HELPING TO REDUCE ENERGY CONSUMPTION

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Some of the information that I am going to give in this talk is taken from the U.S. Forest Research Note #FPL0228, published in 1974. The title is "How to Reduce Energy Consumption in Kiln Drying Lumber." Other publications I am using for reference are written by A. P. Green on surface temperature versus BTU loss and "Production Kiln Drying" by John Devine.

You have all heard about the energy crisis, and I would like to give you some suggestions on helping to reduce your energy consumption around your dry kiln. In 1974, approximately $290.00 in energy cost was required to dry a 50,000 board foot load of green soft wood in a 100% efficient kiln. That was $240.00 for natural gas and $50.00 more for 2,000 kilowatts of electrical power for the fans. Today, that same load would cost $800.00 in energy consumption, plus $60.00 cost for the 2,000 kilowatts of electrical energy. The energy consumed in this dry kiln to dry the 50,000 board feet of wood would heat seventeen to twenty homes for one month with an average gas usage of 75 to 90 therms per month. Following are some suggestions that I hope will help you around your dry kiln.

1. Start increasing your efficiency by air drying when possible. That is, when green lumber arrives and is first cut, immediately get it onto stickers, even if it is going to the kilns soon. Store it where it can air dry, particularly during the summer months. For each percent of moisture lost in air drying, the energy savings in subsequent kiln drying is roughly 50 to 85 BTU's per board foot. For example, on a 50,000 board foot charge, for every percent of moisture lost in air drying, you can save $17.50 in total heat cost.

2. Do not use steam spray or water spray in the kiln, except during conditioning. Let the moisture coming out of the board build up the humidity to the desired level. Steam may be used in leaky kilns, in cold weather, when very small wet bulb depressions are required, or during the conditioning period.

3. Repair and caulk all the leaks, cracks and holes in the kiln structure and doors to prevent unnecessary venting and loss of heat. Make sure doors are closed tightly, particularly at the top, and temporarily plug any leaks around the doors with rags or other new gaskets, shims, strips, or hangers if necessary. In dry kilns use rags and plug material to fill the holes around the bottom of the door near the track openings. Adjust and repair the vents so that they close tightly.

   A. Kiln Doors: Assuming the kiln is running on an elevated schedule for hemlock to 2 x 4 dimension with 200° dry bulb and 170° wet bulb, air loss around the doors is 700 feet per minute with 1/16 of an inch gap. The total kiln schedule is 54 hours. This 54-hour schedule will lose 23,000,000 BTU's. Using a gas-fired boiler that is seventy percent efficient, the equivalent loss is approximately $167.00 per charge for a 68' single track kiln.

B. Vents: Total vents equals 14. Assume seven vents on one side open 1/8 of an inch on the same 54-hour schedule. Heat loss equals 1,350,000 BTU's at an estimated loss of $9.61. The BTU loss through the aluminum lids for all fourteen vents uninsulated would be approximately 610,400 BTU's during the charge, which would be a $4.36 loss or a total loss of $13.97.

C. Panel: Assume that the 68' single track dry kiln constructed of aluminum panels, which would have approximately 4,860 square feet of aluminum housing, the total heat loss during the kiln charge would be about 4,500,000 BTU's with steam supplied to this kiln by gas blower. The gas consumption would be approximately $31.82 loss of heat through these walls.

D. Wood Roof: If this kiln had a wood roof, the heat loss through a 4.5-inch thick roof drying the same material, would be approximately 1,948,000 BTU's during the schedule. This converts to about $13.91 for gas and pre-fab $8.90/charge 2".

E. Hollow Concrete Blocks 8" Thick: If this single track kiln was made out of masonry blocks for the side walls and end walls, the loss through these blocks during the schedule would be about 16,000,934 BTU's. The cost would be approximately $120.00.
   1. If this masonry kiln had a wood roof, the total loss would be approximately $134.87 in heat, plus a total of $139.23 including vents.
   2. If the masonry kiln had a pre-fab roof, the total loss would be $129.86.

F. Doors are a point of major heat loss. Things to improve are:
   1. Door frames are straight and not bowed.
   2. Door sill angles in place or missing, bent or in some way keeping the door from sealing.
   3. Door should close tightly around the jams. Adjustments on the door should be made at the lift bracket and the mullion angles, which can help the door to seal tightly.
   4. Are the rail notches at the bottom of the door excessive? Generally the notches are much larger than they should be and can be improved by crowding around the rail or fastening the smaller notch conforming with the rail shape to the bottom of the door or lift-out rail. I have seen some doors on masonry kilns where the plywood panels have been eaten out as large as two foot holes, so the air from the kiln is going right out the hole in the door. I have also seen where the plywood panel has rotted out and they have replaced it with steel. They have stopped the

air from leaving the kiln, but now they heat the steel up and there is no insulating value.

4. Brick and Block Kilns: Coat the inside of the kiln with a vapor resistant coating. This will prevent the walls and the roofs from absorbing water because dry walls conduct less heat to the outside.

5. In many kilns, more heat is lost through the roof than through the walls. Much of this loss is due to wet insulation. To reduce the heat loss, consider installing a new roof or repair the old one. Add additional insulation if necessary, making sure the interior vapor barrier or coating is intact. In order for any insulation to be effective, it must be reasonably dry. Roofs are always a problem area, even on prefab aluminum roofs. Roof extrusions can become loose and allow the water to leak into the panel. Rain or snow on the roof can cause greater heat loss through the panel because of the larger temperature difference from the inside of the panel to the outside. The vapor then condenses out in the panel and runs down the inside on the inside skin. On flat roofs this can cause a problem. Water puddles up on the panel and remains in pockets created by the weight of the water.

6. Install or repair baffles to obtain uniform air flow in the kilns to prevent waste by short circuiting air travel. This pays off in energy savings. Reverse your fans approximately every six hours if possible. Tighten up the tip clearances on your fans to improve the efficiency (split roller bearings and high performance fan).

7. Research at the Western Forest Products Laboratory in Vancouver, B.C. has shown that in the early stages of drying at high air velocity (more than 600 feet per minute) can accelerate drying. In the later stages, low velocity (250 feet per minute) is as effective as high velocity and uses less energy. Therefore, arrange to adjust fan speed if possible during the run. The later stages of drying, when high velocity is not efficient, is generally defined as below the fiber saturation point or approximately 25 percent moisture content. The two-speed fan system is more important on schedules which require many hours drying from 25 percent moisture content down to the final; for example, schedules for glue lam stock which has to be dried well below the 15 percent moisture content.

8. Have the recorder controller calibrated for efficient operation. The kiln should not oscillate between periods of any venting and spraying and should not spray and vent at the same time.

9. Check the remainder of the equipment such as traps, valves, coils. Make sure that the traps are in good working order and are not blowing steam. Make sure the valves are seating tightly. Check all steam lines and make sure there are no leaks. If you find a leak, repair it. Make sure that you have adequate water to the wet bulb.

10. Accurately determine moisture content of the wood you are drying. Do not waste energy by over-drying your material or by taking too long because the samples were not representative of the bulk. Try to plan your loads so that when they are

sufficiently dry, someone will be able to shut them off and unload the kiln if possible.

11. When unloading and loading the kiln, do it as fast as possible to save the loss of heat retained in the building.

12. During non-use periods, close all valves and doors tightly; use small amounts of steam, if necessary, to keep the kiln from freezing up.

13. Use accelerated schedules when possible. Note that the higher the temperature for drying, the more efficiently energy is used. The drying efficiency at higher temperatures can be illustrated by the fact that 1730 BTU's per pound of water evaporated requires 640 cubic feet of air to be vented for each pound of water removed at 140 dry bulb temperature with a 40 degree depression. With 240 degrees dry bulb temperature and 40 degree depression, approximately 1,090 BTU's are required per pound of water evaporated and 36 cubic feet of air are vented for each one pound of water removed. Another example is at a 10 degree depression. With 110 degree dry bulb, the grains of vapor per pound of dry air are 280, the BTU's per pound of dry air is 69, and the cubic feet of air vented per pound of water removed is 489. Now look at 190 degrees dry bulb temperature and 180 degrees wet bulb. The grains of vapor per pound of dry air is 4,515, the BTU's per pound of dry air is 695, and the cubic feet of air vented per pound of water removed is 51.

In conclusion, as you see by running your kilns, if possible, at higher temperatures, you will vent more moisture per pound of air, which will save energy.