PERFORMANCE OF BORAX, BORIC ACID AND COPPER-SULPHATE SALT COMPLEX AS A WOOD PRESERVATIVE

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ABSTRACT

The effectiveness of the preparation with borax, boric acid and copper sulphate salt (BBC) as a water borne wood preservative was studied in the laboratory soil-block test. Blocks of civit (*Swintonia floribunda*) and chapalish (*Artocarpus chaplasha*) wood were dip-treated with the preservative solution and exposed to a common white rot fungus (*Polyporous versicolor*) and a brown rot fungus (*Poria monticola*). The loss in weight of the wood blocks due to the fungal decay was recorded to be in the range 0-1.4%. This showed that the preservative was very effective. The field test of the preservative is being carried out with chapalish and garjan (*Dipterocarpus spp.*) wood stakes along with untreated ones. All the untreated stakes deteriorated due to fungi or other wood destroying agents within two years, but the treated stakes remained uneffected even after five years of exposure.

সারসংক্ষেপ

বোরাক্স, বোরিক এসিড এবং কপার সালফেট (বিবিসি) সহযোগে প্রস্তুতকৃত পানি বাহিত কাষ্ঠ-সংরক্ষণীর কার্যকারিতা ল্যাবরেটরী সয়েল ব্লক পরীক্ষা দ্বারা যাচাই করা হয়েছে। সিভিট এবং চাপালিশ কাঠের ছোট ব্লক উক্ত সংরক্ষণীতে চুবিয়ে এক ধরনের হোয়াইট রট ছত্রাক (পলিপোরাস ভারসিকুলার) এবং ব্রাউন রট ছত্রাক (পোরিয়া মন্টিকোলার) এর সংস্পর্শে রাখা হয়েছিল। লক্ষ্য করা গিয়েছে যে, ছত্রাক দ্বারা আক্রান্ত হবার ফলে কাঠের ব্লকগুলির ওজন হ্রাসের মাত্রা ০-১.৪% এর মধ্যে রয়েছে। এতে প্রতীয়মান হয় যে, কাষ্ঠ-সংরক্ষণীটি অত্যন্ত কার্যকর। উক্ত সংরক্ষণী প্রয়োগকৃত এবং অপ্রয়োগকৃত চাপালিশ এবং গর্জন কাঠের ষ্টেকসমূহের উপর মাঠ পর্যায়ে পরীক্ষা চালানো হচ্ছে। দেখা গিয়েছে যে, সংরক্ষণী অপ্রয়োগকৃত ষ্টেকসমূহ দুই বৎসরের মধ্যে ছত্রাক এবং অন্যান্য কাঠ ধ্বংসকারী পোকামাকড় দ্বারা বিনষ্ট হয়ে যায়, কিন্তু সংরক্ষণী প্রয়োগকৃত ষ্টেকগুলি পাঁচ বৎসর পরেও অক্ষুণ্ন থেকে যায়।

INTRODUCTION

Wood is easily biodegradable. Its treatment with a suitable preservative can increase its service life many times. Most of the conventional wood preservatives have various limitations because of leachability, high mamalian toxicity, repelling effect of certain preservative treatments, environmental pollution and prohibitive cost (Sivaramakrishnan *et al.* 1991). It is therefore necessary to investigate on the development of a cheap and effective wood preservative satisfying most of the basic requirements.

The toxicity of borax, boric acid and other boron compounds has been recognized to wood destroying fungi for many years (Johnson and Gutzmer 1978). But these chemicals have not been widely used as a wood preservative because of their low level leach

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resistance. The copper compound is appreciably more toxic to fungi than the corresponding zinc compound. It is therefore preferred for use on wood. It does not leach out and if present in an adequate quantity, can give long lasting protection (Findlay 1962). Copper sulphate and other copper salts also have been incorporated in numerous proprietary preservatives, several of which are very effective. (Hunt and Garratt 1953).

Presently in Bangladesh, the most practised water borne wood preservative is copper chromium borate (CCB). The preservative is quite effective and good enough in fixation property. But the high cost of chromium makes the preservative expensive to some extent. On the otherhand, copper compound, borax and boric acid are relatively cheaper than chromium compounds. Razzaque (1981) showed that a complex from borax, boric acid and copper sulphate (BBC) can serve as a wood preservative. But its effectiveness as a preservative was not studied. This study is aimed at assessing the effectiveness of BBC as a wood preservative.

MATERIALS AND METHOD

A complex solution from borax, boric acid and copper sulphate was prepared with the molar ratio of 1:1:3 respectively. The copper borate salt formed by boric acid and copper sulphate was dissolved in a measured quantity of ammonia solution. The preservative was made at two different concentrations viz, 1.69% and 16.9%.

Testing of wood samples for soil block test

The toxicity of the formulated preservative was determined by the soil block test according to ASTM Standard (1971). Civit (*Swintonia floribunda*) and chapalish (*Artocarpus chaplasha*), the two easily available timber species were taken for experimentation. The sapwood of the species, free from knots and showing no visible evidence of infection by mold, stain or wood destroying fungi was taken. Test blocks were prepared in the size of 1.9 cm cubes. A total of 144 number of blocks were prepared from each species for three replications. After marking the blocks, they were dried to a constant weight in an oven at 105 ± 2^0C. Forty eight number of blocks from civit wood were dip-treated with 1.69% BBC solution in a closed glass jar at 25^0C for 72 hours. The retention of the preservative solution was 9.44 kg/m^3. Another 48 number of blocks from the same species were treated with 16.9% preservative solution at the same temperature, and duration. The retention of solution was 37.3 kg/m^3. Similar treatments were done with same numbers of chapalish wood blocks. The retention was 5.92 kg/m^3 and 33.9 kg/m^3 in the two conditions. To prevent floating, glass weights were placed on the blocks during the experiment. After 72 hours, the blocks were removed from the preservative solution, wiped lightly with a fine and soft cotton cloth to remove the adhering solution and weights of the individual blocks were taken immediately. Retention of the preservative solution of the blocks in different concentrations of preservative treatment was determined according to ASTM Standard (1971). Remaining 48 number of blocks of each species were used untreated to serve as the control.

To determine the leachability of the preservative, weathering test of the blocks was performed after 14 days of preservative treatment. In the weathering treatment, 24 number of the treated blocks from each species were placed in beakers under glass weight. The beakers were then kept under running water. After 24 hours, the blocks were removed from the beakers and airdried for another 24 hours. The blocks were again soaked in the beaker under running water for 24 hours. This process was continued for five cycles in 10 days. The same number of the control blocks from each species, were subjected to the weathering treatment. The remaining 24 number of treated blocks from each species along with control ones were not subjected to the test for comparison with weathered blocks.

All the treated and control blocks, both weathered and unweathered were dried in an oven at 105 ± 2^0C till constant weights were recorded.

Preparation of Test Culture

The decay test was carried out against one common white rot fungus, viz, *Polyporous versicolor* and one common brown rot fungus, viz, *Poria monticola*. Thirty two number of glass stoppered jars were taken for the experiment to each species. The fungi inoculum was grown in the flask according to ASTM Standard (1971). The blocks were then placed in the jars in such a manner that the 288 number of blocks of both the species were accommodated in 64 jars. The jars were then placed in the incubation room and kept there for a period of 12 weeks. At the end of the incubation period, the blocks were carefully removed from the jars. They were then cleaned from the fungus mats. Constant weights of the individual blocks were determined and the weight loss due to fungal decay was calculated.

RESULTS AND DISCUSSIONS

The response of the preservative treatment to fungi is given in Table : 1. It is seen from the table that, with the increase of preservative retention, the weight loss due to fungal decay decreased in both the species. The control samples with no treatment showed maximum weight loss (44-62%). This indicates that the untreated control samples do not resist fungal decay. The brown and white rot fungi are reported to utilize the lignin and/or cellulose fractions (Levi 1978). This results in the decomposing of the untreated wood. In the case of unweathered civit species with a retention of 9.44 kg/m^3, the percentages of weight loss for white and brown rots were 1.07% and 0.63% respectively. In weathered civit wood with the same retention, percentages of weight loss for white and brown rots were 1.44% and 0.69% respectively.

In unweathered chapalish wood with retention of 5.92 kg/m^3, the percentages of weight loss for white and brown rots were 1.08% and 1.15% respectively. The weathered chapalish wood with the same retention showed 1.44% weight loss for white rot and 0.91% weight loss for brown rot fungi. Civit wood with the highest retention of 37.3 kg/m^3 and chapalish wood with the highest retention of 33.9 kg/m^3, the percentages of the weight loss were negligible (0.0-0.5%).

It is noted from the table that the weight loss due to fungal decay was slightly higher in civit than that in chapalish in all the retentions. This may be due to the better natural durability property of chapalish over civit wood (Latif *et al.* 1989). It is also observed that there was no significant difference in weight loss in both the weathered and unweathered species.

It is evident from the table, that the percentage of weight loss in the treated samples ranged from 0-1.4%. Sen Sharma and Chatterjee (1965) indicated the rating of the effectiveness of preservative treatment. According to the authors when the treated wood samples are destroyed to the extent of 6%, the preservative is very effective but when the degradation is in the range of 7-17%, it is moderately effective and when the same is above 17% the preservative is considered not effective. The above rating shows that the laboratory evaluation of the treated samples with BBC is very effective against the two fungi, eg, *Polyporous versicolor* and *Poria monticola*. The results are comparable with those obtained by other researchers. Johnson and Gutzmer (1978), showed in the laboratory test that wood treated to specific retention with copper borate is very resistant to fungi decay and termites. Ammoniacal copper borate also seems comparable to or better than ammoniacal copper arsenate in the laboratory decay test (Johnson 1983).

Another encouraging point is that BBC preservative does not need any expensive fixing material (Razzaque 1981). It is because when the ingredients are mixed, an immediate precipitation of copper borate occurs which is dissolved by addition of ammonia. The preservative thus, easily penetrates into the wood and when ammonia evaporates, the salt

Table 1. Percentages of weight loss due to brown and white rot decay fungi of civit and chapalish wood blocks.

Name of species	Preservative retention kg/m^3	Treatment	Weight loss by %	
			Polyporous versicolor (white rot)	Poria monticola (brown rot)
Civit (*Swintonia floribunda*)	37.3	Unweathered	0.16	0.53
		Weathered	0.45	0.41
	9.44	Unweathered	1.07	0.63
		Weathered	1.44	0.69
	0	Unweathered	48.6	62.1
		Weathered	45.5	56.6
Chapalish (*Artocarpus chaplasha*)	33.9	Unweathered	0.28	0.27
		Weathered	0.28	0.07
	5.92	Unweathered	1.08	1.15
		Weathered	1.44	0.91
	0	Unweathered	44.5	51.1
		Weathered	44.1	49.6

of copper borate reprecipitates and becomes non-leachable to a fair extent (Arsenault 1973).

However, laboratory test do not provide a conclusive answer to the suitability of a preservative for commercial uses. Its value as a preservative must be supported by field and/or service test (Baechler 1951). Field test of the preservative is being carried out with treated chapalish wood stakes along with control ones. Sufficient quantity of civit samples was not in hand. So the service test of this species could not be carried out and the test with garjan wood was undertaken instead. From the field test, it was found that within two years, all the control stakes were severely damaged by termites and other wood destroying insects. The treated stakes remained uneffected even after five years of the exposure. The service life of the treated wood is normally sought five times longer than that of untreated ones (Hartford 1973). Natural durability of garjan is 15 months and that of chapalish is two years in average (Latif *et al.* 1989). So, before the completion of the duration of six years for garjan and 10 years for chapalish it is difficult to make a conclusive comment on the effectiveness of the preservative in actual service test. However, till the fifth year of the continuation of the study, there was no decaying in the treated samples in the service test.

CONCLUSION

The performance of the preservative against fungi was very effective in the laboratory evaluation. In the field test, the preservative treated stakes remained uneffected even after five years of exposure, but the untreated stakes deteriorated within two years. If the treated stakes remain uneffected after the completion of the service test, it may be a cheap and effective water-borne wood preservative.

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