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FOREST PRODUCTS UTILIZATION

TECHNICAL REPORT No. 3

MAINTAINING MOISTURE CONTENT CONDITIONS DURING LUMBER STORAGE

After lumber has been kiln dried, it is often placed in storage, unstickered, until ready for use. If storage periods are short (up to 1 month) and the storage building is kept closed most of the time, little change in moisture content will occur. However, in many cases dry lumber is stored for several months or longer in buildings not designed to maintain a fixed equilibrium moisture content (EMC) condition. In some arid regions of the United States, such as Arizona, New Mexico, and southern California, unheated dry storage will hold dried lumber at a low EMC condition. However, in the rest of the country, unheated dry storage will not prevent kiln-dried lumber from gradually increasing in moisture content.

Keeping lumber at a constant EMC condition, using only heat and no steam or moisture supply, is described in the attached article by Ray Rector of Drexel Enterprises, Inc. The article won the S.E. Dry Kiln Club's seasoning award and was published in the Southern Lumberman magazine.

The differential thermostat that Mr. Rector favors can be adjusted to maintain any desired EMC condition. Air at a given temperature and relative humidity condition contains a fixed amount of water vapor, designated its absolute humidity and expressed in grains per cubic foot. When the temperature of this air is raised and no extra water vapor is introduced, the relative humidity of the air is decreased. As a result, the EMC is lowered. For example, the attached figure shows that air at a temperature of 50° F and 80 percent relative humidity (an EMC of 16 pct.), holds about 3.5 grains of water. If this air is heated, what temperature needs to be maintained at this absolute humidity to produce a predetermined lower EMC? A glance at the chart indicates that if 9 percent EMC is desired, the temperature must be raised to 65° F; if 7 percent is desired, the temperature is raised to 75° F.

It can also be seen from this chart that the EMC of wood remains almost constant throughout the range of temperatures shown when a constant relative

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humidity is maintained. (On the chart, the lines of EMC and relative humidity are almost parallel.) For instance, at 35 percent relative humidity, the EMC of wood is held at about 7 percent throughout a wide temperature range. For this reason, hygrostats which hold a constant relative humidity condition are also very popular for maintaining the moisture content of wood in storage or in the plant.

Thermostatic and hygrostatic controls are readily available from manufacturers listed in industrial directories.

For further information on this subject and other areas of forest products utilization, contact your State Forester who cooperates with the USDA Forest Service in providing direct assistance to forest landowners, loggers, and wood processing firms.

These technical reports are issued by State & Private Forestry. Suggestions for topics for this report can be forwarded to Forest Products Laboratory, One Gifford Pinchot Drive, Madison, WI 53705-2398.

Logging and Sawmilling

Dry Storage Operations

By **RAY M. RECTOR**, *Drexel Enterprises, Inc.*®

As may be expected, the interpretation of the phrase "dry storage" varies considerably. What is your interpretation of Dry Storage?

Open Sheds

An open shed that may consist of a roof with no side or end walls, or a shed that may be open on one or more sides, is a dry storage shed and should be advantageously used to store green or air-dried lumber. Also, some products such as plywood, framing and other building materials may be adequately stored in this same type of structure. However, during the next few minutes, we will discuss dry storage of well-seasoned lumber destined for furniture or other high-grade use. Stock of this nature must be stored in a closed shed.

Unheated Closed Sheds

Kiln-dried lumber stored in an unheated closed shed will ordinarily absorb some moisture. Moisture is absorbed because the moisture content of the wood is usually lower than the E.M.C. (equilibrium moisture content) corresponding to the atmosphere within the shed. A study of moisture absorption by lumber stored in an unheated shed proved to be variable, depending on the outside weather conditions. However, any appreciable moisture gain cannot be tolerated if we are manufacturing furniture.

Before ruling out the unheated closed shed, I think it only fair to admit that this type of storage is being successfully used. If the unheated shed is used, then more precautions are to be taken. There should be no delay in the consumption of the lumber, and more precautions are to be taken during the original construction of the sheds.

The unheated shed should be located on a dry, well-drained site with a concrete or asphalt floor. Also, ventilation of the shed should be provided by adjustable openings in the roof and walls. Above all, never expect to use an earthen floor if the shed stands on a low, damp site.

As previously stated, the unheated shed is, in some cases, being used. Per-

sonally, I do not like this practice and will hasten to recommend only the heated shed for dry storage.

Heated Sheds

The efficiency of a closed shed in maintaining a low moisture content in lumber is enhanced if it is heated as weather conditions require. Heat is most useful when the outside air is cool and damp. In an unheated shed, the only possible procedure during cool damp air is to close the vents and hope that the bad weather will not be prolonged. When a source of heat is available, a low relative humidity within the shed can be maintained by increasing the shed temperature.

It has been proven that heating or cooling the air affects the relative humidity of the air and the E.M.C. of wood. For example, assume that the air has a temperature of 30°F, and a relative humidity of 75 per cent. The corresponding E.M.C. of the wood is 15 per cent. If this air is heated to a temperature of 45°F, and no moisture is added from sources within the shed, the relative humidity is reduced to about 41 per cent and the E.M.C. of the wood is eight per cent. Heating sheds according to this system eliminates the need for steam sprays, water sprays, or refrigeration to control the moisture of lumber.

The most practical way to supply heat to a closed storage shed is by means of steam coils, radiators, or unit heaters. Since only enough heat to raise the shed

temperature 10° to 20°F. is usually required, the heating system need not have a large capacity. The heating system should be arranged so that the temperature throughout the shed is reasonably uniform. The inside temperature should be maintained at about 15° above the outside temperature, with a minimum of 32°F, to prevent the return lines and traps of the heating system from freezing.

The heat supply may be controlled manually or automatically. If the manually controlled system is to be used, the following handy and simple device for measuring conditions in the shed may be put to use. A piece of wood whose weight is adjusted so that it indicates the E.M.C. corresponding to the atmosphere will serve this purpose. For example, if the weight has been adjusted so that the oven-dry weight of the piece of wood is 100 grams, then a weight of 106 grams indicates six per cent moisture. When the sample wood indicates a moisture content higher than desired, the heat should be turned on. A day later, the wood sample quite likely will indicate a moisture content lower than desired, and the heat should be turned off.

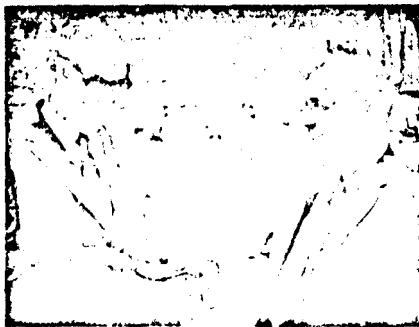
If the heat is to be controlled automatically, several methods may be used.

A hygrostat can be adapted to maintain a given equilibrium moisture content for lumber. As the temperature in the shed drops, the relative humidity increases, causing the hygroscopic element, which in this case is the wood sample, to absorb moisture and swell. The swelling of the wood activates a mechanism that turns on the heat. When the temperature is increased and the relative humidity decreases, the process is reversed.

Differential thermostats can also be used to maintain a given equilibrium moisture content. This is a device that can be pre-set to maintain an advanced temperature in the shed that is related to the outside temperature. As previously stated, the inside temperature should be about 15° above the outside temperature. This will hold the stored lumber at the desired six to eight per cent moisture content.

The differential thermostat is very dependable, economical, easily installed, and the maintenance cost is low.

We have discussed the Open Shed, Closed Unheated Shed, Manually Heated Closed Shed, Hygrostatic Controlled Shed, and the Differential Thermostatically Controlled Shed. All of these have their merits. However, my vote is for the Differential Thermostatically Controlled Shed.



Ray M. Rector, Drexel, N.C. (left), with Drexel Furniture Co. receiving first prize check for \$150 for his paper "Dry Lumber Storage" from C. H. ("Hal") Moore, Lenoir, N.C. with Broyhill Furniture Inds. and president of the Southeastern Dry Kiln Club. The award, was made at the club's recent meeting in Martinsville, Va.

¹This paper was given first place in the Southeastern Dry Kiln Club's Annual Seasoning Award, and was presented during the fall meeting, November 20, 1971, in Martinsville, Virginia.

