

Increasing Kiln Productivity

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Ask The Correct Question

- What is limiting my kiln production?
- In other words . . . Too many operators look for the magic schedule instead of working on the whole process
- Final production depends on the quantity in the batch times the turnover times the percent of acceptable pieces

First Rule

- Build quality into your drying system, and then push production
- In other words . . . If you have quality issues now . . . They will only get worse with increasing productivity

Increasing Productivity

- Lumber
- Kiln factors
- Kiln operating procedures
- Schedule modification
- Eliminate down time



Lumber

- Lumber protection
- Sorting, stacking & loading
- Pre-drying
 - Reduce Moisture
 - Increase Moisture Uniformity

Lumber Protection

- Eighty percent of kiln drying problems are developed before the lumber ever goes in the kiln
- Sometimes it is a valuable exercise to look at your green lumber if you are experiencing unusually high amounts of defects (machine & chain marks, impact damage, rapid surface drying, stain, etc.)

Lumber Protection

- Avoid these problems (checks, warp, un-even moisture and mechanical damage, etc.) and you will be able to push kiln production

Log Storage & Wet Decking

- Helps prevent fungus stain, splitting & checking
- Perfect environment for gray stain to develop and bacteria to multiply



Lumber Protection Such As End Coating

(Needs to be done before defects form)

- Eliminate causes of kiln defects so you do not feel you have to “baby” the lumber through the process



Sorting & Stacking

- Length sort/ uniform end trim
- Insure your package sizes and kiln loading procedures are fully utilizing your kiln capacity (length, width & height) – you want to cube out!!!!
- If you have a lot of short packs or stair stepped packs in the kilns question why
- Eliminate bolsters

Pre-drying Procedures

- Pre-drying for refractory species should protect the lumber from degrade while lowering the moisture content and increasing the moisture content uniformity
- For fast and easy drying species, several days of good air drying conditions can speed kiln drying
- Trend is to move from uncontrolled to controlled pre-drying environment

Air Drying

Drying too fast or too slow, or both!



Preventing Stain



- Put lumber in a fast drying location so the chemical reaction can't occur
- Some operations use blow boxes (fan sheds) to place lumber while waiting for a kiln to empty
- Load the kiln with the fans operating

Drying shed . . .



Cross Flow Fan shed

- 40 feet deep by 200 feet long, 20 feet to eave
- 4 packs deep of 8 feet wide, 32 feet air flow through lumber
- 3 rows of fans, 96 fans total
- Fan motor, belt driven, 1 HP, American Coolair SPL-CABL48L.6, 48 inch blades
- 1725 RPM, 3.5 to 13 ratio
- 2 feet stand off, 2 feet off the ground
- Foundation plus \$171,000
- \$2800 per month of operating cost, \$3.5 per MBF

Air flow 450 to 550 FPM, 1000 FPM at bolsters

Cross Flow Fan Sheds

Notes from T&S Hardwoods - Sylva, NC
Sandy Johnson - kiln supervisor

<u>Species</u>	<u>Starting MC%</u>	<u>Ending MC%</u>	<u>Date M-D</u>	<u>MC% Loss per day</u>
WO 5/4	52%	31%	10-9	0.5%
RO 5/4	42	25	4-7	0.4
WO 4/4	60	35	1-14	0.7
RO 4/4	67	29	5-30	0.5

Average Loss in Fan Shed

RO 4/4 average loss = 0.7

RO 5/4 average loss = 0.4

WO 4/4 average loss = 0.6

WO 5/4 average loss = 0.5

Sticker Size: 7/8 x 1 1/4

Cross Flow Predryer Or Low Temperature Kiln



Kiln Factors

- Heat
- Humidity
- Airflow
- Controls

Heat



- Are you getting to your desired temperature?
- Is the heat uniform in the kiln?
- Uneven, inadequate or irregular steam supply from the boiler
- Low quality steam (condensate) entering the kiln
- Condensate problems in the coils – poor trapping, trying to run condensate uphill
- Excessive venting(kiln envelope problems), wet bulb problems, schedule, etc.
- Inadequate coils

Humidity

- Can't get the depressions you need
 - Inadequate venting – add more vents or power vents
 - Insure schedule is not calling for impossible wet bulb
- Takes too long to condition
 - Dry bulb temperature over-ride
 - Inadequate steam supply (low pressure boiler, poor steam distribution) – water spray systems

High air flow contributes to fast, uniform drying.

At 750 FPM the center is below 19% in 44 hours, range 15.8 to 17.8%.

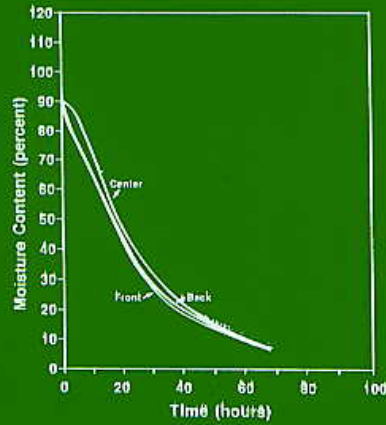


Figure 8. Effect of location in the stack on drying time for low-temperature drying with an air velocity of 750 feet per minute.

Low air flow contributes to slow, non-uniform drying.

At 250 FPM the center is below 19% in 72 hours, range 9.9 to 19.0%.

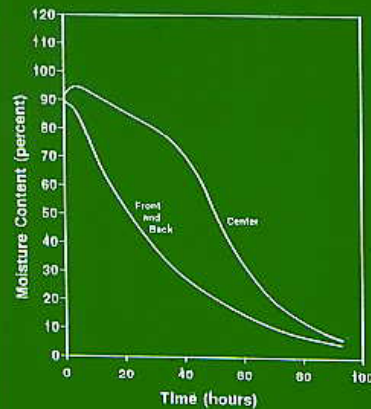


Figure 10. Effect of location in the stack on drying time for low-temperature drying with an air velocity of 250 feet per minute.

Airflow

- Conduct air flow study
- Things you can do
 - Insure fan wall integrity is maintained
 - Improve aerodynamics of fan orifices
 - Adjust pitch of fans
 - Insure all fans are turning in the same direction

Airflow

- Insure belts are tight and sheaves not worn
- Baffles working
- Eliminate cross outs
- Proper stacking and loading
 - Length sort
 - No air channels
 - 4 to 6 inches between the edges of packs

Controls

- Insure your controls are calibrated
- Look at in kiln weighing or sampling systems and or computerized controls
 - Most of them have a “predictive drying function” that tries to achieve a certain drying rate over time
- Many electronic circular chart (Partlow) controls have a ramping function

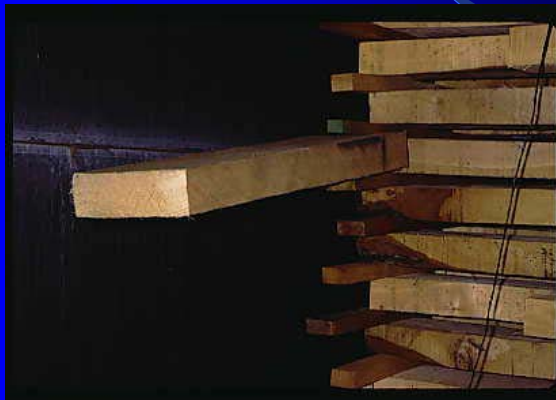
Kiln Operating Procedures

- Sampling procedures
- Start up procedures
- What to do when drying appears to stop
- Schedule modification
- Using moisture loss per day

Sampling Procedures

- Purpose of sampling is to give you information
- Increase your odds of success – more samples and use good sampling procedures
- Check your samples at least once a day
- Make your changes in schedule more often – this means checking your controlling samples more often

It pays not to drive fast if you can't see where you're going!!!



Why It Is Important To Take Samples From the Inside Of A Pack

- Samples were selected from predried material from the outside edge of a pack with a moisture meter
- The sample selected read 50.3% on the moisture meter, in actuality the moisture content was 38.7% by the oven dry method.

Why It Is Important To Take Samples From the Inside Of A Pack

- In the pack, using the oven dry method the following moisture contents were found 53.0%, 44.9%, 32.9% and 30.5%
- What would happen to the wetter pieces if we ran the kiln on the dryer sample?
- Spend the time and effort to pick good samples, especially on partially predried or air dried material

Start Up Procedures

- Look at you daily MC loss and actual kiln conditions at start up
- Consider – northern 4/4 red oak with a 23% controlling moisture content
- Starting step of schedule is DB 110°F, WB is 106°F or 17.6% EMC
 - Too slow, may actually gain surfacemoisture
- Book solution – start at DB 130°F, WB is 90°F or 4.0% EMC
 - May be too aggressive – surface exposed to too low of an EMC

Start Up Procedures

- One solution is use the starting dry bulb temperature of the schedule and an EMC two percent below the surface MC, then work into the schedule
- You need to look at how fast your EMC or wet bulb is rising in relation to your dry bulb during start up
- Work into your desired temperature as fast as you can raise the wet bulb to keep the desired EMC – will change with seasons, staring MC, etc.

What To Do When Drying Appears To Stop

- Usually happens at 15% or below
- Bad sample
- Conditions in the kiln not what you think
- Not enough energy
- Cut intermediate sample
- Raise dry bulb 1 to 5°F – use common sense – don't hurt lumber

Schedule Modification

- Know what drives moisture loss
 - Early stages – relative humidity
 - Later stages – heat
- Know what damages wood
 - Wood is weaker thus more prone to shrink at higher temperatures, especially at higher moisture contents
 - Low EMC's can check the lumber at high MCs and warp the lumber at low MCs

Schedule Modification

- To modify schedules you need consistency in what you are doing now and good record keeping
- Modifying schedules – use recommended procedures in dry kiln manual – order of modifications
 1. Progress steps at higher moisture contents than listed
 2. Use a slightly larger depression (1 or 2°F)
 3. Use more heat (last resort)

Using Moisture Loss Per Day

- Know your wood what your maximum loss per day is . . . Don't rely on an expert . . . You need consistent operating conditions, experience and good judgment
- Looking for consistency
- Theory is:
 - Break the schedule into smaller steps
 - Make small changes
 - Know what drives moisture loss and damage, drop EMC before raising the temperature

Maximum Book Moisture Loss Per Day – Good goal may be 75% of these values

<u>Species</u>	<u>4/4</u>	<u>6/4</u>	<u>8/4</u>
Red Oak (N)	3.5	2.1	1.4
White Oak	2.5	1.5	1.0
White Ash	5.0	3.0	2.0
Hard Maple	5.0	3.0	2.0
Cherry	5.8	3.4	2.4

Book maximum daily moisture loss

- Only a guideline to give you something to think about
- Actual maximum daily moisture content depends on your lumber – so use your common senses and judgment
- In my opinion gaining consistency is more important

Eliminate Down Time

- Attack your bottleneck – upstream or downstream – or your effort will be wasted
- Loading and Unloading
- Boiler problems, etc.
- Re-drying



Loading And Unloading

- Pre-positioning of lumber – limit travel distance of forklift
- Overtime and or extra labor to speed process
- You have to have dry storage area to put lumber – shed roof over kiln area
- Downstream – destacking, etc. should have a potentially higher production rate than kilns . . . why dry it and put it in a growing inventory?

Avoid Re-Drying

- Kiln dried lumber will gain and lose moisture in relation to the EMC
- Use first in first out inventory practices
- Date or color code packs
- A heated shed is the best solution to store the lumber for a long period of time

Keep lumber dry after kiln drying:



Any questions, comments or discussion?



LEFT: EARLY SECTION OF A PIONEER YARD OF THE BIRD-PHANT SAW MILL, FLAHO. AND LIBBYE 1880: IN THE NORTH-WESTERN, KING COMPANY AT BIRCHMOUNT, WA.

Thank You!

