METHODS OF ACCELERATING WOOD DRYING

by

Leif D. Espenas

Oregon Forest Products Laboratory, Corvallis, Oregon

Introduction

Methods of accelerating the drying of wood have always been the subject of keen interest by the wood industries. Rapid drying methods are potentially low cost drying methods and the conveniences inherent in short drying periods provide additional attractions. Unfortunately, some of the methods proposed are not cheaper methods but may be even more costly than the current air drying on kiln drying methods. Others hold little or no promise of being capable of doing a reasonably good job of drying and there are a few proposed methods that do not in fact reduce drying time.

Within modern times, kiln drying, which had its start almost a century ago, has been the most successful method of accelerating drying. Despite the fact that there are some few persons who are still skeptical of the merits of kiln drying, there can be little doubt about its success. Current research in drying is largely directed towards improvement of kiln drying methods. These efforts, however, along with more fundamental studies of the seasoning of wood, may sometime result in even greater success either by kiln drying or by some other method.

Basic Theory of Wood Drying

The basic concepts of the drying of wood involve knowledge of the structure of wood and of moisture diffusion, neither of which are as yet completely understood. Botanists, anatomists, wood technologists and chemists have long been studying wood structure, but theories and studies of the movement of moisture in wood as it dries are about as new as the development of the internal fan dry kiln. Whether or not these are completely understood is not so important for the purpose of the discussion that follows as is the realization that the drying of wood is governed by physical laws.

So far as the drying rate of wood is concerned, there are very few controllable factors known to have an influence. Probably the most important of these factors is the temperature at which the drying takes place. Next in importance is the moisture gradient, or, as it is most commonly understood, the combination of the equilibrium moisture content of the drying atmosphere and the removal of moisture from the wood surface by the drying medium - rate of air circulation in air - and kiln drying. Of far lesser importance is the pressure at which the drying takes place and an unknown factor is the possibility in some methods of removing extraneous materials from the wood thereby making the wood permeable for the diffusion of moisture. Any one or more of these factors may be employed to increase drying rate. However, the effect on the amount of degrade, the possibilities of drying to uniform moisture content, and the relief of drying stresses must not be overlooked in evaluating a drying method.

Accelerated Drying Methods

The methods by which wood can be dried vary widely in nature but the basic factors governing moisture movement apply regardless of the method. In the following listing of drying methods, the main features that can or do speed the rate of drying are mentioned first, followed by a general evaluation from the standpoint of drying results and cost. Because of limited space, these are given only in note form. More detailed information on the methods is available from various publications of the U. S. Forest Products Laboratory, and from various article published by Tiemann in the mid-month issues of the Southern Lumberman from August 1949 - 1952.

Air Drying. Speed of drying is limited by atmospheric conditions but can be accelerated by employing methods that permit taking full advantage of atmospheric conditions. Examples are wider alleys and pile spacing; narrower piles; higher, more open pile foundations; wider chimneys or flues and more space between boards in a layer; thicker stickers.

Portable fans and heaters have been tried in U. S., and a few novel methods tried in Europe. The possibility of using solar energy and radiating surfaces has been suggested.

Good results obtainable in air drying. One of most objectionable features is large inventory which contributes heavily to cost. Cannot dry to low enough level of moisture content for some uses.

Kiln Drying. Faster than air drying because of higher temperature, better air circulation, and in some schedules, steeper moisture gradient. There is a possibility with some wood, and some schedules of speeding drying further by using higher temperatures and steeper moisture gradient. Modern kilns believed supplying about optimum economical air volume.

Good results obtainable except for a few woods especially susceptible to checks, collapse and honeycomb.

Chemical Seasoning. Does not accelerate drying over that obtainable in air-drying or kiln-drying untreated stock in the same conditions, but may permit more severe humidities to be used in early part of schedule without excess checking.

Not now used in West, but theoretically is adaptable to woods especially susceptible to checks. Does not always work so well as anticipated. Reduced degrade must pay for the extra handling costs, the chemical, and any equipment used.

Boiling in Oil. Speed obtained by high temperature and steep moisture gradient. Used for ties, poles, etc., prior to preservative treatment.

Danger of checks, honeycomb and collapse. Casehardening severe and equipment may not be adaptable for relieving it. No EMC control, and equipment may not be designed otherwise for uniformity of drying.

Proper equipment may be expensive. Oil absorbed by wood adds to cost.

Vapor Drying. Speed obtained by high temperature and steep moisture gradient.

Used prior to preservative treatment and being investigated for application to lumber. Developed by Taylor-Colquitt Company, Spartanburg, South Carolina (covered by Graham at meeting in separate discussion).

Solvent Seasoning. Fast drying obtained presumably by effective low EMC and freeing capillary openings of obstructing materials such as resins by cleaning action of the solvent. Developed by Western Pine Association Research Laboratory.

Very good results obtained with pine. Other species not studied intensively. Recovered resins, etc., may help share cost. Equipment expensive and total drying cost somewhat more than kiln drying.

Vacuum Drying. Water in wood diffuses more rapidly in a vacuum than under normal pressures (760 mm Hg) but the effect is not greatly pronounced until pressure is reduced to about 250 mm. As pressure is reduced it becomes more difficult to supply heat for evaporator and adequate circulation to remove surface moisture. Alternate steaming and vacuum cycle used on poles, ties, etc., prior to preservative treatment. This method not believed practical for lumber drying.

Infrared Radiation. Since infrared rays penetrate only slightly, this is an inefficient means of supplying heat to lumber, especially in large volumes. EMC could not be controlled. Heating by electricity more expensive than by steam.

High Frequency Dielectric Heating. At least at present, a high temperature method of drying. Permeable woods easy to dry by ordinary methods have been dried successfully on laboratory scale by this method. Heating is difficult to control. Equipment and power are costly.

Superheated Steam. A high temperature method of drying. Used in this country about 1920 in Douglas-fir region. Use discontinued because of high steam consumption and rapid deterioration of buildings. New developments in Europe being studied by Canadian Forest Products Laboratory.