



The Effectiveness of a Plastic Encasement as a Timber Preservative

A Whitepaper by:
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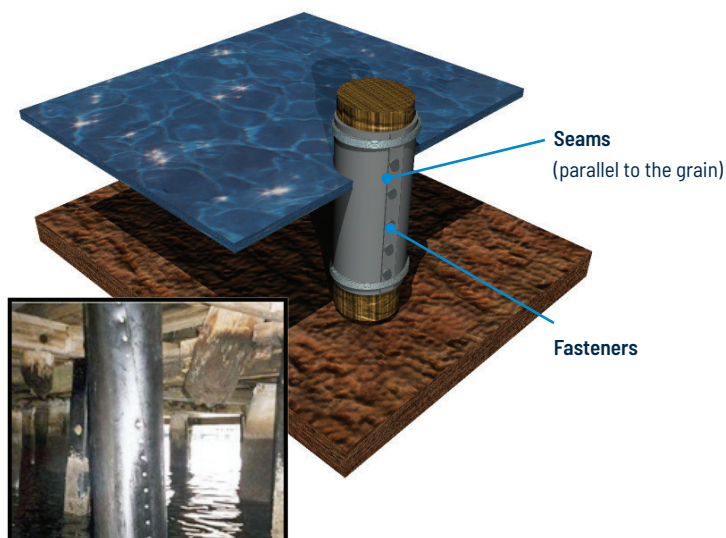
According to The U.S. Army Corps of Engineers, The Air Force Civil Engineer Support Agency, and the Naval Facilities Engineering Command, "Timber structures in a marine environment are subject to attack by a variety of destructive organisms. Thus, they should be properly treated with appropriate preservatives to prevent or retard this type of deterioration."¹

In aquatic environments, timbers and pilings, like any organic bodies, are destroyed through decomposition by fungus, bacteria, termites, and other aquatic invertebrates known as marine borers - with consequences that range from mild cosmetic damage to a complete loss of structural integrity.

The demand to increase the lifespan of structural timber has created a multi-billion dollar industry in wood preservation. New preservation methods are constantly being developed and perfected. While the problems and solutions associated with wood deterioration are simple in nature, the most effective preventative processes are more complex. This paper will outline these preventative processes that happen behind the scenes when using encapsulated marine piling.

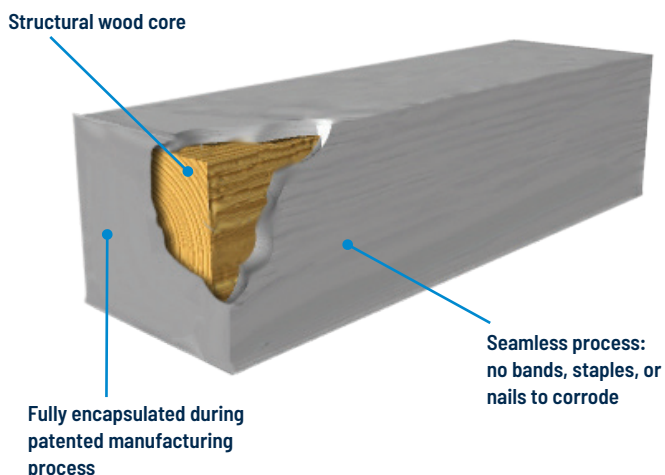
Common Preservation Methods

Since ancient times there has been significant research and development into timber preservation methods. Today, there are three basic types; chemical treatment, pile wrapping, and full encapsulation. The first major breakthrough in wood preservation was treatment with chemical preservatives or pesticides. This method has been implemented in many forms for thousands of years and is still the most widely used type of preservative treatment. Today, chromated copper arsenate (CCA) is the most common pesticide applied to wood for marine use. While this treatment is generally effective against land-born decomposers, it is generally ineffective at combating marine borers. Additionally, CCA is water-soluble and will leach when in direct contact with water, leaving the wood exposed to attack and depositing potentially toxic chemicals to the environment. Like the pesticide creosote, (which was banned by many agencies including the European Union) CCA is beginning to see more and more restrictions in marine and residential applications by the EPA and similar organizations due to possible chemical contamination.



A second technique, known as pile wrapping (typically used in conjunction with pressure treated wood), has seen increased use over the last several decades. Wrapping has been shown to be an effective supplemental preservation method against marine borers but requires chemical treatment to work effectively against all the major wood destroying organisms. Pile wrapping involves wrapping exposed pile sections with an impervious plastic wrap. This technique is focused primarily on limiting marine borer damage after it has already begun. Additionally, the numerous seams and failure points involved in this method leave much to be desired in providing long term preservation.

In their pile wrap evaluation study, Han-Padron Associates concluded the following. "As was the case in this study, the bands that are needed to ensure a good seal can corrode and fall off. This can cause an effectively functioning wrap to fail."²



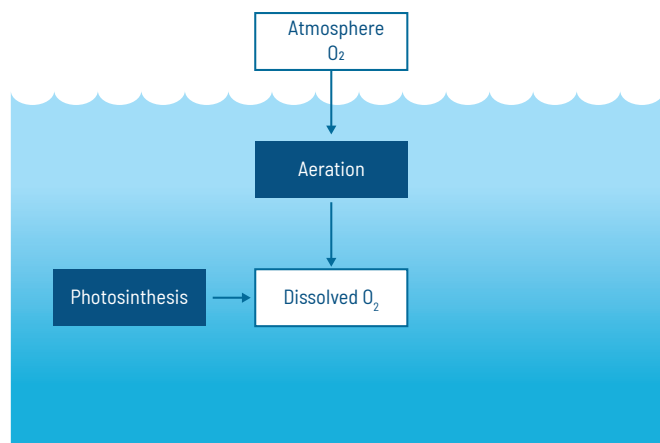
Full encapsulation currently offers the most effective solution to wood decomposition and structural loss. This approach builds on the proven process of conventional pile wrapping and pressure treatment, but virtually eliminates each of their inherent weak points, e.g., staples, nails, banding, seams, and chemical leaching.

This new technology allows a continuous polymer sleeve to seamlessly encapsulate a structural wooden core.

Dissolved Oxygen – Fueling Decomposition

To best understand how to prevent timber deterioration, a look at natural occurrences that lead to the desired result will provide some insight. Fish and other aquatic organisms can die in periods of high cloud cover and low winds. A similar result occurs in a phenomenon known as winterkill, which occurs when ice and snow blanket a body of water. Both of these scenarios create environments unsuitable to sustain aquatic life.

From human beings, to worms, to bacteria, organism survival is heavily dependant on oxygen. In addition to organic matter for food, virtually all decomposers require oxygen for survival. These organisms typically separate dissolved oxygen from the water through gills or other breathing apparatuses.



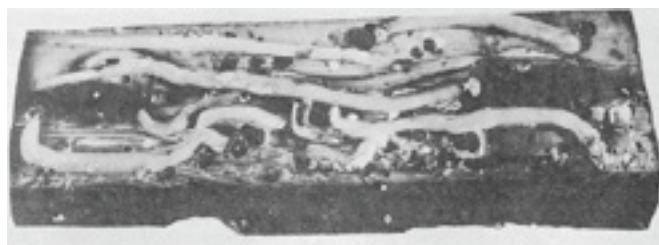
Most of this dissolved oxygen comes from the atmosphere. After dissolving at the surface, oxygen is distributed by current and turbulence. Algae and other aquatic plants also deliver oxygen to the water through photosynthesis.

Because of the contact with the atmosphere and amount of available light, the highest concentration of dissolved oxygen is located at the surface of the water. This level varies linearly

with depth, so the more shallow the water, the more habitable the environment for unwanted pests. This is unfortunate for most wooden marine structures, which are typically located in relatively shallow waters.

Stopping Decomposition

After finding a suitable piece of wood, marine borers and many bacteria burrow into, consume, and decompose the wood, traveling parallel to the grain. This leaves a nice path for water to flow, replacing the old, oxygen deprived water with new oxygen rich water.



Bankia (shipworm) infestation of wood planking

With an established line of oxygen replenishment, these unwanted organisms can enjoy a nutrient rich environment while causing significant cross-sectional damage to the structure. In addition to replenishment by new water circulation, oxygen can be generated locally by photosynthesizing organisms, which feed on light and decomposed material. Requiring only the additional presence of light, a self-supporting symbiotic relationship is formed between the decomposer and photosynthesizer, in which each supports the others' life until no consumable wood remains.

By sufficiently restricting the water circulation and available light, virtually no marine decomposers can survive.

The Effectiveness of Full Encapsulation

Damage prevention from wood decomposition is a two-tiered process:

1. Prevent or deter unwanted decomposers from entering the wood.
2. Create a habitat in which no organism can survive, discouraging those that gain entry and those that existed beforehand.

The most effective way to achieve the first step is simply to block organisms' access to the wood. At first glance, it would appear that the primary function of full encapsulation is to accomplish this goal. While it is highly effective in this way, a much more formidable operation is achieved. The second, but more effective preventative measure, involves restricting the oxygen that most decomposers need to survive.

For years, groups ranging from the U.S. Fish and Wildlife Service to the U.S. Navy have tried to restrict the levels of oxygen getting to marine timber to extend the performance life of pilings. Until recently, pile wrapping provided the best solution. Although typically difficult and expensive to install, when used properly, wrapping was proven to decrease oxygen levels in treated areas and thus provide a longer life for the structure. However, wood expands and contracts. Seams loosen, and over time, fasteners fail. These actions result in easy entry for decomposers and a clear path for water flow, parallel to the grain, providing sustenance.

A study conducted by the Naval Civil Engineering Facilities reviewed the encasement of timber pilings before driving. "The Port of Tacoma used the former method in 1922 and the piling is still in excellent condition today."³ (at the time of publishing in 1987)

Full encapsulation provides the benefits of wrapping to the entire pile and eliminates the weak points in the system. Full encapsulation does not bond to the wooden core, allowing independent expansion and contraction inside the flexible membrane. This means the effectiveness of the seal does not rely on tension, which inevitably fluctuates, nor is the polymer protection susceptible to cracking during freeze thaw cycles. Full encapsulation eliminates seams and fasteners, which are the common failure points. Furthermore, the protected structural system is created as a single unit, in a state-of-the-art manufacturing facility, eliminating the need for on site installation, where quality control is difficult at best.

Full encapsulation provides the best defense against borers and other decomposers by limiting entry into the wooden core, and effectively suffocating whatever life may be within, through the restriction of oxygen and light.

What happens if the encapsulation becomes damaged?

Although remarkably durable, the polymer encapsulation may become gouged or nicked in extreme transportation or installation conditions (stabbed with a forklift, excavator, etc.). Although abusive conditions should be avoided whenever possible, and incidental damage repaired for aesthetic purposes, the bottom line is, even when left untreated, small holes and tears have a negligible effect on performance. While organisms may gain minimal access to the wood, unless the tear exposes significant area parallel to the grain, sufficient water flow to provide enough oxygen to support life cannot typically be achieved

Conclusion

The Naval Civil Engineering Laboratory suggests "In...areas where repairs of chemically treated piling are soon required, it may be advisable to install prewrapped, treated bearing piling to avoid potentially catastrophic delays in wrapping."⁴ While the traditional wrapping of pressure treated wood is currently an acceptable option in many locations, it is not always a feasible solution, and is in most cases a temporary one. Prevention is always better than treatment in the field. The most effective method of limiting light and oxygen to timber, and thus significantly increasing the survival rate of structural timber in water is full encapsulation.

1. DEPARTMENTS OF THE ARMY, THE NAVY AND THE AIR FORCE "Maintenance of Waterfront Facilities" (Army TM 5-622, Navy MO-104, Air Force AFM 91-34). June 1978: 2.1.1

2. Joseph Acosta, Andrew Cairns, Patrick King. Pile Wrap Evaluation Study Han-Padron Associates, LLP, New York, NY 10007

3, 4. D. Pendleton and T.O'Neill. Timber Piling Barrier and Chemical Preservation Annual Costs Comparison. (N-1773) NAVAL CIVIL ENGINEERING LABORATORY, PORT HUENEME, CALIFORNIA 93043. June 1987