Grade distribution and drying degrade of sweetgum and yellow-poplar structural lumber

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Abstract

The fact that the supply of southern pine timber is changing to include more lower quality plantation stock may provide incentive for utilizing lower density hardwoods for structural lumber. Yellow-poplar and sweetgum are potential substitutes for southern pine. A major problem in utilizing soft hardwoods for structural lumber is the difficulties associated with drying. A study of the grade distribution and drying degrade of yellow-poplar and sweetgum structural lumber was completed. The results indicate that grade distribution was much higher for yellow-poplar than for sweetgum, and grade loss after drying was lower for sweetgum. Proper drying is especially critical for reducing degrade of hardwoods.

Dwindling reserves of high quality pine sawlogs may result in shortages of machine stress rated (MSR) lumber in the future. Yellow-poplar and sweetgum are potential substitutes for pine for use as structural lumber. Both species have "clear wood" strength properties comparable to southern pine(6). Currently, stand inventories are abundant and growth is exceeding removals(7). Distribution of yellow-poplar and sweetgum stands is sufficient to furnish current mills with an adequate supply of wood at least to the year 2000 (7).

The use of yellow-poplar as dimension lumber has been investigated (1,4). Relatively little quantitative data are available on the use of sweetgum as structural lumber. The characteristics of interlocked grain, abundant knots, and high volumetric shrinkage would suggest that sweetgum may be difficult to utilize for structural lumber on a commercial basis. Sweetgum is listed as a moderately difficult species to dry (6).

This study was part of a comprehensive study (2) to investigate the utilization of sweetgum as structural lumber. An important aspect of its utilization is to determine expected grade distribution and degrade in the drying process. Approximately 23 thousand board feet (MBF) of sweetgum and yellow-poplar structural lumber (2 by 4, 2 by 8, and 12 ft. long) was manufactured at a mill in the North Carolina piedmont region. Grade distribution based on defects (knots, splits, slope of grain etc.) and warp (bow and crook) was evaluated from this lumber. After drying, all lumber was regraded for warp and splits.

Materials and procedures

Timber was selected from stands of mixed hardwoods and stands containing both mixed hardwoods and softwoods. The intent was to select trees in a similar fashion to most commercial harvesting operations. Logs were bucked to nominal 12-foot lengths in the woods and transported to a modern hardwood mill for processing.

Breakdown of the log is illustrated in Figure 1. A pith-centered cant (nominal 8 by 8 in.) was produced by the primary headrig (bandsaw). The cant was reduced by double arbor resaw into four 2 by 8's. Two 2 by 4's were produced by ripping a 2 by 8 on a linebar resaw. Sideboards were retained for higher grade furniture lumber and were not included in the tally. The intent was to process the logs in a manner similar to a pine dimension mill.

The hardwood lumber was graded for defects and warp by a certified lumber grader. These grades were independent of one another. The defect grade accounted for knots, splits, and slope of grain, which affect strength properties. The warp grade accounted for bow, cupping, and crook, which affect its utilization for structural lumber. Lumber was graded according to pine grading rules (5) to determine their applicability to hardwood structural lumber and reference grade distribution to southern pine.

The sweetgum and yellow-poplar lumber was dried in a steam-heated kiln according to nominal 8/4 red gum redgum.
Table 1 shows the raw tally of sweetgum and yellow-poplar dimension lumber grades (southern pine rules). The table includes the species, dimension, and grade for both defect and warp grades. The results indicate that sweetgum has a lower grade yield than yellow-poplar due to the slope of grain.

Figure 1 illustrates the diagram of log and cant breakdown for producing sweetgum and yellow-poplar lumber. Figure 2 shows the distribution of defect grade for sweetgum and yellow-poplar structural lumber, while Figure 3 displays the cumulative distributions for green and dry warp grades of sweetgum and yellow-poplar lumber.

Results and discussion
Processing of sweetgum and yellow-poplar lumber was carried out as planned, except for some problems in the drying schedule. Errors in calculation of initial moisture content (MC) led to a lower than expected final MC of 6 to 11 percent. The yellow-poplar averaged around 6.5 percent, while the sweetgum averaged 10.5 percent final MC. The yellow-poplar dried more rapidly, resulting in the lower MC. The schedule required 6 weeks to complete due to intermittent loss of steam and the errors in estimating the initial MC. However, at no time during the schedule was the lumber subjected to temperatures higher than the schedule called for. Due to scheduling problems, neither equalizing nor conditioning steps were employed at the end of the schedule. Some collapse was evident in the sweetgum lumber. Cupping was evident in the 2 by 8's.

Raw tally data for grades based on defects and warp are summarized in Table 1. Grade yield based on defects according to pine grading rules was lower for sweetgum than yellow-poplar as illustrated in Figure 2. The lower grade yield can be attributed in part to the slope of grain.
of sweetgum. The certified lumber grader frequently downgraded sweetgum because of sloping grain. The 2 by 4’s yielded slightly lower defect grade for yellow-poplar and sweetgum.

Grade yield based on warp for green and dried lumber is presented in Figure 3. Figure 3 represents the cumulative distribution of green and dry warp grades in a stacked-bar chart. Comparison of green warp grades shows that yellow-poplar yields are slightly higher than sweetgum and 2 by 8 yields are noticeably higher than 2 by 4’s overall. The nature of the cant breakdown favored the 2 by 8’s in terms of warp grade. Generally, the 2 by 8’s were pith-centered, which balanced the growth stresses when 2 by 8’s were cut from the cant. The growth stresses were unbalanced in the 2 by 4’s because they were almost never pith-centered. Undoubtedly, the presence of interlocked grain in sweetgum contributed to the slightly lower yield in green warp grade overall.

The cost for improper drying of hardwood lumber is clearly evident in the warp grade tally for dried and planed lumber. Figure 4 illustrates the percentage loss or gain from each grade due to drying. Degradation of dry No. 1 yellow-poplar 2 by 8’s was almost 52 percent. The majority of this degradation was mostly to reject, due to splitting around the pith. A large portion of the 2 by 8 lumber was pith-centered due to the nature of the cant breakdown. Cupping was evident in the 2 by 8’s due to the lower final MC and pith (juvenile) wood centered in the boards. When the lumber was planed, the feed rolls forced the boards flat, causing the yellow-poplar 2 by 8’s to split through the weaker pith wood. The sweetgum was apparently able to withstand the stresses of planing without splitting. Possibly the presence of interlocked grain in sweetgum helped to resist the pressures of the planer feed rolls. Proper drying practices would have reduced the magnitude of this loss.

Drying degradation of 2 by 4’s is generally lower than 2 by 8’s. Sweetgum 2 by 8 No. 1 showed a loss of 25 percent, mostly to No. 2 grade. Comparing degradation of yellow-poplar 2 by 4’s with sweetgum 2 by 4’s shows very little difference. The yellow-poplar lumber tended to degrade more than one grade level, which is probably a result of the higher occurrence of end splits.

**Conclusion**

The grade distribution for sweetgum was significantly lower than for yellow-poplar. The lower grade distribution is more a result of sweetgum’s less desirable appearance than of its relative structural strength (2). It is probable that sweetgum structural lumber would have to be marketed for concealed applications in order to gain consumer acceptance.

Proper drying is critical for reducing excessive downgrading of sweetgum and yellow-poplar structural lumber. It is apparent that yellow-poplar and sweetgum cannot be mixed in the same drying schedule. The results of this study represent more of a worst case of drying loss for yellow-poplar due to problems in the drying schedule.

**Literature cited**