Hardwood Drying
Bill Smith
SUNY ESF Wood Products
New England Kiln Drying Association
Syracuse, NY

What are Hardwoods?
Why do we care?

Eastern Hardwoods:
- red oak
- hard maple
- black cherry
- white ash
- soft maple
- yellow birch
- black walnut
- poplar
- hickory
- white oak
These hardwoods tend to be used for high value-added interior-use applications:

- Furniture
- Millwork
- Cabinets
- Flooring

These hardwoods are also used for such industrial and commercial applications as:

- Railroad Crossties
- Pallets

But these products are typically not kiln dried….

Hardwood Drying, Specifications:

- Kiln dried to 6-7% MC
  - (North American market; European perhaps somewhat higher)
- Without surface, end or interior checking
- Flat
- Without residual drying stress
- Appropriate color
How are these specifications achieved?

• Control the drying process.
• Know the wood.
• Know the customer.
• Always understand and consider the “big picture”.
• Always understand and consider the “little details”.
• It is not easy!!!

The hardwood drying process:

• Drying begins as soon as the tree is cut.
• Manage logs.
• Manage freshly cut lumber.
• Stack and sticker promptly.
• Dry promptly.
  – Air drying yard.
  – Predryer.
  – Kiln.
• Maintain control!!

Harvesting
So, how do we dry?

- Kiln Dry.
  - Good quality, productive
- Air Dry, then Kiln Dry
  - Energy savings, kiln utilization efficiency
- Predry, then Kiln Dry
  - Good quality, productive (oak)
- Vacuum Kiln Dry
  - Fast, specialty items,
Kiln Drying Schedules -

- The purpose is to dry as rapidly as possible, to be economical.
- However, drying must be controlled to avoid value reducing defects.
- Typically, the temperature and the relative humidity (wood EMC) are controlled.
- Relative humidity lowered as wood dries.
- When below FSP temperature is raised and relative humidity lowered as wood dries.

Some typical schedules -

<table>
<thead>
<tr>
<th>Stage</th>
<th>Wood moisture content</th>
<th>Major defect risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Green to 2/3 green</td>
<td>Formation of surface and end checks, stain, warp</td>
</tr>
<tr>
<td>II</td>
<td>2/3 green to 30% MC</td>
<td>Aggravation of surface and end checks</td>
</tr>
<tr>
<td>III</td>
<td>30% MC to final</td>
<td>Conversion of checks to honeycomb, cupping, overdrying</td>
</tr>
<tr>
<td>IV</td>
<td>Final</td>
<td>Unequal final MC, casehardening</td>
</tr>
</tbody>
</table>

*Green denotes moisture content (MC) in the living tree, not when the lumber is received.

What else do we need to know?

- What is the application?
- What final MC is desired?
  - Interior use? 6-7% MC
  - Exterior use? 12-15% MC
- What is the history – green, air dried, PAD, kiln dried?
- Bacterially infected?
- Pre-existing damage – surface and end checks?
Additional issues with oak -

- The ring-porous nature means that earlywood cells are low density while latewood cells are high density.
- White oak has tyloses in the large vessels which significantly reduces permeability.
- Red, and in particular white oak have large ray cells, which create zones of weakness which contribute to checking.
- Fast end and surface drying causes checks.
Even more additional issues with oak -
• Evaporated acids from drying are corrosive.
• Regional differences in drying characteristics and value.
• May have bacterial infection.

Red Oak

Additional issues maples, and other “white woods” including ash and birch -
• Goal is to keep wood as white, and bright as possible.
• Dry as quickly as possible.
• Keep temperature low (under ~ 105 F, 40 C until MC in core is below 20%).
Also, as wood dries it shrinks, as wood shrinks, stresses develop.
During “Stress Relief”,

- Moisture is added to the “shell” to cause it to try to swell against the core, relieving the stresses.

Stress Relief Conditioning

- High EMC and Temperature
  - Adds moisture
  - High temperature moves moisture faster
  - High temperature means wood is not as strong so stress relieve more readily.
This is firewood, not lumber; but the goal is the same!
Drying characteristics, schedules and other useful information can be found in several sources.

- USDA FPL schedule book.
- FPInnovations Drying Manuals
- Dry Kiln Operator’s Manual
- Drying Hardwoods
- Dry Kiln Association meetings
- Local knowledge.
  - Look to your purchasing agent and contacts in the field.

Thank you!

- Questions?
- Comments?
  - Bill Smith
    - wbsmith@esf.edu
    - 315/470-6832