HOW TO REDUCE ENERGY CONSUMPTION IN KILN-DRYING LUMBER

By

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Our Nation is in an energy crisis; probably every individual and business is feeling the effects. The energy used to kiln-dry lumber is roughly equivalent to the energy needed to heat 5 of every 1,000 homes and businesses. Fortunately, some steps can be taken to reduce the petroleum-based energy consumed in kiln-drying lumber.

Let's look over some energy estimates for kiln drying that are shown in table 1. If we consider a 50,000-board-foot kiln that uses fuel at a cost of $1.50 per million Btu's, the total fuel costs per kiln load are $129 for air-dried hardwoods and $240 for green softwoods. In addition, approximately 2,000 kilowatt hours ($50) of electricity are needed for the fans per load.

One of the most profitable measures to reduce the energy used in kiln drying is to air dry wood before putting it in a kiln. A surprisingly large amount of moisture can be removed from green lumber in just a few days of air drying. For each percent moisture lost in air drying, the energy savings in subsequent kiln drying is roughly 50 to 85 Btu's per board foot. For the conventionally used kiln with a capacity of 50,000 board feet, this means 2.50 to 4.25 million Btu's ($3.75 to $6.38) can be saved for each 1 percent moisture lost in air drying.

Suggestions in this report to reduce the petroleum-based energy used in kiln drying are divided into the following: How to increase efficiency in air drying and how to increase efficiency in kiln drying.

How to Increase Efficiency During Air Drying

1. When green lumber arrives or is first cut, IMMEDIATELY get it on stickers. Even if it is going to the kiln soon, store it where it can air dry (where the wind can blow through the pile). THE RATE OF DRYING IS MOST RAPID THE FIRST 3 TO 4 DAYS; DON'T MISS THIS OPPORTUNITY FOR EFFECTIVE EARLY DRYING.

2. Spread lumber piles out to increase their exposure to drying winds. Spacings in the "Air Drying of Lumber" are minimum. Lumber piled too closely results in an increase in relative humidity in the surrounding area.

3. Maintained at Madison, Wis., in cooperation with the University of Wisconsin.
4. Based on the assumption that 65 pct of U.S. lumber in 1972 was kiln dried (20.9 billion fbm of softwoods and 4.7 billion fbm of hardwoods) times the energy estimates shown in table 1. Heating requires about 1.43 x 10^16 Btu's/yr. Production data are from the Statistical Abstract of U.S., 1972 ed., U.S. Bureau of Census. Washington, D.C.

Species like oak and beech (refractory hardwoods) present special problems. Daily inspection is recommended with refractory hardwoods to discover any problems in either air or kiln drying before they can become serious.

Table 1. --Typical estimates of energy¹

<table>
<thead>
<tr>
<th>Condition</th>
<th>Green softwood</th>
<th>Air-dried hardwood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical specific gravity</td>
<td>0.4</td>
<td>0.55</td>
</tr>
<tr>
<td>Pounds of water per 1 percent moisture content for 1,000 board feet (nominal)</td>
<td>:</td>
<td>24.29</td>
</tr>
<tr>
<td>Energy required to remove 1 percent moisture from 1,000 board feet (Btu)</td>
<td>:</td>
<td>24,727</td>
</tr>
<tr>
<td>Estimated difference between initial and final moisture contents in percent</td>
<td>:</td>
<td>80 - 15 = 65</td>
</tr>
<tr>
<td>Energy required to remove moisture from 1,000 board feet (100 pct efficient process) (Btu)</td>
<td>:</td>
<td>1,600,000</td>
</tr>
<tr>
<td>Estimates of kiln efficiency (percent)</td>
<td>:</td>
<td>50</td>
</tr>
<tr>
<td>Total energy required to kiln-dry 1,000 board feet (Btu)</td>
<td>:</td>
<td>3,200,000</td>
</tr>
</tbody>
</table>

¹ Calculations exclude the electrical energy demand for fans, estimated to be 40 kwh ($1) per 1,000 fbm.

and slows drying. Put the driest lumber on the outside edges of the yard (especially on the edges facing into the wind) so that it will dry even faster. However, it should be noted that for some species, especially oak, beech, and hickory, accelerated air drying (from too wide spacing) can also increase the risk of degrade—checking and honeycomb. Proceed cautiously.²

3. To increase air-drying rates, consider using a sticker that is 25/32 inch or thicker. This will permit both increased air flow and drying. Stickers should be of uniform thickness.

4. Cover the tops of the piles. Why have air-dried lumber exposed to rainfall or snow. (See "Air Drying of Lumber," ⁴ pp. 38-49.)

5. Keep the yard cleared of weeds and debris so that the bottom layers of the pile will also get drying breezes. The pile founda-
tions should be of sturdy open construction and should support the lumber at least 12 inches above the ground. (See "Air Drying of Lumber," 2 pp. 35-38.)

6. Consider investing in a pole-type drying shed (sides open), especially for the refractory species; if air drying is slow 4 to 5 months of the year, consider investing in a forced-air dryer (air is blown through lumber piles without control of humidity with or without heat (maximum of 120°F) and with or without recirculation) or consider investing in a humidity-controlled shed.

7. If you already have an air-drying operation, take time to review it, look for areas that need improvement. (Check pp. 100-102 in "Air Drying of Lumber," 2 or other publications for ideas.)

8. Your State Forester's office may have a utilization specialist on his staff who could view your operation and provide suggestions.

How to Increase Efficiency During Kiln Drying

1. Use as much air drying or forced-air drying as possible—preferably dry to 25 percent moisture content or less.

2. Do not use steam spray or water spray in the kiln except during conditioning. Let the moisture coming out of the wood build up the humidity to the desired level. Steam may have to be used in leaky kilns, in cold weather, and when very small wet-bulb depressions are required. (See "Dry Kiln Operator's Manual," 2 pp. 160-162.)

3. Repair and caulk all leaks, cracks, and holes in the kiln structure and doors to prevent unnecessary venting and loss of heat. Make sure the doors close tightly, especially at the top, temporarily plug any leaks around the doors with rags, and order new gaskets, shimming strips, or hangers if necessary. In a track kiln, use sawdust-filled burlap bags to plug leaks in doors around tracks. Adjust and repair the vents so that when they are to be closed, they are closed tightly.

4. For brick or cinder 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. For outdoor aluminum kilns ONLY, paint the exterior walls and roof a dark color to increase the wall temperature by solar heat and reduce heat loss from the kiln. (Painting would be disastrous on permeable walls like brick or cinder block.) Also check to ensure that weep holes are open, not plugged.

6. 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 heat losses, consider installing a new roof or repairing an old one. Add additional insulation if necessary. Make sure the interior vapor barrier or coating is intact (see suggestion 4).

7. Install or repair baffling to obtain uniform air velocity in the kiln and prevent waste by short circuiting the air travel. This pays off in saving energy. Reverse circulation only every 6 hours or more, if possible.

8. Research at the Western Forest Products Laboratory, Vancouver, B.C., has shown that in the early stages of drying, high air velocities (more than 600 ft/min) can accelerate drying. In the late stages, low velocities (250 ft/min) are as effective as high velocities and use less energy. Therefore, arrange to adjust fan speeds if possible during a run.

9. Have the recorder-controller calibrated and checked for efficient operation. The kiln should not oscillate between period of venting and of steam spraying and should not vent and steam at the same time. (See "Dry Kiln Operator's Manual," 2 pp. 67-73.)


11. Accurately determine the moisture content of the wood you are drying. Do not waste energy by overdrying or by taking too long because your samples are not representative of the load. Try to plan your loads so that when they are sufficiently dry, someone will be available to shut off the kiln (and, if possible, to unload it, reload it, and start it again) rather than allow the kiln to continue to run overnight or through a weekend.

12. Unload and reload the kiln as fast as possible. Try not to do this until the air temperature has warmed up from the morning low—do not cool the kiln unnecessarily.

13. In a battery of adjacent kilns, avoid having one kiln being unloaded or loaded while the adjacent kiln is at 180°F or some other high temperature.

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14. During nonuse periods, close all valves tightly and keep kiln doors closed. Use a small amount of steam if necessary to prevent freezing of steamlines and waterlines.

15. Use accelerated schedules where possible. Check your manuals (for hardwoods, "Dry Kiln Operator's Manual," p. 124-126) to find how to accelerate schedules without risk. Note that the higher the temperature for drying, the more efficiently energy is used.

16. If possible, reduce the length of time used for conditioning; some low-density hardwoods can be conditioned in 6 hours.

17. Finally, check with the manufacturer of your equipment and find out if you can lower steam pressures or reduce gas or oil flow rates during periods of constant dry-bulb temperature. Also have the manufacturer check the burner for top efficiency.

ABSTRACT

The energy used to dry wood can be reduced. More than 20 practical suggestions to reduce fuel consumption, improve drying efficiency, and lower both air-and kiln-drying costs are discussed.