

REDUCING OR ELIMINATING EXCESS HEAT ENERGY DEMAND IN YOUR DRY KILN THROUGH ANALYSIS AND EFFORT

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Before you can reduce the total heat energy demand in your dry kiln you need to know **how** and **where** it's used.

This presentation will provide the typical dry kiln operator a systematic method for **evaluating** and **reducing** the total energy consumption of your dry kiln.

We'll show you the ways in which energy is used in the kiln drying process and how to analyze just where savings may be made and what efforts must be taken to accomplish these savings.

Your Dry Kiln Uses Energy in Three Ways

First is the **minimum theoretical** amount of energy required to dry the material in the kiln. The amount is dependent on numerous factors, including the species of wood, the beginning and target moisture content, the schedule being used, the outside temperature, as well as type of dry kiln, length and holding capacity. The total energy is the sum required to heat up the interior of the dry kiln, to heat the wood, to raise the temperature of the water, to evaporate the free water from the wood, to move the entrained moisture to the surface of the material, and to turn all this moisture to vapor.

Second is the **basic thermal loss** of the dry kiln itself. For this presentation we have assumed a state-of-the-art dry kiln which provides the lowest energy loss for the conditions outlined. These losses include the energy radiated through the building walls, roof, doors, foundation and floor, venting through a heat recovery and pressure venting system, and the use of a steam spray to maintain wet bulb at the end of the schedule as well as conditioning.

The total of these two is the **fixed energy usage** for the material, schedule and dry kiln being evaluated.

Third is the **excess energy consumed** through things that can be changed or corrected in the dry kiln or its operation. This is where we can make a real difference.

This is where we can start reducing or eliminating excess energy use in your kiln!

Our Ideal Dry Kiln and Operating Parameters

To realistically show just how and where heat energy is being used, we have developed an example of an Ideal Kiln based on the following assumptions and shown the energy use in Figure 1.

Dry Kiln Configuration

68 foot long prefabricated aluminum double track dry kiln

Thermax[™] insulation (dry) in the prefabricated wall panels, roof and all doors

Adjustable pitch 72 inch diameter high performance fans in line shaft configuration

Steam heat with heat recovery and pressure venting system (no conventional vents)

Material Dried

120,960 board feet 2 x 6 Hemlock lam stock

Initial moisture content 120%

Target moisture content 12%

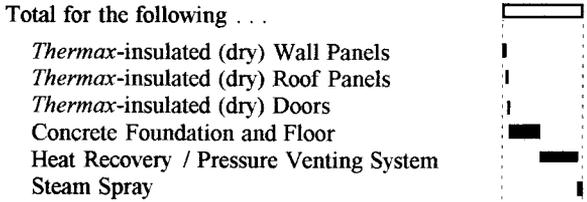
Drying Schedule

Drying Phase	Time (hours)	% water	Dry bulb	Wet bulb
Warm-up	5 hrs	n/a	n/a	n/a
Warm-up/evaporation	3 hrs	3	n/a	n/a
Evaporation 1	11 hrs	27	190	170
Evaporation 2	24 hrs	35	190	160
Evaporation 3	24 hrs	20	190	160
<u>Evaporation 4</u>	<u>24 hrs</u>	<u>15</u>	190	160
Totals	91 hrs	100		

Minimum Theoretical Energy Usage

Warm-up of Dry Kiln Building, Equipment and Wood
Evaporation of Free and Entrained Water from Wood

Basic Thermal Losses (for Ideal Dry Kiln)



Fixed Energy Use

Minimum Theoretical Energy Usage + Basic Thermal Losses (for Ideal Dry Kiln)

Excess Energy Consumed

Building Walls

- Thermax-insulated (dry) (Ideal Kiln)
- Thermax-insulated (wet)
- Fiberglass-insulated (dry)
- Fiberglass-insulated (wet)
- Masonry (dry)
- Masonry (wet)

Building Roof

- Thermax-insulated (dry) (Ideal Kiln)
- Thermax-insulated (wet)
- Fiberglass-insulated (dry)
- Fiberglass-insulated (wet)
- Wood (dry) without Insulation
- Wood (wet) without Insulation

Load and Access Doors

- Thermax-insulated (dry) (Ideal Kiln)
- Thermax-insulated (wet)
- Fiberglass-insulated (dry)
- Fiberglass-insulated (wet)
- Plywood (dry) Panels
- Plywood (wet) Panels

Venting System

- Heat Recovery / Pressure Venting (Ideal Kiln)
- Conventional Vents

Leakage through Gaps

- 1/16" gap around Load Doors
- 1/8" gap around Load Doors
- 1/8" gap around Conventional Vent Lids

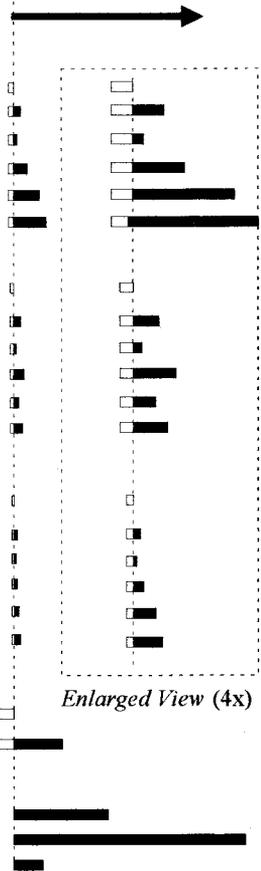


FIGURE 1. Energy analysis. All of the bars are in constant, relative scale for ease of comparison. The total energy consumed is the fixed energy use (to left of dotted line) PLUS the appropriate excess energy consumed for the configuration as it applies to your dry kiln.

Improper Baffling of Load Increases Drying Time

The impact here is not an increase in the energy required to dry the wood (which is a constant), but that the lengthening of the drying period increases both the Basic and Excess energy consumption through longer-than-normal losses. Electricity use for fans would also increase.

One baffle open	11 hours (12%)
No end baffle	14 hours (15%)
All baffles open	31 hours (34%)
No baffles	46 hours (51%)

How can you reduce this excess energy demand?

Improve **operating techniques** through commitment and training.

- Stack and stick for uniform loads
- Eliminate voids at ends of packages which allow airflow by-pass
- Use all ceiling, end and floor baffles. Adjust them so they fit tightly.
- Close load doors securely
- Review and revise schedule as necessary - shorten if possible

Perform **proper maintenance** on existing hardware.

- Repair any holes in external panels
- Replace worn door seals
- Adjust vent lids for tight fit and consistent operation
- Dry out or replace any wet insulation in exterior panels
- Coat interior of masonry kilns
- Replace or repair baffles
- Repair or adjust traps, valves and temperature probes
- Calibrate instrument

Only then should you look at an upgrade of the dry kiln and equipment.

- Replace wood roof with insulated aluminum panels
- Change from conventional venting to heat recovery/pressure venting
- Add computerized controls
- Install variable frequency drive on kiln fan motors.
- Upgrade insulation in all panels

Conclusions

With some simple analysis and a little effort you can reduce excess energy demands in your dry kiln.

Look first at the small, easily correctable things that can be costing you an enormous amount in extra dollars drying every kiln charge!