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The Air-Drying Of Southern Hardwoods

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INTRODUCTION

Why is wood dried? The importance of drying green rough-sawed mill products prior to fabrication has been known for a long, long time. The improved performance of the consumer products attests to the benefits gained by drying. Sometimes rough hardwood lumber is dried at the mill to reduce shipping weight. However, the fabricator of the wood product is definitely more interested in dimensional stability. Thus, the rough mill products are dried so shrinkage can occur before, rather than after, factory processing. The other advantages of drying the rough mill products are perhaps of somewhat lesser importance.

Water in green wood is considered by wood technologists as being held in two forms. The water in the cell cavity is called free or capillary water; that in the cell wall is called bound or hygroscopic water. The drying process must remove all of the free water before the bound water concentration is reduced. A reduction in the amount of bound water results in shrinkage. The lower the water content of the cell wall, the greater will be the shrinkage.

The air-drying process, in general, can then be defined as a process for removing most of the free water. In doing so, however, some bound water is also removed. In most of our Southern hardwoods, the time required to remove free water without damage to the wood is fairly long. In other words, the drying rate is often slow. The cheapest way to accomplish free water reduction in many instances is by air-drying. Let me repeat—conventional air-drying is a process for removing free water from wood. We do it by utilizing the energy that is available for the evaporation of water in the outdoor atmosphere.

Wood dries in response to a moisture concentration gradient—dry on the outside and wet on the inside. The rate at which wood dries depends on the steepness of this gradient and the temperature of the wood. Heat is required to convert the water in the wood to vapor. This heat is provided by the air circulating around the wood. The same air picks up the moisture being evaporated. Although a good air-drying potential in the form of dry warm air may be moving around the boards, the rate of drying is also determined by the structural characteristics of the wood. A permeable wood dries rapidly, but an impervious wood dries slowly. Although the drying rate of a certain species may be reasonably rapid, kiln-drying green from the saw may not be economical. Thus we usually air-dry wood before we kiln-dry it.

THE MODERN AIR-DRYING YARD

At a sawmill of any size, or at a fabricating plant when Southern hardwoods of some volume are being air-dried, rough lumber for air-drying is now being handled with fork-lift trucks of one kind or another. The handling unit is a stickered package of lumber. Hand stacking of lumber in the yard has just about passed out of the picture. The sloped and pitched pile, with flues and spaced boards, has given way to stickered packages of lumber stacked edge to edge, and placed horizontally one above the other, separated by bunkers. Permanent foundations have often given way to portable foundations that can be placed where needed.

The lay-out for a unit package yarding operation may look considerably different than that used for the hand stacking system. The main alleys may be wider to accommodate the greater turning area needed by the fork-lift truck. Main alleys and cross alleys may be black-topped to provide better roadways for lift truck transport. Piles of packages within the rows may be narrower and spaced farther apart.

The lumber-holding capacity per acre may be less than formerly, but the output per year of air-dried stock is often greater. These, new yards are usually cleaner and they are often arranged to allow better drainage. The new yards look different because the high pile foundations are gone. Often the bottom package of a pile is only six or eight inches off the ground. High pile foundations were recommended for the hand-stacked piles because air movement in the pile was considered as being downward. Thus the space under the pile was needed to collect cool damp air so that winds could carry it away. Now we hear more and more about orienting the yard so that prevailing winds create the air movement In the packages.

I remember when Southern hardwood lumber producers end-racked certain species of wood to control blue stain. Now the use of fungicides is much cheaper than rehandling. A lumber producer that is not using a dip tank or spray chamber to treat green lumber and prevent sap stain or blue stain is missing a good opportunity.

One of the significant causes for loss in grade and volume in air-drying Southern hardwoods is warp. To minimize this loss, the stickered packages must be made up of uniformly thick lumber. Mixing 4/4 and 5/4 stock in each course never did restrain warp. When the species being sawn is prone to warp, we recommend not only narrower sticker spacing but good alinement of uniformly thick, dry, narrow stickers. Prevention of warp often calls for sorting stock by length so that the packages are square on both ends. Where sorted-length stacking cannot be justified, box-piling of random-length stock certainly should be considered.

It has been said that the green chain is the last frontier where economy in milling costs can be anticipated. The mechanical sorter ahead of the mechanical stacker is no longer a dream.

Stickered unit packages will continue to be built up by hand, using stacking jigs, but mechanical stackers—either automatic or semiautomatic—will find greater usefulness. Both edge-to-edge and spaced board stacking can be obtained with this labor-saving equipment. Sorting for length ahead of the stacker is often a desirable requirement. Then packages with both ends square can be readily built up.

If the output of a mill is cut back because transport of unit packages is slowed by poor roadways, then yard and mill site surfacing seems justified. A producing mill or woodworking factory that air-dries lumber in unit stickered packages, and subsequently kiln-dries

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them in a package-loaded or conventional track-type dry kiln, needs good solid roadways for truck operation if production costs are to be kept down.

THE IMPROVED AIR-DRYING YARD

Conventional air-drying methods remain the cheapest way to remove free water from many of our Southern hardwoods. As air-drying costs increase, shed-fan-air-drying, forced-air-drying, predrying, and even kiln-drying of the green lumber may be justified. We have used a figure of about 15 cents per thousand board feet per day for the fixed costs of air-drying hardwoods. Stacking costs, take-down costs, and transportation costs are variable costs that must be included to obtain the over-all cost of air-drying. I have been told by researchers that our figure of 15 cents per day per thousand is on the liberal side. However, I have had some mill men tell me that we are on the conservative side. Either way, however, I want to discuss three aspects of air-drying Southern hardwoods that might significantly influence your air-drying costs.

That 15-cent figure includes an estimate of the loss due to grade change or degrade. One place where grade losses take place is in the upper courses of high-grade stock due to exposure to the weather. I am proposing that pile covers or pile roofs can be justified. For years we have urged the use of pile roofs on the basis of grade savings in the upper courses of the top packages. But in addition to the grade savings, pile roofs can also save time and increase yard output per acre.

For example, in the fall and winter, air-drying is retarded by rainy weather. Drying time may be extended by as much as 50 days. With pile roofs we may pick up 30 days of the 50. This is worth $4.50 per thousand plus the grade savings. The brighter, more uniformly dry stock may also have an increased marketability value. This further justifies the use of pile covers.

YARD ORIENTATION

The next subject that I want to touch on is yard orientation. In our Northern states, the yards are often oriented with the main alleys directed north and south. This gets as much sunshine as possible on the alleys to melt snow and ice rapidly. Some of the producers of redwood feel that the yard should be oriented to get rapid rainfall evaporation on their black-topped yards; thus, they obtain a better air-drying potential. This may also be a factor here in the South, provided that the yards are black-topped to absorb solar radiation.

I would like to suggest, however, that orientation is important in the Southern hardwood air-drying yards, though not necessarily because of solar radiation. In this area, I believe, the main alleys should be parallel to the prevailing winds. A number of people do not agree with me on this matter. My main argument is that in a unit package air-drying operation, the prevailing wind is the main means of getting air movement through the packages. How should packages be placed in the yard to assure that the prevailing winds stimulate air movement through the packages? Well, remember how we used to pull a partial vacuum in a bell jar with a water aspirator on a water faucet in the high school laboratory? Here's a modification of that principle. We induce the movement of air through the stickered packages by having the prevailing winds move down the main alleys. The packages are parallel to the main alley, and the air movement within the packages is parallel to the stickers.

The objective again is to accelerate the rate of free-water reduction so that the output per acre of land area in the yard is increased, reducing over-all costs. Remember that 15 cents per day per thousand figure!

Now I come to that real industrial problem of controlling surface-checking in the drying of oak and other refractory woods. The surface checks do not show when most of the free water is evaporated from a board. The fissures are closed up pretty tight and the grade is not changed. The furniture manufacturer, however, may have trouble utilizing this stock. And this brings up a key point. How can I reconcile my recommendations for fast drying, *yet* reduce the likelihood of surface-checking lumber such as flat-sawn oak?

My answer is simply pre-surfacing. Here is an idea that has not been generally accepted. The buyers does not want to pay more for stock that is free of surface checks. He feels that it is the responsibility of the producer to prevent excessive surface checking. The producer presumably cannot afford to pretreat green refractory stock to minimize surface checking. Thus, the argument is that pre-surfacing to reduce surface checking cannot pay its way.

I think pre-surfacing can pay—by making surface control a by-product! Pre-surfaced stock is of uniform thickness, and provides a way to restrain warp through good sticker alinement of uniformly thick, dry stickers. I am of the opinion that the cost of pre-surfacing green refractory woods like oak, particularly mis-cut stock, will be covered by the reduction in grade and volume loss due to warp. The reduced surface checking will be a by-product that the producer can pass on to the fabricator as improved quality at no extra cost.

LOCATING LOSSES

Again I want to state that your air-drying costs can be reduced and the quality characteristics enhanced. The big, big unknown in air-drying is the loss due to degrade. I suggest that you have your grader determine the extent of this loss by dual grading a sample lot some day when the extra time can be justified. Have him tally the grade and volume of an air-dried board as it can be shipped. At the same time, have him tally the grade and volume of the board as it might have been if certain defects had not occurred.

If the reasons for these defects are also tabulated, you will have a good estimate of where your losses are occurring. You can then determine if you can afford to do something about them.

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