GRAIN AND GRADE SORTING TO IMPROVE DRYING QUALITY IN WESTERN RED CEDAR

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Many softwood mills in British Columbia are attempting to transition from being primary producers to providing re-manufacturing opportunities for adding value to their lumber. One such facility which completely transformed itself from a primary to a secondary manufacturer is MacDonald Cedar located on the coast of British Columbia.

Situation before Transition (Primary facility)

For many years this mill dried Western Red Cedar and dealt with two sets of factors in their drying facility:

Natural variation in moisture content and lumber properties.
Induced variation in moisture content.

The natural variation in moisture content in lumber properties was due to (a) geographic location (b) species mix and genetics (c) physical damage and infection. The induced variation in moisture content was the result of storage at the logging site and log yard dry land storage versus water storage.

The natural variation in moisture content has always been accepted as a fixed variable and little attention was given to reducing it either through pruning or in new plantations. This is especially prevalent in British Columbia where most of the forest lands are owned by the government rather than the forest company harvesting and processing the logs. Induced variation was minimized by log sorting to segregate logs coming from different sources, and separate logs transported and stored on land from those transported and stored in water. Both induced and natural variation were further controlled through sorting sawn lumber on the green chain and then applying the appropriate kiln schedule.

The products produced when the plant was a primary facility are listed in Table (1). The moisture content required for the kiln dried products was 19% (±2%).

TABLE 1. Products produced at the primary facility.

Type of Product	Description	Market
2x4, 2x6	Rough Green	US
2x4, 2x6	Surfaced 4 Sides	US
2x4, 2x6	Kiln Dried Surfaced 4 Sides	US
4x6, 4x8, 4x10	Rough Green or Surfaced	Japan

The raw material before the changeover from a primary to a secondary manufacturer consisted of western red cedar logs ranging in diameter from eight to 60 inches (8"-60"). Most logs were transported by water and stored in the river before processing. The initial moisture content fluctuations depended on the following factors:

a) storage of logs,
b) wet pockets,
c) heartwood and sapwood moisture content differences and
d) variations due to geographic locations where the logs were harvested

The main objective was to reduce economic losses when drying to a target moisture content of 19%. To achieve this goal, three approaches were used:

(1) New technology
(2) Rigorous quality control program
(3) Regular drying schedule updating

Weight restraints were introduced to minimize twisting and cupping of the top layers during kilning. A strict quality control program monitored the initial moisture content and grade input and output on a regular basis. The drying schedule was changed to accommodate shorter fan reversal periods and longer conditioning times.

Transition to a Value Added Site

The remanufacturing operation faced significant changes in its raw material input and the greatest challenge was in the drying area. This plant was built because of the shrinking availability of high grade logs and now utilizes green trim ends (measuring 6" to 36") as well as (2x6) economy grade lumber from other facilities. The material is kiln dried and clear sections are prepared for finger-jointing into larger pieces. Bevel siding is then manufactured from the finger-jointed material. This product commands a high price in the marketplace.

At the present time both flat and vertical grain are dried together but they are placed on different pallets so as to make it easier for similar grain orientation and color to be glued together. When the material arrives at the mill, grain sorting is done and this is very labor intensive, but enhancing the appearance of the bevel siding by finger-jointing pieces of the same grain orientation and color overcomes the labor cost. This grain sorted material is then dried in kiln loads combining several pallets of grain sorted trim ends with loads of 2X6 economy lumber.

Apart from inconsistencies in the quality of the raw material, the moisture content varies greatly from one specimen to another as well as from one kiln change to another due to the material's diverse sources and handling.

Figures 1 and 2 show the wide initial moisture content variations typical of the trim end material being dried. The average moisture content shown for two kiln lots sampled ranged from 56.3% to 61.0% but their standard deviations were 30.5 and 43.8 respectively. The challenge was to dry a mix of material ranging from close to the target 10% M.C. up to 200% M.C. The bulk of the specimens sampled fell below 100% M.C., but a significant fraction (10% to 20%) were well over 100%.

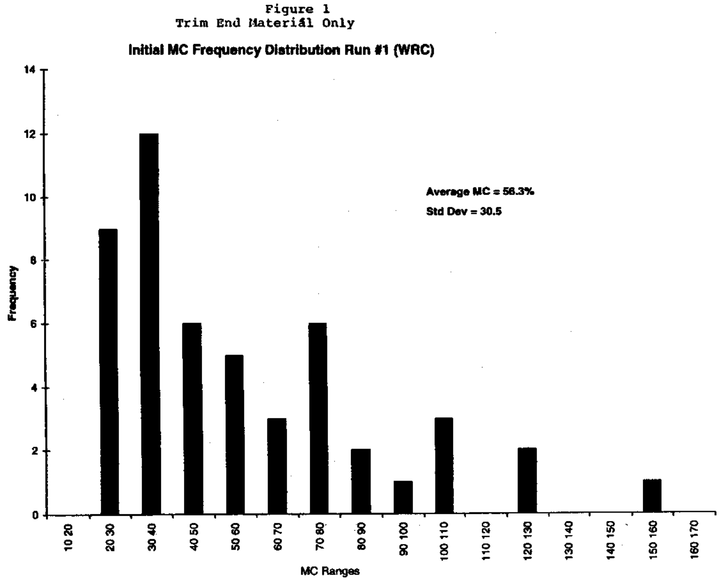

FIGURE 1. Initial moisture content frequency distribution for western red cedar, run #1. This includes trim end material only.

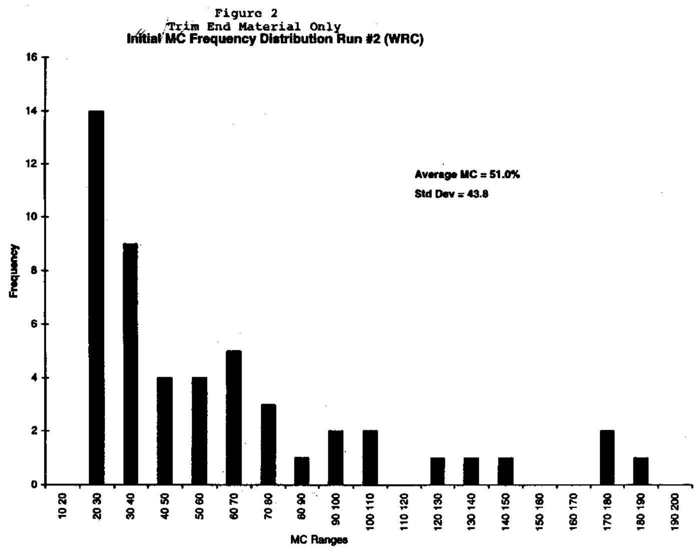

FIGURE 2. Initial moisture content frequency distribution for western red cedar, run #2. This includes trim end material only.

One of the other challenges faced by the new added value facility was the retention of the same kiln used by the primary facility. The two Moore kilns are gas fired and have a capacity of 250,000 bd ft. The controllers are Brauner-Hildebrand.

The transition to remanufacturing required drying to a tighter and lower final (8% to 10%) moisture content. The kiln controller settings selected resulted in the schedule shown in Fig 5. The fan is reversed every two hours with a conditioning period of 12 hours at the end. The measured air velocity was 800 fpm. The total drying times for the 2x6 and trim ends ranged from 10 to 12 days

A combination of good quality control and adjustments to the relatively gentle drying schedule resulted in achieving the final target moisture content while eliminating drying defects such as checks and collapse. The results achieved for the two loads of trim ends investigated are shown in Figures 3 and 4 and summarized in Table 2.

TABLE 2. Summary of drying performance.

Kiln Charge	Initial		Final	
	M.C. (%)	Std. Dev. (%)	M.C. (%)	Std. Dev. (%)
#1	56.3%	30.5%	7.3%	1.0%
#2	51.0%	43.8%	9.5%	9.8%

Average final moisture contents of 7.3% and 9.5% were achieved. The first load had an acceptable standard deviation of 1%, with all samples dried below 10%. However the second charge had a standard deviation of 9.8%, with 20% of the samples above the maximum 10% M.C. required for reliable finger jointing. This unacceptable performance is thought to be due to the kiln and controller's inability to handle the wide initial moisture content range, and perhaps the presence of "wet pockets" that cannot be effectively dried.

Discussion & Recommendations

The already long drying times and unpredictable output of "wets" make it unlikely that further refinements of the present practices for drying trim ends will yield an acceptable quality output at reasonable cost. With no control of, and information on, the trim end material processing at source, the value added plant is faced with continued high costs to inspect and sort material before and after drying, and the difficulty and expense of adapting kiln schedules to varying input characteristics. Therefore, several alternative sorting strategies were considered.

Table 3 shows the percentage of sapwood and heartwood samples in both flat and vertical grain, for the two loads of trim ends sampled. (The proportion of flat and vertical grain in both loads was approximately 60%/40%.) These percentages vary according to the size of the logs and the technique utilized in sawing the logs into lumber. The added value facility has no control in the preparation of the raw material.

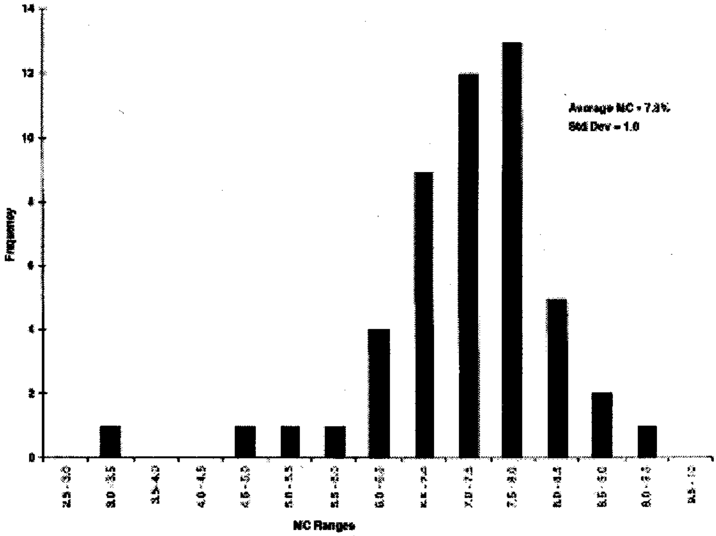

FIGURE 3. Final moisture content frequency distribution for western red cedar, run #1. Trim end material only.

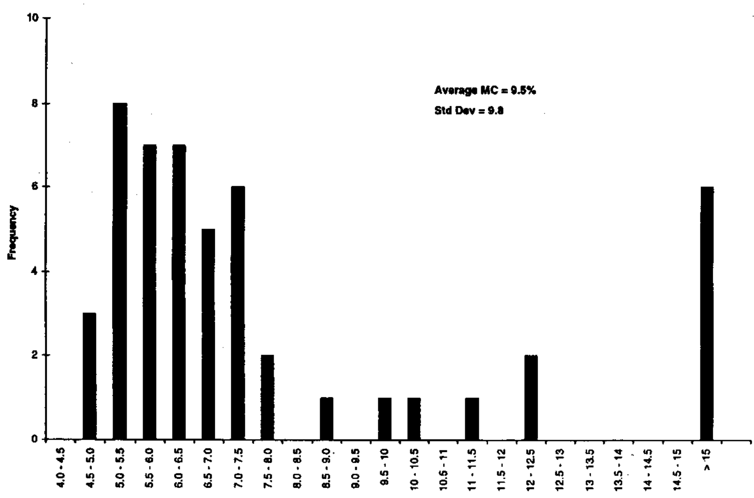

FIGURE 4. Final moisture content frequency distribution for western red cedar, run #2. Trim end material only.

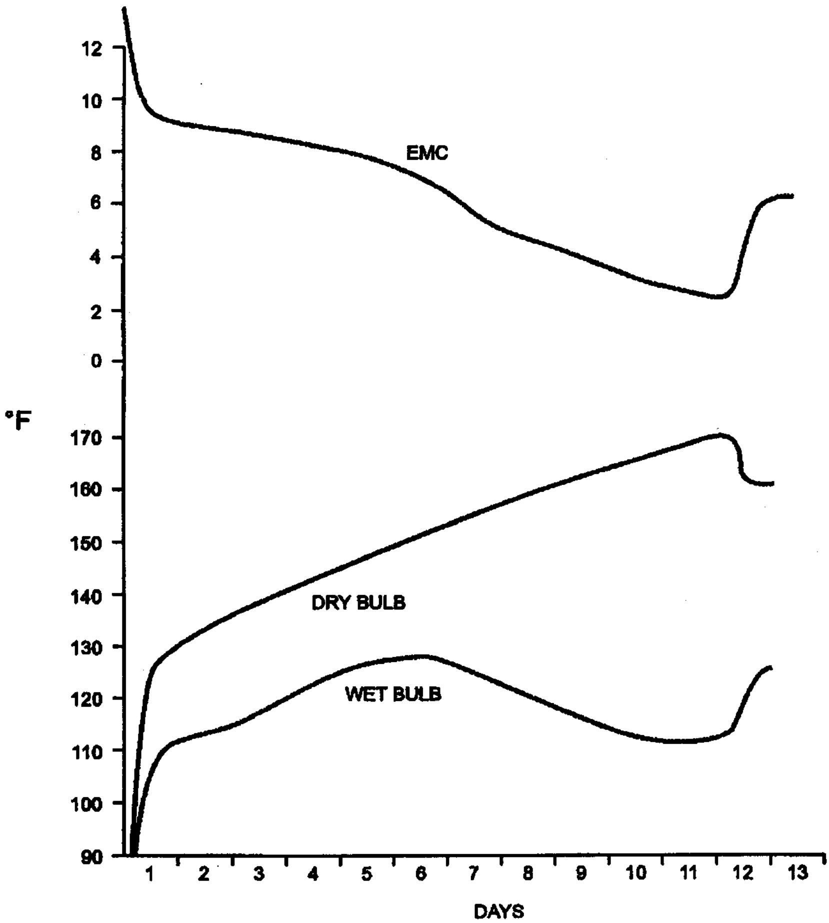

FIGURE 5. Drying schedule for western red cedar.

TABLE 3. Percentages of Sapwood and Heartwood Samples

Kiln Load	Flat Grain		Vertical Grain	
	Sapwood	Heartwood	Sapwood	Heartwood
#1	62%	#1	26%	74%
#2	70%	30%	30%	70%

It was thought that sorting into loads of uniform grain orientation might benefit from the different drying characteristics of flat and vertical grain. It is evident that the significant proportions of heartwood and sapwood, with their differing M.C. and characteristics, of both grain orientations will obviate this advantage - even before considering the uncontrolled M.C. variation in the input.

It was concluded that the most promising approach would be to:

Sort by moisture content
Kiln dry loads made up of packages of trim ends and 2X6 lumber of similar M.C.
Sort by grain orientation and color prior to finger jointing.

The mill is investigating the capabilities and cost of equipment to sort by M.C., in the expectation that the reduced drying time and more controlled drying performance will justify this strategy. If cost effective M.C. sorting equipment is found, automated sorting of the dry trim ends by grain and color will also be considered,.

Summary

We undertook an investigation of the feedstock characteristics at this re-manufacturing facility to evaluate whether sorting by (a) grain orientation (b) sapwood vs heartwood (c) initial moisture would improve the drying quality of the lumber. Preliminary results showed that since both flat and vertical grain contained sapwood and heartwood and the average initial moisture contents are similar, the most effective strategy is to sort by moisture content, kiln dry, then sort by grain orientation and color before finger-jointing. The mill is presently looking at technology to sort by grain and color.