SEASONING OF WOOD

RAYMOND C. RIETZ

The living tree holds gallons and gallons of water in the walls and cell cavities of the fibers that make up the structure of its wood. The fibers dry out and shrink when they are exposed to air. Thus the rough products of the tree—poles, posts, ties, boards, ax-handle blanks, barrel staves—shrink as the water evaporates from the wood. This is the seasoning process—drying and shrinking.

The use to which the seasoned wood is to be put determines how much water is to be removed in drying. Lumber for a barn, which is exposed only to changing outdoor air conditions, need not be dried to as low a moisture content as hardwood boards for fine furniture, which is exposed to heated indoor air in winter. Another example: Wood for a croquet ball, which has to stay round despite knocks and dampness, must be dried and shrunk more than wood that is to be used in a rough packing crate.

Two principal seasoning processes are in common use, air drying and kiln drying, each of which is better adapted to some uses than the other.

The air drying of wood is much like drying the family washing, except that the boards cannot be so simply hung on lines or directly exposed to the sun and the wind. It consists of piling the lumber outdoors so that air currents can circulate through the pile and carry away the moisture from the surface of the wood. As the surface dries, moisture from within the board replaces it and, in turn, is carried away by the air. It is a slow process, but on the whole is quite satisfactory. For some special uses, such as hardwood furniture, flooring, and millwork, air drying in most parts of the United States does not dry wood to a low enough moisture content for satisfactory use. In such cases the hardwood lumber is usually first air-dried at the producing sawmill and then kiln-dried to a still lower moisture content at the woodworking factory.

With a little care and attention to details, lumber can be piled so that it will not warp, check excessively, or become infected with decay while air seasoning.

First, the air-drying yard should be laid out to make full use of the prevailing winds, because the greater the air movement through the pile, the quicker the lumber will be dried. The bottom of the pile should be designed to allow free movement of air underneath, and this pile should usually be arranged so that it slopes from front to rear in order that rain water will drain away readily. The slope of the pile is determined by the arrangement of the piers, those at the front being higher than those at the rear of the pile. To reduce yarding costs, some producers are experimenting with horizontal lumber piles built up from "packages" of lumber moved about with lift trucks. The pile piers are all of the same height to accommodate the handling equipment, and the built-up seasoning piles are flat.

As the pile goes up, it should have a forward pitch of about an inch to each foot of height. Over each layer of boards, narrow strips, called stickers, should be laid crosswise, about 2 to 4 feet apart, to keep the layers separated. An inch or two of space should be allowed between the edges of boards for air to move up or down through the pile. Boards should be placed carefully, so that the various air channels are unobstructed. Stickers likewise should be lined up one above the other; otherwise the boards lying on them may be bent by the weight of the boards above and warp in drying. Finally, a roof consisting of a double layer of boards, the upper layer overlapping the lower, should be put over the pile so that it will overhang the front end 1 or 2 feet and should be held about 6 inches above the top layer of boards by a few timbers laid crosswise on the pile. Piles should be built so there will be no overhanging boards at the rear.

When conditions favor too rapid drying and excessive checking, the checking can be reduced by making wider piles, narrowing the space between piles, piling the boards edge to edge, narrowing the vertical air channels, using thinner stickers, and, sometimes, by using shields around the pile for protection against wind, rain, and sun. When the season of the year reduces likelihood of checking, or the species being dried is not likely to check easily, the circulation of air through the pile can be stimulated by opening up the pile. Faster drying is thereby obtained, and stain and decay are retarded. Roof boards or pile covers prevent exposure of the boards in the top layer to the direct heat of the sun, which will invariably cause checking. At some plants, lumber of high value is air-dried in open sheds to prevent loss of quality by more direct exposure to the elements.

KILN DRYING is a process designed to hasten drying by circulating large volumes of warmed air through carefully piled lumber. Modern drying kilns equipped with blowers or fans can dry wood more thoroughly in a few days than can be done by air seasoning in months. For some kinds of lumber, kiln drying is indispensable.

In modern dry kilns, conditions can be had that favor the fastest possible drying with a minimum of drying defects. In kiln drying, as in air drying, the atmosphere is used as the medium whereby heat is conducted to the wood to evaporate the water it contains. In kiln drying, however, the atmospheric conditions of temperature and relative humidity can be controlled with a reasonable degree of accuracy. Thus, the dry kiln is independent of weather conditions.

Most modern dry kilns are of the forced-air-circulation type. Steam coils are generally used for heating air that is circulated through the loads of lumber. Recently, furnace-type dry kilns have been developed for use where it is not economical to install steam boilers. In such dry kilns, the steam-heated coils are replaced by large pipes or manifolds in which the hot gases resulting from the burning of sawdust, gas, oil, or other fuel are circulated.

Good results depend largely on good piling practices. For kiln drying, lumber is usually flat-piled on kiln trucks with an adequate number of stickers. Warping of boards is prevented by good piling, stickers used in good vertical alinement, and other mechanical devices that make better loads.

The way air circulates within the kiln determines how the loads are to be piled. Thus, in internal-fan kilns designed to move air across the loads, the lumber is piled edge to edge in each layer. In external-fan kilns designed to deliver air upward into the load from a central delivery duct, the lumber is usually stacked with an A-shaped flue in the middle of the load to distribute the delivered air. Many natural-draft kilns are still in use, however, and in such kilns the lumber is piled with spaces between the boards and usually with one or more flues. In contrast to the forced-air-circulation kiln with its edge-to-edge piled loads, the load as piled for a natural-draft kiln contains considerably less volume or footage.

Designing a lumber dry kiln requires a knowledge of mechanical heating as well as ventilation engineering. Some kilns seem to be of simple engineering arrangement, but actually the relation of the size of the room to the size of the kiln charge and the placement of fans, fan baffles, ducts, and heating coils are not simple.

The design of the heating system and the method of coupling it to the temperature-control apparatus (so as to provide uniform temperatures along the length and height of the entering-air side of the kiln charge) are particularly important if precision drying is to be done. The structural materials in the building, whether wood, concrete, brick, or tile, also have a bearing on the expected life and maintenance costs of the kiln. Manufacturers of dry kilns and engineers can provide such engineering services.

The early dry-kiln designs involving forced-air circulation with internal fans were developed at the Forest Products Laboratory, and the patents on them were dedicated to public use. The dry-kiln companies and engineers whose designs are based on those patents attest to the soundness of the design. The development by the Forest Products Laboratory of the internal-fan type of dry kiln resulted from a need for drying freshly sawn lumber quickly, cheaply, and with control of seasoning defects.

Perhaps the most important aspect of kiln operation is the changing of the conditions of temperature and relative humidity within the kiln so as to control the drying of lumber in accordance with a definite schedule. In most schedules, the initial drying conditions for lumber that is freshly sawn are mild enough to prevent seasoning defects, such as end and surface checking. For some hardwoods, the initial temperature may be 105° F.; and some softwoods can be subjected to 180°. The initial relative humidities are quite high (80 percent), but they are rapidly reduced as the stock becomes drier. As the lumber dries, the temperature is usually raised until rather high temperatures and low humidities are reached near the end of the process. Final temperatures are often near 200°, and final relative humidities as low as 15 percent.

A typical drying schedule is based on the moisture condition of the lumber, and changes in temperature and relative humidity are made when certain stages of lumber dryness are obtained. Samples in the kiln are periodically weighed to determine the moisture condition of the stock, and the rate at which the samples dry determines when the changes in temperature and relative humidity are made. Some of the softwoods, however, are dried at such high temperatures and in such short periods of time that the changes in drying conditions are placed on a time basis. In that case, freshly cut lumber is subjected to certain initial drying conditions that are changed after a certain number of hours of drying, the time of the changes having been determined by previous studies or experience.

Before any charge of lumber is removed from the dry kiln, it is desirable to operate the kiln at conditions that tend to bring all of the boards to the same moisture content. Some boards dry faster than others and the drying conditions are changed so that the dry boards will not overdry but the high moisture-content boards will continue to lose moisture. This is called the equalizing period. The time required to equalize a charge of lumber depends on the species, its thickness, and the degree of nonuniformity of its moisture content at the time the stock is ready for equalizing. After equalizing, the lumber may be subjected to a conditioning treatment to relieve stresses that develop during the drying process. If hardwood lumber, for example, is not properly conditioned after kiln drying, boards, when resawn or cut into two thinner pieces, will tend to cup toward the newly sawn faces and may not be suitable for the use intended.

Wood that has been kiln-dried to low moisture-content values that are more nearly in equilibrium with those of winter-heated homes will absorb moisture from the atmosphere if it is stored in warehouses where normal outdoor air conditions prevail.

One of two courses is recommended for lumber stocks that have been kiln-dried to low moisture-content values, such as required in the furniture industry. Either the dry lumber should be fabricated immediately and the products protected from moisture changes with finish coatings, or the stock should be stored in warehouses that are heated sufficiently to reduce the relative humidity.

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PRESERVATIVE TREATMENT OF WOOD

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Wood now in useful service is being destroyed in this country by decay and insects at the rate of several billion board feet a year—an amount approaching the normal average used annually in the construction of dwelling units. The enormous drain upon the resources of our forests can be lessened through greater use of preservative-treated wood, one piece of which may do the work of several replacements of untreated wood.

The railroads long ago found that preservative treatments save wood and money. In the early days when most railroad ties were untreated, railroads required for replacements each year approximately 450 ties to the mile; in recent years when a large percentage of all ties in service were treated, they required less than one-third as many replacements to the mile. The same order of savings also applies to telegraph and telephone poles and to poles for other public-utility lines. Ninety percent of all poles now being set in the ground are either fully treated or butt-treated.

Many other wood products that are exposed to decay and insect attack are not so extensively treated. For example, a large part of the 600 million fence posts set yearly are not treated, although it has been shown that many species of wood in post size will last from 3 to 10 times as long when well-treated as when untreated. The serviceable life of still other products would be increased by preservative treatments.

The type of preservative used and the thoroughness with which the wood is treated have much to do with the length of service rendered by the wood. Good preservatives and poor treatments or poor preservatives and good treatments are of little value. The purpose of treating wood with preservatives is to protect it against decay organisms, insects, and marine borers.

Preservatives of various kinds are used to treat various classes of wood products.

Among the wood-preserving oils, coal-tar creosote has long been effective. It has good penetrating properties and will remain in the wood for many years; it is safe to handle, harmless to wood and metal, readily available, and reasonably cheap. It is used mainly on wood that is to be in contact with the soil and water out of doors, and where its odor will be unobjectionable and painting will be unnecessary.

For wood that is used indoors or not in contact with the ground or water outdoors, water-borne preservatives are usually favored. Among these are zinc chloride, chromated zinc chloride, and several proprietary preservatives consisting of various mixtures of compounds of arsenic, chromium, copper, or fluorine, all of which leave the wood in a paintable condition.

Still other preservatives, such as