ECONOMICAL AND EFFICIENT KILN OPERATION

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Kiln Lay-out

Economical and efficient kiln operations require proper kiln lay-out. The kiln should lie in the path of a straight line for the straight-line flow of lumber from the green chain or point of supply to the point where the product is loaded for shipment. Such operations also require labor-saving machinery -- stacking and unstacking equipment, lumber lifts, switching or transfer cars for moving lumber about the kiln, means of transporting lumber from one place to another, etc. Lumber should not be moved more than necessary, and the means of its transportation should be selected with regard to economy. It should not be handled by hand more than is absolutely necessary.

Lumber Saving

Drying Schedules Affect Losses During Drying

Proper kiln lay-out and labor-saving machinery that permit efficient and economical handling of lumber, also contribute to the effectiveness of kiln schedules by which lumber can be dried in the least time consistent with good quality of product. No one factor influences kiln degrade in lumber as much as the schedules by which it is dried. The Forest Products Laboratory has developed drying schedules for most commercial items of lumber. These schedules are in the main ultraconservative. Moreover, the grouping of species and items of lumber in accordance with the schedules by which they may be dried, is not an accurate measure of their seasoning characteristics. These schedules are in the process of revision, because in emergency needs for lumber their use would unduly prolong drying periods. In designing these schedules, perfect drying was striven for regardless of lumber grade or use. Little or no consideration was given to drying rate, which became critically important under the emergency demands of World War II and which continue to be highly important in the lumber shortage since the war.

In commercial practice, drying schedules are built up to meet certain use requirements. Such schedules will therefore vary from plant to plant. For example, No. 3 B common oak need not be dried so carefully as the higher-grade oak stock lumber or as beer-barrel staves. Kiln schedules may be obtained from various agencies, but in the final analysis the kiln operator must modify his schedules in accordance with his local problems and the standard of drying that his company requires.

Use of Samples

For experimental work.--The initial moisture content and drying characteristics of a charge of lumber vary from board to board. This is true whether the lumber comes to the kiln green from the saw or from various localities in varying degrees of air seasoning. In working up schedules to dry the various classes of lumber, the kiln operator should use as many samples as possible in order to obtain a good understanding of an average cross section of the material with which he is working. As soon as he has developed his schedule to his satisfaction, the number of samples can be decreased in accordance with his experience with the lumber and with the demands other kiln responsibilities make upon his time. It may be that he can reduce his schedule to a time-temperature basis, or he may find that a very limited number of samples is sufficient to guide his judgment. When the process for a given item has been developed to a routine-production status, the experimental part of his work is done.

Routine use of samples.--A kiln operator rarely pulls a charge of lumber without giving it some sort of test for moisture content. The hearing of some operators has become sensitive to the sound produced by the vibration of boards at different moisture values. Others cut into the boards with big knives. Still others pull a board from the load, cut a moisture section from it, and then determine its moisture content by the oven-dry method. Of all these and other methods of testing for moisture content, none are so satisfactory as the use of the familiar sample method. The number of samples used for the purpose will depend upon previous experimental work and upon the time the operator has at his disposal. The samples will aid the operator in following the schedule he has developed during his experimental work and in maintaining his standard of drying with respect to degrade and moisture degree of seasoning.

Drying for Ultimate Use

A kiln operator renders his company maximum service when he is on the alert for the solution of manufacturing problems. Nothing is more convincing than an adequate amount of well-organized data that bear directly upon the problem at hand. Besides his regular responsibility of putting the lumber through the kiln, a kiln operator should feel that it is also his responsibility to study problems that, when solved, will improve his drying technique. Such questions as the following illustrate the type of problems that he might well investigate.

1. Does it pay to condition a certain item of lumber?

2. Is uniformity of moisture in the lumber as it moves through the plant up to standard? What can be done to improve it?

3. Is there a particular sticker spacing in a kiln truck that best controls the warp in a given item of lumber?

4. What are the most expedient methods for handling the lumber from the kiln to the swing saw?

An experimental approach to each of these problems and to many like them will readily occur to the operator. The general research technique that underlies them all is to have everything the same in two or more groups of boards except the variable that one wishes to investigate. To compare the grade or to compare respective yields of the test lots of lumber, the amount of lumber in each test lot should be as large as circumstances will allow, with probably 5,000 board feet as the smallest amount of material that will give reasonably reliable results.

Uniformity of Kiln Conditions

An operator cannot do his best kiln-drying work unless the kiln can be relied upon to maintain uniform drying conditions. In a compartment kiln it is not enough to maintain the desired schedule in the region of the recorder bulbs; the entering-air conditions through the length of the kiln must be uniform. If this requirement is not met, one or more of several things can happen. The lumber in one section of the kiln may check and honeycomb, while in another the lumber may mold. The drying time may be prolonged. The moisture uniformity may fall below par.

Lumber Saving by Proper Stacking

In an interview, a prominent lumberman who fabricates his own lumber made a statement to the effect that warp is the most serious defect in lumber. Warping in some species cannot be entirely controlled. The only means so far devised for minimizing warp is to employ the very best piling methods known. In piling 4/4 gum on a kiln car it may be desirable to have sticker spacing of no more than 1 foot. Commonly, in piling hardwood lumber a 24-inch sticker space is used, but this spacing is not close enough to control the warping of certain items of lumber. Box piling can be used to avoid overhanging ends resulting from piling random lengths on a kiln car. Casual box piling, however, will not pay. Unless the proper technique of making a boxed pile load of lumber is thoroughly understood and the details of the process suitably carried out box piling will encourage warp. An alternate method used by some progressive lumbermen involves separation of each length of lumber on a kiln car by a solid floor of stiff 2-inch planks. The resultant voids between cars are then curtained off to reduce the tendency of the air to short circuit.

Effect of Preliminary Steaming on Conservation of Wood

If air-dried lumber is steamed in a saturated atmosphere at any time during the run, old air seasoning checks reopen when the lumber is subsequently dried. Initial, periodic, or final steaming treatment at relative humidities in excess of 90 percent is harmful to lumber that has previously been surface checked.

Steam Saving

When one realizes that hour by hour a heated kiln loses heat by radiation, the advantage of a short drying period becomes evident. To minimize the steam required to dry a charge of lumber, it is necessary to use the most severe drying schedule the lumber will stand without degrade. To reduce the heat lost by radiation, consideration should be given to the possible need for additional heat insulation on the roof of the kiln. Infiltration of cold air around the doors and through cracks and crevices in the kiln structure should be reduced to a minimum.

These precautions will not only have a direct beneficial effect upon steam consumption, but will also assist in bringing about more uniform temperatures in the kiln. With the uniformity of drying conditions maintained in accordance with the best possible schedule, the wood will dry as rapidly as its seasoning characteristics will permit. Certain general rules may be followed that enable one to maintain the desired conditions with the minimum amount of steam.

Fundamental Rules for Controlling Kiln Condition

Use of Moisture from Wood for Humidification

The difference between the dry and wet bulb temperatures is a rough measure of the amount of heat that is available for evaporating moisture from lumber.

For example, let it be assumed that a wet-bulb temperature of 160° F. can be maintained by the moisture leaving the wood and by the venting of the kiln while a dry-bulb temperature of 180° F. is also maintained within the kiln. Then if a smaller lower wet-bulb depression is not needed to prevent surface checks, or, in other words, if a 20° F. wet-bulb depression is not excessive, the moisture from the wood is sufficient to maintain the desired relative humidity. If, however, the dry-bulb temperature is raised to 200° F., the steam spray would have to be put in operation to raise the wet-bulb temperature to 180° F. With the same wet-bulb depression, in this range of temperatures, no appreciable increase in drying will be effected; hence, the steam required to raise the wet-bulb temperature from 160° to 180° F. would be wasted.

Many wet-bulb control systems open and close the vents automatically. When the dampers on the vents remain closed all the time, and the wet-bulb temperatures coast above their desired temperature, it would be wasteful of steam to vent the kiln so much that additional vapor is required from the steam spray in order to maintain the desired wet-bulb temperature.

Excessive Venting

One of the fundamental rules of kiln operation is to vent the kiln no more than is necessary to prevent the relative humidity from becoming greater than that desired. Air that is vented has to be replaced by cold air that in turn must be heated to the desired dry-bulb temperature and at the same time be humidified so that it has the proper wet-bulb temperature. Evidently, therefore, excessive venting wastes steam spray and also puts an additional burden on the steam coils.

Preliminary Steaming

Steaming a charge of lumber at 100 percent relative humidity usually serves no useful purpose and in many instances is positively detrimental. In any event, the process requires much steam, and while the kiln atmosphere is saturated the lumber cannot dry; hence, the period the lumber must remain in the kiln is prolonged.

Steam for Humidification

When it is necessary to control the humidity with the steam sprays, the dampers on the vents should remain closed most of the time. For best results, the steam pressure should be adjusted so that the kiln is calling for steam about 80 percent of the time. If, when the thermostat calls for steam spray, a large amount of steam is immediately released into the kiln, the wet-bulb temperature will rise above the set point. The result of such operation is cyclic wet-bulb temperature action and a higher average wet-bulb temperature than called for by the schedule. Naturally, the drying time will be prolonged, and the quantity of steam required to dry the charge will be increased.

Unnecessary Radiation

The uniformity of temperature in a dry kiln is a "must" if the kiln is to operate efficiently. In operating long kilns, particularly at low temperatures, experience has shown that at a given steam pressure the use of the smallest amount of radiation that will maintain the desired temperature is more conducive to temperature uniformity than a larger amount of radiation.

Saving Time of Kiln Operator

Routine Inspection

Routine inspection reduces the likelihood of mishaps that will interfere with the easy flow of lumber through the kiln. The routine and experimental work suffers when the time of the kiln operator is wasted by preventable emergencies. Moreover, it is not easy to take care of a kiln wreck or to grease a

hot bearing during the kiln run. A kiln operator will therefore save himself time, effort, and worry when everything about the kiln is in working order, the tracks in line, the trucks greased, the water boxes clean and well supplied with suitable water, all wet-bulb wicks clean and fresh, etc. Of course, the final criterion of a kiln operator's work is his ability to dry lumber in the fastest time consistent with degrade; but lacking this information, there is no better measure of his efficiency than how he keeps house. Housekeeping includes not only neatness of equipment and records, but systematic planning and execution of the job. As the lumber is loaded, sample slots should be built into the load; suitable sample boards be laid out by the stacker; and saws, scales, ovens, etc., be conveniently located so as to avoid confusion and reduce work involved in preparing and placing samples. By developing a suitable routine, the kiln operator will save time so urgently needed to improve schedules and to carry on related research.

Saving Kiln Capacity

One of the kiln operator's functions is to time the loadings and unloadings of his lumber so that the kilns will be drying lumber all the time. In this sense he is literally a traffic manager. This in itself is a big job, particularly when the lumber flow is not steady and where a large number of kilns are involved. Even at best, a certain amount of kiln capacity will be lost because of unforeseen delays and mishaps. Yet it is surprising how much can be done to increase kiln turnover by careful planning. At one plant where careful records were kept for a 6-month period, it was found that only 87 percent of the lumber that could have been dried passed through the kilns. This means that 13 percent of the kiln capacity was lost. At another plant, by improving the drying schedules and doing a better job of keeping the kilns full, it was possible to free 20 percent of the kiln capacity for the drying of items that previously had gone to the yard. Fortunately, in this case the quality of drying was improved while the kiln turn-over was increased. A point is made of this aspect because the quality of drying should not be sacrificed in an attempt to speed up the drying process.

Kiln capacity will be saved by drying lumber as much as possible before it goes into the kilns. A cushion of lumber stacked on kiln cars in front of kilns will provide a prekiln drying period and also insure enough material with which to load a kiln as soon as it is pulled.

Collecting and Saving Records

Complete records of various kiln charges will go a long way toward protecting the dry-kiln department and the management from complaints. It is therefore a good practice to collect and file complete records of each kiln charge. The records should show the performance of the kiln and the moisture and stress conditions of the lumber involved.

A complete library of kiln-run records including schedules, drying rate, kiln performance, steam pressures, and other pertinent information, can be consulted and reanalyzed at any time. Information of this kind is necessary to improve dry schedules and to understand better the drying characteristics of various items of wood obtained from different localities at various degrees of seasoning. Analysis of the records may bring out a peculiarity of a specific kiln and may indicate whether or not it is working properly.

Organization

Naturally, the manager of any business wants to keep his overhead at a minimum. Accordingly, he is constantly on the watch for men in his organization who do not pay their way. But there is scarcely any department where poor work will cost as much or any department where good work will pay such rich dividends as the dry-kiln department. It is therefore good business to give a good kiln superintendent all the responsibility he will take and to give him all the help he needs to make the best of his job. In addition to operating his kilns, it is generally good practice for the kiln operator to supervise the stacking of all kiln trucks.