CLOSING THE INFORMATION GAP IN KILN DRYING

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Never before in history has the kiln operator had as much information about his drying processes. Today it's available!

Historically, kiln operators have not had much information available about what was going on inside the kilns. Drying schedules were arrived at largely by trial and error. But with today's instruments, we can actually "see" into the kiln, and monitor and control the drying process.

I was recently in New Zealand and Australia visiting sawmills. Down under they use very aggressive drying schedules on Radiata Pine. They routinely use kiln temperatures of 160°C (320°F). One of the mills I visited had an entire charge go up in smoke seven hours after it had been pulled from the kiln. According to the kiln manager, this was not an isolated occurrence. His concern, like others, is that the wood is dry. The information was not available to him to avoid a very expensive mistake. The loss was limited to that charge, but I share that story to illustrate the importance of controlling the drying process.

But why would a kiln operator, or mill manager want (short of fire prevention) a kiln monitoring system? Is it worth paying attention to what is happening inside the kiln? Does it really make that much difference? What are the costs? What are the benefits? Can I really effect the bottom line of my company by incorporating this information into my drying schedules? I'll answer these questions now.

In 1969 Bassett presented a paper from Weyerhaeuser's technical center. Bassett stated, "The rate of degrade for softwood dimension lumber is in the order of magnitude of $1.00 to $3.00 per 1000 board feet for every 1% of moisture content lost in the normal drying range." Many thought Bassett's statistics were conservative even in 1969. Consider what that would cost in 1994 dollars.

More recently, Dean Huber presented a technical report on lumber drying in the May 1991 issue of Forest Industries Magazine, now Wood Technology. He states, "The cost of degrade due to over drying is about $3.00 per 1,000 board feet for each 1% reduction in moisture content below 17 percent. This cost and loss increases to about $7.00 per 1,000 board feet for each one percent reduction below 12 percent moisture content."

Let's talk about a fictitious mill that is drying 40,000 MBF per year. In addition, let's assume a loss of $3.00 for every 1 percent moisture content that the wood is over dried. Let us also assume that the mill is drying to a moisture content that is lower than they need to by 5 percent. Therefore, the cost of this over drying would be 3 x 5 or $15.00 per 1,000 BF of lumber dried in that mill. You then multiply 15 x 40,000 MBF you come up with $600,000.00 just for degrade cost. Again, these are very conservative numbers.

The cost of this over drying is:

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\text{($3.00 / 1\% \text{ MC} / 1,000 \text{ BF}) \times 5\% \text{ MC} = \$15.00 / 1,000 \text{ BF}}
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\text{($15.00 / 1,000 \text{ BF}) \times (40,000 \text{ MBF / yr.}) - \$600,000.00}
\]

loss annually
Today, most mills can not sustain degrade losses of this magnitude. Additionally, there are many more costs due to over drying, increased energy costs, less kiln throughput, more interest paid from reduced inventory turns, and less obvious hidden costs. These add up to a significant amount of money that could be gained for the mill through changing their drying process.

So, lets take a look at what it will take for a mill to get some of this money to their bottom line. In order for a mill to reduce their degrade and recover some of these dollars; they must increase the average moisture content in the wood coming from the kiln. The most obvious way to do that is to pull the wood out of the kiln sooner. There are some mills that could do this with no problem. They are already drying their wood to such a low moisture content that raising their moisture content would produce a negligible amount of too wet wood (Fig. #1).

The person drying to very low moisture levels can simply use a shorter drying schedule to raise his moisture content. However, for the person that is not significantly over drying, just raising the moisture content is not as easy. In Fig. #2 the average moisture content is 10 percent. If the average moisture content is increased to 15 percent, as you see in Fig. #3, there is quite a bit of wood that turns out to be too wet. This wood will either need to be re-dried or sold in a different market.

It would be best if all the wood fell into a narrower moisture content range. Then we could move the average moisture content up and still not have a lot of too wet material. It is possible, in the real world, for a kiln operator to get his moisture curves close to an idealistic curve (Fig. #4) by carefully studying and updating his drying operations.

Before people had information about moisture content from the data gathering systems that are now available, they were not sure what the average moisture content was for most of their charges. It was difficult to take action to reduce degrade problems without the proper information.

Newer moisture monitoring and measuring instruments, with reporting capabilities, give information while the wood is still in the kiln. Data can be verified with digital recording hand-held moisture meters or an in-line moisture detector. It is possible to merge reports of the data from all three instruments into the same report. This enables the kiln operator to track the entire drying process. Once he gets a baseline of information he can start making changes to gradually move his histogram curves to where he wants. The in-line moisture detector provides the most detail or specific information because it reads every board that was in the charge. However, sometimes it is after the fact, and the moisture content can change, because it may take several days before the wood is put through the planer or sorting chain of the mill. Therefore, it is ideal to have more than one source of information.

A hand-held moisture detector with recording capabilities enables the operator to take readings at the time that the kiln is being shut down. Previously, the samples that were being taken were limited and often not representative of the whole charge.

An in-kiln moisture monitor has the advantage of being able to shut the kiln down at a preset moisture content, whether or not a kiln operator is on hand at the time the kiln gets to the correct final moisture content. These units are very valuable as long as they measure a significant sample, to ensure that the average moisture content detected by the instrument is representative of the entire charge of lumber.

The in-kiln moisture monitor gives shut downs at a consistent moisture content time after time. The operator doesn't have to guess at when to go in the kiln and do a final check.
Figure 1. Moisture content can be raised without creating wet pieces.

Figure 2. With a wide MC distribution, raising the average MC will create wet pieces.
Figure 3. Wet pieces resulting from increasing average MC from 10 to 15%.

Figure 4. By improving drying practices, the average MC can be raised without creating wet pieces.
Once a kiln operator is getting the consistent average moisture content that he wants, he needs to narrow the range of high and low moisture content for all of the charges in the entire kiln. The newest in-line moisture detectors can reassemble stacks of wood just as they were in the kiln and can allow a person to see what the moisture content was for different sections of the kiln. Typically, some areas of the kiln read higher than average moisture content and others read lower than the average for the entire kiln.

The kiln operator can then start working towards improving the consistency of drying for the whole kiln by changing air flows through baffling and identifying which parts of the kiln have more heat than others. The goal is to get all of the wood in the kiln to dry to the same moisture content at shut down.

The final step is to raise the average moisture content of all of the charges until an acceptably small quantity of boards are in the too wet range.

Realization of these goals greatly improves the quality of the wood overall. Money will be saved in less degrade, increased throughput, decreased energy expenditure, and reduced inventory turns. There are many real and potential benefits from drying to a higher moisture content. Achieving these benefits does require tight control of the kilns. With the information available today, controlling the drying process is a lot easier now than in the past.