



# KILN DRYING 101

by Andrew St. James ARS PhD  
COO Goodwin HeartPine and  
Director of the company dry kiln

Lumber used in residential construction is usually kiln dried, KD. This process and its practical results are not always well understood. Most people understand that kiln drying reduces the amount of water in lumber. The moisture in wood will reach an equilibrium value based on the relative humidity of the surrounding air. In most parts of the USA the value of equilibrium moisture content, EMC, is in the range of 6% to 9% for homes and offices. Seasonal variations in relative humidity causes moisture content changes, causing shrinking and swelling in wood in most geographic areas. It is important to achieve a reasonable initial moisture content for wood based materials that are to be used in construction. Kiln drying can produce a moisture content near enough to the final moisture content in use to avoid shrinkage problems.

## OTHER ADVANTAGES TO KILN DRYING

There are other advantages from kiln drying wood:

- Kiln drying can be used to eliminate insect infestations.
- Because strength increases with decreased moisture content, kiln dried lumber is stronger than green lumber.
- Wood that is wet is susceptible to attack by fungus, which causes rot and bacterial attack which causes discoloration. Kiln drying eliminates this problem.
- From an economic standpoint, kiln drying can reduce overall production times thus reducing the need for the larger inventories required with slower methods.
- Setting pitch in a kiln to reduce sanding cost and lessen finish problems can also be important for the furniture industry.

Unfortunately kiln drying does not eliminate shrinking and swelling brought on by later changes in moisture content.

## SOME NEGATIVES TO KILN DRYING

The situation is not all positive though. Kiln drying introduces internal stresses into wood which can cause defects in the lumber. Separations in the wood, called checks, can be introduced on the surface of the material or lie hidden in the core of the lumber. End checks can also reduce the yield. Twist, bow, crook, and cupping can all occur in the kiln. And improper rapid kiln drying 'case hardens' the wood, producing boards that deform when they are later processed by sawing or milling.

## THE INNER WORKINGS OF A KILN

Different kiln types include direct fired, dehumidification, solar, vacuum, and microwave kilns.

However, the most common dry kilns are buildings in which temperature, relative humidity, and airflow can be controlled. Most commercial dry kilns are heated by steam produced in a separate boiler, but hot water boilers are used occasionally. These boilers are fired with various fuels. Waste wood and natural gas are two of the most common fuels. The energy from the steam is introduced into the chamber through heat exchangers. Large, high capacity fans circulate air through the heat exchangers and then through the lumber stack.

The layers of boards in the lumber stacks are separated vertically by stickers placed parallel to the airflow. This facilitates air passage through the stack. Moisture is expelled from the chamber by venting some of the moist, circulating air to the atmosphere. Excessively low humidity levels are avoided by introducing steam or water spray into the

kiln chamber. Temperature is controlled by regulating the energy flow to the heat exchangers. Baffling, stacking geometry, and fan speed are used to achieve proper air circulation rates. Air circulation in large kiln is typically reversed periodically to even out the drying of the opposite sides of the stack.

Drying times can vary from a few hours to several weeks. Species, initial moisture content, lumber dimension, kiln design, wood density, heartwood content, cut of lumber (flatsawn or quartersawn), drying schedule and allowable degradation all influence the time it takes to dry a kiln charge. Drying schedules balance investment and minimized energy costs against losses due to drying degrade. Kiln dried lumber is usually sold as falling within a stated moisture content range. Typically association graded softwoods are marked to indicate the moisture content as a part of the grading stamp.

## THE RESULTS

The goal of careful kiln drying is to produce a uniform moisture content in a kiln charge both when comparing different boards and when comparing the surface to the core moisture contents. Meters that measure the moisture content in wood are often used to test lumber when the moisture content is critical such as the furniture and flooring industries. As with many other aspects of the wood industry we are generally familiar with a process, but have not been exposed to many of the details involved in producing quality products. Kiln drying is integral to the production of many wood products. This introduction is intended to add to your general knowledge of this process. WS

Goodwin HeartPine is located in Micanopy, Florida. For more information, Mr. St. James can be reached at (352) 466-0339.