Keeping Wood The Tie Material Of Choice

By Paige Townely

Wood has long been used in making crossties for the railroad. In fact, more than 93 percent of all track applications in North America today are made of wood. And while the product has more than proven itself over the decades, numerous researchers are working to make wood even more useful and efficient. Get to know some of the researchers and what they're doing behind the scenes at the University of Tennessee in partnership with private enterprise to help keep wood the material of choice for the railroad industry.

NICOLE LABBE, PH.D.

Nicole "Niki" Labbe is a professor at the Center for Renewable Carbon, Department of Forestry, Wildlife, and Fisheries and an adjunct professor in the department of Biosystems Engineering and Soil Science. She is also a biomass chemist.


LABBE

Over the last few years, her research group has been looking for ways to better utilize used wood ties instead of just burning them when their useful lives are over. Specifically, Labbe's group has been conducting research on how to recover preservatives such as creosote from the used wood ties. They have demonstrated that a two-step thermochemical process is efficient in achieving this goal.

"The results of our research have been very good," Labbe said. "Not only can we recover the creosote, but the technique works with other preservatives as well. We are now testing the process with copper naphthenate treated ties."

This thermochemical process of extracting preservatives provides many benefits to the industry, one of which is giving the chemical a second life, thereby reducing the environmental impact since preservatives are not burned and released into the atmosphere. "In addition, the wood is a very valuable feedstock; it has properties like torrefied wood and can be used in different processes such as pyrolysis and gasification for generation of biofuel, chemicals and products," Labbe added. "The ties are high quality biomass, therefore our goal is to demonstrate their value so that we can start collecting them for the bioenergy industry to develop a viable bioeconomy. These are two great benefits happening at the same time."

ADAM TAYLOR

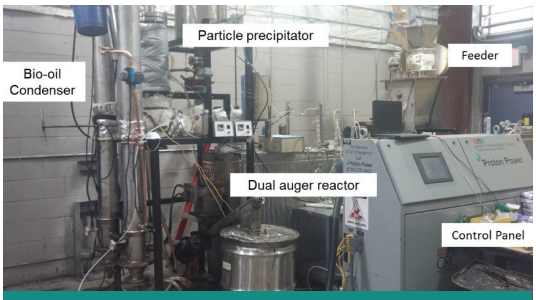
Adam Taylor is a professor and the forest products extension specialist in Forestry, Wildlife, and Fisheries at the University of Tennessee. An interest in the outdoors led Taylor to forestry, and today he is known as an expert on the utilization of hardwoods. He has also done much work on a variety of issues affecting the railroad industry today.

One project studied the use of hot borate solutions with wood ties to kill any insects that might be inside the tie. "Our trial looked at what to do to make sure nothing is living in a green cross tie, for example, before it's moved across a state line if there is a concern about invasive pests there," Taylor explained. The study utilized high temperature solutions, which also allowed for more borate to be dissolved and resulted in high retentions in the treated wood.


TAYLOR

Taylor has also conducted work to verify the performance of Nisus' ambient temperature liquid borate. Essentially, the research looked at the company's two-step process to determine the uptake of borate. This process is now used commercially by at least five different tie producers, and by Class 1, short line and metro railroads. Other companies are using different approaches to the "dual treatment" of ties—combined borates with traditional oil-borne preservatives. "Regardless of how you apply the dual treatment, the presence of borate can be a

Adam Taylor, left, and Jeff Lloyd of Nisus perform original ambient temperature borate treatments.



This is a photo of Niki Labbe's reactor for creosote desorption and capture.

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benefit to the ties," Taylor said. "It allows you to protect deep into the tie and treat the heartwood."

Taylor has also performed research on strength loss during seasoning. During the drying process, fungi can grow in the wood, thereby weakening it. "In a preliminary experiment, we tested for strength loss, and the research revealed that ties are actually pretty robust to that degradation," Taylor said. Despite this, Taylor recommends taking steps to protect ties throughout the manufacturing process to ensure the best possible performance over the long run.

RICHARD BENNETT

Richard Bennett has served on the faculty of the University of Tennessee since 1983, and his area of specialization is structures. A structural engineer, Bennett has taught a short course on bridge inspections for 20-plus years.

In conjunction with Taylor, he has also forged new ground on looking at the strength of bridge ties with and without borate inserts and daps. Specifically, Bennett looked at the treatment developed by Nisus Corporation and whether its process of drilling holes in the tie for the borate inserts affects its strength.

To answer the question, Bennett performed scale model testing utilizing ties with holes drilled in various locations. The research concluded that while a reduction in strength does happen with the inserts, that reduction is marginal as compared to the reduction in strength due to dapping.

Adam Taylor, left, and Richard Bennett perform bridge strength work.

"Dapping reduces the strength more than the holes being drilled," Bennett said. "The holes reduce strength maybe 5 to 10 percent. Our study showed it's very much worth it to have a tie

with the borate insert as it's a great wood preservative that diffuses over time through the wood, so the result is that you get a really good treatment throughout the whole tie."

The first commercial treatments were carried out by Mellott Wood Preserving, and the system has now also been developed further and commercialized by Stella-Jones.

Bennett is studying the cost savings to railroads when it comes to treating ties by looking at the life extension of the ties. "Thus far, we've seen that spending money up front to do a dual treatment on the tie is well worth it as it extends the life of the tie," he said. "The much longer life makes the money spent well worth it with potential savings of $200 to $300 million for a typical Class 1 over the life of a bridge program."

NOURREDINE (NOUR) ABDOULMOUMINE, PH.D.

Nourredine "Nour" Abdoulmoumine is an associate professor in Biosystems Engineering in the department of Biosystems Engineering and Soil Science at the University of Tennessee. He works with a team of researchers, graduate students and an industry partner, Nisus Corporation. Abdoulmoumine works closely with Labbe's group in the Center for Renewable Carbon to develop technoeconomic analysis models that incorporate data produced from her studies on creosote and other preservative extractions.


ABDOULMOUMINE

Their models assess the economics of biomass to biofuel plant where wood preservatives are first extracted and recovered before the remaining preservative-free biomass is converted to gasoline and diesel.

"We are bridging the gap between basic science research and its potential industrial applications by intertwining and complementing our small-scale research activities with technoeconomic simulations to provide us insights into how our findings translate in terms of economics on a much larger scale," he said. "Because used railroad ties are considered waste wood, they have a much lower price than clean wood. Our goal is to compare the traditional wood to fuel scenario with the alternative used ties to fuel scenario to better understand how the lower raw material cost and the additional recovered preservative product stream impact the overall process economic."

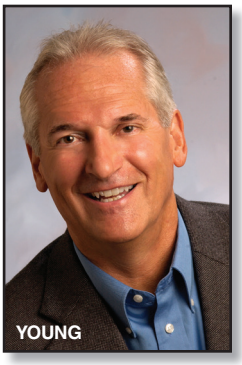
Over the past two years, Abdoulmoumine and his team have found that for the typical plant size expected for this type of wood to gasoline or diesel fuel operation, used railroad ties produce gasoline at a cost of $2.52 per gallon.

"That's the minimum fuel selling price, which means that everything being equal, that's the price our gasoline must be sold at to ensure that we break even," he said. This outcome is significant because most analysis shows that the clean wood conversion to gasoline or diesel is somewhere around $3.50 per gallon, which is around one dollar more. "The lower price associated with used railroad ties makes the economics much more favorable," Abdoulmoumine said. "In addition, the used ties give you the ability to add a second product stream—the recovery of the preservative—which further enhances the economics."

While thus far creosote has been the preservative focused on for the research, Abdoulmoumine, Labbe and their team members are now turning their attention to copper naphthenate.

TIMOTHY YOUNG, PH.D.

Timothy Young is a professor and graduate director in the department of Forestry, Wildlife, and Fisheries at the Center for Renewable Carbon at the University of Tennessee. Throughout his career, he has taught more than 800 manufacturing personnel from more than 25 forest product companies, and he's worked with the wood industry for the past 25 years.


YOUNG

Young and his team are managing research that's looking at real-time statistical data on process control (SPC) for wood product manufacturers, multi-sensor data fusion and real-time process modeling of wood composites.

The goal is to analyze these statistics to improve the processes by reducing variation of key inputs. He is applying these concepts for wood treating processes and attempting to find ways to reduce variation and optimize the process that would lead to lower chemical dosing targets. "Instead of adding more chemicals to the process, which adds cost and makes a business less competitive, we are looking at ways to improve the processes," Young said. "This would not only reduce the variation of key process inputs, but also predict failure processes."

Thus far, the research has resulted in the development of customized software and reporting, along with new measurement systems, which are saving wood products companies up to $300,000 annually across numerous industries. ■


Researchers inspect seasoning decay in wood ties.