VENEER BLOCK CONDITIONING MANUAL FOR VENEER AND PLYWOOD PRODUCTION♣

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ABSTRACT

Veneer blocks are heat-conditioned in water or steam in an effort to plasticize ("soften") the wood. When a sufficiently heated block is cut into veneer, the veneer will bend over the lathe's knife without splitting. This leads to improved volume recovery as the greatest conditioning benefit. Since conditioning adds to the production cost, a site-specific economic analysis will be necessary to determine profit margins.

This manual is based on selected literature sources. It briefly addresses the cost/benefit of block conditioning, heat-conditioning systems, energy demand, target temperatures, and conditioning times.

Keywords: veneer, heat conditioned, conditioning times

COST/BENEFIT OF BLOCK CONDITIONING

Advantages and disadvantages of block conditioning (Resch 1988) are given in Table 1. Based on mill studies and industrial observations, conditioning reportedly increased the volume recovery by 3 to 25 percent. Payback of increased production cost, on the other hand, may often occur at a less-than-10-percent additional volume recovery, assuming fixed capital investment (Resch 1988, Steinhagen et al. 1989). If boiler capacity must be added, payback and return on investment should be carefully calculated. A rigorous cost/benefit analysis of block conditioning has not been published.

Penalties of insufficient block conditioning have been studied in two mills (Steinhagen et al. 1989, Sim et al. 1989). Underheating the blocks by a given amount of time appeared more costly than overheating them. Maximum economic benefit coincided closely with maximum veneer recovery (Fig. 1, where "a" denotes differences between adjacent data points as statistically significant at the 0.05 level, using Scheffé's method)

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Table 1. Advantages and disadvantages of block conditioning (Resch 1988)

Advantages	**Reasons**
Increased volume of recovered veneer	There is less splitting and breakage in handling
Increased quality of recovered veneer from high-quality and frozen blocks	There is decreased splitting, reduced degrade from surface roughness
Reduced knife wear	Knots are softened
Reduced glue spread	Peel is smoother
Tighter veneer with finer checks and reduced nosebar pressure, especially for thickness above 1 /8 inch	Wood is more plastic and less resistant to fine checking, thus reducing deep splits
Greater tensile strength of veneer perpendicular to the grain	Veneer is tighter and fine, checks are shallower
Reduced power required for peeling	Softened wood offers less resistance to Peeling.
Increased production	Faster peeling of softer wood
Reduced drying time with in-line dryers	Some heat is stored in wood, and steamed wood is more permeable
Decreased spinouts	Thoroughly softened wood requires a Iower turning force
Disadvantages	**Reasons**
Increased spinouts	Main block remains cold despite heat-softened ends
Fuzzy veneer surface	Blocks are overheated
End-checking of blocks arid veneer	Blocks are heated in dry steam

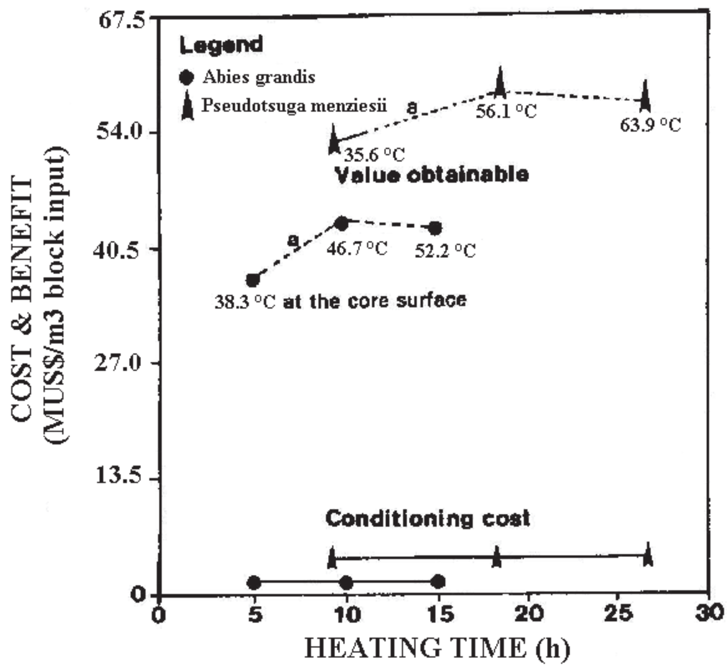

Fig. 1.- Cost and benefit of block conditioning as a function of heating time (Steinhagen et al. 1989)

HEAT-CONDITIONING SYSTEMS

Blocks are usually heat-conditioned via (a) steaming in drive-in chambers which is a batch process, or (b) hot-water spraying (deluging) in drive-in chambers, also a batch process, or (c) feeding through hot water vats which is a continuous process (Resch 1988). An overview is given in Table 2.

Steam chambers (a) are relatively inexpensive to build and maintain. But the condensate from steaming is "dirty" and must be handled in accordance with governmental guidelines on effluent discharge. Also, the steam must be saturated for conditioning, or blocks will dry and check.

In the deluge system (b), the water can be reused in a closed loop. Blocks may not heat evenly by this method.

Feed-through in hot water (c) will heat submerged blocks evenly. This method is very capital-intensive initially.

To help achieve temperature uniformity between blocks, the blocks must be sorted into diameter classes and classes conditioned for various lengths of time. In addition, doors rather than curtains must be used with chambers (a and b) to avoid heat leakage. Also, blocks must be fully submerged in water and the water agitated (c).

Table 2. Methods for block conditioning (Resch 1988).

	Process	
Method	**Batch**	**Continuous**
Steam sprayed under low pressure high pressure	Aboveground chambers (drive-in vaults)	Aboveground chamber (conveyors)
Spray or deluge with hot water: below 90 °C super heated mixed with steam	Aboveground or belowground chambers	Aboveground chamber (conveyors)
Immersion in water heated by: steam coils live steam external heat exchanger	Submerged, covered soaking vat	Feed-through soaking vats, above or below ground

CONDITIONING ENERGY DEMAND

Examples of net energy required to heat green wood (Steinhagen 1977) are given in Table 3. The table values, reflecting unit energy demand in terms of kJ/m^3.°C, vary strongly with moisture content: wood low in moisture content (*Pseudotsuga menziesii* heartwood, etc.) demands relatively little unit energy, and wood high in moisture content (*Quercus sp.*, *Populus sp.*, etc.) demands much unit energy. Thawing also has an important effect on unit energy demand.

Unit energy demand values must be multiplied by the total volume input and the total temperature increase over the heating range to estimate the total net energy demand.

The gross energy demand is the sum of the net energy demand and energy losses to the surroundings. Losses occur by warming up the construction, and by leakage, and reach a peak during winter. Losses may account for 95 percent, and leakage alone for 6O percent, of actual gross energy consumption (Kuhlmann 1962). This should offer substantial opportunities for improvement.

Table 3. Net energy required to heat green wood (Steinhagen 1977).

	Initially nonfrozen (kJ/m^3.°C)	**Initially frozen** (kJ/m^3.°C)
Pseudotsuga mensiezii (heartwood)	1283	1540
Quercus sp.	2566	3079
Populus sp.	2566	3079

CONDITIONING TEMPERATURES

Softwood blocks temperatures suggested for rotary peeling (Resch 1988) are often between 50 and 60 °C or above, measured at the core limit (Table 4). Using the upper-range table values appears economically beneficial (Resch 1988, Sim et al. l989).

Hardwood block temperatures suggested for peeling (Fleischer 1959) are strongly correlated with the wood's specific gravity. For example light wood species (*Tilia sp.*, Populus sp., etc.) peel well at 20 °C, but dense wood species (*Quercus sp.*, *Carya sp.*, etc.) may require 90 °C, measured at the core limit (Fig. 2).

Temperatures recommended for slicing are often 6 to 12 °C higher than for peeling (Lutz l972).

Table 4. Conditioning temperatures suggested for softwood peeler blocks (Resch 1988).

Species	T(°C)	Species	T (°C)
Western		**Western**	
Chamaecyparis nootkatensis	50-60	*Pinus sabiniana*	60-80
Calocedrus decurrens	20-50	*Pinus contorta*	60-80
Chamaecyparis lawsoniana	50-70	*Pinus ponderosa*	60-80
Thuja plicata	60-70	*Pinus lambertiana*	50-60
		Pinus monticola	50-60
Pseudotsuga mensiezii	15-60	*Sequoia sempervirens*	70-80
Abies balsamea	20-55		
Abies magnifica	20-65	*Picea engelmannii*	50-60
Abies grandis	20-65	*Picea sitchensis*	50-60
Abies procera	20-65		
Abies sp.	20-65	*Taxus brevifolia*	180-90
Abies concolor	20-65		
		Southern	
Tsuga heterophylla	50-70	*Pinus tadea*	50-70
Juniperis occidentalis	60-70	*Pinus palustris*	50-70
		Pinus serotina	50-70
Larix occidentalis	60-65	*Pinus echinata*	50-70
		Pinus elliottii	50-70
		Picea sp.	50-60

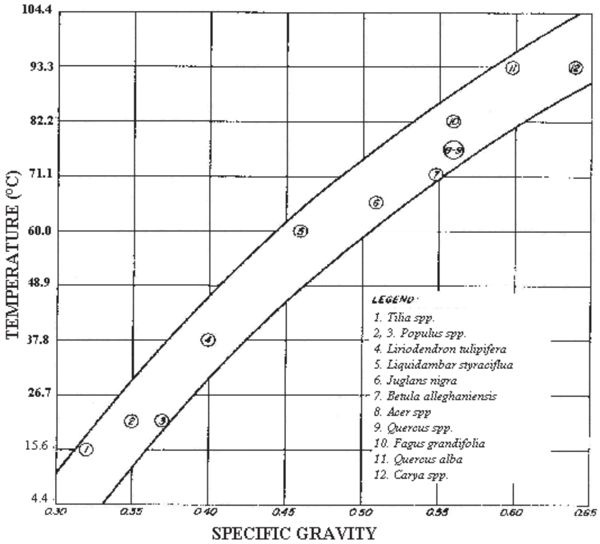

Fig. 2.- Conditioning temperatures suggested for hardwood peeler blocks (Fleischer 1959).

Conditioning times

Conditioning periods necessary to meet target temperatures (Steinhagen 1989) are shown in Figures 3 and 4, respectively, for nonfrozen and frozen peeler blocks 8 feet long and up to 25 inches, in diameter. The graphs apply to a target core diameter of 5 inches, a specific gravity of 0.5, and a moisture content of 100 percent. (Specific gravity and moisture content are used here as a key to the wood species effect, and data for many wood species may be looked up in the USDA Wood Handbook 1987). Also, the steam or agitated water bath temperature must be known or estimated, as well as the block's initial temperature and its target temperature.

As an example of how to use the heating time graphs, let us make assumptions as follows: the block under consideration is nonfrozen; block diameter = 18 inches; the initial temperature of the block ($T_{initial}$) = 21.1 °C; the target temperature of the block (T_{final}) = 60 °C; and the water bath temperature (T_{bath}) = 82.2 °C. Then, $(T_{bath} – T_{final})/(T_{bath} – T_{initial})$=(82.2 °C – 60 °C)/(82.2 °C – 21.1 °C) = 0.36. This value, together with 18 inches of block diameter, gives a heating time estimate of 25 hours (Fig. 3, dashed line). Adjustments, if necessary, can be made as follows;

If the target core diameter = 4 inches, add 1 hour to the hours given by the figure.

If the target core diameter = 6 inches, subtract 1 hour from the hours given by the figure.

If the specific gravity = 0.3, subtract 5 percent from the hours given by the figure.

If the specific gravity = 0.7, add 5 percent from the hours given by the figure.

If the moisture content = 50 percent, subtract 10 percent from the hours given by the figure.

If the moisture content = 150 percent, add 10 percent from the hours given by the figure.

If the water bath is not agitated, add 10 percent from the hours given by the figure.

If the wood species contains much ray volume (*Quercus sp.*, *Carya sp.*, etc), subtract 10 percent from the hours given by the figure.

The user may perform linear interpolations between these values to find the proper adjustment to the hours given by the figure.

The significance of block diameter on heating time should be noted. For example, if block A has twice the diameter of block B, block A will require about five times as much heating time as block B, given equal core diameters. Therefore, small diameter and large-diameter blocks should not be conditioned together and for the same number of hours.

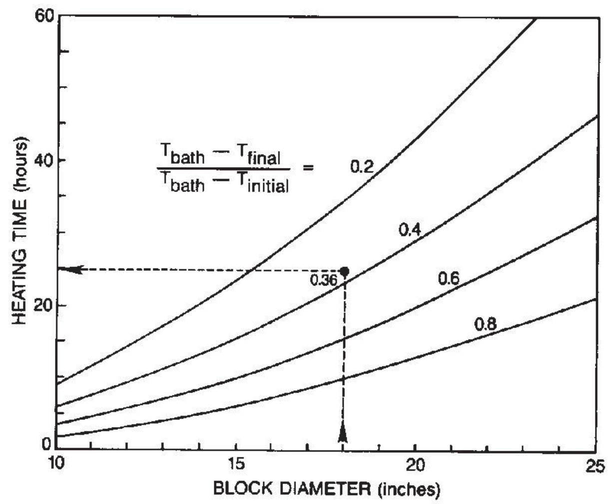

Fig.3.- Conditioning time to reach target temperature in a nonfrozen block, given a specific gravity of 0.5, a moisture content of 100 percent, and a target core diameter of 5 inches. The dashed line and data point refer to the example given in the text (Steinhagen 1989).

Let us now reconsider the previous example but assume that the block is frozen. Then, $T_{bath} - T_{final}$ = 82.2 °C – 60 °C = 22.2 °C. This value, together with the assumed 18 inches of block diameter, gives a heatíng time estimate of 42 hours (Figure 4). For frozen wood, it is not important to know the initial temperature precisely, as long as it is safely below 0 °C.

Adjustments, if necessary, can be made as stated for nonfrozen blocks, with the following exceptions:

If the moisture content = 50 percent, subtract 20 percent from the hours given by the figure.

If the moisture content = 150 percent, add 20 percent from the hours given by the figure.

The effect of block diameter on heating time is the same as mentioned for nonfrozen wood.

Heated blocks cool rapidly during transfer from the conditioning facility to the lathe, particularly in winter. It is advisable to install, for process control, an infrared temperature sensor at the lathe so that veneer temperature can be monitored continuously while the block is peeled (Resch 1988).

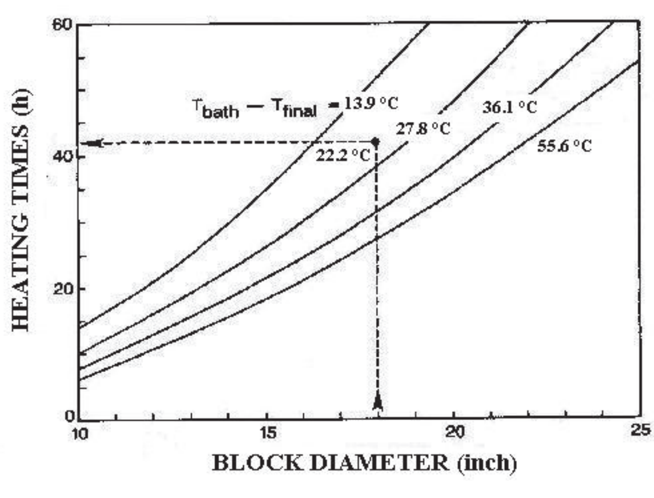

Fig. 4.- Conditioning time to reach target temperature in a frozen block, given a specific gravity of 0.5, a moisture content of 100 percent, and a target core diameter of 5 inches. The dashed line and data point refer to the example given in the text (Steinhagen 1989).

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