Air Drying Through Predrying Lumber

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Wood Education and Resource Center

- Is the center of the US Forest Service effort of support of the hardwood forest industry in the states east of the Great Plains
- Located in Princeton, West Virginia, [www.fs.fed.us/werc](http://www.fs.fed.us/werc)
- WERC project’s websites = [www.cnr.ncsu.edu/woodworkshops](http://www.cnr.ncsu.edu/woodworkshops) and [www.cnr.ncsu.edu/usalocalwood](http://www.cnr.ncsu.edu/usalocalwood)

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Flat Lumber

- Uniformly sized lumber
- Quality sticks – full sized, dry
- Bottom cross pieces, sticks and bolsters should form a continuous column of support
- Weighted stacks
- Avoid overdrying
Types Of Lumber
Refractory Woods

• Easy to check, split, or honeycomb
• We want to slow down the initial drying rate to protect the wood from shrinking too fast and tearing itself apart
• Drying schedules usually start out at low temperatures and high humidities
• Common refractory woods are red oak, white oak and hickory
Severe initial drying equals checks:
Avoiding Checks

- Avoid exposing lumber to direct sunlight and rain
- Avoid low initial humidities
- Use end coating
- Use sheds, fan sheds or cross flow predryers instead of air drying lumber
- Avoid higher than recommended dry bulb temperatures
Types Of Lumber

White Woods

• Lighter colored woods that have a tendency to discolor or stain
• We want to lower the humidity during initial as rapidly as possible drying rate to eliminate the chances of stain
• Drying schedules usually start out at low temperatures and low humidities
• Common whit woods are ash, basswood, hickory, hard maple, soft maple, yellow poplar and white pine
Avoid Air Drying

• For refractory woods protect from the sun and the rain during all handling operations and use sheds, fan sheds or predryers
• For white woods – all effort should go into stickering and placing in the kiln as soon as possible
Log Protection

• Log protection is critical to avoid stain and splits
• Rapid log turnover is one of the most cost effective ways to avoid problems
• End coating logs with wax or anti-stain chemical will help if longer storage is used
Log Storage & Wet Decking

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

- Limit your log inventory
- No longer than 2 weeks in summer
- First in, first out – keep logs rotated
- Low grade versus high grade strategy
Log Storage & Wet Decking

- Use good log inventory practices -
  - Control log inventory
  - Log inventory rotation
  - Water

- Limiting log inventory and end coat or end treat logs may be a much better alternative
Lumber Dipping And End Coating
(Needs to be done before defects form)
Coordinating Lumber Delivery
Preventing Stain

• Stack lumber within 12 hours of being sawn

• Coordinate cutting, stacking, kiln availability and drying

• One advantage of two smaller kilns versus a large kiln is faster loading
Receiving, Grading And Stacking

• Insure you are getting what you paid for
• Lumber should be stacked within 24 hours of receipt
• White woods – white hard maple – should be stacked and placed in the kiln immediately
Stacking Practices
The devil is in the detail:
Quality Stacking

- Uniform sized lumber
- Uniform sized, dry sticks
- Cross outs and sticks should be in vertical alignment
- Protect the ends
Stickers

• Use dry stickers – stickers need to be able to transfer water
• Use stickers that are no more than 1-1/4-inches wide, by 3/4- or 7/8-inches thick
• Stickers should be of uniform thickness and width for their full length
• Use grooved or routed stickers, which allow some air movement under the sticker
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.
Know Your Enemy

- Enzymatic, Oxidative, Gray Stain or Sticker Stain
- Fungus
- Bacteria Infection
- Iron Stain
- Other
Enzymatic, Oxidative, Gray Stain, or Sticker Stain

- Aggravated by log storage, including wet storage, and poor drying conditions such as dead piled lumber
- Dipping does not help, may aggravate
- Need rapid drying
Avoiding Brown Stain In White Pine

• Research, and more importantly practical experience, has shown the most important factor in eliminating brown stain is minimizing the time from when the tree is felled to when the lumber sawn from it is put in the kiln.
Fungus

- Needs air, water and food
- 80 to 100°F prime growing temperature
- Dipping – can often create additional color problems
- Water storage of logs
- Log and lumber inventory management
- Rapid drying
Fungus

- Low airflow and high humidity contributed to the mold on this lumber
Bacteria Infection

• Found in weaker and damaged trees, often transferred by roots, timber that has been cattle grazed
• Weakens wood
• Often identified by smell
• Often associated with a higher moisture content that is more difficult to remove
Bacteria Infection

- Some bacteria does not need oxygen to survive
- Pre-dry at low temperatures to avoid checks
- Can cause dulling of color in kiln dried lumber
- Some aerobic bacteria cause sticker shadow
Iron Stain

- Caused by wet lumber coming in contact with iron resulting in a blue-black discoloration
- Wood is a good absorber of iron
- Prevention is to minimize or avoid contact with iron
- Dip treatment after contamination can reduce the visibility of the problem
Iron Stain

• Effective control measures are based on limiting the contamination of wood by iron
• Look for contamination such as high iron water, iron pipes in log yard spray system, components of the dip tank, contaminated sawdust in tank
• Keep your operation free of wood debris to help avoid insect infestations
Preventing Stain

- Avoid situations that require dipping if at all possible – put “white woods” into kiln as quickly as possible
- Dip as soon as lumber is sawn, if lumber cannot be immediately stacked and dried
Preventing Stain

• Dip tank quality control

• Species change

• Your dip supplier can be a great asset in providing information
Preventing Stain

- Keep lumber out of the rain
Drying too slow results in stain:
Purpose of Predrying

• Reduce moisture content so kiln drying time can be reduced (for this to happen need uniform moisture coming from the shed or pre-dryer)
• Reduce drying degrade by drying under more controlled conditions
T-Sheds

- Roof supported by columns in the center ridge
- Can reduce drying loss compared to air drying
- May be more expensive than pole shed
- May dry to rapidly – use shade cloth
- Lumber exposed to blowing rain
Pole Shed

- Slower drying
- Stain may be a problem
- Good 6/4 to 8/4 solution
Fan Sheds

- Fan Sheds
- Limit thickness on oak to 4/4 and 5/4
- Watch humidity
- Keep fans turned off initially
Operation Recommendations

• Use shed samples
• Check for mold using flashlight
• Use sling psychrometer to keep track of EMC inside the shed as well as outside
• Use of a humidistat that can turn fans on and off based on humidity
Typical drying rates for lumber dried in fan shed in the Appalachians

<table>
<thead>
<tr>
<th>Species and thickness</th>
<th>Time initially piled in shed</th>
<th>Drying time (days)</th>
<th>Change in MC (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/4 red oak</td>
<td>End of January</td>
<td>56</td>
<td>80 to 28</td>
</tr>
<tr>
<td>4/4 white oak</td>
<td>Middle of January</td>
<td>38</td>
<td>60 to 35</td>
</tr>
<tr>
<td>5/4 red oak</td>
<td>Beginning of October</td>
<td>114</td>
<td>96 to 28</td>
</tr>
<tr>
<td>5/4 white oak</td>
<td>Beginning of October</td>
<td>40</td>
<td>52 to 31</td>
</tr>
</tbody>
</table>
Warehouse Predryers

- Most predryers are laid out into zones for better control, not for running different schedules.
- Look at your control chart to see how well you can control.
Points To Consider

1. Location of dry bulb and wet bulb sensors (humidity)
   - Are you measuring the hottest air, lowest humidity etc?

2. Control zones
   - How is the pre-dryer divided up into control zones
   - Which temperature sensors control a zone
Points To Consider

2. Control zones (continued)
   - Ability to control heat and humidity in a zone (heating and venting capacity versus the amount of green lumber)

3. Calibration of controls
   - Humidity wafers – maintenance (new wafers and clean off contacts with steel wool or fine emery paper)
Loading and control strategy is critical

- Load by zone and control by zone, in theory the best, but you can overwhelm venting and heating capacity
- Maintaining a lumber mix in a zone is a compromise, it may however give you the best control.
Warehouse Predryers

- Keeping a balanced mix in each zone
Airflow

- Usually not uniform from top to bottom
- Higher airflow on the bottom
- Lower or negative airflow on top
- Goal is to have uniform airflow top to bottom of 125 to 150 fpm
- Keep 4 to 6 inches between packs
- Use of end baffles and between zones
Predryer Operation

- Check temperature and humidity every day with sling psychrometer or hydrometer (remember, you need enough air flowing past a wet bulb to be accurate)
- Look for mold, stain and checking
- Use samples both on the hot and cool side
- Use lower temperatures, wood is strongest at low temperatures and low moisture contents
- Protect green lumber, put it in the pre-dryer
- Do not add moisture back in on to the surface during kiln start up
- Keep the predryer clean
Cross Flow Predryer
SII Cross Flow Predryer

- Kaufman Stairs (Visador), Muligan Flooring, Piedmont Flooring, Edwards Wood Products
- Controls
  - Temperature in each zone
  - Wet Bulb via venting
  - Airflow – variable speed
- Construction
  - Center fans and heater means clear span building not needed
  - Re-heat coils above
  - 18 to 24 feet of lumber each side, 30 foot forklift aisle each side
    (120 feet width versus 100 feet for a conventional pre-dryer)
Advantages and Costs

Advantages
• Better control
• More uniform & higher airflow

Cost
• Equipment $0.50 to $0.55 per board foot
• Building and concrete $0.50 to $0.55 per board foot
• Total $1.00 to $1.10 per board foot
• Equipment $0.32 to $0.35 per board foot for conventional predryer
Good luck – don’t get hurt!