CMI Waterfront Solutions

THE WORLDWIDE EXPERTS IN MARINE CONSTRUCTION SOLUTIONS AND PRODUCTS

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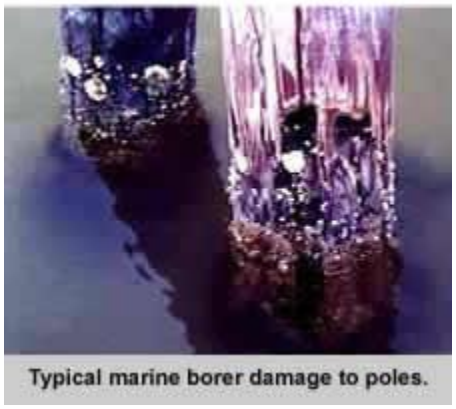
Innovative Alternatives to Chemical Wood Preservatives for Creating Durable Marine Structures

Due to ever expanding restrictions by the EPA and the AWPA on chemically treated wood commercial and residential customers, and governmental entities, are utilizing other methods of building marine structures that are well protected from the elements. For structures that are near the water environmental forces such as sun, rain, snow, salt water splashes, high humidity and storm devastation require a wood protectant that can stand up to Mother Nature's arsenal of surprises. For wood that is constantly submersed in water, it is vital to protect its integrity.

Submersed wood has its own list of variables which cause deterioration over time, thus compromising the integrity of the entire structure. Constant exposure to waves and currents and infestation of wood gribbles, shipworms and limnoria are just some of the issues that marine builders and engineers have been grappling with for decades. Ideally, alternatives to chemical preservatives will last a substantial period of time, be relatively cost effective and also easy to use for their specific application. There are several viable options that have attempted to address this issue.

This paper will summarize the various methods currently in use in the marine construction industry that solve the above problems without using potentially unsafe chemicals. Some of these options include: positive closure wrap systems, overlap closure systems, double layer petroleum saturated systems and a total encapsulation, UV resistant polymer system.

Brief Historical Overview of Past Wood Preservation Methods


Typical marine borer damage to poles.

For decades Creosote treatment was the dominant choice for wood preservation because of its effectiveness against decay and its resistance to most types of marine borers. However, due to toxicity issues associated with creosote, an alternative chemical treatment of chromated copper arsenate (CCA) was implemented for use in the 1970's.

On December 31, 2003, the use of CCA-treated wood was limited by the EPA and the American Wood Preservers Association (AWPA) to certain industrial and commercial applications only. "Effective December 31, 2003, no wood treater or manufacturer may treat wood with CCA for most residential uses. This decision will facilitate the transition in both the manufacturing and retail sectors to wood preservatives that do not contain arsenic, as well as other alternatives, such as naturally resistant woods and plastic wood."[1] Several other alternative preservatives exist including ACZA, CBA and ACQ, to name but a few. Each of these different chemicals has their specific and preferred uses and continues to be available for residential and commercial use in the United States. Most have their limitations when it comes to marine uses and due to stricter guidelines for safe use of chemical wood preservatives by the EPA and AWPA, may be prone to early deterioration. Additionally, only a few have been standardized for marine use as of this writing. While these chemicals do not appear to be leaving us any time soon, it is only a matter of time before they too will be eliminated in favor of less environmentally risky options.

In an abstract entitled *Nanotechnology: A Novel Approach to Prevent Biocide Leaching* the authors state, "In 2003, the wood preservatives industry stopped using chromated copper arsenate (CCA), which has resulted in significant changes in the U.S. wood preservatives market." The authors add, "Newer wood preservative formulations do not "fix" to wood. Although low solubility biocides are often favored because of leaching, this is an inadequate response. Even low solubility biocides will leach, resulting in negative economic and environmental consequences."[2]

Alternatives to Chemical Treatment of Wood for Marine Use

Because of the necessity to seek environmentally safer options, many new innovations appeared on the market to remedy this problem; plastic wraps being one of the first of these alternatives to be introduced. Wraps have been around since the early 1960's and have evolved considerably since that time. Their documented success is achieved through the simple function of limiting the dissolved oxygen in the seawater to a level that will not sustain marine borer life. According to a 1981 report entitled *Controlling Marine Borer Attack of Timber Piles With Plastic Wraps,* the authors state, "Plastic films 20 to 40 mils thick have been used for many years to wrap creosoted timber piles in service to

Marine borer damage to typical wood pilings.

protect them from attack by marine borers. As long as the wrap remains undamaged, this procedure provides complete protection of the pile. Properly applied, wraps generally provide protection for 25 years or longer."[3]

This technology has borne several variations on wraps which include hybrids such as: positive closure wrap systems, overlap closure systems, double layer systems and double layer petroleum saturated systems. One last similar alternative is a total encapsulation, UV resistant polymer system which is better defined as a sleeve enclosure rather than a "wrap." Each of these systems were designed to solve specific problems that were posed by the original, and somewhat antiquated, wrap systems, which included water leakage, deterioration issues and lack of durability. Each are applied in their own unique way.

Positive Closure Systems

There are multiple types of positive closure wrap systems, therefore, there are multiple attachment methods. Eliminating vertical seams is of vital importance with any wrap system. To eliminate vertical seams where water can seep in, some use wood poles and a tightening tool to secure the wrap over the timber pile; the wood poles are then secured with nails and stainless steel bands. Another system uses plastic ribs or flanges along the sides of the wrap which are pulled together to a snug fit on the pile; these are also secured with metal in the form of bolts and steel bands. Other systems use similar application methods. As an added protection measure, most positive closure systems are insulated with polyurethane foam before wrapping. While cumbersome to apply these systems are essentially watertight eliminating the chance of water exchange and thus preventing marine borers from surviving in what lies beneath—the wood pile. They are quite effective, but require periodic maintenance of the metal bands, bolts and nails as these break-down over time.

Overlap Closure Systems

Overlap closure wrap systems also use foam insulation before applying the wrap. To apply the wrapping material over the foam and pile one side of the material is nailed along the length of the wood pile; the excess material is then pulled around until it covers the nailed length. This end is also nailed down onto the pile. The seal, due to the spaces between nails, is not watertight. It's a simple method, and while a little low tech, covers the sides of the pile completely. On the down side, the potential for water exchange exists in the spaces between the nails, thus providing a means for marine borers to propagate.

Double Wrap Systems

Double wrap systems are essentially overlap closure systems that attempt to solve the problem of water seepage by using two layers of wrap instead of one. The inner layer is applied in the same manner as an overlap system and then a second, thicker, layer is

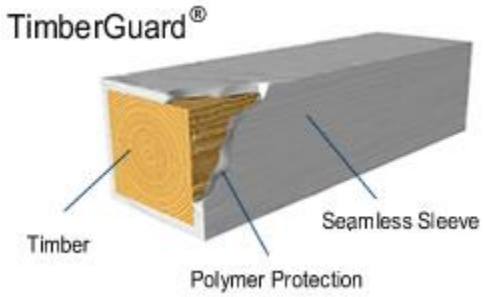
applied in the same manner over the first. While the two-wrap system adds extra protection against marine borers, it is a costly, labor intensive, two-step application process, which means that two wraps are not always better than one.

Double Wrap Petroleum Saturated Systems

Again, this is an overlap system, but in addition to using two layers, or double wrapping, a base layer coating is applied to the pile. The coating fabric is saturated with a petroleum compound that repels water and contains biocides. Like double wrap systems these offer added protection with a second layer, additionally a third level of protection is added with the base application of the petroleum saturated fabric. Provided that the treated fabric stands up over time this is an effective and hearty system. However, it requires a three-step application process which, like double wrap systems, requires more labor to install.

Total encapsulation, UV resistant polymer system

Another option, which has been gaining recognition in the last several years, is a total encapsulation, UV resistant polymer system called TimberGuard. This technology is similar to wraps but, as mentioned, is better described as a sleeve because it protects the entire piling as opposed to a limited portion of the piling. An added benefit is that the continuous sleeve is not "adhered" to the piling with sealants or fasteners, thus wood is able to expand and contract freely with temperature and moisture changes.



Total encapsulation provides many distinct advantages. The primary improvement is that this technology eliminates the most significant shortcoming of wrap systems by eliminating seams that may allow the flow of water to the piling, therefore reducing the dissolved oxygen content of the seawater required to sustain marine borer life. Also, because the entire piling is protected, it eliminates the potential for marine borer access at the base of the installed piling when scouring of the soil exposes the unprotected piling in conventional wrap systems.

In addition, several jobsite advantages are recognized by installers. Since the product is completely encapsulated with the polymer before being sent to the site, the work of preserving the wood has already been done, leaving only installation to be completed, and in the event that a puncture takes place in the polymer, the damaged area can be quickly and easily repaired.

Comparison of These Different Methods

In a 2002-2004 study done by Han-Padron Associates[4], entitled *Pile Wrap Evaluation Study*, it was found that some wrap systems work better than others; positive closure wraps being the overall winners. HPA conducted a two-year test study in New York's East River to analyze which systems were failing and which were succeeding. Wood

piles were enclosed with the systems according to manufacturer specifications and were later tested for marine borer activity. According to their findings the authors stated, "While it appears clear that the positive closure wraps, in general, passed more often than the overlap closure wraps, none passed more than 80% of the time."[5]

While HPA does not endorse or reject any specific product, their findings obviously suggest that even the best of the old wrap systems will fail 20% of the time. One major reason is the use of metals to secure the wraps to the pilings. Metals, even when treated before use, deteriorates underwater well before the wraps do. This deterioration causes the wraps to loosen, and if not remedied quickly, eventually exposes the wood to the elements and marine borers. After speaking with Patrick King, Vice President of Han-Padron, and one of the main researchers involved with the *Pile Wrap Evaluation Study,* King mentioned that Timber Guard was one product that his company was interested in pursuing as a viable option to wrap systems. The advantages that TimberGuard has over wraps are varied. One of TimberGuard's best features is its "total encapsulation" application which makes the polymer completely seamless upon application. This means that there is no need for complicated "attachment" procedures during installation such as the use of nails, staples, bands, bolts, screws or ties to keep it securely in place and keep out marine borers. In addition to cutting labor costs, this elimination of the use of metal objects also has the advantage of excluding the necessity of periodic maintenance due to the deterioration of metal in sea water.

Conclusion

With the increasing restrictions on the use of chemicals for marine structures, it is clear that alternative methods need to be seriously evaluated. The solution recognized as having the most success in years of studies and tests for the protection of wood piles is the use of wrap systems. By eliminating high levels of dissolved oxygen in the wood with a barrier wrap, even if marine borers were to penetrate the wood, it is impossible for them to survive long enough to cause any damage. An advanced solution is using technology which encases the timber in a continuous sleeve, eliminating the need for bands or staples that will corrode in water over time. In certain situations piles cannot be removed from the existing structure and wrapping is the best solution available. However, in situations where piles are completely replaced, or being installed for the first time, the best method of protection is a pile which is fully encapsulated in a polymer sleeve.

References:

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[3] *Controlling Marine Borer Attack of Timber Piles With Plastic Wraps*, The International Research Group on Wood Preservation. Frank Steiger and George Horeczko, May 4, 1981.
[4] http://www.han-padron.com/
[5] *Pile Wrap Evaluation Study*, Joseph Acosta, Andrew Cairns, and Patrick King, Han-Padron Associates, LLP, 22 Cortlandt St., New York, NY 10007.

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