MOISTURE GRADIENT OF LUMBER IN KILNS

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This paper is an outline of the way we set up drying schedules for fir, hemlock and cedar, using the moisture meter only.

I am not trying to evaluate the moisture meter, except to the extent of the relatively close patterns it shows when used as we use it. We have not attempted to make any heat corrections.

We were trying to set up an outline we could follow so that we could have some way to make corrections in our schedules from time to time, as we went along. This method gives us the information that enables us to make corrections without waiting. We feel it has been a great help to us and with very little effort on our part.

Our plant has two double-track Moore cross-circulation kilns, 66 feet long with eight 6-foot overhead fans. Each kiln has a capacity of approximately 100,000 board feet of lumber in 4'x 4' packages, loaded onto kiln cars by fork lifts, 2 packages wide and 3 high on each track. Lumber is loaded one length to each crib.

We are using Delmhorst moisture detector, calibrated for ranges of 7 percent to 12 percent, 12 to 22 percent and 22 to 70 percent. We use No. 26E electrode holder with pins 1-1/16-inch long. This holder is equipped with a scale that shows depth penetration of the pins.

End-coated samples 3 feet long and checked for moisture content are placed in the loads, in various places in the kilns, where they receive the same air velocity as the rest of the lumber in the charge.

Two-inch thick samples were tested at surface, or as close to surface as possible to get a reading, also, at 3/8-inch, 3/4-inch depths and the center of 2-inch material. In 1-inch thickness we tested the surface and the center of the pieces.

At 12-hour periods the sample pieces were taken from the kilns for testing. Readings were recorded and samples replaced in the kilns. These tests were continued until the lumber reached the desired end result. While it is not necessary to run graphs, I am sure it is worth while to do so.

It would be very difficult to set up a formula that would work in all kilns. Therefore, I would like to present graphs of schedules that have given excellent results with our kilns.

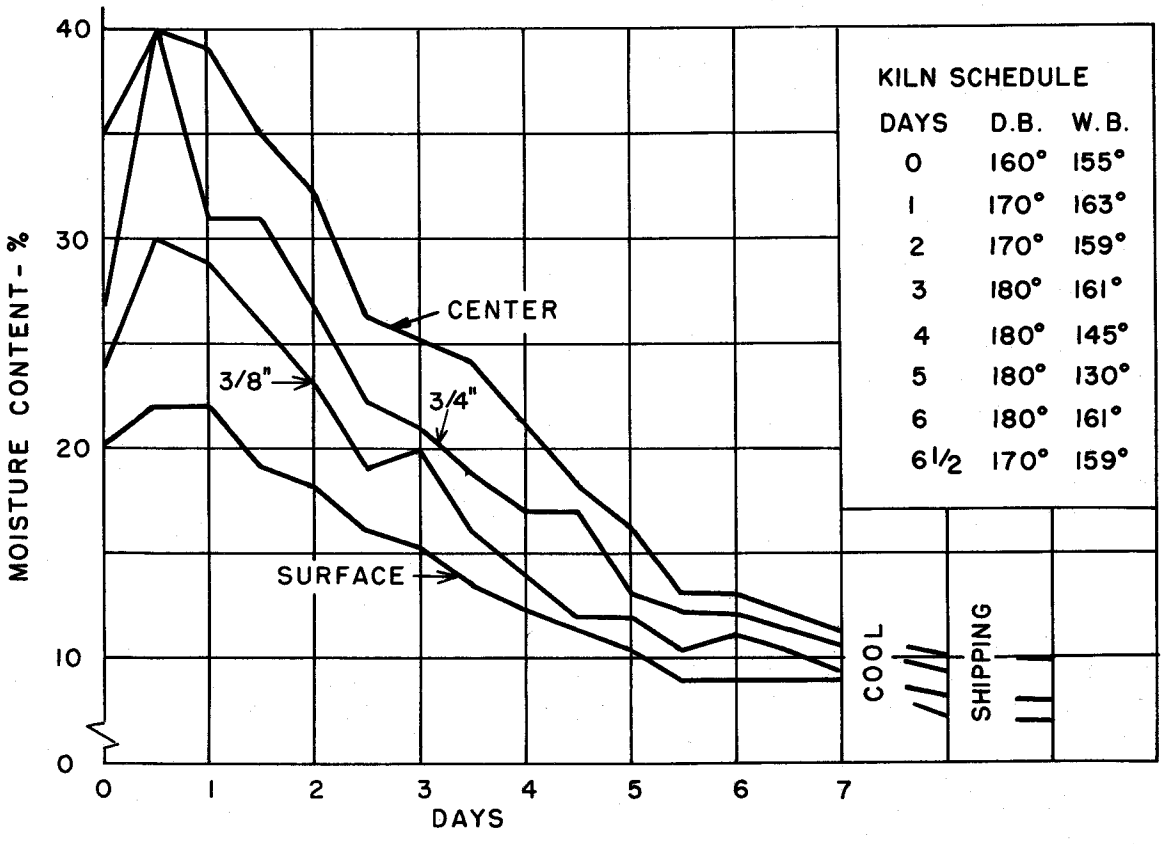
Graph for 2" Old Growth Douglas-fir Clear

This lumber came out of the kiln February 18, 1956. It was shipped on February 25, 1956.

One hundred pieces checked at time of shipment averaged 7.94% on the surface and 9.96% at the center. This averages 8.95%, approximately the same as when checked twelve hours after this lumber was removed from the kiln.

At the time this lumber was started into the kiln, the spread between surface and center was 15%, rose to 18% at 12 hours. After 12 hours the spread began to decrease but not faster than 3% in any 12-hour period. The average M.C. followed very closely the same pattern.

Note that at 132 hours the surface had reached 9% and the center 14%. This schedule, from this point must hold the surface as closely as possible to 9% while the center decreases to point desired. This graph shows that after 132 hours the surface reduced only one point (to 8%) while the center reduced four points (to 10%).



METER READINGS ON 2" DOUGLAS FIR CLEARS

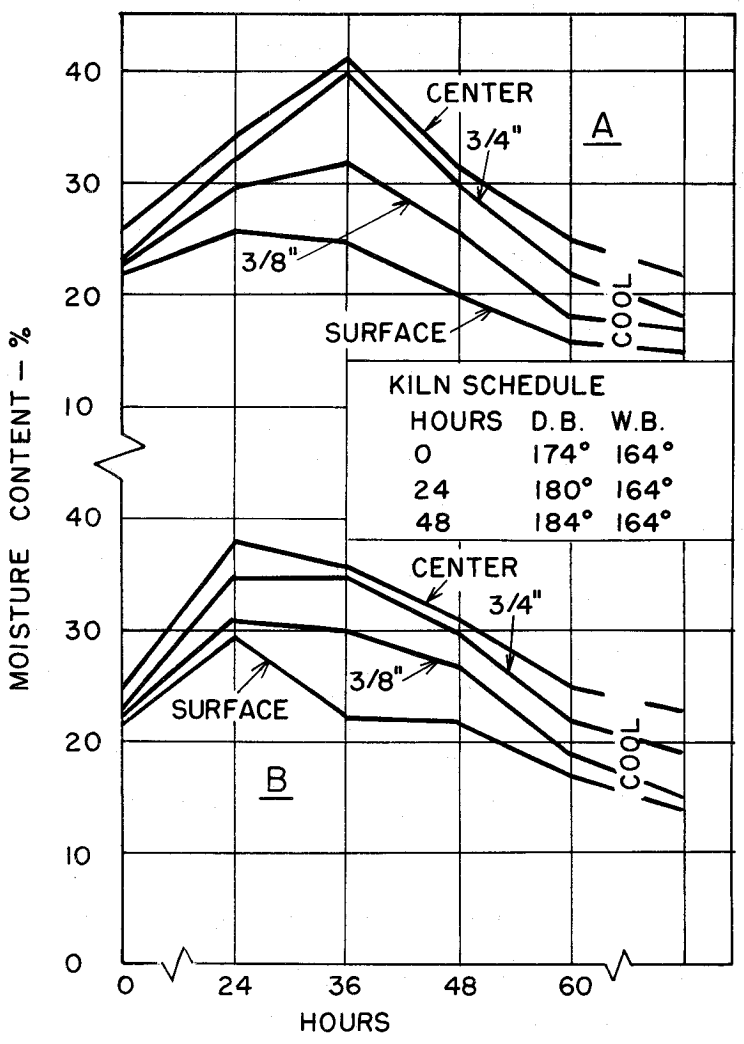
Graph for 2 x 6" Douglas-fir Common

At time of shipment 200 pieces from this charge were tested showing average M.C. of 16.92%.

Kiln samples used were heart pieces, which are the most difficult to dry and retain knots in the pieces.

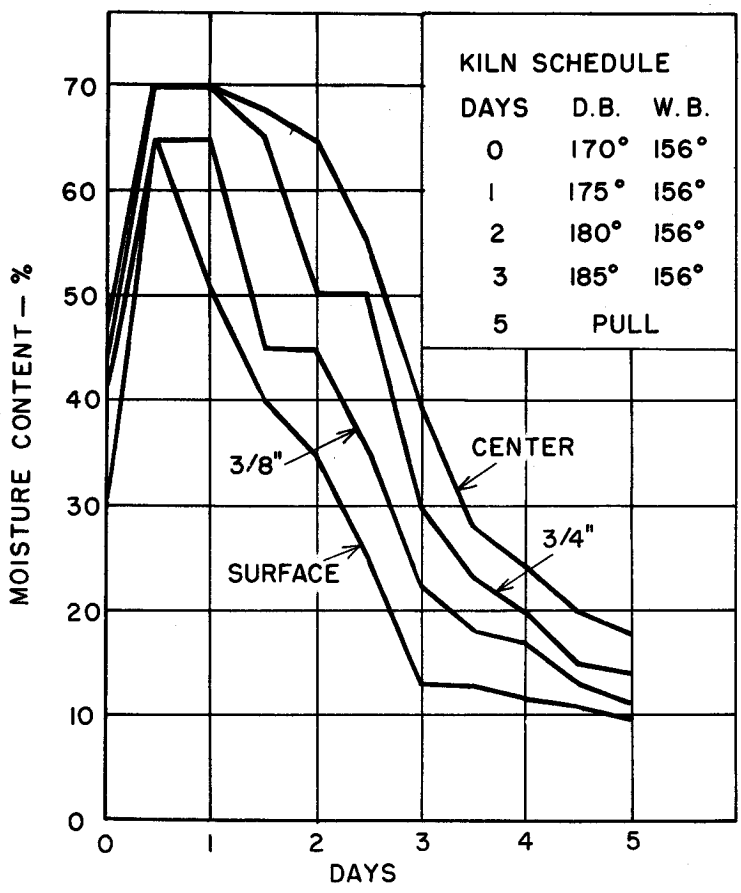
Sample A was from blow-down timber that had been on the ground long enough to have become partly dried in the log. Sample B was from live green timber. Both of these samples were in the same kiln charge.

Sample A showed moisture rise for 36 hours with a wide spread at 36 hours between the 3/8" line and the 3/4" line. Sample B had similar trend, but not so pronounced, and it reached its height in 24 hours. At this point a change to higher temperature and increased humidity is indicated. The higher temperature and increased humidity tend to make it easier for moisture to come to the surface while at the same time retarding drying of the surface.



METER READINGS ON 2"x6" DOUGLAS FIR COMMON

A - BLOW-DOWN TIMBER; B - NORMAL TIMBER



METER READINGS ON 2"x8" HEMLOCK

Graph for 2 x 8" Common Hemlock

This 2 x 8" hemlock was dried with the idea of ripping it to 2x4. It was not sorted. The heavy sap pieces and heart pieces were mixed and a fair percentage of the pieces were very dry before being put into the kilns. The dry pieces must be protected to prevent over drying.

Note the 16% spread between the surface and the center at start. At both 12 hours and 24 hours the spread must have been greater. We could not check because the M.C. was beyond our meter range, and the first reading we were able to get indicated a 28% spread at 36 hours. A 28% to 30% spread continued to 72 hours at which time the surface almost stopped drying, there being only a 3% drop in surface M.C. in next 48 hours, while in the same period the center dropped 22%.

After 12 hours in cooling shed, this stock checked out at average of 11.38% and held at this point until time of shipment. The samples showed only a 3% spread between surface and center. This narrow spread between surface and center is necessary in stock that is to be ripped.

In connection with the moisture meter, readings above 30% should not be taken as true values but as indications only. However, after making the tests on a number of kiln charges, the indications are so closely related to each other that one could use the graphs to advantage. We do at our plant.

By using the indications we are able to maintain better control of the spread of moisture content between the surface and the center of the board. Since using this method, we have been able to increase temperatures, resulting in more rapid evaporation of moisture.

It appears that by using a close check and control on drying gradients in lumber in the kilns, much higher temperatures can be used. If this is so, it would result in shorter drying time, thereby increasing the capacity of the kilns and reducing the unit cost of drying.

I am pleased to have had the opportunity to tell you some of the things I am presently doing in drying lumber. It has been a pleasure to appear before the annual meeting of our western dry kiln clubs here in Berkeley, California.