Fast Curing of Composite Wood Products

New Curing Catalysts Will Reduce Energy Requirements by 40%

Urea-formaldehyde (UF) and phenol-formaldehyde (PF) are highly effective adhesive systems used in manufacturing composite wood products such as oriented strand board (OSB) and particleboard (PB). However, applying these resins typically requires an energy-intensive curing step consuming 40 trillion Btu per year industry-wide. Previous research has shown that catalysts can reduce energy requirements for applying UF and PF resins by accelerating the curing process.

In this project, partners analyzed the curing process using advanced chemistry tools. Analysis of the curing process can inform the development of new curing catalysts designed to reduce energy requirements by reducing press temperatures and times. As an additional benefit, the catalyst research has provided valuable data on composite wood board properties that can help improve product performance. Researchers will use this data to strengthen physical and mechanical properties of the finished boards and thus reduce product damage caused by wood extractives.

Benefits for Our Industry and Our Nation

- Reduced press energy requirements
- Reduced CO₂ emissions
- Improved product performance
- Lower emissions of VOCs

Applications in Our Nation’s Industry

This catalyst technology can lower resin curing time and temperature for composite wood products such as oriented strandboard, medium density fiberboard, and particleboard. This technology is applicable to all UF and PF composite wood manufacturers.
Project Description

**Goal:** Develop new curing catalysts designed to lower curing temperatures to 125-140°C with times of 0.5-1 minute that will reduce curing energy requirements by 40%.

During the first year, researchers established fundamental curing chemistry. Nuclear Magnetic Resonance (NMR) and Differential Scanning Calorimetry (DSC) provided advanced analysis of wood properties and the curing process. In addition, the impact of wood extractives on the physical properties of composite wood board was also evaluated using NMR. Year 2 focused on the development of new curing catalysts. NMR techniques helped establish optimal chemistry for low temperature curing with the new catalysts. Researchers also assessed pretreatments that minimize damage to boards caused by wood extractives.

Results

- The results of this study support the use of low-levels of cationic starch, nanoclay, or the zeolite additives to enhance the curing properties of UF and PF resins and the final board properties.
- The application of a laccase or lipase pretreatment of OSB, MDF, or PB wood furnish enhanced the performance of wood composites against water.
- The incorporation of nanoclay, zeolite, or cationic starch provides distinct benefits for OSB, MDF and PB board production. Enhancements in IB, water absorption and thickness swelling provide a viable approach to lowering press energy requirements by 10 – 25% depending on product specifications. An advantage of these additives is that all are commercially available and are amendable to commercial applications, and all additives can be readily incorporated into modern composite board production facilities with little effort.

Project Partners

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A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

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