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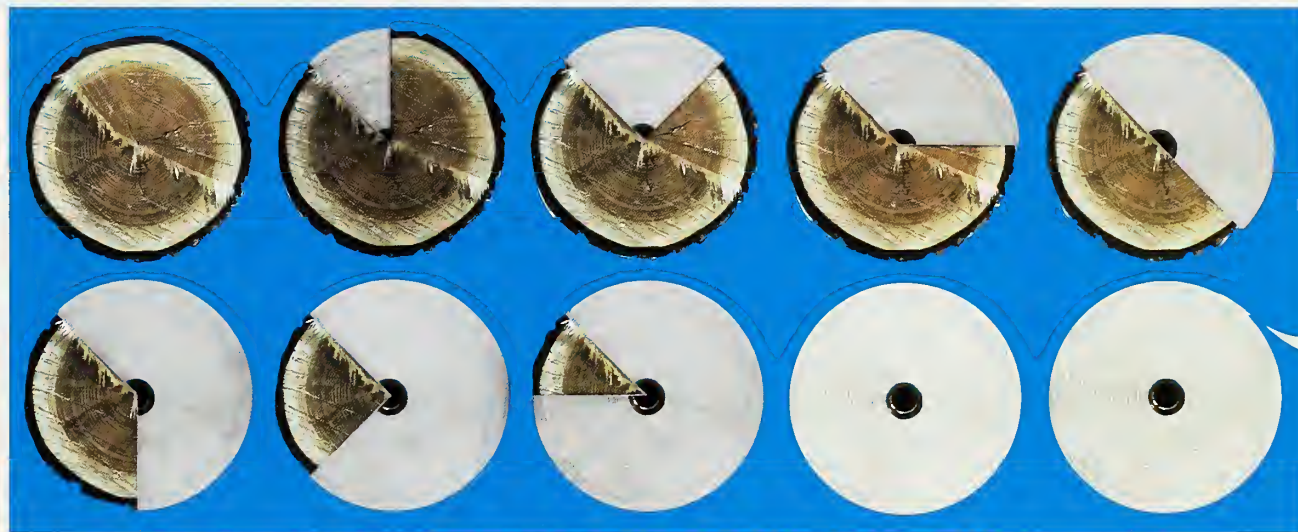
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Exploring the Possibilities  
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*Pulp & Paper*  
Shared Use of the FPL Laboratories



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# Introduction

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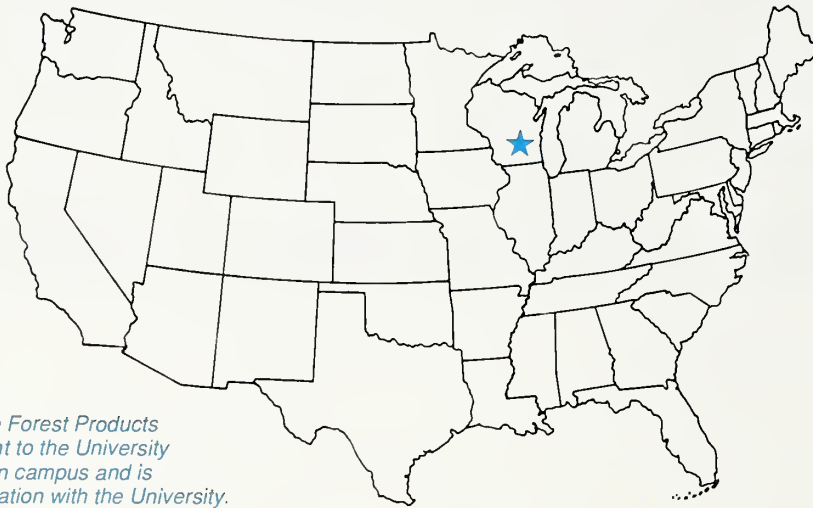
Sharing resources for mutual benefit and insight. That's the aim of cooperative research at the Forest Products Laboratory. We want to collaborate with your company or research organization in using our pulp and paper laboratory's raw-wood-to-finished-product capabilities.

The Forest Products Laboratory (FPL), a USDA Forest Service research center, is located in Madison, Wisconsin. The mission of FPL is to improve the use of wood through science and technology, thereby contributing to the conservation and management of the forest resource. A principal goal of our research is to enhance the competitive position of U.S. forest products in the global economy.

We conduct research in the areas of wood processing and protection; wood products; wood chemistry; pulp, paper, and composites; biotechnology; and energy from wood.

The pulp and paper laboratory has been instrumental in many FPL studies, such as press dry papermaking, environmentally compatible pulping and bleaching methods, and recycling. Major equipment includes pulping digesters, disk refiners, deinking equipment, a low- and high-consistency pulper, a fourdrinier paper machine, a single-facer corrugator, and paper testing and analytical laboratories.

The FPL has a history of cooperative research and shared use of its equipment, staff, and buildings. These resources are available to industry, government, and university cooperators for studies of mutual interest. If you have a project postponed for lack of facilities or are seeking a lower-cost alternative to constructing your own pilot-scale facilities, perhaps FPL's pulp and paper laboratory can benefit you.



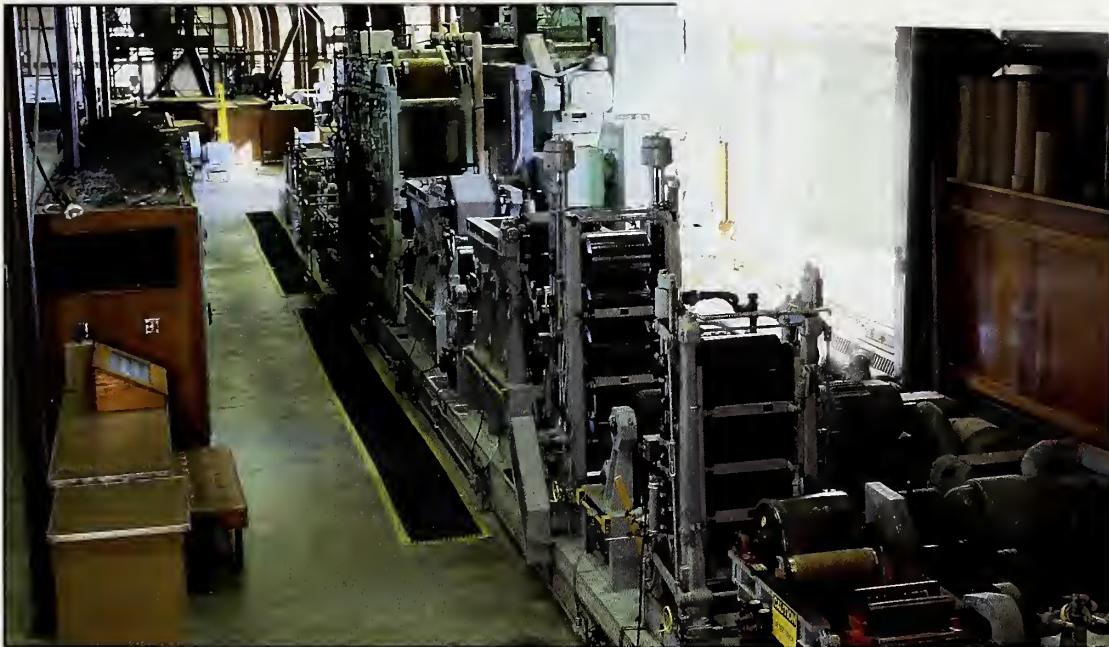
*Founded in 1910, the Forest Products Laboratory is adjacent to the University of Wisconsin-Madison campus and is maintained in cooperation with the University.*

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# Overview

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Most of the pulp and paper equipment is housed in a 45,000-square-foot, two-level building. Constructed in 1967, the building was outfitted with existing equipment. Since then, equipment has been updated and upgraded regularly, including the addition of press drying capability, a 100-cubic-foot digester, deinking equipment, and a 12-inch pressurized refiner. Most of the equipment is demonstration, rather than commercial, scale. A variety of commercial processes can be duplicated, or several experimental variables can be introduced and monitored.



*Above: The upper floor of the pulp and paper building houses a fourdrinier paper machine with its press drying unit, a paper testing laboratory, bleaching equipment, and a drum washer. Below: The spacious lower level accommodates wood preparation, pulping, stock preparation, and deinking facilities.*

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# Facilities

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## Wood Preparation

Equipment is available for determining characteristics and properties of the wood used for experiments. Pulpwood is peeled and can be endtrimmed before chipping. A four-knife chipper can make chips from 1/4 to 3/4 inch in length. A vibratory screen removes oversize materials, slivers, and fines, and a chip classifier can separate chips by size. Wood shavings or flakes and toothpick-size chips can also be made.



*Above: The commercial-type four-knife chipper can produce chips in a range of lengths. Below: After chipping and screening, chips are thoroughly mixed and then weighed into digester-size batches.*

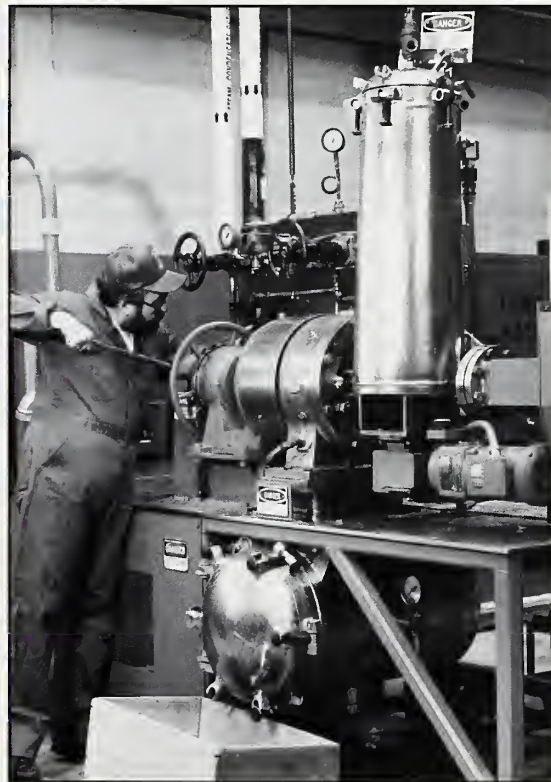
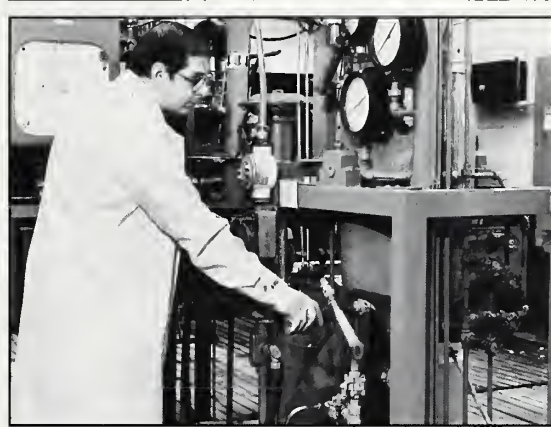




# Pulping

Extensive facilities are available for chemical, semichemical, and chemimechanical pulping. Digesters are 0.8, 14.0, and 100 cubic feet in capacity and can produce up to 500 pounds of pulp in a batch. Acid, neutral, or alkaline pulping are possible.

Refiner mechanical pulping with both single and double rotating disks and a pressurized refiner for producing thermomechanical and chemithermomechanical pulp are also available.



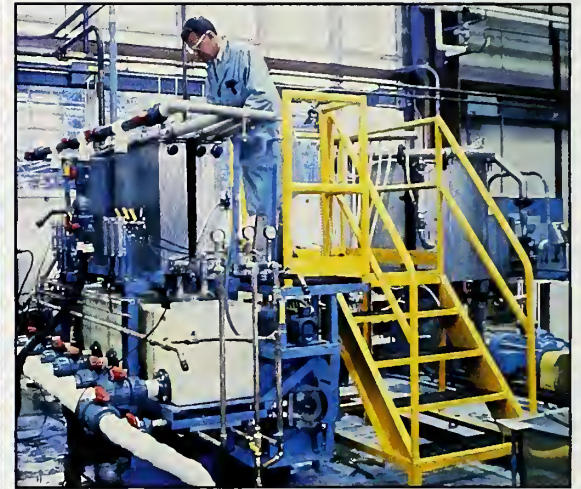
*Clockwise from top right: 1. Small quantities of pulp can be produced in this stationary digester. The 5.5 pounds it produces is sufficient to conduct standard TAPPI pulp strength and bleaching tests. 2. The 12-inch pressurized refiner can produce 10 pounds of thermomechanical or chemithermomechanical pulp for evaluation. It can also be equipped for ink dispersion in recycled fiber and collection of energy consumption data. 3. The 100-cubic-foot digester can produce 500 pounds of pulp in one batch.*

# Stock Preparation and Recycling

Existing stock preparation equipment is adequate for most jobs. Pulp slurries can be made in batches up to 120 pounds, both at low and high consistencies. Two small, diaphragm flat-plate screens and a six-plate diaphragm flat screen are available, as are two systems of centrifugal cleaners. Reverse-flow-type centrifugal cleaners are used for removal of foreign material that is lighter than pulp. For deinking studies, a six-stage flotation unit and a semicommercial single-stage deinking cell are available.

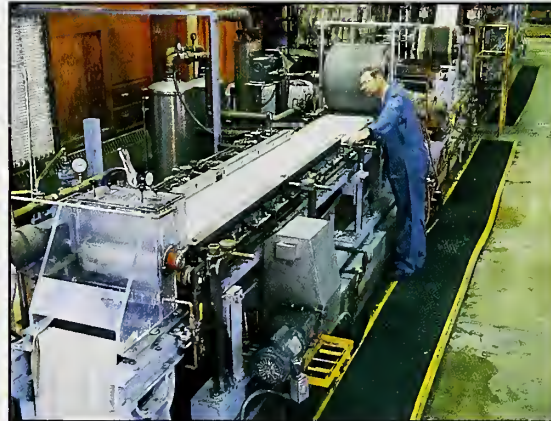
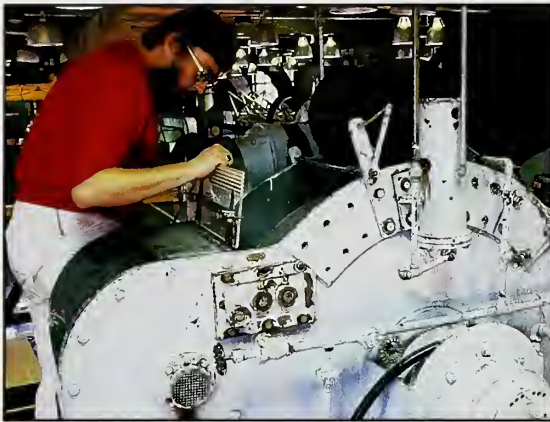
Methods for dewatering pulp include a revolving drum vacuum washer, a sidehill screen, screen boxes of various sizes, and an auger-screen water extractor. The auger-screen extractor can also be used to recover chemical solutions from pulp slurries.

*Clockwise from top left: 1. Processing conditions can be controlled to vary pulp quality with this 36-inch commercial-size double disk refiner. Energy consumption of the refiner can also be measured. 2. Deinking can be accomplished on a pilot-scale, six-stage flotation unit rated at 40 liters per minute. 3. Different plate patterns are available on this 120-pound-capacity slusher, allowing for both low- and high-consistency pulping. 4. Available pulp-cleaning equipment includes this sidehill screen.*



## Bleaching

Chlorination, extraction, hypochlorite, and peroxide bleaching are possible in batches up to 200 pounds. Pulp consistencies up to 5 percent can be achieved. Chlorine dioxide bleaching capability is available on a small scale.



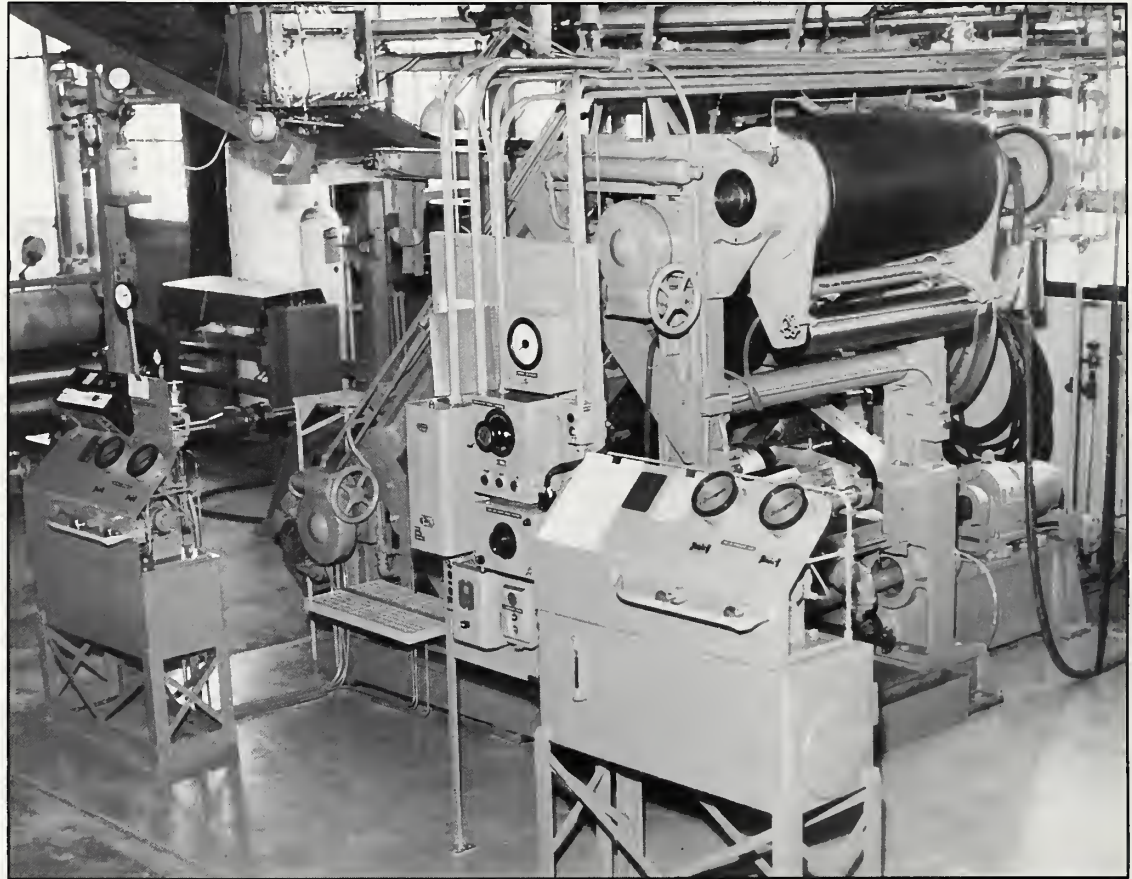
## Papermaking

FPL's fourdrinier paper machine has a wire width of 18 inches and is designed for small-scale production of a wide variety of papers. It can run at speeds from 2 to 350 feet per minute and has a machine chest capacity of 400 pounds of pulp. It has four wet presses (three single felted and one double felted), steam-heated dryer rollers, two calender stacks, and a winder. A press drying unit can dry the fiber web under continuous restraint. Paper machine runs can be made with as little as 50 pounds of pulp.

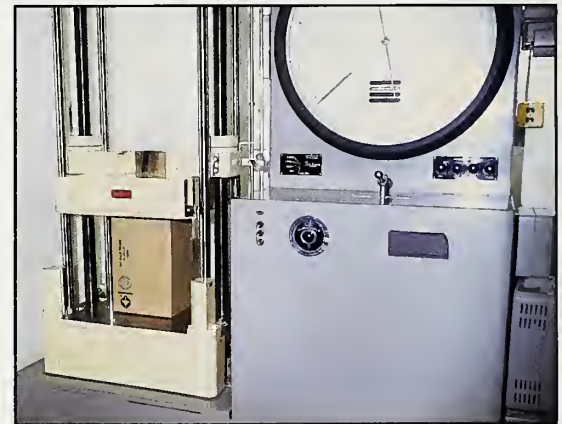
*Top left: This 36-inch-diameter revolving drum vacuum washer is equipped with a variable-speed drive and a pin shredder to crumb the pulp mat discharged by the washer. Center left: Paper can be wound on a reel or on paper cores. Center right: Bleaching equipment includes a chlorinator (right) and a unit for either alkaline extraction or hypochlorite treatments (left). Batches up to 200 pounds can be processed. Lower right: Magnetic flow meters measure and control the flow of stock onto the fourdrinier paper machine's 18-inch-wide, 36-foot-long wire.*

# Corrugated Fiberboard Processing

Paperboards can be converted to corrugated fiberboard and boxes. A single-facer corrugator will accept paperboards up to 20 inches wide. Single-face corrugated fiberboard can be double backed. Physical properties of corrugated fiberboard, such as edgewise compressive strength, pin adhesion, burst, and puncture, can be measured. Laboratory-scale equipment is available for scoring studies and for producing and evaluating boxes.



*Above: The single-facer corrugator accepts paperboard up to 20 inches wide and runs at speeds up to 1,000 feet per minute.  
Below: Corrugated fiberboard boxes can be tested in compression to determine stacking strength.*



# Paper Testing

Facilities are available for image analysis and physical, chemical, and biological analyses of wood, pulp, paper, and paper products. Standard TAPPI test methods for strength and optical properties are used. Ultrastructural characteristics of pulp, paper, and paper products can be studied using scanning and transmission electron microscopes. Image analysis is available for detection and statistical analysis of contaminants and ink specks present in pulp samples obtained from recycled wastepaper. Image analysis techniques can be developed for specific user needs.



*Clockwise from top left: 1. Small-scale test equipment is available for pulp processing, pulp property evaluations, and handsheet making. 2. The image analysis system can determine how effectively recycled wastepaper has been cleaned. 3. Paper tests, such as brightness and opacity, are carried out in an environmentally controlled laboratory.*

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# Cooperation at FPL

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Using the FPL pulp and paper laboratory offers cooperators some unique advantages. It is one of the few U.S. facilities where capabilities from pulpwood preparation to paper testing are available in a single location. The equipment is designed for research. Conditions are better controlled than in a mill environment, and the scale of the equipment reduces the quantity of material needed for tests.

Our experienced technical staff have extensive expertise with the use of their equipment. Because of their familiarity with its operations and maintenance, most problems can be handled on-site. Processing variables, such as special liquor mixes and pulp additives, are easily modified to accommodate special research needs.

FPL's central location makes travel to the pulp and paper laboratory convenient and relatively inexpensive. Overnight accommodations are available within a few blocks of FPL and throughout the Madison area.



*The Forest Products Laboratory comprises 10 buildings on 22 acres. Most of the pulp and paper facilities are located in a single building (right).*

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# Mutual Benefits

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Cooperative users of the FPL pulp and paper laboratory benefit from—

**Opportunity to Explore New Areas.** By sharing equipment and staffing costs with FPL, use of our pulp and paper laboratory can put advanced concept projects within the realm of possibility.

**Access to Expertise.** Cooperators can consult with FPL's scientific and technical staff and draw on their experience in both basic and applied research. Our particular areas of expertise include pulping chemistry, papermaking, high-yield mechanical pulping, biological treatments, bleaching, stock preparation, standard and specialized paper testing, and wastepaper recycling. Additional assistance is available through our longstanding relationship with the University of Wisconsin-Madison.

**Cost Effective.** Using our pulp and paper capabilities can eliminate some capital investment costs, reducing the overall cost of a research and development program. Cooperators are asked to pay only their proportionate share of direct and administrative costs of pulp and paper laboratory use.

We benefit by working with you as well. Sharing the pulp and paper laboratory gives us—

**Opportunities to Implement New Technologies.** Applying our results is the goal of research at FPL. Working with industry, government, and university groups creates the chance for us to share our knowledge with those who may benefit from it the most. Joint studies also let us contribute to the development of new technologies that can improve the competitive position of the U.S. pulp and paper industry.

**New Perspectives.** Cooperators provide a new perspective on current research problems and Forest Service operations. Interaction with cooperators sharpens our focus on current problems faced by wood users and pinpoints areas where research is needed.

**Expanded Cooperation.** Working with you now opens doors for further cooperation. And we have found that cooperative research can be among the most productive and rewarding.

We invite you to visit our pulp and paper laboratory, talk to our staff, and become familiar with what we have to offer. We welcome the opportunity to discuss any proposals you are considering. Each potential project is judged independently of whether the cooperator is an industry, government, or university group. But because we are publicly funded, all projects conducted must relate to the missions of the USDA Forest Service and the Forest Products Laboratory.

The pulp and paper laboratory has already accomplished much for users in the pulp and paper industry. We have the expertise and facilities to help meet your technical needs.

*For further information on FPL's pulp and paper laboratory, please contact:*

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