Selection and Use of Preservative-treated Wood

Most wood, when exposed to continual soaking by water or when in contact with the soil, is subject to deterioration by decay fungi and insects. The heartwood of some species is resistant to decay because of natural chemicals called *extractives* in the wood (figure 1). Species that have naturally durable heartwood include black cherry, black locust, black walnut, bur oak, cedars, osage orange, red mulberry, redwood, and white oaks. All-heartwood grades of lumber from these species can perform well under conditions of moderate decay hazard.

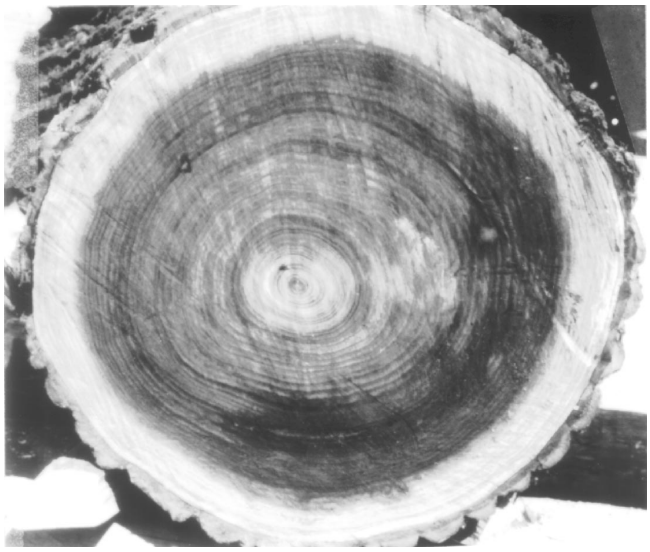

Figure 1. Cross-section of a log showing the darker inner heartwood and the lighter outer sapwood.

However, under severe exposure conditions where a high level of durability is required, only wood that has been pressure-treated with an approved *preservative* should be used. The term *wood preservation* refers to the treatment of wood with chemicals to impart resistance to degradation and deterioration by living organisms.

Types of Preservatives

Commercial wood preservatives are classified as either *oil-type* or *waterborne*. *Oil-type preservatives* fall into two main groups:

- creosote and creosote solutions, and
- oil-borne preservatives.

The first group includes creosote, creosote-coal tar, and creosote-petroleum formulations. Oil-borne preservatives consist of solutions of preservative chemicals dissolved in a nonaqueous carrier. In a very high percentage of such solutions, the preservative chemical employed is pentachlorophenol. Other chemicals that can be used include copper naphthenate and copper-8-quinolinolate. The petroleum-base carriers used in oil-borne preservative formulations typically vary in volatility; the choice may be determined by the need for cleanliness of the treated product.

Creosote, a black or brownish oil made by distilling coal tar, is one of the more important and useful preservatives. It is permanent, highly toxic to wood-destroying organisms, easy to apply, and has a long record of satisfactory performance. Although creosote is well suited for general outdoor use in structural timbers, it is not suitable for indoor uses where people may come in contact with the treated wood. The black color of creosote, the objectionable odor, the potential for soiling clothes, the toxicity of the vapors to growing plants, and the difficulty in finishing makes this preservative unsuitable for many applications. Freshly creosoted wood ignites easily, will burn readily, and produces a dense smoke; however, several months of exposure and seasoning can dramatically reduce combustibility.

Pentachlorophenol (penta) solutions also have a long record of satisfactory service for outdoor use. Penta solutions generally contain 5 percent of the chemical by weight. Wood treated with penta is not suitable for

IOWA STATE UNIVERSITY
University Extension

Ames, Iowa

Pm-1033 | Revised | May 1994

interior use because the chemical may slowly volatilize into the surrounding atmosphere. Direct contact with penta-treated wood can cause skin irritation; growing plants can suffer damage or death when in close proximity.

Water-repellent preservative solutions combine a water-repellent chemical with a wood preservative in a light petroleum solvent such as mineral spirits. In the past, the preservative in these solutions was usually penta. At the present time, other preservatives that are less prone to cause problems with people are being used. Many solutions now being used are simply water-repellents (without a chemical fungicide). Aqueous water-repellent preservative formulations are also available.

In treatments with *waterborne preservatives,* the chemicals are dissolved in water alone or in water containing either ammonia or acidic compounds that hold the chemicals in solution. Chemical changes may take place within the wood; if such changes result in compounds with very low water solubility, the preservative is designated as *leach-resistant*. The leach-resistant waterborne preservatives are ammoniacal copper arsenate (ACA), ammoniacal copper zinc arsenate (ACZA), acid copper chromate (ACC), and three types of chromated copper arsenate (CCA). Two leachable waterborne preservatives used to treat wood are chromated zinc chloride (CZC) and fluor chrome arsenate phenol (FCAP). Wood treated with these two preservatives obviously should not be used where moisture exposure and leaching conditions are severe.

The advantages of waterborne preservatives over oil-type formulations are the cleanliness, paintability, and freedom from odor. Because water is added during treatment, the wood should be dried to the moisture content appropriate to its intended use before fabrication to minimize dimensional changes and to reduce checking and splitting. However, there is an even more important reason for seasoning this type of treated wood. In order for the chemicals to bond with the wood and become nonleachable, the treated wood must be exposed to minimum temperature levels for specific time periods. For example, while only five days are required for chemical fixations to occur in CCA-treated wood at 70° F, it takes two months for fixation when the temperature is only 35°. Some treated wood is dried after treatment and is labeled as KDAT (kiln dried after treatment). But much CCA treated lumber is delivered with obviously high moisture content; this material should be allowed to dry before installation.

New preservatives currently are being developed and marketed in response to active public concerns about preservatives containing arsenic and chromium. Continuing public interest is likely to provide a major marketing advantage for any type of wood preservative that is considered to have minimal health risk and to pose little threat to the environment.

Treating Methods

Wood preserving chemicals may be applied to wood in several ways. *Pressure* methods involve injecting chemicals into the wood in a pressure retort or cylinder. About 90 percent of commercially treated wood is pressure impregnated. *Nonpressure* methods include soaking, dipping, brushing, and spraying. Specialized thermal and nonpressure diffusion processes are also used for some types of applications and products.

Pressure treatment offers several advantages over nonpressure methods. In most cases, the chemicals penetrate deeper into the wood and the penetration is more uniform. Several levels of protection can be realized. Very high retentions are obtainable with pressure methods, and relatively low retentions are also subject to better control by pressure processes. *Nonpressure treatments* may be used where reduced durability is satisfactory. For example, dip treatment of window sash and frames in a water-repellent preservative has a good service record. Nonpressure methods must, of course, be used for treating lumber or plywood products that have already been installed.

The results of treating wood with preservatives may vary greatly within and between species. With pressure methods, the outer ring of sapwood of most species can be impregnated much more readily than the inner heartwood. However, the treatability of heartwood varies greatly between species, as shown in table 1. In some difficult-to-treat species and products, *incising* may be helpful in obtaining the necessary penetration. This process involves making shallow, slit-like holes in the surface of the material before treatment.

Because the penetration of preservative will tend to be greater in lumber produced from species whose heartwood is relatively easy to treat, buyers should look for species identification on the treated wood. Experiences have shown that only southern pine, red pine, and ponderosa pine are readily treatable with all types of waterborne preservatives. These species typically contain a large proportion of sapwood. More difficult to treat woods such as the species groups *hem-fir* can be treated only if the lumber is dry before treatment, the material is well incised, and fairly long pressure periods are used. Still other species such as lodgepole pine and jack pine and species combination spruce-pine-fir generally have exhibited poor treatment results.

Table 1. Treatability of heartwood of some tree species.

Level of treatment difficulty			
Easy or Moderately Easy		**Difficult or Very Difficult**	
basswood	cottonwood	eastern hemlock	alpine fir
green ash	Douglas fir (Coast)	grand fir	black locust
red oaks	eastern white pine	hackberry	Douglas fir (Rocky Mountain)
redwood	ponderosa pine	lodgepole pine	tamarack
river birch	redpine	noble fir	western redcedar
slippery elm	southern pines	spruces	white oaks
white ash	sugar maple	sycamore	
	western hemlock	western larch	
	yellow birch	white fir	

Selecting Treated Wood Products

Wood treated with a preservative should be used only when untreated material will not perform satisfactorily. If ordinary dry lumber will provide the required durability, the extra expense of treated wood is not recommended. For example, most framing lumber in a house or other building need not be treated with wood preservative because this lumber is expected to stay dry and thus not be subject to attack by fungi.

Selecting the right preservative treatment and product depends upon the severity of the decay and insect hazard and upon the specific use requirements. The preservative most commonly used in building construction today is CCA. This pressure-treated wood is labeled to show the chemical retained and the appropriate use. For example, CCA-treated lumber has three labels; these designations relate to the minimum amounts (pounds) of preservative retained per cubic foot of wood:

- *Above Ground* (.25 pounds)
- *Ground Contact* (.40 pounds)
- *Foundation* (.60 pounds)

The first two labels describe where this type of treated wood should be used; the foundation designation was developed to enable use of treated framing lumber and plywood in the *Permanent Wood Foundation System*.

The minimum levels of chemicals to be retained in treated wood are defined in standards published by the American Wood Preservers Association. Standards C-2 and C-9 relate to the preservative treatment by pressure processes of lumber, timber, ties, and plywood. Currently, nine agencies have been accredited by the American Lumber Standards Committee for "supervisory and lot inspections of pressure-treated wood products." Most labels affixed to treated lumber today designate the applicable standards, the level of treatment, and the logo of an accredited inspection agency. However, some treating companies may elect to specify a corporation guarantee on the label and not include a designated outside accrediting agency.

Other requirements, beyond level of treatment, also may be very important; for example, paintability, gluability, and compatibility with metal fasteners are important considerations for many uses of treated wood. As a general rule, waterborne preservatives are most easily painted. However, the wood must be dry before a finish is applied, and a light sanding may be beneficial. Exterior treated wood should be finished to protect the material from weathering by water and sunlight. Wood treated with creosote or pentachlorophenol dissolved in a heavy petroleum solvent usually cannot be painted. Water repellent preservative solutions applied with a brush or by dip treatment generally can be painted; instructions on the container should indicate paintability.

Deposits on the surface of treated wood present problems in gluing. Oil-type preservatives typically present more problems than waterborne treatments. Wood treated with very high retentions of creosote or pentachlorophenol in heavy solvents is essentially nongluable. Low retentions of penta in light solvents may be somewhat more readily glued than wood treated with creosote. Wood treated with waterborne chemicals usually can be glued without major problems, if properly dried. Planing or sanding the surface before gluing is recommended to enhance bonding. Select the adhesive appropriate for the exposure condition among conventional wood adhesives. Only resorcinol resin glues provide completely waterproof gluelines with wood; urea resin glues and polyvinyl resin adhesives generate only modest water-resistant glue bonds. Some types of elastomeric construction adhesives offer good resistance to moisture and are much more tolerant of high wood moisture contents and low temperatures than conventional wood adhesives.

Metal fasteners used on treated wood do not corrode under dry conditions. Even under wet conditions, wood treated with oil-type preservatives usually do not exhibit problems with fasteners. Corrosion of ordinary metal fasteners can occur when wood treated with waterborne preservatives is exposed to wet conditions. Although hot-dipped galvanized fastening may perform reasonably well under most conditions, the preferred type of fasteners for CCA-treated materials are fabricated from stainless steel, silicon bronze, or copper.

Handling and Disposal Precautions

Avoid inhaling sawdust from treated wood; wear a dust mask when machining. Wear safety goggles to protect your eyes from flying particles when power sawing, sanding, or planing. After working with treated wood, wash your hands before eating or drinking. Launder work clothes separately before reuse.

Recycle or reuse treated wood whenever possible. Never burn treated wood in open fires, in stoves, or in fireplaces; some types of treated wood can be burned in approved incinerators or industrial boilers. Scraps of preservative-treated wood generated around the home or farm should be sent to an approved landfill site. Check local regulations on displosal of this type of material.

Summary

Where wood cannot be kept dry and protected from deterioration, preservative treatment can ensure long-term durability. Select the right preservative and the right treating method for the application involved. Properly labeled, pressure-treated wood products generally provide the maximum protection. Wood products treated with waterborne preservatives are the only ones recommended for interior applications and for exterior uses where direct contact with people is involved. New preservatives are coming on the market in response to concerns about chemicals currently being used for treating wood products.

Prepared by Dean R. Prestemon, extension forester (wood products).

File: Forestry 8

Cooperative Extension Service, Iowa State University of Science and Technology and the United States Department of Agriculture cooperating. Robert M. Anderson, Jr., director, Ames, Iowa. Distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914.