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THE USE OF POSTSAVER ® BARRIER WRAPS TO INCREASE SERVICE LIFE OF WOOD IN GROUND CONTACT: INCLUDING IMPLICATIONS FOR CANADA

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Abstract

This paper reviews the tests performed to date on barrier wrap wood preservative systems, and specifically reviews data related to the product PostSaver® USA. Included in this review are the tests performed by the Building Research Establishment, Oregon State University, and Mississippi State University on barrier wrap systems. The ongoing tests have proven that the use of barrier wraps can significantly reduce the occurrence of decay and insect attack on treated and untreated wood structures when the ground contact portion of the wooden member is protected from soil contact by the barrier. The depletion of wood preservative in the ground line zone will also be addressed as part of the existing tests. Future research work is ongoing on this system at outside universities and research centers worldwide and will be discussed briefly. The concept of using above ground retentions of wood preservatives for wooden members in ground contact if the member is properly protected with a barrier wrap will also be discussed. Recent adoptions by both the International Building Codes and the American Wood Protection Association (AWPA) are discussed.

Keywords: Barrier Wraps, Service Life, Decay, Efficacy, Leaching, Depletion, Ground Contact

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1. Introduction

The concept of using a protective barrier to prevent attack on wood is not particularly new. In effect, many chemical preservative systems accomplish this by forming a barrier on the outer portions of the wood to prevent attack on the vulnerable inner portions of the wood. Similarly, millions of utility poles have had their service lives extended through the use of penetrating preservatives that are covered with a barrier wrap. Sometimes the two products are combined into a single "bandage" for simpler application.

Various physical barrier systems, typically plastic wraps, have been proposed for other uses through the years. None of the wrap systems have achieved commercial success though for a variety of problems.

A recent development, Postsaver®, eliminates the problems of past systems through its combination of two essential attributes. First, the barrier system itself is a very thick, UV stabilized polyethylene with proven long term durability. Second, the plastic sheeting is adhered to the wooden substrate with bitumen to form a tight, weather resistant system that affords long term protection to the wooden substrate.

Recent technical reports from well-respected wood research organizations have demonstrated the performance of the barrier preservative systems. This report discusses and summarizes several of the research projects to date.

2. Results and Discussion

Study 1. Soil Bed Test at Oregon State University

In 1997, Oregon State University (OSU) researchers, T.C. Scheffer and J.J. Morrell, reported on a 2 year soil bed test where polyethylene boots were applied to both untreated and low retention treated stakes[1]. Ponderosa pine was chosen for the stakes since its sapwood has low decay resistance. Flat stakes were used and saw kerfs on the entire length of both flat faces were made on some stakes to simulate seasoning checks. These kerfs increased the severity of the test.

Half of the stakes in the test were fitted with a 2-mil polyethylene boot before insertion of the stakes into the test soil. The remaining stakes had no boot. In addition to the completely untreated stakes, stakes with low retentions of either a minimal-leaching ground contact preservative, copper naphthenate, or a boron containing above ground preservative, disodium octaborate tetrahydrate, were included.

The stakes were then inserted for 2 years in soil beds prepared from forest soil. This is the same methodology described in AWPA E14, Standard Method of Evaluating Wood Preservative in a Soil Bed. Water was periodically applied to the soil and "no attempt was made to keep water from entering the boots at the upper end." At the end of the 2 year exposure, the stakes were removed and weighed to determine any losses.

The boots effectively prevented any attack, even on the untreated stakes. The booted stakes whether they were kerfed or nonkerfed had losses ≤ 2% which the authors attributed to loss of extractives. The booted untreated stakes performed as well as the stakes with either of the preservative treatments.

In comparison, the unbooted stakes showed evidence of attack in every group. Most of the stakes had weight losses of 10-40%. The best performing group in the unbooted series, the non-kerfed copper naphthenate group, had 3 of 10 stakes with an average weight loss of 30% while the remaining seven averaged 2%. This could have been due to a localized instance of copper tolerant fungi or uneven preservative distribution. Regardless, it shows the effectiveness of the barrier in that none of the booted stakes showed any attack.

The authors conclude

Booted stakes had little evidence of decay, whereas those without boots experience large weight loss and extreme shrinkage and deformation.

Study 2. Termite Test at Mississippi State University

In 2000, termite resistance tests were conducted at Mississippi State University (MSU) on barrier coated wood in comparison to non-coated wood[2]. The test was done according to AWPA E1, Standard Method for Laboratory Evaluation to Determine Resistance to Subterranean Termites. The barrier coating used in this test was supplied by the manufacturer of the Postsaver system.

For the "no choice" portion of the test, common subterranean termites (*Reticulitermes spp.*) were presented with a test specimen that was either coated or uncoated. There was no other food source available in the test container and this is considered the more severe test for termite resistance.

The results of the "no choice" were very convincing. There was no attack on any of the coated wood and all of the termites had starved to death at the end of the four week test. No detectable weight loss occurred for the coated samples in comparison to the 12-27% weight losses for the uncoated wood. There was heavy attack and only slight termite mortality at the test end for the uncoated controls. In this severe test, the barrier coating clearly showed its termite resistance capabilities.
For the "two-choice" part of this test, both uncoated and coated southern pine wafers are in the containers and the termites can choose a food source. Again, there was no attack on any of the coated wafers while the uncoated ones had mostly heavy attack with some moderate attack. This test shows that the barrier system is repellant to termites and they will seek another food source if one is available.

Study 3. Soil Bed Test by British Research Establishment

In 1998, researchers at the British Research Establishment (BRE) reported the results of a soil bed test done on a barrier system[3]. The testing methodology was similar to that discussed above but it followed appropriate European standards.

An important point in this particular test series in that the stakes were only wrapped with the barrier and not completely booted. Thus there was the possibility of attack on the buried, but unprotected stake end. The wrapping was the two-part Postsaver bitumen-polyethylene system and this test showed the importance of using a "boot" as opposed to a "wrap".

The stakes in this test were about 20 inches long and those that were wrapped had about 4 inches of exposed wood at each end of the stake with the center 12 inches being wrapped. The stakes were planted so that about 2 inches of the wrap was above the soil line and 10 inches was below along with the 4 inch unwrapped end. The samples are evaluated at 16, 32 and 48 weeks for attack and moisture content by cutting and evaluating 2 inch zones of each stake.

The results are again conclusive in that the portions of the stake protected by the barrier system had essentially no attack even though there was considerable attack on the unprotected ends of those stakes. Furthermore, the moisture contents of the below ground wrapped portions were below fiber saturation (<28%) while the exposed portion were 70-115%. Keeping wood dry is the first step in preventing its attack.

The unwrapped stakes were very wet with 95-170% moisture contents. The unwrapped stakes were also severely decayed at the end of the test with 40% weight loss in the ground line zone.

An important point is that there was an "interfacial zone" at the bottom edge of the wrap. Below that 2 inch zone, the unwrapped portion was wet and decayed and above that zone, the wrapped stake was dry and not decayed. In the interfacial zone, the attack and moisture contents were intermediate at 50% moisture content and 5% weight loss at test end. This further demonstrates the efficacy of the wrap in that even if it is breached, the attack is prevented from extending any significant distance. To further elucidate the effect of "breaches" in the wrap, the BRE then conducted field stake tests where a saw cut was made in the plastic wrap.

Study 4. Field Stake Test by British Research Establishment

For this test[4], purposeful saw cuts were made in Postsaver boots that otherwise encased the ends of the stakes. The cuts were halfway between the ground line and the end of the stake and were just through the plastic wrap. For comparison, stakes with undamaged boots and with a wrap as in the soil bed test were included. Naturally, untreated controls were included as well.

The European test protocol, EN252:1989, Field Test Method for Determining the Relative Effectiveness of a Wood Preservative in Ground Contact, was used. This test procedure is essentially the same as AWPA E7, Standard Method of Evaluating Wood

Preservatives by Field Tests with Stakes. The only significant difference between the two procedures is that the rating scale for EN252 downgrades a stake more severely when the two scales are compared on the basis of loss of cross sectional area[5].

For this test, a series of low retention CCA stakes was also included. These stakes were dip treated for 3 minutes to an average 0.09 pcf which is about one-fourth of the normal ground contact level.

Per the test method, the stakes were evaluated by tapping them with a wooden mallet and then inspecting and rating those stakes that did not break upon impact. Obviously, only those portions not covered with the wrap or boot could be examined since the test is continuing.

After four years of exposure, all of the untreated control stakes are decayed as expected. The unwrapped CCA stakes are showing slight attack as are the untreated but wrapped stakes. The wrapped CCA stakes did not show any signs of attack.

All of the booted stakes including those with the purposeful saw cut are totally sound after four years of exposure. The test is continuing but, at this point, it appears that boots are effectively protecting untreated wood. This applies even to boots with significant breaches in the outer plastic barrier. This protection can be contributed to the secondary protective layer of bitumen.

Study 5. Soil Bed Post Test by Forintek

Dr. Paul Morris managed a joint study between Forintek - Canada (Western Lab), PowerTech Labs, The BC Science Council, and BC Hydro. Both CCA-C treated and untreated Lodgepole pine posts were exposed for a period of eight years in a high decay exposure condition in a Soil Bed. Wrapping the ground contact portion of the posts with a bitumen – wax coated fabric wrap prior to exposing them to the conditions of the soil bed significantly reduced the amount of decay in the untreated posts and delayed the onset of decay in CCA treated posts.

After eight years exposure in this accelerated soil bed test, wrapped posts, treated to 4.0 kg/M^3 with CCA-C were performing as well as, or better than, unwrapped posts treated to 10 kg/M^3. The performance increase due to booting is 2.5 times on a retention basis.

For untreated posts, the average time to failure in the soil bed tests was 30 months for unwrapped material and 90 months for wrapped material, thus tripling the expected time for wood in a soil bed to reach a value of 7.0 (considered failure).

Study 6. Field Post Test by Forintek

In a second study, Paul Morris experimented with the use of barrier wraps, again in the form of a bitumen-wax impregnated fabric, at BC Hydro's Vancouver, BC test site over a nine year period by observing decay patterns and occurrence.

At the three-year inspection, treated and wrapped posts were rated at an average value of 8.8 compared to unwrapped CCA posts (pole stubs) rated at a value of 7.3. Time to reach failure (rating of 7.0) was 45 months for unwrapped material and 65 months for wrapped posts. In this study, no significant reduction in preservative was seen from either the wrapped or the unwrapped posts, which is attributed to the excellent fixative nature of CCA. (Other studies performed with mobile wood preservatives show significantly less migration from booted material [6-11].)

Study 7. Barrier Wraps in Canada

Barrier wraps were shown to provide valuable life extension to untreated Jack Pine posts In a extended multi-year study reported by Morris in his 1999 CWPA paper "Field Testing of Wood Preservatives in Canada IX: Performance of Posts and Lumber in Ground Contact". Morris reported that untreated Jack Pine, a non-durable softwood species, had a mean service life of 5.5 years in Canada from posts installed in 1938. Untreated Jack Pine posts installed with a simple polyethylene bag surrounding the ground contact portion of the posts had a mean service life of 7.4 years. Thus, the simple polyethylene bag roughly increased the expected service life by 50% in Canada.

In the same study, but installed in 1967, untreated Jack Pine Posts surrounded by a Polyurethane Foam, when inspected in 1998, still had 5 of the original 17 posts still in service and had a estimated Mean Service Life of >12.5 Years. The foam has more than doubled the life and both of these tests firmly address the concept of barrier wraps extending the useful service life of untreated softwood species in Canada.

AWPA

The American Wood Protection Association has recently recognized the efficacy of the barrier preservative systems in general and a specific barrier (BP-1). A new preservative standard, P-20, outlines the general requirements for barrier systems while the specific barrier systems are listed in U1 Commodity Specification K. It should be noted that BP-1 is the Postsaver system and the table below shows that lower retentions of preservatives in conjunction with BP-1 qualify for higher Use Category uses.

U1 COMODITY SPECIFICATION K, TABLE 1

Barrier Protection System	Preservative System (s)	Parent Commodity Specification(s)	Use Category	
			Without BP System	With BP System
BP-1	CCA-C, ACQ-B, ACQ-C, ACQ-D, CBA-A, CA-B	A Table 3.0	UC4A	UC3B
			UC4B	UC3B
			UC4C	UC3B
	CCA-C, ACQ-B, ACQ-C, ACQ-D, CBA-A, CA-B	B Table 3.1.1	UC4A	UC3B
			UC4B	UC3B

The BP-1 (Postsaver) system was the first system to be standardized by the AWPA but it is just one of many that could come forth. It is hoped that the proponents of other systems will choose to embrace product standardization. Ideally, many new products will be available to both the contractor and to the consumer for protection of wood in ground contact.

Canada

Although not yet standardized by the CSA, it would seem that Canada would be a likely candidate to embrace the work done thus far and to potentially increase the use of treated wood in ground contact by utilizing the barrier wrap concept. It seems reasonable to surmise that retention reductions would also be applicable to Canadian uses since the decay and insect hazards are no worse that those in the USA.

Summary and Conclusions

Barrier wraps can be used to successfully lower the moisture content of wooden members near the ground line and slow decay and insect attack. All the studies published to date on the PostSaver® barrier wrap system show it to be far superior to many other wrap systems since it actually contains dual protection: the bitumen inner layer protects wood in contact with this "tar-like" substance and the outermost polyethylene film layer further hinders attack and prevents water absorption.

Further investigation into barrier wrap systems by Baecker and others has shown that a wooden member that has been protected by a barrier wrap can use a much lower retention of active ingredient in the preservative system and leaching is significantly reduced.

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