PERMANENCE OF A BORAX-COPPER HYDROXIDE REMEDIAL PRESERVATIVE WHEN APPLIED TO UNSEASONED PINE POSTS

A paper by

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PERMANENCE OF A BORAX-COPPER HYDROXIDE REMEDIAL PRESERVATIVE WHEN APPLIED TO UNSEASONED PINE POSTS

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ABSTRACT: In June, 1993 unseasoned pine posts were ground line bandage treated with a remedial preservative containing 3.1% copper hydroxide and forty percent sodium tetraborate decahydrate then field tested according to procedures described in USDA Forest Products Laboratory Research Paper FPL 409. These treated posts, and untreated controls, were installed in a plot adjacent to the test plot where remedial treatments were comparatively tested in 1957. After three and a half years and after six and a half years, two treated posts were removed and sacrificed to determine borax retention and copper hydroxide retention in increments from cross sections ranging from seven inches below ground to fourteen inches above ground. After three and a half years all untreated controls had failed. In the treated posts, the average copper hydroxide retention in the sampled increments was 0.20 pounds per cubic foot after three and a half years and 0.23 pounds per cubic foot after six and a half years. The average sodium tetraborate decahydrate retention was 1.41 pounds per cubic foot after three and a half years and 0.88 pounds per cubic foot after six and a half years.

INTRODUCTION

Remedial preservatives are used to treat poles in line which were previously impregnated with either creosote or pentachlorophenol. The components in a remedial formulation are chosen to be compatible with, and complimentary to, both creosote and penta. Ground line treatments are designed to protect wood containing below threshold levels of creosote or penta. They are also intended to protect the untreated sapwood in individual poles which fail to meet penetration specifications. Furthermore, modern ground line remedial treatments are designed and intended to penetrate and protect untreated sapwood, if any, and untreated heartwood in poles which meet penetration specifications.

It is generally accepted that remedial preservative should contain one active ingredient which fixes in the wood and another which diffuses. The diffusible active moves with water in the pole and penetrates into the heartwood. It should be capable of preventing both insect and decay attack. The fixed active should be proven to penetrate through the sapwood before it becomes immobile. It is especially important for this active to control creosote and pentachlorophenol tolerant decay fungi.

The remedial preservative reported here contains borax and copper hydroxide complexed with ethanolamine. Borax is a well-known diffusible preservative. In recent years ethanolamine complexes of copper have become familiar fixed active ingredients in wood preservatives. Use of borax with ethanolamine-copper buffers the alkalinity of the amine and allows for the production of a remedial preservative requiring only a WARNING signal word on the labeling.

The literature contains considerable data which supports the good performance of copper and borate compounds in combination for general wood preservation. It is known borate compounds leach readily from wood in ground whether or not the borates are combined with copper. Fortunately, the impermeable sheets used to cover ground line remedial applications help to contain the borax in the pole. These impermeable liners also contain the creosote and penta in the pole by physical means.

The studies reported in this paper were initiated by Dr. R. C. DeGroot, and they are installed in a plot adjacent to the one used for comparative testing of remedial preservatives in 1957. Those 1957 unseasoned post tests led to commercial products which have performed well. We do not advocate unseasoned post tests as a sole indicator in judging a remedial ground line preservative. The remedial actives should be shown synergistic, or at least additive, for control of decay and insects when they are combined with either creosote or penta. The actives should also be shown to penetrate standing poles, and their permanence in those poles should be established.

There is much data to support creosote-copper/borax and penta-copper/borax combinations for wood protection. Fahlstrom reports synergism for combinations of borax with as little as 0.02 pounds per cubic foot anhydrous borax needed to protect sub-threshold creosoted wood from decay by creosote tolerant decay fungi. Chapman reports synergism for combinations of borax and pentachlorophenol. Hochman and Amundsen report excellent performance for copper-penta wood preservatives. Creosote and copper together have a long history of successful wood protection. Combined with penetration and permanence studies ongoing since 1993 on standing poles, this data bolsters the case for correlating ground line remedial performance reported here for unseasoned posts to performance on standing poles.

MATERIALS AND METHODS

The remedial preservative used in this study contained 3.1% copper hydroxide and forty percent sodium tetraborate decahydrate as active ingredients. The inert ingredients consisted of ethanolamine, water and thickeners. The test method followed was that described in FPL 409 except six additional posts were treated and installed for periodic removal, examination and assay for copper and boron. The posts were cut and peeled within one week of treatment and installation. They measured an average circumference of 18.9 inches at the base. One-fourth inch of the borax-copper hydroxide paste was applied to a vinyl sheet eighteen inches tall and equal in circumference to the base circumference of the post. Then the bandage was tightly pressed around the base of the post. In June 1993, shortly after treatment, the posts were installed in sixteen inch post holes.

Each year the posts were given a push test, and all the results were recorded. After three and a half years and six and a half years, two posts were removed and sacrificed to yield cross sections from seven to five inches below ground, from one inch below to one inch above ground, from five to seven inches above ground, and from twelve to fourteen inches above ground. The sections were separated into increments of outer half inch, second half inch, second one inch, and core, providing the post was sufficient in diameter to give more than a large pencil-size core. The increments were remitted to TPI where they were oven dried, ground, mixed, and assayed for the two preservative actives. The percentages of borax and copper hydroxide were converted to pounds per cubic foot using the Southern Yellow Pine density given in AWPA A12-89.

RESULTS AND DISCUSSION

All untreated controls had failed when the first two treated posts were removed after three and a half years. There was no visible evidence of insect attack or decay where the cross sections were cut from the treated posts either after three and a half or six and a half years. After six and a half years the top of each treated post was essentially destroyed by decay with some decay extending down the posts. The decay extended down further in some treated posts than in others, but in no case did it extend more than halfway down a treated post.

Results for copper hydroxide and sodium tetraborate decahydrate in the sampled increments of the treated posts after both three and a half and six and a half years are given in **Table 1.** The chemical levels in the two posts removed at the same time varied significantly. Visual examination of the posts for the number of growth rings per inch confirmed the variation in chemical diffusion from the bandage application was directly related to wood density. In all cases the borax tended to concentrate in the above ground portion of the posts while the copper hydroxide concentrated in the outside of the posts.

In the treated posts, the average copper hydroxide retention in the sampled increments was 0.20 pounds per cubic foot after three and a half years and 0.23 pounds per cubic foot after six and a half years. The average sodium tetraborate decahydrate retention was 1.41 pounds per cubic foot after three and a half years and point 0.88 pounds per cubic foot after six and a half years. These results are considered indicative rather than definitive. On that basis the data in **Table 1**

indicates the copper hydroxide is more or less permanent while the borax is less permanent in these posts with the impermeable liners. Nonetheless, the average borax retention in the sampled areas after six and a half years is more than three times its threshold for the most resistant of the five decay fungi studied by Fahlstrom.

LITERATURE CITED

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TABLE 1

POST	YRS.	LOCATION	INCREMENT	PCF ($Na_2B_4O_7.10\ H_2O$)	PCF ($(Cu(OH)_2)$)
W9	3.5	7"-5" BG	1st 0.5"	0.52	0.47
W29	3.5	"	"	0.12	0.30
W33	6.5	"	"	0.21	0.33
W39	6.5	"	"	0.03	0.25
W9	3.5	1" BG-1"AG	"	0.76	0.58
W29	3.5	"	"	0.34	0.35
W33	6.5	"	"	0.53	0.41
W39	6.5	"	"	0.09	0.35
W9	3.5	5" -7" AG	"	8.16	0.50
W29	3.5	"	"	2.50	0.43
W33	6.5	"	"	2.25	0.41
W39	6.5	"	"	1.84	0.54
W9	3.5	12"-14" AG	"	1.58	0.35
W29	3.5	"	"	3.90	0.62
W33	6.5	"	"	2.99	0.52
W39	6.5	"	"	0.77	0.85
W9	3.5	7"-5" BG	2nd 0.5"	0.42	0.35
W29	3.5	"	"	0.11	0.15
W33	6.5	"	"	0.20	0.39
W39	6.5	"	"	0.03	0.15
W9	3.5	1"BG-1" AG	"	0.53	0.28
W29	3.5	"	"	0.25	0.13
W33	6.5	"	"	0.47	0.28
W39	6.5	"	"	0.08	0.12
W9	3.5	5"-7" AG	"	5.34	0.28
W29	3.5	"	"	2.55	0.16
W33	6.5	"	"	2.42	0.22
W39	6.5	"	"	1.44	0.17
W9	3.5	12"-14"AG	"	1.05	0.05
W29	3.5	"	"	1.75	0.15
W33	6.5	"	"	4.14	0.27
W39	6.5	"	"	0.33	0.04
W9	3.5	7"-5"BG	2nd 1"	0.39	0.11
W29	3.5	"	"	0.04	0.05
W33	6.5	"	"	0.23	0.29
W39	6.5	"	"	0.04	0.06

TABLE 1 (Cont.)

POST	YRS.	LOCATION	INCREMENT	PCF ($Na_2B_4O_7.10\ H_2O$)	PCF ($(Cu(OH)_2)$)
W9	3.5	1"BG-1"AG	"	0.45	0.09
W29	3.5	"	"	0.25	0.03
W33	6.5	"	"	0.40	0.19
W39	6.5	"	"	0.07	0.04
W9	3.5	5"-7"AG	"	2.96	0.10
W29	3.5	"	"	1.02	0.02
W33	6.5	"	"	1.97	0.14
W39	6.5	"	"	0.94	0.01
W9	3.5	12"-14"AG	"	0.80	0.03
W29	3.5	"	"	0.45	0.01
W33	6.5	"	"	2.28	0.11
W39	6.5	"	"	0.11	0.00
W9	3.5	7"-5"BG	CORE	0.45	0.02
W29	3.5	"	"	----	----
W33	6.5	"	"	0.21	0.10
W39	6.5	"	"	0.05	0.01
W9	3.5	1"BG-1"AG	"	0.44	0.01
W29	3.5	"	"	----	----
W33	6.5	"	"	0.39	0.18
W39	6.5	"	"	0.09	0.00
W9	3.5	5"-7"AG	"	2.03	0.03
W29	3.5	"	"	----	----
W33	6.5	"	"	----	----
W39	6.5	"	"	----	----
W9	3.5	12"-14" AG	"	0.44	0.01
W29	3.5	"	"	----	----
W33	6.5	"	"	----	----
W39	6.5	"	"	----	----

AB =3D Above Ground BG =3D Below Ground