Permanence and Diffusion of a Borax-Copper Hydroxide Remedial Preservative Applied to Unseasoned Pine Posts: 10-Year Update

Douglas Crawford Forest Products Technologist Stan Lebow Research Forest Products Technologist **USDA** Forest Service Forest Products Laboratory One Gifford Pinchot Drive Madison, WI 53726

Mike West

Technical Advisor Copper Care Industries Route 2, Box 253F Senatobia, MS 38668

William Abbott

President Pole Maintenance Company P.O. Box 707 Columbus, NE 68602

Abstract

In 1993, unseasoned pine posts were treated with groundline bandages containing 3.1% copper hydroxide and 40% sodium tetraborate decahydrate (borax). The soundness of the posts was periodically evaluated using a push test. After 3.5, 6.5, and 10 years, two treated posts were sacrificed to

determine borax retention and copper hydroxide retention in increments from cross sections ranging from 7 in. below ground to 14 in. above ground. After 3.5 years, all untreated control posts had failed. After 6.5 and 10 years, the remedially treated posts were generally sound at the groundline, but most suffered top decay. The average borax retention was 1.51, 0.99, and 0.66 lb/ft³ after 3.5, 6.5, and 10 years, respectively. The average copper hydroxide retention in the sampled increments was 0.23, 0.26, and 0.22 lb/ft³ after 3.5, 6.5, and 10 years, respectively. Although retentions varied among posts, in most cases, the borax retentions were still above the threshold needed to prevent attack by decay fungi even 10 years after treatment.



Post plot, Harrison Experimental Forest, Saucier, Mississippi

Formulation of groundline treatments				
Ingredient	Weight (%)			
$Na_2B_4O_7 \cdot 10H_2O$	40.0			
Cu(OH) ₂	3.1*			
Inert	56.9			

*Equates to 2% Cu by weight.

Results

All the untreated controls had failed when the first two treated posts were removed after 3.5 years. No insect attack or decay was observed when the cross sections were cut from treated posts after 3.5, 6.5, or 10 years. Although the variability between replicates makes it difficult to form definitive conclusions, some trends are apparent.

Borax

- The greatest borax retentions were generally found in the cross section removed from 5 to 7 in. above ground, regardless of assay zone.
- Borax is diffusing into the posts—the average retention in the second half-inch assay zone (1.16 lb/ft³) was only slightly below that in the outer half-inch (1.35 lb/ft³).
- There appears to be some depletion of borax from the posts with time. The average borax retention was 1.51, 0.99, and 0.66 lb/ft³ after 3.5, 6.5, and 10 years, respectively. However, even after 10 years, the average borax concentration in the posts (0.66 lb/ft³) was above the toxic threshold for decay fungi. Fahlstrom (1964) evaluated the toxicity of borax to five decay fungi and reported that the toxic thresholds ranged from 0.05 to 0.18 lb/ft^3 .

Copper hydroxide

- Trends in copper hydroxide retention differed from those of borax.
- The effect of vertical location appeared to depend on assay zone, with higher retentions occurring above ground in the 0- to 0.5-in. assay zone and higher retentions occurring below ground in the two inner assay zones.
- Diffusion of copper hydroxide into the wood was more limited than that of borax. The average copper hydroxide retention in the 0.5- to 1.0-in. assay zone (0.19 lb/ft³) was less than half of that in the outer 0- to 0.5-in. assay zone (0.44 lb/ft³).
- Not surprisingly, copper hydroxide also appeared to be more permanent than borax. Years in test did not have a noticeable effect on average copper hydroxide retention, with levels of 0.23, 0.26, and 0.22 lb/ft³ after 3.5, 6.5, and 10 years, respectively.

istribution of copper hydroxide and borax in treated posts at	
.5, 6.5, and 10 years after installation ^a	

	Amount of copper hydroxide (lb/ft³)b								
Distance from	0- to 0.5-in. depth		0.5- to 1-in. depth			1- to 2-in. depth			
groundline (in.)	3.5 yr	6.5 yr	10 yr	3.5 yr	6.5 yr	10 yr	3.5 yr	6.5 yr	10 yr
-5 to -7	0.385	0.290	0.355	0.250	0.270	0.330	0.080	0.175	0.175
-1 to +1	0.465	0.380	0.360	0.205	0.200	0.125	0.060	0.115	0.070
+5 to +7	0.465	0.475	0.510	0.220	0.195	0.160	0.060	0.075	0.035
+12 to +14	0.485	0.685	0.425	0.100	0.155	0.035	0.020	0.055	0.010
	Amount of borax (lb/ft³)b								
Distance from	0- to 0.5-in. depth			0.5- to 1-in. depth			1- to 2-in. depth		
groundline (in.)	3.5 yr	6.5 yr	10 yr	3.5 yr	6.5 yr	10 yr	3.5 yr	6.5 yr	10 yr
-5 to -7	0.320	0.120	0.215	0.265	0.115	0.200	0.215	0.135	0.205
-1 to +1	0.550	0.310	0.960	0.390	0.275	0.595	0.350	0.235	0.620
+5 to +7	5.330	2.045	1.350	3.945	1.930	2.395	1.990	1.455	0.780
+12 to +14	2.740	1.880	0.315	1.400	2.235	0.220	0.625	1.195	0.095
^a Average of two posts. ^b To convert to kg/m³, multiply by 16.									

Conclusion

A borax-copper groundline treatment has protected the lower half of otherwise untreated pine posts for 10 years.

Borax from the groundline treatments has most effectively diffused into the posts, while the copper appears to be less mobile but more permanent.

Although variability between replicates makes definitive conclusions difficult, it appears that the retentions of borax and copper remaining in the wood were sufficient to prevent attack by decay fungi and termites.

This study indicates that evaluation of untreated posts can be a valuable part of the overall assessment of a groundline treatment's efficacy.





Groundline bandage containing 3.1% copper hydroxide and 40% borax	Location of cross sections removed from posts 12 to 14 in. above ground 5 to 7 in. above ground Groundline 5 to 7 in. below ground -0-to 0.5-in. ring -0.5- to 1-in. ring -1- to 2-in. ring
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Pass/fail condition of posts at 10 years after installation ^a						
	Number of posts					
Ingredient	In test	Passed	Failed			
$Na_2B_4O_7 \cdot 10H_2O/Cu(OH)_2$	6 ^b	6 ^c				
Control (no treatment)	10		10			

^aAWPA E8-56 standard method for field tests with posts. ^bTwo removed for analysis at 3.5 years and two removed at 6.5 years.

^cUntreated tops were decayed.