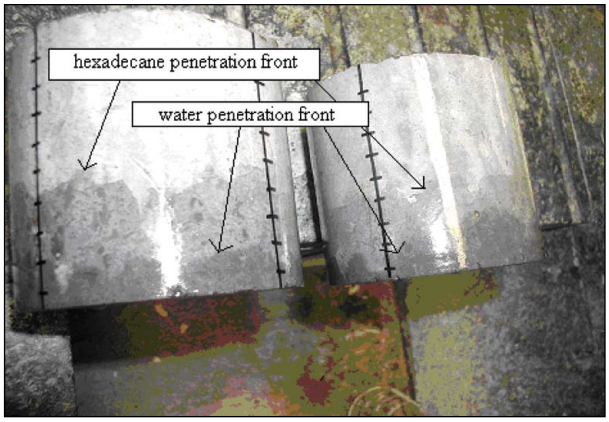
RESEARCH in Progress

Forest Products Laboratory

Understanding Diffusion In Wood and Concrete—New Methods to Remediate Wood and Concrete and Improving Wood Adhesives

When structures are subject to flood damage (such as during hurricane Katrina in 1995 or the Red River flooding in 1997), large amounts of petroleum products are absorbed by the wood and concrete in the structure. The diffusion of organic material into and back out of the wood and concrete determines how clean-up efforts proceed. Diffusion of chemicals, which is also important in adhesive bonding and coating applications, has been studied extensively under pressure and vacuum conditions (such as those used in wood preservation) but is not understood under more normal conditions.



Concrete samples exposed to hexadecane followed by water. Two distinct penetration fronts can be seen.

Background

The diffusion of organic materials into and out of wood and concrete plays an important role in both the remediation of contaminated materials and the formulation of improved wood adhesives. Remediation can be necessary following exposure of wood to chemicals as a result of floods or hurricanes. Diffusion may also play a large role in the formation of epoxy wood bonds. Epoxy adhesives—used in wooden boats and repair of delaminated and decayed wood beams—are two-component systems, and the diffusion rates of the individual components may dictate the strength of the bond.

This is the fourth year of a collaboration between chemists and chemical engineers to understand the role of organic chemical diffusion and to use resulting insights to (1) develop new techniques to effectively and economically treat contaminated materials and (2) develop improved epoxy resin adhesives for wood bonding. This effort involves two projects:

Project 1—Two novel methods of remediating concrete and wood contaminated with organic compounds were developed and tested.

These include activated carbon and bioremediation. Factors affecting transport of organic material out of concrete samples were determined.

Project 2—A new technique to monitor diffusion rates of epoxy and hardener into wood samples was developed. Results will be used to formulate new epoxy adhesives with improved bond characteristics.

Objective

The objectives of Project 1 were to (1) determine diffusion properties of organic contaminants into large-scale concrete and wood samples and (2) test two remediation techniques on these contaminated concrete

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samples. The objective of Project 2 is to determine the diffusion rate of epoxy and hardener into a wood substrate.

Approach

Diffusion characteristics of organic compounds into concrete and wood were determined, with and without the presence of water (photo). Two novel remediation techniques were tested on these samples: Activated carbon or selected bacteria were placed on the surface of the concrete. The activated carbon removed 10% of the contaminants; the bacterial treatment removed 30%. The rate-limited step was determined to be rate of diffusion out of the concrete block.

Diffusion rates of epoxy and hardener—both individually and together—into wood will be determined using diffuse reflectance infrared Fourier transform spectroscopy (DRIFTS).

Expected Outcomes

- An efficient and economical technique for remediation of contaminated concrete suitable for future commercialization
- A new method to determine diffusion rates of epoxy and hardener into wood
- New epoxy adhesives with improved bond performance

Timeline

This work will be completed by 2007.

Cooperators

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