ANTI-STAIN AND MOLD TREATMENTS TO PROTECT LUMBER DURING AIR-DRYING STORAGE AND TRANSIT

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Anti-Stain and Mold Treatments to Protect Lumber During Air-Drying Storage and Transit

ABSTRACT

Eight different chemicals were screened for their effectiveness in controlling sapstain in freshly cut white pine lumber. The materials tested included three proprietary products, two silicon based compounds, and two quarternary ammonium compounds. Sodium pentachlorophenate was included in the study for comparison purposes. The boards treated with the various chemicals and controls dipped in water were exposed in a tropical chamber maintained at 21°C and 90% RH for 12 weeks. At the end of this period, an assessment of the boards for sapstain and molds before and after skip-planing was made. The results indicated that none of the treating chemicals performs as well as sodium pentachlorophenate when examined before skip-planing. However, the three proprietary products gave ratings similar to that of sodium pentachlorophenate and one of the quarternary ammonium compound performed relatively better than the rest.

Introduction

Fungal stain on freshly cut lumber can cause considerable loss to the lumber industry. When freshly sawn lumber is air dried by piling between stickers in a yard various fungi may grow at the surface of the lumber and penetrate into the wood especially into the sapwood causing stain. Such stains seriously downgrade the value of lumber used in millwork or furniture. The fungi, causing most of the stain problems are identified as: Ceratocystis spp., Graphium spp., Alternaria spp., Phialophora spp., Cladosporium spp., and Aureobasidium spp.

Surface treatment with chemicals is a widely used practise for the prevention of such fungal stain on lumber. Among the most widely used chemicals are the sodium salts of chlorinated phenols (1, 2).

In recent years, some concern has been expressed on the effect of such chemicals on the environment as well as their mammalian toxicity, and search for other less toxic materials is continuing. Screening tests to identify alternate chemicals have been continuing at the Eastern Forest Products Laboratory of Forintek Canada Corp. for the past several years (3, 4).

In a recent paper some evidence of silicon tetrachloride as a wood preservative has been presented (5). Also, several quarternary

ammonium compounds are reported to have shown promise as broad spectrum wood preservatives (6). Ammoniacal zinc salts have also been found to have anti-stain and mildewcidal properties (7,8). Hence, in this study, the effectiveness of two quarternary ammonium compounds, two silicon based compounds and three proprietary products reported to contain metal silicates in inhibiting sapstain in freshly sawn white pine lumber has been examined in the laboratory. In addition Bis (tri-n-butyl tin) oxide (TBTO) a wood preservative, was also included. For comparison purposes, sodium pentachlorophenate (NaPCP), a commercial antistain chemical was also used in the study.

Experimental

Preparation of Test Units

Freshly cut (approximately 500 board feet of white pine boards about 250 x 10 x 2.5 cm), were purchased from a local sawmill in the Ottawa Valley and were stored in a cold chamber at -18°C until used. The boards were removed from the cold chamber a day before the treatment with the chemicals and stacked outside with stickers and fans were installed for proper thawing of the boards overnight. Test specimens of 120 x 10 x 2.5 cm were then cut from the boards for the dip-treatment. A total of 120 test specimens were selected having as much of sapwood as possible (~50% of sapwood).

Chemicals for Treatment

The following chemicals were used for the treatment of the test specimens. Except the three proprietary products, all the chemicals used were of technical grade and tap water was used for all the solutions or dilutions.

1. Proprietary Product No. 1 reported to contain
2. Proprietary Product No. 2 metal silicates and
3. Proprietary Product No. 3 bark extractives.
4. Sodium Pentachlorophenol (0.5%)
5. Dow Corning E-2802-107 Silicon Resin
6. Arquad S-50 a quarternary ammonium compound (0.5%)

7. Arquad 16-50 a quarternary ammonium compound (0.5%)

8. Tri-n-butyl-tin oxide (0.25%)

9. Tri-n-butyl tin oxide (0.5%)

10. Silicon tetrachloride (0.5%)

The proprietary products, supplied by Combumat Inc. St. Eugene, Ontario, were used as received. The E-2802-107 Silicon resin, supplied by Dow Corning Corp. Midland, Mich, U.S.A. is a colorless solution (28% solids) in methanolic aqueous ammonia which is miscible with water. The dry solids composition is given as: 37.8% ZnO and 62.2% $MeSiO_{3/2}$. The resin solution was diluted with water to give a solution containing 0.5% ZnO. The quarternary ammonium compounds (Armak Chemicals, Chicago, Ill. USA) obtained as 50 per cent solutions were diluted with water to give the required concentration. The rest of the testing solutions were prepared using appropriate quantities of the chemicals to give the desired concentration.

Treating Procedure

For dipping the test specimens a tank 150 x 30 x 20 cm., contructed from plywood, lined with 6 mil polyethylene sheet was used. The test specimen was treated by hand-dipping individual pieces for 15 seconds in the treating solution, allowed to drain 15 seconds and then placed in a temporary pile. At least 12 specimens were treated with each solution. A set of 12 specimens dipped in water was included as control.

After completion of the dip treatment, all the specimens were transferred to a tropical chamber maintained at 21°C and 90% RH. The specimens were randomly stacked in horizontal layers, spaced at about 5-10 mm, each layer being separated by 3-4 mm thick stickers and the pile was covered with polyethylene sheets to maintain high RH around the specimens. No inoculation of the test specimens with spore suspensions of fungi was carried out for this study. The specimens were examined periodically and after a period of 12 weeks, they were removed from the tropical chamber for final assessment.

Assessment of the Test Specimen for Fungal Sapstain

At the end of the test period of 12 weeks, the pile was opened up and each test specimen was visually examined for fungal stain. The specimens were rated according to an arbitrary scale based on the coverage of the test specimen by the stain. After the initial examination, the specimens were air-dried and skip-planed, and rated again for fungal stain.

The rating scale used was as follows:

0 - clear - stain less than 5%

1 - light stain - covering between 5 and 15% of the specimens faces

2 - Moderate stain - covering 15 to 45% of the specimen faces

3 - Heavy stain - covering more than 45% of the specimen faces

Results

The average ratings of the fungal sapstain of the test specimens following the exposure in the tropical chamber and after air-drying and skip-planing are shown in Table I.

It is seen from Table I that none of the treatments performed as well as sodium pentachlorophenate during the initial examination of the test specimen before skip-planing. Average for all treated materials was 2 or more indicating moderate to heavy sapstain.

When the specimens were skip-planed, removing outer 1 mm of the surface, the ratings of the three proprietary treated specimens considerably improved and were comparable to that of sodium pentachlorophenate. The quarternary ammonium compound Arquad S-50 performed relatively better than the rest.

Silicon tetrachloride gave an average rating similar to Arquad S-50 before skip-planing. However, after skip-planing it increased to value higher than 2. The rest of the treated specimens showed an average rating 2.5 or more indicating that those products are ineffective in controlling sapstain at the concentration used. All the controls showed an average rating of close to 3 indicating heavy sapstain both before and after skip-planing.

It is interesting to note that in some cases, the average rating was slightly increased after skip-planing. It seems that in those cases, the sapstain developed below the surface.

Summary and Conclusions

Three proprietary products, two silcone compounds, tri-n-butyl oxide and two quarternary ammonium compounds were screened for their effectiveness in controlling sapstain in freshly cut white pine lumber and their performance was compared to that of sodium pentachlorophenate. Initial evaluation after exposing the treated material for 12 weeks in tropical chamber indicated that none of the chemicals performed as well as sodium pentachlorophenate. However, after skip-planing, the three proprietary products gave average stain ratings comparable to that of sodium pentachlorophenate and one of the quarternary ammonium compound Arquad S-50 performed relatively better than the rest. Silicon tetrachloride gave a rating similar to that of Arquad S-50 in the initial evaluation before skip-planing. However, after skip-planing, it showed a rating of more than 2. Based on these results, further field tests should be carried out with the three proprietary products, Arquad S-50 and possibly silicon tetrachloride. Also, additional laboratory screening tests of the rest of the chemicals at higher concentrations should be considered.

Acknowledgements

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References

1. Scheffer, T.C., and Lindgren, R.M. Stains of Sapwood and Sapwwod Products and Their Control. USDA Tech. Bull., 714 124p (1940)

2. Cserjesi, A.J. Prevention of Stain and Mold in Lumber and Board Products. Wood Technology, Chemical Aspects; I.S. Goldstein (ed.) ACS Symp. Series No. 43, Am. Chem. Soc., Washington, D.C. p. 24. (1977)

3. Unligil, H.H. Prevention of Fungal Stain on Pine Lumber - Laboratory Screening Tests with Fungicides. For. Prod. J. 26 (1), 32 (1976)

4. Unligil, H.H. Laboratory Screening Tests of Fungicides of Low Toxic Hazard for Preventing Fungal Stain on Lumber. For. Prod. J. 29(4), 55 (1979)

5. Ownes, C.W., Shartle, W.C. and Shigo, A.L. Preliminary Evaluation of Silicon Tetrachloride as a Wood Preservative. Holzforschung 34, 223 (1980)

6. Nicholas, D.D. and Preston, A.F. Evaluation of Alkyl Ammonium Compounds as Potential Wood Preservatives. Proc. AWPA (1980) p. 13.

7. Desai, R.L. and Clarke, M.R. Control of Brown Stain in Kiln-Dried Eastern White Pine. Can. For. Ind. 92(12), 47 (1972)

8. Shields, J.K., Desai, R.L. and Clarke, M.R. Simple Surface Treatment for Protection of Wood. For. Prod. J. 23(10) 28 (1973)

TABLE 1

Average Rating[1,2] for Fungal stain on White Pine

for Various Treating Solutions

Treating Materials	Average Rating	
	Before Skip-Planing	After Skip-Planing
Proprietary Product No. 1	2.1	1.0
Proprietary Product No. 2	2.0	1.0
Proprietary Product No. 3	2.4	1.0
Sodium Pentachlorophenate (0.5%)	0.8	1.0
Silicone Resin (0.5% ZnO)	2.8	3.0
Arquad S-50 (0.5%)	2.0	1.8
Arquad 16-50 (0.5%)	2.5	2.5
Tri-n-butyl tin oxide (0.25%)	2.7	3.0
Tri-n-butyl tin oxide (0.5%)	2.1	2.6
Silicone Tetrachloride (0.5%)	2.0	2.3
Control (dipped into water)	2.9	2.9

1. Average of 8 to 12 specimen

2. Rating Scale: 0 - clear - stain less than 5%
   1 - light stain - covering between 5 and 15% of the specimen faces
   2 - Moderate stain - covering 15 to 45% of the specimen faces
   3 - Heavy stain - covering more that 45% of the specimen faces