Dual Borate and Copper Naphthenate Treatment of Bridge Timbers – Potential Cost Savings by Various Performance Enhancements

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Abstract

Dual treatment technology combining diffusible preservatives with oil borne preservatives, widely used for crossties in the USA, has now also been commercialized with bridge ties/timbers. In order to understand the implications of these changes, the historic service life of creosote treated bridge timbers in northern and southeastern USA were considered as well as field test data for both creosote and copper naphthenate. These were used to estimate potential future service life. Estimates on life expectancy with added borates were also made from published data on performance.

Cost benefit analysis based on creosote and copper naphthenate costs as well as assumptions made from field test efficacy data suggest cost savings of up to $20 per timber per year of additional service. Service life extension and the resulting cost savings could be achieved in a number of ways: change preservative from creosote to copper naphthenate; increase active ingredient retention; and/or add dual treatment protection. A preservative change from creosote to copper naphthenate would be the simplest and lowest cost way of increasing service life of bridge timbers, with potential savings to both treater and railroad. An increase in copper retention could also give significant life extension, could be carried out at little additional cost and without increasing bleeding. The addition of borate to protect the heartwood also provides significant assumed increase bridge tie life, and can be used with either creosote or copper naphthenate treatments.

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Fig. 1. Commercially dual treated borate (Cellutreat® liquid 50) and copper naphthenate (QNAP®) bridge timbers. Timbers have been rip sawn after borate and plug (BTX®) installation and Boulton treatment, and one half subsequently curcumin sprayed (Smith and Williams 1969) to show the presence of borate (red in two middle pieces).

Discussion and conclusions

The assumed service life extensions resulting from switching to copper naphthenate, increased loadings, and/or dual treatment more than outweigh any additional initial costs, as shown by positive capital recovery over the lifespan of the tie. Although the values will vary with interest rates, the trends will be the same. Savings are greater over the life of the ties when the cost of money (interest rate) is low because of the upfront cost of the ties and treatment (it assumes the money is borrowed or not invested elsewhere over the time period).

Changes to tie treatment can result in savings for all scenarios, in both the southern and northern regions, but potential savings are greater in the south where the decay hazard is higher. A simple change from creosote to copper naphthenate even has an upfront saving of $2 per tie and yet also gives an additional ~ $5 per year in the north and ~$10 in the south. An increase in copper retention has little upfront cost and requires no change to treatment plant equipment etc., so is a sound move for both treatment plant and railroads with savings of more than $10 in southern climates but is not really financially justified in the north where simply changing to copper naphthenate at lower retention and obtaining the upfront cost saving is better.

For railroads in regions where copper naphthenate might not be available, adding the borate as part of a Boulton treatment to creosote gives estimated savings in excess of $15 per year in high hazard climates and more than $5 per year in lower hazard climates. The few dollars of savings per tie modelled here imply huge potential savings for a railroad, which may own hundreds of bridges, containing many thousands of ties. As an example, for 3000 bridges with 500,000 ties assuming an extra 30 years' service life, would give $300 million savings.

Service life of wood products is difficult to predict, especially when it involves new or developing protection technologies, so the values modelled here are uncertain. For example, it is unknown if the benefits of the treatment options are additive, coincidental or synergistic.

The data presented here, based on our assumptions, clearly demonstrate the incentive for railways to examine their options and make changes that extend tie service life. For those that wish to make different assumptions in terms of costs or longevity improvements, the calculations have been included and the scenarios can be re-modelled.

Regardless of the potential paybacks modelled here, in many circumstances there will be reluctance to adopt any new technology that requires additional up-front costs. We recognize the prevalence of short-term financial horizons in businesses such as railroads, but we also urge all users to consider the life cycle costing approaches, such as done here when considering investments in their infrastructure.

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