RESEARCH HIGHLIGHT

Technical Series 00-118

Performance Evaluation of Water Repellents for Above-Grade Masonry

INTRODUCTION

Water penetration across brick masonry exterior walls is a problem that building owners and construction professionals must deal with frequently. In some remedial applications, they often use water repellents to resolve the problem. Unfortunately, little information exists to help select such products and evaluate their performance and durability. As part of a CMHC research project, Patenaude-Chiovitti Inc. carried out an evaluation of commercially available water repellents used for this purpose.

The primary objective of the research was to evaluate and compare the performance of five water-repellent products, and evaluate practical methods to assess their effectiveness. A secondary objective was to monitor the short-term and long-term performance of the repellents after exposure to the elements.

Another important characteristic of water repellents that builders should consider is their vapour-diffusion performance. This characteristic was not covered by the present study, but has been evaluated in a related research project.

RESEARCH PROGRAM

Apparatus

The researchers conducted tests on six brick-wall specimens erected under field conditions within a specially designed exterior test chamber. Five of the brick-wall assemblies were treated with the different water repellents identified below. (The products are identified generically to protect the manufacturers' identities). The sixth assembly, which served as a control panel, was left untreated.

Panel A: 40 per cent Silane (solvent based)
Panel B: Polysiloxane blend (solvent based)
Panel C: Silane/polysiloxane blend (water based)
Panel D: Siloxane/silane blend (water based)
Panel E: Elastomeric waterproof coating
Panel F: Control panel (no coating)

The brick-wall samples consisted of standard clay brick with nominal dimensions of 230 mm x 70 mm x 88 mm (9" x 2 3/4" x 3 1/2"). Pre-mixed mortar was used to construct the samples, which were erected within the steel framing of the test chamber. A metal flashing was installed over the second row of bricks to collect infiltration water in the test chamber.

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The front sides of the brick panels faced south and were exposed to the elements to allow for the evaluation of the water repellents after exposure. A series of five tests were conducted in the seven months between May and November 1996.

The test chamber was constructed of steel and wood framing, plywood sheathing and metal cladding. It was designed to create and maintain a differential static air pressure across the wall specimens.

Test procedure

The researchers used three different tests to evaluate the change in performance resulting from the application of the water repellents. To assess water-penetration performance, they used a modified ASTM E-514 test and a water uptake tube test. To assess the air leakage characteristics of the brick assemblies, they used an air infiltration test.

The modified ASTM E-514 test involves spraying water on the brick panels from a shroud and spray-rack assembly fastened to the test chamber. Five tests were conducted on each of the wall specimens over the seven-month period. The first test was undertaken on the bare wall specimens before the water repellents were applied.

The water uptake tube test used a pipe-like apparatus designed for measuring water uptake on vertical surfaces. Three tests were undertaken on each of the wall specimens, and readings were taken at mortar joints and on the brick face of each wall specimen.

For the air infiltration tests, researchers used a separate air chamber, designed to fit on the interior side of the wall specimen and clamped to the chamber framing. Two tests were conducted on each of the wall specimens. The first test was carried out before the water repellents were applied, and the second test was conducted after the application.

ANALYSIS OF RESULTS

The application of the various masonry coatings to the test panels resulted in a dramatic decrease in the rate of water penetration for all the coated panels. Generally, there was a reduction of 44 per cent to 99 per cent from the initial water-penetration rates of the uncoated specimens.

In addition, the researchers found a consistent drop in the performance of masonry panel assemblies during the water-penetration tests conducted over the seven-month period. While this could indicate a trend of decreasing performance over time, more data would be needed to support this finding. Figure 1 plots the performance of the panel assemblies with respect to time.

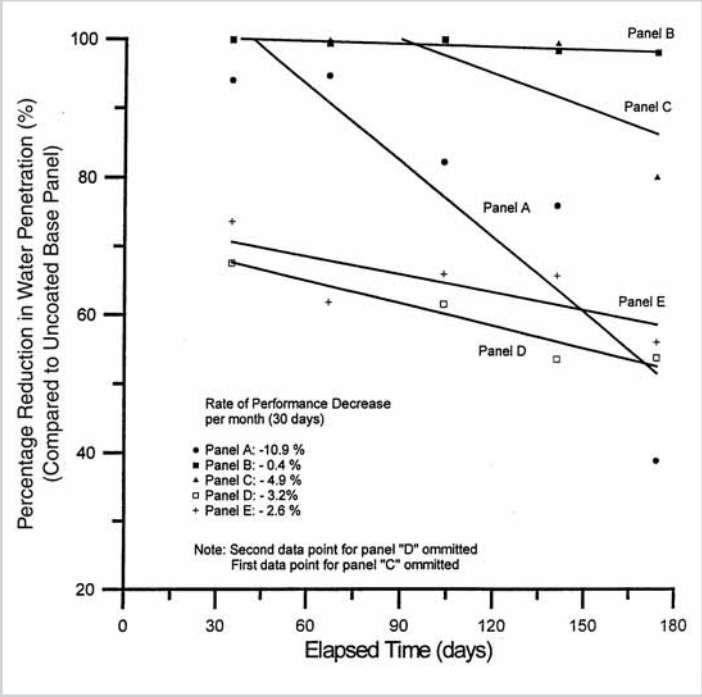

Figure 1 Estimated Coating Performance vs Time

Using the limited test data, the researchers estimated the rates of percentage decrease in performance for the various masonry coating materials over the initial base performance of the uncoated panels. From these estimates, they computed the respective rates of performance decrease.

Based on these rates, the performance decrease and the projected reduction in water penetration for the assemblies were determined for periods of three, six and nine months, and one, two and three years following the application of the masonry coatings.

It appeared that several of the applied coatings might require reapplication in order to maintain a suitable level of effectiveness. The summary provided in Table 1 shows some of the key findings of the modified E-514 series of tests.

Table 1 Performance Evaluation Following Modified ASTM E-514 Testing

Item	Panel Performance Level		
	High	Moderate	Low
Water Penetration:			
Initial Performance	A, B	D, E	C
Best Performance	A, B, C	D, E	
Worst Performance	B	E	A, C, D
Average Performance	B, C	A, E	D
Durability:	B	C, D, E	A

During the water uptake tube tests, data representing the time required to empty the graduated 5-ml volume of the tube were recorded at predetermined mortar joints and brick-face locations. Reductions in the rate of water penetration across the panel assemblies at the mortar joints in the order of 34.1 per cent to 99.7 per cent in comparison to the uncoated panel assembly, were obtained. For the brick-face locations, reductions in the order of 92.4 per cent to 99.9 per cent were obtained.

The significant difference in these results indicated that more data were needed to establish the actual performance of the masonry coatings using this method. As such, an evaluation of the water repellents' performance could not be undertaken. However, as a whole, all of the products exhibited very high levels of water repellency.

The researchers also conducted air infiltration tests on the brick assemblies before and after the application of the masonry coatings. The results indicated there was no significant change in performance for any of the assemblies. It was, therefore, concluded that the application of masonry coatings had no affect on the masonry wall's performance as an air barrier. As such, the evaluation of the air leakage characteristics was terminated.

FINDINGS

The results and analysis indicated substantial improvements in the resistance to water penetration when masonry coatings were applied to the test samples. However, several factors could have biased the results, including normally occurring imperfections in the wall assemblies.

Even the presence of a small opening in an otherwise impervious sheet of material can result in significant amounts of water being transported across the material at high-pressure differentials. To better evaluate the effect of such imperfections of the assembly on the test results, a larger sample population would be required.

Similarly, the results obtained by the water uptake tube method are very susceptible to the effects of surface imperfections. An accurate assessment of the materials' water repellency based on this method would require a significant number of tests distributed over a large surface.

Another finding of the ASTM E-514 test was the possibility of a trend indicating an increase in the rate of water penetration over time. This phenomena could have been the result of deterioration of the water repellents, and would necessitate their reapplication over a given time interval. The researchers suggested that further investigation be carried out to evaluate these phenomena.

CMHC Project Manager: Jacques Rousseau

Research Report: *Performance Evaluation of Water Repellents For Above-Grade Masonry*

Research Consultants: Domenic Chiovitti, Mario Gonçalves, and Antonio Renzullo, 1996

Related Research Project: *Determination of Water Vapour Diffusion Across Brick Masonry Treated With Water Repellent Sealers*

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