ESTABLISHING NEW KILN SCHEDULES IN PINE KILNS BY SOUTHERN OREGON-NORTHERN CALIFORNIA DRY KILN CLUB. PAUL LAYMAN, CAR ADCO COMPANY, KLAMATH FALLS, OREGON, PANEL LEADER.

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Developing dry kiln schedules based on the moisture content of the wood, with control samples. By Lyle Hickman, Palmerton Lumber Company, Klamath Falls, Oregon

A proper schedule for the kiln drying of wood, green from the saw, is a series of temperature changes and relative humidity conditions that guides the operator efficiently through each stage of the drying process. The desired objective is to produce the fastest drying rate that is satisfactory without causing objectionable drying defects. This objective, however, cannot be realized by use of a standard set of kiln schedules because of the following reasons:

1. Difference in the characteristics of the wood.
2. Local productions and selling practices.
3. In the degree of care in the kiln operations.
4. Kiln characteristics, such as the venting system, circulation and amount of heat available.

When I first started operating dry kilns, I asked the late Mr. Forest Cobb for help in planning schedules for drying Ponderosa pine and he gave me the following general guide, which I have kept and used to some extent, ever since.

1. Wet bulb not over 110 degrees at any time before lumber reaches F.S.P.
2. Hold dry bulb low enough to prevent sap boards from sweating.
3. Don't let wet bulb depression get so much that lumber checks excessively.
4. On air dried stock, watch sap boards for transfusion of moisture from the center of board to surface.
5. Watch lumber constantly.

Although this is an excellent guide, we need more definite information as to what is going on in the kiln, especially since we are now working with more species of wood and to a great part, with a poorer type of lumber than we had several years ago. Also, it has to be dried more uniformly for the more precise and complex re-manufacturing done now.

It has been found that in general, drying defects can be controlled best by the use of safe initial drying conditions. Drying rates can be accelerated with the greatest safety during the intermediate and especially the final stages of drying. Since temperatures are most critical with respect to honeycomb and collapse while the moisture content is above the F.S.P., the maximum safe initial temperatures should not be increased appreciably until after all wood is well below 30 per cent moisture content. Relative humidity is most critical with respect to surface checking. In drying green wood, the minimum safe initial relative humidity can be dropped gradually but at a progressively greater rate, during the time the wood is losing approximately, the second one-third of the original green moisture content, and still greater rate during the last one-third of the drying time.

These rather general guides in planning a schedule are mentioned to show that schedules based on the moisture content of the wood during the entire drying operations, instead of schedules based on time, are necessary to do a uniform and efficient job of drying. For this reason kiln schedules should be based on the information obtained by use of adequate control samples placed with the kiln charge.

A desired minimum number of control samples is at least one two-foot sample to each side of each crib. No less than six samples should be used in each kiln charge. The average moisture content of the wettest one-half of the samples govern the scheduled changes in the kiln conditions. Elaborate equipment is not necessary to handle the control samples. A regular oven, triple beam balance and regular spring dairy scale that is marked off in one-tenth of pounds, is all that is necessary. Technical men may frown at the use of such crude scales, but fair results may be obtained if one man weighs all the samples and gives and takes in regard to the tenth pounds, the same each day. More accurate weights may be obtained by using regular scales that are marked off in pounds and ounces. The ounces can be quickly converted to decimal equivalents with a regular machinists decimal equivalent scale used to convert fractions of inches to decimals. As there are sixteen ounces per pound, one ounce is equal to one-sixteenth inch or .062 on the scale, two ounces equal one-eighth in or .125, three ounces equal three-sixteenth inch or .187, etc.

An interesting example of setting up schedules is our experience in drying Philippine mahogany. This is not presented as the proper method of drying Philippine mahogany, but as an example of what any kiln operator may run up against at any time. When we received this stock, there was very little information available on how to handle it. With what we found out ourselves and with the cooperation of the Forest Products Laboratories, we set up schedules with very little hit or miss involved.

In sizing up our problem, we found the following good and bad points:

1. It did not check excessively.
2. Stain was no object.
3. There were no knots to loosen up or crack.
4. Shrinkage was great.
5. Collapse and honeycomb occured very easily, if stock was dried too fast before it reached the fiber saturation point.
6. The moisture content ranged from 25% to 90%.
7. Stock was partly air dried when received and "case hardened".
8. Several species are grouped together and handled as one product.
9. Some pieces gave up moisture readily while others were almost impossible to dry.
10. It seemed that the slow drying pieces were more likely to collapse than the faster drying pieces.

The schedule we decided on after taking all these facts into consideration, was about as follows:

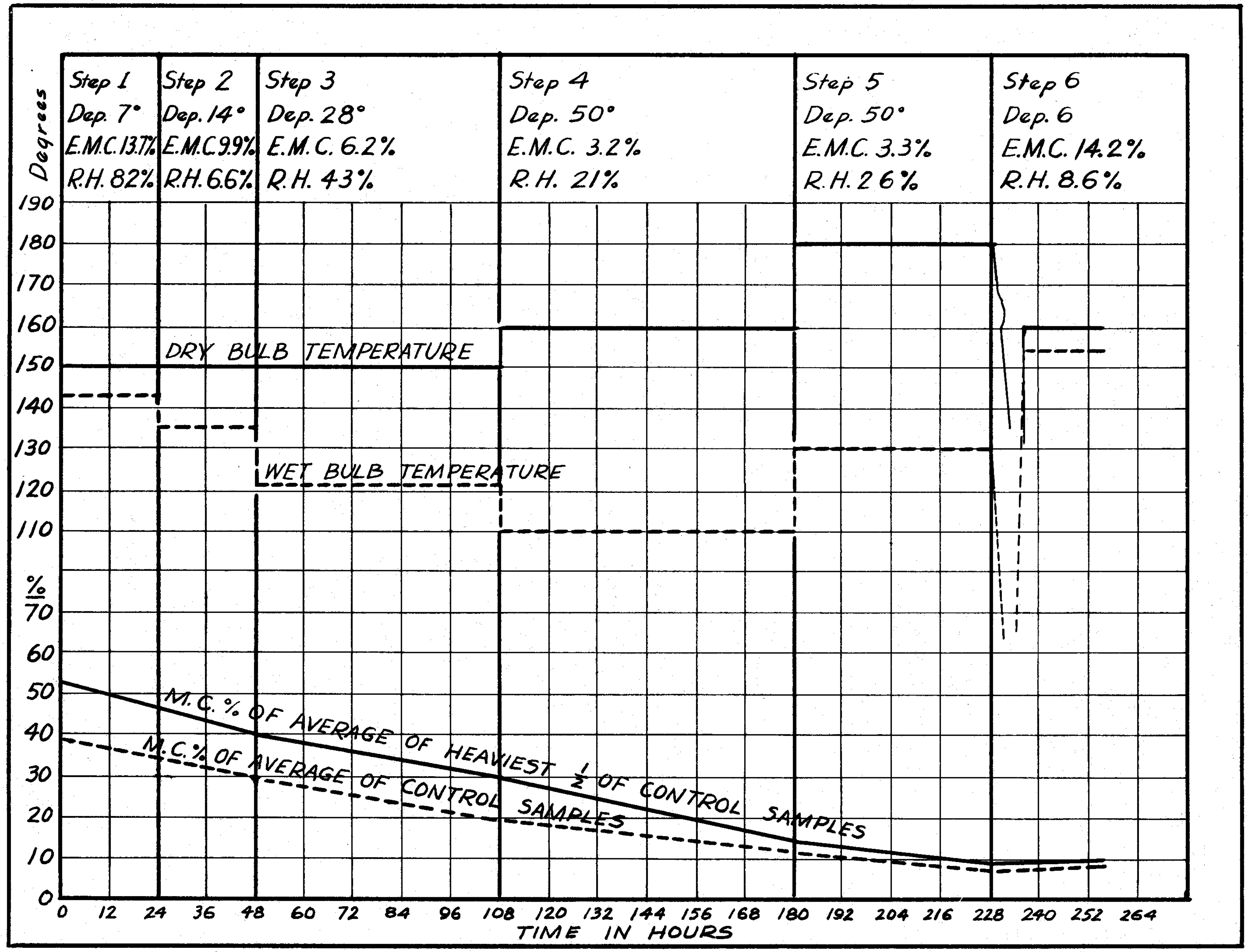
The schedule was divided into steps in relation to the average moisture content of the heaviest one-half of six control samples placed in the kiln charge, with exception to the first step. Due to the "case hardened" condition of the lumber when received, we thought it might be wise to steam it for twenty-four hours in an attempt to plasticize the surface and relieve some of the surface stress. The temperature was dry bulb 150 degrees, wet bulb 143 degrees, depression 7 degrees, relative humidity 82%, E.M.C. 13.7%. We have no proof that this step helps, but it does no harm and the moisture content of the lumber drops some during this step.

The second step starts after twenty-four hours and has also a high humidity setting. Dry bulb 150 degrees, wet bulb 136 degrees, depression 14 degrees, relative humidity 66%, E.M.C. 9.9%.

The third step starts when the control samples reach 40% moisture content. Dry bulb 150 degrees, wet bulb 122 degrees, depression 28 degrees, relative humidity 43%, E.M.C. 6.2%.

The fourth step starts when the control samples reach 30% moisture content. Dry bulb 160 degrees, wet bulb 110 degrees, depression 50 degrees, relative humidity 21%, E.M.C. 3.2%.

The fifth step starts when the control samples reach 15% moisture content. Dry bulb



Step 1
Dep. 7°
E.M.C. 13.7%
R.H. 82%
Step 2
Dep. 14°
E.M.C. 9.9%
R.H. 66%
Step 3
Dep. 28°
E.M.C. 6.2%
R.H. 43%
Step 4
Dep. 50°
E.M.C. 3.2%
R.H. 21%
Step 5
Dep. 50°
E.M.C. 3.3%
R.H. 26%
Step 6
Dep. 6
E.M.C. 14.2%
R.H. 86%
Degrees
%
DRY BULB TEMPERATURE
WET BULB TEMPERATURE
M.C. % OF AVERAGE OF HEAVIEST 1/2 OF CONTROL SAMPLES
M.C. % OF AVERAGE OF CONTROL SAMPLES
190
180
170
160
150
140
130
120
110
70
60
50
40
30
20
10
0
0
12
24
36
48
60
72
84
96
108
120
132
144
156
168
180
192
204
216
228
240
252
264
TIME IN HOURS

180 degrees, wet bulb 130 degrees, depression 50 degrees, relative humidity 26%, E.M.C. 3%.

The sixth step or reconditioning period, starts when the control samples reach 7% or 8%. We cool in the kiln four hours and steam twelve hours. Dry bulb 160 degrees, wet bulb 154 degrees, depression 6 degrees, relative humidity 86%, E.M.C. 14.2%. Oven samples from stock average about 8%.

It took ten or twelve days to dry green 4/4 and about thirty days to dry 8/4. This proved that it took too long to bring the slow drying pieces down to the fiber saturation point safely. The slow drying pieces would air dry to the F.S.P. almost as fast as they would in the kiln. Therefore, it proved more economical to re-saw all stock green, if possible, then air dry it. This eliminates most of high humidity steps of the schedules and shortens the drying time on 4/4 to four or six days.

By control sample method, we had all stock under control at all times and lost very little stock from de-grade. By hit or miss methods, we would have been months finding even usable schedules and may never have been able to have done a reasonably good drying job.