# Research & Development Summary

Value to Wood

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## *Improving the Performance of Wood Decking Through Coating*

*Figure 1: Natural weathering set up*

Approximately 2 million cubic meters of softwood lumber are treated annually with copper amine [alkaline copper quaternary (ACQ) and copper azole] wood preservatives for residential exterior appearance products. In addition, significant amounts of commercial and industrial products are treated with chromated copper arsenate (CCA) and there are many CCA-treated residential structures still in service. The premature removal of treated wood from service due to weathering checking, distortion and UV degradation leads to product substitution by competing products such as wood/plastic or plastic lumber products, which are promoted as "low maintenance" compared to wood. Early removal of treated wood products also results in concerns for landfill disposal and other waste management options for dismantled structures. Application of a durable coating should reduce the effects of weathering and thus increase the service life of treated wood. These could be factory-applied, or applied after installation of a structure, to ensure long-term protection against moisture changes and UV degradation. Development of criteria to define appropriate coating systems for different treated wood products will promote continued preference for these wood products over competing materials. It could also help reduce pressure on landfills and promote value-added pre-finished products. These coatings could also reduce leaching of preservatives from the wood, reducing their environmental impact.

Different wood preservative systems change the physical and chemical nature of wood surfaces, and different coating types may bond and perform differently on different treated wood types. In this study, the effects of penetrating stain characteristics (resin type, solvent, solids content, physical properties) on coating performance on different wood treatments were evaluated in short term screening tests, accelerated weathering tests and natural weathering exposure.

### *The objectives of this study were to:*

- test compatibility and interaction of different types of commercially available coatings with various treated wood surfaces;
- find correlations between coating properties and weathering performance.

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## Methodology

Fourteen commercial penetrating stains were applied to wood samples treated with the three preservatives and evaluated in a laboratory soaking test for water exclusion and preservative leaching properties. Based on these findings, eight coatings were selected that represented a wide range in performance characteristics for further testing by an accelerated weathering protocol that exposed larger samples to cycles of UV light exposure, water spray, freezing and drying. Based on these results, five coatings with diverse performance properties were applied to larger pine samples and exposed horizontally in water collection containers (***Figure 1***) to natural weathering conditions in Toronto, Ontario. At monthly intervals, water samples were collected and analyzed to determine the amounts of leached preservative components. The samples were also evaluated for moisture uptake, colour changes, splitting and coating condition.

## Results

Water uptake by samples was affected by type of coating and the preservative treatment as shown by the accelerated weathering results which involved cycles of water spray, UV exposure and drying (***Figure 2***). For example, the polyurethane (PU) based coating (#14) effectively excluded water on CCA-treated and untreated samples, but was less effective on the copper amine based ACQ- and CA-treated wood. A solvent-based alkyd stain (#9) and a water-based alkyd acrylic stain (#4) effectively reduced water absorption for all treatments. A second solvent-based alkyd (#5) and water-based alkyd-acrylic stain (#2) were less effective at excluding moisture.

The performance of the penetrating stains, in terms of reducing checking and retaining their colour and integrity over fifteen months of natural weathering exposure, also depended on the type of stain and on the preservative used to treat the wood. Generally, stains performed better on CCA-treated wood than on ACQ-treated wood (***Figure 3***).

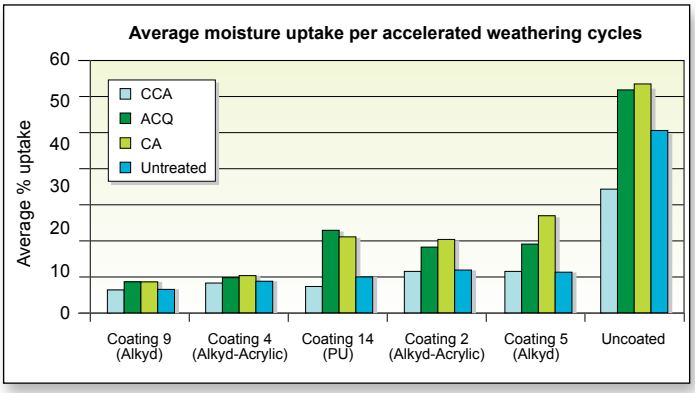


*Figure 2: Comparison of average water absorption during spraying of pine samples exposed to accelerated weathering conditions.*

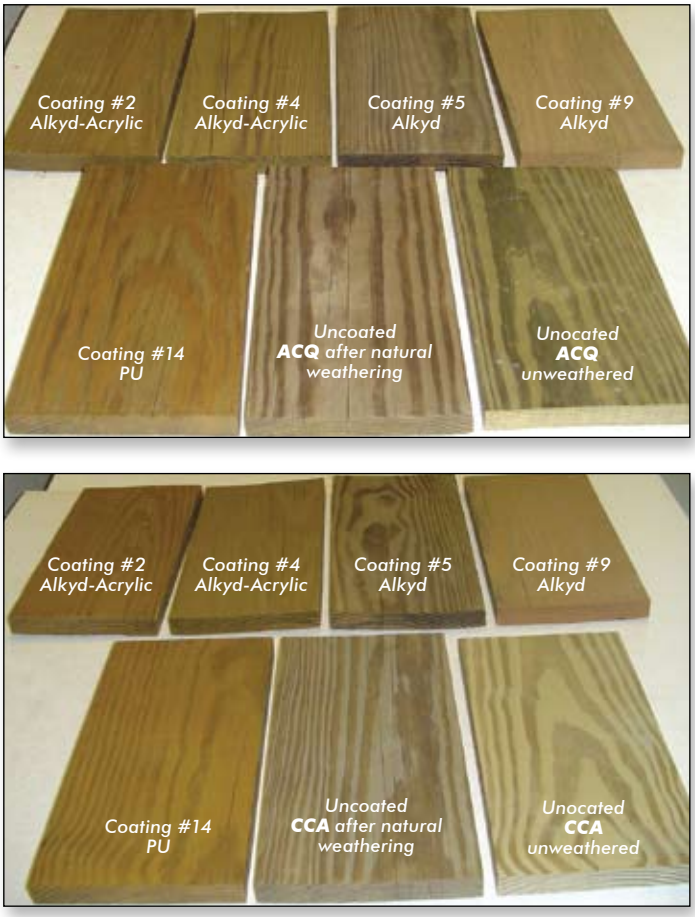


*Figure 3: Comparison of coating performance on (top) ACQ- and (bottom) CCA-treated pine after 12 months of natural weathering exposure.*

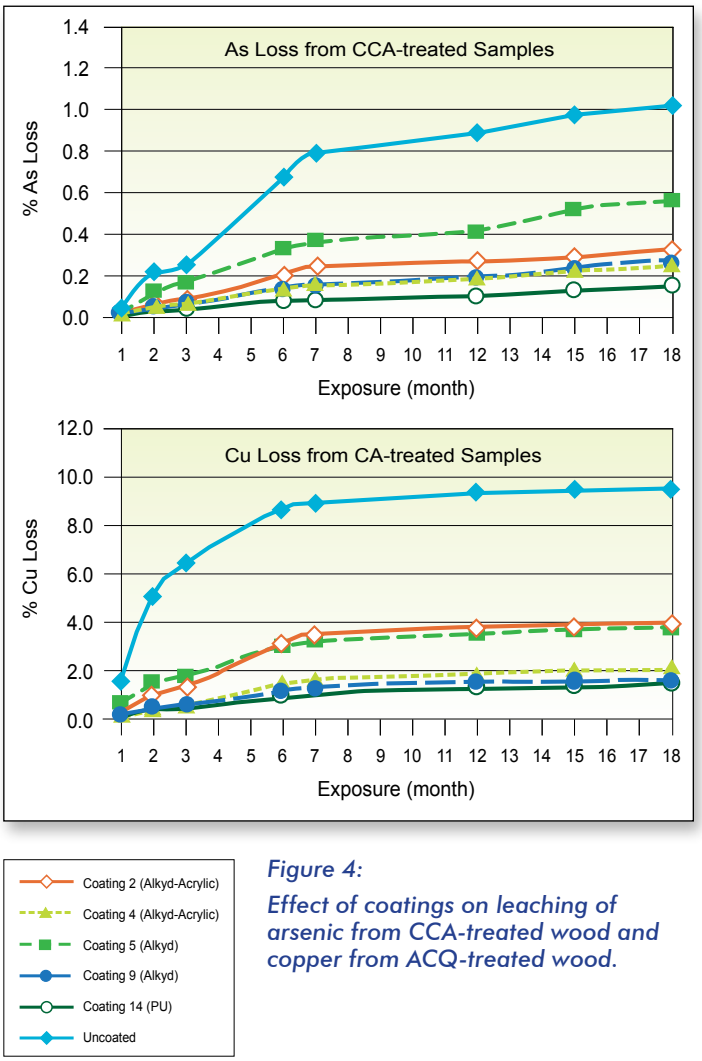


*Figure 4:*
*Effect of coatings on leaching of arsenic from CCA-treated wood and copper from ACQ-treated wood.*

All stain products evaluated were very effective at reducing preservative component leaching as shown in ***Figure 4***.

Generally, the natural weathering performance of stains could be predicted by short-term laboratory studies or by accelerated weathering exposures. For example, in terms of leaching minimization, coatings were ranked the same after 15 months of natural weathering as they were after two weeks of laboratory leaching tests. Thus it should be possible to screen a large number of coating types using shorter term laboratory studies.

Generally, the coatings that performed the best in terms of reducing water absorption and preservative leaching were those that were viscous and did not penetrate rapidly into the wood when applied. Of the commercial finishes tested, water-based polyurethane, a water-based alkyd/acrylic and a solvent-based alkyd performed the best.

## Potential benefits application

This project creates an opportunity for the manufacture of higher value-added factory finished treated wood products that have lower maintenance requirements and longer service life than conventionally treated wood. By identifying and promoting the benefits of applying appropriate finishes to treated wood, the market for preservative treated wood is supported by reducing maintenance costs and premature removal, and minimizing concerns for health, and the environmental impacts of these materials.

A coated treated wood decking product could be priced well below plastic decking lumber and other competing appearance products, while adding considerable value relative to conventional treated lumber. This creates an opportunity for the treating industry or for manufacturers of value-added decking, fencing, garden and cladding products to increase the value of their product and provide longer performance guarantees. In addition, application of recommended finishes by homeowners would have the effect of extending the service life and adding value to the product, resulting in less substitution for alternative products such as plastic and composite “lumber”. Environmental benefits associated with reduced preservative leaching would also benefit the wood treating industry, consumers and the Canadian environment.


## Acknowledgements

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