Forest Products Laboratory

NewsLine

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New Soy-Based Adhesive Offers Earth-Friendly Alternative for Bonding Wood

By Rebecca Hoene, Public Affairs Specialist

A wood adhesive that contains up to 75 percent soy has been developed at the Forest Products Laboratory (FPL) in Madison.

Researchers from FPL collaborated with researchers from Heartland Resource Technologies of Oelwein, Iowa, to create a low-cost, durable product that is more environmentally friendly than today's petroleum-based adhesives.

A look into the history of wood adhesives gave researchers a clue to the future of the product.

Soy-based glues were popular in the early 20th century and worked well in plywood panels, as long as they were kept dry. The poor water resistance of soy-based adhesives limited their use to internal applications. This factor led to their almost complete replacement by petroleum-based adhesives, which were superior in durability and lower in cost. Since the transition, petroleum-based glues have dominated the markets.

The recent increase in the price of petroleum would make soy-based glues an attractive alternative if previous limitations could be overcome. Charles Frihart, Supervisory Research Chemist at FPL, and James Wescott, Chief Operations and Technical Officer of Heartland Resource Technologies, decided to study soy as an adhesive and see if they could improve upon old formulations.

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Evergreen participants tour FPL's facilities and meet with researchers to discuss possible business opportunities.

Partnership for Progress: FPL and The Evergreen Foundation Team Up to Energize Small Businesses and Improve Forest Health

By Rebecca Hoene, Public Affairs Specialist

It seems like a simple solution.

Approximately 470 million acres of forestlands nationwide are at risk for catastrophic wildfire, insect infestation, and disease. Thinning these forests will improve their health, but it is a costly process.

On the other hand, many forest products industries are in need of a wood supply to sustain

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New Soy-Based Adhesive

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"The purpose of this project was to see if we could build on the advantageous properties of soy and overcome its main deficiency of failing when wet," said Wescott.

In order to do this, the two decided to look at the project from a new angle.

"Although soy research isn't new, our approach is different," said Frihart. "We took a very scientific, systematic approach to understanding the chemistry of soy adhesives. Others have looked at how much soy can be added to an adhesive. We're looking at making soy an integral part of the network that actually gives strength to the material."

A Promising Product

Researchers developed several formulations of soy and phenol hybrid adhesives and used them in the face section of strandboard. The samples were tested using standard methods, including immersing the boards in water for 24 hours and boiling them for 2 hours. The samples were then evaluated to determine how well they held up.

"We were able to create an adhesive that was up to 75 percent soy, with the remainder being phenol and formaldehyde, that proved to be very durable," said Wescott. Not only does this adhesive use much less petroleum-based phenol than a standard adhesive, but it also uses less natural-gas-based formaldehyde.

In addition to studying the fundamental chemistry of the adhesive, researchers knew that what they developed had to be commercially viable. With those two aspects of the project in mind, they created an adhesive that performs equally as well as those available today and can be manufactured using a process very similar to what manufacturers currently employ.

The new formulation provides several environmental benefits, as well. In addition

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

This soy-based adhesive is environmentally sound and is produced using a renewable resource.

to reducing the amount of petroleum in the product, soy-based adhesives put an underused resource to work. According to Wescott, soy is grown and harvested primarily for its oil. Once the oil is extracted, the remaining flour, or soy meal, is used as animal feed. Soy flour is used to manufacture this new adhesive, thereby creating a higher value product from a low-value material.

"This is a feel-good project," said Wescott. "Environmentally and economically, this is the right way to go."

A Productive Partnership

Frihart and Wescott credit the success of this project to the strong partnership between FPL and Heartland Resource Technologies. This partnership is a shining example of a Cooperative Research and Development Agreement (CRADA), which allows government agencies to work with private industry toward a common goal.

"CRADAs provide interactions with others in similar fields," said Frihart. "This leads to sharing of knowledge and ideas, furthering basic and applied research, and support for technology transfer efforts."

In this case, Heartland Resource Technologies, a small business with no laboratory capabilities, was able to benefit from the use of FPL's research facilities and the time and knowledge of the adhesives research group located there. FPL researchers gained an opportunity to further their knowledge and perform basic, fundamental research that furthers the mission of the Lab.

At their best, Wescott says CRADAs are a win-win situation. "They can be a positive collaboration where everyone involved is helping each other," he said.

Frihart hopes the success of this partnership will lead to future collaboration. "This CRADA shows private industry that the government has productive, cooperative interactions that are worth pursuing," he said.

Partnership For Progress *(continued from page 1)*

their businesses. Creating valuable products from forest thinnings is one way to offset the cost of thinning operations while also boosting rural economies that depend on the forest industry.

A recent Forest Service study determined that thinning 60% of Class II and III lands (those at the highest risk for catastrophic fire) would result in the removal of 30 million bone dry tons of wood per year for 30 years. This study projected that the majority (86%) of trees that could be removed are less than 10 inches in diameter. Nearly two billion trees are in the 2-inch-diameter class alone.

Although the resource is there, very few businesses are equipped to handle small-diameter material.

Recognizing this, the Forest Products Laboratory (FPL) is teaming up with the Evergreen Foundation to help small businesses see the value in putting forest thinnings to use, for the benefit of their companies and for the good of the land.

FPL and the Evergreen Foundation first teamed up when FPL's Technology Marketing Unit (TMU) contacted the foundation about the possibility of a story in Evergreen Magazine, focusing mainly on technology the Lab was developing to create high-value products from low-value materials, such as forest thinnings. Following a visit to the Lab by Evergreen's founder, Jim Petersen, a story did emerge. But Petersen wanted to do something bigger.

According to FPL Director Chris Risbrudt, Petersen wanted to educate the people who could make the most of the Lab's research. Petersen proposed coordinating trips to the lab for the key players in the forest industry, such as owners of small- to medium-sized mills and other entrepreneurs.

"It's important for us to reach small business owners, community leaders, and anyone who plays a role in the forest products industry and supports getting new products to market," says Risbrudt. "Ultimately, we hope to have people starting new business lines using FPL technology."

Join us!

The next Evergreen entrepreneur tour is planned for Fall 2004, and we are looking for participants.

Tours are two days long and include

- an overview of the Forest Products Laboratory,
- tours of our research facilities, including the research demonstration house, composites lab, engineering mechanics lab, and paper plant,
- poster presentations by our research work units, and
- one-on-one discussion time with researchers of your choice.

If you are interested, contact Gordie Blum at 608-231-9325 or gblum@fs.fed.us for more information.

The Forest Service study mentioned in this article, "A Strategic Assessment of Forest Biomass and Fuel Reduction Treatments in Western States," can be found at www.fs.fed.us/research/pdf/Western_final.pdf

Keith Olson, executive director of the Montana Logging Association, visited FPL on an Evergreen tour. As a professional forester, he was always interested in FPL's mission and contributions. And now he sees great opportunity for the Lab, as well as for small businesses in his area, as we face the challenge of restoring the health of overstocked forests.

"The on-the-ground expertise and technology to perform this crucial work exists," says Olson. "But if we're going to get serious about fuels reduction, these projects must pay for themselves."

Olson says that in a few instances, thinning projects will pay for themselves, but the vast majority will not—unless new products and markets are developed for the enormous quantities of small roundwood that fuels reduction projects will produce. According to Olson, the Forest Products Lab has developed the technology to do just that.

During his visit to FPL, Olson was struck by the enormous potential of what was being developed and admits that his first visit to the Lab was a bit overwhelming. From composite products to energy, he saw new markets for the small-diameter material that needs to be removed from our forests.

Olson believes that success in creating new markets and products using small-diameter material will open a new chapter in American forestry and allow forest stewardship to be practiced on an unprecedented scale.

"We have to make this process work, for the sake of the forests and the economy," says Olson.

As a member of the Navajo County Board of Supervisors in Holbrook, Arizona, Pete Shumway witnessed the loss of infrastructure in the Apache–Sitgraves National Forest as forest sales declined and the number of small trees in the forest increased.

Shumway was already aware of possible uses for the small-diameter material and biomass crowding forests in his area. From energy and composites to structural uses and flooring, Shumway saw opportunities for small businesses, so he decided to participate in an Evergreen tour to see what the Forest Products Laboratory was developing in these arenas.

"The visit to the Lab was very productive," says Shumway. "We're moving in a positive direction, and learning to use this resource in cooperation with the Forest Products Laboratory is important to us."

Cooperation with members of the forest products industry is important to FPL as well. According to Gordie Blum, FPL public affairs director, many exciting opportunities can come of the Lab's research, but the developments must be implemented by industry to have an impact on forest health and rural economics.

The Evergreen tours have helped extend the reach of FPL developments to the people that can best put them to use.

"Small businesses have been so receptive to our research," says Blum. "They are often willing to take chances on new technology, and for this reason, they may hold the key to restoring some of the lost forest products industry infrastructure."

FPL Research Leads to Patents

by George Couch, Public Affairs Specialist

Two U.S. patents were awarded recently for inventions by FPL researchers. Both patents were assigned to the USDA.

One patent was for a method that uses fungi to degrade creosote-treated waste wood (such as old railroad ties and utility poles), thereby reducing the amount of toxic waste requiring expensive disposal. The naturally occurring creosote-tolerant fungi metabolize the creosote and degrade the waste wood, reducing its volume and potentially rendering it suitable for reuse in paper or wood composites. FPL's Barbara Illman and Vina Yang and former FPL researcher Leslie Ferge are listed as inventors. The patent is the fifth in a series of patents awarded to Illman's team for using fungi to remediate wood treated with pentachlorophenol (PCP), alkaline copper quat (ACQ) and copper chromated arsenate (CCA).

The other recent patent is for a slow-acting termite bait that uses the naphthalenic laser dye N-hydroxynaphthyalimide (NHA) as the toxicant. Unlike most termidicides, NHA contains no heavy metals. FPL microbiologist Frederick Green III discovered the compound's biocidal effect on termites while researching it as a wood preservative. He contacted entomologists M. Guadalupe Rojas and Juan A. Morales-Ramos at the USDA's Agricultural Research Station in New Orleans, who combined the compound with a cellulose matrix that would attract termites, especially the large and highly destructive colonies of the Formosan subterranean termites, who tend to avoid existing termite baits. Rojas, Morales-Ramos and Green are listed as the inventors. Because the termite bait is effective at low doses, it is considered environmentally friendly and cost-effective.

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Questions?

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ASK FPL

We get thousands of questions each year about wood and paper products. In each issue of NewsLine we print what we feel are some of the best. Here are two we recently received.

I have an antique chair with a broken leg. I'd like to replace the leg with the same type of wood, but I don't know what the chair is made of. Can someone at FPL identify the wood for me?

Yes, experts in our Center for Wood Anatomy Research can perform wood identifications for the public. In fact, researchers identify more than 1,500 samples per year.

Identifications are performed using a hand lens and a microscope, which magnify the wood cells to make them clearly visible. FPL houses the largest collection of wood samples in the world, which can be used to compare samples that are difficult to identify.

Researchers will perform five wood samples per year free of charge for the public. Persons or businesses in need of more than five identifications per year should contact the Center for Wood Anatomy.

For more information about submitting a sample for identification, visit the Center for Wood Anatomy website at www2.fpl.fs.fed.us/WoodID/idfact.html or contact the Forest Products Laboratory.

I was told that the discoloration on lumber I plan to use for construction is caused by blue stain. What is blue stain and will it damage the wood?

Blue stain is caused by microscopic fungi. The spores of blue stain are carried to the wood by insects, and in favorable conditions, the spores grow rapidly.

Blue stain fungi often cause a bluish or grayish discoloration of wood, but various shades of yellow, orange, purple, and red sometimes appear. The discoloration may occur as specks, spots, streaks, or patches of color.

Blue stain does not cause decay. The fungi has no effect on the strength of the wood and therefore does not affect its usefulness. In fact, some people like the look produced by blue stain and use the wood for decorative wood products.

Forest Products Laboratory

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Chris Risbrudt
Director

Open House at FPL

"Ask FPL" is the theme for the 2004 Open House at the Forest Products Laboratory in Madison, Wisconsin. The event will take place on Saturday, September 18, 2004, from 10 am to 3 pm. Experts will be on hand to answer questions about wood, paper, and composites and to discuss current research projects. Highlights of the day include tours of the Research Demonstration House, Engineering Mechanics Lab, and paper Pilot Plant, and a display of artwork created using wood products. Visitors can bring wood samples for identification, participate in a hands-on papermaking demonstration, and see the latest in water filtration using wood fiber. For directions to the Lab, visit our website at www.fpl.fs.fed.us.

Our 4 bedroom, 2300 square foot Research Demonstration House and many other areas of the FPL campus will be open to the public on Saturday, September 18 from 10 a.m. until 3 p.m.