

Harmonizing Timber Circularity: A Comprehensive Approach to Sustainable Wood Resource Management in Australia

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ABSTRACT

Timber, renowned for its low embodied carbon and renewable characteristics, stands as an ideal candidate for integration into the circular economy. However, challenges arise in the reuse, repurposing, and recycling of chemically treated materials. The National Centre for Timber Durability and Design Life (NCTDDL) at the University of the Sunshine Coast (USC) is spearheading a collaborative initiative with Forest and Wood Products Australia (FWPA) and a consortium comprising timber producers, chemical suppliers, and timber users. This joint effort aims to delineate circular pathways for preservative-treated timber and engineered wood products (EWP).

The Timber Circularity Project focuses on key areas, including assessing current and projected volumes of end-of-life PTT and EWP and their distribution. Furthermore, it endeavors to evaluate the resource condition concerning residual chemicals and the potential for recycling. Understanding the intricate web of local, state, and federal regulations impacting transport and reuse options is also a pivotal aspect of the project. Geographic mapping, encompassing available resources, transport routes, regulatory influences, councils with established circular economy strategies, and potential resource users, serves as a comprehensive strategy to enhance the sustainable integration of timber into the circular economy. This concerted effort seeks to address the environmental challenges associated with timber treatment and ensure a more sustainable and circular approach to timber utilization in the future.

Evaluation of Wood Fiber-Based Insulation Materials for Mold and Fire Resistance

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ABSTRACT

Wood fiber-based insulation offers a renewable, non-toxic, and carbon negative alternative to traditional fiberglass insulation. However, as a wood-based material, flammability and susceptibility to mold colonization are key concerns. In this study, 5 types of wood-based insulation materials were evaluated for fire and mold resistance using standardized test methods. Mold testing results showed that 4 of the wood-based fiber insulation materials exhibited better mold resistance than both plywood and southern pine comparative controls. Fire resistance testing showed that the higher the density of the wood-fiber material, the longer the time to ignition. The commercial additives, PMDI, borates and others likely act to some degree, but further testing is needed.

Exploring the Strength Impacts of Incising

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ABSTRACT

Refractory timbers such as Douglas-fir and the Hem-Fir species group require incising to meet industry preservative penetration standards for treatment. While incising markedly improves treatment to the depth of the incisions, it can negatively impact material properties. Design standards for incised wood require a reduction in design values of as much as 20 percent to account for these effects. These design value adjustments can impact the use of incised wood in engineered applications such as bridges. Research is underway to determine if the current standard design value adjustments are overly conservative and should be revised to reflect accurate strength effects.

Evaluating the Efficacy of External Pastes and Internal Fumigants for Enhancing Durability of Wood Products

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ABSTRACT

This study examined the efficacy of external preservative pastes and internally applied compressed dazomet sticks for utility poles. Field tests demonstrated that a paste containing copper and boron (MP500-EXT) provided continued protection against external decay for a minimum of 10 year on pine wood and Douglas fir poles. Separate tests showed that internal treatments with a compressed basamid rod (Osmofume) and an internal void treatment (HollowHeart CB) as an accelerator for basamid decomposition to methylisothiocyanate (MITC) effectively arrested internal fungal attack and remained at effective levels for the same time. Our findings reveal promising results for both treatments, highlighting their effectiveness in prolonging the lifecycle of wood products. Furthermore, data on the movement of MITC from compressed dazomet and copper and boron from external paste will be presented, enriching our understanding of the mechanisms underlying these treatments.

Product Stewardship: Environmental Dynamics

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ABSTRACT

Discussion of Creosote Council III support of Phase I work carried out Oregon State University by Skylar Foster and most recently Dr. Iman Rashidi Jouybari (OSU Post Doc) who compiled all the data summarizing the migration of PAHs from commodity sized treated timbers of Douglas Fir and Southern Yellow Pine treated to AWWA standards with Creosote. Sampling for PAHs associated with creosote utilized sachet sampling methods where the sachets were analyzed for 16 PAHs at 3-month intervals from 0-6 months, and then at 6-month interval out to 12 months. The sachets were positioned at the surface, mid-water column, and just above the water/sediment interface and at the specified timepoints sachets were collected and analyzed for PAHs, and with the replacement with a fresh sachet. Upstream control and water-flow dynamics were collected over the accumulation of PAHs over the sampling period to provide a perspective of the PAH concentrations and movement in the water column. In addition, water samples were captured at the surface, mid-water column, and at the water/sediment interface and measured at Smithers Laboratories where the limit of detection (LOD) ranged from 0.001 to 0.004 µg/L and limit of quantification (LOQ) ranging from 0.007 to 0.10 µg/L. The results showed a variability in migration with expected higher concentrations initially and falling at the subsequent time points. Real-time measurements by Smithers Laboratories showed non-detects for any of the PAH's monitored at the 3- & 6-month samplings. The PAH concentrations measured from the sachets are an accumulated concentration of PAHs over a 3-month period with the last timepoint being a 6-month accumulation; when considering water flow and time, all concentrations would be below the EPA's maximum contaminant level (MCL) and EPA's primary drinking water standards for PAHs and benzo(a)pyrene (BaP). However, it was interesting to note that at the 12-month sampling timepoint PAHs showed an increase at the treated posts as well as the upstream control posts which coincided with increase rains prior to the sampling. Strongly suggesting that there are other sources of PAHs that contributes to environmental PAHs.

This data will pave the way for a more comprehensive environmental assessment, as the Creosote Council has completed the environmental data requested by the US EPA DCI for Creosote. Data includes acute & chronic freshwater vertebrates and invertebrates with chronic sediment dwellers, midge life-cycle, algal, and duckweed data. As the Council will be working with OSU to develop a more defined predicted environmental concentration (PEC), that is representative of creosote and be more able to define potential levels of concern (LOC) in the environment.

Wood Railroad Tie Market Overview

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ABSTRACT

The Railway Tie Association was organized in 1919. Predecessor groups, dating back to the late 1800s, including The National Association of Railroad Tie Producers, supported the railroad tie industry and worked to preserve forests through conservation. The mission of the RTA is to provide the forum and direction for continual improvement in the life-cycle of the engineered wood crosstie system. The purpose of the RTA is to promote the economical and environmentally sound use of wood crossties. RTA activities include: research and development projects, gathering industry statistics, outlining sound specifications, and supporting operations that promote and maintain high standards of quality for wood crossties. From a government affairs perspective, RTA works closely with many strategic partners to support all efforts to ensure the health of the railroad, wood preserving and sawmill communities. RTA hosts three in-person events each year and publishes in many outlets to provide ample outreach and education for the industry. RTA works to keep tie markets strong and healthy. RTA's ongoing efforts include working to enhance the potential for our members' products and to make sure those products meet the market demands. The key to successful competition in today's railroad industry is information. RTA is your best resource for information about treated wood crossties.

Using Treated Wood in California

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Gemini Forest Products
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ABSTRACT

This presentation will focus on four ways that treated wood is used in California:

1. Railroad Ties - What's the future for Creosote and DCOI?
2. Marine Construction - Why we worked on introducing Protective Barrier Systems.
3. Wooden Guardrail in California - The decline of usage from CalTrans
4. Regulatory issues - Perception over reality (from Thunderbolt)

Benefits of Utilizing Advanced Technology in the Treating of Cross ties

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ABSTRACT

Koppers is presenting on the construction and operation of its state-of-the-art treating facility in North Little Rock, Arkansas. Completed in 2023, the facility allows for greater productivity along with improved environmental and safety performance.

Evaluation of Water Ingress into Various Retentions of Creosote Treated Gum, Liquidambar styraciflua, Via Wetting Angle After Weathering

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ABSTRACT

One significant component of the functional endurance of wood products is its resistance to decay. Temperature, oxygen, moisture, and food are some of the basic factors that any living organism needs to survive; controlling environmental factors is one way to arrest or slow the deterioration of wood. Wood is a hygroscopic material that could adsorb or desorb water in response to temperature and relative humidity of the atmosphere surrounding it. Water's interaction with coatings or preservatives on wood play a role in preventing wood from deteriorating since water is a factor of both physical change in wood (shrink/swell) and aiding in biological development of wood destroying organisms. In a past A WP A publication, "Development of Artificial Intelligence to Monitor Water Ingress into Wood Treated with Coatings and Preservatives: A Focus on Creosote", testing showed that industrial treated creosote cross ties take more than a 28-day accelerated weathering exposure to reduce the wetting angle.

These tests also showed that specimens should be prepared in the lab to reduce debris and dirt that affected the wetting angle measurements. A total of 25 Sweetgum (*Liquidambar styraciflua*) samples were cut from two green untreated ties in the dimension of 2 in. x 4 in. x 4 in. (55.88 cm x 10.16 cm x 10.16 cm), sanded, and treated with various retentions to evaluate the effectiveness of the various creosote retentions exposed to severe weathering. The creosote toluene dilution retentions for these freshly treated gum samples are 4-lb/cft (64 kg/cm), 8-lb/cft (128 kg/cm), and 16-lb/cft (256 kg/cm). These samples are currently being tested under a lengthened weathering criteria in a series of 28-days sessions until droplets fail to achieve more than a 90-degree water contact angle reading at 15 seconds. Data discussing wetting angles, preservative water interaction, and any degradation during weathering will be discussed in the future publication.

Environmentally friendly wood innovative hardening solution

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ABSTRACT

The construction sector is a major contributor to global greenhouse gas emissions, accounting for 40% of the total, with building materials and construction alone responsible for 10% of these emissions [1]. This trend is expected to grow significantly by 2030. However, the use of green materials, such as wood products, can rapidly reduce the energy impacts and carbon footprint associated with building construction and operation. Wood is the main renewable material used in construction products, particularly in North America. However, its low hardness and flammability limit its use in non-residential construction.

Densifying wood reduces voids in its porous structure, increasing its density and hardness, while improving other properties such as dimensional stability, service life, and mechanical properties. Densification adds value to low-density wood products. However, many densification technologies are harmful to the environment since they are associated with high energy consumption, significant emissions of volatile organic compounds (VOCs), and the use of fossil chemicals. Among these chemicals, formaldehyde, recognized by the World Health Organization as a human and animal carcinogen, presents environmental risks. However, since 2021, the Canadian Environmental Protection Act limits VOC concentrations and restricts the use of formaldehyde.

It is therefore essential to implement a densification system that reduces energy consumption, the time required, and the use of toxic chemicals such as formaldehyde and VOCs. Although the advantages associated with biobased raw materials are obvious, it is imperative to develop a strategy focused on their performance. This research, therefore, aims to develop a wood densification method based on biobased raw materials, focusing on increasing wood hardness. It comprises three stages:

1. Develop fast-curing formulations using green chemistry principles, involving the in-situ polymerization of biobased acrylates and malonates by the Michael addition reaction as a green chemistry reaction.
2. Explore Michael addition-based formulations for impregnating local wood species, including sugar maple, red oak, and yellow birch, with low energy consumption and minimal environmental impact.
3. Evaluate the impact of formulation viscosity on wood hardness across different species using mathematical modeling.

Therefore, various malonate-acrylate systems are formulated, optimized, and tested based on the Michael addition reaction, at room temperature, and the best formulation will be selected for wood densification. In conclusion, this study rationalizes the production of densified wood products, offering cost-effective bio-sourced formulations, an environmentally friendly curing process, and energy efficiency.

Durability and thermal properties of biomineralized Southern Yellow Pine (SYP) via bacterium *Sporosarcina pasteurii*

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ABSTRACT

Biom mineralization is a process by which living organisms produce and deposit minerals (carbonates, silicates, sulfates, and oxides) to improve the performance of inorganic-based materials. However, this process has not been explored in organic materials, e.g., wood and wood-based products and composites. The main objective of this study is to improve the fungal and fire resistance of Southern Yellow Pine (SYP) using the bacterium *S. pasteurii* through microbially induced calcium precipitation (MICP). The surface morphology, fungal resistance, and thermal properties of the biomineralized SYP wood blocks were investigated. The presence of biomineral (calcium carbonate) was determined by optical microscopy and FTIR spectroscopy. It is expected that the biomineralized SYP wood blocks will have increased durability after soil block test and improved thermal properties (lower mass loss and thermal degradation rate) when evaluated by Thermogravimetric Analysis (TGA). This will be a novel and environmentally friendly approach to designing green building material that is durable, thermally stable, and fire resistant.

Determining the minimal level of CCA penetration required to protect *E. nitens* heartwood from fungal decay

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ABSTRACT

The traditional pressure treatment of numerous Australian hardwoods often yields limited penetration into the heartwood and an uneven treatment of less than 5 mm around a mostly untreated core. This poses a significant challenge for many low-durability plantation hardwoods in Tasmania, which contain substantial proportions of heartwood. While extended studies on softwoods like spruce decking indicate that superficial barrier treatments can offer decades of protection, it remains uncertain if similar treatments would be as effective for lower durability hardwoods. Conducting field tests to yield meaningful results would require several decades, though expedited laboratory decay tests might help bridge this testing gap.

This research assessed a laboratory technique aimed at establishing the minimum effective level of chromated copper arsenate (CCA) penetration into the heartwood of *Eucalyptus nitens* to prevent fungal colonization by the brown rot fungus *Fomitopsis ostreiformis*. Findings from visual observations and culturing indicated that barriers of 2, and 4 mm were ineffective in preventing fungal colonization on untreated surfaces. A level of penetration of 6 mm effectively precluded fungal colonization when aided by a waterproofing and tar varnish coating.

Durability, moisture resistance and spectral analysis of thermally modified wood produced from North American wood species

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ABSTRACT

Thermally modified wood is rapidly gaining popularity in North America where it is being produced from local wood species. To ensure uniform performance of these materials across manufacturers, third party quality control methods are needed, but have been more difficult to develop because of the lack of a quantifiable active chemical agent in the products. This study sought to identify spectral properties of commercially produced modified woods from North American species that can predict durability and moisture performance. Thermally modified Douglas-fir (*Pseudotsuga menziesii*), ponderosa pine (*Pinus ponderosa*), yellow poplar (*Liriodendron tulipifera*), western hemlock (*Tsuga heterophylla*), and red alder (*Alnus rubra*) lumber were acquired from commercial sources as well as untreated source material. Dimensional swell and fungal resistance were measured using DIN 52 184, and an AWP A E10 soil bottle decay test, respectively. Heat treated samples generally were more dimensionally stable when wetted compared to their controls. Thermally modified Yellow Poplar and Red alder had little effect on antifungal resistance toward the two brown rots *Rhodonias placenta* and *Gleophyllum trabeum* and the white rot fungus *Trametes versicolor*. Thermally modified Ponderosa Pine and Douglas-fir similarly showed no improvements in fungal resistance except against *R. placenta* where mass losses were reduced by 44% and 39%, respectively. Thermally modified western hemlock showed the greatest improvement in durability over its untreated control and the modified wood showed similar or better performance to several naturally durable woods. FTIR scans showed an increase in absorbance from phenolics and aromatics, which are formed from lignin degradation. Phenolics, specifically, have been attributed to an increase in fungal defense. Aromatics could also increase the thermally treated wood hydrophobicity. FT-IR analysis also showed a reduction in C-O-C bonds which could indicate a loss in hemicellulose that is characteristic of thermal modification and diminishes the ability of water to bond to cell wall components. These results show dramatic differences in performance of different commercially produced modified woods and highlights the need for standardization across manufacturers using some kind of quality control methodology.

Certification of Thermally Modified Timber - the European experience and the view of an industrialist

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ABSTRACT

Quality control and certification of thermally modified timber (TMT) in Europe has undergone a number of changes after the product was introduced on the industrial market in the 1990's. But the standards and certification still leave a lot of questions, misunderstandings and faults to be resolved before it will provide a sound and true basis for product and quality assessment. The paper deals with these issues based on theoretical and practical experience by an equipment/process supplier (Moldrup-SSP) as well as plant operator. Even the latest version of EN113-2 from 2020 and EN350 from 2016 have major flaws and fail to address the basic question of how to provide quality assessment and certification for durability based on the use areas of TMT. Treated product control as mostly done today may not offer a good picture of the quality of the finished product when bought by the final user and may result in disappointed expectations that will have an unnecessary negative impact on the product in the long term.