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Decay in Wood TiesProblem Solved!

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Creosote-treated wooden crossties have, in general, performed well in a variety of geographic regions since the early 1900's. Increased tie life resulted from the development of new treating standards and acceptable practices by organizations such as the American Wood-Preservers' Association (AWPA) and the Canadian Wood Preservers Association (CWPA) and the efforts of associations such as the Railway Tie Association (RTA), The Association of American Railroads (AAR), and the American Railway Engineering and Maintenance-of-Way Association (AREMA).

In spite of these efforts, however, relatively short service life of some ties continues to occur, particularly in the warm, humid areas of the southeastern U.S. that fall in AWPA Hazard Zones 4 and 5. The relatively poor performance of some refractory tie species in these regions has prompted some railroads to separate them for use in regions with lower indices of biodeterioration (AWPA Hazard Zones 1 – 3). Analysis of probable factors contributing to reduced service life of ties indicated that (1) decay occurring in air-drying stacks and (2) the use of wood species whose heartwood is not treatable with traditional preservatives such as creosote (eg, white oaks) likely were the primary causes.

Assuming that these factors are the primary causes of the problem, the solution to achieving relatively uniform service life of wooden crossties requires their treatment prior to air-seasoning with a biocide that would penetrate the heartwood, even of refractory species. Biocides with such properties would need to be water-soluble and capable of diffusing through wood cell walls. Borates and fluorides are possible candidate biocides with such properties.

Borates are effective biocides against both wood decay fungi and insects, have low mammalian toxicities, are corrosion inhibitors, do not adversely affect wood strength properties, and their presence can be verified by a color test. As a consequence, borates were chosen for use in a field test jointly sponsored by the RTA and AAR. Ties of different species were treated with heated borate solution, bulk-stacked under a tarp for a few weeks to permit the borate to begin to diffuse through the ties, and stacked for air-drying. The dried ties then were over-treated with creosote and placed in active rail lines in different AWPA Hazard Zones. These studies are documented in a progress report authored by T. L. Amburgey and S. C. Snyder dated Jan. 12, 1989, that was submitted to the AAR/RTA and in an undated progress report authored by D. D. Davis and K. J. Laine. Five-year results were reported in *Technology Digest* (February 1994) and *Crossties* (July/August 1994) in manuscripts authored by Davis and Laine. Results of the 2002 inspection were summarized in a presentation by Amburgey at the RTA Annual

Convention in St. Louis and in an article in *Crossties* (Jan./Feb. 2003) authored by James Gauntt.

After about 15 years in track, the Norfolk-Southern (NS) allowed track time and furnished personnel so that test ties could be removed from sections of their lines in Georgia. Basically, this test demonstrated that ties, including white oaks, pretreated with borates continued to perform well and had minimal decay and no spike kill. The results of this inspection are documented in, "Extending the service life of wooden crossties by using pre- and supplemental preservative treatments. 15 year report" in *Crossties* (May/June 2003) authored by T. L. Amburgey, J. L. Watt and M. G. Sanders.

Results of the early phases of this study indicated the following:

1. Borate up-take and diffusion was greater in unseasoned than in seasoned ties.
2. Borate up-take and diffusion was greater in ties bulk-stacked and covered for six weeks prior to being air-stacked than in those air-stacked following treatment.
3. Borate up-take and diffusion was greater in incised than in non-incised ties.
4. Large amounts of borate were lost from ties that were vapor-dried and treated with creosote shortly after six weeks of bulk-stacked, covered storage.
5. Very little borate was lost from air-dried ties during creosote treatment.

The 15-year inspection was at a site near Cordele, GA, on a mainline, fully signaled track. Sample ties in each treatment group were removed from track and sectioned through the inner spike holes at both ends to check for decay, insect damage and spike kill. Samples were obtained for borate analysis between the inner spike holes from the upper surface to the center and from the lower surface to the center. Results of the 15-year inspection can be summarized as follows:

1. Borates had diffused through the cross-sections and, after 15 years, were present at above toxic threshold levels for decay fungi.
2. No decay or termite damage was observed in either the creosote dip- or pressure-treated ties.
3. No spike kill was observed in borate pre-treated ties, and no evidence of excessive metal corrosion was observed in tie-plate areas. Spikes were clean and essentially free of rust.
4. Borate-treated ties did not negatively impact electronic signaling in the test track.
5. Borate retentions were higher in the lower than in the upper half of the ties, indicating how borates move to areas of higher moisture (eg, where decay would be most likely to occur).
6. Evidence indicates that the creosote over-treatment reduces the rate of borate leaching from ties.
7. White oak ties pre-treated with borates are performing well on mainline track in the South.
8. It may be possible to use reduced retentions of creosote if ties are properly pre-treated with borates and stored to maximize diffusion during the drying process.
9. Results of other phases of this study demonstrate the effectiveness of periodic supplemental treatments for protecting creosote-treated ties from decay and spike kill.

In 2004, the NS placed their first order for commercially borate pre-treated ties that were to be over-treated with creosote. From the start-up in 2004 through June 2005, 95,000 such ties were ordered by NS. Ties that have been shipped from the treating facility now are in track in AWWPA Hazard Zones 4 and 5. An additional 250,000 borate pre-treated ties have been ordered by NS for 2006.

At about the same time, the Canadian National (CN) ordered borate pre-treated and creosote over-treated ties and have installed approximately 40,000 to date. In 2006, CN intends to order an additional 100,000 borate pre-treated ties and 7500 switch ties. The CN plan is to eventually use borate pre-treated ties on lines south of Memphis.

Some railroads have been reluctant to use borate pre-treated ties because they fear the borates would cause signaling problems. In spite of the fact that no signaling problems were experienced in the RTA/AAR test track areas in over 15 years, many engineers remain unconvinced that such problems will not occur. Prior to placing borate pre-treated ties in track, NS sponsored electric impedance tests. A large-scale test with white oak ties that were either only creosote-treated or borate pre-treated and creosote over-treated was established. All ties had spiked tie plates on both ends. Impedance measurements showed that approximately the same percent of borate pre-treated and creosote-only (27% vs 29%) white oak ties would pass the minimum 20,000 ohm resistance currently used as a standard. The test also showed that the impedance measurements of the creosote-only and the borate pre-treated ties overlapped to a significant degree. In addition, NS and CN have experienced no unmanageable signal problems in any track sections where borate pre-treated ties have been installed.

CONCLUSIONS

Experience to date indicates that borate pre-treated ties that are over-treated with creosote have experienced essentially no biological or iron-mediated (spike kill) deterioration when exposed in AWWPA Hazard Zones 4 and 5. In addition, track sections containing borate pre-treated ties have experienced no unmanageable signal problems. Two Class 1 railroads, NS and CN, now are procuring borate pre-treated ties for use in their tracks in AWWPA Hazard Zones 4 and 5.