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FIELD PERFORMANCE OF PRESERVED SHAKES AND SHINGLES

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ABSTRACT

A series of long-term field tests have been evaluating the performance of various preservative treatments for shakes and shingles. This report updates the performance data for these products. CCA continues to be highly effective in protecting shakes. After 45 years in test, western redcedar shakes treated with CCA-B remain serviceable. After 20 years in test, pine and spruce shakes, treated with CCA, had no confirmed decay. ACQ-D and CA-B were effective in protecting western redcedar shingles, with little decay observed after 15 years of exposure. Propiconazole and oxine copper were associated with greater levels of decay and would not be recommended for protecting western redcedar shingles at the retentions evaluated. Longer exposure time is needed to evaluate the efficacy of the DDACarbonate and alkylamine oxide treatment.

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MAINTAINING MARKETS FOR WOOD PRODUCTS

ACKNOWLEDGEMENTS
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The FPInnovations field test site at Maple Ridge, BC is maintained within and with the assistance of the Malcolm Knapp Research Forest of the University of British Columbia, Faculty of Forestry.

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OBJECTIVES

- To assess the long term field performance of preserved shakes and shingles

INTRODUCTION

In 2018, British Columbia exported $167 million worth of western redcedar shakes and shingles. In many applications, western redcedar has sufficient natural durability to meet the needs of the market. However, preservative treatment is required to provide long service life in environments conducive to decay. While CCA has been restricted from many residential uses, it is still registered by Health Canada's Pest Management Regulatory Agency for protection of shakes and shingles.

When CCA was voluntarily withdrawn from much of the residential market in 2003, it was decided that alternative preservatives for western redcedar shingles should be evaluated.

An experiment was set up to assess the ability of ACQ-D, CA-B, oxine copper and propiconazole to protect western redcedar shingles (Morris *et al.* 2013). A formulation containing DDACarbonate and alkylamine oxides was added in 2015, following two years of vertical exposure in an extractives staining test (Stirling 2015).

This report documents the long-term performance of CCA in western redcedar, pine and spruce shakes. It also documents the performance of newer systems that could potentially replace CCA for treatment of western redcedar shingles. Currently, CSA O80 only specifies CCA for the treatment of shakes and shingles (CSA Group 2015). The data described in this report could be used to support standardization of alternative preservative systems to extend the service life of shakes and shingles.

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MATERIALS AND METHODS

Evaluation of 45-year old WRC shakes treated with CCA-B

Old-growth western redcedar shakes pressure treated with CCA-B were prepared as described by Cserjesi (1976) and Morris *et al.* (2013) (Table 1). The test was initiated in 1973 on south facing panels at the Maple Ridge site. The material was most recently inspected in September 2018.

Table 1. Western redcedar shakes treated with CCA-B

Preservative	Gauge retention (kg/m^3)	Assay retention, butt (kg/m^3)	Assay retention, face (kg/m^3)
Untreated	0	0	0
CCA-B	4.7	16.5	3.8

Evaluation of 20-year old pine and spruce shakes treated with CCA-C

Pine and spruce shakes were pressure treated to the retentions listed in Table 2 as described by (Morris and McFarling 1995). The test shingles were installed at the Vancouver test site on south facing racks on May 1, 1995. The material was most recently inspected in 2015. Photos presented are from May 1, 2019.

Table 2. Pine and spruce stakes treated with CCA-C

Species	Target retention (kg/m^3)	Pooled assay retention (kg/m^3)
Pine	4.0	4.2
Spruce	4.0	4.1

Evaluation of 15-year old WRC shingles treated with ACQ, CA-B, oxine copper and propiconazole

Untreated second-growth western redcedar shingles were pressure treated with the preservatives listed in Table 3 as described by (Ingram and Morris 2009). Test shingles were installed on north and south facing sides of a sign shelter at the Maple Ridge test site in September 2003. The material was most recently inspected in September 2018.

Table 3. Preservatives included in sign shelter study

Preservative	Target retention (kg/m^3)	Gauge retention (kg/m^3)	Full length assay (kg/m^3)
Untreated	0	0	0
ACQ-D	4.0	3.9 (1.0)*	4.7 (1.6)
CA-B	1.7	1.7 (0.4)	2.0 (0.7)
Oxine copper	0.32	0.41 (0.15)	0.38 (0.06)
Propiconazole formulation	0.24	0.27 (0.05)	N/A

*Standard deviations appear in parentheses

Evaluation of WRC shingles treated with DDACarbonate and alkylamine oxide

A field test of WRC shingles dip-treated or pressure-treated with DDACarbonate and alkylamine oxide was installed in 2012 in a south facing sidewall configuration at the Vancouver site to evaluate the ability of these treatments to inhibit extractive stain formation (Stirling 2014). After two years of exposure the material was transferred to the Maple Ridge test site and installed in a roofing configuration on October 1, 2014 to assess long-term impacts of treatment on decay resistance and weathering (Stirling 2015). Twenty shingles were included in each test group. Materials were inspected on April 29, 2019.

Table 4. Western redcedar shingles treated with DDACarbonate and alkylamine oxides

Treatment	Gauge retention (kg/m^3)
None	0
Dip	2.0 (0.2)*
Pressure	2.0 (0.4)

* Standard deviations appear in parentheses

Test Sites

FPInnovations' Maple Ridge test site is located within the University of British Columbia's Malcolm Knapp Research Forest in Maple Ridge, British Columbia. The site is a grassy field surrounded by a second growth coastal western hemlock forest. The site has an average annual precipitation of 2150 mm and an average annual temperature of 9.6°C. It falls within the

moderate decay hazard zone for exterior above-ground exposures with a Scheffer Climate Index of 63 (Morris and Wang 2008).

FPInnovations' Vancouver test site is located in the backyard of the lab located on 2665 East Mall. It is a grassy strip of land that was initially exposed to full sun, but is now partially shaded due to the growth of surrounding trees. The site has average annual precipitation of 1250 mm and an average annual temperature of 10°C. The site falls within the moderate decay hazard zone for exterior above-ground exposures with a Scheffer Climate Index of 50 (Morris and Wang 2008).

Inspection Methods

The shakes and shingles were evaluated for extent of decay based on estimated cross-section of decay. The AWPA E25 10 to 0 rating scale, modified for shakes and shingles, was used to estimate extent of decay (AWPA 2015). In addition, each specimen was evaluated for erosion and splitting using the 0-4 scale defined in Table 5.

Table 5. Erosion and splitting ratings for shakes and shingles

Rating	Erosion	Splitting
0	None	None
1	< 1 mm	1 – 10 mm
2	1 – 3 mm	10 – 50 mm
3	3 – 5 mm	50 mm – Full length
4	> 5 mm	Full length

RESULTS AND DISCUSSION

The accuracy and applicability of the findings should be considered within the limitations of the methods and procedures applied in the project. Results apply only to specimens tested.

Evaluation of 45-year old WRC shakes treated with CCA-B

After 45-years of exposure, all untreated western redcedar shakes had failed (Figure 1). Most had failed much earlier. In contrast, CCA-B treated western redcedar shakes were in relatively good condition, with an average decay rating of 8.9 (Table 6). Two of the 79 CCA-B treated shakes had failed due to decay. A moderate amount of erosion was observed. Splitting was more variable, with some shakes showing no splitting, and others fully split along the length of the shake.

Figure 1. Untreated western redcedar shakes (left) and CCA-B treated western redcedar shakes (right) after 45 years of exposure in Maple Ridge, British Columbia.

Table 6. Performance of western redcedar shakes treated with CCA-B

Preservative	Average AWPA Decay Rating	Erosion Rating	Splitting Rating
Untreated	0 (0)*	N/A	N/A
CCA-B	8.9 (0.8)	2.4 (0.5)	2.2 (1.5)

* Standard deviations appear in parentheses

Evaluation of 20-year old pine and spruce shakes treated with CCA-C

After 20-years of exposure, untreated pine and spruce shakes had advanced decay, or had failed (Figures 2-5). In contrast, CCA-treated pine and spruce shakes remained in excellent condition with no confirmed decay. The untreated western redcedar reference had low to moderate decay with an average rating of 8.0.

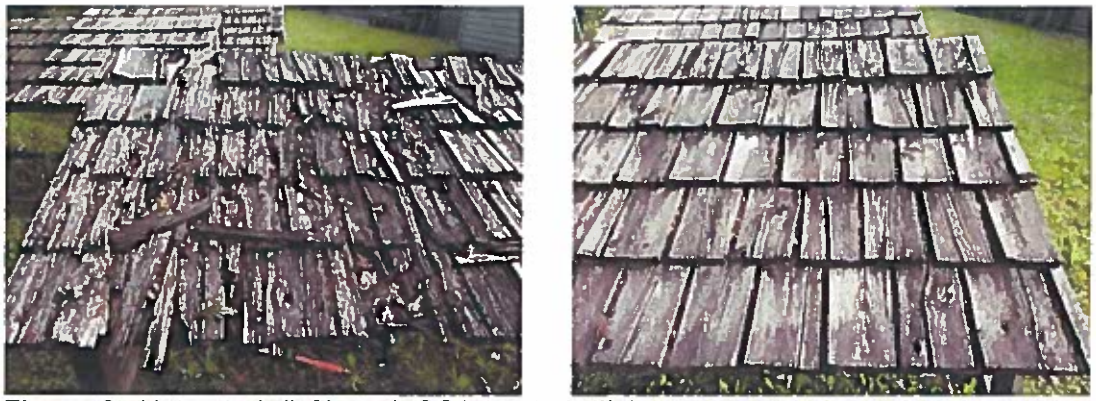

Figure 2. Untreated (left) and CCA-treated (right) spruce shakes after 24 years of exposure in Vancouver.

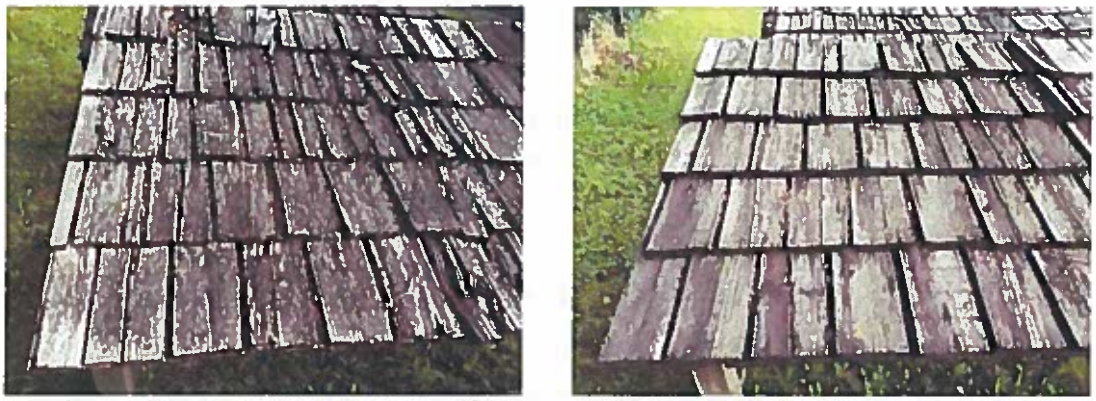

Figure 3. Untreated (left) and CCA-treated (right) pine shakes after 24 years of exposure in Vancouver.

Figure 4. Untreated western redcedar shakes after 24 years of exposure in Vancouver.

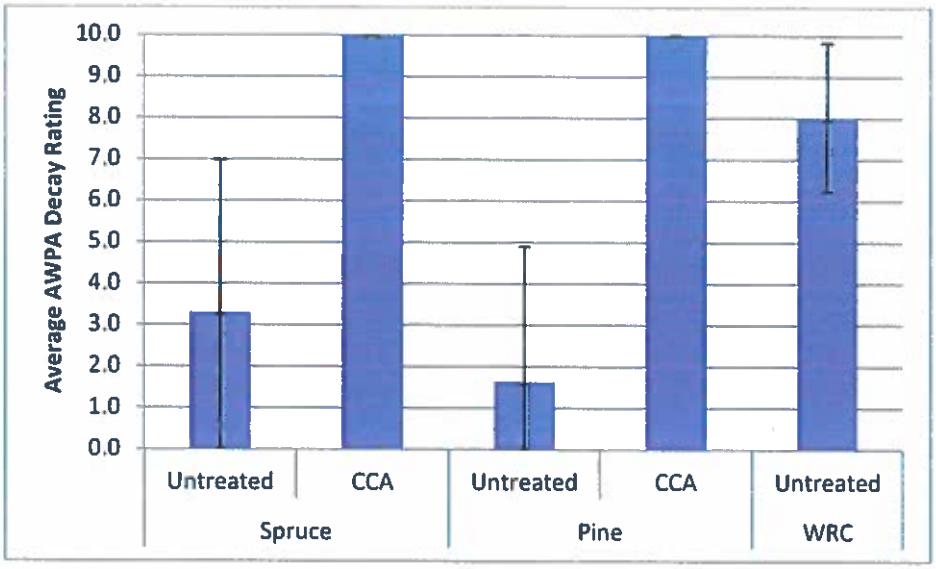

Figure 5. Average decay rating of shakes treated with selected preservatives after 20 years of exposure in Vancouver (error bars represent standard deviations).

Evaluation of 15-year old western redcedar shingles treated with ACQ, CA-B, oxine copper and propiconazole

After 15 years of exposure, the sign shelter remained serviceable (Figure 6). Early stages of decay were observed in south facing untreated western redcedar shingles, while advanced decay was observed in the north facing shingles (Figure 7). This is likely because the north facing shingles would be slower to dry, and therefore susceptible to decay for longer periods of time. This rate of decay is similar to previous evaluations of untreated western redcedar shakes (Morris *et al.* 2013). ACQ-D and CA-B treated shingles were mostly sound after 15 years of exposure. Early stages of decay were observed in shingles treated with oxine copper or propiconazole.

Erosion was more prominent on north facing samples that were untreated, or treated with oxine copper, or propiconazole (Figure 8). ACQ-D and CA-B treatments were associated with low levels of erosion on both north and south facing surfaces. This is further evidence of the photo-protective effects of copper when present in sufficient quantities (Liu *et al.* 1994).

There was little splitting observed in any of the north facing groups (Figure 9). A small amount of splitting was observed in the south facing groups, with the greatest amount present in untreated and CA-B treated samples. This is likely due to the greater stresses caused by more rapid drying on the south facing shingles.

Figure 6. The sign shelter after 15 years of exposure in Maple Ridge.

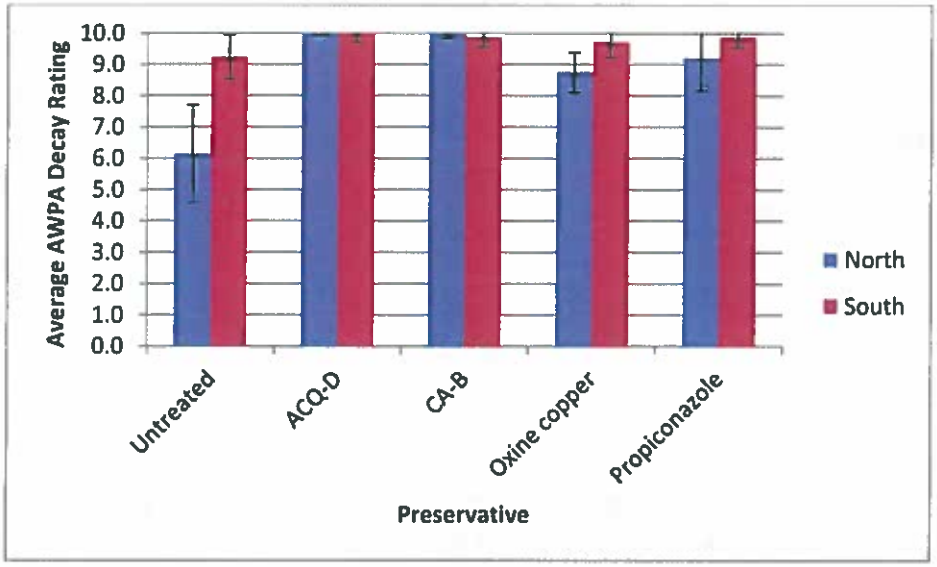

Figure 7. Average decay rating of western redcedar shingles treated with selected preservatives after 15 years of exposure in Maple Ridge.

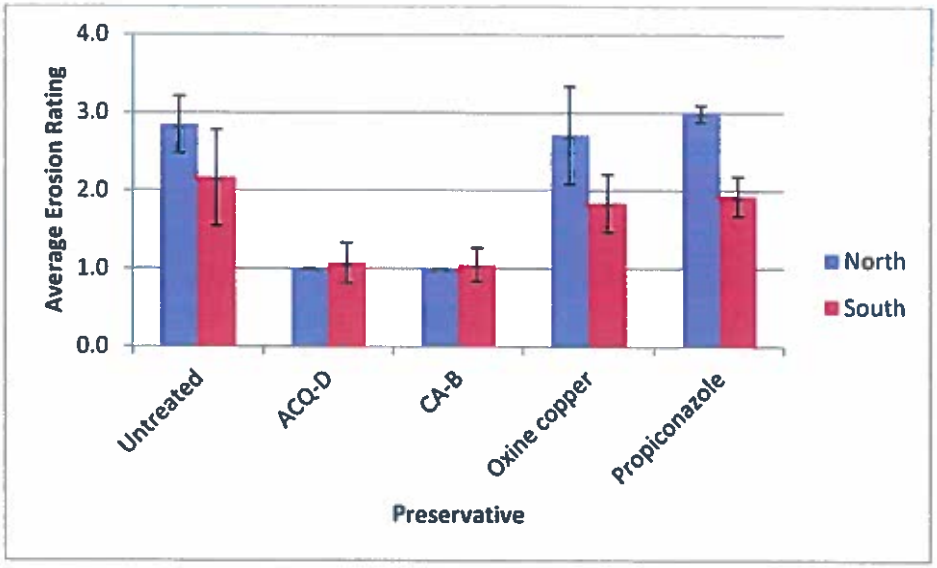

Figure 8. Average erosion rating of western redcedar shingles treated with selected preservatives after 15 years of exposure in Maple Ridge.

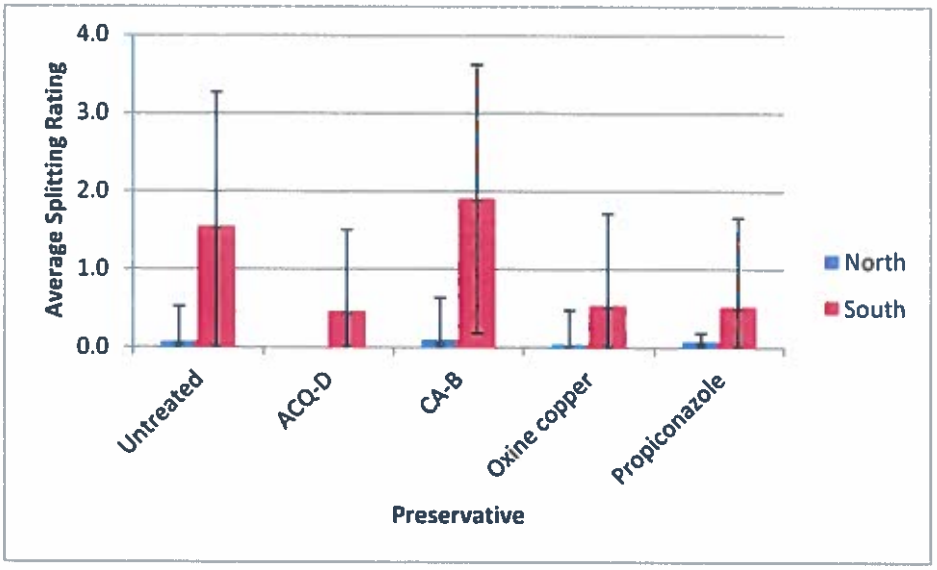

Figure 9. Average splitting rating of western redcedar shingles treated with selected preservatives after 15 years of exposure in Maple Ridge.

Evaluation of WRC shingles treated with DDACarbonate and alkylamine oxide

There was no evidence of decay in any of the untreated or treated western redcedar shingles in this study (Figure 10). Average erosion ratings were the same in each group, though it was observed that the DDACarbonate and alkylamine oxide treated shingles had retained their brighter colour (Stirling 2014). Only one untreated specimen was rated 1 for splitting; all other specimens were rated 0 (Table 7). The lack of activity after approximately five years of exposure is consistent with results from previous experiments.

Figure 10. Western redcedar shingles dip treated with DDACarbonate and alkylamine oxide (left), pressure treated with DDACarbonate and alkylamine oxide (centre), and untreated (right).

Table 7. Performance of western redcedar shingles dip or pressure treated with DDACarbonate and alkylamine oxides

Treatment	Average AWPA Decay Rating	Erosion Rating	Splitting Rating
None	10 (0)	1.4 (0.5)	0.1 (0.2)
Dip	10 (0)	1.4 (0.5)	0 (0)
Pressure	10 (0)	1.4 (0.5)	0 (0)

* Standard deviations appear in parentheses

CONCLUSION

CCA is highly effective in protecting shakes. After 45 years in test, western redcedar shakes treated with CCA-B remain serviceable. After 20 years in test, pine and spruce shakes treated with CCA had no confirmed decay.

ACQ-D and CA-B are effective in protecting western redcedar shingles, with little decay observed after 15 years of exposure. Propiconazole and oxine copper were associated with greater levels of decay and would not be recommended for protecting western redcedar shingles at the retentions evaluated.

Longer exposure time is needed to evaluate the efficacy of the DDACarbonate and alkylamine oxide treatment.

RECOMMENDATIONS

- Terminate the CCA experiments
- Continue the evaluation of alternative preservatives and inspect again in five years

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