The Future of Industrial Wood Protection: A Bridge of Sustainability

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Summary

A brief look at where we have been, where we are today and where we need to go for our future was discussed from the perspective of an environmentalist and an industry scientist working for a relatively new preservative supplier in North America (www.NisusCorp.com).

With consumer and regulatory concerns about 'toxic' bleeding chemicals, contaminated lands (49 treatment plants are still on the EPA National Priority List in the USA), premature failures (decks and bridge ties) and even fatalities (e.g. nydailynews.com/news/national/collapsed-berkeley-balcony-decorative-report-article-1.2260785), we as an industry have given ourselves, and wood, a poor reputation and now face some serious challenges.

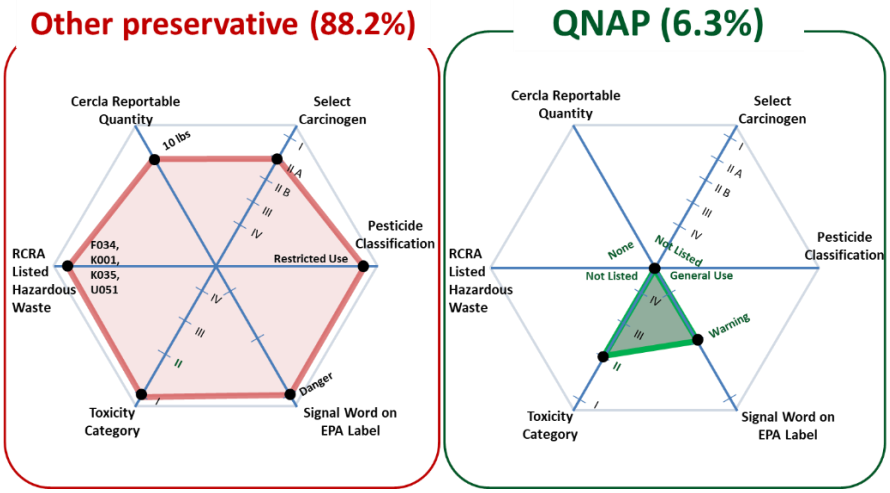
Preservative Bleeding from Utility Poles and Bridges Ties

Most traditional industrial wood products are now available in non-wood alternatives and in some instances have even been extensively replaced, concrete rail ties, composite poles and steel guard rail being some examples. Irrational, even unfair regulatory activity has also lead to new restrictions minimizing active ingredients (especially in Europe) and has massively increased the costs associated with pesticide registrations, often higher than the market will support. For example, some preservatives are reproductive toxicants, the same as alcohol, and yet we drink alcohol and we do not drink wood preservatives – but it is easier to regulate against the preservative. Others are essential micronutrients applied to crops for their healthy growth or intentionally applied to bodies of water as algaecides, yet again, an effort is made to minimize, if not prevent, all environmental release of these same chemistries when used as preservatives.

Regulators tend to like to tick boxes and may not look at any form of relativity, logic or often even appropriate risk assessment. Somehow, we need to make them aware that life cycle assessments (LCA) prove the environmental impact of the non-wood materials is far greater (Bolin & Smith, 2013; Smith & McIntyre, 2011; Townsend & Wagner, 2002) and that even some non-biocidal wood treatments (which are allowed in Europe without registration!) are more hazardous than traditional wood preservatives. Their actions can have very negative environmental consequences.

Already, the industry has recognized many of these challenges and has met them with improved technologies such as the dual treatment of rail and bridge ties that more than double their service lives (RTA 2010; Zeta-Tech, 2011), the wide adoption of voluntary best management practices to reduce environmental impact (www.woodpreservation.ca, www.wwpinstitute.org) and the movement away from restricted use pesticides to non-restricted use heavy duty preservatives such as copper naphthenate (available commercially as QNAP from Nisus corporation) (e.g. Gauntt, 2012) to reduce the EH&S footprint, with often even greater efficacy and no bleeding as additional benefits.

Environmental, Health and Safety Footprint of Two Different Industrial Wood Preservatives showing 'relative footprints' of 88.2% and 6.3%

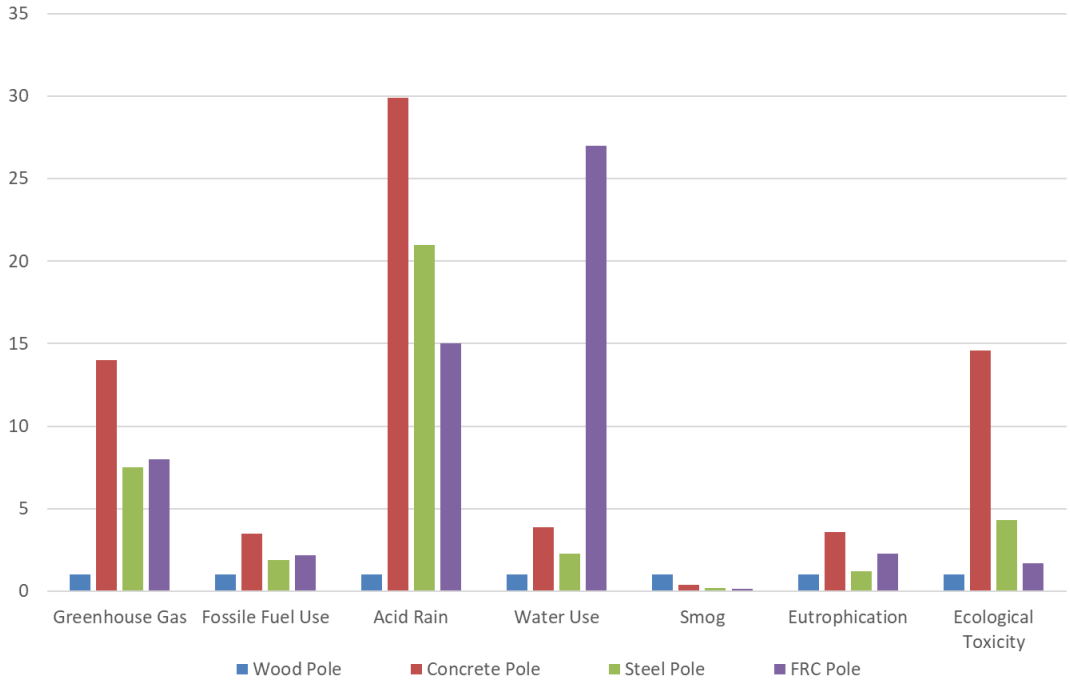


Moving forward the industry will need to further embrace sustainability. This will be achieved by longer service life (which enhances LCA results) through the avoidance of internal heart wood decay, as well as improved protection by design that can both improve service life and potentially reduce chemical usage or leaching into the environment. Pole caps and wraps (e.g. www.biotrans-uk.com) are starting to be recognized for both their performance and environmental benefits and hybrid treatment systems (e.g. a borate treated pole above ground, with a copper naphthenate treatment below ground as presented by Amburgey et al., 2016) along with more heartwood protection with through boring or dual treatments with diffusible preservatives deserve even wider acceptance.

Dual Treated oak railroad tie cross-section and Douglas fir utility pole longitudinal section shows how the borate (shown red using curcumin after Smith and Williams 1969) penetrates to protect the heartwood.

Biotrans® Pole Sleeves improve service life and reduce preservative leaching into the environment.

It will not be achieved by not using preservatives where they are necessary. For example, in mass timber/CLT structures, mold, decay and wood destroying insects will be very difficult to control in situ (Taylor et al., 2016) and will again give wood a bad name. It is all very well to say that the wood is designed to remain dry, but this is also true of the condos in Canada where we had leaky condo syndrome and of the homes in NZ where we had leaky home syndrome and of homes in the USA where there is a $billion remedial market. Note also that mold and dry rot are specifically excluded from insurance policies and that wood destroying insects typically attack dry wood anyway – so buyer beware. Somehow, we need to educate the public, especially regulators and less educated environmentalists, that wood treated with anything is more environmentally friendly than the non-wood alternative (Bolin & Smith, 2013; Smith & McIntyre, 2011; Townsend & Wagner, 2002).



Environmental Impact of Wood and Non-Wood Utility Poles (courtesy Steve Smith – Bolin & Smith, 2011).

Finally, it is suggested that the greatest attribute of wood is now one of its most under-emphasized. Wood is the only effective carbon sink that can potentially reverse our legacy of greenhouse gas emissions and global warming, but to utilize this benefit at the end of service life we need to avoid non-methane captured land fill at all costs and try to use the material as fuel in boilers and carbon as a reducing agent in metal smelting - both to offset fossil fuel use; or even to generate biochar for permanent carbon sequestration. Research in this area is showing promise whilst also allowing the recovery of preservative for re-use (e.g. Kim et al., 2016 a b). Fortunately for our industry, and the planet, we have better and brigter still to come. For a glimpse into our future make sure you're an attendee at the 50th annual scientific conference for the International Research Group on Wood Protection, to be held in Quebec Canada.

The Future of Our Industry. Students and Young Scientists Receiving the Ron Cockroft Award in 2017 at the International Research Group on Wood Protection Annual Scientific Conference (www.irg-wp.com).

References

Amburgey, T.L., Watt, J.L., Sanders, M.G. (2003). Extending the service life of wooden crossties by using pre-and supplemental preservative treatments. 15-year exposure report. *Crossties* (May/June), 1-5.

Amburgey, T.L., Sanders, M.G. (2009). Tie dual treatments with TimBor and creosote or copper naphthenate. *Crossties* (November/December), 20-22.

Amburgey, T. L., Sanders, M. G., & Barnes, H. M. (2016). Evaluating the Efficacy of Borate/Copper Naphthenate Treatments for Protecting Southern Yellow Pine Posts. Proceedings of the American Wood Protection Association Annual Meeting.

AREMA News (2017). RT & S Railway Track and Structures. 13 1 ISSN 0033-9016

Arthur, L. (1967). *Exposure tests on Timborised Keruing railway sleepers*. Borax report No:TR. 6742.

Asmus, R.W., Kelso Jr., W.C., Hein, R.W. (1985). *Copper naphthenate: a proven wood preservative*. In: Proceedings of the 8th Wood Pole Institute, Colorado State University, Ft. Collins, CO USA, 137-149.

AWPA U1-11 (2016). *Use category system: User specification for treated wood.* American Wood Protection Association, Birmingham, AL, USA.

Bolin, C.A., Smith, S.T. (2013). Life cycle assessment of creosote-treated wooden railroad crossties in the U.S. with comparisons to concrete and plastic composite railroad crossties. *Journal of Transportation Technologies*, 3, 149-161.

Bolin, C.A., Smith, S.T. (2011). Life cycle assessment of pentachlorophenol-treated wooden utility poles with comparisons to steel and concrete utility poles. *Renewable and Sustainable Energy* 15, 5 2475 – 2486.

Brient, J.A. (2014). Copper naphthenate treatment for wood crossties and timbers. The International Research Group on Wood Protection, IRG/WP/14-30647.

Brient, J.A., Webb, D.A. (2002). *The performance of copper naphthenate ties in service.* Proceedings of the American Wood Protection Association, 98, 112-115.

Crawford, D.M., Woodward, B.M., Hatfield, C.A. (2002). *Comparison of wood preservatives in stake tests. Progress Report.* Research Note FPL-RN-02. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.

Dickinson, D.J., Murphy, R.J. (1991). *The cause and control of pretreatment decay in home grown poles.* Proceedings of the British Wood Preserving and Damp Proofing Association.

ECETOC (1995). *Reproductive and General Toxicology of some Inorganic Borates and Risk Assessment for Human Beings.* Technical Report No. 63. European Centre for Ecotoxicology and Toxicology of Chemicals. Avenue E. Van Nieuwenhuyse 4, (BTE 6) B – 1160 Brussels, Belgium.

Freeman, M.H., Crawford, D., Lebow, P., Brient, J.A. (2003). *A comparison of wood preservatives in posts in southern Mississippi: Results from a half-decade of testing.* Proceedings of the American Wood Protection Association, 101,136-143.

Gauntt, J. (2012). Norfolk Southern leads the way again – Major commitment for copper naphthenate treated ties continues tradition of innovation. *Crossties*, 92(6), 14-18.

Kim, J.-W., Taylor, A.M., Köse, C., Lloyd J.D. (2011). *Ambient-temperature borate dip-diffusion treatment of green railroad crossties*. The International Research Group on Wood Protection, IRG/WP/11-40556.

Kim, P.; Lloyd, J.; Kim, J. W.; Abdoulmoumine, N.; Labbé, N., Recovery of creosote from used railroad ties by thermal desorption. *Energy* **2016,** *111*, 226-236.

Kim, P.; Lloyd, J.; Kim, J. W.; Labbé, N., Thermal desorption of creosote remaining in used railroad ties: Investigation by TGA (thermogravimetric analysis) and Py-GC/MS (pyrolysis-gas chromatography/mass spectrometry). *Energy* **2016,** *96*, 294-302.

Lebow, S.T., Woodward, B., Kirker, G., Lebow, P. (2013). Long-Term Durability of Pressure-Treated Wood in a Severe Test Site. *Advances in Civil Engineering Materials*, 2(1), 178–188.

Lloyd, J.D. (1998). Borates and their Biological Applications. The International Research Group on Wood Protection, IRG/WP/98-30178.

Lloyd, J.D., Chambers, T., Kim, J.-W. (2014). Cost effective extension of service life of bridge tie (sleepers)-Effectively applying borate during Boulton conditioning and treatment with copper naphthenate. The International Research Group on Wood Protection, IRG/WP/14-30637.

RTA (2010). Norfolk Southern, RTA Showcase Long-Term Research - Field Trip To 23-Year-Old Test Site - Eye-Opening for 50 wood tie industry members. *Crossties* (March/April).

Smith, S.T., McIntyre C.R. (2011). Life Cycle Assessment Comparison of Treated Wood to Alternate Materials – Overview, Results and Lessons. The International Research Group on Wood Protection, IRG/WP/11-50282.

Smith, D.W., Williams A.I. (1969). Procedure for determining penetration of timber preservative using curcumin reagent. *Journal of the Institute of Wood Science* 4: 3-10.

Taylor, A., Bennett, R.M., Harper, D.P., Lloyd, J.D. (2017). Impacts of preservative ports on bridge tie strength. *Forest Products Journal* 67 (1/2), 24-28.

Taylor, A., Lloyd, J., Shelton, T. (2016), An Open Letter to Proponents of CLT/Massive Timber IRG/WP 16-40755 Paper prepared for the 47th IRG Annual Meeting Lisbon, Portugal 15-19 May 2016 Proceedings IRG Annual Meeting (ISSN 2000-8953)

Townsend, P., Wagner, C. (2002). *Timber as a building material: An environmental comparison against synthetic building materials.* National Association of Forest Industries Ltd.

Woodward, B.M., Hatfield, C.A., Lebow, S.T. (2011). *Comparison of wood preservatives in stake tests: 2011 progress report.* Research Note FPL-RN-02. Madison, WI: U.S. Department of Agriculture, Forest Service, Forest Products Laboratory.

Zeta-Tech (2011). Determination of Effect of Introduction of Dual Treatment (Borate-Creosote) Ties on Average Tie Life and Wood Tie Life Cycle Costs. The Railway Tie Association (RTA). Prepared by Zeta Tech A Harsco Rail Business Unit 900 Kings Highway North, Cherry Hill NJ 08034.