

THE CORRELATION BETWEEN GREEN DENSITY AND THE OCCURRENCE OF HONEYCOMB IN KILN-DRIED RED OAK LUMBER

ROBERT A. HARRIS
PHILIP A. ARAMAN

ABSTRACT

Fresh-cut, 5/4 red oak (*Quercus* sp.) boards were weighed, measured to determine volume and then kiln-dried to determine if the initial green density (green weight/green volume) was correlated to the occurrence of honeycomb. A positive relationship was found between the occurrence of honeycomb during drying and the initial green density. These results indicate that it should be possible to use density sorting prior to kiln-drying to segregate boards with a high probability of honeycomb to reduce drying degrade and improve drying efficiency. The higher density boards could be dried with a milder schedule, to reduce honeycomb, and the lower density boards could be dried with an accelerated schedule.

Improvement in kiln-drying operations are generally centered around two objectives: 1) to reduce the kiln-drying time; and 2) to reduce drying defects. These two objectives are often difficult to achieve simultaneously, since accelerating the drying generally increases defects.

Most recent attempts to decrease drying time have been based on improved operational procedures. For example, computer controls have been developed to change the few stepwise adjustments in kiln temperature and humidity to a constant monitoring situation where thousands of small adjustment steps are implemented. This approach has been somewhat successful.

In kiln-drying, the control of the kiln is based on the "worst case" boards in the kiln. That is, the highest moisture content (MC), slowest drying boards are monitored and provide the basis for changes in kiln conditions. Thus, the faster drying boards must "wait" for the slower drying boards to catchup before kiln conditions can be adjusted. Segregating the boards can result in a more

uniform product in the kiln, which could improve kiln-drying efficiency. Results of a previous study that used 2.5-inch-diameter round red oak dowels indicated that as green density increases, the probability of honeycomb also increases (1).

Sorting by weight has been used to increase drying efficiency for ponderosa pine, sugar pine, white fir, and Douglas-fir (5), and reduce drying time and final MC variation in southern yellow pine (4,6). Tropical woods have been divided based in part on specific gravity and initial MC, into groups with similar drying characteristics (3).

OBJECTIVE

The objective of this study was to determine if a correlation exists between green density of freshly cut red

oak lumber and the occurrence of honeycomb during kiln-drying.

MATERIALS AND METHODS

Five-quarter red oak lumber (*Quercus* sp.) was obtained, freshly cut, from a sawmill in coastal South Carolina. The lumber was transported in an enclosed van to Clemson University, Clemson, S.C., where it was processed and then kiln-dried in a laboratory dry kiln. Two separate charges of red oak lumber were collected and kiln-dried to an MC of 7 percent.

The random-width lumber was 10 feet or longer in length. Each piece was cut to a length of 7-1/2 feet. Samples were cut from each end of the board for initial MC and specific gravity measurements, leaving the boards 7 feet in length for kiln-drying. Exact width and thickness were measured at both ends and in the middle of each board for volume calculations. Each board was end coated, numbered, weighed, and placed in the dry kiln. Initial green density was calculated by dividing the initial weight by the board volume.

The dry kiln is a 500-board-foot, aluminum panel, forced-air kiln. One charge held 84 boards and the other held 88 boards. The lumber was dried utilizing the T-5, D-2 schedule (2) instead of the recommended T-4, D-2 schedule. The more severe schedule was employed to enhance the occurrence of

The authors are, respectively, Associate Professor, Strom Thurmond Institute, Clemson Univ., Clemson, SC 29634; and Project Leader, USDA Forest Serv., Southern Research Station, Brooks Forest Products Center, Virginia Tech, Blacksburg, VA 24061-0503. The authors wish to acknowledge the USDA Forest Serv., Southern Res. Sta. for partial support. This paper was received for publication in November 1992.

© Forest Products Society 1995.
Forest Prod. J. 45(5):53-54.

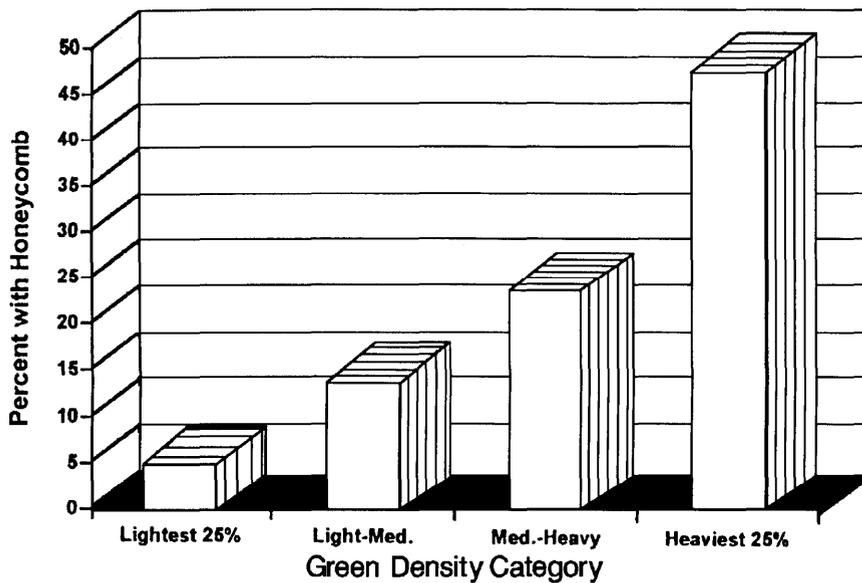


Figure 1. — Histogram illustrating the occurrence of honeycomb in four categories of green density.

honeycomb. After drying, equalizing, and conditioning, each board was weighed and cut into four equal-length sections. The cross section of each cut was examined, and any sign of honeycomb was used to classify the entire board as containing a honeycomb defect.

RESULTS

In the first charge, 32 percent of the dried boards contained honeycomb. The initial green densities of the boards ranged from 1.009 g/cm³ to 1.249 g/cm³. Boards with green densities under 1.081 g/cm³ represented the lightest 15 percent of the boards and 8 percent of

these had honeycomb. Boards with green densities over 1.202 represented the heaviest 15 percent of the boards and 38 percent of these had honeycomb.

In the second charge, 23 percent of the boards had honeycomb and the initial green densities of the boards ranged from 0.963 g/cm³ to 1.253 g/cm³. Boards with green densities under 1.044 g/cm³ represented the lightest 15 percent and these boards contained no honeycomb. Boards with green densities over 1.156 g/cm³ represented the heaviest 15 percent and 62 percent of these boards contained honeycomb. **Figure 1** illustrates the relationship between the

increasing green density and the increasing occurrence of honeycomb for the second kiln charge.

SUMMARY

These results support the conclusion of an earlier study (1), which states, "A positive correlation existed between the green density of red oak and the occurrence of honeycomb during kiln-drying." Thus, it should be possible to sort boards on the basis of density prior to kiln-drying in order to identify those that have a high probability of honeycomb occurrence. These boards could be dried with a milder schedule, thereby reducing the incidence of honeycomb while the remaining boards, which have a lower propensity to honeycomb, could be dried with an accelerated schedule.

LITERATURE CITED

- Harris, R. A., M.A. Taras, and J.H. Syme. 1988. The correlation between green density and the occurrence of honeycomb in kiln-dried red oak rounds. *Forest Prod. J.* 38 (7):64-66.
- Rasmussen, E.F. 1968. *Kiln Operator's Manual*. Agri. Handb. 188. USDA Forest Serv., Forest Prod. Lab., Madison, Wis.
- Simpson, W.T. and C.K. Baah. 1989. A method for grouping mixtures of tropical species for kiln drying. Res. Note FPL-RN-USG. USDA Forest Serv., Forest Prod. Lab., Madison, Wis. 14 pp.
- Taylor, F.W. and W.T. So. 1989. Sorting southern pine lumber to improve drying. Departmental Pubs., Mississippi State Univ. 21 pp.
- Tjoelker, W. 1990. Specific gravity sorting raises kiln drying efficiency. *Forest Industries*. June. pp. 34-36.
- Walters, E.O. 1970. Saturation principle of moisture measure to establish drying sorts. *Forest Prod. J.* 20(2):25-28.