A QUALITY IMPROVEMENT PROCESS IN HEMLOCK DRYING

Neil Odegard
Weyerhaeuser Corporation
Snoqualmie, Washington

The first thing I'd like to say is this; I'm not here to tell you what to do, or how and when to do it ... I wouldn't presume to do that; because you're the experts in your field and your plant-sites. I'm here to tell you a few stories ... and in the process of those stories, I hope to illustrate a quality improvement process that I've used successfully for many years.

During the next half hour or so, I may run the risk of over simplifying the process, but ... that's the way I've operated; break it down to the simplest, smallest common denominator. When you've done that ... now, you've got a hold of one piece of the puzzle ... one piece of a very complex puzzle called kiln drying.

My first story begins with my first day as a kiln operator trainee. The first thing I remember the old kiln operator teaching me was how to do a moisture check at the planer. (You thought I was going to say hot check, didn't you.) This was way back before we had in-line moisture meters. If you wanted to know your drying results, you got the cold check meter out and started stabbin' lumber and writing down numbers. When we got there, they'd just started a new stack of lumber at the un-stacker. The kiln operator said, we'd have to wait a few minutes because you don't want to take a moisture check on the top two feet or so of the stack. Now, I remember thinking, "This is cool, the first thing he teaches me is to stand around and do nothing for a while ... I think I'm going to like this job!"

Now, being rather young and stupid at the time ... It didn't occur to me to ask that first critical question; "WHY?" "Why don't we do a moisture check on the top of the stack?" It took quite awhile for that question to occur to me ... but, eventually it did and so I asked him. He said it was drier on the top ... and if you took a moisture check from there it wouldn't be a true representation of the entire kiln charge. Well ... OK, that made perfect sense to me at the time.

Now again, I have to remind you I was still somewhat young and ... well, you know ... and it took awhile for that second critical question to occur to me; ... again, "WHY?" "Why is it drier on top?" Anyone want to guess what his response was? He said, "It's always been that way."

Now, an answer like that should raise some red flags in your mind. I don't know if it did for me at the time or not, but I tell you, I was maturing fast and I wasn't about to accept that for an answer; and so I pressed him further on the question. He assumed the reason was ... you've got this large mass of hot lumber ... and heat naturally rises ... so as it cools off, the top continues to dry from the latent heat underneath it. ... Ok, ... again that made pretty good sense but how can we be sure that's the cause? That's the next question; "How?" How can we prove that latent heat theory? And, "When" does it occur?

First, I got a ladder and did some cold checks in the cooling shed to see if what he told me was true or not; ... and it was ... it was dryer near the top of the stacks than

it was near the bottom. So, I backed up one step in the process and did some hot checks at the end of the schedules using a ladder to check near the top of the stacks (did you ever try that ... you know how hot it is up there!). Well, I found that it was dryer on top at the end of the schedules ... so, I backed up one more step and did some hot checks at the set up point; which is about 2/3 the way into the schedule ... and I found that it was drier near the top of the stacks even that early in the schedule. Well, so much for his latent heat theory ... it didn't hold water (so-to-speak). My point is: question everything, and never assume anything ... always prove it with facts and data. Do you know what the definition of "assume" is? (note the spelling) To assume is to make an ass out of you and me. Sometimes you assume right, and sometimes you're wrong. If you assumed right, you may have saved some time ... if not, you may be chasing your tail for months or years.

If you ask the right question ... pursuing the answers to that question will produce the data ... that establishes the facts. Operate from facts and data ... not assumptions ... and especially ... don't operate from, "because it's always been done that way".

As time went on and technology improved, we finally got an inline moisture meter. It's a brand that many of you may be using today ... a Wagner 683. One of the features it has is the unit-by-unit moisture report. I found it very useful in building kiln profiles ... where I average multiple kiln charges together into one profile to see if there's a wet or dry trend at any location in each kiln. I mentioned earlier that using hot checks had proven our kilns produce drier moisture content near the top of the stacks as compared to the bottom. And the unit-by-unit report feature confirmed that pattern.

So, this information answered another key question ... "Where?" The kiln profiles indicated our kilns naturally produced a moisture content pattern of drier on top, wetter on the bottom, drier at each end, and wetter in the middle. Even though we would hit a good average moisture content, the dispersion of the moisture through out the kiln was not uniform. Again, you have to ask why, how, when and where?

To answer these questions, we wired up thermocouple wires to a data logger and built temperature profiles. We also put together air velocity profiles. The data from these test told us it was drier near the top of the stacks because the temperature and air velocity were higher at that location.

So ... basically, some of these overdry and wet boards were occurring because of the design of the kiln. Next key question is: "What If?" ... What if we could alter the distribution of temperature and air velocity within the kiln? And that's what we did. We developed a baffle system to balance the environment within the kiln that would result in a more uniform moisture content throughout the kiln. It works very well to this day. However, there was one little problem. One of our kilns has a high speed cross-shaft fan system ... the higher air velocity blew the baffles off ... so, we had to make changes there. And, most newer, computer controlled kilns have options built in that allow you to alter the environment throughout the kiln by biasing temperatures or whatever means ... you can achieve the same results. But, for older, low air velocity kilns, this works very well.

It's been my experience that you'll get the most accurate profiles if you use the same length lumber in the kiln, not mixed lengths per charge. So, if you haven't done it already, I would encourage you to put together profiles of your kilns ... you may be surprised at what you find.

Once I realized some of our overdry and wet lumber were there by design, an idea began to form in my mind. For lack of a better term, I'll call it a Premise. The Premise is this: ... the best the kilns can do for the planer ... is to provide them with lumber that's

within target range (avg. m/c) and with a minimal amount of overdry and wet. In an ideal world, the goal should be zero overdry and zero wets. But, in the real world of hemlock drying ... we may have to settle for minimal. And when you hit in target with minimal out-of-bounds, from a drying standpoint, the grade yield will be the best it can be ... depending on the quality of the stock. Have any of you noticed this ... that occasionally you'll get very good grade yield from a kiln that's a little too dry or too wet? And, occasionally you'll get really poor grade yield from a kiln charge that's perfect! (in target) It's been my experience, that the quality of the raw material has a lot to do with it. But, in general, you'll get your best grade yields when you hit in target with a minimal amount of overdry and wet.

So, what do I mean by "hitting in target"? Well, the "powers that be" decided we would have a 2.0 target window. That's plus or minus one percentage point above or below the target. For those of you drying hardwood ... this may not look very good ... or be an acceptable range. But, for those of us drying hem-fir ... I'd say a 2 point target window is a good goal ... and for hemlock ... I'd call it a rather optimistic goal.

So, from that premise there are two means of measuring improvement; the % you hit in target and % of overdry and wet. As to hitting in target more often ... I discovered a clue to another piece of the puzzle one day while checking the roof vents. The vents were just starting to open on a kiln and the steam was starting to roll out ... when a gust of wind came along, blew that steam sideways and it sucked it right in the intake vent of the same kiln. Now I'm thinking, this is not good, we're trying to get the moisture out of this kiln and it's sucking it right back in! Well, to make a long story short, eventually it led me to this question: How does the relative humidity of the ambient outside air affect the drying process? To answer that question, I got information from the local weather bureau covering an entire year ... then I put the average relative humidity for each day on a one year time line. Then I went through the records and found all the 2x4 hemlock charges that ran exactly the same timed schedule. Then I figured out from my time line the average relative humidity of the ambient air that went into each of those charges during their drying process; then I grouped them together in 5% increments of relative humidity and Figure 1 was the result. Higher relative humidity produced higher moisture content ... and lower relative humidity produced lower moisture content ... at the same timed schedule.

Well, in the meantime, we installed a TDAL means of measurement system in our kilns and I found that I got the same results with a TDAL target number as I did with timed schedules. Higher relative humidity produced higher moisture content ... and lower relative humidity produced lower moisture content ... at the same TDAL set up target number. Well, eventually, I developed a computer controlled adjustment scale. It's a patent pending process that I hope to have available on the market in the near future. The adjustment scale is based on the R/H of the ambient air that was drawn into the kiln during the drying process. The adjustment scale raises the set up target at lower relative humidity and lowers the set up target for higher humidity. The results are a more consistent final moisture content. Figure 2 shows the results after two fine tunings of the adjustment scale. I've made a 3rd adjustment to the higher R/H end of the scale and I'll be updating those results by the end of this month.

The improvement process begins with a question; pursuing the answers to that question will produce the data ... that establishes the facts. If you operate from facts and data, improvements happen.

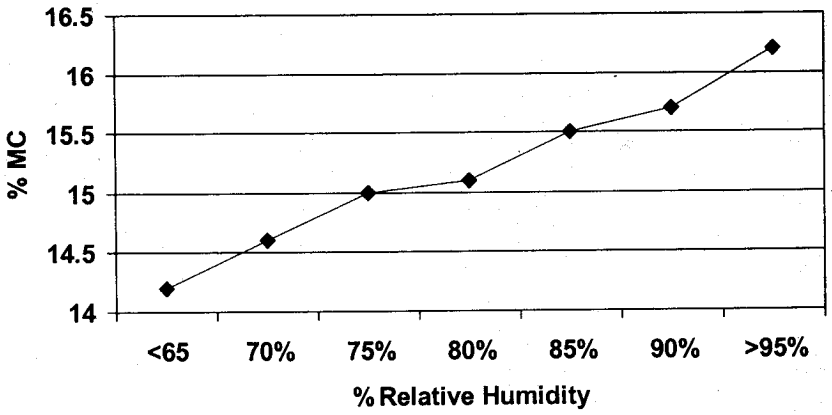

FIGURE 1. Recent final dry MC versus relative humidity for a one-year period.

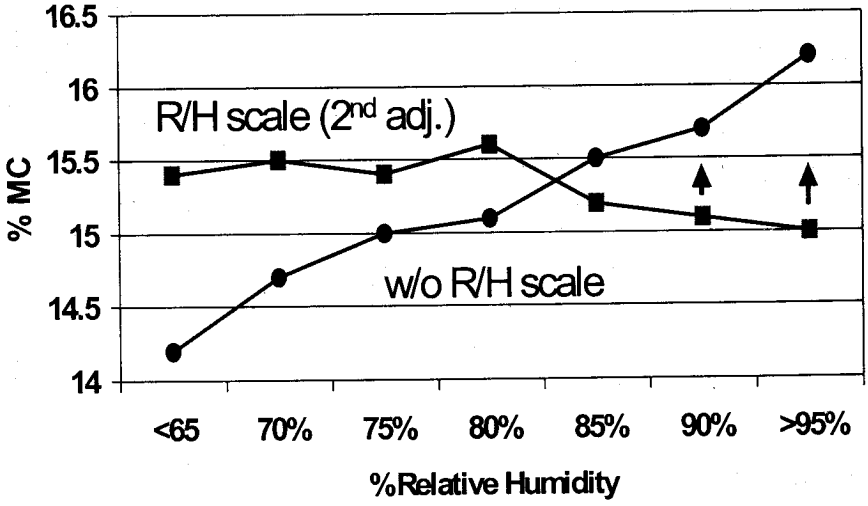

FIGURE 2. Improved final MC with relative humidity adjustment.

If you ask any politician, they'll tell you there's power in information. An improvement in technology that we've adopted is a bar coding database system. There are several systems available on the market today. I've found this system very useful in updating kiln profiles. With it you can get the % of overdry & wet, all the various grade yields, dates and times for each unit of lumber; as well as putting the entire kiln charge back together in the proper order with all of that information attached. That's a tremendous amount of information ... Information that's necessary in order to answer questions. With the database systems available today, you can answer these and many more questions with the historical facts and data from your kilns.

I mentioned earlier about "hitting in target". Another "What" question. What should the moisture content target be? I have to give the head graders some credit here ... for the most part they know what moisture content the target should be ... But, not always.

With the database system I just mentioned, you can query that database to find the answer to that question. According to the historical records, you get the highest #1 & better yields at 13.0% m/c. But, 13.0% is a risky target to shoot for because, as you can see, the grade yield drops like a rock if you hit on the dry side of that. At the same point, the low grade begins to skyrocket; waste goes up, production goes down, upset conditions due to break-ups occur and eventually ... somebody gets hurt. Our target for 2x10 hemlock is 15.0% m/c. We stay on the safe side of that peak ... it's more profitable at 15.0%.

Some items have multiple high grades like 2x4 hemlock. The J-grade peaks out at 15.0%, MSR peaks out at 19.0%, and for decking, well, the wetter the better. Our primary market is export ... and our target here is also 15.0%.

Years ago, I was at a safety conference, and I was talking with a guy during one of the breaks ... and he was kind of joking around when he asks me what I did for a living ... and I told him I was a Kiln Operator. And he says, "O-o-oh, you're one of them voodoo witch doctors that does their magic inside them big black boxes". And I said, "no-no-no ... we've got it down to an exact science". That was probably the biggest lie I've ever told. But, as I thought about it later ... that's what the goal should be ... to get kiln drying down to an exact science.

I spoke earlier about pieces of the puzzle. As we keep getting a hold of one more piece of the puzzle ... and one more piece ... eventually, all the pieces will be in place, and then, we'll have it down to an exact science.

How do we get there? ... by pursuing answers to questions. The questions I've illustrated are: why, how, what, when, where, which, what if, and my favorite which I'll conclude with is ... "So What?" So what has all this done for you?
From the premise there's two means of measuring improvement. The % you hit in target and the % of out-of-bounds (Figure 3). Over the past 8 years, this has been the trend; a reduction in total out-of-bounds from nearly 30% down to just under 20%. You'll notice that the total out-of-bounds went up a little in 1999 and 2000 ... that was market driven. We were pursuing a decking market at the time ... raising our moisture targets and accepting an increase in wets.

As to the other half of measuring improvement; Figure 4 shows the % in target. Back in the hot check days ... we hit inside that 2 point target window 53.5% of the time. The TDAL means of measurement improved that to 58.8%. The Relative Humidity Adjustment Program improved it to 64.6% in target. There were many other little pieces to the puzzle along the way ... as well as a few projects I'm working on now ... which has brought our YTD average for 2002 up to 68.4% in target.

The key has been ... pursuing answers to questions.

I began today by saying I wasn't here to tell you what to do ... I was here to tell stories ... and I'll conclude with this: ... It's the facts ... and the data ... they will tell you what to do, how and when to do it.

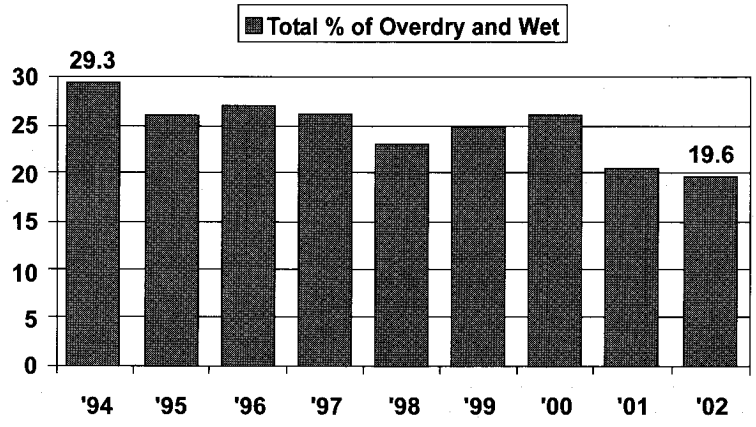

FIGURE 3. Historical records of wet and dry hemlock.

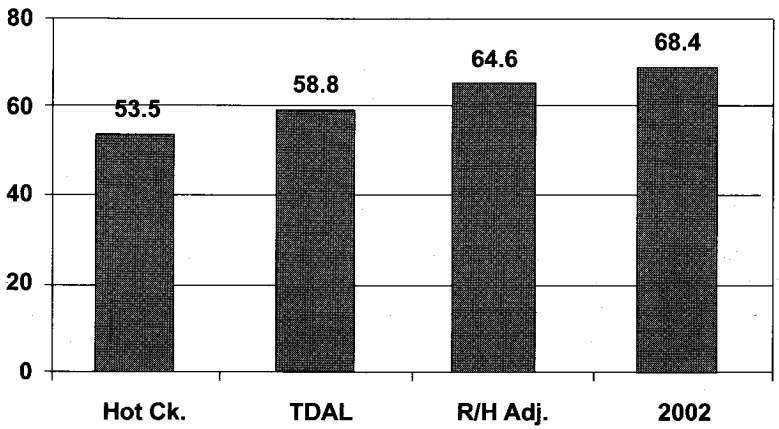

FIGURE 4. Historical record of percent in target.