Causes and Control of Stain and Degrade When Kiln Drying Lumber

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Harry Watt
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Kiln Drying Defects

- Warp
  - Crook
  - Bow
  - Twist
  - Cup
- Checks (or cracks)
- Splits (through cracks)
- Collapse
- Stain
- Casehardening
Warp

**Crook** – board distortion in which the edges deviate from a straight line from end to end.

**Bow** – board distortion that deviates from flatness lengthwise but not across faces.

**Twist** – warp caused by turning of the board edges such that the 4 corners of any face are not planar.

**Cup** – board distortion in which there is deviation from flatness across the board width.
Checks

Checks (or cracks) – a lengthwise separation of the wood that usually extends across the rings of annual growth and parallel to the wood rays.

Checks result from drying stresses, whether from the air drying yard, dry kiln, or while in use.
Surface Checks

A surface check is a check starting on the wide-grain surface and extends into the interior of a board.
End Checks

A check starting on an end-grain surface and extending along the length of the board
Internal checks, also called honeycomb or bottleneck checks, may originate in the interior of a piece of wood but more often are extensions of surface and end checks.

Hydraulic pressures from water evaporation on the surface creates great pressures in the interior.
Splits– a lengthwise separation of a piece of lumber extending from one surface to another.
Collapse – the severe distortion or flattening of single cells or rows of cells in wood during drying, often evidenced by a caved-in or corrugated appearance of the surface of the lumber.
Casehardening (drying stress)

A condition of stress and set in wood in which the outer fibers are under compressive stress and the inner fibers under tensile stress, the stresses persist when the wood is uniformly dry.
Stain

Stain – a discoloration in wood that may be caused by micro-organisms, metal, or chemicals.

- **Blue sapstain** – fungal
- **Chemical** – modification / concentration extractives
- **Iron tannate** – often oak, caused by wet wood contacting iron
- **Mineral** – often caused by bird peck on living tree
- **Sticker stain** – gray, blue or brown stain under sticker
- **Water** – yellowish to blackish surface stain caused by dripping water
- **Weather** – grayish-brown surface discoloration on air dried lumber
### Common White Woods That Have Stain Problems-
*sapwood species*

<table>
<thead>
<tr>
<th>Ash</th>
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<tr>
<td>Basswood</td>
<td>Tupelo</td>
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<tr>
<td>Hickory</td>
<td>White Pine</td>
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<tr>
<td>Maple-Soft &amp; Hard</td>
<td>Oak Sapwood</td>
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<tr>
<td>Yellow Poplar</td>
<td>Hackberry</td>
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Know the Stain Enemy!

• Enzymatic, Oxidative, Gray and Sticker Stain

• Fungus = Blue Stain

• Bacteria Infection

• Iron Stain-Wet Logs, Conveyors, Injuries

• Other Stains
Enzymatic, Oxidative, Gray and Sticker Stains

• Aggravated by Long Log Storage, Including Wet Log Storage Methods, Poor Lumber Drying Methods—Such as Dead Piling

• Dipping Does Not Help and May Aggravate!

• Best Solution is Rapid Surface Drying
Enzymatic, Oxidative, Gray and Sticker Stains

- Wood Cells Do Not Die Immediately When a Tree is Harvested, So Food Cells Are Available to Feed Stain Organisms

- Living Cells Produce Chemical Pre-Cursors for Stains

- Warm Temperatures Support Stain Growth
Avoiding Brown Stain in White Pine

• Must Process White Pine Lumber Quickly From Sawmill to Dry Kiln

• Cannot Air Dry and Keep White Pine Free of Brown Stain!

• Will Lose Significant Value if Convert Bright White Pine Lumber Into Brown Stained White Pine Lumber!
Solving Fungus Problems in Lumber

• Must Have Sufficient Air Flow to Drop Air Humidity Levels Within Packs of Green Lumber

• Mold Will Feed on Food Cells in Wood When Have High Humidity and Warm Temperatures

• Must Not Use Steam on During Kiln Startup-Turn Off as the Lumber Has Plenty of Moisture
Solving Bacteria Infection Problems

• Some Bacteria Can Survive Without Oxygen = Anaerobic Bacteria

• Pre-Dry in Kilns at Low Temperatures to Avoid Checks and Prevent Bacteria Attack

• Sticker Shadow Problems Are Caused by Aerobic Bacteria

• Air drying yards need sufficient air flow
Bacterial Infections

• Are Often Found in Weaker and Damaged

• Often Associated With Cattle Grazing Problems

• The Bacteria Weakens the Wood and Problems With Checks and Splits May Occur

• Bacteria May Cause the Wood to Smell Bad

• May Cause the Lumber to Dry Slower
Iron Stain

- Caused When Wet Lumber Comes in Contact With Iron Machinery

- Typically Seen as a Blue/Black Discoloration

- Best to Work on Prevention = No Contact

- Some Dip Chemical Treatments Can Help Reduce the Visibility of Iron Stain

- Watch Out for High Iron Content Water and Iron Pipes as Well as Sawdust Problems in Chemical Dip Tanks
Many Problems Can Be Caused By Mis-Management of Chemical Dip Tanks

- Making the Chemical Concentration Stronger Often Lowers the pH and Increases Iron Stain Problems
- Below pH = 2 You Can Have a Hazardous Waste
- Color Changes May Occur at Low pH Levels That Customers May Not Like
Quality Control on the Log and Lumber Yard

- Find Sources Where Bugs and Stain May Thrive, Such as Scrap Wood Piles and Remove Them
- Set Up a System Where Problems Are Eliminated
- Watch Air Flows and Keep Rain Off Stacks of Lumber—be sure water moves off the yard and not under piles
- Limit the Time Logs Are on the Yard Before Sawing
- Saw on a First In and First Out System
- Think About High Grade Versus Low Grade and Value
Log Protection Strategies

• Studies Have Show Lots of Improvement Can Occur When Using Wax Log End Sealers

• Water Yard Spraying Treatment is Not a Cure-All, Its Better to Limit Log Storage Time
Stacking Strategies for Preventing Stain

• Stack Quickly After Converting Logs Into Lumber

• Use More Smaller Kilns Than a Few Large Kilns to Limit Time Needed to Load the Kiln

• Use Dry Stickers and Free of Dirt

• Use Stickers 1-3/4” Wide or Less and Either ¾” to 7/8” Thick

• Use Grooved Stickers to Limit Surface Coverage Area
Open Shed and Fan Shed Strategies

• Sheds Are Good For Keeping Rain Off Green Lumber

• Place Lumber in a Fan Shed That When Storing Until a Dry Kiln is Ready

• Turn on the Kiln Fans When Loading the Kiln As Loading Package Kilns Can Be a Slow Operation
Dry Kiln Problems to Avoid

Understand Your Dry Kiln Shortcomings and Have a Strategy to Overcome

- Low Air Flows
- Poor Distribution of Heat
- Inadequate Venting
- Excessive Depth of Lumber to Dry
- Fans May Not Reverse Properly
Kiln Operator Stain Prevention Strategies

• Use High Air Flows (not for oak)

• Do a Good Job of Using Baffles

• Reverse Fans Every Two Hours During Early Drying

• Reduce Depth of Lumber Packs if Having Problems With Kiln Equipment for Large Kilns
Other Ideas for Kiln Operators on Preventing Stain and Keeping Bright and White Color

• Keep Steam Spray Off During Startup

• Use Larger Starting Wet Bulb Depressions at Lower Starting Temperatures

• Use Lower Ending Temperature-Stop at 140 Dry Bulb

• Limit or Eliminate Venting When Equalizing

• Check the Kiln Controls to Insure Quality Drying
Old Schedules for Hard Maple-4/4 & 5/4 - note starting at 130 degrees and ending at 180 degrees

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New White/Bright Schedules for Hard Maple-4/4 & 5/4-
ote starting at 104 degrees and ending at 160 degrees

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Comparison of Traditional Vs. Bright/White Schedules for Hard Maple

- Much Lower Starting and Ending Dry Bulb Temperatures
- Goal is to Get Surface Water Off the Lumber ASAP
- Wider Starting Wet Bulb Depressions
- Lower Ending Temperatures Help Keep Lumber White
- Total Kiln Cycles Are Comparable for Traditional Versus Bright/White So BWF Schedules Save $
Traditionally Schedules for White Pine-4/4 & 5/4

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Summary-Controlling Stain and Drying for Bright, White and Flat Lumber

• Move Logs Quickly Through Yard to Sawmill
• Stick Lumber Quickly and Get Under Sheds or Into Kilns Quickly
• Kiln Dry Using Lower Starting Dry Bulb Temperatures
• Use Wider Wet Bulb Depressions
• Final Drying Steps At Lower Temperatures