

Chemistry of Wood–Plastic Composites Weathering

Solid wood has been traditionally used for decking and siding in the United States and other countries. However, a shift to the use of wood–plastic composites (WPC) for these products is occurring due to environmental and performance issues with solid wood. With this shift, a growing concern is the long-term weatherability and durability of WPC in exterior applications. Several studies have been conducted on degradation of WPC, including biodegradation (fungi and bacteria), mechanical degradation, and photodegradation. Photodegradation has been shown to be the most pronounced, especially in the presence of moisture. To improve the weathering properties of WPC, chemical changes occurring during the weathering process need to be better understood.

Background

The USDA Forest Products Laboratory (FPL), University of Idaho (UI), and the Wood Material and Engineering Laboratory at Washington State University have conducted preliminary research on weathering of WPC—both natural and accelerated (UVA and xenon arc). Results have clearly shown that chemical and color surface properties of wood–plastic composites change with exposure time. Surface chemical analysis of high-density polyethylene–pine composites



Researchers examine a weathered wood–plastic composite sample.

using Fourier transform infrared–attenuated total reflectance (FTIR–ATR) spectroscopy showed that lignin content decreased and surface oxidation increased during exposure to accelerated weathering.

Objectives

The overall objective of this project is to understand the chemistry of WPC weathering and establish the relationship between chemical changes

and physical properties. Two specific objectives are to (1) evaluate

color and chemical changes of weathered WPC and (2) establish the relationship between chemical and color changes of weathered WPC.

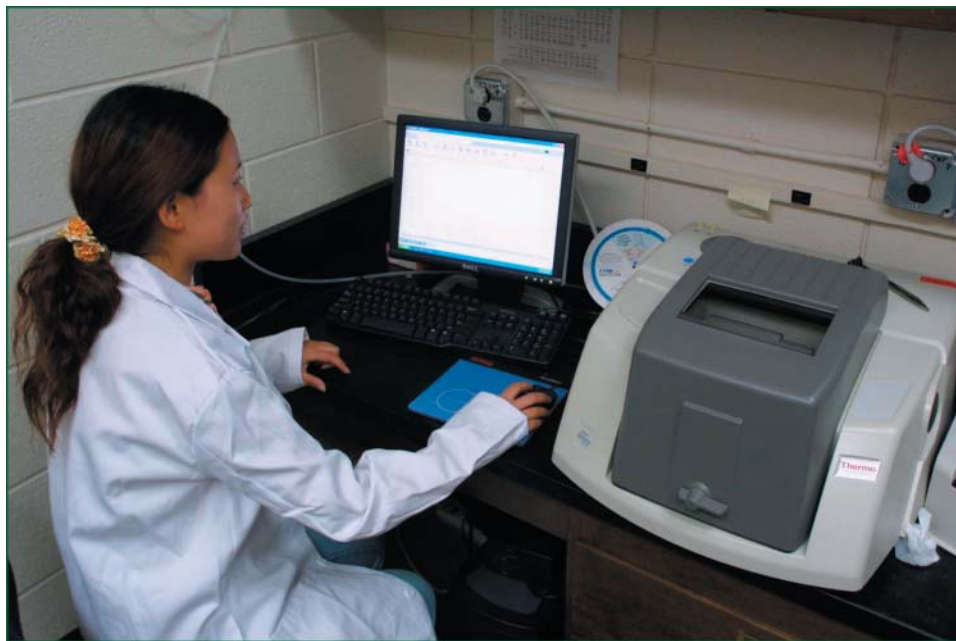
Approach

The study will be conducted in four basic stages:

- Prepare WPC samples from modified wood fiber.
- Subject samples to weathering (both accelerated and outdoor exposure).
- Evaluate over time the color and chemical changes due to weathering.
- Establish a correlation between wood composition and color change of WPC during weathering.

Expected Outcomes

This study will allow us to determine the influence of weathering on the chemistry of WPC and establish a



Chemical analysis of wood–plastic composites using FTIR spectroscopy.

correlation between changes in chemical composition and color. Preliminary studies showed that weathering causes changes in WPC chemistry (such as surface oxidation, lignin, cellulose, and plastic) and color properties. We expect this study to provide detailed information on changes in WPC molecular structure and weight of cellulose, lignin, and plastic and the correlation of these factors with color. The results of this study will be used to further research and development of WPC with improved weathering performance.

Timeline

Sample preparation is planned to begin fall 2005. Weathering exposure should begin in early 2006, with monitoring and chemical analysis proceeding through the year. Data analysis and reporting will likely begin in early 2007, with reports becoming available by mid-2007.

Cooperators

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