

Water-repellent preservative treatment of brick molding prior to factory priming improves paint service life

R. Sam Williams, Alan S. Ross, Peter Sotos, Chuck Cheeks

ABSTRACT

One end of each piece of brick molding (about 35 mm long) was dipped in a water-repellent preservative (WRP). Following the WRP treatment, the sections were divided into two groups and painted with one of two different primers formulated to be typical of factory-applied primers. Each of the primed groups was further divided into four groups to determine the effect of primer weathering on paint service life. The primed moldings were exposed without a top coat for about 0, 3, 6, or 9 months 15 km west of Madison, Wisconsin. Alkyd-oil or acrylic-latex top coats were field-applied and the moldings were evaluated over 3 years for flaking and cracking of the paint. It was found that pretreatment of the specimens with WRP greatly improved the paint performance. Weathering the primer decreased the paint performance for the alkyd-oil top coats without the WRP pretreatment but not for the acrylic-latex top coats. The acrylic-latex top coats had better service life than the alkyd-oil top coats.

INTRODUCTION

When wood products are used for residential construction in areas having cold winters, it is not possible to paint exterior wood until the weather warms in the spring. However, even during the winter months, sun-light and moisture cause the wood surface to degrade. This degradation is sufficient to cause the subsequently applied paint to fail. Factory priming of wood products could protect the wood surface, but it is not known if weathering of the primer during winter months would lead to premature failure of the paint system after the top coat was field applied in the spring. Brick molding was selected for this study because it is typical of wood products that could be factory primed.

Four variables were selected for evaluation.

- 2 water-repellent preservative pretreatments (waterborne and solventborne)
- 2 primers (high and low pigment loading)
- 4 primer weathering periods prior to applying the top coat (fall/winter exposure)
- 2 types of top coats (alkyd-oil and acrylic latex)

A full-matrix experimental design of these variables with 5 replicates gave 160 specimens.

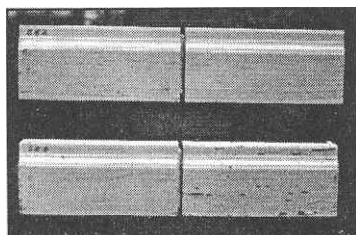


Figure 1—Painted brick molding attached to the test fence 15 km west of Madison, Wisconsin. Note the saw kerf separating the WRP treated half (left) from the untreated half (right).

MATERIALS AND METHODS

Ponderosa pine sapwood brick molding sections 350 mm in length were cut with a saw kerf on the tangential and radial surfaces in the center of the pieces to separate the two ends for WRP treatment (Fig. 1). One end of each piece was dipped in either a commercial waterborne or solventborne WRP to half of its length for 15 seconds.

After the WRP cured, the sections were hand painted by brush using one of two different commercial primers typical of those used for factory priming wood. The primers contained the same type and amount of a vinyl acrylic resin, but each was formulated to have a different pigment volume concentration (PVC) and one was tinted.

They are designed as

Tan(T) 54%PVC

White(W) 41%PVC

To determine the effect of primer weathering during the winter months, the primed sections were separated into 4 groups (0, 3, 6, and 9 months of primer weathering). The first group (9 months weathering) was placed outdoors on a test fence 15 km west of Madison, Wisconsin, in August 1996. Another group was placed outdoors after 3 and 6 months, and the last group (0 months of primer weathering) was placed on the fence in May 1997. Shortly after the last group was placed on the fence, all four groups were top coated using either an acrylic-latex or alkyd-oil top coat (Fig.2).

The specimens were evaluated for paint cracking and flaking over 3 years. The specimens were evaluated visually on a scale of 10 to 1 (10 being the highest).

Each of the five replicate specimens received two ratings: one for the WRP treated (left) end and one for the untreated (right) end.

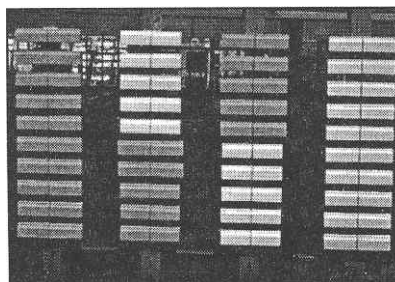


Figure 2—Brick moldings (40 of the 160 specimens) were attached to vertical supports using silicone caulk. They were mounted vertically facing south.

RESULTS AND DISCUSSION

Paint cracking—solventborne WRP

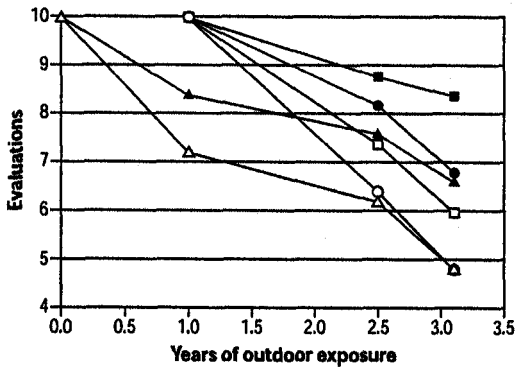


Figure 3—High-PVC (tan) primer/alkyd-oil top coat

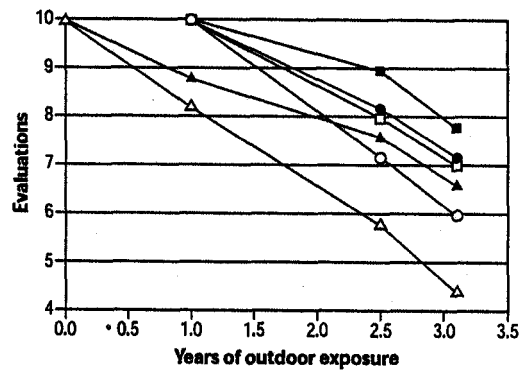


Figure 4—Low-PVC (white) primer/alkyd-oil top mat

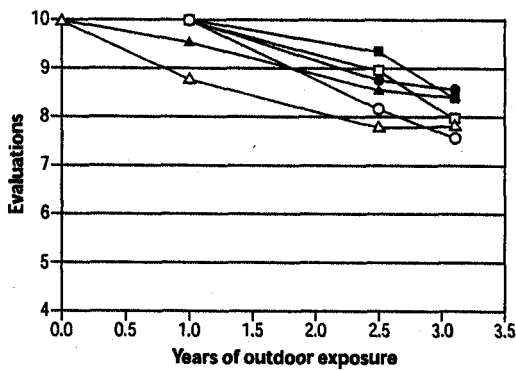


Figure 5—High-PVC (tan) primer/acrylic-latex top coat

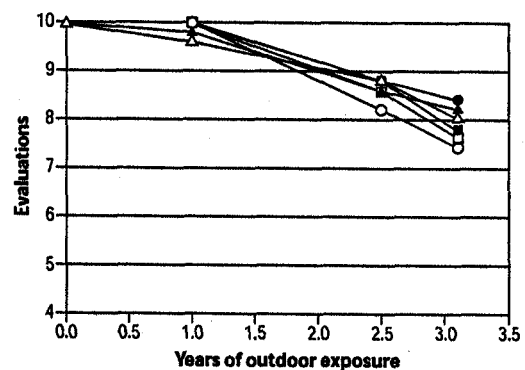
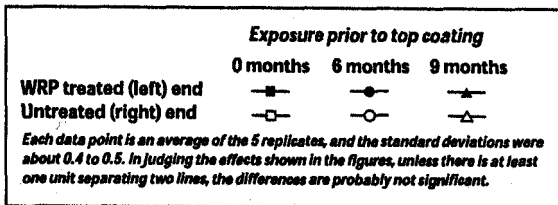


Figure 6—Low-PVC (white) primer/acrylic-latex top coat

For the two different primer formulations (tan primer, Fig. 3; white primer, Fig. 4), the solventborne WRP improved the paint performance and primer weathering decreased the performance. For example, the WRP-treated and unweathered high PVC (tan) primer was rated at 8.4 after 3 years, whereas the untreated was 6.0 (Fig. 3). After weathering the primer for 9 months, the WRP-treated specimens were 6.6 and the weathered ones were 4.8. The same trend can be seen for the low-PVC (white) primer (Fig. 4). The effect of pigment concentration was not apparent in the evaluations. For example the high-PVC (Fig. 3, tan primer) and low-PVC (Fig. 4, tan primer) top coated with an alkyd-oil paint are quite similar.

For the specimens top-coated with and acrylic-latex paint, there is no effect from the primer weathering and only a very slight improvement from the WRP pretreatment (Figs. 5 and 6).



Paint cracking–waterborne WRP

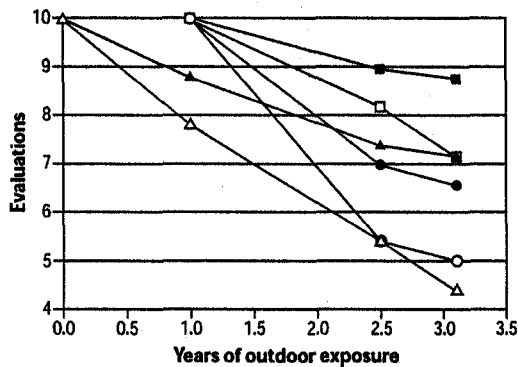


Figure 7–High-PVC (tan) primer/alkyd-oil top coat

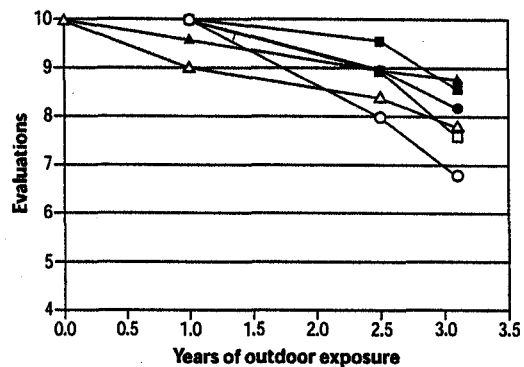


Figure 8–High-PVC (tan) primer/acrylic-latex top coat

For the waterborne WRP (high-PVC primer, Figs 7 and 8), the trends are similar. Figure 3 (solventborne WRP) and Figure 7 (waterborne WRP) are almost identical. The WRP improves the performance of the paint system, and primer Weathering caused poorer paint performance. The performance of the low-PVC primer was about the same with the two WRP. With the acrylic-latex top coat, the results are about the same (Figs.5 and 8). The primer weathering had no effect and there is only a slight improvement from the WRP.

Paint flaking

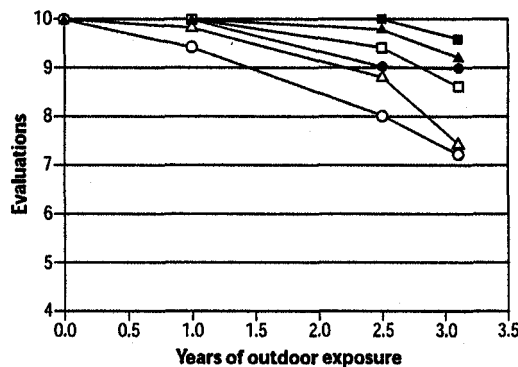


Figure 9–High-PVC (tan) primer/alkyd-oil top coat

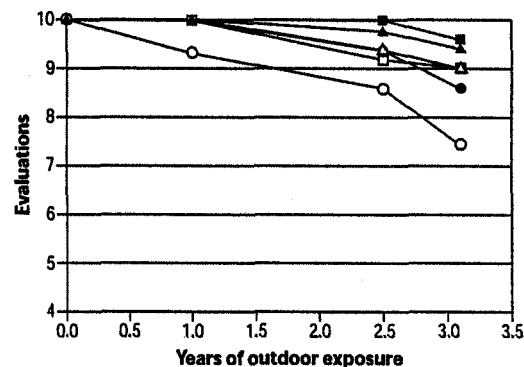


Figure 10–High-PVC (tan) primer/acrylic-latex top coat

Generally, after the paint coating cracks, moisture intrusion to the paint/wood interface weakens the paint bond and flaking occurs. The flaking ratings parallel the cracking ratings but lag behind them (Figs.9 and 10). Compare the flaking ratings for the waterborne WRP/high PVC (tan primer)/alkyd-oil top coat (Fig.9) with the cracking ratings for the same paint system (Fig. 7). For the same WRP/primer having an acrylic-latex top coat, compare Figure 10 and Figure 8.

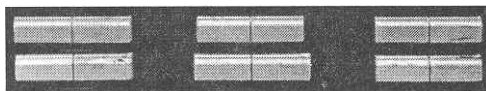


Figure 11–Acrylic-latex and alkyd-oil top coats

Top: Solventborne WRP/low-PVC primer/acrylic-latex top coat
Bottom: Solventborne WRP/high-PVC primer/alkyd-oil top coat

An example of acrylic-latex and alkyd-oil top coats after 3 years of outdoor weathering is shown in Figure 11.

The photograph clearly shows the improved performance of the paint provided by the WRP treatment (left half). In all case, the acrylic-latex top coat had better ratings than the alkyd-oil top coat.

CONCLUSIONS

- Both the waterborne and solventborne WRP improved the service life of the paint.
- The primer weathering of the primer paint decreased the service life of the alkyd-oil top coat, but not the acrylic-latex top coat.
- There was little difference between the two primer formulations.
- In general the acrylic-latex top coat was superior to the alkyd-oil top coat.

PROCEEDINGS

Ninety-Seventh Annual Meeting

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P.O BOX 5690 **GRANBURY, TEXAS 76049**