Above Ground Testing of Preservatives - A comparative evaluation of three experimental procedures.

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Abstract

Standardised test methods for evaluating ground contact preservatives have been available for many decades but comparable above ground test procedures have not been universally accepted. Recently the A.W.P.A. approved the L-joint test (Standard M9, 1987) as an above ground preservative test for mill work/joinery.

This paper describes two alternatives to the L-joint test - an above ground fully exposed hazard and a more severe above ground covered exposure. Comparative data on the performance of several standard preservatives using all three methods is presented.

Keywords:

L-joints, above ground testing, preservative evaluation

Introduction

The wood preservation industry is actively pursuing the development of new, environmentally acceptable, preservative chemicals. To fully evaluate these new preservatives, suitable test methods must be developed to simulate the different exposure hazards in which treated timber is used. From a commercial standpoint these methodologies need to provide definitive performance data in as short a time as possible.

Over the years there have been many attempts to develop an above ground test procedure to evaluate preservative performance. Few of these methods have gained universal acceptance. One major problem confounding the development of a standard test is the simple fact that not all above ground decay hazards are created equal. For example, the decay hazard for painted window joinery is different to that for exposed decking although both commodities are used above ground. One test method, which uses L-joint assemblies to simulate mill work/joinery, has recently been approved by the AWPA (Standard M9-1987). The L-joint method appears well suited to examining the performance of preservative treated mill work but the use of the test for other above ground treated commodities is questionable.

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Over the past two years, in conjunction with an active program to develop new preservative systems, CSI-Laporte has been developing test methodologies to assess the above ground performance of those systems. Two alternatives to the L-joint method have been under evaluation at two geographically different test sites, one in Hilo, HI and the other in Harrisburg, NC. One of the test methods provides an above ground fully exposed hazard (e.g. decking) and the other, a potentially more severe, above ground covered exposure.

The purpose of this paper is to provide experimental details for the two techniques, to present preliminary findings on the performance of several preservatives using the techniques and to compare those findings with data obtained from the L-joint test method. Only data from the Hilo, HI test site are discussed.

Methods

Above ground covered test procedure

The test units consist of nine 450 mm x 300 mm x 100 mm concrete blocks arranged in a 3 x 3 square grid pattern flat on the ground. The blocks are covered by a black, porous, agricultural shade cloth supported on a square 150 mm x 25 mm CCA treated wooden frame, sized to fit around the blocks (Figure 1). Preservative test specimens are cut from southern yellow pine sapwood (100 mm x 50 mm x 20 mm) and are placed flat side horizontal, on the concrete blocks. Each unit can hold about 50 wooden samples arranged randomly on the blocks.

At six month intervals the samples are inspected for evidence of fungal attack using a blunt metal probe. A visual rating scheme adapted from methods used to assess soil contact stakes is used (Table 1).

Above ground exposed test procedure

This test was designed to simulate a horizontal decking situation using 300 mm x 50 mm x 20 mm southern yellow pine samples. Preservative treated and untreated samples are randomly arranged on metal racks 450 mm off the ground fully exposed to the weather (Figure 2). Samples are evaluated every six months using the same methods as desribed for the above ground covered test.

L-joint test

The test procedure conforms closely with the test methodology described in AWPA standard M-9 1987. Test samples consist of 2 38 mm x 38 mm cross section ponderosa pine sapwood pieces arranged at right angles and joined with a mortice and tenon joint (Figure 3). These samples are installed above ground on a horizontal rack.

Preservative treatments

The performance of a range of organic solvent borne preservatives was evaluated using all three of the test arrangements just described. For the preservative treatments, a double vacuum treatment schedule was employed. This consisted of an initial vacuum of -16 kPa for 3 minutes followed by 3 minutes at atmospheric pressure and a final vacuum of -88 kPa for 60 minutes. The net solution uptake using this cycle was approximately 35-45 l m^3. A mineral spirits based solvent was used as the carrier for the active ingredients. All treatment solutions contained 2.5% polyethylene resin as a binder but no water repellent components were included in the formulations.

The performance of several waterborne preservative formulations is being examined using the above ground covered and the above ground exposed test procedures only. Treatments were carried out using a conventional full cell process consisting of an initial vacuum of -88 kPa for 30 minutes followed by a 1385 kPa pressure for 30 minutes.

Results and Discussion

In the design of the above ground covered test it was envisaged that the porous shade cloth would allow the test samples to wet up through natural rainfall and, at the same time, moisture evaporation and drying would be retarded. In theory test specimens would remain at a moisture content conducive to fungal attack for a longer period than might normally occur if the samples were fully exposed. The above ground exposed test was designed to simulate an exposed horizontal decking situation which would allow the specimens to wet up readily in the rain and allow unimpeded drying at other times.

Performance data for a range of organic solvent treatments using the above ground exposed test are presented in Figure 4. The histogram reveals that the Hawaiian test site presents a fairly harsh above ground environment. After 17 months the mean soundness of the untreated material was just above 20 %. All untreated samples had failed at the end of 24 months exposure. The RH-287 (4,5 dichloro-2-n-octyl-4-isothiazolin-3-one), pentachlorophenol and copper naphthenate samples are performing well after 24 months. All samples treated with 0.25% TBTO have failed completely after 24 months and samples treated with higher concentrations (0.5 and 1.0 %) are exhibiting severe decay. IPBC (3-iodo-propynyl butyl carbamate) exhibits a definite concentration response, samples treated with a 1 % a.i. solution show a mean percent soundness of approximately 95% after 24 months exposure.

Performance data for the same preservatives using the above ground covered test are presented in Figure 5. The mean soundness of the untreated material is the same as that in the exposed test suggesting that the two methods present equivalent decay hazards. However, the performance of RH-287 and IPBC appears to be worse in the covered test than in the exposed test. These comparisons can be more easily made in Figure 6 which illustrates the relative performance of the different preservatives in all three test procedures. In all cases it is apparent that the L-joint test is the least severe of the three methods. This is probably a reflection of the fact that the L-joints are painted and the other test samples are not. The data also shows that the performance of a given preservative is markedly influenced by the test method used. For example, TBTO treated material seems most susceptible to decay in the above ground exposed test whereas IPBC performs badly in the above ground covered test. At this point, possible reasons for these results are speculative and further investigation is necessary before definitive explanations can be found.

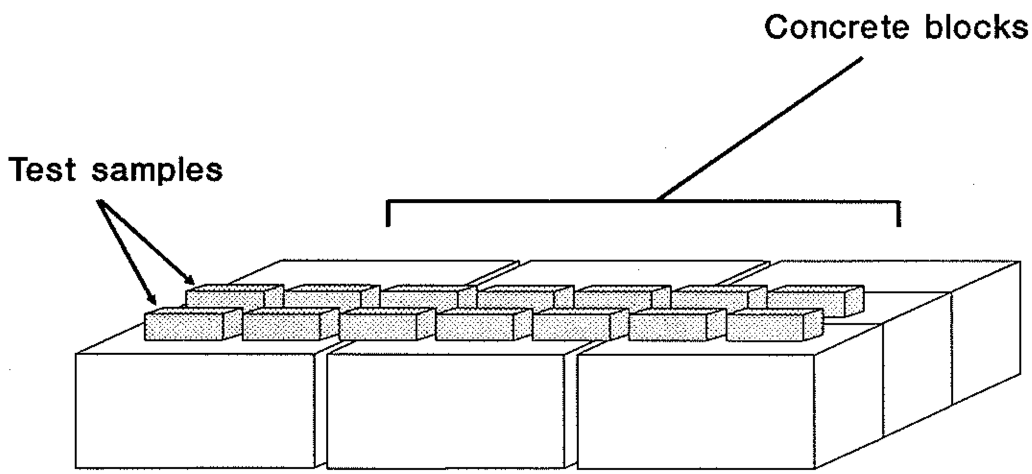
The performance of CCA type C, a copper chromium borate formulation and an alkylammonium compound (AAC) with and without a water repellent can be compared in Figure 7. After 24 months exposure in the above ground covered and the above ground exposed test procedures, the incidence of decay in all but the copper chromium borate without water repellent and untreated samples is very low. The data suggest that the addition of water repellent may improve the performance of the AAC formulation only marginally but in contrast the performance of the copper chromium borate formulation is greatly improved by the water repellent additive. It is possible that the water repellent reduces boron leaching from the copper chromium borate samples but this will need to be confirmed by chemical analysis.

Summary and conclusions

The Hilo, Hawaii test site appears to provide a severe above ground test environment. After two years' exposure we are generating comparative performance of a number of preservatives in above ground exposure situations. Vacuum-pressure treatments with waterborne preservatives are performing better than LOSP systems treated with double vacuum schedules in all three test procedures. It is also apparent that the three test procedures create three different exposure hazards. When challenged in these three environments a given preservative will behave differently. Comparative data from the three tests may provide useful data on the true performance of preservatives under real life situations. Other test configurations such as a true horizontal decking situation are under evaluation. It is hoped that with a combination of these different tests we can judge the commercial feasibility of candidate preservatives in relatively short periods with a great deal of confidence.

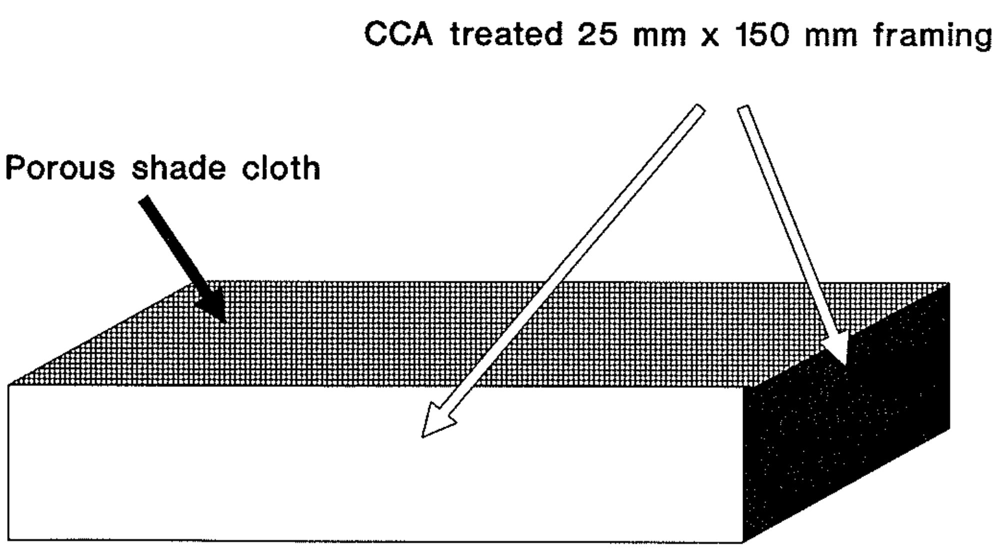
Table 1 Ordinal scale used to evaluate preservative performance

Visual Rating	% soundness	Description
1	100	no decay
T	99	suspicion or trace
2	90	minor but established
3+	75	established and deepening
3	70	well established
3-	65	severe
4	40	in danger of failure
5	0	failed



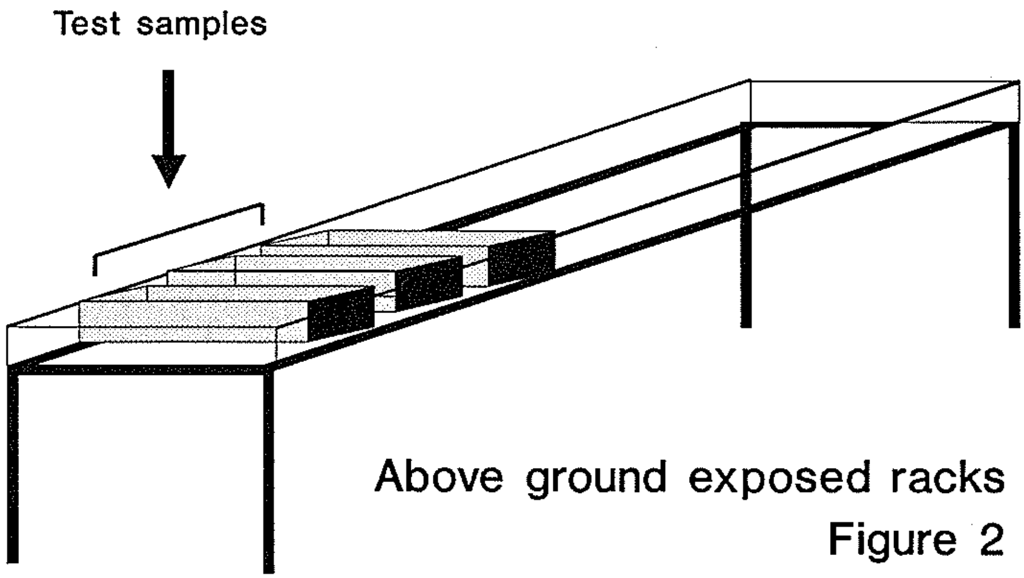
Above ground covered test unit

Figure 1 A

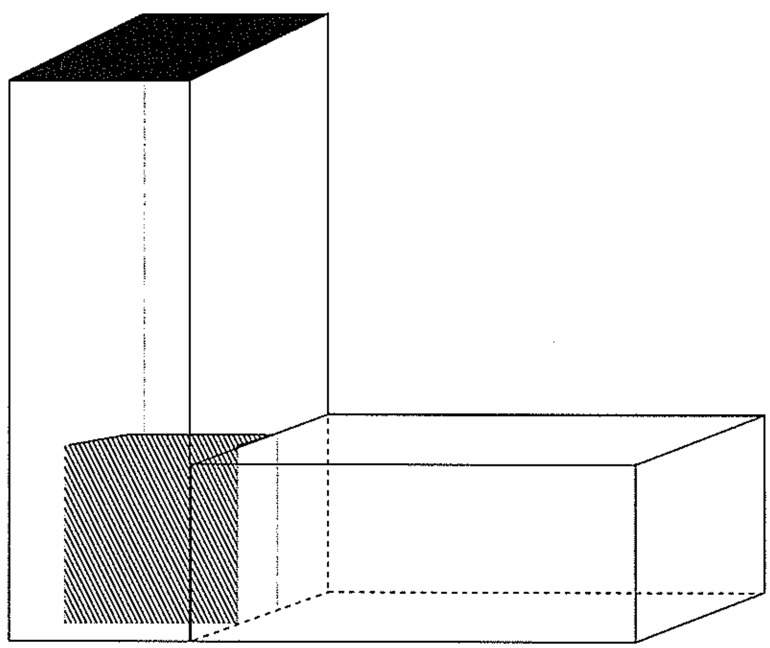


Above ground covered test unit

Figure 1 B



Above ground exposed racks
Figure 2



L-joint configuration
Figure 3

Preservative performance
Above ground exposed test Hilo

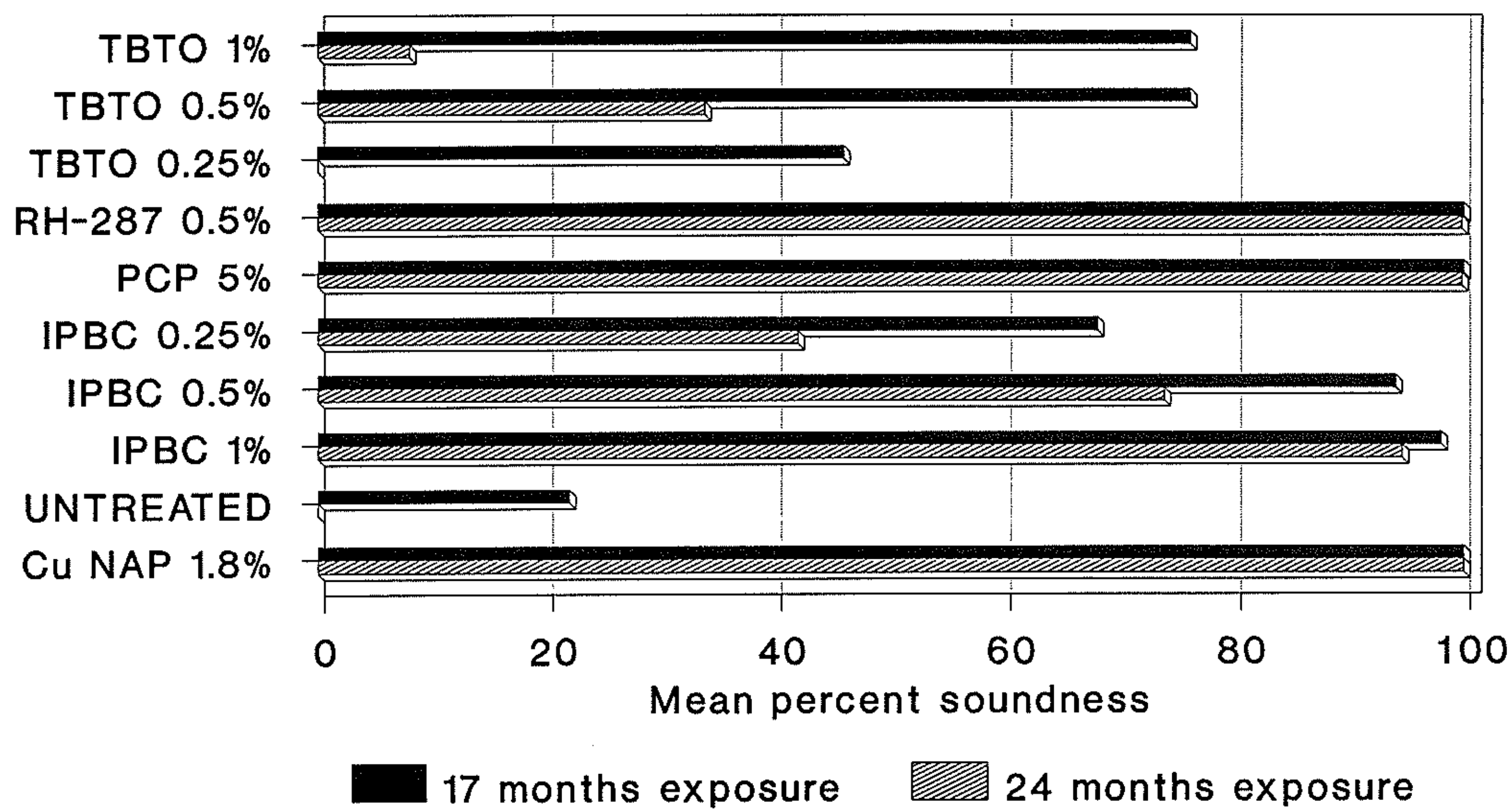


Figure 4

Preservative performance Above ground covered test Hilo

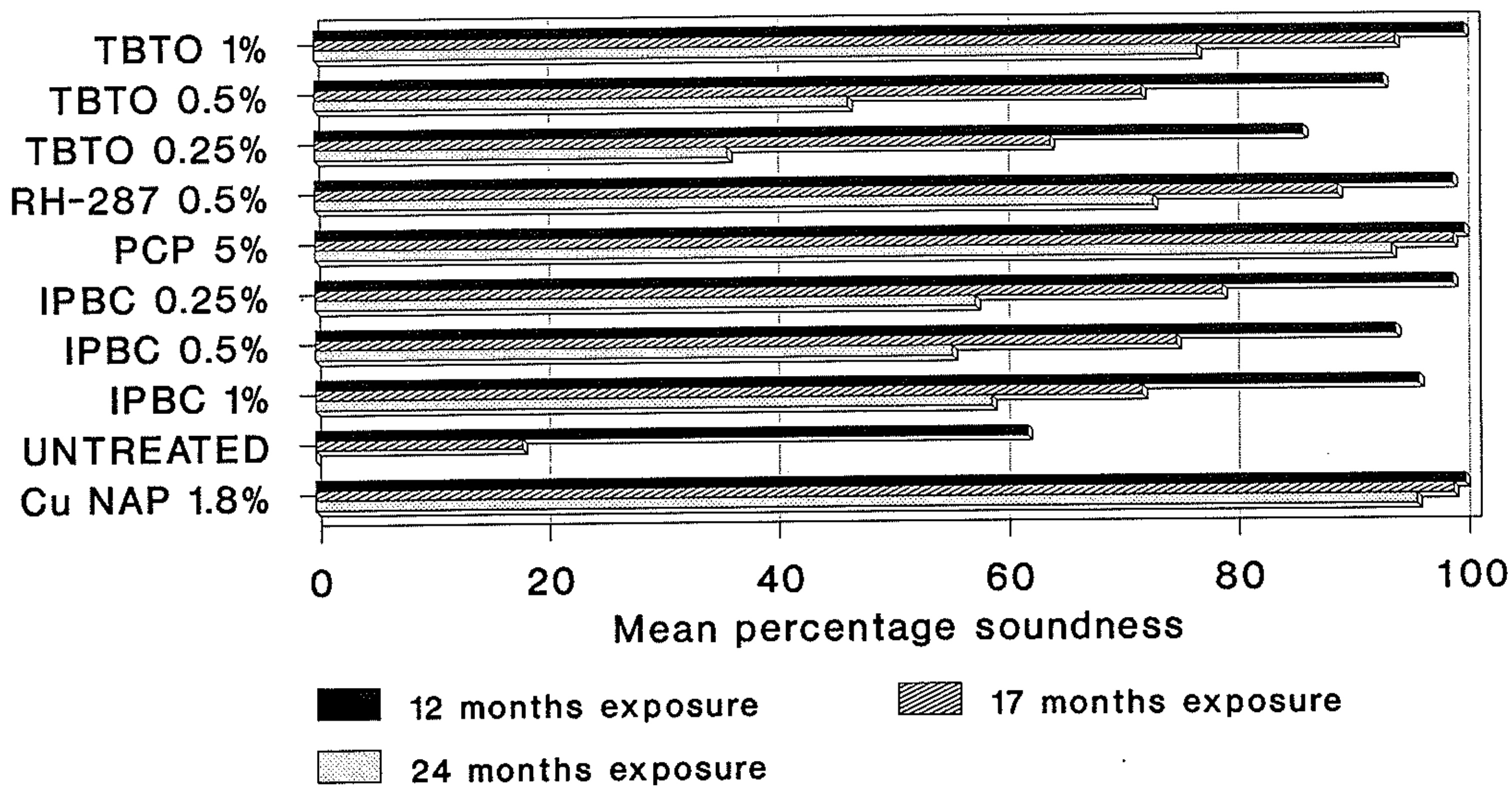


Figure 5

Test method comparison (24 months exposure)

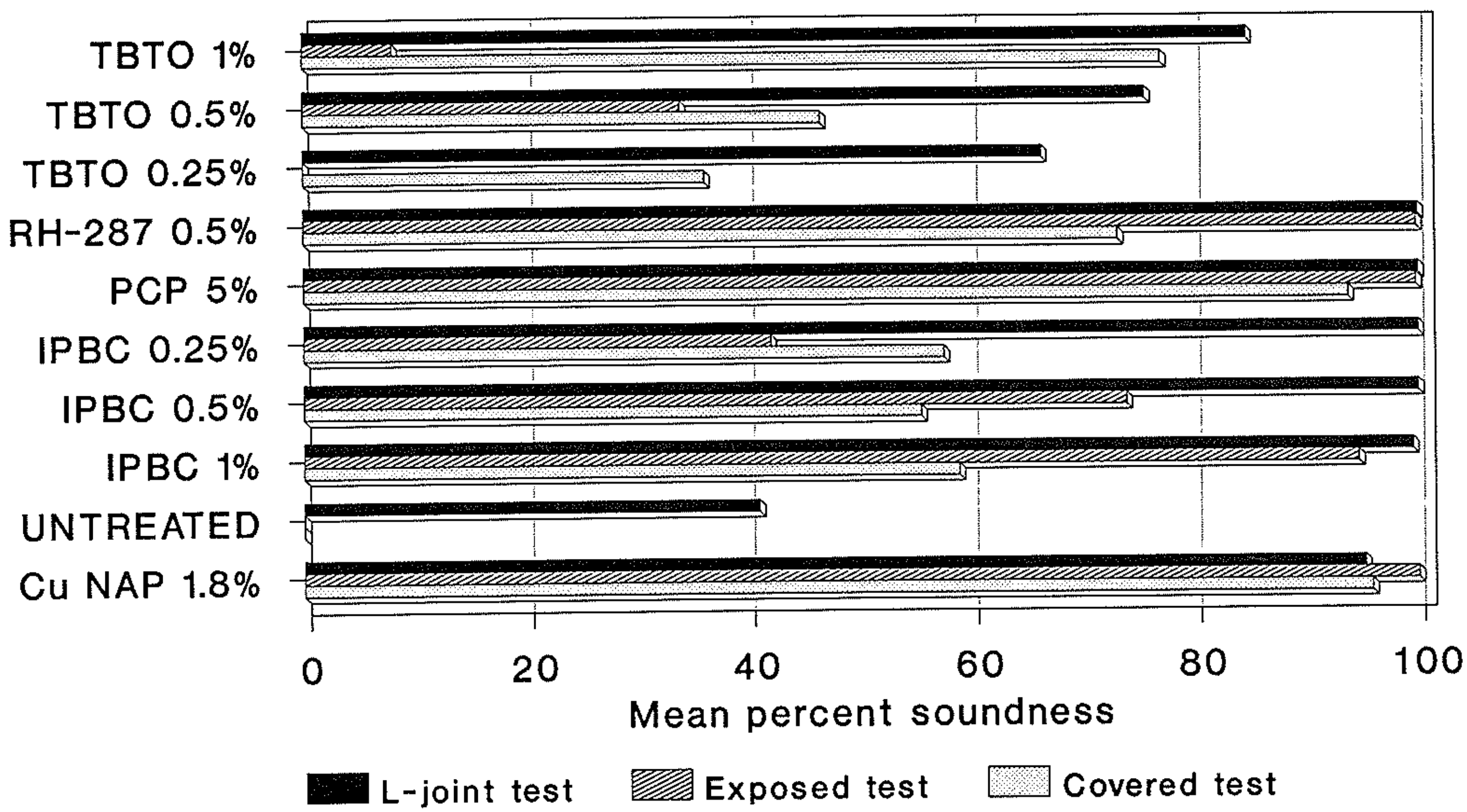


Figure 6

Waterborne preservatives 24 months exposure Hilo

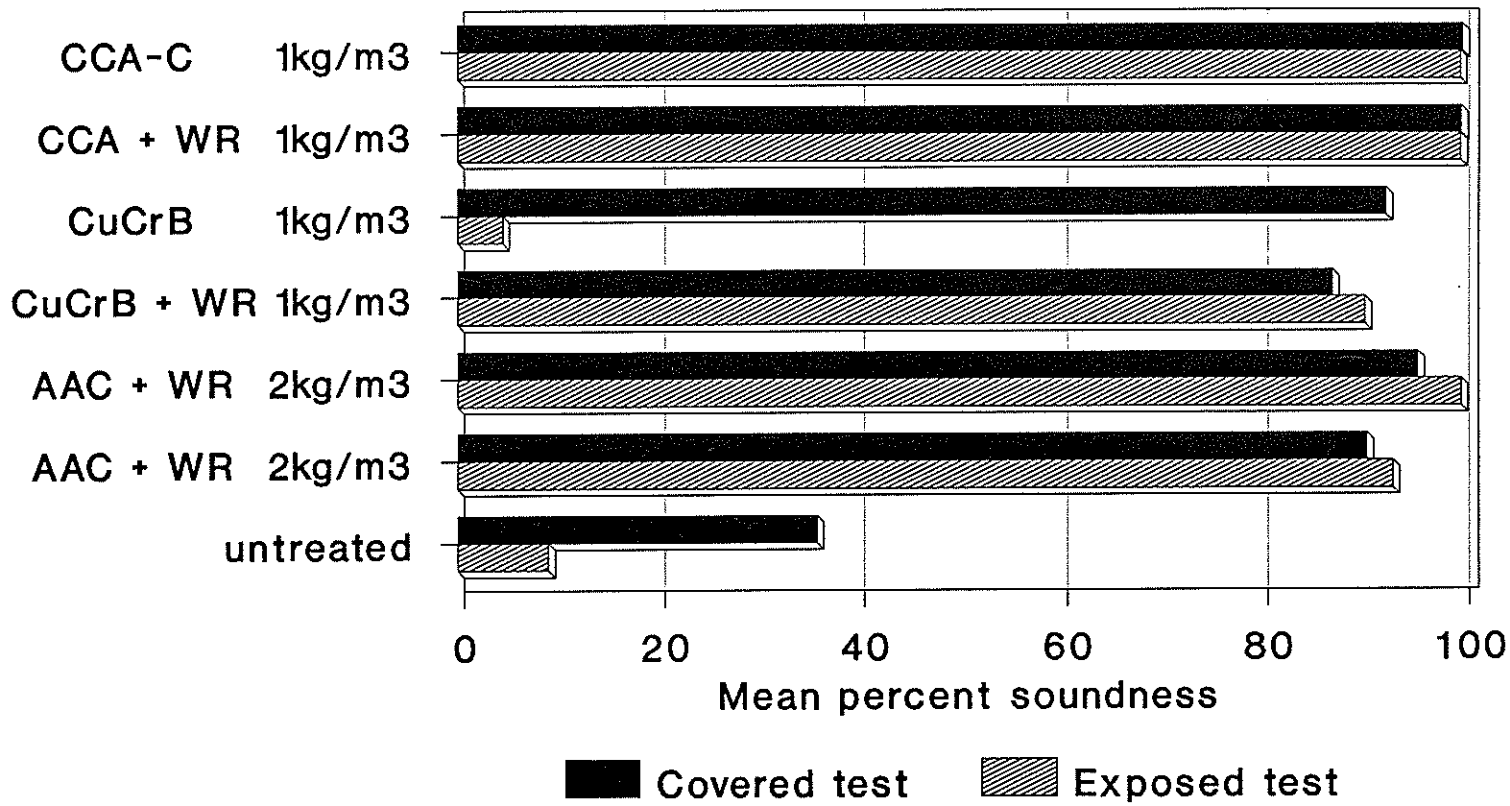


Figure 7