Kiln Drying Basics for the Small Producer

Joe Denig
NC State University
Wood Products Extension
Raleigh, NC
Tel: 919-515-5582
E-mail: Joe_Denig@ncsu.edu

Downloadable References

- Go to www.fpl.fs.fed.us
- Look under publications
- Drying hardwood lumber
- Dry Kiln operator’s manual
- Dry kiln schedules for commercial woods

Hard References

- Go to www.forestprod.org
- Look under publications

- Drying hardwood lumber
- Dry Kiln operator’s manual
- Dry kiln schedules for commercial woods

2010 Dry Kiln Operators' Courses

- Haywood Community College
  - Clyde (Near Asheville NC)
  - July 27-30, 2010
  - Whit Whitmire
  - Phone: 828-565-4246
  - E-mail: mwhitmire@haywood.edu
- University of Minnesota
  - August 16-19, 2010
  - Harlan D. Petersen P
  - Phone: 612-624-3407
  - E-mail: harlan@umn.edu

Warning: Decide if it is a hobby or a business ?

- Don’t be cheap
- Do things right
- Go to a kiln operator’s short course

Log Protection

- Log protection is critical to avoid stain and splits
- Rapid log turnover is one of the most cost effective ways to avoid problems
- End coating logs with wax or anti stain chemical will help if longer storage is used

Quality Stacking

- Uniform sized lumber
- Uniform sized, dry sticks
- Cross outs and sticks should be in vertical alignment
- Protect the ends

Principles Of Drying

- Heat
- Humidity
- EMC
- Airflow

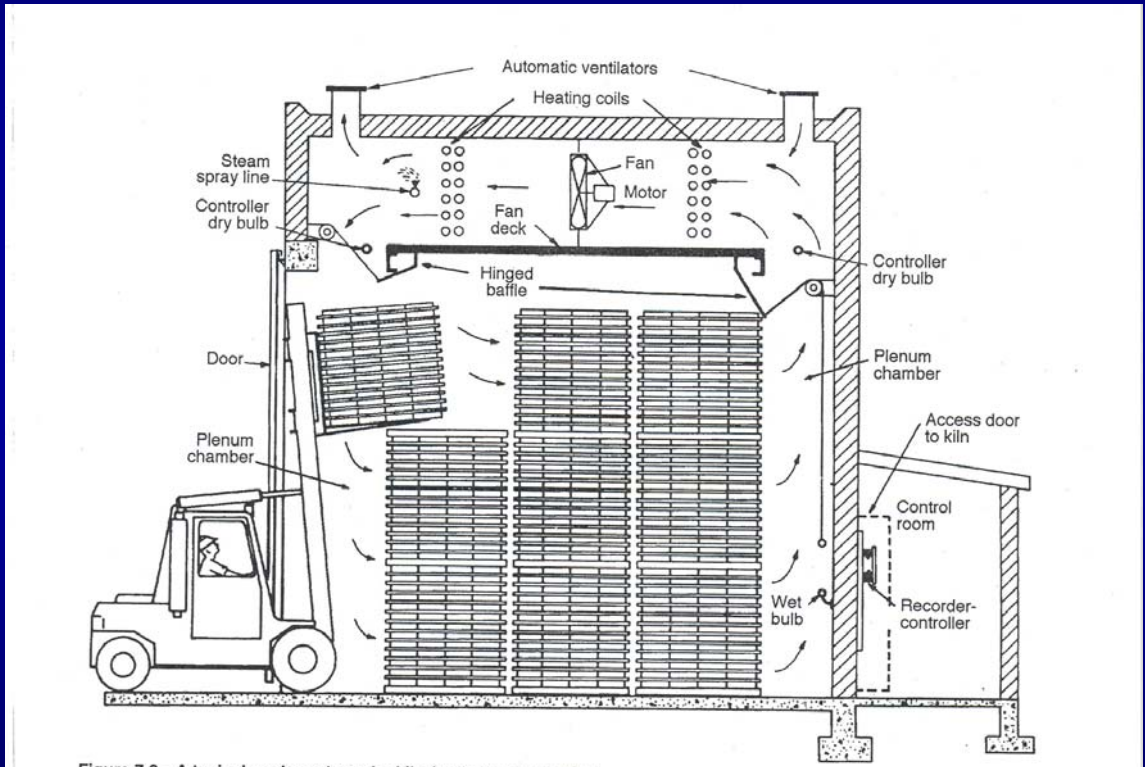


Figure 7.2—A typical package-type dry kiln for hardwood lumber.

Heat

- Evaporate water
- Move water molecules from center of the lumber to the outside
- Wood is weaker at higher temperatures
- Use only enough heat to get the job done
- Dry bulb temperature

Humidity

- Relative Humidity
- Allows water to evaporate from the lumber surface
- Controls the drying rate at the beginning of drying
- More humid on the exiting air side of a load
- We use a wet bulb or Equilibrium Moisture Content (EMC) wafer to measure humidity in a kiln
- Need airflow past wet bulb to get an accurate reading

Airflow

- Used to bring energy to the wood, and take away moisture
- Too little airflow can lead to slow drying, variable drying and staining
- Too much airflow can lead to checking

Airflow

- Oak 300-350 FPM (1.5-1.8m/sec.)
- Poplar 600-700 FPM (3.1-3.6m/sec.)
- Hard Maple 350-450 FPM (1.8 -2.3m/sec.)
- White Pine 600-700 FPM (3.0 -3.6m/sec.)
- Southern Pine (low temp) 650-750 FPM (3.3-3.8m/sec.)
- Southern Pine (high temp) 1200-1600 FPM (6.0-8.1m/sec.)

Hot Room Drying

- Air dry or shed dry first
- Move lumber to progressively warmer and dryer environment
- End up in a heated part of your house for at least one heating season for 4/4 lumber

Solar Drying

- Sounds like a good idea (using the sun, etc)
- Need production all of the time
- Can get expensive with all the bells and whistles
- Need to be selective on what you dry (stain & checking)

Solar Drying

- Solar collectors gather approximately 1000 to 1200 BTUs per square foot
- As a general rule have the solar collector at an angle from horizontal as the collector is located north or south of the equator
- In this hemisphere face it south
- It takes approximately 1000 BTUs to evaporate one pound of water

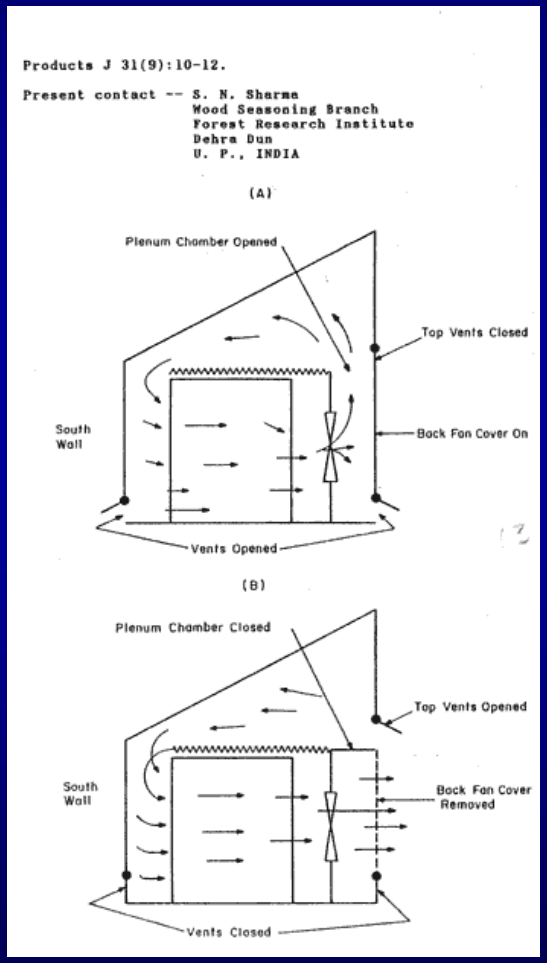
Solar Drying

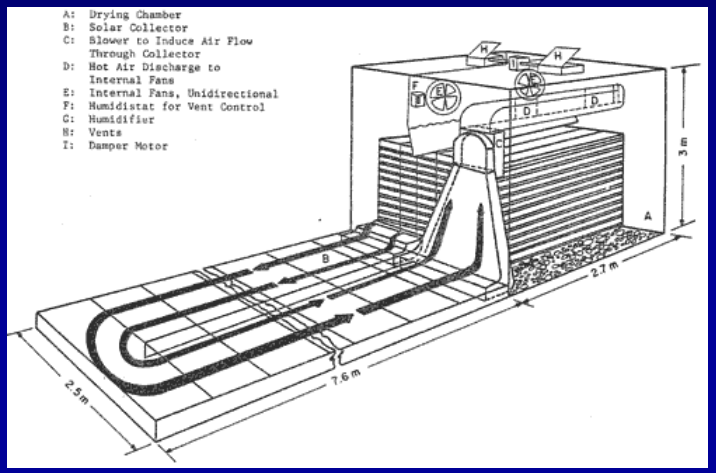
Species	Daily MC% Loss Target	Weight Per 1 MBF Dry	Weight Of Moisture Loss	MBTUs/MBF/Day or area in square feet of solar collector
SYP	30.0%	2710 lbs.	813	813
Poplar	30.0%	2315lbs.	695	695
H. Maple	5.0%	3045lbs.	152	152
Cherry	4.5%	2692lbs.	121	121
Red Oak	2.75%	3270lbs.	90	90

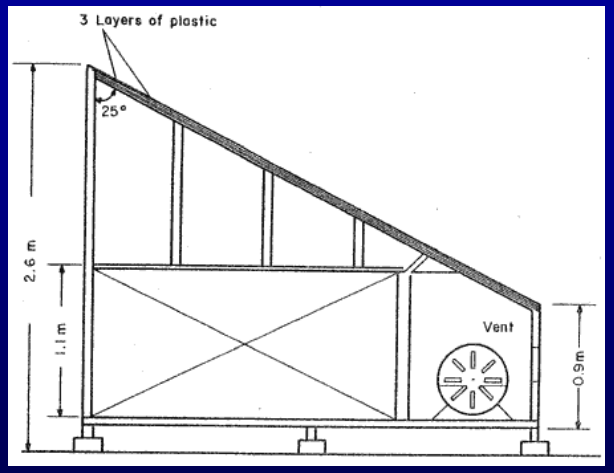
Solar Drying

- For slow drying species the solar collector ratio of 100 ft^2 per MBF can be used
- For moderately drying species the solar collector ratio of 200 ft^2 per MBF should be used

Solar Drying





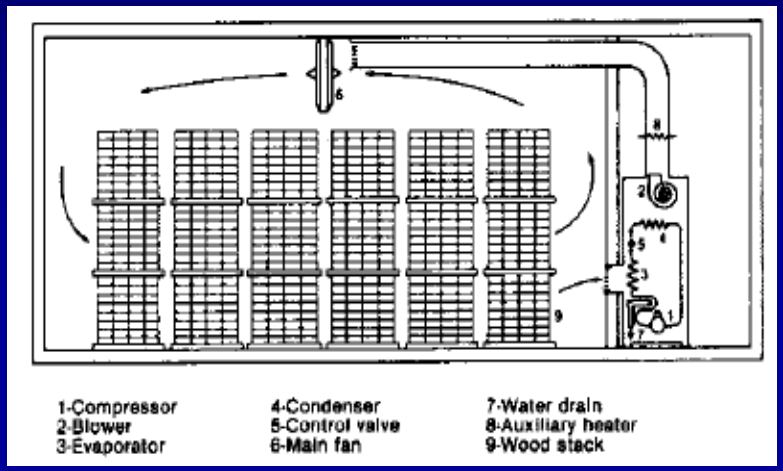


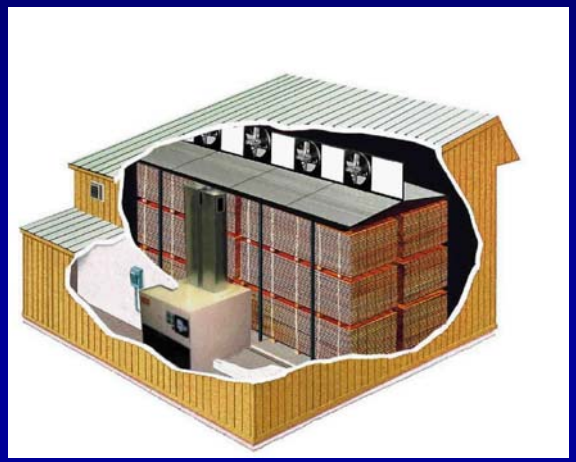
Solar Drying - Poplar to Oak

Suggestions

- Start with an easy to dry wood and learn your kiln
- Top vent is for overheat (can get up to 140ºF)
- Bottom vents are to allow moist air to escape and bring in fresh air
- Baffle well
- Can add small dehumidifier and or heater

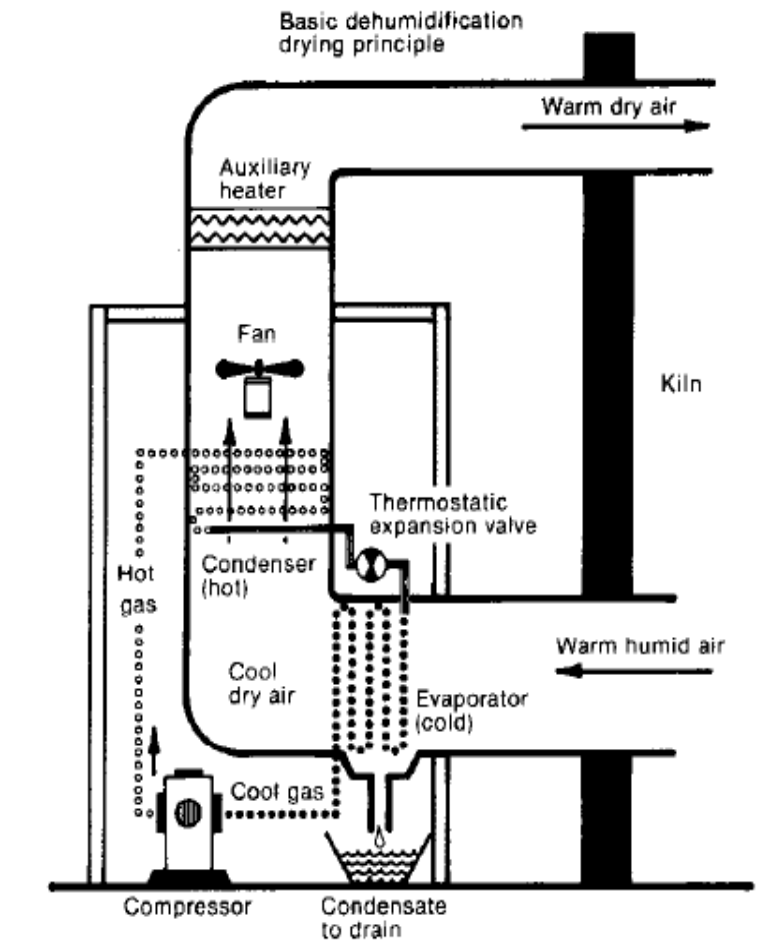
Dehumidification Drying





- No boiler needed
- No vents, closed loop system
- Energy efficient but you are using electricity
- No heat up system or humidifying system

Dehumidification Drying



- Compressing gas heats the gas up, which in turn can heat the air
- Expanding gas cools the gas down, which is used to lower the air temperature or condense water out of the air stream

Dehumidification Drying

- Slow drying species, oak – 0.50 to 0.75 hp/mbf
- Moderate, ash – 1.00 hp/mbf
- Fast drying, pine – 1.50 to 2.00 hp/mbf
- Better to slightly undersize than oversize

Dehumidification Drying

- Compressor and electrical outside the kiln
- Stainless steel coils
- Ability to reach higher temperatures (160^{o}F)
- Enough airflow
- Well insulated
- Auxiliary heat and humidification system

Cost

- Energy Cost reported to be between $50 to $80 per MBF
- Need a well insulated building!!!!

Using a reefer

Conventional Steam Kiln

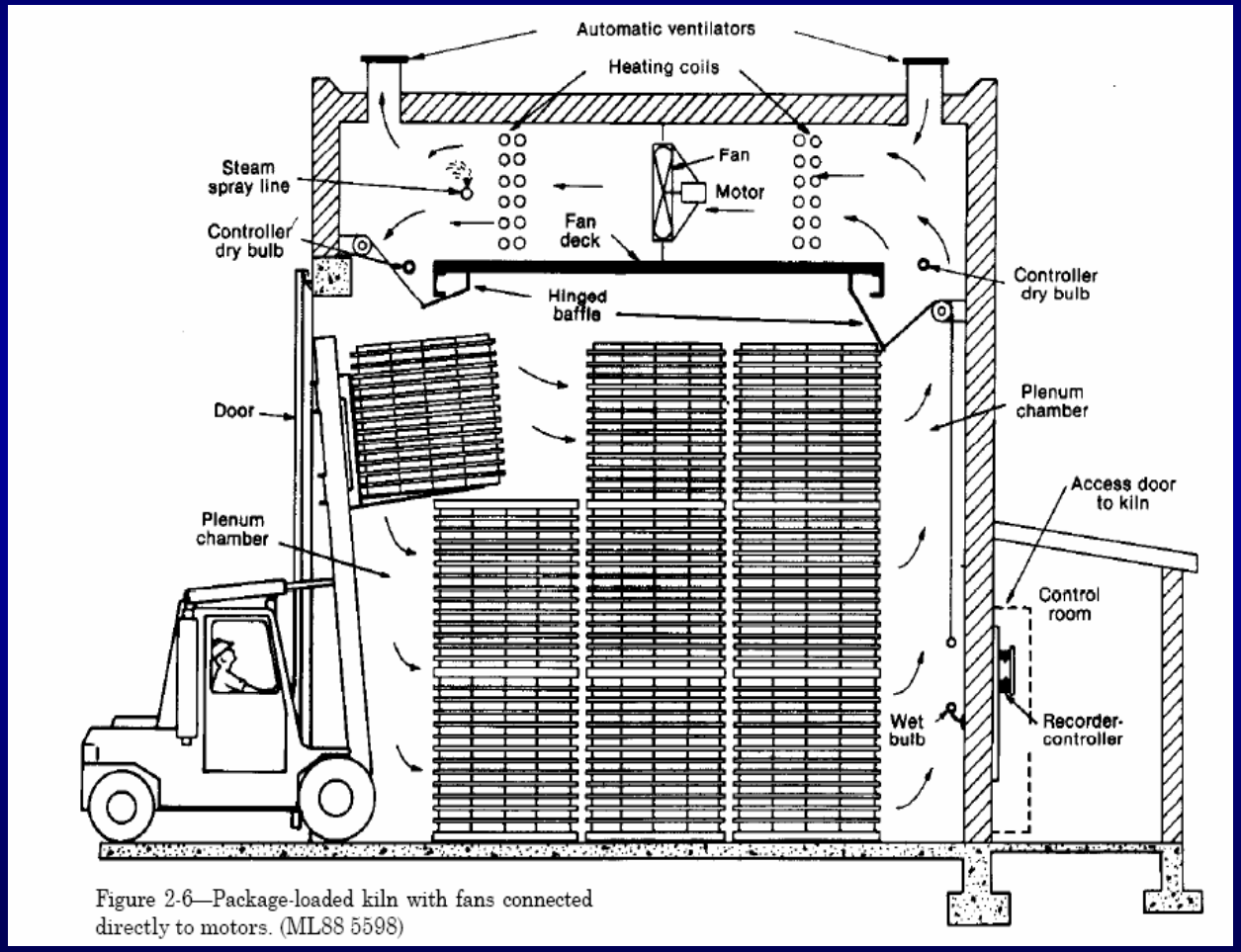


Figure 2-6—Package-loaded kiln with fans connected directly to motors. (ML88 5598)

Conventional Steam Kiln

- My former student, Miguel Angel Camara Rubio, as part of his Master's project built a kiln at his family business in Mexico City.
- He wanted a kiln that was highly flexible in terms of ability to dry different species and thicknesses

Pine lumber – notice the quality of stacking

Hardwoods

Lysiloma spp. – T’zalam

Variable speed fan control gives a lot of flexibility

Notice what gives him good results- good sample techniques and records

Small kilns can also be used to heat treat pallet material as well as dry lumber.

Other Alternatives

Other Alternatives (Small)

- 7,000 BF capacity
- Direct fired
- Computer controlled
- Optional 6 MC% resistance sensors
- Five 20” fans, 2HP
- Bi-fold doors

Good luck!