications/specific_pub.php?posting_id=67339&header_id=p

Steve Schmieding, Forest Products Laboratory

"Controlling exposure to, and protection from, moisture is one of the best ways to prevent biodeterioration in covered bridges."
~ Stan Lebow

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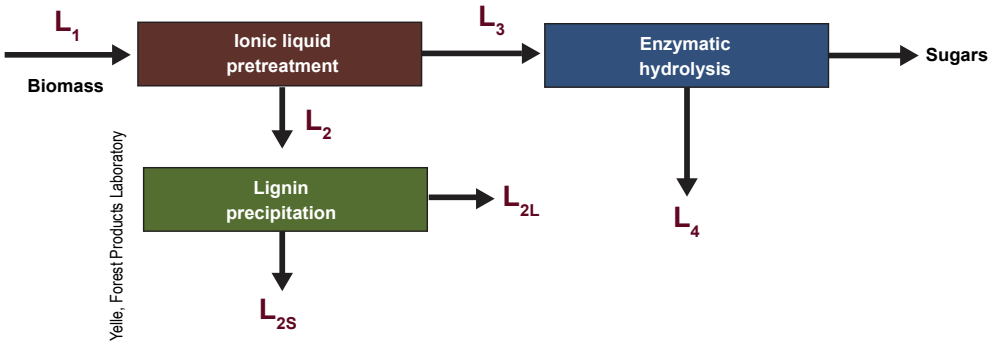
Set Free the Cellulose! Enhancing Biorefinery Economics through Ionic Liquid Pretreatment

By James T. Spartz, Public Affairs Specialist



Above, a representation of the ionic liquid pretreatment process for converting biomass to sugars suitable for manufacturing liquid biofuels.

As the most abundant biopolymers on earth, cellulose and lignin form the building blocks for trees and other plants. For centuries the durable, renewable benefits of wood have helped provide shelter and energy for people around the globe. Using trees such as loblolly pine and other lignocellulosic biomass like wheat straw and miscanthus (commonly known as elephant grass) as renewable, plentiful, non-food and non-petroleum resources can help reduce dependence on oil products by supplementing traditional gasoline supplies with liquid biofuels.

One of the biggest challenges of converting wood to energy is releasing the sugars within the lignin itself. Daniel Yelle, a research forest products technologist at the Forest Products Laboratory, says lignin is recalcitrant, meaning it does not break down very easily. Yelle has been working with a team of researchers to unlock the recalcitrant nature of lignin in an effort to improve refinery efficiencies in the production process for advanced biofuels. Their research has been published in the scientific journal *Green Chemistry* and can be found here: http://www.fpl.fs.fed.us/products/publications/specific_pub.php?posting_id=67662&header_id=p.

Higher plants such as trees, says Yelle, contain cell walls that are rich in lignin and complex sugars—polysaccharides like cellulose. However, cellulose is naturally entrapped in a matrix of lignin. Cellulose is the ideal biopolymer for biofuel production, says Yelle, "because of its simplistic long-chain glucose structure," but the separation of the cellulose from its lignin counterpart typically involves harsh chemical pretreatments. These chemicals may release the cellulose to a certain degree, but says Yelle, "make the remaining lignin even more recalcitrant." Overcoming pretreatment barriers would help make the biochemical conversion process more efficient and thus more appealing for commercial renewable energy interests.

Yelle and colleagues' research analyzes lignin following an ionic liquid pretreatment. Ionic liquids, says Yelle, are used to more easily dissolve the lignin that directly surrounds the desired polysaccharides. The non-toxic and recyclable ionic liquid used in this study was able to more effectively disrupt the lignin, allowing for its extraction in a more native state, as compared to previous pretreatment strategies. The subsequent use of enzymes to break down the polysaccharides into simple sugars is thus more effective. Furthermore, the size of the lignin polymer that is removed can be customized and routed into different product streams and help improve biorefinery economics.

Steve Schmieding, Forest Products Laboratory

"Cellulose is the ideal biopolymer for biofuel production because of its simplistic long-chain glucose structure."
~ Daniel Yelle

IPCC Report Cites Value of Wood Products to Mitigate Climate Change

By James T. Spartz, Public Affairs Specialist

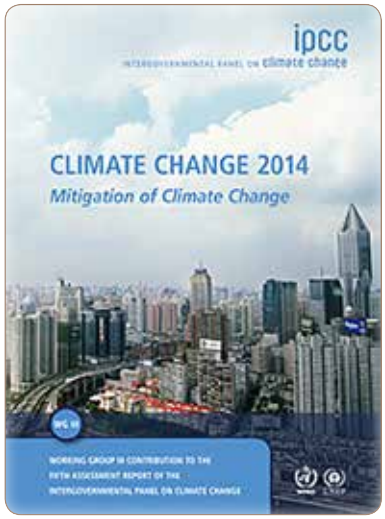
Some key climate change mitigation benefits from the use of wood have been cited by the Intergovernmental Panel on Climate Change (IPCC) 5th Assessment report on Mitigation of Climate Change.

One key measure related to slowing down, or mitigating, the rate of climate change impacts is greenhouse gas (GHG) emissions. In general the report finds that "Provision of products with low GHG emissions can replace products with higher GHG emissions for delivering the same service (e.g., replacement of concrete and steel in buildings with wood, [and] some bioenergy options)." [p. 22]

According to economist Ken Skog, supervisory research forester and leader of the Economics, Statistics and Life Cycle Analysis Research group at the Forest Products Laboratory, the report "confirms findings that efforts to expand use of wood in long-lived applications such as multistory buildings are a key means to hold down GHG emissions and mitigate climate change."

Specifically, the report cites research indicating wood-based wall systems use 10–20% less embodied energy than traditional concrete wall systems. Concrete-framed buildings, in turn, use less embodied energy than their steel-framed counterparts.

The report states that "increased wood use does not reduce GHG emissions under all circumstances." Wood harvest "reduces the amount of carbon stored in the forest, at least temporarily, and increases in wood harvest levels may result in reduced long-term carbon storage in forests."



http://mitigation2014.org/report

"The report confirms findings that efforts to expand use of wood in long-lived applications such as multistory buildings are a key means to hold down GHG emissions and mitigate climate change."
~ Ken Skog

Steve Schmieding, Forest Products Laboratory

However, research shows that reducing wood consumption through paper recycling, for example, can reduce GHG emissions, and using wood grown in sustainable forestry systems, rather than "emission intensive materials such as concrete, steel, or aluminum" can further reduce emissions, mitigating the long-term effects of climate change.

Using wood from sustainably managed forests rather than non-wood materials in the construction sector (concrete, steel, etc.), research shows, reduces GHG emissions in most cases throughout the construction process for single-family homes, apartment houses, and industrial buildings. Most emission reductions in this process result from reduced production emissions rather than carbon sequestration in products, which "is relatively small."

Greenhouse gas benefits are highest, the report states, "when wood is primarily used for long-lived products, the lifetime of products is maximized, and energy use of woody biomass is focused on by-products, wood wastes, and end-of lifecycle use of long-lived wood products."

The report can be found online at http://mitigation2014.org/report.

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