

AN INVESTIGATION INTO THE STAINING PROBLEM IN WESTERN HEMLOCK (A TEST CASE)

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Introduction

In 1994 at one of the coastal mills in British Columbia customers expressed concerns about staining problems in the mill's western hemlock products. This was taken seriously since the mill could easily lose their competitive position in the market place if buyers turned to other suppliers due to perceived quality problems.

The mill grader reported that a visual inspection revealed that from 2% to 25% of the pieces had some stains, and the stains ranged in color from brown and gray to even a light orange. With many differing opinions expressed as to the cause of the stains, the mill manager decided to assemble a team to investigate the cause of the problem and to take corrective action. The team comprised of a lumber grader, the log yard superintendent, the kiln operator and an outside observer.

Objectives of the Team

- To categorize the type of stains occurring in western hemlock
- To collect samples of the different classes of stains.
- To classify the staining according to the probable causes.
- To remedy the situation by making changes in storage methods, stickering, kiln schedule and pre-spraying to avoid the growth of mold

Method

The team put together a comprehensive 5-step plan to investigate and solve the problem.

Step 1: Literature Study

The first step was to conduct an extensive literature survey to ascertain whether in the past such staining problems had been encountered by the mills, what remedies were proposed, and which solutions worked.

Step 2: Log Yard

The log yard superintendent examined and labeled 100 logs in the storage area and noted the time when the logs were delivered to the mill, and when they were processed. The foresters also input information as to when the logs were harvested. The ends of the logs were examined for any signs of staining. Pictures were taken so that later the colour could be matched to the type of staining.

Step 3: Green Yard

Since it was difficult to follow the 100 logs through the manufacturing process, 264 pieces of 2x6x16 were selected at random, unstickered, labeled and examined for stains. The graders recorded rot, mold, brown stain, and any unusual appearance. The 264 pieces were stickered and stacked again and placed in the kiln for drying.

Step 4: Kiln Yard and Dry Planed Lumber

After kilning, the specimens were unstickered and examined again by the graders for any additional stains. The specimens were planed to the correct target size and each piece was again graded and any staining recorded.

Step 5: Green Planed Lumber

Since 40% of the lumber is sold as S4S (surfaced 4 sides) green, a number of bundles of green lumber were also evaluated after planing and awaiting delivery to customers.

Findings

Literature study

The literature survey revealed that brown stain, mold and decay in western hemlock had been thoroughly investigated going back as early 1938 - before most of us were born. In 1958 Eades published results on the differentiation of sapwood and heartwood by color tests after investigating staining. Barton and Gardner in 1960 studied brown stain formation in western hemlock and their investigation showed that brown stain was found in the absence of fungal or bacterial attack and resulted from a phenolic tannin like component. Hegert in 1960, 1961 found that brown stain was more prevalent on the surfaces of the heartwood-sapwood boundary. The literature survey also indicated that brown stain is easily removed by drying and planing.

Brown stain is formed as catechin normally present in sapwood along with a soluble enzyme is transported with moisture to the surface of the lumber during drying and accumulates there. When the water evaporates oxidation takes place to create a brown polymerized tannin.

Log yard

Table 1 shows the results from the log yard where 100 logs were examined.

TABLE 1. Log yard investigation – transit and storage times.

Number of logs	Time from logging to delivery	Time from delivery to processing
100	3 to 4 months	1 to 2 months

Table 2 shows the classifications of the various stains found on the ends of the logs.

TABLE 2. Log yard investigation – proportion of logs showing staining

Total number of logs	Stained by mold	Brown stain	Rot
100	3%	40%	2%

While only a few logs exhibited rot or staining of the ends due to mold the, 40 percent of the logs exhibited brown stain.

It was observed that mold could have been avoided if there was less time elapsed from logging to processing. It was also observed that the time of year in which the logging was done influences the development of brown stain. Logs felled in the winter months exhibit very little brown stain but those logged in the spring show the worst staining. The reason for this is the higher extractive concentration in the sap in the spring.

From the data obtained from the tests the mill decided to:

- 1) Spray the ends of the logs with an anti-stain and apply end seal solution
- 2) Rearrange operations in the log yard so that the turnaround time from delivery to processing was reduced by 50% (1 month) for all logs.

Kiln, yard and dry planed lumber

The 264 pieces labeled and evaluated in green, rough dry and planed condition. Table 3 presents the results.

TABLE 3. Staining and discoloration [% of 264 pieces]

Green			Kiln Dry, Rough				Kiln Dry, Planed			
Rot	Mold	Brown Stain	Rot	Mold	Brown Stain	Sticker Stain	Rot	Mold	Brown Stain	Sticker Stain
0.5%	1%	10%	0.5%	0%	15%	3.5%	0.5%	0%	0%	2.5%

The 3 ½ percent of the pieces that had sticker stains were determined to be due to the use of green sticks. When the material is kiln dried to 14 % and surfaced all the tannin deposits from the surface are removed and this eliminates the brown stains and their unsightly appearance.

The corrective measure taken by the mill was to use stickers that meet the required specifications.

Green planed lumber

Three hundred pieces of 2x6x16 Western Hemlock randomly extracted from ten bundles of lumber processed without kiln drying and assessed by graders. The following results were obtained:

- 6 percent had brown stain,
- 1 percent contained rot and
- 2 percent showed mold.

It was determined that brown stain is a primarily a problem in the marketing of green S4S lumber. The mill sold 30 percent of their lumber non-kiln dried. As the lumber air-dries after planing, the extractives are brought to the surface and produce brown stain. The staining affects the appearance of the lumber sold in this state since it occurs after

the lumber is planed and likely continues to develop in shipment and storage enroute to the merchant and end user.

The corrective measure taken by the mill was to kiln dry more of the lumber.

Conclusion

Staining problems in western hemlock can be a serious concern to mills in today's demanding marketplace. Even when, as with brown stain and sticker stain, the wood's functional properties are unaffected, unsightly staining creates an impression of poor quality in the mind of the purchaser and user, affecting customer satisfaction, salability and margins.

The investigation reported here shows the benefits of using a team drawing on all the involved mill functions and a systematic approach to identifying the apparent product defect(s), understanding its character and determining the root cause(s) before taking action. A problem that was thought to be a significant kiln drying defect was traced to multiple causes and readily eliminated as a concern for kiln dried wood.

References

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