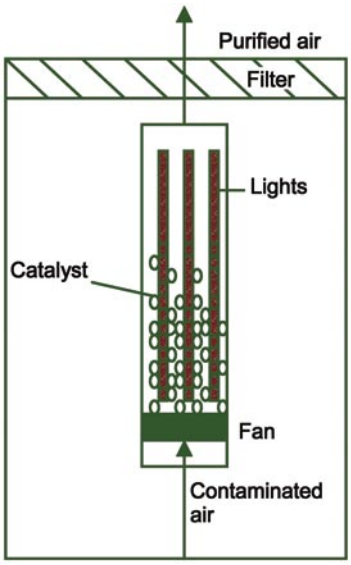
RESEARCH in Progress

Forest Products Laboratory

# New Methods of Improving Indoor Air Quality and Wood Adhesives

Chemical contamination of indoor air may result from chemical spills, manufactured wood-based building materials, and catastrophic floods. Current approaches to indoor air cleanup are based on physical removal of contaminated air by ventilation, with or without subsequent treatment of the exhaust air. This approach is inefficient, insufficient, and wastes energy. Finding better methods of indoor air decontamination is a high priority for building and maintaining healthy and energy-efficient homes.




**Schematic of the new air purifier.**

## Background

This is the third year of a collaborative effort between chemists and chemical engineers to (1) develop simple and efficient methods of maintaining and improving indoor air quality in wood-based buildings and (2) develop improved epoxy adhesive resins for wood laminates. The effort involves three related projects:

1. Two novel protocols for removal of toxic chemicals entrained in building materials (wood and concrete) are being developed: bioremediation and photoremediation. Efficiencies have been demonstrated in bench-scale studies.

2. A novel indoor air purification device is being developed, based on photocatalytic oxidation (PCO) and involving unique alumina–titania photocatalysts specifically designed for use in fluidized-bed devices. An efficient bench-scale device has been developed.

3. The third project is aimed at determining the mode of failure of wet wood glued with epoxy adhesives. Failure is likely due to stresses and strains developed as the wood expands and contracts with absorption and desorption of water.

## Objectives

The immediate objective for the first two projects is scaling up to real-world applications. In the first project, efficiencies of commercially relevant bioremediation and photoremediation methods will be tested on full-scale wood and concrete samples (basement partition walls and main-level subflooring). In the second project, a full-scale indoor air purifier will be designed, constructed, and optimized, including development of novel photocatalysts and testing of catalyst additives. The immediate objective of the third project is to describe the stress–strain behavior of both epoxy-treated and untreated wood samples, with the ultimate objective of developing improved epoxy adhesive resins for greater structural stability of building materials made of glued wood.

## Approach

The first step in the remediation project is completion of the sorption–desorption study to determine how contaminants move in wood and concrete. The focus will then shift to developing the most efficient protocols for removal of pollutants from building materials. The air purification device will be scaled up

Advanced Housing Research Center
Forest Products Laboratory
Madison, Wisconsin

USDA Forest Service
Forest Products Laboratory

UND University of North Dakota

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**Analysis of chemical contaminants in wood in University of North Dakota laboratory.**

with a fluidized-bed design, which allows the amount of catalyst to be orders of magnitude greater than that in current indoor air purifiers, thus significantly improving operational efficiency and stability.

## Expected Outcomes

1. Efficient protocols for subsequent commercial use of bioremediation and photoremediation will be developed for the removal of chemicals from contaminated materials.
2. A full-scale indoor photocatalytic oxidation air purifier prototype will be manufactured, and preliminary testing will be conducted toward developing it for commercial use.
3. The effect of physical dimensions of glued wood samples on stress developed within the wood will be described, separating stress and strain behavior. This will help determine why wet wood samples with adhesives fail under physical stress.

## Timeline

The projects will be completed by August 2006.

## Cooperators

USDA Forest Service, Forest Products Laboratory
University of North Dakota

## Contact Information

Charles Frihart, Project Leader
USDA Forest Service
Forest Product Laboratory
Madison, Wisconsin
(608) 231-9208, cfrihart@fs.fed.us

Evguenii Kozliak, Principal Investigator
University of North Dakota
Department of Chemistry
Grand Forks, North Dakota
(701) 777-2145, ekozliak@chem.und.edu