Forest Products Laboratory

NewsLine

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Urgent Phone Call Rekindles Forest Service Laboratory's Interest in Wood Propellers—and Military Aircraft

By George Couch, Public Affairs Specialist

In mid-July 2006, an anxious phone call from a leading manufacturer of airplane propellers to the USDA Forest Service's Forest Products Laboratory (FPL) rekindled FPL's involvement with wood propellers and research to meet wartime needs of the U.S. military.

Nearly 90 years ago, as World War I dragged on in Europe, FPL, which had been conducting research related to wood aircraft frames for the U.S. War Department (predecessor of today's Department of Defense), established an experimental propeller laboratory to investigate the problem of warping and twisting caused by atmospheric humidity. Technicians worked around the clock, in three shifts, producing experimental propellers under controlled temperature and humidity conditions. When the war ended, the military asked FPL to complete the work because of its importance.

The recent phone call, from Sensenich Wood Propellers in Plant City, Fla., echoed that wartime project. Sensenich makes propellers from laminated sugar maple veneer for the Shadow 200™ tactical unmanned aerial vehicles (TUAV), which are used for reconnaissance and surveillance by American soldiers in Iraq. The harsh operating conditions in Iraq necessitate frequent prop replacement.

Sensenich has been making wood propellers since 1932, and they've been making propellers for military UAVs for more than 40 years. But making propellers that would be subjected to the conditions experienced in Iraq was new.

Steve Boser, vice president for engineering at Sensenich, wanted to know more about the potential effect on the propellers of the transition from the humidity of Florida to the dry conditions in Iraq, where they might be stored for up to several months.

Boser wanted to find out just how much the predrilled mounting holes would move or shrink as the seasoned wood endured the extreme conditions of Iraq. So he called on one place he had often called before when technical questions arose about the performance and engineering qualities of wood: FPL, the nation's leading research facility focusing on wood utilization and preservation. Researchers there have accumulated masses of data about the behavior of wood under a variety of conditions.

Describing the problem to FPL's Rick Bergman and Robert Ross, Boser asked if FPL could provide precise data on the shrinkage of the propellers as they dried. Given the urgent nature of the project, the FPL researchers agreed to tackle the problem immediately and process the paperwork later.

On July 20, a package of seven propellers, two of them sealed in plastic bags, arrived at FPL. After some initial measurements were made, they were placed in a controlled-environment room to stabilize at a uniform "normal" 11 percent moisture content. A few days later, the five unsealed blades underwent a series of measurements . . . 66 measurements per propeller. On Friday, July 28, the props went into a laboratory oven

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A Flood of Problems

Researchers address a health hazard that lingers long after flood waters recede

By Rebecca Wallace, Public Affairs Specialist

Before the catastrophic hurricane season of 2005 drew widespread attention to the issue of flood-related pollution, researchers from the Forest Products Laboratory (FPL) and the University of North Dakota (UND) began studying the problem of indoor air pollution that can follow massive flooding.

Personal experience is what drew Drs. Evguenni Kozliak and Wayne Seames of the UND Chemistry and Chemical Engineering departments toward this complex form of pollution. In April 1997, the Red River flooded Grand Forks, North Dakota, spurring long-lasting indoor air pollution problems.

During the flood, fuel oil tanks in residential basements ruptured and spilled their contents into the floodwaters. The volatile mixture was absorbed into concrete walls and wood building materials and became embedded in these porous materials. After the flood, slow evaporation of the oil and water continued, releasing hydrocarbons into the air and exposing residents to indoor air pollution for years to come.

When chemicals are absorbed into building materials such as wood or concrete, common remediation techniques, such as heating or washing, are ineffective. The chemicals can become trapped along with water inside the porous spaces of the solid materials, making them inaccessible to common treatments. Complete removal of the contaminated materials is also common, although it can be nearly impossible when the entire foundation of a structure is affected by pollution.

In search of a feasible solution to this problem, UND researchers went looking for anyone who had information on decontamination methods and the unique properties of building materials. Their search led to a partnership with FPL.

"When flooding causes massive damage to large sections of buildings, traditional methods of remediation, such as material removal, are no longer feasible," says Dr. Charles Frihart, research chemist and head of the Wood Adhesives Science and Technology unit at FPL. "Our partnership and research with UND started focusing on removing the contaminants instead of the materials themselves." Eventually, the research evolved into two different approaches to addressing this particular cause of indoor air pollution.

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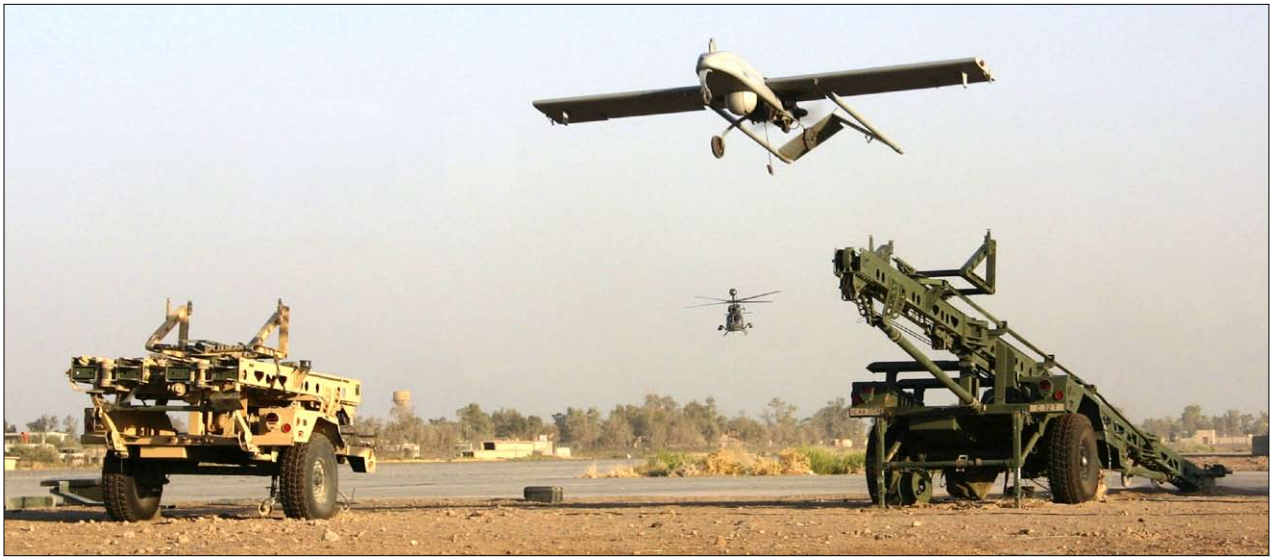
Check out our website at http://www.fpl.fs.fed.us

Urgent Phone Call Rekindles Forest Service Laboratory's Interest in Wood Propellers—and Military Aircraft *(continued from page 1)*



A propeller-driven Shadow 200 unmanned reconnaissance vehicle is launched at a base in Iraq. (Photo courtesy of AAI Corporation)

at 150° F to dry to 3 percent moisture content, similar to the condition expected following a few months storage in Iraq. That weekend, FPL electronics technician Marc Joyal repeated the measuring process seven more times at six-hour intervals as the wood dried. The resulting data were used to produce engineering drawings depicting the shrinkage and resulting movement of the mounting holes. Digital imaging verified the physical measurements obtained with calipers.

FPL reported back to Boser that analysis of the measurement data revealed shrinkage and movement of the predrilled holes consistent with earlier research findings about wood shrinkage. In his formal report to Boser, FPL's Bergman suggested a few approaches to avoiding problems, such as making the laminated blanks and shaping them into propellers under controlled-humidity conditions more similar to conditions in Iraq, or sealing them in airtight packaging to prevent further drying.

For FPL's Joyal, who spent the weekend measuring and remeasuring the propellers, the importance of what he was doing—and doing it quickly—was clear. Joyal had served several months in Iraq in 2003 as a First Sergeant in an Army National Guard unit from Wisconsin.

Wood You Believe...

- that FPL has over 103,000 specimens in our xylarium (wood collection).
- that we can identify samples of wood you bring in or send to us using our wood identification procedure. For more information on how to send in wood id samples, visit www.fpl.fs.fed.us or contact us at (608) 231-9200.

Ask FPL

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

Questions?

Contact us at
Forest Products Laboratory,
One Gifford Pinchot Drive,
Madison, WI 53726-2398

http://www.fpl.fs.fed.us

or write

mailroom_forest_products_laboratory@fs.fed.us

We can also be reached by telephone at

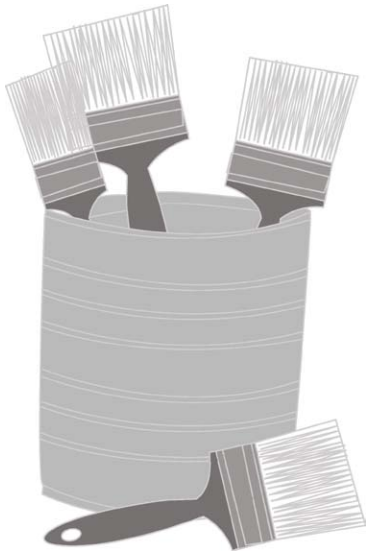
608-231-9200

TDD: 608-231-9544

FAX: 608-231-9592

How late in the fall can I apply a finish to exterior wood?"

As the leaves change color and temperatures drop, we suddenly realize that autumn is here and the outdoor "to do" projects we listed in the spring haven't all been completed. So we start hustling to get those outdoor projects finished. This time of year, we receive many questions regarding finishing wood outdoors (decks, exterior siding, outdoor furniture, fences, art work, etc.).



When finishing wood outdoors, temperature is one of the first things to consider. If applying a pretreatment of paintable water-repellant preservative (recommended method), temperature should be greater than 70°F for the best possible results. Temperature should be at least 40°F for applying oil-based paints and at least 50°F for latex paints.

Next, is the wood wet or dry? A wet surface will need at least one sunny day to dry before you apply a finish. Saturated wood will need several days of sun or wind before a finish can be applied. After washing the surface to remove dirt, mold, or mildew, allow a day or two for the surface to dry before applying a finish. For any surface that is already clean, wait until the morning dew has dried off the surface before you start painting.

Avoid painting when the sun is directly on the surface you are finishing. "Follow the sun around the house"—paint the east side in the late morning, the south side in the middle of the afternoon, the west side late in the afternoon. The north side can be painted at any time during the day, but allow at least 2 hours for the paint to set before temperatures cool to the point that dew forms.

If you move outdoor furniture and artwork inside to apply a finish, observe appropriate safety measures. The area should be well ventilated. Solvent-borne formulas are flammable and volatile—be sure to read and follow all directions and precautions on the container of the finish you are using. Preservatives should not be used indoors unless recommended.

Publications and tech sheets on finishes and application methods are available on the FPL website (www.fpl.fs.fed.us). If you would like any of these publications mailed to you, please contact us by email (mailroom_forest_products_laboratory@fs.fed.us) or phone (608-231-9200).

The Building Materials Reuse Association (BMRA) Conference on Deconstruction and Building Materials Reuse

details at www.buildingreuse.org

Plan Now to Attend!

Sponsored by the BMRA and the USDA Forest Products Laboratory in cooperation with WasteCap Wisconsin

May 14–16, 2007
Madison, Wisconsin
University of Wisconsin Campus

A Flood of Problems *(continued from page 2)*

Cleaning Contaminated Materials With Tiny Organisms

One route the decontamination research has taken is the potential for bioremediation—the process of applying bacteria that have the ability to degrade contaminants directly to the affected building materials.

UND researchers had successfully completed a feasibility study on bioremediation of concrete, so researchers wanted to expand those existing protocols to wood, which has a significantly different pore structure than concrete. Achieving this required fundamental research to fully understand how bioremediation would work for wood.

"One interesting aspect of this research is that the migration rate of chemicals through wood is not well known," says Frihart. "Much has been learned about driving large amounts of chemicals into wood, for example by pressure-treating, for the purpose of preservation. However, little is known about what happens in terms of migration when chemicals simply come in contact with wood."

To test the effectiveness of bioremediation, researchers contaminated various-sized specimens of southern yellow pine with pollutants, chosen based on their solubility in water and volatility. The specimens were then treated with bacteria under various controlled conditions, and the efficiency of the bacteria at removing the pollutants was analyzed. Based on their findings, researchers were able to develop a parametric equation describing the penetration of various chemicals in wood and create protocols for the effective removal of chemicals from wood using bioremediation.

And Cleaning Air With…Sunlight?

A typical approach to indoor air purification is the physical removal of contaminated air by ventilation. Unfortunately, current methods are inefficient and waste energy.

Seeing improved air filtration as a promising remediation method, FPL and UND researchers began focusing on photoremediation. Photoremediation involves a photocatalyst, such as titanium dioxide, which is activated by a light source. A photocatalyst exposed to ultraviolet light—such as that in sunlight—generates reactive radicals capable of oxidizing any organic matter, rendering it harmless. Modified properly, photocatalysts can perform this important function without producing any toxic by-products, such as ozone or hydrogen peroxide.

Preliminary research led FPL and UND scientists to the formulation of an efficient titanium dioxide-based photocatalyst that is currently being patented. Researchers used this formulation in the development of a novel indoor air purification device that has been demonstrated at bench-scale.

A Very Viable Technology

The next step for both the bioremediation and photoremediation projects is scaling them up to real-world applications. Researchers will be testing commercially relevant bioremediation methods on full-scale wood and concrete samples, such as basement walls and subflooring. They will also be designing and constructing a full-scale indoor air purifier, expected to be complete by fall 2006.

"Developing an air filtration system using photoremediation is a very viable technology," says Frihart. "It is one of the most promising aspects of this research as far as it having a direct impact on people affected by indoor air pollution."

Frihart adds that the results of this research will benefit a large segment of the population, not only those affected by flood-related indoor air pollution. "By adding this technology to existing electrostatic purifiers currently on the market, we will be able to address all types of indoor air pollutants with one filtration system," he says. "This includes everything from chemical pollutants to biological contaminants such as mold and dust mites, which many people are allergic to."

And with that development on the horizon, perhaps we'll all be able to breathe a little easier.

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Chris Risbrudt
Director

Treated Wood In Use

Preservative-treated wood is used for walkways in many different climates throughout the country. Shown here are some preservative-treated walkways located in Yellowstone National Park, which spans Wyoming, Montana, and Idaho. Treated wood is often the material of choice for these applications because it is durable, easy to work with, and fits well with the natural setting. Researchers at the Forest Products Laboratory (FPL) are evaluating and developing wood preservatives that protect wood while remaining compatible with the environment. For more information about preservatives or preservative research, contact FPL or visit our website: www.fpl.fs.fed.us.