Wood Drying-Techniques and Economics

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If air-drying conditions were always like summer in Montana, a great deal of our lumber could be seasoned by the air-drying process. Unfortunately, only seven months in the South are considered as really effective for air-drying. The other five months have low temperatures and high relative humidities; however, they are no worse than two of the months classified as effective for air-drying in upper Michigan. Thus, it is imperative that we know and understand the various drying techniques thoroughly and use them economically if we are to improve the quality of lumber and promote its sale.

Drying Techniques

The best techniques of air-drying have been developed by extensive research and are well known (9), but are ignored more often than used. The redwood industry of California, which has the poorest air-drying weather of the major U. S. producing areas, was forced to use the best air-drying practices to stay competitive. Figure 1 shows a redwood yard illustrating excellent site selection, lay-out, surfacing, spacing, foundation design, and techniques of stacking and roofing. This is not an isolated case. Elsewhere, others have applied the same principles in different combinations, as at Martinsville, Va. (7). Generally, air-drying can rapidly dry most items of lumber to a moisture content between 20 and 30 per cent with a minimum of degrade during the active drying periods of the year. Research has disclosed that forced air-drying can be more effective than normal air-drying and reduce drying time by 50 per cent or more (12). Figure 2 shows how rate of moisture loss is increased by lowering the equilibrium moisture content (EMC) when air velocity through the load is in the neighborhood of 400 to 600 feet per minute. EMC is the moisture content to which wood will come when placed in contact with air of a given temperature and relative humidity condition. The effects of air velocity rates, length of air travel through the loads, and other factors are set forth in the published research. Furthermore, substantial knowledge in the forced air dryer field has developed as a result of practical experience (13). For example, manufacturers and users have developed methods to turn the fans off, with fast drying woods, when the relative humidity gets too high. On the other hand, with refractory woods like oak, the fans can be turned off when the humidity gets too low. For any wood there should be a high and a low humidity limit between which it is practical and safe to have the fans on, and the fans can be controlled by simple instruments. This band of safe and practical operating conditions should be broad either at the natural air-drying temperatures of single-pass fan drying or in low temperature drying with a small amount of supplemental heat. This also can be studied more closely in the future and forced air-drying can become established as one of the technically sound methods of wood drying.

The techniques of modern kiln drying are well known and described in the Dry Kiln Operator’s Manual by Rasmussen (11). Control is adequate and kiln-drying equipment has come a long way since the old hot box and natural circulation kiln. Appropriate schedules of temperature and wet-bulb depression are established. These schedules are not, however, iron-clad rules. The Dry Kiln Operator’s Manual suggests many schedule modifications to reduce drying time and cut costs. The schedules for easy drying woods

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1 Maintained at Madison, Wis., in cooperation with the University of Wisconsin.
2 Numbers in parentheses refer to Literature Cited at the end of this article.
such as soft maple and black ash can be simplified by using common sense and a few cautious trials. Those who manage or are technically responsible for kiln-drying operations ought to review Chapter 8 of the Manual with their operators and see where opportunities for schedule modification and simplification exists.

In the processing of wood, drying is one of the most time-consuming operations. The question has been raised: Should so much of our wood be dried in conventional lumber sizes? One of the major points brought to the attention of forest products research personnel during the Madison conference on drying fundamentals was the reduction of the material to the smallest practical size before starting drying.

This favors drying wood in particles or flakes, as veneer, or as the thinner items of lumber. It is significant that considerably shorter driving time is one of the important aspects of manufacturing veneer and plywood, and the Southern pine plywood development is occurring at a time when the jet dryer is becoming available. In such dryers, drying time may be reduced by 50 per cent by impinging air vertically on the face at very high velocities. One of the first studies being undertaken by the new research project on the utilization of Southern pines at Alexandria, La., is the feasibility of sawing or slicing woods-run small Southern pine logs into thin boards or extra-thick veneers and laminating them into useful or high demand products after rapid drying.

There now are two domestic jet veneer dryers available, and one foreign manufacturer also is in the market.

In view of the industry trend to consider processes that handle wood in smaller sizes, the wood drying research project at the Forest Products Laboratory is directing some of its efforts toward the drying of thin lumber and "slicewood." New emphasis is being placed on basic fundamentals that apply to all sizes. In addition, applied drying research is being expanded at field centers of the forest experiment stations, such as those at Athens, Ga., Alexandria, La., and Stoneville, Miss.

Drying Economics

It is difficult to get facts and make significant economic studies in the field of wood drying, since such studies must be made under production conditions. But if unreliable "hunch" decisions are to be avoided and choices are to be made between available alternatives, economic facts must be considered. Since extensive studies of drying economics have not been made in the South, this paper is a review of studies made elsewhere. The results should be helpful in solving many Southern problems by analogy. They also should encourage lumbermen to make economic studies of their own.

The best study of comparative costs of air-drying and pre-drying was made in Australia by George W. Wright of the Division of Forest Products, CSIRO, Melbourne (14). The results were based on actual studies and records of the Division. Such studies are highly important to the Australian timber industry, because drying of the refractory eucalyptus and other species represents one-fourth of the lumber production cost. In this country, drying costs do not make up such a high proportion of the total, but they certainly are high enough to merit considerable study.

The Australians have found, when air-drying or pie-drying is to be followed by kiln-drying, that there is a considerable penalty for removing stock from the yard or pre-dryer too soon. An extra three or four days in the kiln is required. To this would be added the degrade costs of collapse and honeycomb if too severe drying.
conditions are used at the start of the kiln-drying portion of the operation. This latter does happen in the drying of oak, from both South and North, when starting temperature is too high. Fortunately, this is not so frequent as in times past. The Australians have also found the heating costs make up a large share of the total drying costs—from 25 to 30 per cent of the cost in a pre-dryer, from 30 to 40 per cent in a kiln.

One of the major costs of air-drying is the development of an efficient yard site and lay-out. In Australia they often use a track-type system for handling stacks of lumber. The transportation equipment, known as the Christensen truck, is similar to an end-applied pallet lift: The lumber is let down on permanent supports on each side of the tracks. In the Australian study it was found that a yard with a capacity up to 21/2 million board feet per year, using a four-month air-drying cycle, was most economically laid out so that both air yard and kiln were serviced by the Christensen truck and transfer system. This would be somewhat analogous to having the air-drying yard serviced by kiln trucks in this country. Beyond the 21/2 million board foot figure, a combination of fork-lift on an open yard and the Christensen system was most economical.

The next consideration in the Australian study was the establishment cost, for establishing the yard and equipment. This cost was least for air-drying plus kiln-drying, intermediate for pre-drying plus kiln-drying, and most for kiln-drying green from the saw. But when the entire cost to put the system into full operation, which included the timber, was considered, the set-up with the pre-dryer was lowest. Its cost was about 80 per cent of the kiln-drying-green cost. The air-drying plus kiln-drying cost was 96 per cent of the straight kiln-drying cost.

The actual drying costs for the different combinations of methods would vary depending on whether the air-drying was done under good or bad conditions. Figure 3 shows costs for drying one-inch Australian hardwood to 20 to 25 per cent moisture content. To put these costs in terms of dollars per thousand board feet, multiply by 10. Under good air-drying conditions it was quite evident that air-drying was by far the cheapest. Under poor conditions, costs were about the same for air- and pre-drying, but the time required in air-drying was 13 times as long. Only three days would be saved by doing the early as well as the final drying in a kiln, since the Australian hardwoods require very low temperatures for kiln-drying from green. But the cost in the kiln is about three times the cost on the yard or in the pre-dryer. In Australia it has been stated that the initial expense of the pre-dryer is really insignificant compared with the capital saved and the streamlined production achieved, in comparison with air-drying.

In drying to 12 per cent moisture content, the cost of air-drying under poor conditions plus kiln-drying or pre-drying plus kiln-drying was about $22.50 per MBM compared with $37 for kiln-drying green from the saw. Under good air-drying conditions, the combined air- and kiln-drying cost was $18.

There have been several studies in this country (2, 10) showing definitely that the use of pile roofs for higher grade oak and other hardwoods substantially reduces degrade and, consequently, drying cost. The effect of such roofs on drying time and drying rate at different seasons of the year has not been as clearly shown. Figure 4 shows results obtained in Australia (14). Drying rates are definitely lower and times...
The custom drying operation described above employs many of the methods for accelerating drying embodi­ned in the FPL kiln schedules, also the suggestions for schedule modific­ation and operating economies in Chap­ters 8 and 10 of the Dry Kiln Operator's Manual (11). The subject of maximum economies in kiln operation deserves considerable attention by the kiln operator in consultation with his man­agement. Some practical suggestions along this line have been made by De­vine (5).

One factor not taken into account by any of the studies mentioned above is the cost of degrade. In improperly dried wood in its various forms, and during the course of drying, a potential green grade is also assigned to each piece, and the reasons for down-grading are pin-pointed to exact causes.

Conclusion

Many favorable techniques exist for drying wood in its various forms, and technical information about them is readily available. Government reports may be obtained from the Southern Forest Experiment Station, New Orleans, and the Southeastern Forest Experiment Station, Asheville, N. C., as well as the Forest Products Labora­tory. Other information is available through the forestry schools and agri­cultural extension services of the uni­versities and colleges.

Economic studies can be made. Any company can make its own, the first step being the division of all costs into discrete units and the keeping of good records. If some favorable organi­zations, government agencies are able to make partial cost studies, and, in a few favorable places such as Australia, one can survey the whole picture. Some of the best studies, however, have been made by organizations commonly known as kiln clubs, which frequently function as wood-drying associations covering the whole field of wood drying. Management participates upon a technical level with the kiln operators and yard fore­men. In many of these studies, technical direction by a participating lumber association has been a prime factor. It is evident that drying economics should be studied more.

Literature Cited


Eikon's Note: This article is based on a paper presented at the full meeting of the Midsummer Section of the Forest Products Research Society, New Orleans, La., October 14 and 15, 1963.