WOOD SEASONING--A DELIGHT OR HEADACHE

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Any work carried on in an ideal condition brings delight to the worker, while any deviations from the ideal conditions are generally accompanied by headaches, problems, or challenges to the worker. Let us examine the subject of wood seasoning in this context of delights or headaches and challenges.

Wood seasoning is necessary for various reasons, e.g. weight reduction for economic rail transportation to the markets, to prevent stain, decay and insect attack, to increase strength and stiffness in use and, above all, to reduce shrinkage and accompanied degrade in use. Generally, it is one or all of these reasons that creates the market demand which in turn requires the manufacturing operations to dry lumber. New code requirements have been recently imposed on the final desired moisture content of dried lumber as well as on the size of lumber. Lumber drying economics have to be carefully watched so that the additional cost of drying (kiln cost + dollar degrade) does not exceed the sales margin between green lumber and kiln dried lumber.

Some mills dry all the lumber they manufacture in the sawmills, while the majority of mills manufacture green lumber for export markets and for kiln drying.

To take a closer look into the delights and headaches of wood seasoning, let us examine various steps in the ideal setup and see what are the general deviations from the ideal conditions and how the problems attached to these deviations have been or can be solved.

1. Characteristics of lumber to be dried
2. Preparation of lumber for drying
3. Kiln geometry
4. Kiln schedules
5. Handling of K. D. lumber

Let us now discuss these five points.

1. <u>Characteristics of Lumber to be Dried</u>

   Like human beings, no two pieces of lumber are exactly alike. They could vary in specific gravity, moisture content, sapwood, heartwood ratio, flat grain and edge grain, etc. The author visited some sawmills recently where all the production was geared for dimension grade kiln dried lumber. The thickness variation was $\pm$ 1/32" and the green chain was directly connected to kiln stackers, where the loads were being prepared on one length sort only. This was close to the ideal situation which will make working conditions quite pleasant for most of the kiln operators. However, in general practice, the lumber when received for kiln drying is not so uniform. Personalized kiln schedules cannot be provided for each piece by taking into account its own variations. Hence, one has to group the lumber to be dried to the best of his abilities in practical mill conditions.

Random sampling of thickness distribution in lumber of 2" nominal thickness shows a range of 1 5/8" to 2 1/4". This creates headaches and problems for the kiln operator.

Similarly, the specific gravity and initial moisture content distribution in lumber received for drying is also very large. The ratio of sapwood and heartwood within each piece and in loads also varies to a great extent. In veneer drying, the segregation of high and low moisture content and sap and heartwood is done is some mills. Similarly some mills do segregate the "sinker stock" from the regular lumber for drying.

Mathur (7) pointed out that blanking (surfacing of green lumber) of green softwood lumber improves the drying characteristics as well as greatly reducing the degrade. Rietz and Jenson (9) pointed out similar results in drying blanked green oak. Blanking is one way of correcting for thickness variations that are so common in the present sawmill industry.

It has also been reported (4, 6, 7) that the residual stresses imparted by the use of band szw, circular saw or planer knife are different in nature and have a bearing on surface checking. It has been shown that the surface of lumber produced by planer knife results in minimum surface checks. Thus blanking of green lumber could result in improved grade recovery due to its surface characteristics as well as better restraint in a uniform stack.

It is to be pointed out that by predetermining the average allowance for shrinkage due to drying to the desired final moisture content, and allowance for final dressing at the planer, a minimum desired thickness of the stock can be calculated. Thus by presorting to the thickness dictated by such a calculation, excessive degrade might be avoided.

2. <u>Preparation of Lumber for Drying</u>

The lumber pulled out at the green chain for drying is generally sorted out for grade, nominal thickness and length in 2 ft. increments.

As discussed earlier, thickness variation in one nominal thickness sort could vary a great deal depending on the accuracy of the cut at the saws. At present, most of the mills prepare kiln carloads at the automatic stacker using these variations in thickness of the board and the length in 2 ft. increments. This step gives a great deviation from the ideal requirements of a kiln load, i. e. lumber of uniform thickness, length of boards and uniform thickness of stickers. These stickers should all be arranged so as to restrain the lumber from any movement. Less careful stacking methods create problems resulting in dollar losses for poor quality and quantity of dried lumber.

An ideal procedure might be to blank all the lumber to be dried, followed by thickness sorting to remove undersize stock. The undersized stock could be recycled later for blanking to the next lower thickness requirement. This process would provide good restrained kiln loads as well as improve drying characteristics.

Block loading of kiln cars is also very important. At present, most of the mills block load one end of the kiln car and the other end retains the problem of 2 ft. overhang or unrestrained ends. This step results in more degrade along with a reduction in kiln capacity.

Proper restraining of kiln loads is very important to reduce degrade in the dried lumber. In the present day technique of stacking, the bottom few layers of the 10 ft. high load bear a great restraining force, resulting in warp and sticker marks, while the top layers do not have enough restraint to hold them from warping. Kozlik (5) presented a study showing the effect of the restraining forces on degrade. A restraining spring loaded stirrup designed by the Forest Products Laboratory at Princess Risborough could also be used.

Apart from the size sorting for preparing kiln stacks, it has also been suggested by some research workers that lumber be segregated for initial moisture content to remove 'sinker stock' and dry it separately. However, extensive space requirements for introducing moisture segregation prior to drying are required. In addition, there is not always a clear relationship between initial moisture content and the length of time required to dry the lumber because of variation in the permeability of the lumber. Therefore, for these two reasons, segregation has not become a commercially accepted practice.

3. <u>Kiln Geometry</u>

There are at least a dozen companies manufacturing dry kilns and equipment for kiln drying. Each has some patentable feature and the net results are there are a great variety of compartment kilns (very few companies have progressive kilns for drying lumber). However, fundamentally all kilns provide control of three major requirements:

- Air circulation
- Temperature
- Relative humidity

Without going into the merits of each design of kiln, it is important to note here that the limitations of kiln design should be known to the operator, e.g. design of a fan system puts a limit on maximum air circulation speed; available steam pressure and amounts limits the maximum temperature and capacity and rate of heat exchange to the circulating air; venting systems may limit control of relative humidity.

The size of kiln compartments guides the size of the kiln cars as well as the number of kiln cars of different length combinations. Kiln operator's problems are reduced if he has a proper built-in baffling system in the kiln so that he can avoid any short circuiting of the air from the end and between loads or from top and bottoms of the loads during drying.

Accurate measuring of the temperature and relative humidity conditions as well as its controls is another problem area. Most of the kiln equipment suppliers could correct any problems in this area.

4. <u>Kiln Schedules</u>

Now that the lumber is properly stacked and kept in the kiln, the next question arises as to the best schedule which will dry all the lumber to the required moisture content with minimum degrade in the shortest possible time. Here again, the ideal condition would be if a schedule for each piece of lumber, based on its inherent characteristics (initial moisture content, specific gravity, permeability, etc.) could be used. This could never be possible as the kiln loads have a large number of lumber pieces where their inherent characteristics could all be different. However, since the inherent characteristics can be bracketed, a general drying schedule can be prepared to give optimum results.

The kiln drying schedules for different species, grades and sizes of lumber are developed at Forest Products Laboratories in most of the countries. However, as a rule these are generally very conservative schedules requiring greater drying time and resulting in less degrade than the generally accepted commercial schedules in use. It has been the general practice in the industry to develop specific drying schedules at each operating division, taking into consideration the species, grades, thickness and other local variations. The dry kiln manufacturers have also assisted individual mills in developing their own drying schedules.

A kiln drying schedule for drying 2" thick hemlock clears could call for start up and maintaining a constant dry bulb temperature at 200°F, and wet bulb depression changing from 5°F to 40°F in 10 days' time, with an average air velocity of 550 ft. per minute. The same lumber could be dried in 15 days drying schedule with relatively less degrade by starting the dry bulb temperature at 150°F and gradually raising it to 190°F, keeping the wet bulb temperatures constant at 150°F, and maintaining an average air velocity at 400 ft. per minute. However, the kiln productivity is then substantially decreased.

Dedrick (2) has developed a patented Constant Rising Temperature (CRT) schedule, and has claimed to reduce drying time and degrade. However, this patented system needs a new kiln humidity control system and so far has found limited use on the North American continent.

McMillan (8) and Espenas (3) explored the subject of drying stress and kiln drying schedules. According to them, the drying schedule should be kept mild during the early stages of drying (while the surface is in tension stress) to avoid developing surface degrade. However, once the drying proceeds to the stage where stress reversal takes place (surface is in compress stress), then the rate of drying can be increased by raising the dry bulb temperature and the wet bulb depression without risking development of degrade.

Schedules based on the stress development might have great merit in drying industrial clears and shop lumber, and more research work in this area is needed.

Drying of dimension grade lumber under the new ALS rules of 19 percent or less final moisture content has taken a great deal of time in developing new schedules at individual mills. Bramhall (1) reported a survey of results on interior B. C. mills' efforts to meet the new grade rule requirements. Much work has been done in coastal mills to adjust the drying schedules and process to assure the compliance of new standards.

The answer to the question of what is the best schedule of kiln drying a particular species, grade, thickness at a certain type of kiln has to be developed at the individual mill itself.

5. Handling of Kiln Dried Lumber

To get a good planed surface, it is important to cool the kiln dried lumber as it is discharged from the kilns. This is achieved in the industry by putting the entire kiln dried loads in cooling sheds for at least 24 hours prior to unstacking. At the unstacked, great care should be taken in collecting the kiln sticks (without effecting any mechanical damage) as this could save a great deal of problems during their reuse.

In the past, the moisture meters were installed behind the planer, although several research workers have advocated the use of in-line moisture detectors at the unstacker. This enables the rough dried lumber with higher than allowed moisture content to be rejected prior to being planed. This 'wet lumber' could either be sent back to the kiln stackers or sold as green, depending on the economics of rehandling. If this 'wet lumber' is planed before moisture metering, then by sending it for redrying, it has no chance to meet the original size requirements. Recent advances for in-line measuring the moisture content of rough lumber has made it possible to detect moisture at the unstacker itself. The use of this type of moisture detector could help guarantee meeting the code requirements related to moisture content of kiln dried lumber.

Headaches/problems do arise if the kiln dried lumber is not properly stored until it reaches its final end use destination. Kiln dried lumber, being a hygroscopic material, can pick up moisture if placed in an environment at equilibrium moisture content higher than its own moisture content. Therefore, as you know, it is usually recommended that a vapour barrier should be provided to either individual boards or to the entire packages of lumber. Such a vapour barrier can be provided by use of a water repellent treatment behind the planer or by wrapping in plastic coated paper or strippable polyethylene shrink wrap.

Another challenge in wood seasoning lies in increasing the capacity of drying lumber in the existing facilities. Apart from developing shorter and better drying schedules, one should also consider the following steps to increase the capacity:

1) Uniform thickness of lumber--by better sawing techniques or by pre-blanking.
2) Use of stickers of uniform thickness--a calculation should be made to determine minimum thickness of stickers that can be used in a specific kiln considering the capabilities of its air circulation system.
3) Block loading of kiln cars.

These steps could increase the capacities by 10 - 30 percent, depending on the existing conditions in a given kiln drying process.

This paper has covered some of the problems or challenges of lumber drying and how some of the identified problems have been solved to date.

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