SINGLE-STAGE BORATE TREATMENT FOR CROSSTIES AND TIMBERS

(An operational enhancement of the 2-step creosote-borate treatment process)

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Summary

This is an extended abstract – a full paper cannot be provided due to patent restrictions.

This presentation is an outline of work on an improved method to incorporate boron and creosote into railway ties. This is an operational enhancement from a 2-step to a 1-step dual treatment process for which there is a patent pending.

Stella-Jones is a leading North American supplier of treated wood products that concentrates on industrial markets, with utility poles and railway ties accounting for about 85% of sales. It is one of the few treaters that is actively engaged in research and development. Its core competency is the ability to treat any species of wood with any preservative.

Creosote is the standard preservative for protecting railway ties from microbial decay and is a combination of over 300 individual compounds derived from coal tar. Many of these compounds are polycyclic aromatic hydrocarbons. Creosote is one of the longest used broad spectrum biocides whose mode of action includes the denial of water required by wood decaying micro-organisms, high acidity, and the interruption of metabolic activity at the cellular level. However, creosote has one main drawback, which is its inability to penetrate non-incised heartwood. This can leave the interior portions of ties susceptible to attack by organisms such as termites, which cause considerable damage to wood products in termite-prone areas, which are concentrated in more southern climates.

Boron is the standard chemical treatment for control of termite damage. It is a trivalent metalloid element which occurs abundantly in nature as the evaporite ores borax and ulexite. Boron is similar to carbon in its capability to form stable covalently bonded molecular networks. It is a broad spectrum fungicide, insecticide, and herbicide, with low mammalian toxicity and minimal environmental impact. It is non-volatile and non-corrosive and is readily diffusible even into refractory wood species. This means that boron can penetrate completely through an entire railway tie. However, its natural diffusion tendency also leads to a high susceptibility to leaching. This problem is reduced by using a dual treatment process, where the hydrophilic boron is blocked by a second hydrophobic preservative, like creosote, which forms an “envelope” over the outer layer of the wood. Boron’s mode of action with termites is not fully understood, but it is widely thought to be a stomach poison. It is believed to kill the protozoa and bacteria in the gut that excrete cellulases and other enzymes that decompose wood fibers to release nutrients for use by the termite. Boron essentially causes the termite to starve to death.

The dual treatment of ties with boron and creosote was pioneered by Mississippi State University as a 2-step process. The historic 2-step method involves first treating ties with borate and then

allowing an extended period of storage time for the boron to diffuse throughout the wood. The ties are then taken back into the plant and treated with creosote. This envelope treatment has the diffusible borate penetrate throughout the heartwood and which is then protected from leaching losses by the hydrophobic layer, or envelope, of creosote. Stella-Jones has developed an operational enhancement of this process, where dual treatment with both boron and creosote can be accomplished in a single step, while meeting threshold efficacy levels for both preservatives. Essentially, creosote serves as the carrier for boron in this procedure. The 1-step process utilizes a proprietary form of boron, which releases this as boric acid in response to the customized treatment protocols for which a patent has been applied for.

The 1-step dual treatment process is faster and can be used with wetter wood, making it more cost effective, as it offers several operational advantages, including a reduction in both handling, turnover times, and seasoning needs, and the requirement for less equipment usage. These cost savings can be passed on to the customer. In the development of this process Stella-Jones has ensured that it meets, or exceeds, the guidelines for the concentration of both boron and creosote in ties. The dual preservative solution employed is stable and is not subject to phase change reactions, has the ability to be boiled under a vacuum, and ensures diffusion of boron and its mobility between oil and water in the tie. There are no adverse effects on the mechanical properties of the wood, no additional environmental impacts, no increase in conductivity, no loss of efficacy, and no loss in the ability of either preservative to penetrate the wood. Complete boron diffusion can be accomplished within 10 hours from the start of the treatment cycle. This is in contrast to the many weeks required for diffusion in the 2-step process.

To date, the 1-step dual treatment process has been running at full scale at two of Stella-Jones' plants. Ties treated by the 2-step and the 1-step processes have been compared using AWPA testing protocols and there are no statistical differences between the treated ties relative to conductivity, leaching, fungal efficacy, mechanical properties, and corrosion. The burning of either tie raises no issues and comparative long term stake trials are presently underway in the USA for termite damage, etc. The newly developed 1-step process is not a replacement for 2-step treatment, but is a more economical option which can allow for more boron-containing ties to be placed in service. Stella-Jones offers both treatment options.

Stella-Jones is presently advancing this research by developing a 1-step dual treatment process for poles, where boron is combined with pentachlorophenol (PCP). PCP is the most widely used preservative for use in poles and the goal of this new process is to provide complete treatment with boron throughout the pole's heartwood, thereby limiting the need for subsequent field treatments with boron rods and wraps. A patent is also pending on the 1-step boron-penta-chlorophenol treatment process.