

DRY KILN AIR FLOW DESIGN

WHAT IS IT?

WHY IS IT IMPORTANT?

Mike Sprague
M-Sprague, Inc.
Portland, Oregon

The purpose of the dry kiln is to dry the material in a uniform manner to a desired moisture content.

The dry kiln should be designed in such a manner as to evenly dry all the material within the kiln. The dry kiln is a large box or container where the wood is placed into, to be dried. The drying process needs three things to function: dry bulb temperature, wet bulb temperature, and air flow (Figure 1).

Dry Bulb Temperature

Dry bulb temperature is the heat used in the drying process. This heat can be produced by several different means. Some of these means are as follows: direct fired heat source, steam, hot oil, hot water, solar, and other types. These heat sources will be the means for raising the dry bulb temperature which will heat the wood and the water.

Wet Bulb Temperature

The wet bulb is the means to control the rate of moisture removal. This is done by adding or removing moisture from the air of the dry kiln. The vents will decrease the amount of moisture in the air, while the steam spray line will add moisture if needed. Not all dry kilns have a steam spray line. The dry kilns that do not have steam spray to control the wet bulb have to be watched closely on the depression so that they do not let the air dry out too quickly. This type of dry kiln has larger moisture variation in the total E.M.C. of the wood.

Air Flow

The air flow is the conveyor for the dry kiln. In other words, it is the means of activating the drying process. The air moves the heat from the heat source to the material being dried. So there is a real need for uniform heat distribution from end to end. These two things should operate together to provide a uniform temperature control.

The air conveys the heat through the sticker opening warming the wood and the water. The water is then evaporated from the surface of the wood into the air and in some cases, not enough air can cause wood stain. However, alternatively, in other situations too much air will collapse or case harden the wood.

The air flow through the sticker opening is very important and should have the same amount of air being processed through each opening. This effects the

LEGEND

-  = MOLECULE
- H = HEAT
- A = AMBIENT AIR
- W = WATER

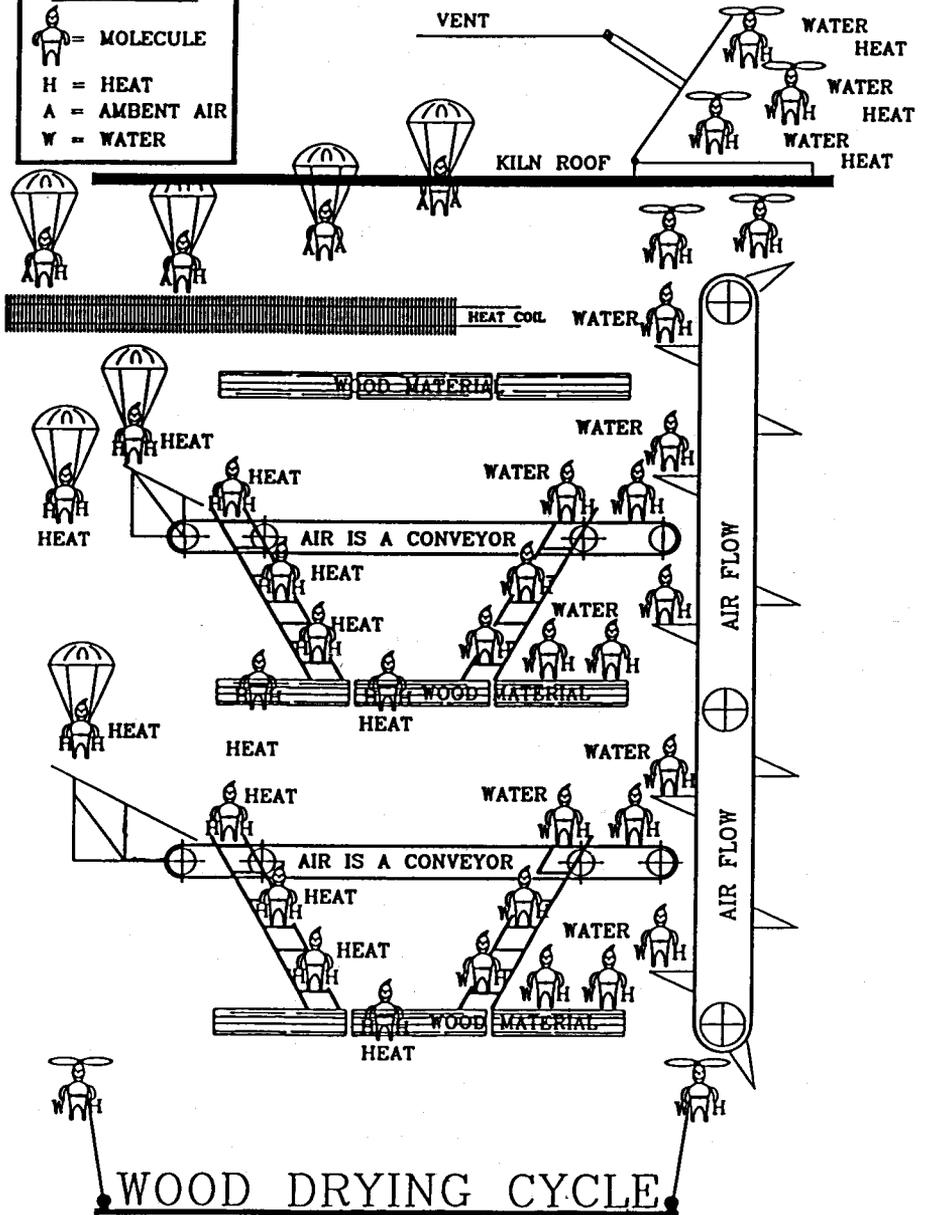


FIGURE 1. Movement of heat and moisture in a dry kiln.

moisture uniformity of the material. For this reason, the size of the plenum area will affect the sticker velocity.

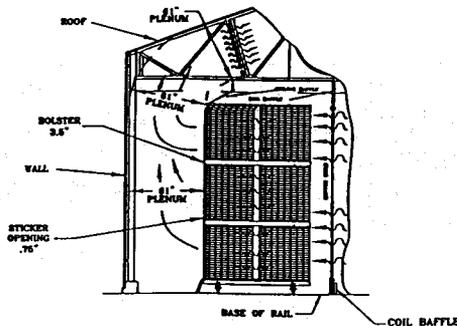
The ideal plenum will be as big and the total number of sticker openings times the sticker thickness, times the number of packages. Then this number added to the total number of bolster openings times the bolster size. This will give you the minimum number of inches which the plenum should be which is the distance from the kiln wall to the edge of the kiln load.

If the plenum is smaller than the number indicated, you will see an uneven air flow from the top to bottom of the package. The amount of verification will depend on how much under the minimum distance you are (Figure 2).

Air will take the path of least resistance and for this reason, the load of material should be tight form end to end. All of the baffle system should be used, as far as floor, ceiling and end baffles. By not using end baffles, you would reduce air flow by 25 percent of the total amount of air passing through the load. If the floor baffles are not used properly but the end and ceiling baffles are used, then the air flow would be reduced by 25 percent. All percentages are approximate because it will depend on the size of the load and the percentage can increase or decrease depending on height or length of the load (Figures 3 and 4).

One other condition that will affect the air flow is mixing two lengths per package. This will also reduce the air flow through the stickered package. The air will go through the larger openings rather than the sticker openings.

With the right size plenum area, all baffles in and being used correctly, along with one size material per package, then this will add excess static pressure.



PLENUM CALCULATION

LOAD SPECIFICATIONS

STICKERS - 24
 STICKER SIZE - .75"
 BOLSTER SIZE - 3.5"
 No. OF BOLSTERS - 2

CALCULATION

24 STICKERS x .75" THICK x 3 PACKAGES HIGH = 54"
 2 BOLSTERS x 3.5" THICK = +7"
 MIN. PLENUM MEASUREMENT 61"

FIGURE 2. Calculation of plenum width.

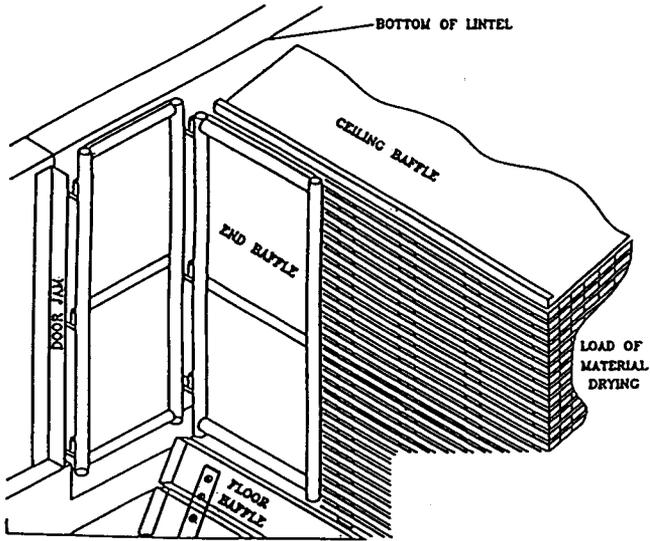
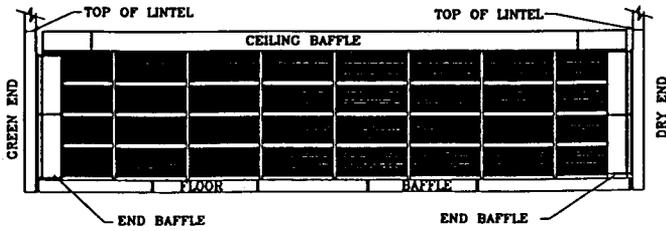


FIGURE 3. All baffles should be used.



SIDE VIEW OF LOAD WITH BAFFLES
 POSITIONED FOR DRYING PROCESS
 (BAFFLES FORM A PICTURE FRAME AROUND LOAD)

FIGURE 4. Side view of load with baffles positioned for drying process. The baffles should form a picture frame around the load.