QUALITY, SPEED, RETURN-TO-THE-LOG AND OTHER KILN DRYING BASICS

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I. Summary

A. Backdrop

"Return-to-the-Log" is the only "hard money" a primary manufacturer makes in the wood products business. "Return-to-the-log" based decisions consider weighted dollar effects of any changes in: a). production (including lumber drying and product mix); b). sales realization; and c). recovery (over-run). This Operating Strategy results in improved net cash-flow, and net 'bottom-line'. Strategies developed out of convenience, tradition, "production-is-the-only thing", and "we've-always-done-it-this-way" are dinosaurs in today's environment.

Delivered logs in the Western U.S. constitute from 60-80% of the total costs of finished lumber, therefore, recovery improvements offer a 'jump-start' to better profit margins and cash flow.

Projected improvements in sales realization, through product mix changes, must be net of adverse impacts on recovery and production costs, to produce real dollar benefit. I find it startlingly common for a mill to make a specialty item drawing a "premium price", and requiring significantly more in solid wood percentage and incremental production costs than the value of that "premium."

Improvements made in kiln drying offer unique or even rare opportunity. Better recovery, sales realization and production costs are all likely to result. So, aside from learning more about local 'house' odds, producing better "Return-to-the-Log" through improved kiln drying is why we're here.

B. Preview

Exploiting opportunities presented by unrestricted and high velocity air, heat supply, condensate handling, as well as conditioning and choice of ending moisture content are likely to improve your mill's survival chances. Some of the following you may gauge to be elementary. I think so too -- some are as fundamental to effective kiln performance as blocking and tackling are to winning football. I've found moderate to severe problems in these fundamental areas in all but very few of the thirty plus mills I've visited in the last decade. Therefore, it seems the economic consequences of skipping over these fundamentals are not well understood or accepted.

II. High Velocity Air -- My, What a Difference !!

A. Regular Stuff First

1. Here are essential elements to proper air circulation and retaining lumber value through the drying process -- at available air velocities:

a). Foundation elements are: precise placement of uniform thickness stickers; unvarying load height except for top units; and cart loading with 3-4-inch chimney down the long axis of the crib between units; all done consistently well. 1). No brainer -- right?? How many use stickers whose thicknesses vary from 3/4-inch to less than 5/8-inch, or have missing stickers at or near the ends of loads?

b). Properly placed and maintained baffles. How many of you: 1). have single track kilns with overhead baffles on only one side? ; 2). have floor baffles that are broken or have large gaps in wooden baffles?; 3). have no floor baffles under the center coil in double track kilns ?; 4). have gaps of 18-inch or greater between fan floor and overhead heating coils, or between the kiln wall and heating coils?; 5). have missing or broken end baffles ?

c). The single most important feature in reducing wet spots and obtaining relatively uniform ending moisture content throughout a charge of lumber is unrestricted, flow -- ie: if you can't see through the sticker slots on lumber cribs, air flow is restricted or blocked. Unrestricted air flow brings heat to the wood, driving moisture to its surface, which in turn is removed by the air flow. Such unrestricted flow also reduces damage from over-drying, enabling drying time for boards in the core section of cribs to approach that required for the peripheral portions or "shell" of those cribs.

B. If a Little Air is Good, What About a Lot ?

1. For purposes here, "standard" air velocities are regarded as being 350-600 fpm, and "High Velocity" as being ≥ 900 fpm through the sticker slots.

a). Presently in the West, "greater than" means operating velocities in excess of 1500 fpm.

b). For a considerable period, certain kiln vendors, as well as some under-informed manufacturing management people told (are telling??) those who cared to listen, that HV air wasn't necessary or useful in the West. There have even been "reverse conversions" from HV to SV. Perhaps by coincidence, those mills are gone or about to be.

2. What Benefits from High Velocity Air?

a). Dean Huber did (and published) important work showing how heat penetrates a crib at different air velocities and sticker openings. Dr Fred Taylor (Mississippi State) has done extensive studies (also published) showing benefits of high velocity air in drying lumber -- work largely ignored in the West.

b). HV air improves heat transfer ("U" factor -- see FIGURE 1) from fin-tube to air stream and from air stream to lumber -- more efficient use of available steam/heat.

c). HV air can dramatically reduce kiln residence times and improve MC uniformity. It is easier to design schedules that produce an almost constant drying rate throughout (FIGURE 2) using HV air. I've found as that rate is approached, quality retention and appearance of the wood improve.

d). Converting to HV air can provide a win-win combination that drops black ink straight to the bottom line of a P&L statement -- improving inventory turnover and cash flow in the process. Improved return-to-the-log produced in a very clear form.

3. Risks or Downside Considerations

a). Checking and other drying related stresses can easily be amplified to moderate or severe levels if schedule design fails to ensure moisture will be driven to the surface of the lumber at a rate similar to rate of removal by the air stream.

b). Stain and unnecessary stress results if there is insufficient venting capacity. Cost effective drying with HV air demands balancing rate of moisture removal with adequate supply/exhaust capacity, so saturated air is not continuously re-circulated through the lumber.

c). Over-drying risk -- and serious attendant damage and dollar loss -- is increased if there is not a technologically reliable means of stopping drying included in the controls package.

4. Variable Frequency Drives. Should we use them to slow down our fans at the end of drying-- or not?

a). Bonneville Power says its good to slow down. They're willing, through client utilities, to provide credits for investing in variable freq drives (and get intimately involved in your business with you) so you can do this. Hey, if a federal bureaucracy is on board, it must be good!!

b). If you're running essentially conventional schedules with long 'flat-line' Dry Bulb temps in the last 40% or so, drying rate has slowed materially, and it is likely a prudent move to slow down fans in that period. Under these circumstances slowing will help avoid serious checking and other lumber damage, and save energy costs.

c). Otherwise, reducing air velocity is just another means of extending kiln residence hours unnecessarily. Is has been shown extended kiln residence, per se -- no matter how "gentle" or "conservative" the schedule -- is a cause of unnecessary drying related damage and dollar loss.

III. Heat Source Uncertainties

A. To avoid unnecessary drying related damage to lumber and other economic loss, and to exploit benefits available from HV air, your heat source must perform reliably. If not, 'droops' in DB temperatures cause:

1. unscheduled changes in rate of heat exchange to the wood, and therefore disruptive short-term changes in drying rate;

2. changes in relative humidity in kiln environment -- often resulting in kiln stain and other degrade.

3. extended kiln residence times, generating lumber damage and adversely affecting cash flow.

B. Remedies -- Places to Look First

1. What percentage of rated boiler pressure reaches your kiln header?

a). Are supply and header pipe diameters large enough for needed volume at your customary operating pressure -- with some safety factor above "expert" calculation?; are there traps in long runs from boiler (or are you bringing hot water to your kilns?).

b). Boiler: Fuel type or particle size problems; slow (or unfortunate timing of) grate cleaning; improper under/over fire air balance or volume situations.

1). is "make-up" tank too small, limiting boiler output to less than design ?? This is all too often encountered as an unmerited (read--"penny-wise") restriction on hourly steam production.

c). Steam valves. Are they really sized for the job? Do you have reduced diameter pipe sections to small valves that "calculations" show will do the job ?? While $500-600 per valve capital cost may have been saved, it may cost you that much per charge in combined losses. This is an especially critical consideration with low pressure systems (15-50 psig) where heat available to transfer from steam to kiln is relatively low.

d). Fin-tube. Does air go through, or around it ?? Large gaps floor-to-tube, and tube-to-wall? Air does seek path(s) of least resistance; it must be 'disciplined' with baffles or other means to go through radiators and effect maximum heat transfer.

1). Enough lineal feet of tube, properly sized for most efficient heat release at available steam pressure?

IV. Condensate and Traps

This area is obviously an extension of the heating problems outlined above, but it is so often a major feature of heat supply difficulties that I've treated it separately here.

A. Questions about system foundations; Is gravity working with or against condensate flow in your kilns? If so, is there room in the drain lines for max flow??

1. The most common errors in kiln design and maintenance I find, are: failure to use benefits of gravity to help keep condensate flowing back to boiler; and using lines -- radiator-to-trap, trap-to-main, and main-to-tank -- that have insufficient capacity under full condensing load. Increased costs, drying times and lumber degrade result.

2. Things to Check

a). Are lines from radiators and traps sloped (Minimum of 4-6-inches per 50 feet) so they have the benefit of gravity's effect to keep water moving towards traps and main condensate tank? Adjustment is usually simple.

b). How much back pressure on your traps? Check only when battery of kilns are pulling hard, condensing lots of steam.

c). Location, elevation (gravity flow to condensate tank?), "de-aeration" of condensate so pumps don't cavitate, 'float' position, pump capacity, and size of condensate tank are all important design and maintenance features of an effective system.

V. Survival -- Some "Gut-Check" Issues that Impact

1. Conditioning -- Has someone told you its not necessary for some species or items?

2. Every drying method/schedule, including "air", causes some amount of stress to develop in Western softwoods -- some drying ideas cause more than others, and some species, or timber age classes, show more stress effects. Stress causes degrade and trim loss; that results in lost dollars, poorer return-to-the-log, and a reduced survival opportunity.

3. If you're spraying at the end of drying, are you really conditioning your lumber?

a). Considerations: need saturated steam; temperature/pressure that permits holding proper WB depression, ie: 10-15 degrees; sufficient steam volume -- modified by valve/line sizes and number and size of openings in spray line.

b). You've got a "state-of-the-art control system? How do you determine MC, ie: the point at which you want drying to stop? See my paper on the impacts of over-drying.

1. Who, in your operations, calls the 'plays' on what that MC should be? On what basis? What % of "wets" by species does your operation target? How was that standard determined?

2. Do you believe your hand meter? Should you? What's at risk? How to check meter consistency and reliability -- OD testing.

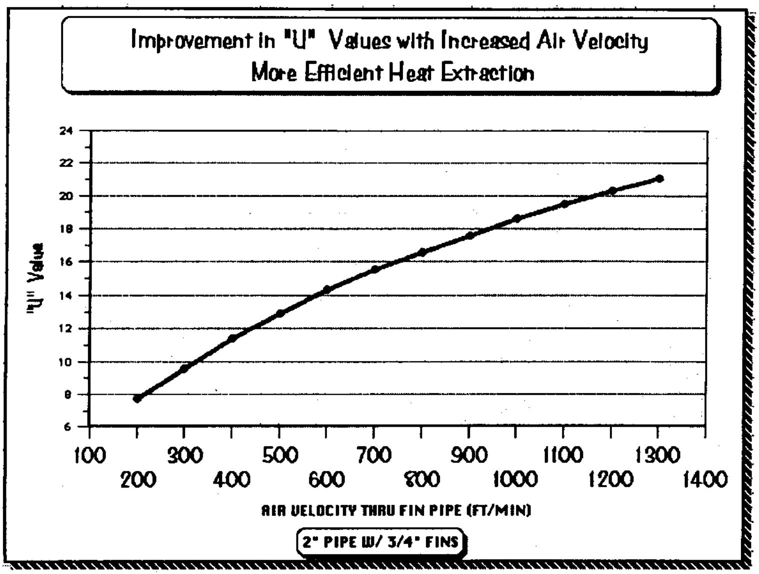

FIGURE 1. Improvement in "U" values with increased air velocity.

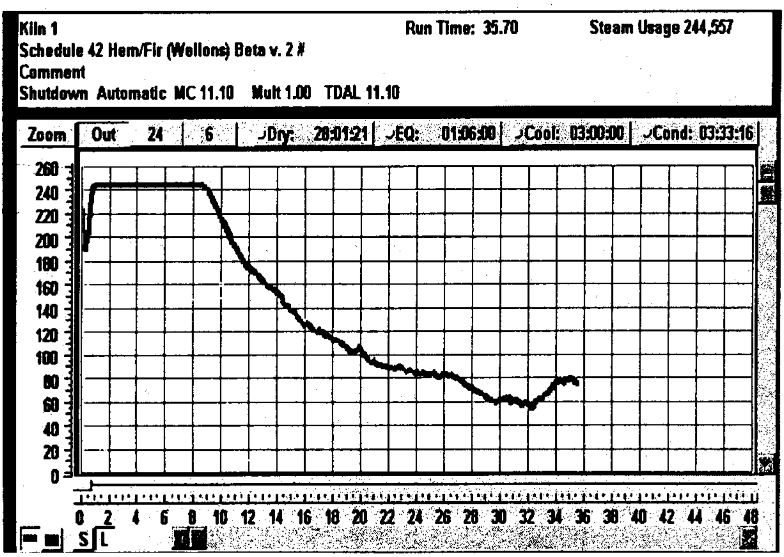

FIGURE 2. A constant drying rate can be achieve.