UPDATE ON O.S.U. STAIN-CONTROL TRIALS ON WESTERN WOODS

Donald J. Miller and Jeffrey J. Morrell
Forest Research Laboratory
Oregon State University
Corvallis, Oregon

PREFACE

The storage conditions employed in these field trials are considerably worse than would normally occur in usual yard storage. They attempt to simulate a worst-case situation as in the core of a tightly strapped bundle of green, sappy lumber. These severe conditions help to assure that stain will develop on untreated wood included in each bundle and thereby verify that the chemical treatment is indeed being tested. The test bundles contain unusually large amounts of sapwood; each board has a full, or nearly so, sapwood face. A plastic sheeting wrap helps to keep bundles damp throughout, rather than just in the ore. All of these conditions promote development of fungal stain, mold and, eventually, decay.

Some of the chemicals included in these trials have been tested elsewhere. When comparing the results of different tests, be aware of any differences in dilution of chemical and duration of testing. Other factors that may be overlooked, or not well defined, are climates at the test sites and also the season of test start-up; both can be expected to affect results of outdoor trials.

BACKGROUND

Increasingly tight environmental restrictions against the use of penta and other similar chlorinated phenols to control fungal stains on lumber has driven many mills to seek alternative means of control. Ideally, alternative fungicides would be as effective as the penta solutions, but safe enough so that any waste generated would be nonhazardous. Such chemicals could be disposed of in sanitary landfills or incinerated as boiler fuel.

Numerous alternatives to the traditional penta-based formulations have been introduced during the past few years and more new candidate products are likely to be forthcoming.

These trials are intended to evaluate the effectiveness of several non-penta products for control of fungal stains on sapwood.

SCOPE

Selected non-penta products are being compared with a penta-dip treatment on fresh sapwood of Douglas-fir, hemlock or hem-fir,

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pine, and red alder. Parallel field and accelerated tests use the same chemical and wood materials.

Accelerated tests incubate small, dipped and inoculated specimens for 6 weeks or longer in the laboratory.

Field trials store bundles of dipped lumber outdoors for periods up to 1 year at Corvallis, Oregon where the bundles are opened periodically and inspected for stain.

SMALL SCALE ACCELERATED TESTS (J.J. Morrell)

Evaluation of the potential stainicides was undertaken using small sapwood coupons of red alder, Douglas-fir, western hemlock, and ponderosa pine in an accelerated laboratory test. In these procedures, the coupons were dipped in a series of graded solutions of the test chemicals, allowed to surface-dry, and placed into plastic containers. Each tier of test coupons was sprayed with suspension containing spores from several well-known stain fungi and the box was sealed and incubated at 30°C for 6 weeks. At that time, each coupon was rated for degree of stain on a 0 (no stain) to 10 (completely stained) basis. A total of six chemicals have been included in these tests, Busan 1030 (thiocyanomethylthiobenzothiazole), Nytek-GD (copper-8-quinolinolate), Koppers NP-1 (Quaternary ammonium plus iodopropynylbutylcarbamate), Protek (latex emulsion; Technical Industrial Sales), Chapman PQ-8 plus Borax (copper-8-quinolinolate), and Rodewod SC-5033 (Azaconazole). These chemicals were tested at a minimum of six concentrations, two levels above and three levels below the recommended application rate. Additional concentrations of NP-1 were added at the request of a cooperator. The ability of these formulations to prevent stain was compared with the performance of sodium pentachlorophenate.

Results of the stain evaluations following the first six weeks of exposure indicate that most of the chemicals are providing adequate protection to the Douglas-fir, western hemlock, and ponderosa pine coupons (Table 1). The exception to this trend has occurred with Protek. This treatment contains no fungicide and its performance depends on the ability of a thin latex film to protect the wood from fungal invasion. Poor field performance of this chemical was attributed to a failure to allow the film to form after dipping; however, the test coupons in the laboratory tests were thoroughly surface-dried prior to application of the spore suspension. These results indicate that the absence of a fungicide in the anti-stain formulation results in inadequate wood protection. However, this treatment is capable of passing Oregon Department of Environmental Quality's aquatic toxicity test.

Most of the formulations provided decreased stain protection to alder, although stain ratings at the recommended concentration for all chemicals except Busan 1030 reduced the average stain rating to one half that of the untreated controls. The failure of Busan 1030 to protect the alder is confusing, since this chemical provided excellent protection against a reddish-purplish stain caused by Ceratocystis picea. The lower levels of performance on alder probably reflect the higher levels of free sugars present in the ray cells of this wood species and suggest that higher concentrations of the chemicals or the use of chemical

combinations may more effectively protect this species.

These tests will be reevaluated after 10 weeks and additional chemicals will be tested this spring.

FIELD TRIALS (D.J. Miller)

Freshly sawn, rough lumber was selected off the green chain (or bins) each board being 6' to 8' long x 4" nominally wide by 1" or 2" thick and having sound, bright sapwood over all or most of one face.

Boards for field testing were treated within 24 hours after collection. Untreated material was sometimes stored overnight at 35°F or under waterspray, if necessary. Material for accelerated lab tests was stored frozen.

Boards were individually dipped to half-length for 15 seconds in stain-control solutions at high, medium, and low concentrations recommended by the formulator. Dipped specimens were drained briefly, then close-piled by species, and end coated. The piles were strapped, draped with plastic sheeting and stored outdoors at Corvallis, Oregon.

Each bundle will be broken down after 2, 6, and 12 months of storage and the specimens examined visually for extent and severity of discoloration and decay on the sapwood face. Each bundle will be repiled in the original order for continued storage after the 2nd and 6th month inpsections.

-- Extent of storage defect (stain, etc.) on the sapwood face of a specimen was separately estimated as percent of the treated and untreated sapwood areas.

-- Intensity of sapwood discoloration was classified visually according to Roff's (*) ratings for "light," "medium," and "heavy" (dark) stain, but with additional categories for "light-to-medium" and "medium-to-dark" discolorations. Wane areas having exposed cambium, which is unusually susceptible to dark mold growth, were excluded.

Trials on alder have been deferred until fall when its overall staining hazard, including nonfungal stain, is thought to be worst.

Results of the first inspections, made after 2 and 6 months of storage, are summarized in Tables 2, 3 and 4.

Some formulations have performed about as well as, or even better than, penta (101) under some trial conditions and with certain species, but no particular one has been consistently superior. This preliminary information should not be regarded as conclusive, nor as having overall application to other conditions such as longer storage, other solution concentrations, or considerably warmer or cooler storage temperatures. As these trials progress, more complete information will be accumulated to provide a sounder basis for evaluating the treatments.

We began additional trials this spring of more highly concentrated solutions for protection during the coming warm summer weather. We also expect to bring other formulations into the trials.

Roff, J.W., Cserjesi, A.J. and Swann, G.W. (1980). Prevention of sap stain and mold in packaged lumber. Forintek Canada Corp. Techn. Rept. No. 14R.

Table 1. Preliminary results of small scale laboratory anti-stain chemical evaluations

Chemical	Conc.%	Average Stain Rating Douglas-Fir	P. Pine	W. Hemlock	Alder
BUSAN 1030	1.200	3.00	0.0	0.0	3.0
	0.600	0.1	0.0	1.3	4.1
	0.300	0.3	0.6	2.1	7.3
	0.230	1.0	2.7	3.4	7.6
	0.150	1.7	4.9	2.6	8.0
	0.120	1.0	6.6	3.1	8.4
	0.000	3.3	7.8	5.5	8.8
NYTEK GD	0.25	2.0	0.0	0.0	-
	0.13	3.0	0.0	0.0	-
	0.06	4.1	1.1	1.0	-
	0.04	5.1	3.3	1.6	-
	0.03	5.4	4.7	1.9	-
	0.00	5.4	8.1	4.7	-
KOPPERS NP-1	1.440	0.6	0.0	0.0	-
	0.720	0.0	0.4	0.9	-
	0.360	0.4	1.4	1.3	-
	0.290	1.1	0.7	1.1	-
	0.240	1.6	0.0	0.0	-
	0.210	3.0	2.4	2.0	-
	0.160	2.3	2.1	0.5	-
	0.000	4.8	8.5	8.4	7.3
PROTEK	50.000	3.9	1.1	2.1	7.9
	20.000	5.6	3.7	4.0	3.0
	11.111	6.9	6.1	8.3	3.1
	1.667	6.0	6.9	8.1	3.4
	.000	4.8	8.5	8.4	7.3
PQ-8+BORAX	0.041	-	2.9	0.4	2.7
	0.021	-	3.0	0.6	3.0
	0.014	-	2.9	2.1	3.4
	0.010	-	2.5	3.4	4.6
	0.007	-	3.0	3.9	6.6
	0.005	-	2.9	6.3	8.3
	0.000	-	8.0	6.2	8.2

Table 1. Preliminary results (cont'd.)

Chemical	Conc.%	Average Stain Rating Douglas-Fir	P. Pine	W. Hemlock	Alder
Azaconazole	1.000	1.4	0.0	0.0	3.4
(SC-5033)	0.500	0.7	0.6	2.0	3.0
	0.200	1.6	1.1	1.9	3.1
	0.100	3.6	2.4	4.3	3.9
	0.050	3.4	2.9	5.3	7.4
	0.025	3.9	4.9	5.3	6.9
	0.000	4.0	7.4	6.8	8.5
Na-PCP	1.50	3.1	1.8	-	-
	1.00	2.6	2.2	-	-
	0.50	2.5	4.1	-	-
	0.25	3.5	4.5	-	-
	0.00	6.9	8.8	-	-

1. Based upon a stain rating of 0 (no stain) to 10 (completely discolored). Each value represents the average of several replicates.
2. Active ingredient basis for Busan 1030, Koppers NP-1, Azaconazole, and Na-PCP, percent copper basis for Nytek GD and PQ-8.

Table 2. Percent of hem-fir studs that were bright or stained after late summer-fall-winter storage. Dip treatment at medium concentration; August 20, 1986

Treatment	No of studs	Months stored	Bright, slight stain	Stained studs 10-30% of face	40-60% of face	70-100% of face
			%	%	%	%
BU 1:100	15	2	47	40	7	7
NY 1: 60	15	2	53	33	7	7
PQ 1:100	14	2	78	7	7	7
NP 1:128	15	2	80	13	0	7
101 1: 33[1]	13	2	93	8	0	0
BU do	15	6	7	27	27	40
NY do	15	6	7	47	7	40
PQ do	14	6	36	43	14	7
NP do	15	6	33	40	13	13
101 do	13	6	69	15	8	8

[1]High concentration

Table 3. Percent of Douglas-fir studs that were bright or stained after late summer-fall-winter storage. Dip treatment at medium concentration; August 22, 1986

Treatment	No of studs	Months stored	Bright, slight stain	Stained studs 10-30% of face	40-60% of face	70-100% of face
			%	%	%	%
BU 1:100	15	2	40	33	20	7
NY 1: 60	15	2	47	27	13	13
PQ 1:100	15	2	60	27	13	0
NP 1:128	15	2	93	7	0	0
101 1: 33[1]	15	2	73	27	0	0
BU do	15	6	20	27	7	47
NY do	15	6	7	33	33	27
PQ do	15	6	20	27	27	27
NP do	15	6	40	27	13	20
101 do	15	6	33	33	0	33

[1]High concentration

Table 4. Percent of ponderosa pine studs that were bright or stained after late summer-fall-winter storage. Dip treatment at medium concentration; September 4, 1986

Treatment	No of studs	Months stored	Bright, slight stain	Stained studs 10-30% of face	40-60% of face	70-100% of face
			%	%	%	%
BU 1:100	15	2	73	27	0	0
NY 1: 60	15	2	80	20	0	0
PQ 1:100	15	2	87	13	0	0
NP 1:128	15	2	7	53	13	27
101 1: 33[1]	15	2	100	0	0	0
BU do	15	6	0	20	27	53
NY do	15	6	13	20	40	27
PQ do	15	6	27	67	7	0
NP do	15	6	0	0	7	93
101 do	15	6	20	53	20	7

[1]High concentration