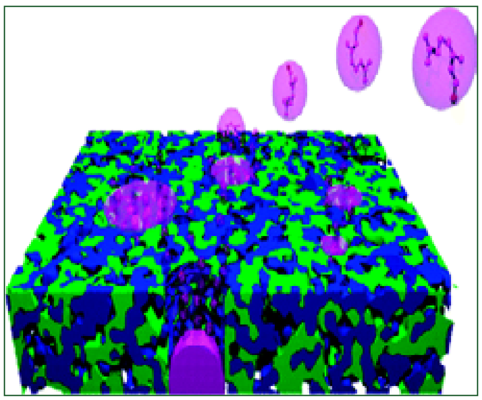
RESEARCH in Progress

100 Years of Service
Forest Products Laboratory
1910–2010

Self-Assembling Nanopolymers for Packaging and Release of Wood Preservatives

Vulnerability to moisture and biodeterioration are important limitations to the expected long service life of in-service wood and wood products and can result in substantial economic and resource losses. Each year, decay and termite infestations result in over $10 billion combined damage to wood structures in the United States. Although mold growth does not cause structural damage to wood, it heightens health concerns, and if the moisture level in a building is sufficient for mold growth, other types of biodeterioration will soon follow. Organic biocides are under development for indoor applications for both solid wood and composite building materials. Self-assembling nanopolymer systems for organic biocides may increase the long-term efficacy of organic biocides through controlled release and thus increase durability of building materials treated with nanopolymer-encapsulated biocides.



Self-assembling nanopolymer networks act like the holes in a sponge to hold "guest" molecules, such as biocides (shown in purple).

Background

Self-assembling nanopolymers were first created by melding two normally incompatible polymers and cross-linking the mixture. The complex surface of the resulting hyperbranched nanopolymer is likened to the holes in a sponge; it is able to encapsulate and hold various "guest" molecules until a change in the physical environment triggers their release. This technology has been successfully demonstrated for applications ranging from anti-fouling agents to fragrances. The same technology will be used to encapsulate organic biocides for targeted delivery and controlled release in solid wood and composite products.

Objectives

This project has four main objectives:

1. To assess the ability to encapsulate organic biocides in hyperbranched nanopolymer networks.
2. To assess the ability to control the release of the biocide under various conditions.
3. To evaluate long-term efficacy of nanopolymer-encapsulated biocides in composites and solid wood in laboratory tests.
4. To conduct field evaluations of successful nanopolymeric networks loaded with biocides.

Approach

Hyperbranched fluoropolymer−poly(ethylene glycol) cross-linked networks (HBFP−PEG) have been created that can encapsulate "guest" molecules, such as anti-fouling agents. HBFP–PEG nanopolymers will be loaded with several experimental organic biocides and evaluated for controlled release over a range of increasing temperatures. Biocide-loaded nanopolymers will be scaled up to treat wood samples for evaluation in laboratory tests and eventual field tests.

Expected Outcomes

A principal outcome of this project will be the development of designer biocide encapsulated nanopolymeric systems with controlled release for composites and solid wood applications.

Timeline

By 2010, self-assembled polymeric networks will be created and treated with experimental organic biocides; loading efficiency and release rate of each biocide will be evaluated when exposed to increasing temperature. By 2011, polymeric networks will be refined to optimize loading and provide precisely controlled release in laboratory setting. By 2013, successful technology will be scaled up for evaluation with wood products in laboratory and field tests.

Cooperators

USDA Forest Service, Forest Products Laboratory
Texas A&M University, Summerdale, Inc.

Contact Information

Carol A. Clausen
USDA Forest Service
Forest Products Laboratory
Madison, Wisconsin
(608) 231-9253; cclausen@fs.fed.us