The Care and Feeding of White Woods

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**Kinds of:**

- **Challenges:**
  1) Rotation.
  2) Color Retention (interior and exterior)
  3) Stain (fungal, chemical, and…)
  4) Drying environment (Air Drying and kilns)
  5) Dimensional stability
  6) Kiln / boiler limitations
  7) Bruising
  8) Stick Shadow
  9) Mixed loading / MC variation
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Kinds of:

- Solutions:
  1) Fast from tree to thee as fast as possible.
  2) Scheduling, winter cut, fast rotation
  3) storage, scheduling...
  4) High airflow, low temp / RH schedule
  5) Cutting, sticking, stacking, rotation
  6) Airflow, heating / venting capacity
  7) Eliminate sawmilling process
  8) Breeze dry sticks / dry sticks
  9) LCD scheduling

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Rotation.
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- **Rotation – basic steps:**
  1) Winter – Have lumber in the kiln before tree knows it is dead.
  2) Spring, Summer, Fall – Have lumber in the kiln before the tree hits the ground.
Rotation

Rotation

Rotation
Rotation

Rotation, not

Color Retention
Color Retention

Color Retention
Color Retention

Color Retention
Stain

Drying environment
Drying environment

Drying environment
Drying environment
Dimensional stability - stacking

Dimensional stability - stacking
Dimensional stability - sticking

Dimensional stability - stacking
Dimensional stability - full courses

Kiln / boiler limitations
Kiln / boiler limitations

Bruising
 Stick Shadow

 Mixed loading / MC variation
Mixed loading / MC variation

Mixed loading / MC variation
Some SUNY ESF Laboratory Research

Spectrophotometer Color Analysis
What is color?

Light source
Spectral energy

Object
% reflection

Observer
Eye and brain responses

White (L=100)

Yellow (+b)

Green (+a)

Blue (-b)

Red (+e)

Black (L=0)
## Drying Schedules

<table>
<thead>
<tr>
<th>Step</th>
<th>Moisture Content (%)</th>
<th>Relative Humidity (%)</th>
<th>Temperature in degrees F</th>
<th>Wet Bulb Depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Above 40</td>
<td>86</td>
<td>130</td>
<td>125</td>
</tr>
<tr>
<td>2</td>
<td>40 to 35</td>
<td>81</td>
<td>130</td>
<td>123</td>
</tr>
<tr>
<td>3</td>
<td>35 to 30</td>
<td>72</td>
<td>130</td>
<td>119</td>
</tr>
<tr>
<td>4</td>
<td>30 to 25</td>
<td>57</td>
<td>140</td>
<td>121</td>
</tr>
<tr>
<td>5</td>
<td>25 to 20</td>
<td>35</td>
<td>150</td>
<td>115</td>
</tr>
<tr>
<td>6</td>
<td>20 to 15</td>
<td>22</td>
<td>160</td>
<td>110</td>
</tr>
<tr>
<td>7</td>
<td>15 to final</td>
<td>26</td>
<td>180</td>
<td>130</td>
</tr>
</tbody>
</table>
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<th>Wet Bulb Depression</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Above 40</td>
<td>70</td>
<td>110</td>
<td>100</td>
</tr>
<tr>
<td>2</td>
<td>40 to 35</td>
<td>60</td>
<td>110</td>
<td>96</td>
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<tr>
<td>3</td>
<td>35 to 30</td>
<td>47</td>
<td>110</td>
<td>90</td>
</tr>
<tr>
<td>4</td>
<td>30 to 25</td>
<td>32</td>
<td>120</td>
<td>85</td>
</tr>
<tr>
<td>5</td>
<td>25 to 20</td>
<td>22</td>
<td>130</td>
<td>80</td>
</tr>
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**Spectrophotometer a*b* color values for winter harvested material**

- **T3-C5 -Fresh log**
- **T3-C5-4wk log**
- **T3-C5-8wk log**
- **T8-C3-Fresh log**
- **T8-C3-4wk log**
- **T8-C3-8wk log**
Spectrophotometer a*b* color values for summer harvested material

- Summer fresh T3-C5
- Summer fresh T8-C3
- Summer 4wk T3-C5
- Summer 4wk T8-C3
- Summer 8wk T3-C5
- Summer 8wk T8-C3

Fresh log
4 wk log
8wk log

Winter
Spring
Summer
Average L* color values

<table>
<thead>
<tr>
<th>Fresh</th>
<th>4 wk log</th>
<th>8 wk log</th>
<th>Fresh</th>
<th>4 wk log</th>
<th>8 wk log</th>
</tr>
</thead>
<tbody>
<tr>
<td>T3-C5</td>
<td></td>
<td></td>
<td>T8-C3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Winter Harvested
- Spring Harvested
- Summer Harvested

Air dry

- Winter
- Spring
- Summer

Fresh log
4 wk log
8 wk log
Average L* color values for air dried material

Winter Harvested
Spring Harvested
Summer Harvested

Interior Color
<table>
<thead>
<tr>
<th>Drying days</th>
<th>0.5</th>
<th>1</th>
<th>1.5</th>
<th>2</th>
<th>2.5</th>
<th>3</th>
<th>7</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>@ 90°F</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image1.png" alt="Image" /></td>
<td><img src="image2.png" alt="Image" /></td>
<td><img src="image3.png" alt="Image" /></td>
<td><img src="image4.png" alt="Image" /></td>
<td><img src="image5.png" alt="Image" /></td>
<td><img src="image6.png" alt="Image" /></td>
<td><img src="image7.png" alt="Image" /></td>
<td><img src="image8.png" alt="Image" /></td>
</tr>
<tr>
<td><strong>@ 110°F</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td><img src="image9.png" alt="Image" /></td>
<td><img src="image10.png" alt="Image" /></td>
<td><img src="image11.png" alt="Image" /></td>
<td><img src="image12.png" alt="Image" /></td>
<td><img src="image13.png" alt="Image" /></td>
<td><img src="image14.png" alt="Image" /></td>
<td><img src="image15.png" alt="Image" /></td>
<td><img src="image16.png" alt="Image" /></td>
</tr>
</tbody>
</table>
### Drying days at 130°F

<table>
<thead>
<tr>
<th>Drying days</th>
<th>0.5</th>
<th>1</th>
<th>1.5</th>
<th>2</th>
<th>2.5</th>
<th>3</th>
<th>7</th>
<th>12</th>
</tr>
</thead>
</table>

### Drying days at 150°F

<table>
<thead>
<tr>
<th>Drying days</th>
<th>0.5</th>
<th>1</th>
<th>1.5</th>
<th>2</th>
<th>2.5</th>
<th>3</th>
<th>7</th>
<th>12</th>
</tr>
</thead>
</table>
CONCLUSIONS

• Critical temperature to cause interior darkening seems to be around 110 F

• The proof:
  1. Interior darkening started immediately with above 130F drying
  2. 90F drying did not result with interior darkening.
  3. During 110F drying, interior darkening started when core temperature plateaus.
Past experience ....

Interior darkening developed above FSP.
Not much color change developed below FSP

In this study:
2 days at Core temp. 110 F, AMC 30, Core MC higher than FSP. Darkening has started.
3 days at Core temp. 110F, AMC 20, Core MC is around FSP, Darkening progresses.
5 days at Core temp. 110F, AMC 15, Core MC below FSP, Darkening ended.

Recommendation
• Keep core temp below 110 F until Core MC is below FSP (average MC below 20%)

<table>
<thead>
<tr>
<th>Dry Side Schedule T°C</th>
<th>Wood Color #</th>
<th>W.H. %</th>
<th>AMC %</th>
<th>Core MC °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>80-10-20</td>
<td>100</td>
<td>37</td>
<td>27.5</td>
<td>40-42</td>
</tr>
<tr>
<td>65-10-25</td>
<td>100</td>
<td>37</td>
<td>27.5</td>
<td>40-42</td>
</tr>
<tr>
<td>60-15-20</td>
<td>105</td>
<td>37</td>
<td>27.5</td>
<td>30-40</td>
</tr>
<tr>
<td>45-20-15</td>
<td>115</td>
<td>48</td>
<td>45%</td>
<td>30-40</td>
</tr>
</tbody>
</table>

Key points for keeping sample white:
1. Promptly refer material standards for FSP and AMC.
2. This USDA PF is considered a high-risk area and should be scheduled accordingly. The AMC % should be closely monitored to ensure that no damage occurs.
3. Laboratory drying standards can cause problems and require careful monitoring to ensure that the MC is maintained at the correct levels. If the AMC % is not maintained, the sample may be damaged.
4. Keep a close eye on the surface and interior color, and surface checking. If there is surface checking, measure the wood density to ensure that the MC is maintained at the correct levels.
5. Laboratory drying standards can cause problems and require careful monitoring to ensure that the MC is maintained at the correct levels. If the AMC % is not maintained, the sample may be damaged.

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Some of our competition...
In China
Thank you!
any Question, Comments?