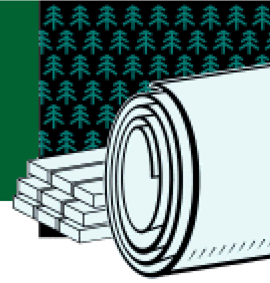
FOREST PRODUCTS
Project Fact Sheet



TREES CONTAINING BUILT-IN PULPING CATALYSTS

BENEFITS

- Uses experience and expertise of IPST in genetic engineering of plants
- Leverages IPST's research on sulfur-free selective pulping now underway
- Reduces odor emissions by requiring few or no sulfur promoters to catalyze pulping
- Eliminates expenditures for commercial AQ
- Increases pulp yields
- Improves industry's productivity and competitiveness
- Applies knowledge gained for further processing improvements
- Exploits termite resistance of wood that contains methyl-AQ

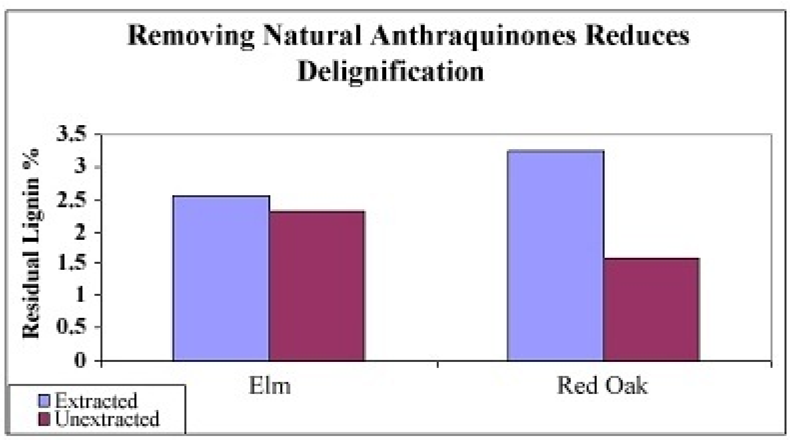
APPLICATIONS

Once the AQ clones are available, no specialized training or equipment will be needed to transfer them to field conditions and make them available to foresters for improving the pulping process.

Investigators Will Genetically Engineer Trees with Natural Pulping Catalysts

Tree lines that produce anthraquinone (AQ) naturally will improve the productivity and cost-effectiveness of the pulping process, and lessen the environmental impact of the pulp and paper industry. Self-catalyzed pulping will increase pulping rates and product yields and reduce costs for industry. Kraft pulping ordinarily uses sodium sulfide and sodium hydroxide to degrade lignin, and bleaching agents to brighten the pulp. By eliminating the need for these chemicals, industry will reduce its emissions of sulfur-promoting odors and bleaching residues. It will also avoid the cost of AQ, an expensive chemical product.

Research is underway on the feasibility of exploiting the natural production of AQ by the trees themselves. Investigators believe that by genetically engineering trees to contain pulping catalysts, catalyst-containing and non-catalyst-containing wood can be pulped together, eliminating the use of commercial AQ.



Both elm and oak wood contain extractable anthraquinone-like chemicals. When AQs are removed by extraction, pulping studies indicate lignin removal becomes more difficult. The greater change in red oak compared to elm is indicative of the larger amount of natural AQs present in oak.

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ENERGY EFFICIENCY AND RENEWABLE ENERGY • U.S. DEPARTMENT OF ENERGY

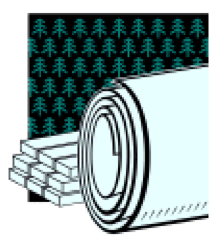
PROJECT DESCRIPTION

Goal: To genetically engineer trees to produce anthraquinone-based materials as an alternative to commercial chemicals for conventional pulping processes.

Some plant species are known to produce high levels of AQ-like chemicals — teak, for example, has already been investigated. The Institute of Paper Science and Technology is attempting to transfer foreign genetic material into cottonwood trees and later, loblolly pine. Success in producing trees with adequate levels of AQ would allow non-AQ-containing wood to be pulped together with catalyst-containing species, and eliminate the cost of commercial AQ. AQ at levels of as little as 0.1 percent in pulping mixtures increases pulping rates and product yields, and lowers the environmental impact of the process. It is considered feasible to produce a tree that contains ~0.1 percent AQ by weight. Other areas of investigation will be on improving the tear strength of AQ-treated pulp, and exploiting the termite resistance of trees that contain Methyl-AQ.

PROGRESS & MILESTONES

- It has been shown that 1 pound of teak wood contains enough 2-Methyl AQ, an efficient catalyst for pulping wood, to catalyze the pulping of 3 to 5 pounds of loblolly pine wood.
- Of the 66 million tons of wood pulp produced in North America in 1995, 84 percent were produced as chemical pulps. If the AQ-related process increased this yield by 1 percent, an additional 0.5 million tons of pulp would have been generated, valued at more than $200 million.
- In the first year of the two-year effort, the release of AQ by teak chips will be studied, and other components present in teak extract will be defined.
- Ten other commercial hardwoods and loblolly pine will be surveyed for possible AQ release, and genetic engineering studies will be initiated.
- The second year will focus on isolating specific genes involved in AQ production and transferring the DNA to a model plant (Arabidopsis), and the target tree cottonwood or a commercial hardwood with natural AQs.



PROJECT PARTNERS
Institute of Paper Science and Technology, Inc.
Atlanta, GA

FOR ADDITIONAL INFORMATION PLEASE CONTACT:

Elliott Levine
Office of Industrial Technologies
Phone: (202) 586-1476
Fax: (202) 586-3237
e-mail: elliott.levine@ee.doe.go

Dr. Gerald Pullman
Institute of Paper Science and
Phone: (404) 894-5307
Fax: (404) 894-4778
e-mail: gerald.pullman@ipst.edu

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov

Office of Industrial Technologies
Energy Efficiency and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

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