STUDY IN STEAM CONSUMPTION IN KILN BATTERIES AT THE BOOTH-KELLY LUMBER COMPANY, SPRINGFIELD, OREGON

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In considering the consumption of steam in drying lumber in kiln batteries it would be appropriate to take into account the variables that occur. The following is a list of variables showing the bearing they have on kiln drying. I will show how the Booth-Kelly kiln rates on each one.

1. Insulation and covered steam supply pipes.

There is a large steam loss with kilns without insulation on the roofs and insulation on the steam supply lines. A vapor seal on the inside of the kilns also does some good.

We have insulated roofs, insulated steam supply lines and a vapor seal on the inside of the kilns.

2. Tight fitting doors.

Doors that leak excessively will cause the sprays to work to maintain the humidity causing higher steam costs.

Our doors are only average.

3. Maintenance on equipment.

Any equipment that is not in proper condition will cause a waste of steam. Such as leaking steam traps and valves.

We keep everything working in top order.

4. Reloading of kilns.

The sooner the kiln is reloaded, the less building heat loss will occur. We take one to two hours to reload our kilns.

5. Schedules.

By using a split schedule, an advantage can be had in steam consumption. This method is not to always raise the dry temperature to increase the wet bulb depression, but to lower the wet bulb. By doing this, the same drying results can be obtained without increasing the heat of the lumber and the kiln building. It takes less steam to reheat the air that is replaced by venting than to increase the temperature of the lumber and building. This can be used to an advantage at certain times in schedule changes. We use this method whenever advantageous. Steam consumption for other than the evaporation of the moisture from the lumber may run as high as three-fourths of the total steam used. The heat loss through buildings and supply lines is very great, so prolonged schedules would run the steam consumption up unnecessarily high. Our schedules are all based on minimum time for maximum quality.

6. Outside temperature and weather conditions.

Steam consumption is much higher in the winter than in the summer. Ice and frost on the lumber would take more steam to bring it up to temperature, also there would be more heat loss through the building in freezing weather. The lower the temperature of the outside air, the more steam needed to heat it as it comes into the kiln.

Steam consumption could be expected to vary with the seasons of the year and also in different localities.

We had a mild winter this year.

7. Moisture content.

It takes more steam to dry lumber as lower moisture contents are reached. Therefore, it would increase the steam consumption to dry lumber to a lower moisture content than is required.

We run samples in our charges to determine the moisture content and time to end the drying.

8. Reconditioning lumber.

Reconditioning lumber does use a large amount of steam for this is a heavy spraying time. Some operations do not recondition anything while others recondition a few items, then some mills recondition everything.

We recondition all charges. I want you to keep this in mind when reading the average figures on our steam consumption. This is one place in our operation that we do not spare the steam.

9. Venting.

Quite often kilns will have to spray to recoup the proper humidity immediately after venting. A kiln that has the tendency to over vent will use more steam than is necessary.

Our kilns never have to spray to recoup humidity.

Other variables could be listed, but these are enough to show that there could very easily be differences in steam consumption between operations by original equipment, maintenance and operating.

The steam is measured at The Booth-Kelly Lumber Co. by a Bristol Mechanical flow meter. This is the restricted orifice type. It is installed on the main supply line to the dry-kilns. This measures all the steam going to the kilns, loss in the supply line, spray to kilns and steam to the heating coils.

We have a battery of ten (10) R. A. Simmons internal fan cross circulation dry kilns, 103 feet long, constructed of reinforced concrete. There are four propeller type fans. One in each corner of the kiln, driven on a short shaft. These fans are in an overhead duct system that is built in the kiln. Two fans at each end working in tandem. These fans are reversible so as to reverse the flow of air. The kilns are all single track with doors on one end. All are equipped with the latest type Foxboro instruments. There are twelve 1" fin pipes straight through the kiln with the header at the door end. Most drying is done with one-half of the coils. These kilns have proven very successful.

The lumber is piled flat and loaded on the kiln cars in packages or units. Four units to the car. These units are loaded by an overhead crane. This leaves

a vertical space between units and also a horizontal space between bottom and top units.

The following is how we arrived at pounds of water evaporated per thousand board feet. This illustration is for 2" Common Fir dried to an average M.C. of 19.4%.

$$\frac{3,300}{1 + \frac{40\%}{100}} = 2,357 \text{ lbs. oven dry weight per M.}$$

2,357 X (100 19.4%) = 2,814 lbs. per thousand current weight.

3,300 - 2,814 = 486 lbs. of water evaporated per M.

Clear Fir. 3,500 O.G.W. at 40% M.C. = 800 lbs. of water evaporated at 8% M.C.

Hem. Com. 3,800 O.G.W. at 100% M.C. = 1,710 lbs. of water evaporated at 10% M.C.

Hem. Clr. 4,000 O.G.W. at 110% M.C. = 1,948 lbs. of water evaporated at 8% M.C.

The following is for a consecutive number of weeks of operation:

Species	Footage	Moisture Content	Lbs. of water evaporated
Clear Fir	5,897,014	8%	4,717,611
Com. Fir	1,258,849	19.4%	611,800
Com. Hem.	1,957,796	10%	3,347,831
Clear Hem.	162,496	8%	316,542
Totals	9,276,155		8,993,784

Total steam consumption: 25,607,700 lbs.

Averages:

2.76 lbs. of steam per board foot.

2.84 lbs. of steam per lb. of water evaporated.

2,760 lbs. of steam per thousand board ft.

Clear Fir = 63.58% of total footage & 52.46% of water evaporated.
Com. Fir = 13.57% " " " 6.80% " " "
Com. Hem. = 21.10% " " " 37.22% " " "
Clear Hem. = 1.75% " " " 3.52% " " "

Using 2.84 lbs. of steam per lb. of water evaporated:

Fir Clear = 2,272 lbs. of steam per M.

Hem. Com. = 4,856 " " " " ".