

# **DESIGN CONSIDERATIONS OF A COMMERCIAL Q-SIFT INSTALLATION FOR REDRYING HEMLOCK LUMBER**

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## **Introduction**

Hemfir by its nature is a species group that has a significant amount of kiln drying non-uniformity depending on what time of the year it was processed, what part of the tree the lumber came from, how long it was allowed to air-dry, the relative mixing of commercial species (i.e., inclusion of true firs in the processing), water transportation, bacterial infection, etc. Commercial issues are encountered due to the high variability of kiln-dried hemlock:

- ◆ Target sizes have to be increased to compensate for shrinkage of over-dried wood at low moisture content, resulting in higher losses of lumber recovery.
- ◆ Lumber fall-down for conventionally kiln-dried hemlock is unacceptably high.
- ◆ Too many wet pieces from the dry kiln result in a large proportion of the product having to go to another market place at a lower sales price; or unrecoverable costs are incurred for a wet product having to be remanufactured.
- ◆ Distortion of lumber (twist, cupping, bow and crook) due to shrinkage, aggravated further from over-drying to low moisture contents in an attempt to minimize the volume of wet lumber.
- ◆ The market place is requiring a more uniform product quality, including kiln-dried moisture content (i.e., the "box stores" and house pre-fabricators)
- ◆ There has been recent liability concerns surrounding wet lumber used in home construction.

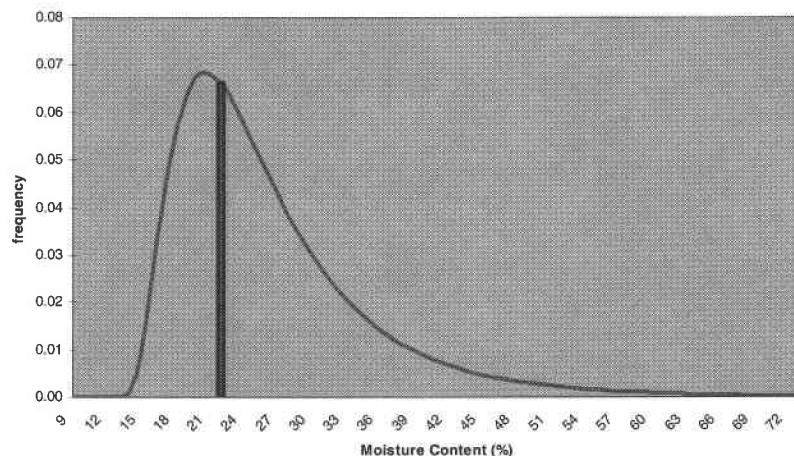
Numerous solutions have been proposed over the years to address the problem of hemlock kiln "wets" including both, pre-processing and post-processing strategies while encompassing the conventional kiln-drying process (Bassett, 1973; Milota and Wu, 1995). HeatWave has developed a post-processing strategy that incorporates a E-field/Vacuum kiln as a re-dryer for lumber wets coming from the first-pass in the conventional kiln. This process is known as "Q-Sift" or Quality Sifting (Zwick and Avramidis, 2001). This paper discusses the design considerations for a Q-Sift processing system at a commercial

hemlock sawmill and attempts to identify all the issues outside of the operational aspect of an RFV kiln as it relates to a RFV kiln installation used for Q-Sift.

## Q-Sift Fundamentals

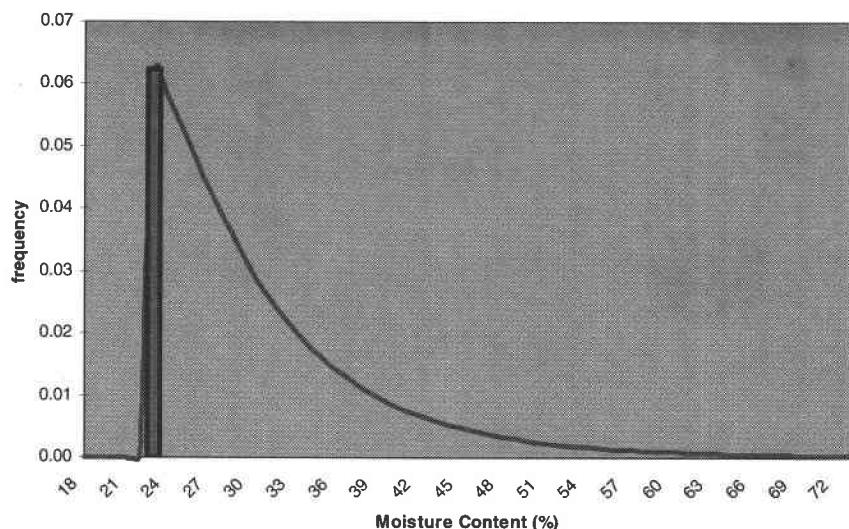
HeatWave's Q-Sift process in conjunction with RFV drying addresses all the above hemlock drying issues in a cost effective manner. Q-Sift is a process strategy whereby the wood is first-pass dried in a conventional kiln to relatively high average moisture content (MC), for example 26%. Even at this high average MC, our experience and analysis has shown a large proportion of pieces acceptably meets the market requirement for kiln-dried hemlock. The sole purpose of Q-Sifting to a higher average MC is to guarantee that no pieces are dried to a MC relating to an unacceptably high shrinkage and lumber degrade (shrinkage is inversely related to MC, i.e., the higher the MC, the lower the shrinkage and degrade). Previous investigations have shown that hemlock drying degrade is directly attributable to low MC (Dedrick and Ziegler, 1984).

Unacceptably high "wet" pieces (say for example MC greater than 22%) are drop sorted at the planer before the product is to be planed (Figure 1).



**FIGURE 1.** The drop-sort is set at 22% MC (vertical line)

The "wet" pieces are automatically stacked without lumber stickers, into a solid pack and re-dried in the RFV kiln. Shown in Figure 2 is the frequency distribution of the drop-sorted lumber entering the RFV kiln.



**FIGURE 2.** The frequency distribution of the drop-sorted lumber entering the RFV kiln

The wet lumber is circulated through a RFV kiln until it reaches acceptable MC for planing. On average, almost all the wet lumber will be dried within one RFV re-dry cycle and never more than a second re-dry cycle for a very small portion of the total hemlock lumber population.

**Advantages for the HeatWave Q-Sift drying process include:**

- ◆ RFV drying has less shrinkage (by approximately 30%) than conventional drying methods (Avramidis and Zwick, 1996).
- ◆ drying allows for the total control of the drying process and it can be stopped accurately at pre-determined average MC (this is difficult to do with conventional drying methods).
- ◆ The cost of resorting/restacking lumber is very low for RFV drying with no re-stickering required.
- ◆ Energy costs are very low and drying times are very fast for RFV re-drying. RFV drying is focused totally on MC. Therefore, heat energy is not unnecessarily wasted on heating the kiln building, massive piles of stickered wood, etc.
- ◆ Degrade of RFV dried wood can be at least half of conventionally dried lumber (Avramidis and Zwick, 1996)
- ◆ The opportunity exists to have 100% of the wood destined to the kiln-dried market place, rather than dealing with expensive remanufacturing of wet pieces to alternative markets.

Drying conventionally with the first-pass to higher average MC reduces the severity and occurrence of undesirable shrinkage defects such as bow, crook, cupping, and twist. Warp is the primary cause of grade defects found in conventional kiln drying (along with splits and checks). To further reduce this defect for the second-pass drying, HeatWave uses a hydraulic loading system that greatly reduces warping (coupled with the fact that RFV dried wood has literally no splits or checks).

### Economic Considerations of a Q-Sift Installation

The sawmill requires establishing the economics of Q-Sift by gathering some information on their present operation. What falls out of this analysis is the equipment required for the Q-Sift installation. The key economic factors to establish are:

- Revenue increase
- Operating cost of Q-Sift operation
- Capital cost

#### Establish revenue increase

Investigation into the justification of a Q-Sift by the sawmill first requires establishing the increase in revenue. This includes:

- ◆ A mill study to establish what potential value is in the wet lumber  
There is a sales price discount for wet lumber in the market place. However, if that lumber could be dried properly, HeatWave studies have shown the "wets" lumber pile consists of a higher average grade than found in the mill-run lumber. There is an old adage that "the best grade of lumber is found in the wets". The sawmill needs to establish not only the improved value of the re-dried "wets" lumber but if that lumber is dried with high grade yields, the value of the lumber will be above the average value of kiln dried lumber.
- ◆ Value increase from modified conventional kiln schedule grade increase  
The first-pass conventional kiln schedule is modified to eliminate over-dried lumber since there is now a solution to the "wets" problem. The kiln schedule is shorter in duration and the kiln operator need not be overly concerned if there are too many "wets" in the kiln charge. The reduction in over-dried lumber in the first-pass conventional kiln charge directly translates to an improvement in grade and value coming out of the kiln. The mill needs to establish this value. With this investigation, the volume of "wets" lumber produced coming out of the first pass needs to be established. This is an important aspect of the study since the volume of "wets" establishes the processing capacity of the RFV kiln installation.
- ◆ Revenue increase due to increased throughput of total kiln production  
With the shorter conventional kiln schedule, there is increased throughput of the higher-grade kiln-dried lumber through the conventional kilns. A Q-Sift installation results in an increase of total production of kiln-dried lumber.

◆ Improved lumber recovery due to target size improvements

The Q-Sift processing strategy results in an increase in MC of the driest pieces in the population of kiln-dried lumber being produced. Lumber shrinkage is directly related to the MC of the board. With the driest pieces no longer being severely over-dried, a greater planing tolerance results. HeatWave studies have shown that if a mill can increase the MC of their driest pieces in a kiln-dried population by 2% to 3%, this can translate to an increase in target size greater than 0.006 inch for hemlock lumber.

**Establish expected operating cost of Q-Sift operation**

A sawmill study is needed to determine the expected operating cost of the Q-Sift installation.

◆ Decrease in unit operating cost (energy and production costs) due to increase conventional kiln throughput

The conventional kiln schedule is reduced in a Q-Sift installation. This translates to a reduction in energy consumption for the first-pass lumber going through the conventional kiln. A good estimate is approximately half the percentage of the reduced drying times. So if the kiln schedule is reduced by 10% in drying time, energy costs are reduced by 5%.

◆ Operating cost of RFV kiln operation (mill needs to establish initial/final average MC's of re-dry lumber in order to establish RFV kiln drying times)

A study at HeatWave's facility is done on the "wets" lumber before the second-pass RFV re-dry kiln charge is performed. This is required to characterize the "wets" distribution in order to predict drying times and throughput of the RFV kiln with the expected volume of "wets" lumber. This results in the establishment of the size of the second-pass RFV kiln installation. This study also establishes the energy costs for re-drying the lumber.

◆ Maintenance cost of RFV kiln

The maintenance costs of a RFV kiln installation is well known by HeatWave due to the many years of operating the commercial facility in Crescent Valley, BC. The sawmill can be assured of the expected maintenance cost for a RFV kiln installation.

◆ Operating cost to drop sort and re-stack wet lumber for re-dry

Stickering is not required for the lumber to be re-dried in a RFV kiln, and therefore no operator is necessary for the stacker since it can be monitored by the planer in-feed operator. There is however, an operating cost associated with the drop-sort and stacking operation which the mill needs to establish and be comfortable with.

## **Establish capital cost of a Q-Sift installation**

From the investigations listed above that are conducted jointly by the mill and HeatWave, the Q-Sift installation is sized. This includes:

- The capacity of the proposed RFV kiln
- Current production capacity of the planer in-feed and the modified production capacity of planer mill in-feed (planer in-feed lug speed would likely need to be increased by approximately 30%)
- Modification costs of the planer in-feed
- Transverse MC
- Drop sorter
- Transfer chains to re-stacker
- Lumber stacker
- Site preparation of the RFV kiln
- Electrical supply of the RFV kiln

There are some advantages with an RFV kiln over that which is normally experienced with new conventional kiln installations. This includes:

- No building permit required for a RFV kiln
- No steam engineer or specialty-trained technician for operating
- No requirements for VOC permitting
- No fire sprinkling requirements
- No special permitting required from environment regulatory authorities with conventional septic disposal of the kiln effluent
- Limited land area is required for the RFV installation

## **Summary**

The feasibility of a Q-Sift installation is established by summarizing the total of all revenue items on an annualized basis, and then subtracting the expected operating and maintenance costs. The remaining balance is the expected annual increase in net cash flow. Divide the annual increase in net cash flows into the capital cost of the project to determine the payback.

Aside from the tangible calculation of paybacks in capital expenditure, there are also intangible benefits to be considered. For instance, changes to marketplace on kiln-dried MC requirements. Does the market place accept average 19% MC and no consideration of peak MC; peak 19%; average 19% but peak 22%; how big and how large of a peak MC is allowed, etc., etc.? Q-Sift is a processing strategy that can inherently adapt to any changes in the marketplace as it relates to final moisture content requirements.

Another intangible benefit is that over the years, there has been an increasing trend of customers not willing to accept wet lumber. Particularly the "Box Stores" and home pre-fabricators are becoming increasingly stringent on final MC requirements and there is a cost becoming associated with improperly dried lumber. There is also becoming a corporate risk in selling KD lumber but having "wets" be part of the "dry" lumber shipment. One lawsuit related to moldy lumber can significantly impact a company.

There has been over 500 Mfbm of lumber tested in re-drying trials and over 30 separate trials of veneer drying done with HeatWave clients. Q-Sift is a proven, well-established processing strategy and a leading hemlock sawmilling company has purchased and is installing an E-field/vacuum Q-Sift system this year. Corporate risk is minimized utilizing the Q-Sift processing strategy by being able to supply kiln-dried hemlock lumber to exactly what the marketplace demands.

This technology has strong demonstrated paybacks, and this paper outlines a proven approach to move forward with putting together the justification for a Q-Sift installation. More efficient use of capital, lower operating costs, and increased revenue through improved grade recovery are the justifications. EFV drying is a "green" solution that supplements the existing conventional drying equipment the sawmill has.

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