

## 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%.

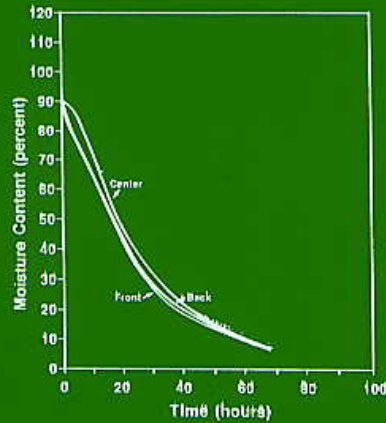


Figure 8. Effect of location in the stack on drying time for low-temperature drying with an air velocity of 750 feet per minute.

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%.

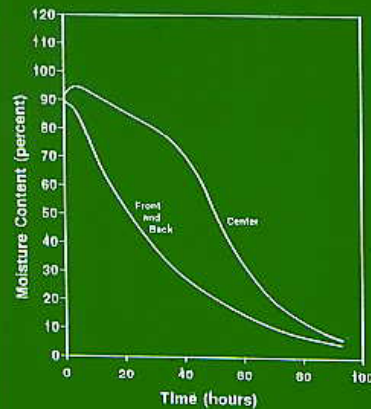


Figure 10. Effect of location in the stack on drying time for low-temperature drying with an air velocity of 250 feet per minute.

## 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

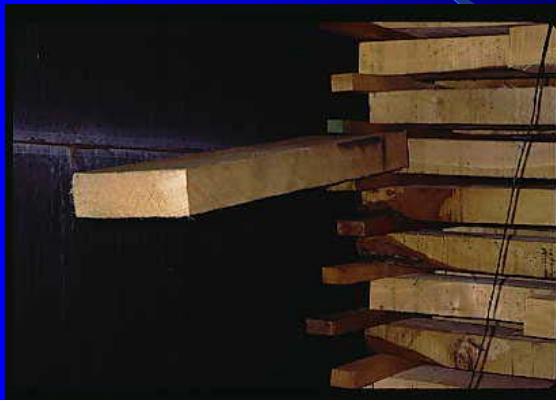
## Kiln Operating Procedures

- 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, starting 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 FARRINGHAM YAN OF THE BARKPORT SAW MILL, FLA. AND LIBBEY 1880 IN THE NORTHERN MANUFACTURING COMPANY AT ARKWOOD, VA.

Thank You!

