Science & Sustainability Through Collaboration

A research review by Dr. Jeff Lloyd

Mike Sanders of Mississippi State University inspects borate-treated structures at the Nisus field test site in Florida. Sanders also oversees the RTA tie field tests in which Nisus uses both Cellutreat and QNAP copper naphthenate treatments.

Jeff Lloyd of Nisus, left, is pictured with the late Mike Pourney of Gross & Janes Co. in 2014 at the Gross & Janes tie borate treatment plant in Arkansas.

Collaboration is critical to the scientific process. This is why Nisus Corp. strives to work with research experts around the world and with members of organizations such as the Railway Tie Association (RTA), American Wood Protection Association (AWPA) and International Research Group on Wood Protection (IRG-WP).

Nisus team members Jim Brient, Ken Laughlin, Dr. Jeff Lloyd, Dr. Mark Manning and Dr. Jae-Woo Kim have presented research papers to these associations, and some have served in leadership roles.

Collaborative research has also been presented to RTA by Mike Sanders of Mississippi State University (MSU) and Prof. Adam Taylor, Dr. Niki Labbe and Prof. Richard Bennett of the University of Tennessee - Knoxville (UT).

For the last 20 years, Nisus has worked collaboratively with a focus on tie longevity research through wood protection as a way to provide the greatest impact for the railroads and the environment.

One example of this research includes the work on two-step borate treatments and the development of ambient temperature two-step treatment for crossties developed collaboratively with other RTA members that played a key role in railroads' acceptance of dual treatments.

Dual Treatment

Stemming from early work by Len Arthur in Malaysia in the 1960s and work done by Dr. David Dickinson with utility poles in the United Kingdom in the 1980s, Dr. Mark Manning started work on pressure treatment with borates with Gross & Janes and Union Pacific (UP) in 1990 and presented at RTA in 2004.

MSU Prof. Terry Amburgey's work showed that protecting ties from seasoning decay (stack burn) and then protecting heartwood in service led to at least a doubling of tie life.

Research shows dual treatment of ties doubles and may even triple tie life, especially in higher biological hazard zones. Nisus-led research conducted with UT developed both the hot sterilizing borate treatment published in the *Forest Products Journal* (Taylor and Lloyd, 2009) and the ambient temperature treatment using Cellutreat Liquid 50 DOT Borate Wood Preservative.

The ambient temperature treatment process was developed in collaboration with Prof. Adam Taylor and Dr. Jae Woo Kim (then at UT) and Dr. Coşkun Köse with the Faculty of Forestry at Istanbul University in Turkey and presented at IRG-WP in New Zealand (Kim et al., 2011).

Using a Nisus-patented formulation, this treatment was shown to be the best way to achieve AWPA Standards and AREMA retentions (0.25 pcf as disodium octaborate tetrahydrate) from a single dip, as opposed to the double hot dip required by Amburgey. Importantly for efficacy, it also achieves relatively uniform retention across all the wood species used for ties, so properly protects the non-durable refractory species.

Early implementation on ambient temperature treatment was done in conjunction with Kansas City Southern (KCS) and Norfolk Southern (NS). Commercial treatments were then rolled out across many geographic regions with RTA members further increasing the reach of this new technology.

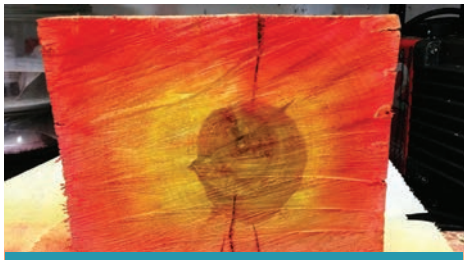
Longevity of tie performance has a huge impact on the Life Cycle Analysis (LCA) of wood crossties, has become a focus of the Nisus ESG and Sustainability programs, and was presented at the Railroad Sustainability Symposium meeting in 2017.

From a crosstie perspective, the ability of dual treatment to double tie life means ties that lasted 10 years in high-hazard zones now last 20 years or longer. With a lower demand for new ties in high-hazard zones, railroads can more easily replace millions of other ties that may be compromised, creating safer roads. Or, railroads can consider $75/tie savings for a tie that is not replaced, which can be measured using capital recovery or net present value. These savings result from the reduction of:

- wood needed for ties;
- chemicals used for protection of that wood;
- fossil fuel used for transportation;
- installation costs;
- track time for installation; and
- number of ties that need to be recycled or disposed of at end-of-life.

Bridge Ties

The financial benefits of dual treatment are tremendous for crossties, and NS felt the impact could be even greater for bridge ties, which have a higher value than crossties. The difficulty in getting track time to replace bridge ties and the high cost to replace bridge timbers meant that longer life would be even more significant for bridge ties. Nisus worked with NS on ways to achieve greater protection for bridge ties, which often have even more untreatable heartwood.



One of the early cross-sections from the ambient temperature treatments showing borate penetration as red using curcumin reagent.

The successes of dual treatment of green bridge ties were achieved at Mellott in Needmore, Pa., using the Nisus BTX plug and fill process, which was patented in 2013.

NS, CSX, CR, Genesee Valley, Delaware & Ulster, and Genesee & Wyoming are also now taking advantage of this newer technology.

Recent Research Collaborations

More recent collaboration with sawmills have led to the commercialization of the tie "pre-dip," which provides borate protection even earlier in the tie production process. This provides protection to green ties, which may sit dead stacked for some time, before they are shipped by rail. Sawmills can now reduce down-grades and get more quality ties to treaters with a pre-dip process. Such early treatment also raised the possibility of using yellow poplar as an additional abundant species for certain track applications. Research has shown that properly dual-treated yellow poplar has a greater strength than gum after air seasoning (presented by Prof. Taylor at the West Virginia Forestry Association and hopefully at RTA to come). ■

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