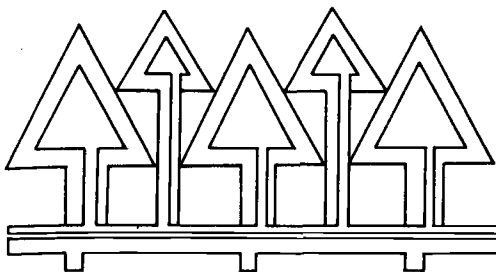


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FOREST RESEARCH LABORATORY

RESEARCH NOTE 80

Presteamming to Minimize Mottling in Partially Air-dried Red Alder Lumber

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Abstract

Unseasoned lumber from red alder discolors from ivory to a mottled yellow to red as it air-dries. Adjusting kiln conditions to reduce or eliminate mottling would increase market value of partially air-dried lumber. In this study, fresh-sawn and partially air-dried lumber were presteamed for 6, 12, 18, 24, or 30 hours before kiln-drying. Dry-bulb temperature for presteaming was either 150°F or 170°F, with a 5°F wet-

bulb depression. Fresh-sawn lumber required 12 hours of presteaming to prevent mottling. Lumber air-dried to a moisture content of approximately 30 percent required 24 hours of presteaming. Lumber air-dried to a moisture content of 16 to 18 percent required 24 to 30 hours; generally, 30-hour treatment of lumber at 16 to 18 percent moisture content produced better color uniformity.

Introduction

Unseasoned red alder lumber, whether tight-piled or placed on stickers, discolors from a fresh-sawn ivory to mottled yellow or deep red as air-drying progresses. Mottled boards have irregular shading, ranging from light tan to reddish tan or brown. Discoloration is greater during seasons with warm days and cool nights. Although alder lumber air-dries very quickly without degrading, 4/4 to 6/4 lumber is kiln-dried as soon as possible to prevent mottling.

1985, red alder production was approximately a \$400 million industry in the Pacific Northwest (D. Swietzer, personal communication). Red alder is rapidly increasing in importance as an export to Pacific Rim countries. Adjusting kiln conditions before drying lumber so as to reduce or eliminate mottling would enhance the value of alder lumber in domestic and foreign markets.

All producers of alder lumber encounter this problem. Marketing mottled lumber, especially Select and No. 1 grades, may be difficult. Although mottling does not downgrade the lumber, most customers prefer a uniform honey-brown or other uniform color in these grades. In

Kozlik (1967) reported that fresh-sawn red alder lumber can be bleached to ivory by presteaming for 6 hours at a dry-bulb temperature of 212°F with a 1 to 2°F wet-bulb depression. Presteamming partially air-dried lumber having a moisture content (MC) of 15 to 22 percent at 212°F for at least 12 hours also reduced mottling and produced uniformly ivory to light-tan lumber.

In experiments at the Forest Research Laboratory of Oregon State University (Corvallis), presteaming partially air-dried lumber at 212°F produced light-tan boards (Kozlik 1967). Pacific Hardwoods, Inc. (Philomath, Oregon) steamed air-dried lumber (12 to 17 percent MC) at 155°F dry-bulb temperature with a 3 to 4°F wet-bulb depression for about 24 hours. About 80 percent of the lumber was uniformly colored after it was surfaced; the remainder was slightly mottled. When air-dried lumber was kiln-dried without this pretreatment, nearly 100 percent of the charge was mottled. Using similar conditions, Hearin Forest Industries, Inc. (Eugene, Oregon) kiln-dried several charges of partially air-dried lumber (MC

of 25 percent or higher) for 24 hours; the surfaced lumber was uniformly light-tan. Maintaining a dry-bulb temperature of 150°F with a 4 to 6° wet-bulb depression also successfully produced light-tan boards at both mills.

Although presteaming alder lumber at 212°F successfully prevents mottling, commercial kilns do not have this capability. This report describes practical methods for presteaming discolored air-dried lumber at temperatures below 212°F to produce uniformly colored lumber. If kiln capacity is insufficient, the producer can partially air-dry the lumber and complete drying in the kiln in 2 or 3 days after presteaming.

Materials and Methods

Green or fresh-sawn, random-width lumber in 6-, 7-, and 8-foot lengths was selected from local mills. Part of the lumber was immediately stacked for presteaming and kiln drying in the experimental kilns of the Forest Research Laboratory at Oregon State University. Lumber to be partially air-dried was stacked and stored outside at the laboratory. The lumber was mill-run and contained grades from Select to No. 3. Each kiln charge or lumber pile for air-drying contained approximately 1000 board feet.

The MC of lumber stacked for air-drying was determined periodically with a resistance meter. Measurements were taken on 12 to 20 boards in the center of each lumber stack. Three initial MC's were selected to represent the following classes: green lumber, 60 percent MC and higher; lumber near the fiber saturation point, approximately 30 percent MC; and air-dried lumber, approximately 18 percent MC. Lumber at each MC was presteamed for 6, 12, 18, 24, and 30 hours. Initial dry-bulb temperatures were either 150 or 170°F, with a 5°F wet-bulb depression.

After presteaming, the lumber was kiln-dried according to the kiln schedules in Table 1 to a final average MC of 8 percent or less. After the lumber had cooled for 24 to 36 hours, a MC reading was taken on every other board of each kiln charge with a resistance meter. The lumber was returned to the cooperating mills and surfaced S2S to 15/16 inch. Color uniformity of each board was assessed visually. Boards rated "Good" had no mottling on either surface. Boards with mottling that would surface out at

13/16 inch were rated "Fair," and boards with mottling that would not surface out at 13/16 inch were rated "Poor." All three classes were assessed visually for sticker stain and for red or purple stain caused by *Ceratocystis piceae* (Morrell 1987). Uniform color in 80 percent of the lumber in a kiln charge is usually acceptable in industrial practice.

TABLE 1.

KILN SCHEDULES FOR DRYING LUMBER AFTER PRESTEAMING.¹

Step ²	Time (hours)	Dry-bulb temperature (°F)	Wet-bulb depression (°F)
1	12	150 or 170	10
2	24	155 or 170	15
3	24	165 or 170	25
4	48 (or until dry)	180	40
5	12	180	10

¹ Lumber was dried to a final average moisture content (MC) of 8 percent.

² Steps 1 through 5 were used for kiln-drying unseasoned lumber; steps 2 through 5, for lumber air-dried to 30 percent MC; steps 3 through 5, for lumber air-dried to 18 percent MC.

Results and Discussion

Ratings of color uniformity obtained at each of the five presteaming times and three MC's are given in Table 2 (for presteaming at 150°F) and Table 3 (for presteaming at 170°F). Average actual MC of the air-dried lumber before presteaming and MC ranges and average MC's after kiln-drying are also included in these tables.

Presteaming green lumber for 6 hours was insufficient to eliminate mottling; only 10 percent of lumber presteamed at 170°F and 53 percent of lumber presteamed at 150°F was rated "Good." Because results of previous industrial and laboratory trials (unpublished data) have shown

that 6 hours presteaming does not eliminate mottling in lumber air-dried to 30 and 18 percent MC, no charges with these MC's were tested.

Green lumber presteamed for 12 hours had a "Good" rating of 86 percent when presteamed at 150°F and 74 percent when presteamed at 170°F. These levels (especially that obtained at 150°F) are acceptable and commensurate with those obtained in previous laboratory and industrial trials. Forty-two percent of lumber at 30 percent MC was rated "Good" when presteaming was at 150°F and 40 percent was rated "Good" when presteaming was at 170°F. These levels, which

TABLE 2.
COLOR UNIFORMITY AND MOISTURE CONTENTS (MC) OF LUMBER PRESTEAMED AT 150°F WITH A 5°F WET-BUL

Test group ²	Moisture content (%)			Color uniformity ¹						
	Initial	Final average	Final range	Good			Total	Fair		
				Unstained	Biological stain	Sticker stain		Unstained	Biological stain	Sticker stain
6 Hours										
Green	NM	7.4	6-11	53	0	0	53	36	0	0
30% MC	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
18% MC	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
12 Hours										
Green	NM	7.6	6-9	86	0	0	86	14	0	0
30% MC	22.8	6.4	6-8	42	0	0	42	54	0	0
18% MC	13.7	7.5	6-9	78	0	0	78	21	0	0
18 Hours										
Green	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
30% MC	27.5	7.4	6-8	8	1	7	16	28	17	17
18% MC	17.9	7.4	7-8	3	0	8	11	11	4	38
24 Hours										
Green	NM	6.7	6-7	32	62	1	95	3	2	0
30% MC	25.8	8.1	7-9	34	38	11	83	6	9	0
18% MC	17.1	7.6	7-9	53	26	15	94	5	1	0
30 Hours										
Green	NM	7.3	6-10	19	66	0	85	3	10	0
30% MC	23.4	7.3	6-9	53	26	15	94	5	1	0
18% MC	13.6	6.9	6-8	23	49	4	76	8	16	0

¹ Expressed as percent of total charge.

² Each test group was presteamed for the time indicated before kiln-drying. Average initial moisture contents were (more), lumber near the fiber saturation point (30 percent MC), and air-dried lumber (18 percent MC).

NM, not measured.

were not acceptable, also agreed with levels obtained in previous tests. However, at 18 percent MC, 78 percent of the lumber presteamed at 150°F and 83 percent of that presteamed at 170°F was rated "Good." These values are close to acceptable levels and were unexpected on the basis of this and previous experiments (Kozlik, unpublished data). Lumber at 18 percent MC was collected from the same mill and at the same time as the charges that were presteamed green or at 30 percent MC. Intensity of the mottled color appeared the same in all charges presteamed for 12 hours; lumber in these charges had no sticker or biological stain. Therefore, the high

ratings at 18 percent moisture content cannot be readily explained.

Presteamming partially air-dried lumber for 18 hours also failed to eliminate mottling. Lumber at 30 and 18 percent MC had "Good" ratings of 16 and 11 percent, respectively, when presteamed at 150°F and 17 and 20 percent, respectively, when presteamed at 170°F. From 53 to 62 percent of the boards in the four charges had a "Fair" rating, indicating that 18 hours of presteaming did not produce acceptable color uniformity. These results also agreed with previous trials (unpublished data).

Since biological stain is often a problem to alder producers and was particularly bad during the period of this study, the 24- and 30-hour test of presteaming of air-dried lumber at 18 and 30 percent MC included green or fresh-sawn lumber for comparison. Lumber presteamed for 24 hours (Table 2 and 3) had a "Good" rating of 93 to 95 percent in 5 kiln charges. The remaining kiln charge, presteamed at 150°F from an air-dried MC of 30 percent, had a "Good" rating of 83 percent. From 13 to 62 percent of the lumber (Tables 2 and 3) had purple stain. Because it was difficult to determine the depth of this biological stain after surfacing, the stained boards were not down-rated, as were the boards containing sticker stain. It is easier to assess the depth of sticker stain visually and to determine if the additional 2/16-inch of surfacing will remove the stain.

Although presteaming both green lumber and air-dried lumber for 24 hours gave excellent results, lumber was presteamed for 30 hours to determine whether any differences in color uniformity resulted. Four charges had a "Good" rating of 92 to 94 percent (Tables 2 and 3). Green lumber presteamed at 150°F had a "Good" rating of 85 percent, and lumber at 18 percent MC presteamed at 150°F had a "Good" rating of only 76 percent. The occurrence of purple stain was high for all the lumber presteamed for 30 hours, ranging from 20 to 66 percent.

Biological stain was not uniformly distributed in the lumber, even though the lumber was sawn within one day's time and solid-piled at the mill for 3 to 4 days. This stain made it difficult to rate color uniformity of many boards. This probably explains the variability in staining shown in Tables 2 and 3. During one extreme period (August and September, 1985) of biological staining, any lumber solid-piled for one week or more had nearly 100 percent stain and was not included in this study.

B DEPRESSION.

Total	Unstained	Poor		Total
		Biological stain	Sticker stain	
36	11	0	0	11
NM	NM	NM	NM	NM
NM	NM	NM	NM	NM
14	0	0	0	0
54	4	0	0	4
21	1	0	0	1
NM	NM	NM	NM	NM
62	11	3	8	22
53	24	4	8	36
5	0	0	0	0
15	2	0	0	2
6	0	0	0	0
13	2	0	0	2
6	0	0	0	0
24	0	0	0	0

are chosen to represent green lumber (MC of 60 percent or

TABLE 3.

COLOR UNIFORMITY AND MOISTURE CONTENTS (MC) OF LUMBER PRESTEAMED AT 170°F WITH A 5°F WET-BU

Test group ²	Moisture content (%)			Color uniformity ¹						
	Initial	Final average	Final range	Good			Total	Fair		
				Unstained	Biological stain	Sticker stain		Unstained	Biological stain	Sticker stain
6 Hours										
Green	NM	7.1	7-9	8	0	2	10	49	0	4
30% MC	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
18% MC	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
12 Hours										
Green	NM	7.6	6-10	74	0	0	74	23	0	0
30% MC	23.1	6.6	6-9	40	0	0	40	57	0	0
18% MC	13.6	6.4	6-7	83	0	0	83	16	0	0
18 Hours										
Green	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM
30% MC	27.4	8.3	7-10	11	2	4	17	42	6	8
18% MC	17.8	7.4	7-8	6	1	13	20	24	13	25
24 Hours										
Green	NM	6.2	6-7	81	13	1	95	4	1	0
30% MC	26.5	9.1	9-10	46	35	12	93	5	1	1
18% MC	17.8	7.2	6-9	73	19	1	93	6	1	0
30 Hours										
Green	NM	7.5	7-9	37	57	0	94	4	2	0
30% MC	26	7.1	6-8	54	37	1	92	5	3	0
18% MC	13.8	6.8	6-8	54	20	18	92	4	4	0

¹ Expressed as percent of total charge.

² Each test group was presteamed for the time indicated before kiln-drying. Average initial moisture contents more), lumber near the fiber saturation point (30 percent MC), and air-dried lumber (18 percent MC).

NM, not measured.

Recommendations

To improve color uniformity, green or fresh-sawn lumber should be presteamed for at least 12 hours at a dry-bulb temperature of 150 to 170°F and a wet-bulb depression of 5°F. Lumber air-dried to 18 to 30 percent MC requires at least 24 hours of presteaming under the same conditions. A 30-hour presteaming is recommended for lumber at 16 to 18 percent MC.

If weather conditions promote occurrence of biological stain, lumber should be stickered immediately after sawing and kiln-dried. If kiln capacity is inadequate, stickered piles should be oriented to the prevailing wind and air-dried in an open yard.

Literature Cited

KOZLIK, C.J. 1967. Establishing color in red alder lumber. Forest Research Laboratory, Oregon State University, Corvallis. Report D-8. 11 p.

MORRELL, J.J. 1987. A reddish purple stain of red alder by *Ceratocystis piceae* and its prevention. Forest Products Journal, 37(2):18-20.

JLB DEPRESSION.

Total	Unstained	Poor		Total
		Biological stain	Sticker stain	
53	36	0	1	37
NM	NM	NM	NM	NM
NM	NM	NM	NM	NM
23	3	0	0	3
57	3	0	0	3
16	1	0	0	1
NM	NM	NM	NM	NM
56	23	3	1	27
62	15	2	1	18
5	0	0	0	0
7	0	0	0	0
7	0	0	0	0
6	0	0	0	0
8	0	0	0	0
8	0	0	0	0

were chosen to represent green lumber (MC of 60 percent or

Acknowledgments

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The Author

The author is Associate Professor, Department of Forest Products, Oregon State University.

Conversion Table

1 board foot = 0.0024 m³
 1 foot = 0.3048 m
 °C = (°F - 32)/1.8

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