RTA: On Track & Learning

To borate or not to borate...'tis a persistent question. Answers may be found this year.

By Jim Gauntt

Editor's Note: Gary Hunter of Union Pacific Railroad provided editorial contributions to this report.

Since 1987, the Railway Tie Association (RTA) and its members have been involved in several serious research projects to determine the opportunities that alternative treatments may offer to enhance wood tie performance. The initial project involved placing various alternatively treated ties—and remedially treated ties—in track for field evaluation.

To supplement this work, RTA began standardized stake tests at Mississippi State University in 1992. These tests included a variety of creosote- and borate-treated 2x4 and three-quarter-inch stakes.

In 1993, Gross & Janes Co. and the Union Pacific Railroad (UPRR) also installed an extensive test site containing more than 3,000 borate-only treated ties in Livonia, La. RTA Research & Development Committee members and railroad guests visited the site in January.

A nexus of interests has driven the reevaluations of all these research projects this year. For example, railroads have asked RTA to revisit tie performance issues in Southern, wet and high-decay locations. RTA members and railroads have also learned of the potential problems posed for wood ties in certain coastal areas by the Formosan Subterranean Termite (FST).

Furthermore, questions regarding species usage in certain operating environments are being discussed in RTA committee work. Added to this is the fact that RTA members have always sought meaningful advancements for the wood tie. In fact, the RTA Mission Statement refers to this as "...the continual improvement of the engineered wood crosstie." That so many long-term studies were planned and initiated in the 1980s and early 1990s speaks volumes about RTA members and their ongoing drive to explore innovative ways to enhance tie performance.

The 1987 project, containing borate pretreated red oak, white oak and gum ties located in several areas of the country, was first reported on in 1992 by Ken Laine and Dave Davis of the Association of American Railroads (complete report available from RTA).

The hypothesis of the test was best summarized in the following report paragraphs.

"...It is hypothesized that treating unseasoned ties with borates can protect them from insects and decay fungi during air seasoning, which will invariably result in a higher quality yield of ties that are installed in track.

"Borate treatment alone is not necessarily a substitute for creosote so much as an enhancement. A subsequent application of creosote or similar laminating type of treatment could act as a barrier, preventing borates from leaching out of the tie over time. A lower concentration of creosote is speculated to be necessary to treat ties that have been pretreated with a borate solution as an additional benefit of the pretreatment process. Such a combination of treatments would also be a preventative deterrent to soft-rot fungi, which cannot be controlled by borates alone. Another supplemental advantage of using borates may be in their ability to resist corrosion in iron fasteners and thus reduce the number of spike-killed ties due to iron degradation reactions."

Conclusions offered in the 1992 report of this research included the following:

"Creosote pressure treatment and borate-dip treatment are compatible. Creosote pressure treatment had virtually no effect on borate concentration levels in air-seasoned ties. Analysis of borate levels in ties immediately before and after creosote pressure treatment showed no significant differences.

"The effect of species on (pre-) treatment (with borates) concentration levels is minimal. The effects of moisture content and surface condition at the time of treatment are considered more important than species."

The text further suggested that at the time of the report's composition, there had not been enough time in track for conclusions to be drawn about performance.

This is one of the reasons that in March of this year, RTA, in conjunction with Mississippi State University (MSU), The Crosstie Connection and Norfolk Southern, will reexamine the ties still in track from this test in Jesup and Cordele, Ga. At nearly 15 years of exposure, there should now have been ample time for any performance differentials to be documented. A full report on this analytical work is expected from MSU's Terry Amburgey, Ph.D., at the RTA Convention in St. Louis this fall.

Borate-based compounds have proven to be remarkable, safe wood preservatives in a wide variety of applications all over the world. And, they are likely to see some use in the tie industry in the future.

Supplementing this in-service fieldwork, RTA began stake tests according to the American Wood-Preserver's Association Standard E7 at MSU's Forest Products Lab in 1992. This research contained both 2x4 and three-quarter-inch stakes treated with a variety of combinations of borate and creosote treatments, as well as toluene controls. The most recent data from this test was generated in mid 2001.

As expected, in the 2x4 stake tests, the toluene sugarberry and red oak controls failed early on in the second and fifth years, respectively. The Timbor™-only (U.S. Borax borate brand name) treated 2x4 stakes performed only marginally better, as did the lower retentions (<6lbs/cf) of creosote-only and borate/creosote combinations.

The Timbor™-only sugarberry stakes saw failure in year three, and the oak in year five. The lower retention P2 creosote-only treated sugarberry stakes (<4lbs/cf) were rated as failed in years seven and nine.

Interestingly, at least one conclusion has been noted by the researchers: Performance of sugarberry with lower creosote retention (<6lbs/cf creosote) is improved with a Timbor™ pretreatment. This would seem to also validate one of the 1987 study's hypotheses.

The best performing stakes continue to be at the higher retention levels of creosote (>7lbs/cf), both stand alone, and in conjunction with borates. But currently, there does not seem to be any performance differentials between the P2 creosote-only samples and those pretreated with borates at these higher creosote levels. More time in test will be required to determine if such performance differentials exist.

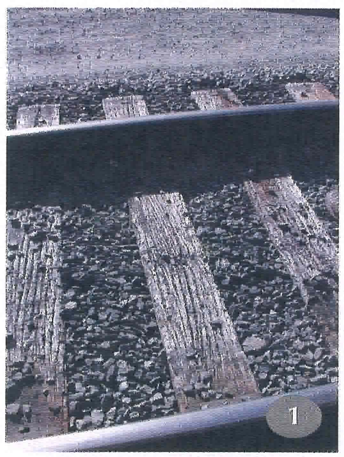
Researchers suggest that in the future a test designed to expose stakes in a horizontal position could be developed. One thought is that standard stake exposure, buried in the ground vertically, may minimize the ability to draw meaningful conclusions about performance differences for crossties. Testing in a horizontal position may make sense in that this is closer to the way ties are exposed in application.

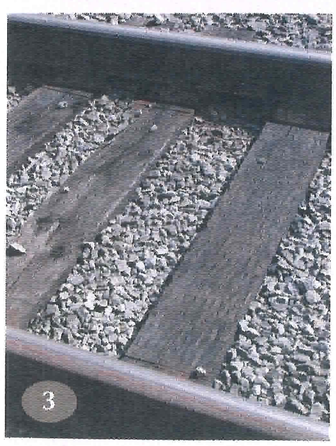
The three-quarter-inch red oak, Southern pine and sweet gum stakes installed were only treated with varying retentions of creosote. In these stakes, it would again appear that retention levels equal to or more than 7-8lbs/cf are the best performers. This suggests how important it is to specify the correct quantity of creosote for tie treatment to achieve optimal performance in severe environments.

The desire to perform large-scale, in-service testing of borate-only treated ties in severe environments is the reason that Gross & Janes Co. and UPRR began working together on a project in Livonia in 1993. In a recent field trip to UPRR's Livonia Yard, RTA members and guests viewed 3,000 Timbor™-only treated red oak, white oak and gum ties, as well as a separate but adjacent line that contained creosote-only ties that were also installed in 1993. These creosote ties were not part of a formal test but gave attendees a visual and timely reference to the borate-only treated ties.

The field trip was organized in conjunction with the Formosan Termite seminar that was held in Baton Rouge on Jan. 16 (*see story on page 14*).

As with any visual track inspection, opinions tended to vary on what was seen and, to some degree, what one hopes to find. It seemed clear to most that the gum ties were performing significantly below the level of the oaks. One project researcher present commented that there was evidence of soft-rot on the surface of the gum ties. The depletion rates for borates in gum ties have been documented as being higher than in oak ties by the same researcher, and it was this that was suggested as one of the possible reasons. Because of this, some sources have wondered if newer, non-leaching treatments containing borates might perform differently in mixed hardwood ties.





1. Borate-only gum ties surface appearance.

2. Borate-only oak ties surface appearance.

3. Creosote-only ties on adjacent track also installed in 1993.

On the other hand, many of the oak ties appeared to be performing well. Of course, eight to nine years is not an extremely long time in service, but considering the severe southern Louisiana environment, many who saw the oak ties came away impressed with their appearance.

The creosote ties appeared as one might expect after about eight years in track in a Southern location and served as a visual reference to the borate-treated ties. The photos provided on this page give an idea of the tie conditions found.

One thing is sure; the follow-up work this year on Norfolk Southern that will look at ties that have been in track nearly twice as long as the Livonia ties is a very important piece of the puzzle. That puzzle is, of course, what are the optimal recommendations as far as borates and wood ties are concerned.

Various recommendations have been suggested for the use of borates. Some say to definitely pre-treat with borate before seasoning and creosote treatment, especially for Southern or wet applications. Others suggest that there may be certain dry locations, particularly in the West, that could use borates as a stand-alone preservative. Some remain skeptical as to the potential for borates in exterior applications and feel that meaningful recommendations will be hard to come by outside of a standards-writing body.

There are also some unsettled issues. For example, what initial borate-retention levels are to be used for FST-infested areas? What may the role be for newer, non-leaching, borate-containing compounds? And, there may be other questions that need to be considered before companies are prepared to accept any formal recommendations. Railroads may end up making the call on using borate treatments in processing wood ties on their own.

However, as the results of the additional research that MSU conducts for RTA are published, a better picture may come into focus. The fact that this research will also carry with it the value of an academic institution's inherent neutrality will be a plus for those who seek the facts about using borates to preserve wood ties. The tie and wood-preserving industries should soon be able to grapple with the formulation of specific recommended practices based upon substantial scientific work.

Borate-based compounds have proven to be remarkable, safe wood preservatives in a wide variety of applications all over the world. And, they are likely to see some use in the tie industry in the future. With the advent of new, non-leaching versions and the data that are collected this year, what is certain is that the open and honest evaluation of their merits will be beneficial to railroads. §