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# Wood Preservation and Wood Products Treatment Training Manual

OREGON STATE UNIVERSITY EXTENSION SERVICE

# Contents

# Wood Preservation and Wood Products Treatment Training Manual

*G. Thomasson, J. Capizzi, F. Dost, J. Morrell, and D. Miller*

Federal and State regulations establish standards that you must meet before you legally can use certain pesticides. Effective November 1986, Federal regulations administered by the Environmental Protection Agency (EPA) restrict the sale and use of certain preservatives to ensure that only properly trained applicators, or people under their direct supervision, will have access to them.

Wood preservatives affected by these regulations are creosote, pentachlorophenol (penta), and inorganic arsenicals. This publication will help those preparing for the wood preservative pesticide licensing examinations administered by the State departments of agriculture in the Pacific Northwest.

Wood pesticides (preservatives) extend the life of wood products by protecting them from damage by insects, fungi, marine borers, and weather. Preservatives are applied on the basis of how and where the products will be used, the expected conditions of exposure to wood-destroying agents, and the cost per year of service life.

Crossties, poles, posts, and other wood products that contact the ground or are exposed to the weather must be protected with preservatives to ensure a reasonable service life. Other wood products not in contact with the ground may be treated as a precautionary measure even though they are not exposed to moisture and weather.

Long-term tests and experience show the levels of protection needed for various products and uses. These guidelines become industry-wide when they are accepted by the following groups:

- Groups that use the treated products
- Regulatory agencies
- Wood-preserving organizations

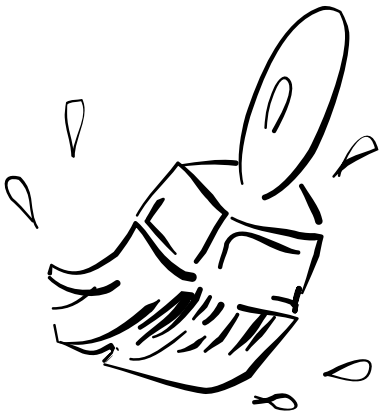
There are many standards and specifications to control the quality of treated wood and protect the purchaser. Federal and State specifications and requirements of the American Wood Preservers Association are the regulations most commonly used.

## Properties of wood

Crosscut a Douglas-fir or cedar tree, and inside the bark you'll find a zone of lighter wood (sapwood) surrounding a core of darker colored wood (heartwood). Fast-growing trees usually have deeper sapwood than slow-growing trees.

Ninety percent of wood is made up of minute, hollow fibers oriented lengthwise along the tree stem. These fibers, ⅕ inch long, are 100 times longer than wide. Through them, the tree transports water and nutrients vertically within the tree.

The remaining 10 percent of the wood is composed of short, hollow, brick-shaped cells oriented from the bark towards the center of the tree as ribbons of rays of unequal height and length. These rays distribute food, manufactured in the leaves and transported down the inner bark, to the growing tissues



between the bark and the wood.

Wood is composed of a complex mixture of substances, but the main constituent of all wood is a complex sugar called cellulose. This material serves as the primary source of energy and nutrition for many forms of life on this planet. People use this same source of energy, not as food but as heat, when they stoke up the wood stove or fireplace.

## Pests that damage wood

People use wood for millions of things other than as a heat source. Under proper use conditions, wood can give centuries of good service; under unfavorable conditions,

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This publication was revised from a University of Georgia Cooperative Extension Service publication by *Gary Thomasson,* Extension entomologist, Washington State University, and the following from Oregon State University: *Joseph Capizzi,* Extension entomologist emeritus; *Frank N. Dost,* Extension toxicology and agricultural chemical specialist emeritus; *Jeffrey J. Morrell,* associate professor of forest products; and *Donald J. Miller,* professor of forest products emeritus.

wood readily may be damaged and destroyed by fungi, insects, and marine borers. These pests can attack in many ways, so wood must be protected to ensure maximum service life when used under conditions favorable to these pests.

## Wood-inhabiting fungi

Wood decay, mold, and most sapwood stains are caused by fungi. These organisms, which feed on living or dead wood and produce spores (microscopic seeds), are distributed by wind and water. The spores can infect moist wood during storage, processing, or use. All fungi that grow on wood have two basic requirements:

- Favorable temperature. This usually ranges between 50 and 90°F. Optimum temperature conditions generally are between 70 and 90°F. Wood usually is safe from decay at temperatures below 35 and above 100°F.
- Adequate moisture. Fungi will not attack dry wood (wood with a moisture content of 19 percent or less). Decay fungi require a wood moisture content of about 30 percent or the generally accepted fiber saturation point of wood.

Thus, air dried wood, usually with a moisture content not exceeding 19 percent, and kiln-dried wood with a moisture content of 15 percent or less, usually can be considered safe from fungal damage.

The many fungi that develop on or in wood can be divided into two major groups based upon the damage they cause: wood-destroying fungi (decay fungi) and wood-staining fungi (sap-staining fungi, mold fungi).

### *Wood-destroying fungi*

Both the sapwood and heartwood of most tree species are susceptible to decay, and unprotected sapwood of all trees deteriorates rapidly in warm, moist soil. Douglas-fir, western larch, western hemlock, and most other species also have nondurable heartwood. Heartwood of cedar, redwood, and a few other species is durable, lasting three to five times longer than nondurable woods.

Decay fungi may grow in the interior of the wood or appear on wood surfaces as fan-shaped patches of fine, threadlike, cottony growths or as rootlike shapes. The color of these growths may range from white through light brown, bright yellow, and dark brown.

The spore-producing bodies may be mushrooms, shelf-like brackets, or structures with a flattened, crust-like appearance. Fine, threadlike fungal strands grow throughout the wood and digest parts of it as food.

In time, the strength of wood is destroyed. For example, untreated poles or posts first rot in the sapwood just below the groundline, where moisture and temperature are most favorable for fungal growth. Once established, the fungal strands may extend several inches or more into the heartwood.

Decay will stop when the temperature or moisture conditions in the wood are unfavorable for fungal growth; however, decay will resume whenever the conditions become favorable.

Wood-decay fungi can be segregated into three major categories: brown rots, white rots, and soft rots.

**Brown rot fungi** break down the cellulose component of wood, leaving a brown residue of lignin. Brown-rotted wood can be greatly weakened even before decay can be seen. The final stage of wood decay by the brown rots can be identified by the dark brown color of the wood, excessive wood shrinkage, cross-grain in cracking, and by the ease with which the dry wood substance can be crushed to powder.

These fungi probably are the most important cause of decay of softwood species used in above-ground construction in this country. (When dry, brown rot sometimes is called dry rot. This is a poor term because wood will not decay when it is dry.)

**White rot fungi** break down both lignin and cellulose in wood and have a bleaching effect, which may make the damaged wood appear whiter than normal.

**Soft rot fungi** usually attack green, water-saturated wood, causing a gradual softening of wood from the surface inward. The damage done by these fungi resembles that caused by brown rot fungi.

### *Wood-staining fungi*

The primary damage caused by these fungi is simply discoloration of the wood. They have little or no effect on its strength.

**Sap-staining fungi** penetrate and discolor sapwood, particularly among the softwood species. Unlike staining by mold fungi, typical sap stain can't be removed by brushing or planing. Sap stain fungi may become established in the sapwood of standing trees, saw logs, lumber, and timbers soon after they are cut and before they can be adequately dried. One of these fungi, blue stain, is carried to trees by pine beetles, thus infecting trees before they are cut.

Where appearance of the wood is important, sap-stained wood may be unfit for use.

**Mold fungi** first become noticeable as green, yellow, brown, or black fuzzy or powdery surface growths on softwoods. Freshly cut or seasoned stock, piled during warm, humid weather, may be noticeably discolored within a few days. Although brushing or planing

will remove the stain, these fungi can increase the capacity of wood to absorb moisture, thereby increasing the likelihood of attack by decay fungi.

## Chemical stains

Although they may resemble fungal blue or brown stain damage, chemical stains are not caused by fungi; rather, they're caused by chemical changes in the wood during processing or seasoning. Chemical stains can downgrade lumber for some uses, but these stains usually can be prevented by rapidly drying the wood at relatively low temperatures during kiln-drying.

## Insects

Several kinds of insects attack living trees, logs, lumber, and finished wood products for food and shelter. The most important pests of wood and wood products include termites, carpenter ants, and various beetles.

### *Termites*

Termites use wood for both food and shelter. Nationally, termites are the most destructive of all wood pests. Although they are not considered the number one wood pest insect in this area, termites account for a significant amount of structural damage in the Pacific Northwest. The two major species of concern in the PNW are subterranean termites and dampwood termites.

**Subterranean termites** can attack any unprotected wood or wood product. They live in and obtain their moisture from the soil. Although subterranean termites prefer the soil environment, they will build mud tubes over exposed surfaces from the soil to a food source.

**Dampwood termites** live in the wood on which they feed and rely on the wood as a source of water; consequently, these termites attack only wood with a high moisture content—but once established, they can extend their activities into sound, dry wood.

### *Carpenter ants*

These are the most destructive insects of wood and wood structures in the PNW. They usually live in stumps, trees, or logs, but will infest virtually any wood. These insects cannot use wood for food, but they often are confused with termites. There are, however, several distinct physical differences between these two groups of insects. Ants have "elbowed" antenna; termites do not. Ants have very narrow waists, but termites' bodies are broad.

### *Beetles*

**Powderpost or Lyctus beetles** attack both freshly cut and seasoned hardwoods and softwoods. Adults lay eggs in the wood pores. Emerging larvae burrow through the wood, making tunnels packed with a fine powder. The Pacific powderpost beetle damages structures from California to Alaska, feeding mainly on well-seasoned wood.

**Anobiid beetles** attack softwoods in damp or poorly ventilated spaces beneath buildings.

**Roundheaded and flatheaded borers** infest live trees as well as recently felled or dead, standing softwood trees. They can cause considerable damage in rustic structures and some manufactured products. Some species live in wood from 2 to 40 years.

### *Marine borers*

Submerged portions of marine pilings, wharf timbers, and wooden boats are damaged extensively by a group of animals known collectively as "marine borers." Untreated timbers can be infested and destroyed by these organisms in less than a year. Major marine borers in the Northwest include species in the Mollusca (related to clams and called "shipworms") and the Crustacea (related to crabs or sow bugs and called "gribbles").

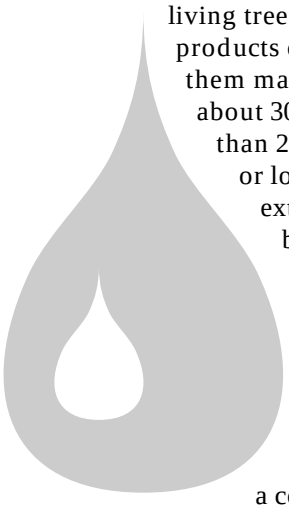
Shipworms drill tunnels in wood and line them with a thin shell-like substance. The giant shipworm *Bankica setacea* and species of Teredo are the most common forms.

Gribbles mine the outer part of piling and other marine structures. Attack takes place from the mud line to the upper tidal level. Common "gribble" species include *Limnoria lignorum.*

# Controlling pests that damage wood

Wood should be protected whenever it is used where it will be subject to pest attack. This protection can be achieved by controlling the wood moisture content, using wood that's naturally resistant to the pests, or by treating the wood with a chemical preservative.

## Moisture control



The moisture content of living trees and the wood products obtained from them may range from about 30 percent to more than 200 percent. Timber or logs stored for extended periods before processing can be protected from fungi and insects by keeping the logs submerged in pond water or by subjecting them to a continuous water spray. The water reduces the oxygen content and temperature of the logs to levels below those needed for pest development.

Much of this moisture must be removed for most uses. Green lumber usually is seasoned or dried to do the following:

- Prevent development of stain and decay organisms
- Reduce insect damage
- Control wood shrinkage
- Reduce weight and increase strength
- Prepare wood for chemical preservative treatments

The moisture content of wood usually is reduced either by air-drying in a yard, shed, or pre-drier; or by drying in a kiln, retort, or radio frequency drier. The most efficient and widely used system is kiln-drying because it offers better control of air movement, temperature, and drying rate than does air-drying.

Although kiln-drying is more expensive than air drying, it's much faster, and it provides better quality and more uniform drying. Furthermore, unless lumber is properly stacked and protected, air-drying may result in surface cracking (checking), end cracking, warping, staining, and discoloration due to weathering.

Even after being well seasoned, wood may again reach a moisture level favorable to pests, especially if exposed to rain or prolonged high humidity and favorable temperatures.

## Using naturally resistant wood

The sapwood of all native tree species and the heartwood of most species has low natural resistance to decay; however, the heartwood of some trees, such as cedar and redwood, is quite resistant to decay. These species are resistant—but definitely not immune—to attack by decay fungi and insects. Unfortunately, these naturally resistant woods usually are quite expensive.

## Chemical control

The proper application of chemical preservatives can protect wood from decay and stain fungi, insects, and marine borers, thus prolonging the service life of wood for many years.

The effectiveness of preservative treatment depends on the chemical formulation selected, the method of application, the proportion of sapwood to heartwood, the moisture content of the wood, the amount of preservative retained, the depth of chemical penetration, and the distribution of the chemical in the wood.

Sapwood of most commercial lumber tree species accepts preservatives much better than heartwood, and softwood species generally can be more uniformly treated than hardwood species. Preservative treatment by pressure usually is required for wood exposed to high risk of attack by fungi, insects, or marine borers.

### *"General Use" pesticides*

There are hundreds of pesticide products registered for application to wood and wood products in the PNW. Most of these have been designated "General Use" pesticides. Exposure to such chemicals is considered less hazardous than exposure to "Restricted Use" pesticides.

"General Use" pesticides commonly used by the wood preservation industry are copper naphthenate and copper 8 quinolinolate; 3-iodo propynyl butylcarbamate, zinc naphthenate, and sodium octaborate tetrahydrate also are used. Unlike wood treated with "Restricted Use" preservatives, copper 8 quinolinolate has been approved for food-contact uses such as for boxes, crates, pallets, truck decking, and related uses involving the harvesting, storage, and transportation of food.

### *"Restricted Use" pesticides*

Three groups of chemical wood preservatives have been designated "Restricted Use" pesticides. This designation includes the requirement that only those who are trained and licensed may purchase or use creosote, pentachlorophenol (penta), and inorganic arsenicals.

Table 1 summarizes the advantages and disadvantages of these three pesticides.

**Creosote** is an oily liquid produced when coal is heated in the absence of air; it's the by-product of making coke from bituminous coal for the steel industry. This material usually is used as a preservative for railroad ties, large timbers, fence posts, poles, and pilings.

**Pentachlorophenol (penta)** is the product of a complex chemical process. It's insoluble in water, so it's generally dissolved in petroleum or other organic solvents that will penetrate wood. However,

this versatile chemical also is formulated as a water-emulsifiable compound or as a water-soluble salt (ammonium pentachlorophenate) to protect freshly sawn lumber from sap stain fungi.

Penta is used to commercially treat poles, crossarms, lumber, timber, and fence posts. It's not recommended for use in marine installations, or close to plants, and it may not be used inside buildings except as indicated on page 11. Penta is no longer available for the do-it-yourselfer.

**Inorganic arsenicals** are preservatives consisting of combinations of copper and arsenic. The most commonly used compounds are chromated copper arsenate and ammonical copper arsenate. These preservatives are water-soluble; but when they're applied to wood, they become fixed in the wood in an insoluble form. The copper provides protection against attack by fungi, and the arsenic prevents insect attack. These preservatives are considered highly versatile, and their use is expanding.

## Protecting human health

Most chemicals used to protect wood from insects and decay must be toxic to be effective. The goal is to select chemicals and methods that will control the pests without harming the applicator, the user, the public, pets, plants, or the environment.

It's the responsibility of the manager of any wood-preserving operation to ensure that the proper handling procedures, protective clothing, and necessary safety equipment are provided to workers, to protect their health and to conform with label instructions.

The EPA-approved labeling and mandatory Material Safety Data Sheets (MSDS's, see page 9) for wood preservatives are the primary sources of information on application methods, precautionary measures, emergency first aid, and disposal instructions.

The label is a legal document and its provisions are enforced by State regulatory agencies. Therefore, make sure that labels for each formulated product used in a wood treatment operation are readily available; all responsible personnel should be thoroughly familiar with their contents.

### Hazards to applicators

All handlers of wood preservatives must know about the potential hazards and the precautions necessary when working with these chemicals. Those who apply the chemicals are most subject to excessive exposure; those who use the wood are at far less risk from preservative exposure. Therefore, it's especially important for those who apply preservatives and handle recently treated wood to minimize their exposure to these chemicals.

Exposure to wood preservatives can occur in a variety of ways: during mixing and handling the chemicals, entering pressure-treatment cylinders, working around preservative spraying or dipping operations, handling freshly treated wood, cleaning or repairing equipment, or disposing of wastes. Closed systems for handling the chemicals and mechanically handling treated wood reduce potential exposure but do not eliminate accidental exposure for workers.

Like other pesticides, wood preservatives can enter the body through the mouth (oral), through the skin or eyes (dermal), or through inhalation (respiratory). Since most preservatives have a strong odor and taste, accidental ingestion of a dangerous amount of these chemicals is very unlikely. The more likely routes of exposure would be through skin contact or by inhaling preservative vapors, dust, or other contaminated particles.

Human skin varies in thickness and other characteristics from one place to another on the body. The skin also varies in its ability to absorb chemicals. The eye, eyelids, and the groin area will absorb almost 100 percent of some chemicals while the hand, especially the palm, will absorb less than 10 percent of the same chemicals. The addition of organic solvents to any preservative will enhance its ability to penetrate human skin.

Human lungs consist of a very large, membranous surface area well supplied with blood vessels. Any chemical vapor or minute liquid droplets taken into the lungs will be absorbed into the bloodstream very rapidly.

### Toxic effects of preservatives

The toxic effects of the chemicals can be either acute, based on high-level, short-term exposure; or they can be chronic, based on low-level, long-term exposure. Human exposure to preservatives can produce both acute and chronic toxicity.

### Use pesticides safely!

- Wear protective clothing and safety devices as recommended on the label. Bathe or shower after each use.
- Read the pesticide label—even if you've used the pesticide before. Follow closely the instructions on the label (and any other directions you have).
- Be cautious when you apply pesticides. Know your legal responsibility as a pesticide applicator. You may be liable for injury or damage resulting from pesticide use.

Table 1.—*Restricted-use pesticides creosote, pentachlorophenol, and inorganic arsenicals: advantages, disadvantages, toxic effects (acute and chronic), special precautions, and limits on use.*

| Pesticide | Advantages | Disadvantages | Toxic effects | | Special precautions | Limits on use |
|---|---|---|---|---|---|---|
| | | | Acute | Chronic | | |
| Creosote | 1. Toxic to fungi, insects, and marine borers.<br>2. Insoluble in water.<br>3. Ease of handling and application. | 1. Dark color.<br>2. Strong odor.<br>3. Leaves oily, unpaintable surface.<br>4. Tendency to bleed or exude from wood surface.<br>5. Can't be used in homes or other living areas because of toxic fumes. | 1. Skin irritation, burns, or dermatitis.<br>2. Vapors irritating to eyes and respiratory tract.<br>3. Ingestion can cause nausea and abdominal distress. | 1. Laboratory animal studies indicate that it is a carcinogen (cancer-causing agent).<br>2. Has been associated with skin cancer in some occupationally exposed workers.<br>3. Bacteria and laboratory animal studies indicate that it is a mutagen (causes gene defects). | | 1. Can't be applied indoors, nor can it be used where it may contaminate food, feed, drinking water, or irrigation water.<br>2. Can't be applied to wood intended for use in interiors, except for those support structures that are in contact with the soil in barns, stables, and similar sites, and that are subject to decay or insect infestation. Two coats of a sealer must be applied to such support structures. |
| Pentachlorophenol | 1. Toxic to fungi and insects.<br>2. Can be dissolved in oils having a wide range of viscosity, vapor pressure, and color.<br>3. Low solubility.<br>4. Can be glued, depending on diluent or carrier.<br>5. Easy to handle and use. | 1. Can leave oily, unpaintable surface, depending on carrier used.<br>2. Provides somewhat less protection than creosote.<br>3. Not suitable for use in homes or other living areas.<br>4. Toxic and irritating to plants, animals, and people. | 1. Irritating to eyes, skin, and respiratory tract.<br>2. Ingestion or excessive dermal or inhalation exposure can lead to fever, headache, weakness, dizziness, nausea, and profuse sweating.<br>3. Prolonged high exposure levels can lead to acne-like skin condition or other skin disorders; it may cause damage to the liver, kidneys, and nervous system. | 1. Considered a teratogen because it causes birth defects in laboratory animals.<br>2. A dioxin contaminant in penta has been shown to cause cancer in laboratory animals, although it's not the most toxic of the dioxins. | 1. When you empty or mix prilled, powdered, or flaked formulations of this chemical, you must use a closed system.<br>2. When you use the spray method of application, you must operate the spray apparatus to minimize visible mist, and the apparatus must be free of leaks. When you observe spray mist in the work zone, workers must wear approved respirators, goggles, and clothing impervious to the preservative formulation (including overalls, jacket, gloves, boots, and head covering). | 1. Can't be applied indoors, nor can it be used where it may contaminate food, feed, drinking water, or irrigation water.<br>2. Can't be applied to wood intended for use indoors, except for millwork with outdoor surfaces, or for support structures that are in contact with the soil in barns, stables, and similar sites, and that are subject to decay or insect infestation. In these instances, a sealer must be applied to the wood.<br>3. It's prohibited to apply pentachlorophenol to logs used in the construction of log homes. |

Table 1.—*Restricted-use pesticides creosote, pentachlorophenol, and inorganic arsenicals: advantages, disadvantages, toxic effects (acute and chronic), special precautions, and limits on use (continued).*

| Pesticide | Advantages | Disadvantages | Toxic effects | | Special precautions | Limits on use |
|---|---|---|---|---|---|---|
| | | | Acute | Chronic | | |
| Inorganic arsenicals | 1. Toxic to fungi, insects, and most marine borers.<br>2. Produces no smell or vapors.<br>3. Suitable for use indoors.<br>4. Suitable for use near growing plants.<br>5. Treated surface can be painted. | 1. Unless re-dried after treatment, wood is subject to warping and cracking.<br>2. Doesn't protect wood from excessive weathering. | 1. Exposure to high concentrations can cause nausea, headache, diarrhea, and abdominal pain (if ingested); extreme symptoms can progress to dizziness, muscle spasms, delirium, and convulsions.<br>2. Prolonged exposure can produce persistent headaches, abdominal distress, salivation, low-grade fever, and upper respiratory irritation.<br>3. Long-term, high exposure can cause liver damage, loss of hair and fingernails, anemia, and skin disorders. | 1. Bacteria and laboratory animal studies indicate that it causes genetic defects.<br>2. Shown to be associated with cancer in people who either drink water or breathe air contaminated with arsenic. | 1. If the level of ambient arsenic in the work zone is unknown, or if the level exceeds 10 micrograms per cubic meter of air averaged over an 8-hour work day, all exposed workers will be required to wear approved respirators.<br>2. Processes used to apply inorganic arsenical formulations shall leave no visible surface deposits on the wood. Small, isolated, or infrequent spots of chemical on otherwise clean wood shall be allowed. | |

EPA's decision to classify creosote, pentachlorophenol, and inorganic arsenicals as "Restricted Use" pesticides was based on potential human health hazards associated with long-term, low-level exposure or chronic toxicity.

Table 1 lists the toxicity effects—acute and chronic—of the three "Restricted Use" preservatives.

## Protecting the applicator

Anyone working with wood preservatives will be exposed to these chemicals to some extent, but the exposure can be minimized by following the directions on the preservative label and developing good work habits.

### *Personal hygiene*

Basic, commonsense hygiene rules can significantly reduce the risks of chronic exposure to wood preservatives. For example:

- Wash hands often, especially before using the restroom, smoking, or eating.
- Don't eat, drink, or smoke in the work area—these activities will increase the amount of preservative absorbed into the body.
- Remove gloves to handle paperwork, phones, or equipment that others may handle with unprotected hands.
- Launder protective clothing at the work site. If work clothes must be laundered at home, wash them separately from other laundry.

### *Protective equipment and clothing*

The pesticide label will specify the type of protective equipment and clothing that should be worn when working with wood preservatives. Where skin contact is expected (for example, handling freshly treated wood or manually opening pressure-treatment cylinders), the label will specify the use of impermeable gloves.

Leather may protect hands from slivers, but leather gloves don't protect the wearer from wood preservatives! In fact, preservative-contaminated leather gloves definitely will contribute to the amount of preservative absorbed into the body.

Individuals who enter pressure-treatment cylinders or other related equipment contaminated with wood-treatment solutions must wear protective equipment that does not allow the wood treatment solution to penetrate. This includes overalls, jacket, gloves, boots, and respirator.

## First Aid

Since accidents do happen, first aid information on the chemical(s) in use must be readily available. The product label provides basic first aid directions, as do Material Safety Data Sheets supplied by the chemical manufacturers (see page 9). Take the following steps if accidental exposure to wood preservatives occurs:

- **In cases of skin contact,** first remove contaminated clothing in contact with the skin and immediately wash the affected skin areas with mild soap and water. Don't irritate the skin with vigorous scrubbing. If you notice skin inflammation later, consult a physician.

- **In cases of eye exposure,** immediately flush the eyes with running water. Lift the upper and lower eyelids for complete irrigation and continue for 15 minutes; then see a physician.
- **If accidental inhalation occurs,** move the victim to fresh air and apply artificial respiration as needed. *Get medical help immediately!*
- **Accidental ingestion of any wood preservative requires immediate medical attention.** If creosote or penta was swallowed—and if the person is conscious—give one or two glasses of water, induce vomiting, and then administer two tablespoons of "USP Drug Grade" activated charcoal in water. *Never attempt to administer anything orally or induce vomiting to an unaware or unconscious person.*
- **If an arsenical chemical has been swallowed**, the victim should drink large quantities of water or milk. *Get professional medical help immediately!*
- **Acute toxicity symptoms** for all three preservatives usually are noticed soon after exposure and usually are treatable if first aid is administered quickly.

Respirators must be approved by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health (MSHA / NIOSH), and they must be properly fitted and maintained.

***Special precautions***

See Table 1 for special precautions on pentachlorophenol and arsenicals.

## Limits on use

EPA regulations on wood preservatives include some limitations on treating wood intended for certain uses, and on certain uses of treated wood. Not all the limitations are the responsibility of commercial treaters, but all wood treaters should understand these limitations. Table 1 includes a summary of these use limitations.

## Material Safety Data Sheets (MSDS)

Material Safety Data Sheets are available from the manufacturers and distributors of the wood preservatives they sell. Each MSDS provides information about the toxicity, first aid, protective equipment, storage and handling precautions, disposal procedures, transportation, etc. for a specific product.

*All wood treaters should have an MSDS on file for each different formulation they use. In Washington and Oregon, the Right to Know Law requires this.*

## Voluntary Consumer Awareness Program

The treated wood industry has developed a voluntary Consumer Awareness Program (CAP) designed to inform the consumer about the proper uses of treated wood and the proper precautionary measures to take when using such wood. The treated wood industry is committed to the implementation of the CAP and the education of the consuming public.

The treated wood industry has developed a model Consumer Information Sheet (CIS) containing use site precautions and safe working practices for each of the three types of preservatives. The CIS serves as the main vehicle for conveying information about treated wood to consumers.

The focus of the CAP is to ensure the dissemination of the CIS at the time of sale or delivery to end users. Wood treaters assume primary responsibility for dissemination of the CIS to consumers.

The following wording appears on the Consumer Information Sheets for the three "Restricted Use" chemicals:

***Wood pressure-treated with an inorganic arsenical***

"Consumer information—This wood has been preserved by pressure treatment with an EPA-registered pesticide containing inorganic arsenic to protect it from insect attack and decay. Wood treated with inorganic arsenic should be used only where such protection is important.

"Inorganic arsenic penetrates deeply into and remains in the pressure-treated wood for a long time. Exposure to inorganic arsenic may present certain hazards: Therefore, the following precautions should be taken when handling the treated wood, in determining where to use the wood, and in disposing of the treated wood.

"Use site precautions—Wood pressure-treated with waterborne arsenical preservatives may be used inside residences as long as all sawdust and construction debris are cleaned up and disposed of after construction. Do not use treated wood under circumstances where preservatives may become a component of food or animal feed in such sites as structures or containers used to store silage or food.

"Don't use treated wood for cutting boards or countertops. Only treated wood that is visibly clean and free of surface residue should be used in patios, decks, and walkways.

"Don't use treated wood for construction of those portions of beehives that may come into contact with the honey. Treated wood should not be used where it may come into direct or indirect contact with public drinking water, except for uses involving incidental contact such as docks and bridges.

"Handling precautions—Dispose of treated wood by ordinary trash collections or burial. Treated wood should not be burned in open fires, wood stoves, fireplaces, or residential boilers because toxic chemicals may be produced as part of the smoke and ashes. Treated wood from commercial or industrial use (for example, construction sites) may be burned only in commercial or industrial incinerators or boilers in accordance with State and Federal regulations.

"Avoid frequent or prolonged inhalation of sawdust from treated wood. When sawing and machining treated wood, wear a dust mask. Whenever possible, these operations should be performed outdoors to avoid indoor accumulations of airborne sawdust from treated wood. When power-sawing or machining, wear goggles to protect eyes. After working with the wood, and before eating, drinking, or using tobacco products, wash exposed body areas thoroughly. If preservatives or sawdust accumulate on clothes, launder before reuse."

***Wood pressure-treated with creosote***

"Consumer information—This wood has been preserved by pressure treatment with an EPA-registered pesticide containing creosote to protect it from insect attack and decay. Wood treated with creosote should be used only where such protection is important.

"Creosote penetrates deeply into and remains in the pressure-treated wood for a long time. Exposure to creosote may present certain hazards; therefore, the following precautions should be taken both when handling treated wood and in determining where to use the treated wood.

"Use site precautions—Wood treated with creosote should not be used where it will be in frequent or prolonged contact with bare skin (for example, chairs and other outdoor furniture) unless an effective sealer has been applied.

"Creosote-treated wood should not be used in residential interiors. Creosote-treated wood in interiors of industrial buildings should be used only for components that are in ground contact and are subject to decay or insect infestation, and for wood block flooring. For such uses, two coats of an appropriate sealer must be applied. Sealers may be applied at the installation site.

"Wood treated with creosote should not be used in the interiors of farm buildings where the wood may be in direct contact with domestic animals or livestock that may crib (bite) or lick the wood. In interiors of farm buildings, where domestic animals or livestock are unlikely to crib or lick the wood, creosote-treated wood may be used for building components that are in ground contact and are subject to decay or insect infestation; however, two coats of an effective sealer must be applied. Sealers may be applied at the installation site. Coal tar pitch and coal tar pitch emulsion are effective sealers for creosote-treated woodblock flooring. Urethane, epoxy, and shellac are acceptable sealers for all creosote-treated wood.

"Don't use treated wood for fallowing or brooding facilities. Don't use treated wood under circumstances where the preservative may become a component of food or animal feed in structures or containers used for storing silage or food. Don't use treated wood for cutting-boards or countertops. Only treated wood that's visibly clean and free of surface residues should be used for patios, decks, or walkways. Don't use treated wood for construction of those portions of beehives that may come in contact with the honey.

"Creosote-treated wood should not be used where it may come into direct or indirect contact with public drinking water or with drinking water for domestic animals or livestock, except for uses involving incidental contact such as docks and bridges.

"Handling precautions—Dispose of treated wood by ordinary trash collection or burial. Treated wood should not be burned in open fires, wood stoves, fireplaces, or residential boilers because toxic chemicals may be produced as part of the smoke and ashes. Treated wood from commercial or industrial use (for example, construction sites) may be burned only in commercial or industrial incinerators or boilers in accordance with State and Federal regulations.

"Avoid frequent or prolonged inhalation of sawdust from treated wood. When sawing and machining treated wood, wear a dust mask. Whenever possible, these operations should be performed outdoors to avoid indoor accumulations of airborne sawdust from treated wood. When power-sawing or machining, wear goggles to protect eyes.

"Avoid frequent or prolonged skin contact with creosote-treated wood. When you handle the treated wood, wear long-sleeved shirts and long pants. Use gloves that are impervious to the preservative (for example, gloves that are vinyl-coated). When you're power-sawing or machining, wear goggles to protect your eyes. After working with the wood, and before eating, drinking, or using tobacco products, wash exposed body areas thoroughly. If preservatives or sawdust accumulate on clothes, launder before reuse."

***Wood pressure-treated with pentachlorophenol***

"Consumer information—This wood has been preserved by pressure treatment with an EPA-registered pesticide containing pentachlorophenol to protect it from insect attack and decay. Wood treated with pentachlorophenol should be used only where such protection is important.

"Pentachlorophenol penetrates deeply into and remains in the pressure-treated wood for a long time. Exposure to pentachlorophenol may present certain hazards; therefore, the following precautions should be taken both when handling treated wood and in determining where to use the treated wood.

"Use site precautions—Logs treated with pentachlorophenol are not to be used for log homes. Wood treated with pentachlorophenol should not be used where it will be in frequent or prolonged contact with bare skin (for example, chairs and other outdoor furniture), unless an effective sealer has been applied.

"Pentachlorophenol-treated wood is not to be used in residential, industrial, or commercial interiors except for laminated

beams or building components that are in ground contact and are subject to decay or insect infestations and where two coats of an appropriate sealer are applied. Sealers may be applied at the installation site.

"Wood treated with pentachlorophenol is not to be used in the interiors of farm buildings where the wood may be in direct contact with domestic animals or livestock that may crib (bite) or lick the wood. In interiors of farm buildings, where domestic animals or livestock are unlikely to crib or lick the wood, pentachlorophenol-treated wood may be used for building components that are in ground contact and are subject to decay or insect infestation; however, two coats of an effective sealer must be applied. Sealers may be applied at the installation site. Urethane, shellac, latex epoxy enamel, and varnish are acceptable sealers for pentachlorophenol-treated wood.

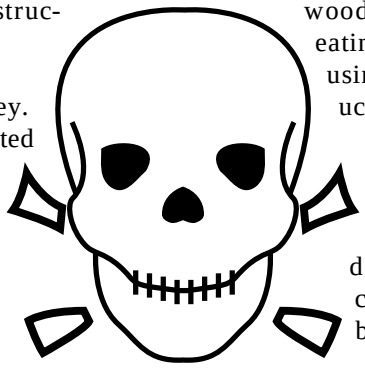
"Don't use pentachlorophenol-treated wood for fallowing or brooding facilities. Don't use treated wood under circumstances where the preservative may become a component of food or animal feed in structures or containers used for storing silage or food. Don't use treated wood for cutting boards or countertops. Only treated wood that's visibly clean and free of surface residues should be used for patios, decks, or walkways. Don't use treated wood for construction of those portions of beehives that may come into contact with the honey.

"Pentachlorophenol-treated wood must not be used where it may come into direct or indirect contact with public drinking water or with drinking water for domestic animals or livestock, except for uses involving incidental contact such as docks and bridges.

"Handling precautions—Dispose of treated wood by ordinary trash collection or burial. Treated wood should not be burned in open fires, wood stoves, fireplaces, or residential boilers because toxic chemicals may be produced as part of the smoke and ashes. Treated wood from commercial or industrial use (for example, construction sites) may be burned only in commercial or industrial incinerators or boilers rated at 20 million BTU / hour or greater heat input or its equivalent in accordance with State and Federal regulations.

"Avoid frequent or prolonged inhalation of sawdust from treated wood. When sawing and machining treated wood, wear a dust mask. Whenever possible, these operations should be performed outdoors to avoid indoor accumulations of airborne sawdust from treated wood. When you're power-sawing or machining, wear goggles to protect your eyes.

"Avoid frequent or prolonged skin contact with pentachlorophenol-treated wood. When handling the treated wood, wear long-sleeved shirts and long pants. Use gloves that are impervious to the preservative (for example, gloves that are vinyl-coated). When you're power-sawing or machining, wear goggles to protect your eyes.



After working with the wood, and before eating, drinking, or using tobacco products, wash exposed body areas thoroughly. If oily preservatives or sawdust accumulate on clothes, launder before reuse."

## Protecting the environment

### Waste disposal

Wastes from preservative-treating operations can kill plant life and harm aquatic life if they're allowed to enter waterways. Oils and organic solids damage aquatic life by reducing oxygen supplies.

Some treating plants discharge their wastes into approved municipal sewer systems for processing along with municipal wastes. Many plants use closed chemical and wastewater recovery systems to contain wastes that could be harmful. Recovered solutions may be used again. If they are contaminated, they can be filtered to remove solid wastes. Liquid waste materials may be diverted to settling ponds.

Door sumps should be used under pressure-chamber doors and under hard-surfaced drainage areas. Any excess chemicals that drip or are rinsed from freshly treated material are thus channeled into the waste or recovery system. It also is important to contain the runoff from areas where toxic chemicals are used to protect stored logs, poles, or lumber before processing or during seasoning.

Remember to read the preservative label carefully for disposal information. The U.S. Environmental Protection Agency requires treatment facilities to meet certain disposal standards. EPA also requires that treatment plants obtain permits for discharging excess chemicals. Compliance with the label and EPA regulations should assure proper environmental protection.

## Storage and disposal of containers

Packaged chemicals should be stored in a dry, well-ventilated, securely locked area. Keep them in well-sealed containers whenever possible. Protect liquid storage against tank rupture. Wherever spills, leaks, or flooding could occur, be sure that runoff will drain into a recovery or disposal system.

Protect concrete vats against freezing, cracking, or spillage. Thoroughly rinse containers and empty them into storage or treating tanks before disposal. Dispose of the containers at an approved landfill or by other approved means. Be particularly careful not to contaminate streams or groundwater.

Be sure to read and follow the label requirements and the Material Safety Data Sheet (MSDS) for each preservative. If you're in doubt about how to safely store a product or dispose of the empty containers, contact the chemical supplier or your State agency that regulates storage and container disposal.

## Spills

Correct cleanup procedures depend on the chemical involved. Treating-plant personnel should know what chemicals are being stored and used, and they should have an advance plan for handling spills. All workers who might be involved should know what help is available and who to notify in case of a major spill.

## Environmental exposure

It's not only people who can suffer from the careless use or disposal of wood preservatives—your community's environment also may suffer. Creosote, pentachlorophenol, and inorganic arsenicals are toxic. They must be toxic to kill or repel the fungi, insects, and marine borers that destroy wood. Unfortunately, these chemicals are not selective; they can harm nontarget organisms.

Contaminated runoff can pollute lakes, streams, and wetlands, thereby damaging habitat for fish and wildlife. Specifics vary, but penta, creosote, and inorganic arsenicals are all toxic to fish and other wildlife.

### *Pentachlorophenol*

This chemical is not uncommon in the aquatic environment and is extremely toxic to fish. Exposure to penta concentrations in the parts-per-billion range can cause death within minutes for many species of salmon and trout.

Circumstantial evidence, including the identification of penta in rainwater, indicates that penta occasionally may be present in ambient air. Low levels of this compound have been detected in both wastewater and surface water.

While the source of these residues often is unclear, it's been suggested that, in addition to direct contamination of water by penta, degradation of other organic compounds or chlorination of water may result in the chemical production of penta.

Penta is moderately persistent in the aquatic environment. It was reportedly detected in lake water and fish 6 months after an accidental spill.

Penta also is moderately persistent in the soil. Persistence reportedly ranges from 21 days to 5 years. Under most conditions, penta seldom will persist in the soil for periods exceeding 9 months because many soil microorganisms have been identified that are capable of degrading penta.

Since the major uses of penta don't involve applying it to the soil, the likeliest source of soil contamination is the leaching or bleeding of the preservative from treated wood. This may result in low levels of penta contamination in the immediate vicinity of the treated wood.

Significant accumulation of penta in plants and mammals is not likely to occur because penta is not translocated in plants, and it's rapidly eliminated by mammals following exposure.

### *Arsenicals*

No problems have ever been found in the literature as to the effects of arsenical wood preservatives on the environment. Arsenate, the form present in aerobic soils, is bound tightly to the soil components and becomes unavailable for plant uptake or leaching.

### *Creosote*

There are no recorded reports of wild or domestic animals being injured by creosote. The amount of creosote that enters the environment as a liquid is relatively small. The fate of creosote in the environment isn't known, but most of its components are quickly biodegraded.

### *Groundwater pollution*

Use of wood preservatives over the years has been cited as a source of pollution in surface and groundwater in many parts of this country. Some of this problem has come from obvious sources such as spills or illegal discharge of chemicals into ditches, storm drains, or sewers. Another less obvious source is the uncontained drippings from freshly treated wood.

Although preservative pollution of surface water is more obvious and can be a serious problem, groundwater pollution potentially is a very serious problem. In many communities, groundwater is the only source of drinking water. When groundwater becomes contaminated with any chemical,

cleanup—where possible—is very difficult and costly. Testing has documented contamination in public and private wells at levels exceeding health advisories.

Groundwater typically is affected by contamination of the overlying soil. Such contamination usually is the result of applying preservatives to soil, spills, overflow from tanks or holding ponds, and improper disposal.

To reduce the chance of environmental contamination, proper protective measures must be an integral part of all your wood preservation operations.

## Definitions

Definitions for some of the terms used in the manual were taken mainly from *Wood as an Engineering Material, Wood Handbook,* USDA Agricultural Handbook 72, Revised 1974.

**Cellulose.** The carbohydrate that is the principal constituent of wood and forms the framework of the wood cells.

**Check**. A lengthwise separation of the wood that usually extends across the rings of annual growth and commonly results from stresses set up in wood during seasoning.

**Decay**. The decomposition of wood substance by fungi.
*Incipient decay.* The early stage of decay that has not proceeded far enough to soften or otherwise perceptibly impair hardness of the wood. It usually is accompanied by a slight discoloration or bleaching of the wood.
*Advanced (or typical) decay.* The older stage of decay in which the destruction is readily recognized because the wood has become punky, soft and spongy, stringy, ringshaked, pitted, or crumbly. Decided discoloration or bleaching of the rotted wood often is apparent.

**Dry rot.** A term loosely applied to any dry, crumbly rot, but especially to that which, when in an advanced stage, permits the wood to be crushed easily to a dry powder. The term actually is a misnomer for any decay, since all fungi require considerable moisture for growth.

**Green**. Freshly sawn or undried wood that still contains tree sap. Wood that has become completely wet after immersion in water would not be considered green, but may be said to be in the "green condition."

**Hardwoods.** Generally one of the botanical groups of trees that have broad leaves in contrast to the conifers or softwoods. The term has no reference to the actual hardness of the wood.

**Heartwood**. The wood extending from the pith to the sapwood, the cells of which no longer participate in the life processes of the tree. Heartwood may contain phenolic compounds, gums, resins, and other materials that usually make it darker and more decay-resistant than sapwood.

**Kiln**. A chamber having controlled airflow, temperature, and relative humidity for drying lumber, veneer, and other wood products.

**Lignin**. The second most abundant constituent of wood, located principally in the secondary wall and the middle lamella, which is the thin cementing layer between wood cells. Chemically, it's an irregular polymer of substituted propylphenol groups (so no simple chemical formula can be written for it).

**Millwork.** Planed and patterned lumber for finish work in buildings, including items such as sash, doors, cornices, panelwork, and other items of interior or exterior trim. Doesn't include flooring, ceiling, or siding.

**Moisture content.** The amount of water contained in wood, usually expressed as a percentage of the weight of the ovendry wood.

**Ovendry wood.** Wood dried to a relatively constant weight in a ventilated oven at 101 to 105°C.

**Preservative.** Any substance that, for a reasonable length of time, is effective in preventing the development and action of wood-rotting fungi, borers of various kinds, and harmful insects that deteriorate wood.

**Sapwood.** The wood of pale color near the outside of the log and just under the bark of a tree. Under most conditions, the sapwood is more susceptible to decay than heartwood, and usually it is more receptive to impregnation with preservatives and fire retardants.

**Seasoning.** Removing moisture from green wood to improve its serviceability.
*Air-dried.* Dried by exposure to air in a yard or shed, without artificial heat.
*Kiln-dried.* Dried in a kiln with the use of artificial heat.

**Soft rot.** A special type of decay developing under very wet conditions (as in cooling towers and boat timbers) in the outer wood layers, caused by cellulose-destroying microfungi that attack the secondary cell walls and not the intercellular layer.

**Softwoods**. Generally, one of the botanical groups of trees that, in most cases, have needlelike or scalelike leaves: the conifers, also the wood produced by such trees. The term has no reference to the actual hardness of the wood.

**Weathering.** The mechanical or chemical disintegration and discoloration of the surface of wood caused by exposure to light, the action of dust and sand

carried by winds, and the alternate shrinking and swelling of the surface fibers with the continual variation in temperature and moisture content brought by changes in the weather. Weathering doesn't include decay.

**White rot.** In wood, any decay or rot that attacks both the cellulose and lignin and produces a generally whitish residue that may be spongy or stringy rot, or occur as pocket rot.

## For further reading

If you would like additional copies of EM 8403, *Wood Preservation and Wood Products Treatment Training Manual,* send $1.50 per copy to:

Publication Orders
Extension & Station Communications
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***Other publications***

The publications listed below are intended to provide basic information essential to safe handling of pesticides and to prepare treaters for certification. Changes in pesticide registration and use require continuing study to keep up to date. Proceedings, standards, and other publications of the American Wood Preservers Association provide current information for wood preservers. Other trade publications also will prove helpful.


Fuller, B., et al., *The Analysis of Existing Wood Preserving Techniques and Possible Alternatives,* Metrek Division / The Mitre Corporation, developed under contract with the U.S. Environmental Protection Agency, June 1977.

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Morrel, Jeffrey, Guy C. Helsing, and Robert D. Graham, *Marine Wood Maintenance Manual: A Guide for Proper Use of Douglas-fir in Marine Exposures,* Oregon State University, FRL Research Bulletin 48, October 1984.

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*Safe Handling Guide to Sapstain Control Chemicals,* Western Wood Products Assn., 1500 Yeon Bldg., Portland, OR, 1982. 14 pp.

Stalker, Ian, and Milton Applefield, *The Preservation of Wood,* University of Georgia, Extension Entomology (Athens, 1986). A correspondence course for wood treaters. 150 pp.

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