PALLET CANT SOUNDNESS AT APPALACHIAN SAWMILLS AND MARKETING RECOMMENDATIONS

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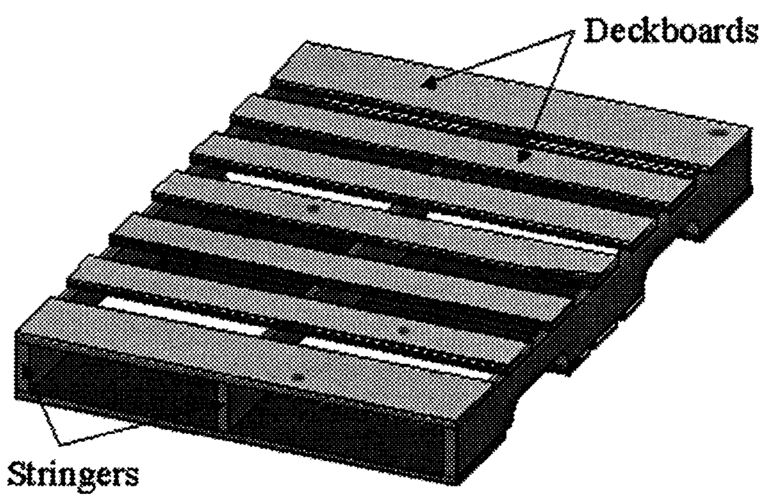
ABSTRACT

Pallet cants were inspected at selected sawmills in Virginia and West Virginia. We were looking for unsound defects such as splits, wane, shake, holes, rot, decay, unsound knots, bark pockets, and mechanical defects. Red oak (Quercus *rubra,* L.), white oak *(Quercus alba,* L), yellow-poplar *(Liriodendron tulipifera,* L.) and basswood *(Tilia americana,* L.) cants were inspected. White oak and poplar had higher percentages of unsound defect volume compared to red oak and basswood. Regardless of the mills and species, splits accounted for the highest percentage of defect volume per cant. Ninety percent of the cants had defect volumes less than 10 percent, and two percent of the cants had unsound defect volumes higher than 30 percent. This study suggests that cants can be pre-sorted for sale to pallet producers and that some should be culled at sawmills. The resulting cant product will help pallet producers reduce processing costs and produce high quality, longer-lasting pallets.

Figure 1. A typical 48x40 inch pallet with stringers and deckboards.



Every year, over 400 million new wooden pallets (Figure 1) are manufactured; consuming 4.5 billion board feet of hardwood lumber (Bush et al. 1997). Annually, about 30-40 percent of sawn hardwoods goes into the manufacture of wooden pallets. Cants are the primary raw material for producing pallet part components, such as stringers (the structural center members that support the load), and deckboards (the top and bottom members that provide dimensional stability and product placement).

Usually, the cants are produced from small logs or the center portion of normal sawlogs, and have a higher percentage of defects and less market value compared to grade lumber sawn from sawlogs.

Pallet cants are sold to pallet producers ungraded, but the cant quality based on the percentage of sound wood in the cant can affect pallet production and costs. Use of higher quality cants results in higher part yields, a higher grade of pallet parts and ultimately a longer pallet life cycle. Also, if the quality of pallet material is improved, there is a greater possibility of promoting multiple uses of discarded pallet parts. An economic analysis by Schmoldt et al. (1993) demonstrated the benefits of grading, sorting, and culling pallet parts. Mitchell (1999) found that differences in pallet cant quality affect pallet costs.

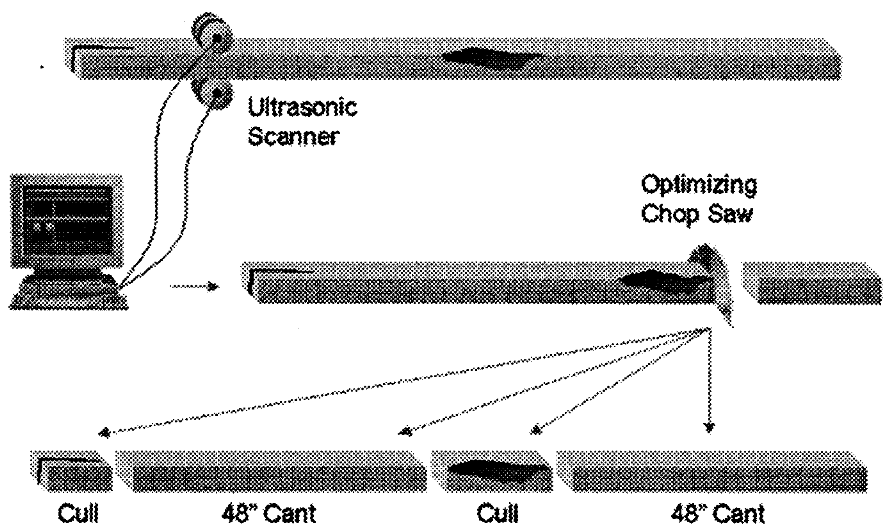
Mitchell (1999) proposed a single cant grade based on a minimum volume of clear wood. Initially, the study was aimed at developing three possible cant grades based on the percentage of unsound material. Cants were graded No. 1 for 0-15 percent unsound wood, No. 2 for 16-30 percent, and No. 3 for over 30 percent unsound defects (White 1999). The percentage of unsound material was calculated by taking volumetric measurements of defects, such as splits, unsound knots, wane, shake, insect holes, rot and decay. The definitions and descriptions of each defect type are given in Table 1. They are found in the National Hardwood Lumber Association (NHLA) grading rules (Anon 1994). While assuming three cant grades, mill samples indicated that nearly 90 percent of all cants were either grade No. 1 or No. 2. Also, the most significant reduction in pallet part yield occurred between grades No. 2 and No. 3. Therefore, a single grade consisting of a maximum allowable unsound defect volume of 30 percent was recommended by Mitchell (1999). The characterization of these defects may play an important role for grading cants, both manually and by automated systems. In this study we choose to expand Mitchell's research by randomly inspecting pallet cants at sawmills to look at the supply side of the equation. Our look at the frequency of different unsound defects in several hardwood species allows us to make some marketing recommendations.

Table 1. Definitions of unsound defects.

Defect type	Definition
Split (SP)	A separation along the grain caused by drying stresses.
Unsound knot (UK)	A knot not solid across its face or else softer than the surrounding wood, due to decay or other defects.
Wane (W)	Bark or lack of wood usually occurring along the edge of the cant.
Shake (SH)	A separation along the grain, the greater part of which occurs between the rings of annual growth.
Hole (HO)	A void caused by insects or any other means.
Rot (RT)	Advanced stages of decay.
Decay (DC)	The decomposition of wood substance by fungi.
Bark pocket (BP)	A bark-tilled blemish in the cant.
Mechanical (M)	A defect caused by anything but natural circumstances.

Knowledge of defect types is needed for our automated scanning, grading and processing research. An attempt has been made to grade pallet parts using an automated ultrasound scanning system (Kabir et al. 2002, Schmoldt et al. 1996). This study showed that the ultrasound scanning system is able to successfully detect, locate, and classify defects. A similar system could be developed to grade, sort, and cull pallet cants. Furthermore, an automated cant to parts processing systems could be developed to maximize yields and part quality at pallet part producers. Many sawmills are now producing pallet parts for sale and could benefit from this technology as depicted in Figure 2.

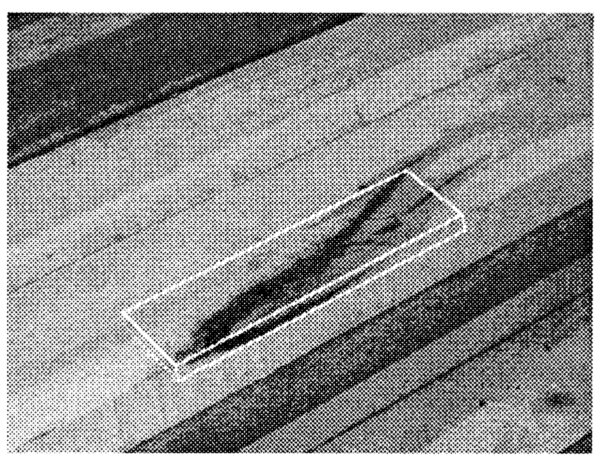
Figure 2. Potential ultrasonic scanning and automated processing of full length cants to part length cants



MATERIALS AND METHODS

Seven sawmills were selected in Virginia and West Virginia to participate in this study. A crew of four people, working in groups of two, measured individual cants as they came off the green chain or from stacks of cants recently processed and ready to be shipped. The species studied were red oak, white oak, yellow poplar, and basswood, depending on the availability in the sawmill. The species and dimensions (length, width and height) were first recorded for each cant. Defect data was then collected for any occurrence of splits, wane, shake, holes, rot, decay, unsound knots, bark pockets, and mechanical defects. Defects were identified and classified according to the NHLA grading rules (Anon 1994). An imaginary rectangular solid was visualized around each defect, such that the entire unsound area was encompassed. Length, width, and height dimension measurements were taken of the imaginary solid. All the measurements were taken from the wide face of the cant, even if the defect was located on the narrow face. If a defect was only visible on one face of the cant, the dimension of the hidden face was estimated. Figure 3 shows a typical defect measurement on a cant.

Figure 3. Typical defect measurement on a yellow-poplar cant.



RESULTS AND DISCUSSIONS

The number of cants sampled at each mill and for each species is shown in Table 2. A total of 823 cants were studied for defect characterization, the majority of which (73 percent) were oak. This is fairly representative of the pallet cant production for the region. Table 3 shows the total volume (in board feet) of cants sampled at each mill for each species. The largest volume of cants was studied at Mill 3 (15.5 MBF) while the smallest volume was studied at Mill 4 (4.1 MBF). Red and white oak accounted for about 69 percent of the total cant volume.

Table 2. Number of individual cants sampled at each sawmill.

	Number of cants sampled				
Mill	**Red Oak**	**White oak**	**Yellow poplar**	**Basswood**	**Total**
1	0	98	0	0	98
2	49	0	0	49	98
3	154	0	83	0	237
4	52	0	0	0	52
5	0	77	0	0	77
6	58	65	0	0	123
7	0	49	89	0	138
Total	**313**	**289**	**172**	**49**	**823**

Table 3. Total volume of cants sampled at each sawmill.

	Volume of cants sampled (board feet)				
Mill	**Red Oak**	**White oak**	**Yellow poplar**	**Basswood**	**Total**
1	0.00	6069.19	3217.50	0.00	9268.69
2	4469.81	0.00	0.00	3549.00	8018.81
3	9515.19	0.00	6003.38	0.00	15518.56
4	4067.58	0.00	0.00	0.00	4067.58
5	0.00	5664.00	0.00	0.00	5664.00
6	5959.04	7091.88	0.00	0.00	13050.92
7	0.00	4365.00	8921.72	0.00	13286.72
Total	**24011.63**	**23190.06**	**18142.59**	**3549.00**	**68893.28**

Figure 4 depicts the average unsound defect percentage for each defect type and species. White oak had higher percentages of splits, wane and shake compared to other defect types. The majority of unsound defect volume found in poplar was comprised of splits, rot and decay. Overall, basswood had fewer defects than the other wood species. Regardless of the mills and species, the largest volume-occupying defect was splits, followed by decay as shown in Figure 5. Bark pockets, shake and holes were the third, fourth, and fifth most abundant defects respectively, and each contributed approximately the same amount to the total defect volume. Figure 6 shows the average unsound defect percentage for each species over all mills. White oak had the highest (4.92 percent) average percentage of unsound material while basswood had the lowest (2.28 percent).

Figure 4. Average unsound defect percentage by defect type for all mills and species.

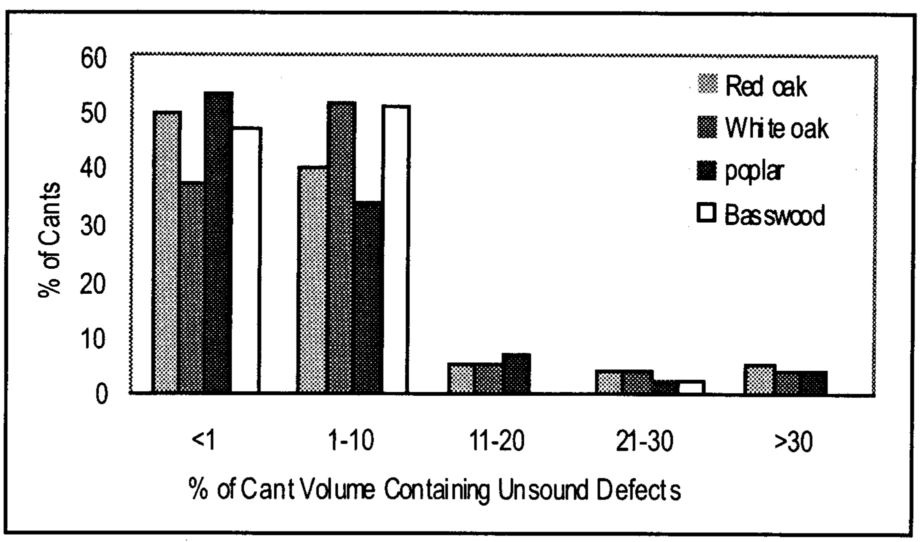


Figure 5. Average unsound defect percentage by defect type regardless of the mills and species.

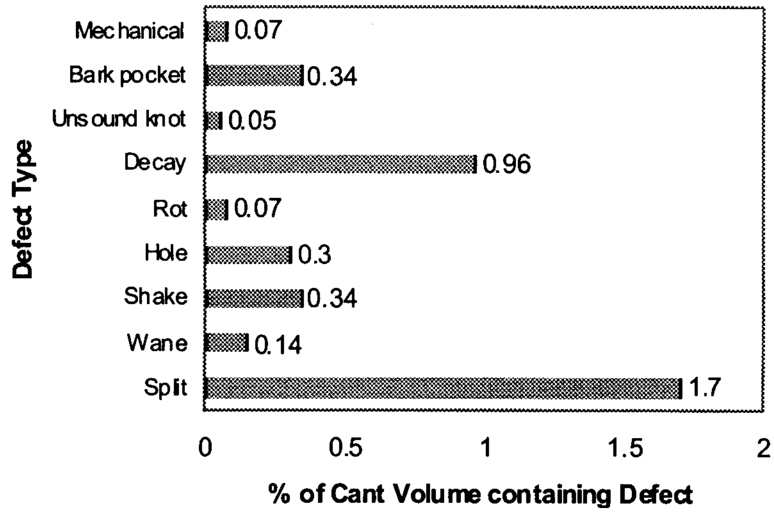
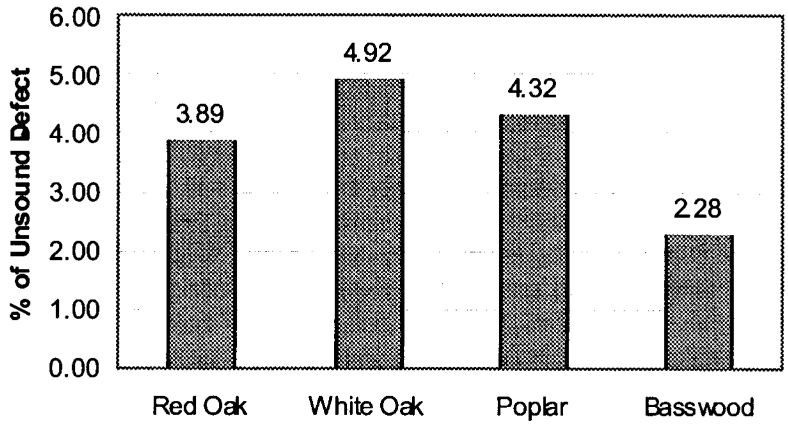
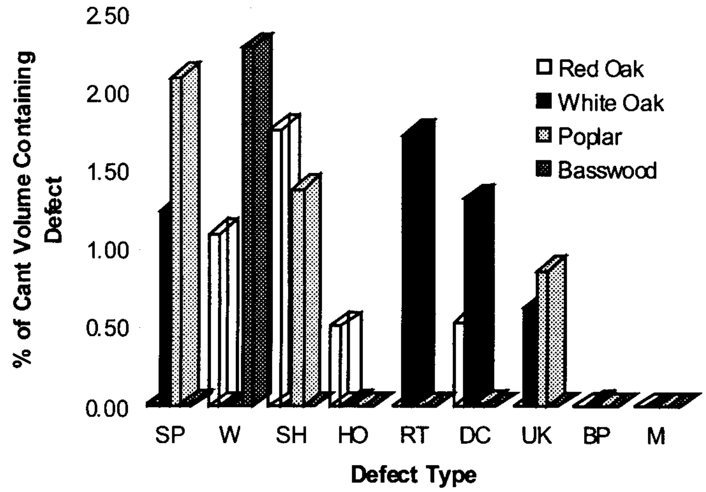


Figure 6. Average unsound defect percentage by species for all mills.



All cants were classified based on the total defect percentage and the results are presented in Figure 7. Regardless of mills or species, 90 percent of all cants have less than 10 percent unsound defects while only 10 percent of the cants have more than 10 percent unsound defect volume. Only 2 percent of the cants have an unsound volume greater than 30 percent. Since, this was the proposed cutoff for a minimum pallet cant grade, only 2 percent of the cants sampled would have been considered below grade. Figure 7 shows this information broken down by species.

Figure 7. Average unsound defect percentage by mills for all species.



SUMMARY OF MILL DATA

For all species sampled, splits exhibited the highest percentage of defect volume, followed closely by decay. Bark pockets, shake and holes were the next most abundant defects, each comprising approximately 7 percent of the total defect volume. Splits, wane, and shake were the most common defects found in the cants, although high percentages of decay and rot were found in white oak. White oak showed the highest percentage of unsound defects whereas basswood exhibited the lowest. The average unsound defect volume percentage per cant varies from mill to mill and for each species. Ninety percent of the cants studied were found to have less than 10 percent of total unsound volume, and only two percent of the cants had more than 30 percent unsound volume. The cants with more than 30 percent unsound volume should be chipped at the sawmill due to the low yield of useable parts if processed to pallet parts.

The results from this study can be used by scientists developing automated grading and processing systems (see Figure 2) for pallet cants. They need to know the frequency of the unsound defects in pallet cants to focus their efforts on highly occurring defect types. The results can also be used to suggest a pallet cant marketing system based soundness of the cants.

PROPOSED MARKETING SYSTEM

A sawmill with a cant scanner could separate and market cants based on soundness. The following guidelines could be used:

- Premium Grade Pallet Cants – 0 to 1 percent unsound
- Grade 1 Pallet Cants – 1 to 10 percent unsound
- Grade 2 Pallet Cants – 10 to 30 percent unsound
- Cull – anything over 30 percent unsound

The poorest cants would be eliminated and a premium could be possible for the remaining cants. Both sellers and purchasers could both benefit from this proposed marketing system for pallet cants.

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