TECHNOLOGY DIGEST
Timely Technology Transfer

Performance Evaluation of Alternative Tie Treatments

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Summary

Field evaluations of experimental crosstie preservative treatments suggest that the life of a tie may be extended. Alternatives and supplements to conventional creosote pressure treatment of green ties are available. These alternatives can enhance the durability of an already long-lived product. This project, conducted as a cooperative effort of AAR, railroads, and supply industry sponsors, is part of an extensive AAR Track Research effort to improve track component performance.

After five years of field testing, several in-place treatment products show promise of extending tie life. Sodium Fluoride rods, Borate rods, Sodium Fluoride pads and Borate-Cunapsol pads all show potential to extend tie life for several years. In general, sprays are too short-lived. Solid materials, which remain in contact with the wood, show better performance.

The creosote treated crosstie has served the industry well for many years; recent developments in the inspection, planning and environmental areas make alternative treatments more attractive. Concerns about environmental regulation make development of alternatives highly desirable. The pressure to reduce capital outlays (estimated at $600 million/year on wooden crosstie replacement in US alone), make remedial (in-place) treatments almost imperative. Remedial or "in-place" treatments of ties already in track have great potential economic benefits. Life extensions as short as one year, result in savings of several dollars per tie. The number of ties which can be successfully treated depends on the traffic and climatic conditions of each line. The longer pay back period of green tie treatments requires longer life extensions and lower initial costs to be economical.

The long term objective of this work is to develop guidelines/recommendations for use of alternative treatments; including both the chemicals and method of application. The field treatment results provide a preliminary basis for these recommendations. Future work will include detailed autopsies of test ties, track performance results and evaluation of treatments for iron degradation prevention.

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Research and Test Department

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INTRODUCTION AND CONCLUSIONS

The issues of crosstie disposal, creosote environmental regulation (at the tie plant, and possibly in-track), improved track inspection techniques (which make in-place treatments practical), and the requirement to reduce capital expenditures have combined to show the need for alternative or supplemental treatments to creosote.

The Alternative Tie Treatment test is designed to evaluate tie life prolongation through the application of treatments other than the traditional green tie, creosote pressure treatment. The program is divided into three phases. Phase I addresses the borate treatment of green ties prior to air seasoning. Phase II addresses an in-place application of the products to crossties already in track as a remedial measure of treatment. Phase III addresses an in-place application of treatments applied to the adzed area of the crossties in conjunction with a rail relay program.

In-track treatments have potentially large economic benefits due to the relatively short period of time before receiving the benefit of extended tie life. The Phase III approach is especially attractive for several reasons. First, the additional costs of applying a product along with an ongoing rail relay operation is minimal. Secondly, this application provides access to the critical and vulnerable tie plate area. This area is at risk of failure due to high moisture (decay), high loading (mechanical failure) and metal contact (iron degradation).

The products under test have been proven to control wood decay in laboratory situations. There are three basic treatments which are utilized in this study. Disodium Octaborate, a wood preservative considered to be water diffusible, is exclusively used in Phase I and is also used in Phases II and III. It is applied as a solid (rods and pads) and a liquid (spray and non-pressure dip treatment). Sodium Fluoride, also considered to be water diffusible, is utilized as a solid (rods and pads) in Phase III. Copper Napthanate, which is not generally considered to be water diffusible, is utilized in Phases II and III as a liquid and a paste.

The treatments have been in test for five years. Treatment retention analysis as well as physical measurements have been conducted throughout this time. Measurements taken for each test section include: track performance (gage and crosslevel), tie performance (plate cutting, moisture content, loose spike counts) and treatment concentration levels (at various depths in the tie). The performance measurements are meant to provide a measure of the current condition of the track structure, as well as a tool to determine deterioration rate of the track properties which are being measured.

Findings and Conclusions of this test include:

* Borate Dip treatment of green ties is compatible with creosote pressure treatment; the two can be used in conjunction to provide a more thorough and deeper treatment that begins at the sawmill.
* Bulk stack storage of ties, after borate dip treatment and before air drying will increase borate retention levels. This extra handling step allows high rates of treatment diffusion.
* A short duration borate dip treatment is sufficient to attain lethal treatment concentrations. Virtually all Phase I ties had treatment concentrations above the required threshold (required to kill active decay) at the one inch depth level at the time of installation. Treatment concentrations remained above the threshold for 2 to 5+ years in the railroad crosstie environment.
* The Green tie borate dip treatment performs much better in terms of retention when done in conjunction with a surface water barrier treatment (e.g. creosote dip, Copper Napthanate dip). Ties treated only with borates showed a much higher rate of treatment loss in track.
* The performance of the in-place treatment products was dependant on the method of application. In general, solid rods performed better than pads. Pads were better than spray treatments. The ability to keep the treatment in

contact with the wood is good for solids (rods and pads) and poor for sprays. The rods and pads were able to provide years of treatment above threshold; whereas, sprays were not. The sprays are the easiest to apply, however.

* The Sodium Fluoride and Borate treatments show the ability to move (i.e. Diffuse) through the wood in crossties in track. Thus, these treatments are capable of treating the entire cross-section of the crosstie.

* None of the test ties has shown excessive degradation in Track/Tie Performance since treatment.

ALTERNATIVE TREATMENT OF GREEN TIES

Creosote pressure treatment and borate dip treatments 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. Chemical drying of ties after borate dip treatment reduces the borate retention levels significantly.

Bulk stack storage of ties for six weeks following a 3 minute borate dip treatment significantly increases borate retention. The solubility of borates is quite temperature dependant; using a solution saturated at 130°F greatly increased the effectiveness of dip treating. The level of concentration in the second half inch of the treated ties is more than double the concentration of the ties which were not bulk stacked. This increased retention can be seen down to a three inch depth throughout the five year assessment period (Exhibit 1).

FIELD TRIAL TREATMENT ANALYSIS

Field evaluation of the green tie dip treatments at six sites gives a good indication of the performance of this treatment in the railroad environment. A time series of samples was used to establish the initial concentration levels and rates of change of concentration at various locations in the tie. At the first inch depth level, the ties have concentrations above the prescribed threshold levels of 0.06 pcf boron (0.35 B.A.E) at installation (Exhibit 2). The treatment levels remain above threshold for 2 to 5+ years after installation.

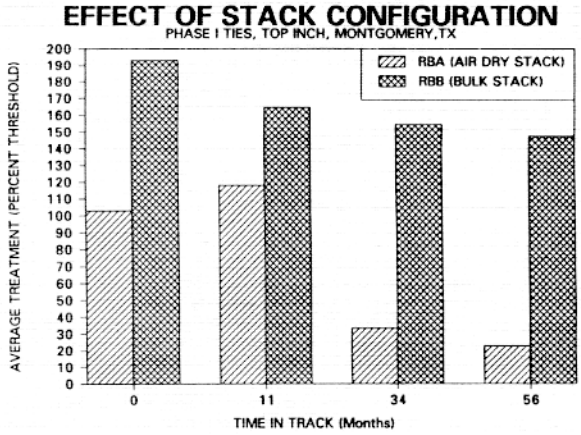

Exhibit 1. The Beneficial Effect of Bulk Stacking on Treatment Retention.

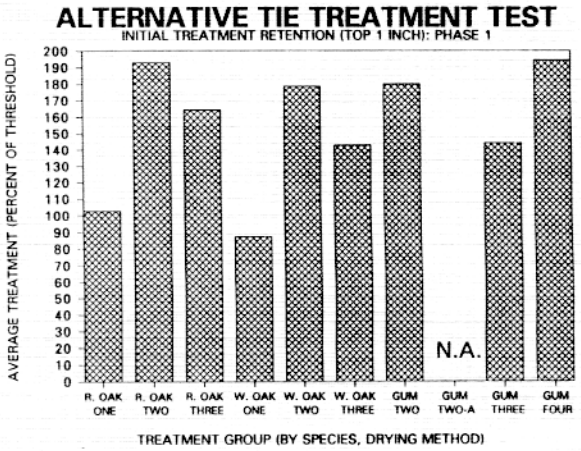

Exhibit 2. Phase I Treatment Retention Levels at Installation.

The bulk stacked storage ties consistently outperform the conventional stack air-dried ties. The efficacy of the in-place treatments was evaluated at four test sites. The Phase II spray products, both copper and boron based, never reach treatment threshold levels (Exhibit 3). These were applied without benefit of rail removal. The Phase III products have results as

varied as the products (Exhibit 4). The rod products (Sodium Fluoride and Disodium Octaborate) had the best performance with generally high treatment levels (above thresholds) for periods of two or more years.

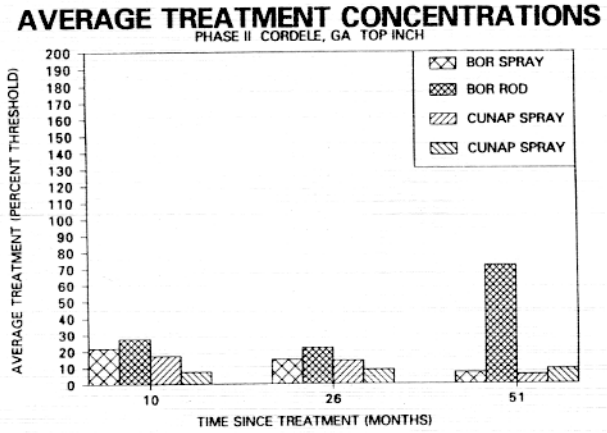

Exhibit 3. Phase II Treatment Concentrations vs. Time at Cordele, GA.

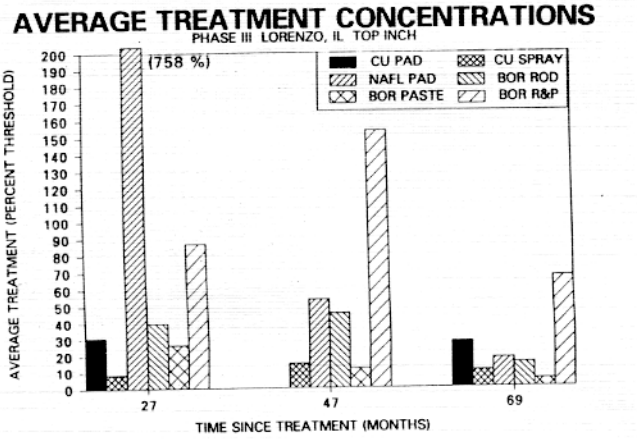

Exhibit 4. Phase III Treatment Concentration vs. Time in Track at Lorenzo, IL.

The pad products also showed good performance. The Sodium Fluoride pads have treatment levels above threshold (in the top inch of wood in the plate area) for 2 to 4 years. The copper and boron based pads have two treatment products in one paste. While neither copper nor boron thresholds are exceeded, the combination may be sufficient to be toxic to decay. The copper levels are increasing with time. The Phase III spray products (copper napthanate) also do not reach threshold levels. While the spray application may not be able to kill actively growing decay, they would provide some benefit to many ties in keeping decay from starting in this area.

The Sodium Fluoride and Borate treatments show the ability to move (or Diffuse) through the wood in crossties in track. Chemical analysis of core samples show movement of these treatments into the interior of the crosstie. This is especially true in the high moisture plate area. The Copper Napthanate products do not show this ability.

Products applied to the surface, such as sprays and pastes, show migration to the tie interior. Products applied to the interior migrate to the surface. Surface applied products appear, in measurable quantities, at the three inch depth level within 3 years (Exhibit 5). Much larger sized timbers may be treated by these products than can be effectively treated by pressure methods.

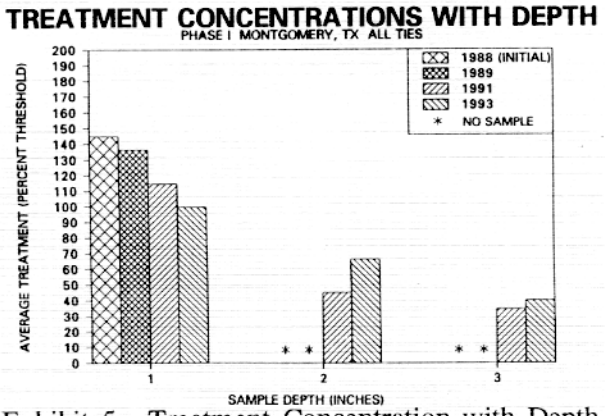

Exhibit 5. Treatment Concentration with Depth and Time.

Note: Contact David D. Davis at (312) 808-5851 with questions or comments about this document.