EQUALIZATION OF WESTERN HEMLOCK TO JAPANESE EQUILIBRIUM MOISTURE CONTENT

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This study was designed to quantify the response of kiln-dried western hemlock to Japanese humidity and temperatures after drying matched samples in each of a conventional kiln, a superheated steam/vacuum kiln and a radio-frequency/vacuum kiln. Only the results from the conventionally dried material are presented here.

Moisture content of wood is dependent on both the relative humidity and the temperature of the air surrounding it. If wood remains long enough in air where the relative humidity and temperature remain constant, the moisture content will also become constant at a value known as the equilibrium moisture content (EMC). Ideally, solid timbers should be dried to the average EMC they will reach in service. However, with thick timbers, this is seldom practical and as such, dimensional changes are to be expected. To minimize any impacts of frame shrinkage, a maximum difference of 5% between installation moisture contents and end-service moisture contents is usually recommended.

The cyclical nature of EMC presents a challenge for Pacific Northwest coastal lumber exporters. During the winter months, Japan (Tokyo) reaches its minimum EMC of 12% coinciding with the PNW reaching its maximum EMC of 19% (Figure 1). The net effect is possible movement of the lumber in service, an undesirable attribute for post and beam housing components.

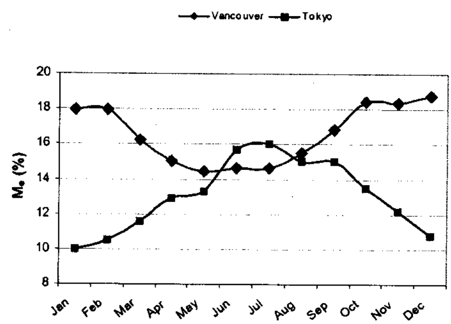
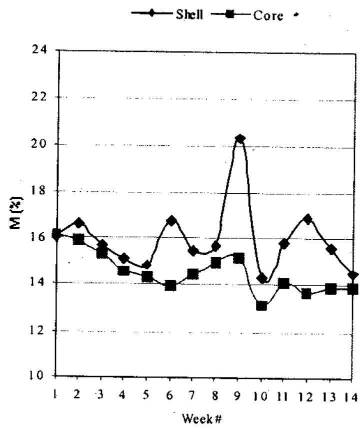
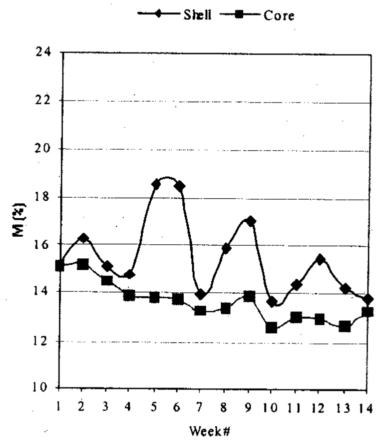


FIGURE 1. Cyclic nature of equilibrium moisture content (Mc) in Vancouver and Tokyo.

The following observations were noted:

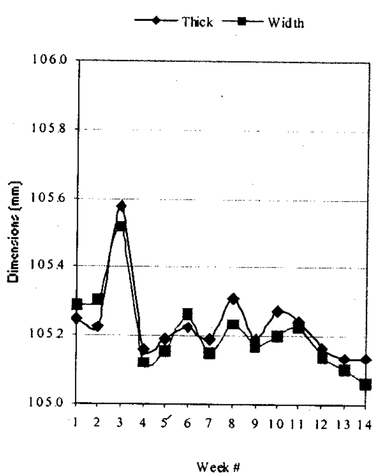
The moisture content response time of exposed western hemlock to an EMC of 12% is in the order of weeks, and appears to be independent of wood density. The shell is much more susceptible to fluctuations in EMC than the core (Figure 2a & 2b).

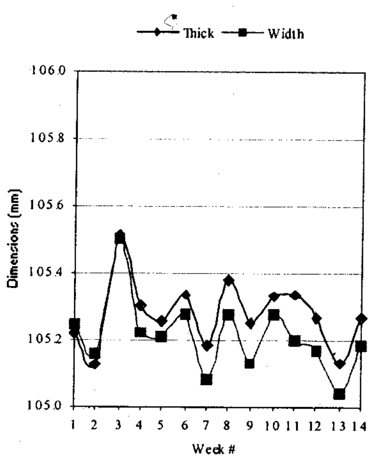




FIGURES 2a and 2b. (a) Moisture content response of low basic density hemlock. (b). Moisture content response of high basic density hemlock.

The dimensional response of planed 105 mm x 105 mm western hemlock is minimal. Maximum shrinkage values of 0.6 mm were recorded, which kept the product within the target size range of 105 mm. Longitudinal shrinkage was not measured but, unless the product is load carrying, the longitudinal shrinkage due to moisture content changes is minimal (Figure 3a and 3b).





FIGURES 3a and b. (a) Dimensional response of low basic density hemlock. (b) Dimensional response of high basic density hemlock.

When exposed to an EMC of 12%, the stability response of unrestrained western hemlock is also minimal. Stability indicators measured were twist, bow, and crook, and were referenced at the beginning of equalizing. The twist results are presented as coefficient of variation (Figure 4a and b). Average movement values range from 0.5 to 1.5 mm for all three indicators. The error of measurement is +/- 0.2 mm. There were only a few instances of increasing checks or shake. Knots with a diameter larger than 5 cm were observed to split frequently, probably due to the different wood characteristics of the knot.

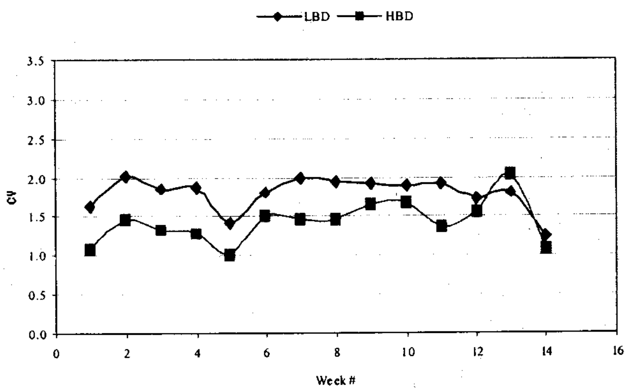


FIGURE 4a. Twist response of low basic density hemlock.

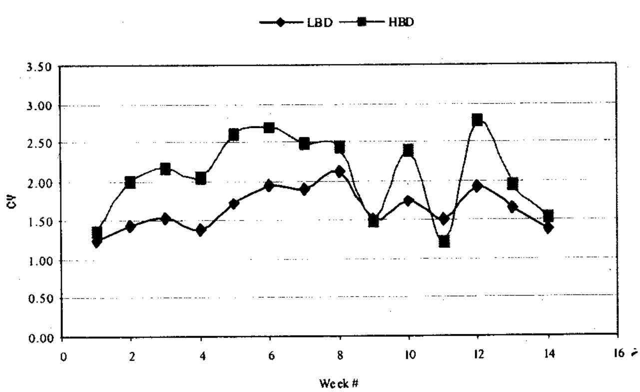


FIGURE 4b. Twist response of high basic density hemlock.

Summary

The variation of response in western hemlock to Japanese EMC's should be expected when wood is examined in its natural, variable context. Unless the fiber is converted into an engineered product, these results represent a worse case scenario as the material was unrestrained during testing.

An effective drying strategy for PNW kiln operators, designed to ensure the stability of the product in service, would be to target at least 19% at the core. A conditioning/equalizing period at the end of drying would reduce any extreme drying gradients and relieve any casehardening if the lumber is to be remanufactured.