Depending on the wood species and drying conditions, wood crossties require four to 14 months of air seasoning. Stacking allows air to flow around each tie.

Crosstie treatment: The inside story

Proper seasoning and treatment are essential for wood ties to perform effectively.

The creosote pressure-treated wood crosstie has been the foundation of American railroading for more than 100 years. Over the years, the American Wood Preservers Association has developed standards covering the creosote preservative treating process and analyses methods. The purpose of the standards is to ensure that wood products are properly pressure treated to protect them from insect and fungus attack.

The American Railway Engineering Association also has recommended practices for conditioning and treating wood crossties, as well as procedures for handling after treatment.

Regardless of the timber species used, crossties are to give satisfactory service life, they must be conditioned (seasoned) properly before being pressure treated with preservative. Seasoning reduces the moisture content of the tie so that the desired penetration of preservative can be achieved during the treating process. During seasoning, wood ties develop checks which are cracks or fissures in the wood. Seasoning checks provide avenues for preservative penetration into the tie during treatment. Three processes are used to season crossties: Air seasoning, boultonizing and vapor drying.

Air seasoning involves stacking ties in a manner permitting air to flow freely around and between each tie. Air seasoning will require four to 14 months, depending on the wood species and drying conditions. Table 1, taken from AWPA Standard C6-90, can be used as a guide for air drying various species.

Ties being air seasoned are held in stacks until they reach the proper moisture content, which will allow proper penetration and retention. The moisture content for each species should not be more than shown in the table.

The moisture content can be obtained by running oven-dry weights on 2-inch borings taken from the midpoint of a sampling of ties. AREA also has established guidelines for yarding and stacking air-dried wood ties.

Boultonizing involves the vaporization of moisture (water) from ties using boiling creosote under vacuum (18 inches of vacuum at 170 degrees F). The water obtained in this process is passed through a condenser and collected so it can be weighed and measured. This process is continued until the moisture content is low enough to allow proper treatment (see Table 1).

The vapor drying technique uses a vaporized moisture with an aromatic hydrocarbon solvent (such as xylene). There currently is only one crosstie treating plant using this method to condition wood crossties.

Both vapor drying (12-14 hours) and boultonizing (16-24 hours) permit immediate preservative treatment of freshly-cut material, but they involve relatively high energy costs. The processing of air-dried material is less costly, but inventory costs can be higher due to the length of time required for seasoning.

Pressure treatment

Regardless of the seasoning method, the basic process used for pressure treatment of ties with preservatives is similar. Generally, the purchaser will specify the retention or number of pounds of preservative per cubic foot (pcf) of wood retained in the tie. Common retentions for crossties are usually 6-8 pcf (see Table 2). AREA recommends 7 pcf for oak and mixed hardwood ties. The preservatives that are used to treat crossties are creosote solution meeting AWPA P2 Standard, or creosote petroleum solution meeting the P3 Standard. Creosote is a very effective preservative against fungal decay and insect attack. It

Table 1
AWPA-specified air drying standards

	Seasoning Calendar Months	Percent of Oven-Dry Moisture Content
Oak, Locust, Black Walnut	9-14	50
Douglas Fir, Western Larch	5-10	20
Gum -Black, Tupelo, Sweet	4-7	40
Southern Pine	3-6	30
Hickory and other hardwoods	4-10	40

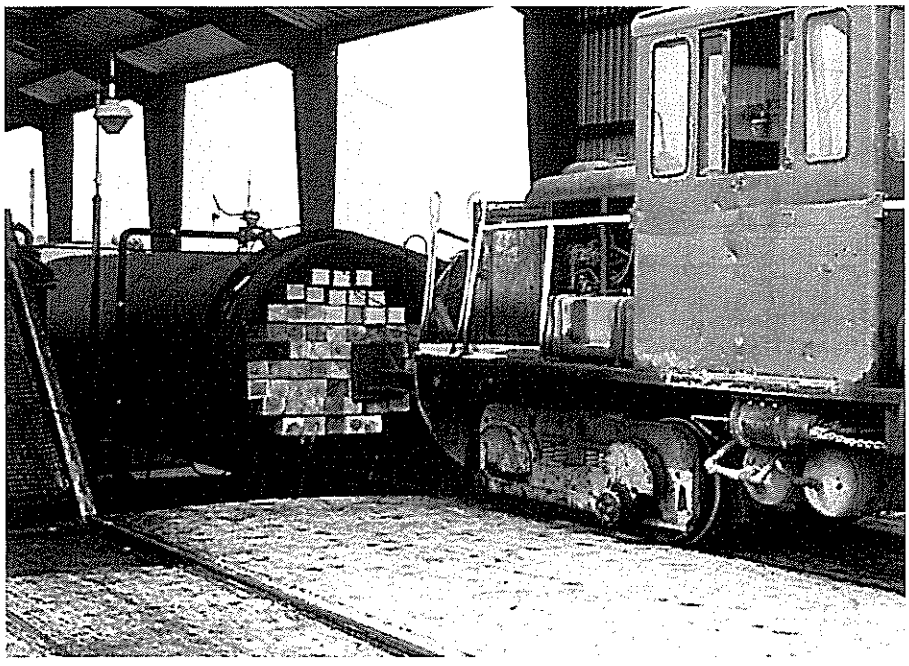
also restores the natural elasticity of wood which is reduced during the drying process.

Most crossties are treated by the empty-cell process. The average treating cylinder is loaded with 300-700 ties. Air pressure in the cylinder is increased 25-70 pounds per square inch (psi) depending on the species and conditioning method being used for treatment. The air not only fills the void space around the crosstie but also enters the wood and fills the cell cavities within the wood itself. While maintaining initial air pressure, the preservative is pumped into the cylinder. The air is then trapped in the cell cavities of the wood. After the cylinder is filled with preservative, the pressure is increased to 150-200 psi. The temperature of the preservative during this process is between 190 and 210 degrees F.

Pressure is maintained for a period of four to six hours or until the desired injection of preservative into the wood has been achieved. Following the pressure phase of the cycle, the excess preservative remaining in the cylinder is returned to the supply or working tank. The pressure is then reduced to atmospheric with a vacuum drawn on the cylinder over one to two hours. The air trapped in the cells of the wood expands and forces most of the

Table 2
AWPA specified requirements

		Oak and Hickory	Mixed Hardwoods	Southern and Ponderosa Pinewoods	Cypress, Pacific Coast Douglas Fir, W. Hemlock, W. Larch	Intermountain Douglas Fir	Jack, Red and Lodgepole Pine
2.2	**INCISING**	Optional	Optional	Optional	Required	Required	Required
3.0	**Conditioning**						
	Steaming	Not Permitted	Not Permitted	Permitted	Not Permitted	Not Permitted	Permitted
	Temp. - Deg. F. Max	—	—	245	—	—	240
	Duration - Hrs. Max	—	—	18	—	—	3
	Vac. - Inches Min	—	—	22	—	—	22
3.2	**Boulton Drying**	Permitted	Permitted	Permitted	Permitted	Permitted	Permitted
3.3	**Kiln Drying**	Permitted	Permitted	Permitted	Permitted	Permitted	Permitted
3.4	**Vapor Drying**	Permitted	Permitted	Permitted	—	—	—
3.5	**Controlled Air Drying**	Permitted	Permitted	Permitted	—	—	—
4.0	**TREATMENT**						
4.12	**Pressure** - Lbs. Max	250	200	200	150	150	175
	Lbs. Min	150	150	50	50	50	50
4.13	**Temp.** - Deg. F. Max	210	210	210	210	200	220
	Deg. F. Min	180	180	180	180	180	180
5.0	**TREATMENT RESULTS**						
5.1	**Retention - pcf, Min.**						
5.11	**Creosote**	7 or Refusal	7	8	8 or Refusal	Refusal	6
	Creosote Solution	7 or Refusal	7	8	8	Refusal	7
	Creosote-Petroleum Solution	7 or Refusal	7	8	8	Refusal	7
5.12	**Pentachlorophenol** (4.5% Solution Min.)	0.35 or Refusal	0.35	0.40	0.40	Refusal	—
5.2	**Penetration in inches or % of Sapwood - Min**	White Oak - 95% Sapwood Red Oak - 65% Annual Rings	1.5 or 75%	2.5 or 85%	0.5 and 90%	90%	0.5 or 90%
5.21	**Penetration Determination**	A borer core shall be taken from the center of 20 ties in each charge. If 80% of the borings meet above requirements the charge shall be accepted. Except for oak, if the average penetration of the 20, 3.0" borings meet the penetration requirements, the charge shall be accepted.					



Untreated ties are loaded on tie trams and placed into the treatment cylinder where they are pressure treated for four to six hours at 190 to 210 degrees F.

excess preservative out of the wood. This leaves the cell walls of the wood coated with the preservative rather than the cell cavity being filled, resulting in an effective and economic treatment. Once the treating cycle is completed, the cylinder door is opened, and the tie trams are pulled out of the cylinder. The ties are held on a drip pad until all dripping has stopped, at which point the ties are ready for inspection and can be shipped to the customer or placed in inventory.

Quality assurance

Since pressure-treated wood crossties are the foundation of the railroad track structure, it is necessary for the producer companies to maintain a quality product. This is done in a number of ways.

The quality control of the wood crosstie can be assured by determining the penetration and retention of the chemical preservative. This can be achieved in two ways.

(1) Information from the treatment charge reports indicates the volume of preservative (pcf) that has been retained in the wood.

(2) An increment borer can be used to take a sample core of wood to indicate penetration of the preservative.

In each case, the penetration and retention of preservative must conform to either the customer's specification or the AWPA C6 Standard for crossties (depending upon the wood species).

Suppliers of treated wood products must be current with industry quality control standards and environmental regulatory guidelines. Buyers of wood crossties should obtain from the supplier a consumer information sheet (CIS), which is part of a voluntary consumer-awareness program developed by the wood-treating industry and the Environmental Protection

Agency. A purchaser of treated wood products should receive a CIS with each shipment of crossties.

Even though creosote and creosote solutions for the treatment of wood crossties have been used for more than a century, there is an ongoing need for continued research and development of new products and new processes for treatment.

In recent years, there has been an emphasis on producing crossties that are "free" of surface residue. These ties are easier to handle and do not present excessive exposure to people and the environment. The cleaner wood surface of a crosstie has been achieved through the use of extended post-conditioning, or clean-o, cycles that are a part of the treating process. In addition, The Railway Tie Association has an active research and development committee which has focused on projects which include:

—Investigation into the treatability and serviceability of various hardwood species, such as red maple and hackberry, which will structurally perform as a crosstie material but previously have not been used for crossties. The RTA has recently initiated a series of stake tests in cooperation with Mississippi State University to evaluate some of these hardwoods.

— Evaluation of dowel-laminated crossties and ties equipped with end and wear plates. These tests are being performed in conjunction with FAST tests at the Transportation Test Center at Pueblo, Colo.

—The RTA, in cooperation with the Association of American Railroads, also has four ongoing test projects. These include the evaluation of wood crossties as part of the Heavy Axle Load tests at the TTC, and tests of dowel-laminated ties in cooperation with Chicago & North Western at Des Plaines, Ill. Two additional tests with six evaluation sites are looking at in-place treatment of crossties in the tie-plate area using wood preservative solutions such as copper naphthenate, creosote and borates.

Over the years, the wood crosstie has been a steady performer in the railroad industry. Through the use of the pressure treating processes with creosote and its solutions, wood crossties can do equally well in the future. ■

This article was prepared by The Railway Tie Association Research & Development Committee with help from Floyd Bowlby, Burke-Parsons-Bowlby Corp., David A. Webb, Koppers Industries, Inc. and other RTA producer members.

Reprinted from Railway Track & Structures September 1992 issue.