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Forest Products Laboratory's

Newsline

WINTER 2012

Research into Reuse
Benefits Multiply when Art and Science Combine Efforts

By Rebecca Wallace, Public Affairs Specialist

Christine Lee, a California-based artist and designer, first met Forest Products Laboratory engineer John Hunt when she was an artist-in-residence in the University of Wisconsin Art Department's wood program. Since then, their partnership has proven that great things can happen when art meets science.

Lee's art often aims to reveal the hidden potential in discarded materials. While at the University of Wisconsin, she wanted to take the idea of reuse one step further, creating a work of art from waste materials and then using the waste from her art project to create yet another product.

Lee was familiar with FPL's work, and Hunt seemed a natural fit for partnering, as much of his research revolves around using waste material as well. Working with material ranging from recycled cardboard to cow manure, there is certainly an element of creativity to his research, and Hunt was interested in seeing what an engineer and an artist could come up with together.

"It was great to work with Christine and get out of the 'forest products' mentality," says Hunt. "She came to the project with a completely different viewpoint, and had fresh ideas about how things look, fit together, or might be used. It challenged me to think differently and opened up a whole new realm of possibility for the product we created."

Lee began with a large supply of scrap wood that would usually be turned into mulch. Using specific woodworking machines, Lee used the scrap wood to create multiples of a building block inspired by her childhood experience with Lincoln Logs. She also collected the sawdust generated from her project, and separated it according to species.

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Christine Lee

Christine Lee

Above: Artist Christine Lee's installation at the Madison, Wis., Children's Museum. Below: Lee works in FPL's composites lab to create panels from sawdust and recycled paper.

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Steve Schmieding, USDA FS-FPL

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Upcoming Events

SmallWood 2012: Forest Restoration for a New Economy

May 1–3, 2012, Little America Hotel, Flagstaff, Arizona

This conference will give you the skills and information you need to adapt to changes and be successful in our current dynamic economy and industry. By focusing on our forest resources as well as the forest products industry, we will begin to understand key interactions and how to build a true forest restoration for a new economy. You will engage with an international slate of speakers, including researchers, material and equipment suppliers, manufacturers, and end-users providers. Presentations will be on multi-partnership development, forest health restoration, supply and availability, harvesting systems, processing and manufacturing, energy from woody biomass, and sustainability of biomass operations. For more conference information visit www.forestprod.org/assets/images/small_wood_2012.pdf.

12th International Conference on Biocomposites–Transition to Green Materials

May 6–8, 2012, Niagara Falls, Ontario, Canada

Join us for this important international conference that will examine the latest developments in the innovation commercialization, technology, economics and applications of greener materials and biocomposites in automotive, building and packaging sectors. The conference will include oral, panel, and poster presentations as well as industrial exhibitions. This is also an excellent opportunity for networking with academia, industries, government, and colleagues from around the world. Topics include green resins and biofibers, nano processing technologies, single-step manufacturing technologies, design and performance issues, application and prototyping, and economic and environmental issues. For more conference information visit www.biocomposites-toronto.com/.

Wood You Believe?

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Recycle paper grocery bags!

- Recycling a single run of the Sunday New York Times can save 75,000 trees.
- If American households went online to view and pay their bills, it would save over 16 million trees.
- A 15-year-old tree = 700 paper grocery bags. A busy supermarket uses that many in an hour. In a year, one supermarket can use over 6 million paper bags!

Source: www.plant-trees.org

Meet the Beetles
An FPL Framework for Using Beetle-Killed Trees in Western United States

By James T. Spartz, Public Affairs Specialist

Finding uses for millions of tons of beetle-killed trees as a way to offset forestland restoration costs and developing market-oriented ways to use the biomass are priorities for the USDA Forest Service. The Forest Products Laboratory (FPL) has developed a new strategic framework for approaching these issues in a new report, Economic Use of Beetle-Killed Trees. This framework is supported by decades of FPL research in the sustainable and economically viable use of beetle-killed trees.

Out of a total 749 million acres of forest in the United States, 9.2 million acres of trees were killed by insects and disease in 2010. Various beetles, including mountain pine, western bark, southern pine, and spruce, will continue to kill millions of trees across North America every year. The mountain pine beetle (Dendroctonus ponderosae), a native insect found in the western United States, kills about 74% of these trees, nearly 7 million forested acres annually.

Mountain pine beetles have a one-year life cycle and spend most of their life feeding on conductive tissues between bark and wood. Trees are killed by the destructive galleries mined by the beetles and the blue stain fungus carried by the insects. This fungus decreases the wood moisture content and weakens the tree's defense mechanisms. Blue stain carries over into products made from the stained logs, and the physical condition of the wood affects how it can be processed. As such, profitability and usefulness of stained wood can be adversely affected. Infested trees also dry and develop splits and checks as the drying stresses are relieved.

Challenges associated with manufacturing wood products from beetle-killed timber exist through all phases of production, including harvesting, transportation, log storage, processing, and end-product marketing. Timber stands left in the wake of the current mountain pine beetle outbreak, however, represent a significant economic resource.

A key issue in this complex problem is the amount of time, or shelf life, associated with capturing economic values and how this may vary between locations. Where current local infrastructure exists to produce value-added products, the FPL provides a framework for overcoming technical and economic barriers to using beetle-killed trees. Where local infrastructure is inadequate or completely lacking, FPL seeks to develop and help commercialize new value-added uses for the wood. Best-use scenarios have economic and market potential on a scale matching the degree of forest biomass available and justify the capital investment required.


www.forestryimages.org


www.forestryimages.org

Various beetles, including mountain pine, western bark, southern pine, and spruce, will continue to kill millions of trees across North America every year.

In carrying out this type of work, FPL routinely seeks to develop public–private partnerships with various organizations and forestland managers. Diversifying inputs and partnerships helps to overcome technical and economic barriers and can promote the commercial use of beetle-killed trees in traditional and non-traditional forest products and bioenergy. FPL seeks to apply its expertise and capabilities in research, development, and deployment of new and improved technologies to benefit private sector partners in successful commercialization efforts.

UMaine and FPL Collaborate to Produce Novel Nanomaterials

By James T. Spartz, Public Affairs Specialist


USDA FS-FPL

The University of Maine's Forest Bioproducts Research Institute recently announced that it is building a pilot-scale plant to manufacture cellulose nanofibrils, a wood-based material of interest for its reinforcing properties and potential use in replicating synthetic plastics. This innovative project, involving six other universities and the Forest Products Laboratory (FPL), seeks to investigate wood at the nano-scale. Particles at the nano-scale range from 1 to 100 nanometers in at least one dimesion.

One nanometer represents one-billionth of a meter, or roughly one-millionth the thickness of an American dime. Cellulose nanofibrils (CNFs) are one of the smallest components of wood that researchers have been able to work with, about 1,000 times smaller than paper fibers.

Zhiyong Cai, a project leader in engineered composite science at the FPL, has been involved in the UMaine research collaboration since April, 2010, when researchers started investigating the conversion of wood components into these unique nanomaterials. CNFs can be incorporated into a variety of forest products, thus increasing potential functionality, durability, and end-use performance.

Cellulose nanocrystals (CNCs) are another highly sought-after wood-derived nanomaterial. Though related in size and strength characteristics to nanofibrils, these two wood-based nanomaterials differ in how they are produced. At its most simplistic, nanofibrils are produced through mechanical means (a sort of vigorous pounding impact process), whereas nanocrystals are typically derived through chemical processes, essentially bathed in sulfuric acid to break down the basic constituents of wood for further use.

Real-world applications for cellulose nanofibrils include car parts, paint and coating additives, and water filters. Both CNFs and CNCs have potential in medical and electronic applications. The production of these nanomaterials in the United States, through pilot projects like the one at UMaine, will decrease dependency on foreign sources, such as those developed in Japan and Germany. Increased domestic production will also provide sufficient quantities for greater practical testing and demonstration.

FPL recently purchased reactor equipment (two 100-gallon, one 1,000-gallon, and one 1,500-gallon glass-lined reactors) and a filtration system for the pilot-scale production of cellulose nanocrystals. Researchers at FPL hope to use the robust strength of CNCs to produce high-performance composite materials, including applications requiring high clarity, such as bullet-proof glass for military vehicles.

New Web-Based Video Series: Moisture Management in Residential Construction

By Rebecca Wallace, Public Affairs Specialist

The Forest Products Laboratory recently partnered with the National Association of Home Builders (NAHB) Research Center to develop a series of web-based instructional videos aimed at overcoming moisture-related challenges in home building. These 14 short videos cover the basic functions of the building enclosure (the shell of the house that separates the indoors from the outdoors) and provide specific guidance on recommended practices. The videos were recorded at construction sites to illustrate moisture management techniques in action. Several topics are featured:

- Overview of the building enclosure, including foundation, exterior walls, and roof
- Installation of house wrap, windows, and exterior doors
- Installation of absorptive cladding systems, including brick and stone veneer
- Issues relating to managing heat flow, air flow, and water vapor flow
- Importance of a quality management system, with an example of "hot spot" quality training


www.flickr.com/creativecommons

Watch and learn at http://www.fpl.fs.fed.us/products/presentations/video-moisture-management-residential-construction-series.php

Presidential Honor Awarded to FPL Scientist Samuel Zelinka

By Rebecca Wallace, Public Affairs Specialist

Steve Schmieding, USDA FS-FPL

Sam Zelinka

President Obama named Forest Products Laboratory (FPL) engineer Samuel Zelinka as a recipient of the Presidential Early Career Awards for Scientists and Engineers. Zelinka is one of 94 recipients for the 2011 award, the highest honor bestowed by the U.S. government on science and engineering professionals in the early stages of their independent research careers.

Sam Zelinka, USDA FS-FPL

"It is inspiring to see the innovative work being done by these scientists and engineers as they ramp up their careers—careers that I know will be not only personally rewarding but also invaluable to the Nation," President Obama said. "That so many of them are also devoting time to mentoring and other forms of community service speaks volumes about their potential for leadership, not only as scientists but as model citizens."

Zelinka is a research materials engineer in FPL's Durability and Wood Protection Research unit. He conducts fundamental research on how wood reacts to water and also studies the corrosion of metals in wood. He has also developed several time-saving methods to evaluate how metal fasteners react in new preservative formulations for treated wood. Zelinka's research directly contributes to FPL's work on obtaining the economic and environmental benefits of using wood and wood products in green building construction.

The honor is the first of its kind to be awarded to an FPL scientist. "We are very proud of Sam and his scientific accomplishments," says FPL Acting Director Ted Wegner. "His diligence and dedication to research are reflected by this honor, and will serve him well as his career progresses."

A graduate of the University of Wisconsin, Zelinka is passionate about what he does. "I have a great job. I get to explore phenomena that are not, and have never been, understood," he explains. "And I have the freedom to choose how I want to probe these questions. It's addicting."

The Presidential early career awards embody the high priority the Obama Administration places on producing outstanding scientists and engineers to advance the Nation's goals, tackle grand challenges, and contribute to the American economy. Sixteen Federal departments and agencies join together annually to nominate the most meritorious scientists and engineers whose early accomplishments show the greatest promise for ensuring America's preeminence in science and engineering and contributing to the awarding agencies' missions.

The awards, established by President Clinton in 1996, are coordinated by the Office of Science and Technology Policy within the Executive Office of the President. Awardees are selected for their pursuit of innovative research at the frontiers of science and technology and their commitment to community service as demonstrated through scientific leadership, public education, or community outreach.

"It is inspiring to see the innovative work being done by these scientists and engineers as they ramp up their careers—careers that I know will be not only personally rewarding but also invaluable to the Nation."

-President Obama

FPL Research Supports USDA's $80 Million Biofuels Investment

By Rebecca Wallace, Public Affairs Specialist

Steve Schmieding, USDA FS-FPL

JunYong Zhu

Washington State University (WSU) and University of Washington have each been awarded a five-year, $40 million grant from the U.S. Department of Agriculture to help develop alternatives to petroleum-based fuels and chemicals. As a partner in the WSU-led Northwest Advanced Renewables Alliance (NARA), the Forest Products Laboratory (FPL) will receive $1.1 million to pretreat woody biomass for conversion to aviation fuel.

"This is an opportunity to create thousands of new jobs and drive economic development in rural communities across America by building the framework for a competitively priced, American-made biofuels industry," Vilsack said. "Public–private partnerships like these will drive our nation to develop a national biofuels economy that continues to help us grow and out-compete the rest of the world while moving our nation toward a clean-energy economy."

NARA includes a broad consortium of scientists from universities, government laboratories, and private industry. The WSU-led grant aims to address the urgent national need for a domestic biofuel alternative for U.S. commercial and military air fleets. NARA researchers envision developing a new, viable aviation fuel industry using wood and wood waste. The project also will focus on increasing the profitability of wood-based fuels through development of high-value, bio-based co-products to replace petrochemicals that are used in products such as plastics.

FPL research engineer JunYong Zhu will demonstrate his patent-pending technique, SPORL (Sulfite Pretreatment to Overcome Recalcitrance of Lignocellulose), in the NARA program. Zhu has successfully used SPORL on lodgepole pine woody biomass (juvenile wood with a high lignin content), but his contribution to NARA will be using SPORL on biomass of another softwood, Douglas-fir, grown by Weyerhaeuser.

SPORL was developed on the basis of sulfite pulping technology, which has been carried out at a large commercial scale for decades. By making use of existing equipment, processes, and knowledge of the pulp and paper industry,

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SPORL presents fewer technical barriers to building new plants or to retrofitting existing pulp mills to production of biofuels. The process also reduces energy requirements and will address feedstock variability of bark, needles, and branches. This pretreatment process is an integral part of converting woody biomass to aviation fuel. The pretreated materials will be sent to Weyerhaeuser and Gevo for conversion to renewable chemicals and advanced biofuels, respectively.

Continued from page 1 – Research into Reuse

The individual blocks are made of both solid wood and sawdust elements and feature interlocking notches. Lee fit the blocks together to create a large-scale suspended sculpture that is now on permanent display at the Madison Children's Museum. The installation also includes blocks for children to create their own structures, and is titled "A Product's By-product, A By-product's Product."

As for the collected sawdust, Hunt used the waste from Lee's project to create a series of test panels. Made from sawdust and recycled paper pulp fibers, Hunt produced the panels using wet-forming and heat-pressing processes without the use of adhesives.

Hunt went on to evaluate the physical and mechanical properties of the binder-less boards, and he and Lee presented the findings of their collaboration at the Building Materials Reuse Association's DECON 11 conference.

"It's great that we were able to present a successful collaboration that worked across the disciplines of art, design, and engineering," says Lee. "This feels like the right way to go in the future. If design students are introduced, early in their schooling, to the idea of science and technology behind design, that mix of perspectives greatly opens the potential of what they can achieve."

Lee and Hunt plan on continuing their collaboration and further investigating uses for the panels they've developed. Potential uses include cabinetry and furniture products.

Christine Lee

Artist Christine Lee used scrap wood to create multiples of a building block inspired by her childhood experience with Lincoln Logs.

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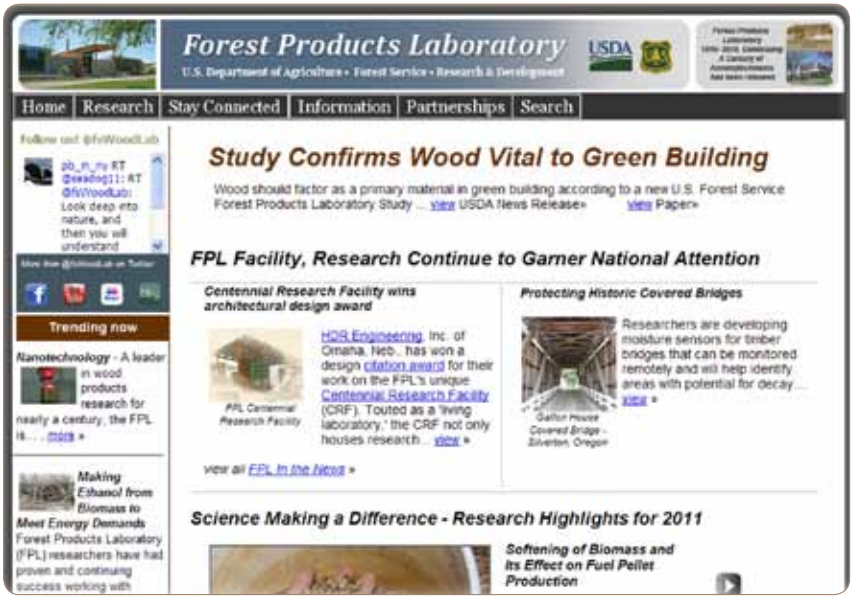
Research at the Forest Products Laboratory is always evolving.

Keep up with the latest research news by visiting our website at www.fpl.fs.fed.us and following @fsWoodLab on Twitter.



Wood as a Green Building Material

Agriculture Secretary Vilsack urges U.S. builders to prioritize wood in green buildings

USDA FS-FPL, FPL_GTR-206

USDA FS-FPL, FPL_GTR-206

By James T. Spartz, Public Affairs Specialist

Findings in a recent Forest Products Laboratory (FPL) study suggest that wood should factor as a primary building material in green building. The report, Science Supporting the Economic and Environmental Benefits of Using Wood and Wood Products in Green Building Construction, reviews the scientific literature and determines that using wood in building products yields fewer greenhouse gases than using other common materials.

"This study confirms what many environmental scientists have been saying for years," said Agriculture Secretary Tom Vilsack. "Wood should be a major component of American building and energy design. The use of wood provides substantial environmental benefits, provides incentives for private landowners to maintain forest land, and provides a critical source of jobs in rural America."

The report suggests that greater use of life cycle analysis in building codes and standards would improve the scientific underpinning of such codes and standards. Advancement in life cycle analysis procedures and the development of new technologies for improved wood utilization are needed to further advance wood as a green construction material. The sustainability of forest products can be verified through credible third-party rating systems such as the Sustainable Forestry Initiative, Forest Stewardship Council, or American Tree Farm System.

The use of forest products in the United States currently supports more than one million direct jobs, particularly in rural areas, and contributes more than $100 billion to the country's gross domestic product.

"In the Rockies alone, we have hundreds of thousands of dead trees killed by bark beetles that could find their way into the building supply chain for all types of buildings," said Forest Service Chief Tom Tidwell. "Taking a harder look at wood as a green building source could reduce the damages posed by future fires, maintain overall forest health, and provide much-needed jobs in local communities."

The report identifies several areas where peer-reviewed science can contribute to sustainable green building design and decisions:

- Updating and revising information on environmental impacts across the lifecycle of wood and alternative construction materials
- Ensuring that green building codes and standards adequately recognize the benefit of a lifecycle environmental analysis to guide selection of building materials
- Developing educational, technology transfer, and demonstration projects to promote the acceptance of wood as a green building material

Research recently initiated by the wood products industry in partnership with the FPL will enable greater use and valuation of smaller diameter trees and insect- and disease-killed trees. Research on new products and technologies has also been initiated, including improved cross-lamination techniques and increased use of nanotechnology.

These developments are especially important amidst a changing climate because forest managers will need to increasingly thin densely forested areas in coming years to reduce the impacts from longer and more severe wildfire seasons. Continued research of wood-based products and technologies will contribute to more environmentally responsible building materials and increased energy efficiency.

2012 Woody Biomass Grants Program

The U.S. Department of Agriculture will be requesting proposals to address the nationwide challenge of using low-value woody biomass material to create renewable energy and protect communities and critical infrastructure from wildfires. These proposals must pertain to wood energy projects that require engineering services.

Examples of projects might include engineering design of a

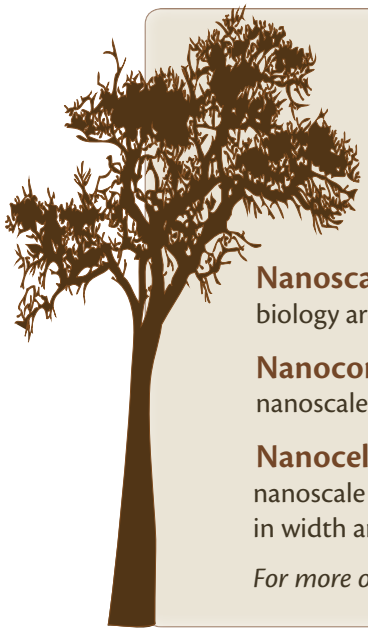
- woody biomass boiler for steam at a sawmill, hospital, or school,
- non-pressurized hot water system for various applications, or
- biomass power generation facility.

Proposed projects will use woody biomass, such as material removed from forest restoration activities, wildfire hazardous fuel treatments, insect and disease mitigation, forest management due to catastrophic weather events, and/or thinning overstocked stands. The woody biomass shall be used in a bioenergy facility that uses commercially proven technologies to produce thermal, electrical, or liquid/gaseous bioenergy. Funds from the Hazardous Fuels Woody Biomass Utilization (WBU) Grant program must be used to further the planning of such facilities by funding the engineering services necessary for final design and cost analysis.

TMU, USDA FS-FPL

Check for full application preannouncement information at www.grants.gov (search CFDA number 10.674). Applications are due March 1, 2012.

Wood Wise—*Terms from the World of Wood*



Nanometer: A distance unit representing one-billionth of a meter, or one-millionth of a millimeter (roughly one-millionth the thickness of an American dime).

Nanotechnology: A collective term referring to the understanding and engineering of materials at the nanoscale. Physical phenomena are found at this microscopic scale that differ from those operating at the macroscopic scale.

Nanoscale: A size range from 1 to 100 nanometers, where many of the fundamental structures of biology are formed and where composite materials may take on distinctive characteristics.

Nanocomposite: A material composed of two or more substances, at least one of which has a nanoscale dimension, such as nanoparticles dispersed throughout another solid material.

Nanocellulose: Also called microfibrillated cellulose, this microscopic material is composed of nanoscale cellulose fibrils with a high length-to-width ratio. Typical dimensions are 5–20 nanometers in width and up to 2,000 nanometers in length.

For more on nanotechnology visit www.nano.gov.

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