

# Veneer recovery from live and dead lodgepole pine

Thomas A. Snellgrove  
Susan Ernst

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## Abstract

Recovery of dead lodgepole pine for core-stock veneer is probably feasible but varies with time-since-death and size. Volume recovery for 1-year dead was not practically different from live trees, but 3-year-dead recovery was about 30 percent less. Recovery by grade of veneer was not related to time-since-death, but a higher percentage of random strip was produced from the older dead logs.

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Lodgepole pine (*Pinus contorta* Dougl.) sawtimber has traditionally been used in round-log form as house logs and corral posts or manufactured into sawn products. The most common sawn product is studs with a substantial portion also being manufactured into random length dimension (13). Although lodgepole pine has been used for years, it has not been a preferred species for production of sawn products, primarily because of its small diameter relative to associate species. The mountain pine beetle (*Dendroctonus ponderosae*) epidemic and the resultant volumes of dead material have, however, increased utilization interest in lodgepole pine (4). To effectively use this material, all reasonable avenues of utilization should be explored including both sawn and peeled products.

A number of recovery studies have been conducted to evaluate the use of lodgepole pine for lumber (2, 7, 8), but a literature review yielded no information on veneer recovery. This lack of information, along with the need to look at alternative utilization opportunities, prompted a study to determine the veneer recovery of live and dead lodgepole pine in southern Oregon. The objective of this paper is to compare the recovery of live and two classes of dead lodgepole pine and to discuss

problems and advantages associated with using the dead material.

## Methods

### Sampling

All trees were selected from two areas on the Winema National Forest in southern Oregon. From an area on the Chiloquin Ranger District, 30 live trees were selected, while 33 live and 61 dead trees were selected from an area on the Chemult Ranger District. Live trees were selected on the basis of DBH and over the range of quality available. In addition, time-since-death was used to stratify the dead sample. Only two classes of dead trees were available for sampling — those with red needles (dead 1 yr.) and those with no needles (dead 3 yr.). Time-since-death was determined from local records of the beetle attack. Because few trees were found that represented the 2-year-dead class, no sample was selected. A tally of the sample trees by DBH and class is shown in Table 1.

### Felling, bucking, and scaling

All trees were logged following normal industry practices for that general area. Trees were bucked to a minimum top diameter of 5 inches. After bucking, logs from each tree were identified such that all subsequent information could be related back to the woods-length log and tree from which it came.

Woods-length logs were scaled by USDA Forest Service and industry check scalers independently. Scribner and cubic volumes were determined for all logs in accordance with *National Forest Log Scaling Handbook* rules (10, 11). All cubic volumes were calculated

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The authors are Research Forest Products Technologists, USDA Forest Serv., Pacific Northwest Forest & Range Expt. Sta., 809 NE Sixth Ave., Portland, OR 97232. This paper was received for publication in November 1982.

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TABLE 1.—Distribution of live and dead sample trees by DBH and location.

DBH	Chemult live (Sample I)	Chiloquin live (Sample II)	Chemult 1-year dead (Sample III)	Chemult 3-year dead (Sample IV)
	------(No. of trees)-----			
8	5	3	5	3
9	5	2	5	3
10	4	2	7	4
11	4	5	3	2
12	4	2	4	4
13	4	5	4	4
14	4	2	4	2
15	3	5	3	2
16	0	1	3	0
17	0	0	1	0
Total	33	30	37	24

using Smalian's formula. The individual scales were compared and differences were resolved by jointly re-scaling the logs. The scales taken are defined as follows:

- *Gross Scribner* which estimates the board-foot content of a log on the basis of a theoretical amount of 1-inch lumber that can be produced from within the scaling cylinder of a log of specified diameter and lengths;

- *Net Scribner* which is gross Scribner adjusted for defects expected to reduce lumber recovery;

- *Gross cubic* which estimates log volume in cubic feet from length and diameter measurements. By contrast with Scribner scale, volume is not limited to a scaling cylinder nor is it specified in units of any particular product; and

- *Product cubic* which is gross cubic adjusted for all defects expected to affect yield of solid wood products (lumber or veneer).

### Mill processing

Logs were bucked into 52-inch blocks and diameters of both ends of these 4-foot blocks were taken. The blocks were steamed and then peeled on a 4-foot lathe at Alpine Veneer Company in Klamath Falls, Oregon. The lathe was equipped with an automatic charger that chucked the block on geometric center. The 4-foot lathe chucks had a 3-inch center chuck with a retractable 5-inch outer chuck. Veneer was peeled to a nominal 3/16 inch; the actual dry thickness was .164 inch. Spur knives were set at 50.5 inches. Identity of each piece of veneer produced (whether a half-sheet or a random-width strip) was maintained with reference to the 4-foot block, log, and tree from which it came. Techniques described by Lane (6) were used to maintain the identity.

Veneer was dried, graded, and tallied at the Four-Ply Veneer Company in Grants Pass, Oregon, in accordance with their normal practices. Because of differences in moisture contents between logs from live and dead trees, veneer was separated for drying and schedules were adjusted accordingly. Veneer was graded by or under the supervision of American Plywood Association quality supervisors as either C or D (12). All veneer was tallied by grade as either the number of half-sheets

(approximately 2 by 4 feet) or the measured width of each piece of random strip. Since surface roughness is not a criteria for C or D veneer and all the blocks were steamed before peeling, roughness was not measured.

### Layup loss

A study to assess veneer losses at the glue spreader (layup losses) was conducted as an adjunct to the main study. The sample included half-sheet and random-width veneer from live or dead trees. No distinction was made between the two live or two dead samples. We chose some loads which had both live and dead veneer mixed. Distribution of the sample is shown in the following tabulation:

	Half-sheets	Random-width
	------(No. of loads)-----	
Live	16	5
Dead	9	3
Mixed	3	1
Total	28	9

The total width of dry veneer in each load was determined, then all veneer in the load was processed through the glue spreader in the normal manner. The width of each piece of veneer discarded at the infeed or outfeed of the glue spreader was measured. Likewise, any veneer extending beyond an untrimmed panel length of 101 inches (overhang) was also measured. The total width of overhang plus discards was divided by the total inches in the load to determine percent loss.

### Analysis

The main objective of this analysis was to determine if there were differences in recovery among the four samples (Table 1). Recovery is defined as the volume of veneer produced from a given volume of log or block. While the veneer yield from a given block or log does not change, recovery varies according to how the log or block volume was estimated. Recovery could be based on woods-length logs or 4-foot blocks, Scribner or cubic scale, gross or net volume. We chose woods-length log cubic scale for roundwood volume estimates because it provides the most reliable estimate of recovery (1, 9) and woods-length is a primary unit of measurement for timber sales in this area. Gross cubic scale was chosen because it represents actual losses in recovery whereas product cubic includes both actual losses and the scalers' ability to estimate them.

Two methods have been used to compare recoveries, recovery ratio (veneer volume/log volume) versus small-end diameter (3) and product volume versus scale (5). Comparisons based on small-end diameter were considered inappropriate for woods-length logs because of the limited diameter range (5 to 9 in.). Therefore, veneer volume versus gross cubic scale was used to test for differences. A linear relationship was used because previous analysis and a screening of alternatives showed that to be the best model form. Regression coefficients were estimated for each sample, and co

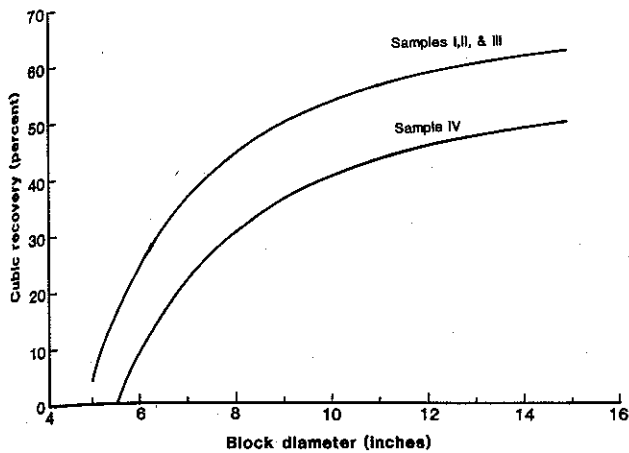


Figure 1. — Cubic recovery percent — cubic feet of veneer per cubic foot of block by block diameter.

Statistical information —

$$y(\text{Samples I, II, III}) = 69.56 - 1634.2(1/D^2)$$

$$y(\text{Sample IV}) = 57.52 - 1754.8(1/D^2)$$

	Samples I, II, III	Sample IV
Coefficient of determination ( $R^2$ )	.461	.441
Standard error of estimate ( $Sy.x$ )	13.56	13.52

variance analysis was used to test for differences in slopes and intercepts among the four data groups.

Significant differences were detected among all four samples, so the two live and the 1-year-dead samples were then compared (Samples I, II, and III). Although no significant differences were found in these slopes, a significant difference was found at the .05 level but not at the .01 level for the intercepts. No practical differences were found when the regression lines for Samples I, II, and III were plotted. Therefore, the three samples were combined to estimate one set of coefficients. The 3-year-dead sample (Sample IV) was found both practically and statistically different from the other data groups and separate coefficients were estimated.

## Results and discussion

### Volume recovery

**Blocks.** — Dry veneer recovery by block diameter is presented in Figures 1 and 2 and Table 2. There were no practical differences in recovery between Samples I, II, and III, but recovery from Sample IV was significantly lower. Cubic recovery percentage — percentage of block volume recovered as veneer — increased dramatically within the 5- to 9-inch diameter range for both data groups, then increased gradually to 14 inches (Fig. 1).

This trend is caused by the fact that the core volume, expressed as a percentage of block volume, decreased as block diameter increased (Table 2). The form of the cubic recovery percentage curve for Samples I, II, and III is consistent with, but slightly lower than, that

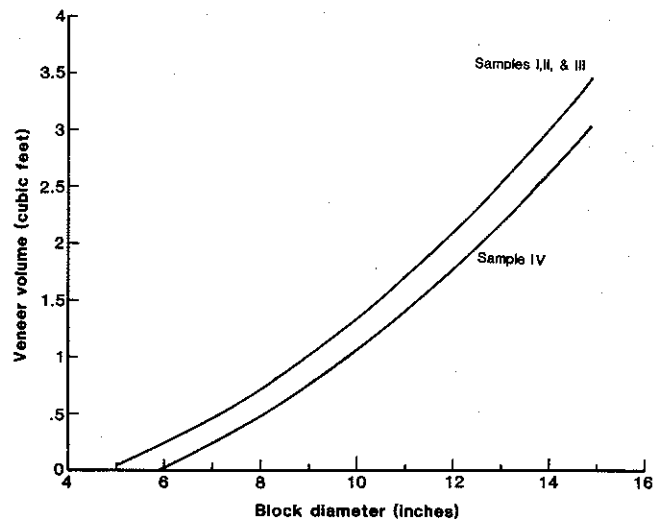


Figure 2. — Volume of veneer produced from blocks by block diameter.

Statistical information —

$$y(\text{Samples I, II, III}) = -.385 + .0173(D^2)$$

$$y(\text{Sample IV}) = -.553 + .0162(D^2)$$

	Samples I, II, III	Sample IV
Coefficient of determination ( $R^2$ )	.882	.819
Standard error of estimate ( $Sy.x$ )	.291	.272

shown for live western hemlock (3). Interestingly, Figure 2 shows that it required about a 1-inch larger diameter block in the Sample IV material to produce the same volume of veneer as the Sample I, II, and III blocks. For example, 9-inch Sample I, II, and III and 10-inch Sample IV blocks produced about 1 cubic foot of veneer. The primary cause of the reduced recovery in the older dead sample is drying checks.

**Woods-length logs.** — Recovery for woods-length logs is shown in Table 3 and Figure 3. As with blocks, recovery from Sample IV woods-length logs was significantly lower than Samples I, II, and III — averaging about 30 percent less recovery. This compares to a 20 percent reduction in recovery when 3-year-old dead lodgepole pine was processed into studs (2).

**Recovery based on net scale.** — We presented our results on the basis of gross cubic scale for blocks and woods-length logs. We realize, however, that estimates of net scale can and should be important in predicting recovery. Recovery averages for the original four data groups, by scaling system, are shown in Table 4.

Recovery based on gross cubic and gross Scribner scale follows a logical pattern — there is little difference between the live logs, some reduction in the 1-year-dead logs, and additional losses in the 3-year-dead material. Adjustments in log volume for defects with product cubic and net Scribner scale are reasonable for the 1-year-dead material but are totally unrealistic for the 3-year dead. The high recovery for that sample results from the scale rules requiring too severe deductions for

TABLE 2. — Distribution of dry veneer and core volumes expressed as a percentage of block volume by block diameter.

Block diameter (in.)	No. of blocks	Block volume (Cubic ft.)	Veneer recovery ----- (%) -----	Core
<b>Samples I, II, and III</b>				
4	2	1.2	0	85
5	81	67.3	17	47
6	127	137.4	29	35
7	166	233.6	39	27
8	149	266.8	46	21
9	120	268.0	53	16
10	101	275.1	54	14
11	79	260.8	56	11
12	49	188.3	60	10
13	40	186.8	60	9
14	16	81.7	60	8
15	8	50.7	56	6
16	1	8.1	41	10
<b>Total</b>	<b>939</b>	<b>2025.8</b>	<b>50</b>	<b>18</b>
<b>Sample IV</b>				
5	6	5.0	7	46
6	36	38.1	13	43
7	36	51.1	29	26
8	29	53.4	28	24
9	29	64.1	34	20
10	21	58.4	42	15
11	10	33.3	48	13
12	9	36.4	52	13
13	1	4.5	64	10
14	2	10.9	46	11
<b>Total</b>	<b>179</b>	<b>355.2</b>	<b>35</b>	<b>22</b>

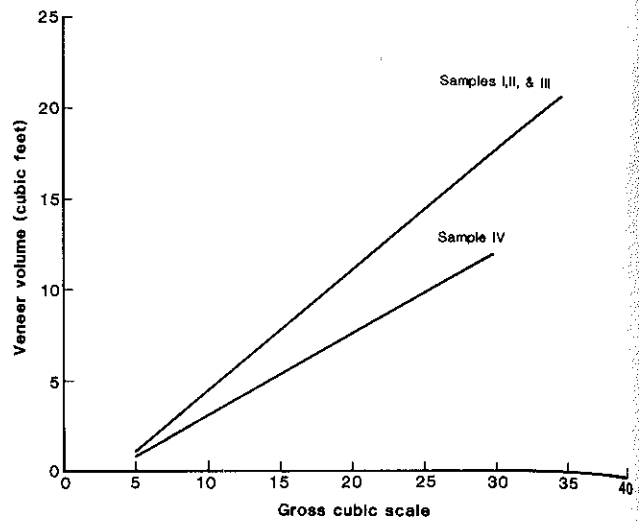


Figure 3. — Veneer volume of woods-length logs by gross cubic scale.

Statistical information —

$$y(\text{Samples I, II, III}) = -2.223 + .662(\text{scale})$$

$$y(\text{Sample IV}) = -1.419 + .447(\text{scale})$$

	Samples I, II, III	Sample IV
Coefficient of determination ( $R^2$ )	.951	.817
Standard error of estimate ( $Sy_x$ )	1.336	1.330

TABLE 3. — Dry veneer and core volume as a percentage of woods-length log volume by scaling diameter.

Log diameter (in.)	No. of logs	Log volume (Cubic ft.)	Defect	Veneer recovery ----- (%) -----	Core
<b>Samples I, II, and III</b>					
5	43	393	5	42	28
6	48	612	7	46	22
7	7	101	6	47	18
8	11	226	6	58	14
9	9	208	6	63	13
10	6	180	6	64	10
11	5	162	5	64	9
12	1	36	3	62	7
13	1	42	1	55	7
<b>Total</b>	<b>131</b>	<b>1960</b>	<b>6</b>	<b>52</b>	<b>18</b>
<b>Sample IV</b>					
5	5	52	31	35	28
6	12	149	49	28	26
7	4	75	48	42	15
8	3	57	60	48	15
9	1	10	100	51	34
<b>Total</b>	<b>25</b>	<b>343</b>	<b>50</b>	<b>36</b>	<b>23</b>

TABLE 4. — Comparison of veneer recovery by sample and scaling system.

Sample	Cubic scale		Scribner scale	
	Gross	Product	Gross	Net
	----- (%) <sup>a</sup> -----		----- (ratio) <sup>b</sup> -----	
I	53	54	3.7	3.9
II	53	56	3.5	3.8
III	49	55	3.6	4.1
IV	36	72	3.1	12.9

<sup>a</sup>Cubic feet of veneer divided by cubic foot of scale times 100.

<sup>b</sup>Square feet of veneer on a 3/8-in. basis divided by board foot of scale.

the effect of weather checks. This overdeduction for weather checks is consistent with past studies (9).

#### Grade and dimension recovery

Only two grades of veneer, C and D, were produced. Grade recovery did not appear to be related to time-since-death, but overall averages were 93 percent grade C and 7 percent grade D. Since both grades of veneer are used interchangeably for core stock and are typically priced the same, grade recovery was not critical in this study.

Recovery by width of veneer, i.e., half-sheets or random-width strip, did appear to be related to time-since-death as shown in the following tabulation:

Sample	Half-sheets	Random-width
	----- (%) -----	
I	84	16
II	83	17
III	79	21
IV	69	31

The live samples produced the least random-width veneer and the 3-year-dead logs produced the most. The increased proportion of random-width veneer in the 3-year-dead sample is primarily due to drying checks (splits) in the bole of the tree (Fig. 4). These splits, which result from unequal drying stresses, generally penetrate to the pith and result in some loss of volume and more random strip veneer. On the other hand, about 70 percent of the dry veneer held together to produce half-sheets even though splits were prominent (Fig. 5).

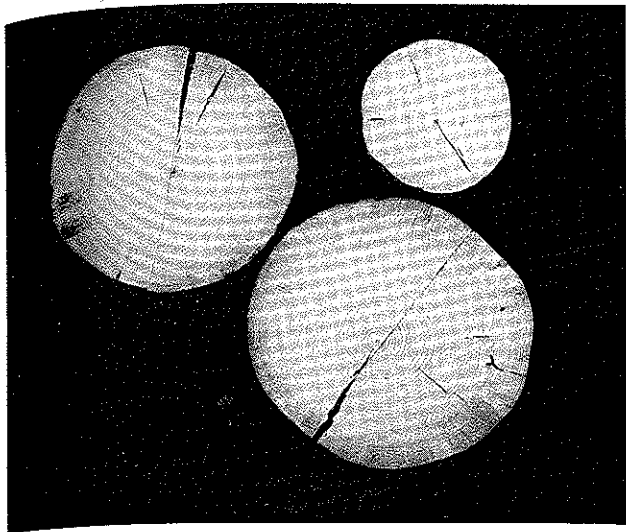


Figure 4. — Drying checks in the bole of a 3-year-dead lodgepole pine.

### Summary and conclusions

Use of dead lodgepole pine for veneer is probably feasible, but recovery varies with time-since-death and size. Volume recovery for 1-year dead was not practically different from live trees, but 3-year-dead recovery was substantially lower — averaging about 30 percent less. Recovery by grade of veneer was not related to time-since-death, but a higher percentage of random strip was produced from the older dead logs. In most green veneer sales between mills, lodgepole pine veneer is not priced by grade or width, but the amount of random-width strip is typically limited to a given percentage of a total shipment. This percentage limitation may create problems in marketing veneer from dead logs.

We found higher losses in layup for random-width strip than for half-sheets; for both strip and half-sheet, losses were highest from mixed loads and lowest from live loads. The higher layup losses from the mixed loads suggest that veneer should be segregated into live and dead loads to avoid overdrying the dead veneer. Segregating the dead veneer would also reduce drying time, save energy, and increase dryer availability.

There are some advantages to using dead lodgepole pine for veneer. Stumpage value will likely be less than for green timber, yet recovery, particularly for recent dead, may be nearly the same. Dead material being drier would weigh less resulting in more volume per truck for both logs and veneer, reduced drying time, and the associated savings in energy.

*Layup loss.* — Although veneer recovery was not followed to the finished panel, we did assess losses through the glue spreader with results shown in Figure 6. This reflects the layup loss to an untrimmed panel size of 101 by 50.5 inches. An additional loss of about 10 percent will occur when the untrimmed panel is

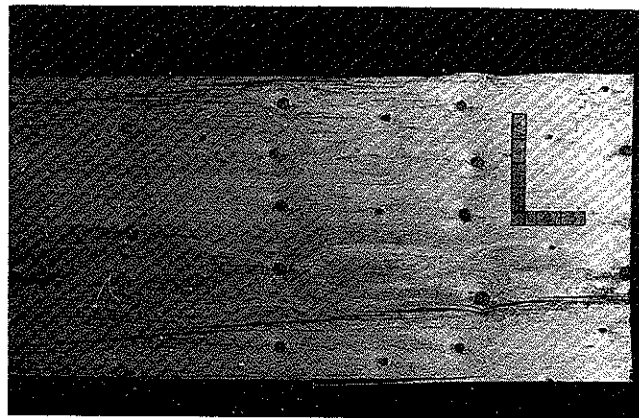


Figure 5. — Even though this half-sheet of veneer had prominent splits, it held together through the layup process.

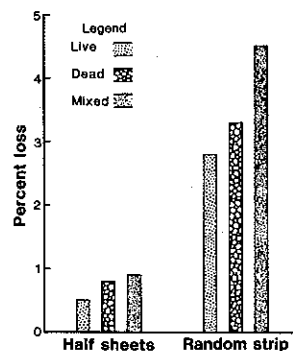


Figure 6. — Average percentage veneer loss for half-sheets and random strip during plywood layup.

trimmed to a finished size of 96 by 48 inches. Losses in half-sheets were minimal averaging less than 1 percent while losses in random-width strips were about 3 percent.

For both random-width and half-sheets, losses were lowest for the live loads and highest for the mixed live and dead. The mixed loads were dried at schedules for green veneer; consequently, the dead material was overdried. Overdrying increases brashness which apparently increased breakage during handling.

Although we found higher losses in laying up veneer from dead timber, workers at the glue spreader were not concerned about using the material. These workers are paid on a "piece-count" basis and are very aware of anything that slows their production.

*Application.* — The information given in this paper is applicable over the commercial range of lodgepole pine. The presence of rot in the dead timber may vary in

different climates. Since a 2-year-dead timber sample was not available, no definitive information can be given but we think that the recovery would probably be close to that reported for the 3-year-dead sample.

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