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In-Place Treatments for Control Of Decay in Waterfront Structures

Terry L. Highley

WOOD IN THE ABOVE-WATER PORTION of marine structures, even though pressure treated, is often subject to decay. The heartwood portions of creosoted Douglas-fir fender piles and large structural members (decks, curbs, wales, etc.), with checks that penetrate beyond the treated zone, are particularly prone to decay.[1] To determine what simple in-place preservative treatments might best eliminate these deep check decay problems, cooperative experiments were set up 10 years ago.[2] In-place treated, simulated Douglas-fir pile cutoffs, and southern pine and Douglas-fir simulated deck planks, were exposed aboveground at the USDA Forest Service National Exposure Site near Gulfport, Mississippi. An earlier paper reported results after 5 years and explained the details of the experimental design.[3] This note reports results after 10 years.

The experiments on simulated decks used in-place, top-surface "flooding" with fungicide to control decay in decks constructed of untreated planks. Such flooding should get the preservative into weathering-caused checks where rainwater accumulates and supports decay. The experiments directed at treated, simulated piles sought, in part, to determine which preservative, when brushed on untreated heartwood exposed at the top of the piles, would prevent decay from forming.

Materials and Methods

Decks, Brush Treatment

Twenty-five deck units of untreated Douglas-fir and southern pine were constructed using five planks (4 by 10 in.) per unit. After a year at the exposure site to allow development of checks, deck planks were subjected to one of four brush treatments (Table 1). Three out of five planks per unit received annual treatments and two were treated only 5 years after the initial treatment. Decay in individual planks was rated numerically:

0 No evidence of decay
40 Definite but limited decay

TABLE 1. - ***Average decay ratings of southern pine and Douglas-fir deck planks after 10 years' aboveground exposure in Mississippi.***

Preservative treatment[a]	Southern pine: Initial plus 5-year treatment only	Southern pine: Annual treatment	Douglas-fir: Initial plus 5-year treatment only	Douglas-fir: Annual treatment
None (control)	100[b,c]		76	
Sodium penta	100	100	0	0
Sodium penta plus water repellents	100	100	0	0
Penta in mineral spirits plus water repellents	100	100	0	0
FCAP	4	0	0	0

[a]Penta concentrations were 5 percent. FCAP, 12 percent mixture in water (4% actual solution).
[b]Values for controls, 5-year treatment, and annually treated planks represent 25, 10, and 15 planks, respectively.
[c]On a scale of zero to 100, a rating of 80 indicates sufficient decay to warrant replacement of a plank.

[1]Highley, T. L., and T. C. Scheffer, 1978. Controlling decay in above-water parts of waterfront structures. Forest Prod. J. 28(2):40-43.
[2]The study was made in cooperation with the Naval Facilities Engineering Command U.S. Dept. of the Navy, Y-F51.543.002.02:002
[3]Highley, T. L., and T. C. Scheffer. 1975. In-place treatment of simulated waterfront structures for decay control. Mater. und Org. 1057-66.

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This excellent protection of uncapped piles by ammonium bifluoride in drilled holes has prompted additional experiments using brush flooding of this compound and other waterborne preservatives on pile tops. Evidently some waterborne chemicals may have an unexpected ability to protect items with deep checks. Protection against decay of pile tops without caps is most important; should the cap be damaged and not repaired, decay would still be inhibited.

Conclusions

The service life of Douglas-fir planking (heartwood moderately decay resistant) not in contact with soil can be substantially increased by flooding the top surface with penta or **FCAP.** Retreatment may not be required for at least 5 years. However, southern pine planking (decay susceptible) under the same conditions may be protected by the partly soluble **FCAP** but not by penta.

Only in creosotetreated Douglas-fir piles covered by a cap did the fungicide, supplementarily applied to the cutoff tops, protect the heartwood from decay. In all the piles not covered with a cap, only ammonium bifluoride in holes drilled in the top prevented decay after 10years.

60 Decay general, but not warranting replacement of the item
80 Decay sufficient to warrant replacement of the item
100 Item failed

Piles, Fungicide Treated

Conventionally pressure-treated fender piles were cut into 2-foot sections. Ten sections were cut for each of seven fungicide treatments. The basal end of all sections was thoroughly flooded with 25 percent pentachlorophenol (penta) concentrate and then coated with a mixture of one part epoxy and three parts rock tar (Detroit Graphite Co.) to prevent decay from ground contact. A cap of Noah's Pitch (Philip Carey Co.) was applied to 7 of the 10 section tops in each treatment. The other three tops were not capped to indicate what might happen if damaged caps were not repaired on heavily used piers. The untreated control sections consisted of seven uncapped and three capped section tops. The fungicides applied, and the method of application is described in Highley and Scheffer[3] and Table 2.

TABLE 2. - ***Number of decayed and sound units from supplementary-treated Douglas-fir pile cutoff tops after 10 years.***

Treatments[a]	Capped tops		Uncapped tops	
	Sound	Decayed	Sound	Decayed
Penta grease				
Ammonium bifluoride in holes 1 in. diameter, 2 in. deep	7	0	3	0
Ammonium bifluoride in holes 2 in. diameter, 1 in. deep	7	0	3	0
Penta (12.5%) in No. 2 fuel oil in holes 1 in. diameter, 2 in. deep	7	0	0	3
Penta (12.5%) in No. 2 fuel oil in holes 2 in. diameter, 1 in. deep	7	0	1	2
Penta (25%) and water repellents	7	0	0	3
Penta (25%), no water repellents	6	1	0	3
No preservative, controls	1	2	0	7

[a]To reduce loss of volatile oil carrying the penta, penta-grease containing 10 percent penta was troweled on and then covered with a sheet of 6-mil polyethylene for 48 hours. The penta solutions not applied in holes were flooded on the pile top.
[b]Wood without obvious decay but decay fungi isolated.

Decay Determination

Surface decay was observed by probing with a pick. Internal decay was determined by extracting increment borings and culturing the fungi. The cultures obtained confirmed that the prevalent fungus was *Gloeophyllum saepiarium* (Wulf. ex Fr.).

Results and Discussion

Decks, Brush Treated

Table 1 shows the 10-year results of southern pine and Douglas-fir deck planks treated in place. The 5-year interim results of onsite-treated southern pine planks showed that the penta treatments were ineffective, but that planks treated with fluor-chrome-arsenic-phenol (FCAP) were free of decay. After 10 years the FCAP continues to give excellent protection to the southern pine planks. All of the planks annually treated with FCAP, and all but one of the planks treated at the 5-year interval, were without decay. It is suspected that the moderate leachability of the FCAP component is sufficient to protect the planking on other surfaces besides the treated top. Because of these encouraging results, onsite treating experiments have been initiated with waterborne compounds other than FCAP.

Decay was not observed in the untreated Douglas-fir planking until the 6th year of exposure. Once started, however, the decay progressed rapidly. All Douglas-fir planks brush treated with preservative remain sound at 10 years. Results indicate that, after the initial treatment, retreatment of Douglas-fir planks is not necessary for at least 5 years.

Thus, the service life of a moderately decay-resistant wood such as Douglas-fir heartwood can be substantially increased by onsite brush treatment of the top surface with penta or FCAP. Onsite brush treatment of checks in large, horizontal Douglas-fir members was reported ineffective in another paper.' However, in that case the wood was probably too deeply infected already for existing decay to be arrested. The 10-year results presented here indicate that had the preservatives been applied earlier in the other study, the checks might have been protected from decay.

The more decay-susceptible southern pine planking, when exposed in a severe climate such as Mississippi's, is not adequately protected by onsite treatment of the upper surface with penta. Under these same conditions the partly soluble FCAP preservative, which may penetrate the wood better by wetting, does appear effective. Scheffer, et al.[4] found that failure occurred after 6 years in untreated pine floor units, and decay began in 7 years in units treated on all surfaces by dipping for 3 minutes in 5 percent penta. It is possible that the penta treatments would have been more effective in the study described here had they been applied immediately to the pine rather than a year later. Because of the high susceptibility of pine to decay in aboveground exposure, the deck planks may have been already too deeply infected for the penta to be effective.

Piles, Fungicide Treated

After 5 years, the uncapped Douglas-fir heartwood pile cutoff controls were decayed throughout their 2-foot length. Of the three capped untreated piles, one decayed after 6 years, one after 8 years, and one was without decay after 10 years (Table 2). Only one pile treated with a fungicide and covered with a cap had interior decay; this pile had been brushed on top with penta (25%, no water repellents). These results show the importance of a well-maintained cap in retarding decay.

After 10 years, just one fungicidal treatment without a cap, ammonium bifluoride in holes drilled in the pile top, continues to protect all pile tops from decay. During the same period only one of six piles treated with 12.5 percent penta in similar holes was free of decay.

[4]Scheffer, T. C., A. F. Verrall, and G. Harvey. 1963. On-site preservation treatments: their effectiveness for exterior millwork of different species used in various climates. Forest Prod. J. 13(1):7-12.