Technology Profile

Value to Wood

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Drying Aspen and Birch – Northern Hardwoods Need A Special Approach

Western Canadian hardwood lumber is not difficult to dry. However, each of these commonly available species has certain characteristics that will cause problems in the drying process if not dealt with correctly. Significant business failures have resulted when producers have ignored these hardwood-specific characteristics and applied generic softwood drying schedules. As a rule, typical softwood drying practices will not produce good results for hardwood products.

Drying hardwoods for quality

Most hardwood lumber is destined for applications that capitalize on the physical beauty of the material. In these high-value products the wood is covered with a coating that usually does not conceal defects, either natural, such as knots or rot, or those that occur in the manufacturing process. Specific drying defects are those that can result when the moisture content (MC) of the wood has not been reduced to a level at which it is likely to stabilize in service. Other drying stresses, such as surface- or end-checking, case-hardening, and honey-combing can result from a drying schedule that is too aggressive. Staining and discolouration can also be a problem. For example, prolonged exposure to drying temperatures in excess of 160°F will cause darkening of the wood, which may not be acceptable to certain customers.

The objective in drying is to add value and profit to the product. Communication with the end-user is the key to determining the required degree of drying quality.

Drying characteristics

White birch is quite permeable and dries well at low or at conventional temperatures (Table 1). However, it may shrink considerably during drying and it has a tendency to develop end-checks. End-checking can be minimized by placing the outermost stickers flush with the ends of the loads, and by restricting by-pass air. White birch has a moderate tendency to warp and will benefit from the use of some form of weight restraint, such as concrete or metal weights placed on the top of the load.

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Table 1. Drying Characteristics of White Birch and Trembling Aspen

	White Birch	Trembling Aspen
Average initial moisture content	72%	90%
Initial moisture content uniformity	Uniform	Variable with wet pockets
Specific gravity	High (0.508)	Low (0.374)
Prone to collapse	No	Yes
Prone to honey-combing	No	Yes
Impermeable wet pockets	No	Yes
Tangential shrinkage	9.3%	6.6%
Radial shrinkage	6.8%	3.6%
Tendency to end-check	Yes	No
Estimated drying time for 1-inch lumber	7-8 days	6-8 days
Tendency to warp	Medium	Low

Trembling aspen is a relatively easy species to dry with the sapwood and sound heartwood drying rapidly with few or no defects. Checking is not serious in trembling aspen. However, two potential problems are the presence of tension wood and wetwood.

Tension wood is the tree's natural response to external forces placed upon it during its growth (e.g., wind). Tension wood shrinks considerably in length causing warp. Depending on where this occurs in the board, it can lead to crook, bow, or twist. To reduce the effect of warp in the final product, stickers should be placed no more than two feet apart and a weight restraint should be used.

Wetwood is impermeable, discoloured wood found mainly in the zone between the sapwood and the heartwood. In green lumber, it is typically wetter than the surrounding wood, but at the end of the drying schedule its moisture content can still be considerably higher than that of the surrounding 'normal' wood. Wetwood is prone to checking and collapse. Trembling aspen, particularly thicker stock, is sometimes best dried slowly to avoid pockets of high moisture content. The careful application of air-drying will reduce energy costs while minimizing degrade.

Drying Schedules

Moisture content-based schedules minimize drying losses and maximize drying efficiency. They are well-suited for drying hardwoods. With correct use of the schedule, there will not be a significant variation in the final moisture content of the kiln charge. Progressive adjustments are made to these schedules based on the moisture content of the lumber. As the moisture content decreases and the internal strength increases, the schedules allow for more aggressive drying conditions.

Time-based schedules can be used with northern hardwoods but a larger variation in final quality and moisture content distribution should be expected. Final moisture content will need to be determined by some other means in order to know when to initialize equalizing and conditioning. Because the moisture content is not considered as the schedule progresses, a real danger of excessive degrade or unnecessarily long drying times exists. Ideally, these time-based schedules should only be developed from a history of several MC-based kiln charges. These time-based schedules will be species-, site-, equipment-, and season-specific. Because of the uncertainty associated with time-based schedules, most producers of quality hardwood products should use MC-based schedules.

A selection of drying schedules is shown in Tables 2 and 3 (more examples can be found in the 'Northern Hardwood Initiative Industry Resource Manual'). All schedules should be treated as guidelines and modified with caution to suit specific equipment or product specifications. All of the schedules share the same maximum temperature (160°F) and the same maximum depression (50°F). They also provide for more aggressive drying conditions as drying progresses. Many of the conventional drying schedules specify a maximum dry bulb temperature of 180°F with a maximum wet bulb depression of 45°F. However, it is recognized that by using a lower maximum temperature and a smaller maximum depression, both colour and machinability will be improved and cupping will be reduced.

Prevention of staining

Since colour is an important attribute of hardwood lumber, the development of stain will have a negative impact on its value in the marketplace. Stain can result from fungal activity (sapstain) or chemical activity (e.g., sticker stain). In either case, stain is generally the result of slow drying conditions when the moisture content in the wood is high. The light colour of northern hardwoods makes them particularly susceptible to stain. The following are some practices that will minimize stain development:

- Use fresh logs that have been stored for less than two weeks during warm weather;
- Sticker the sawn lumber within 12 hours of milling;
- Use dry, grooved, 3/4-inch thick by 1-1/4-inch wide stickers with a moisture content of 8 to 10%;
- Protect lumber from rain and snow;
- Load stacked lumber directly into the kiln or move to a fast-drying location;
- Build narrow kiln loads (less than 16-feet);
- Use an air velocity over 500 ft/min and relatively quick fan initial reversals (every two hours);
- Achieve a depression of at least 10°F within the first six hours of drying;
- Use lower dry-bulb temperatures.

Table 2. A Selection of MC-based Schedules for White Birch and Trembling Aspen

4/4, 5/4 & 6/4 White Birch

Moisture content (%)	Dry bulb (°F)	Wet bulb (°F)
>40%	140	133
40%	140	130
35%	140	125
30%	150	125
25%	160	120
<20%	160	115

Equalize and condition as necessary

4/4, 5/4 & 6/4 Trembling Aspen: Higher quality, lighter colour

Moisture content (%)	Dry bulb (°F)	Wet bulb (°F)
>60%	130	110
60%	130	100
50%	130	90
40%	130	85
30%	140	95
25%	150	105
<20%	160	115

Equalize and condition as necessary

4/4, 5/4 & 6/4 Trembling Aspen: Lower quality, with some darkening

Moisture content (%)	Dry bulb (°F)	Wet bulb (°F)
>60%	150	130
60%	150	120
50%	150	110
40%	150	105
<30%	160	115

Equalize and condition as necessary

Table 3. A Selection of Time-based Schedules for White Birch and Trembling Aspen

4/4 Upper grade White Birch to 8 to 10% MC

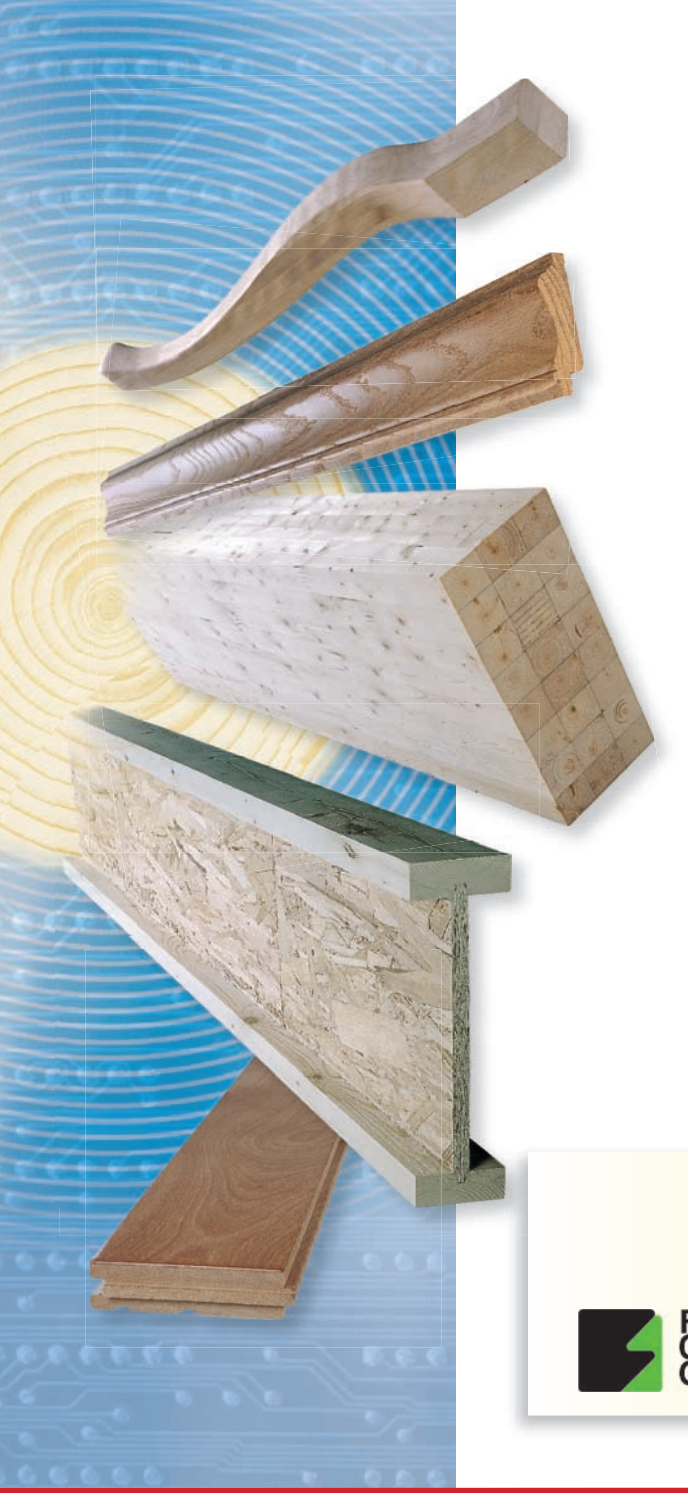
Step time (hours)	Dry bulb (°F)	Wet bulb (°F)
48	140	130
36	150	135
36	160	140
24	160	135
24	160	125
24	160	115

Equalize and condition as necessary

4/4 Upper grade Trembling Aspen to 8 to 10% MC

Step time (hours)	Dry bulb (°F)	Wet bulb (°F)
72	160	140
36	160	130
36	160	120
36	160	115

Equalize and condition as necessary



A costly but particularly effective method for minimizing stain is to disassemble the stack after several days of drying and to re-stack the lumber with the dry sticks placed a short distance away from their original placing. This procedure may be warranted if there is potential for a significant gain in value in the end product.

Conclusion

There are no standards for drying hardwood lumber as there are for softwood dimension lumber. Almost every product made from hardwood has its own set of specifications regarding acceptable drying quality. To satisfy market expectations and ensure operational profitability, hardwood lumber producers must be especially diligent in communicating with their customers to find out exactly what the end-use needs are and to determine appropriate levels of drying quality to meet those needs.

For information on the 2003-2004 ***Value to Wood*** research program, visit www.valuetowood.ca

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As part of the ***Value to Wood*** program, funded by Natural Resources Canada, Forintek's Industry Advisors are providing technical services to value-added wood product manufacturers in all regions of Canada. If you need information on any technical issue related to wood product manufacturing, you can:

- Send a request via *valuetowood.ca* (Help Desk).
- Contact a *Value to Wood* co-ordinator at one of the following locations:

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