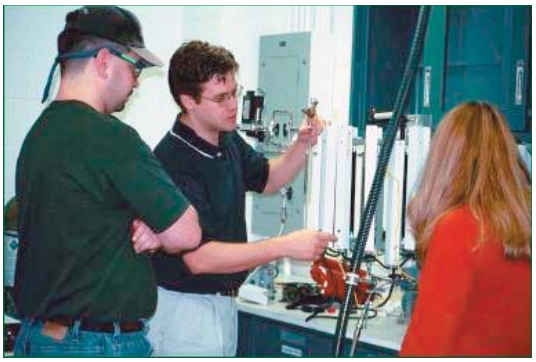
RESEARCH in Progress

Forest Products Laboratory

Remediation of Chemically Contaminated Buildings to Improve Indoor Air Quality

Introduction

Chemical contamination of indoor air results from chemical spills and manufacturing of wood-based building materials. Current approaches to indoor air cleanup are based on the physical removal of contaminated air by ventilation with or without subsequent treatment of the exhaust air. This approach is inefficient and wastes energy – both in hot and cold climatic zones. Therefore, finding efficient methods of *indoor* air decontamination is a high priority for building and maintaining healthy homes with efficient energy usage.



Dr. D. Muggli with his students in the lab.

Background

The proposed solution is based on the use of either bioremediation or photoremediation. Bioremediation is the application of bacteria on contaminated building materials. Photoremediation uses photocatalysts, i.e., semiconductors, such as titanium dioxide and a light source. A photocatalyst under UV light generates reactive radicals that are able to oxidize any organic matter. A properly modified photocatalyst generates radicals only on its surface, without producing any toxic by-products, such as ozone or hydrogen peroxide. The selectivity of the catalytic photooxidation can be varied (i.e. either specific chemicals or the entire spectrum of organic contaminants can be removed). This process can be used for the removal of both chemical and biological contaminants, including protein allergens, mold and dust mites, from indoor air.

Objectives

The research is split into two projects:

- Develop a protocol for reclamation of building materials (wood and concrete) contaminated with toxic chemicals that may affect indoor air quality.
- Develop a simple and efficient method and related compact device for indoor air purification.

Approach

In the first project, wood and concrete samples are contaminated with model pollutants; then either a bioresource or photocatalyst and UV light will be applied to the material surface. The rate of pollutant removal and transformation are monitored. Preliminary research has demonstrated that bioremediation is a viable option, although this treatment is slow. Photoremediation is much simpler but may not be applicable for some pollutants.

In the second project, the research consists of three steps: construction of a bench-scale apparatus, formulation of the TiO_2-based photocatalyst, and experimental testing under varied parameters. This research is generating preliminary data that point towards the conditions under which photocatalytic removal of indoor air pollutants is feasible. Airborne

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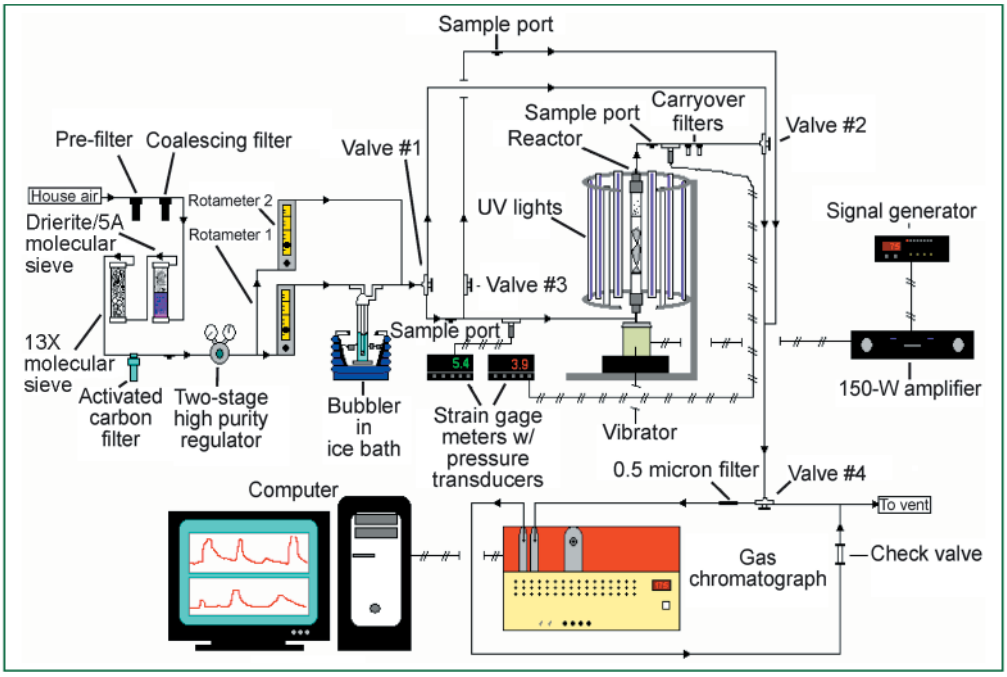

pollutants are quantitated using gas chromatography, and pollutamt removal efficiency is calculated and analyzed.

Expected Outcomes

1. A protocol for the biological and/or photochemical cleanup of contaminated building materials will be developed.

2. The impact of building material parameters on the diffusion rate of model pollutants will be determined.

3. A bench-scale apparatus for indoor air purification will be manufactured and tested (with a limited set of experimental variables). The information obtained in the present study will be used then to expand the approach to other chemical and biological pollutants.

Timeline

Small-scale diffusion, bioremediation, photoremediation and proof-of-concept air purification studies are expected to be completed in May 2005; larger scale studies are planned to be continued to develop effective technologies.

Cooperators

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