

Final Report

Western Juniper Log Storage Project

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Abstract

*Western juniper (*Juniperus occidentalis*) product trials in 1992 and 1993 revealed a potential problem with excessive end-splitting during drying and remanufacture. Splitting reduces raw material recovery and may cause reductions in quality and value of finished products. It was theorized by academicians and manufacturers that the problem might in part be caused by "raw material handling", e.g., excessive log storage time and improper log storage methods.*

Oregon lottery funding was obtained by the Western Juniper Commercialization Steering Committee to study effects of differing log storage methods (end-coated vs. non end-coated) and storage duration on product

recovery and value. The sample set consisted of 25 logs: Eight were left as a control, 8 were end-coated on both ends, as well as all knots over 3 inches, and 9 were simply coated on both ends. All were harvested in early October, 1995 from the same site and classified as "saw logs" by a local mill with experience sawing juniper. A representative sample of the "green" logs was then sawn into lumber, dried, and remanufactured into finger-joint blanks. The remaining logs were sawn, dried, and remanufactured into finger-joint blocks after 250 days of storage.

Recovery figures for lumber and finger-joint blanks were calculated for both storage periods. Lumber recovery ⁽¹⁾ values were approximately 1.66 (i.e., the lumber recovered was 1.66 times the volume predicted by the gross log scale) for logs stored 30 days. Lumber recovery for logs stored 250 days was approximately 1.43. Lumber recovery was approximately 20 percent greater for logs stored for 30 days than for logs stored for 250 days. Finished product recovery ⁽¹⁾ in the form of finger-joint blanks was 53 percent for lumber sawn from logs stored 30 days and 44.7 percent for lumber sawn from logs stored for 250 days. This slight decrease in finished product recovery is likely insignificant.

Data were unable to be gathered comparing specific effects of log storage on end-coated versus uncoated material. It was impossible to distinguish end-coated versus uncoated logs after 250 days due to weathering. End-coating probably contributed to a better than expected lumber recovery, however, to what extent could not be determined.

Purpose

The purpose of this project was to compare results of different western juniper (*Juniperus occidentalis*) log storage methods and storage duration on product recovery and value. Results will provide manufacturers guidance about the effects of long-term log storage on product recovery and value, as well as log storage methods to improve product recovery and value.

Need

Western juniper product trials in 1992 and 1993 indicated a potential problem with end-splitting. Observers commented on the tendency for small end-splits in green lumber to continue propagating (in some instances up to 12 inches or more) while the wood was in service. End-splitting is not an unusual problem for wood. Western juniper, however, may split more easily and to a greater extent than other common commercial species. The tensile strength perpendicular to grain in the radial direction (a key strength value related to "ease of splitting") for western juniper at 12 percent moisture content is approximately 235 psi (Burke 1994). This value is quite low when compared to other common commercial woods such as Douglas-fir (390 psi) and ponderosa pine (420 psi) ⁽²⁾ and therefore, there is reason to believe that western juniper may be more susceptible to end-splitting and checking.

A separate project has been conducted to study drying techniques for western juniper to improve finished product quality (Leavengood et al. 1996).

Background

This project was formulated and designed by members of the Western Juniper Commercialization Steering Committee, a loosely-organized cooperative venture of the U.S. Forest Service, Wood Products Competitiveness Corporation, Inc. (WPCC), and Oregon State University Extension Service. Steering Committee membership is composed of wood products industry representatives (small, medium and large companies), government agencies, non-profit economic development and environmental organizations, and private landowners.

An Oregon Multi-Region Program grant proposal was prepared and submitted to the Governor of Oregon in the fall of 1994, and was approved in April, 1995 (Swan 1996). Work began in the fall of 1995 and the project was completed in the fall of 1996.

Prior Work

A literature review conducted prior to the project revealed no citations concerning the effects of log storage method and storage duration on recovery and value of western juniper products. However, work has been done on storage duration and methods for other species.

For example, Carpenter and Toole (1963, p.25) found that after 1 year of storage without water spray or end-coating, checking and staining were so severe in eastern cottonwood (a species with very low resistance to staining and decay) that the logs were "...not worth sawing". Other researchers have reported the benefits of water spray or water storage to reduce end-checking and staining due to fungi. Researchers have also shown that end-coating reduces degrade in logs during storage providing the coatings are applied when logs are still very green (Rosen and Miceli 1980; Rice 1995).

It is unlikely that western juniper manufacturers will use water spray or storage techniques because of high capital investment and maintenance requirements, as well as increasing environmental restrictions. End-coating, on the other hand, requires far less capital outlay and appears economically and logistically practical for most juniper manufacturers.

Current Practices

The vast majority of western juniper logs (approximately 80 to 90 percent) are unsuitable for sawing into lumber because of large and numerous limbs, spiral grain, rapid taper, bark seams, and rot⁽³⁾ (Swan personal communication). It can take several months to accumulate a sufficient number of quality logs to be sawn economically by mills which produce more than 10,000 board feet per day⁽⁴⁾. Many small manufacturers working with juniper, especially those operating portable mills, currently store logs for months before processing and do not end-coat.

Western juniper, like other wood species, develops end-checks rapidly after harvest. Long storage periods aggravate the problem. Use of end-coating helps retard moisture loss, and reduces checking and splitting. End-coating is commonly practiced with higher value species, such as oak, which require lengthy "pre-drying" before being kiln dried. It is rarely used with softwoods in the Western United States due to the availability of other storage methods, such as water spray and mill ponds, prompt drying of green lumber, lack of perceived need, and the perception that processing costs would significantly increase, due to additional labor and material.

Methodology

Twenty-five trees were harvested by High Desert Wood Products in early October, 1995, near Bonanza in south central Oregon. All came from the same site and exposure, and were classified as "saw logs" by the manufacturer, who has extensive experience processing juniper. Diameter at breast height (DBH) ranged from 8 to 14 inches. Trimmed-out logs averaged 24 feet. There was very little butt rot and only 1 tree had a slight spiral grain.

Eight logs were left as a control (uncoated), 8 were end-coated on both ends, as well as all knots over 3 inches, and 9 were simply coated on both ends⁽⁵⁾. The logs were decked on a south-facing slope and oriented with the prevailing wind toward the butt ends of the logs.

Phase I

In early November, 1995, approximately 30 days after harvest, 6 logs were bucked into segments 8½ feet in length, resulting in a total of 18 segments. The average small- and large-end diameters for the segments were 11 and 15 inches, respectively.

Four days later, the 18 segments were sawn by All Native Hardwoods (Roseburg, Oregon) into "full-sawn" 1 inch thick by 3 inches wide by 8½ foot long boards. A Wood Mizer portable horizontal bandmill was used for this operation. Green lumber recovery based on actual board dimensions (versus nominal dimensions) was recorded for each log segment. The lumber was then immediately covered and transported to Oregon State University's (OSU) Forest Products Department for drying.

After drying, the material was transported to Henderson Millworks in Klamath Falls, Oregon, for remanufacture into finger-joint blanks. Target rip width was 2¾ inches. Two "back-up rips" of 2½ and 2 inches were allowed. Material was graded as clear or tight-knot, and recovery was measured using an "industry standard block tally" (volume of stacked blocks determined by multiplying width times length times height, and converting to board feet).

Phase II

In mid-June, 1996, approximately 250 days after harvesting, the remaining logs were bucked into 35 segments, 8½ feet in length. Average small- and large-end diameters for the segments were 10 and 14 inches, respectively. The logs were sawn the next day at All Native Hardwoods in Roseburg, using the same Wood Mizer portable horizontal bandmill and sawyer, but slightly different specifications: Logs were manufactured into 1 inch thick lumber instead of 1-inch lumber as in Phase I. Width and length specifications remained the same as in Phase I. Lumber recovery was recorded for each log segment.

After drying, the material was transported to Rainier Wood Products, Sweet Home, Oregon, for remanufacture into finger-joint blanks. Target rip width was changed to 3 inches, from 2¾ inches, due to market demand. Only one "back-up rip" width of 2 inches was allowed. As in Phase I, material was graded as clear or tight-knot, and recovery measured using an "industry standard block tally".

Results

Gross log scale for the log segments in Phase I (logs stored approximately 30 days) was 780 board feet using Scribner Decimal C tables. Total board feet of green lumber recovered was 1297 board feet (tallied actual size). Total lumber recovery⁽¹⁾ was 1.66 (i.e., the lumber recovered was 1.66 times the volume predicted by the gross log scale).

For the remanufacturing portion of Phase I, recovery was calculated as a percentage of lumber input (board feet finger-joint blanks ÷ board feet lumber). Of the 1200 board feet of lumber which was remanufactured (97 board feet were provided to interested parties for small product samples) 641 board feet or 53.4 percent were recovered as finger-joint blanks. Recovery breakdown was:

- clear 2¾" x RL- 321 BF
- tight-knot 2¾" x RL- 222 BF
- tight-knot 2½" x RL- 38 BF
- tight-knot 2" x RL- 24 BF

(where *RL* is random length and *BF* is board feet)

(36 board feet were removed before tallying and used for product trials)

Gross log scale for the log segments in Phase II (logs stored approximately 250 days) was 1285 board feet using Scribner Decimal C tables. Total board feet of green lumber recovered was 1840 board feet (tallied actual size). Total lumber recovery was 1.43.

For the remanufacturing portion of Phase II, of the 1840 board feet of lumber remanufactured, 823 board feet (44.7 percent) were recovered as finger-joint blanks. The recovery breakdown by grade was:

- clear 3" x RL- 306 BF
- clear 2" x RL- 104 BF
- tight-knot 3" x RL- 378 BF
- tight-knot 2" x RL- 35 BF

Discussion

Green Lumber Recovery

Total green lumber recovery (as a percentage of gross log scale) decreased nearly 20 percent for logs stored for 250 days versus logs stored only 30 days. This is despite the fact that almost 70 percent of the logs in this sample were end-coated.

It should be noted that raw material variability can significantly affect such a small sample. For example, western juniper logs from the same site may differ from one another in terms of degree of taper, amount of rot present, log size, degree of bark fluting, bark seams, and spiral grain. However, steps were taken to avoid this problem: 1) All logs were harvested from the same stand of trees and the same exposure; and 2) Average log diameters were maintained for both phases of the project.

Analysis of recovery data revealed that, even with the measures taken to assure log consistency, there was a significant amount of variability in recovery between individual logs. *However, statistical analysis of lumber recovery data provided evidence of a difference in recovery between the two phases of the project above and beyond what can be explained by inherent variability in log size or quality.*

Finger-Joint Block and Grade Recovery

Total finger-joint block recovery (as a percentage of lumber tally) was approximately 53.4 percent and 44.7 percent for logs stored 30 days and 250 days, respectively. This amount of variability is likely insignificant. It appears that while lumber recovery is adversely affected by long storage periods, finished product recovery is not.

Value recovery, as evidenced by grade recovery of finger-joint blanks, was similar for the two phases: 26.8 percent clear material (as a percentage of lumber input) was recovered in Phase I and 22.3 percent in Phase II. It is difficult to determine if duration of storage impacted value recovery, because variables such as equipment operators and specifications were not controlled (for example, two backup rips were allowed in Phase I, but only one backup rip was allowed in Phase II).

The ability to distinguish end-coated versus uncoated logs was lost during the project due to weathering. It is impossible, therefore, to compare the long-term effect of end-coating on product recovery. Based on end-coating studies performed with other wood species, it is highly probable that the decrease in lumber recovery observed in this project was due, at least in part, to end-checking on the uncoated logs. According to Bill Breedlove, a clear difference in extent and depth of end-splitting between end-coated and uncoated logs was observable after only 30 days (Breedlove personal communication).

Recommendations

To optimize lumber recovery, it is recommended that if juniper saw logs will not be processed within 30 days following harvest, they be end-coated immediately following falling. It is also recommended that log storage time be minimized.

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1. Lumber Recovery = BF Lumber/ BF Log Scale, Finished Product Recovery = BF Finger-joint Blocks/ BF Lumber, where BF = Board Foot [Back to Abstract](#), [Back to Results](#)
2. Strength values from the Wood Handbook: Wood as an Engineering Material, 1987 [Back](#)
3. Juniper pocket rot (*Pyrofomes demidoffii* [*Fomes juniperinus*]) (Scharpf 1993), also referred to as white trunk

rot, attacks a large percentage of living trees. There is also an unidentified brown cubicle rot (Dealy 1990).
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4. For comparison, many portable mills, such as those commonly found in Eastern Oregon, are hard-pressed to consistently saw more than 1,000 board feet per day (Swan personal communication).[Back](#)

5. End-seal product used was: Anchor End Seal. Cost at the time of the project was about \$33 for five gallons. Supplier was Lacey-Harmer, Portland, Oregon (1-800-367-9992).[Back](#)