Wood Preservatives

Methods of Applying Preservatives to Wood

Treating wood so that it can withstand fungal decay and insect damage is critical to producing a high quality wood product. It is also a potentially dangerous process that can affect the person who is treating the wood and their environment.

Throughout recorded history, the unique characteristics and relative abundance of wood have made it one of mankind’s most valuable and useful natural resources. Today, thousands of products that we take for granted are made from solid wood, wood pulp, and chemicals derived from wood. Only wood is a renewable resource. No other building material can be regenerated, as can trees. They can also provide wildlife habitat and recreational areas while they grow.
Advantages of Wood.

- Available in many species, sizes, shapes, and conditions and can suit almost every demand.
- Readily available and is a material most people are familiar with.
- Requires far less energy to process into products.
- Has a high strength-to-weight ratio and therefore performs well as a structural material.
- Easily cut and shaped with tools and fastened with adhesives, nails, screws, bolts, and dowels.
- Lightweight and easy to install.
- Good insulating properties against heat, cold, sound and electricity.
- Good shock resistance, absorbs, and dissipates vibrations.
- An esthetically pleasing material that can be enhanced by many finishes.
- Easily repaired and remodeled.
- Combines with almost any other material for functional and esthetic uses.
- Highly durable if properly protected and treated.

Disadvantages of Wood.

- Biological deterioration, source of food for fungi, insects, and other organisms.
- Fire, combustible when combined with adequate heat and oxygen.

Different Uses for Treated Wood.

Replacement of concrete foundations for homes with permanent wood foundation (PWFs).

- Previously known as all-weather wood foundations (AWWFs).
- Can be fabricated on site or in factories.
- Lumber requires kiln drying.

Pile foundation

- Used in “piling” for building rigid bases in coastal areas or unstable soil conditions.
- Used in many vacation homes.
- Treated to high preservative retentions.
Do It Yourself (DIY) Projects.

Lumber
- Decking
- Framing
- Siding
- Walkways
- Jetties
- Fencing slats
- Above ground pools

Posts
- Fencing
- Arbors
- Gazebos
- Carports

Timbers
- Landscaping
- Pathways
- Playground equipment
- Retaining walls

Aesthetic Demands.
- Surface cleanliness
- Improved color of treated wood

**Government Agencies.**

Federal, state, county & city agencies specify treated wood for a variety of uses such as:

- Military installations
- Building and bridge construction
- Docks
- Poles and posts

Federal government issues standards and specifications for preservatives and treatments.

**Utility and railroad industries.**

- Treated poles such as electric and telephone
- Many railroad crossties
Treated Wood Provides Protection from:

Further reduction of forest resources saves a quarter of a million trees each year.

Decay from moisture and contact with the ground:

**Biological deterioration**

**Fungi**

- Decay fungi
- Brown rot
- White rot
- Mold fungi
- Chemical stain

**Insects**

- Subterranean termites
- Drywood termites
- Wood-boring beetles
- Carpenter ants
- Carpenter bees

**Marine borers**

- Molluscan borers
- Crustacean borers

**Preservative Treating Processes.**

Most preservative flow occurs by means of the vertical fiber tracheids and the horizontal tracheids.

It is possible to fully saturate some softwoods with preservative.

**Hardwood Cubicle**

- Only the vessels and the ray tracheids can conduct preservatives.
- Often leaves extensive regions of fibers unprotected.
- As this gives hardwoods much of their strength, this can be a very serious situation.
Classification of American Woods with Respect to Heartwood Penetrability

- Fibers in hardwoods can act as a tight, impenetrable mass, which is difficult or impossible to treat with a preservative, depending on the species of wood.

| Table 5.1 Classification of American woods with respect to heartwood penetrability. |
|---------------------------------|---------------------------------|
| Softwoods                       | Hardwoods                       |
| Group 1. Heartwood Easily Penetrated | Basewood, *Tilia americana*  |
| Bristlecone pine, *Pinus aristata*  | Beech (white heartwood), *Fagus grandifolia* |
| Pinon, *Pinus edulis*            | Black gum, *Nyssa sylvatica*   |
| Ponderosa pine, *Pinus ponderosa* | Green ash, *Fraxinus pennsylvanica lanceolata* |
|                                | Pin cherry, *Prunus pennsylvanica* |
|                                | River birch, *Betula nigra*     |
|                                | Red oak, *Quercus spp.*        |
|                                | Slippery elm, *Ulmus fulva*    |
|                                | Sweet birch, *Betula lenta*    |
|                                | Tupelo gum, *Nyssa aquatica*   |
|                                | White ash, *Fraxinus americana* |

<table>
<thead>
<tr>
<th>Group 2. Heartwood Moderately Difficult to Penetrate</th>
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<tbody>
<tr>
<td>Douglas fir (Pacific-coast type), <em>Pseudotsuga taxifolia</em></td>
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<td>Jack pine, <em>Pinus banksiana</em></td>
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<td>Loblolly pine, <em>Pinus taeda</em></td>
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<td>Longleaf pine, <em>Pinus palustris</em></td>
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<td>Norway pine, <em>Pinus resinosa</em></td>
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<tr>
<td>Shortleaf pine, <em>Pinus echinata</em></td>
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<td>Western hemlock, <em>Tsuga heterophylla</em></td>
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<th>Group 3. Heartwood Difficult to Penetrate</th>
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<tbody>
<tr>
<td>Eastern hemlock, <em>Tsuga canadensis</em></td>
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<tr>
<td>Engelmann spruce, <em>Picea engelmannii</em></td>
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<tr>
<td>Lowland white fir, <em>Abies grandis</em></td>
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<tr>
<td>Lodgepole pine, <em>Pinus contorta</em></td>
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<tr>
<td>Noble fir, <em>Abies procera</em></td>
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<tr>
<td>Sitka spruce, <em>Picea sitchensis</em></td>
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<tr>
<td>Eastern larch, <em>Larix occidentalis</em></td>
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<tr>
<td>White fir, <em>Abies concolor</em></td>
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<td>White spruce, <em>Picea glauca</em></td>
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<th>Group 4. Heartwood Very Difficult to Penetrate</th>
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<tr>
<td>Alpine fir, <em>Abies lasiocarpa</em></td>
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<tr>
<td>Corkbark fir, <em>Abies lasiocarpa var. arizonica</em></td>
</tr>
<tr>
<td>Douglas fir, (Intermountain type) <em>Pseudotsuga menziesii</em></td>
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<tr>
<td>Northern white cedar, <em>Thuja occidentalis</em></td>
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<tr>
<td>Tamarack, <em>Larix laricina</em></td>
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<tr>
<td>Western red cedar, <em>Thuja plicata</em></td>
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Effect of Treatment on Penetration

Brush or spray: The deepest penetration is at the ends (transverse or cross sections, where tracheid ends were exposed to the preservative liquid.) Brushing and spraying are not good treating methods for preserving wood exposed to high risk of decay, such as for ground contact uses.

Cold soak or steep: Cold soaking is when an unheated oil solution of preservative, such as penta or copper naphthenate, is used. Steeping is treatment of wood by preservatives in a water solution. Three advantages over brushing: longer time for absorption; forcing the preservative into the wood cells; easier than respraying or rebrushing during the 24 hour treating period.

Thermal process or hot-and-cold bath: As the fencepost heats up, air in the wood expands and bubbles out, escaping through the preservative liquid into the atmosphere. Used mainly for treating poles with creosote mixtures.

Vacuum pressure methods: Simplest and most common of the vacuum-pressure processes. The full cell process is used for most of the pressure treatments using chromated copper arsenate (CCA) and pentachlorophenol-based (PCP) preservatives. It gives the deepest possible penetration and the highest loadings (retentions) of preservative with easily treated species. Virtually all the air in the wood cells can be replaced with preservative.
Figure 5.2 a,b,c,d
Effect of treatment on penetration

Diagram of round pine fence posts, rip-sawn after treatment by four methods using the same preservative and showing the penetration pattern for each method.

Note that methods (a) and (b) leave untreated sapwood which could easily be exposed to decay through checks or splits that develop in the post as it dries out.

Lesson 5: Preservative Treating Processes
Treating Schedule for the Full Cell (Bethell) Process

- Enclose dried wood (timbers, lumber, poles, etc.) in a pressurable cylinder or retort.
- Use a vacuum pump to remove most of the air from the cylinder. Hold a partial vacuum to allow air to be removed from the wood cells.
- Without releasing the vacuum, allow the cylinder to fill with liquid preservative.
- Apply pressure to the preservative to force it into the wood cell spaces previously occupied by air, now occupied by a partial vacuum.
- When the desired and measured amount of liquid preservative has been absorbed, release the applied pressure and drain the cylinder (initial drain).
- Apply a final vacuum to expand the air remaining in the wood. This forces excess liquid to exude from the surfaces and run off.
- Release final vacuum. As the remaining air in the cells contracts, much of the surface wetness will be reabsorbed into the wood (this reduces dripping later).
- Remove the treated wood products from the cylinder.
Treating Schedule of the Lowry (empty cell) Process

- In this process after the wood has been closed in the cylinder, preservative is pumped in, and no air is allowed to escape.

- Air compressed inside the wood expands when the pressure is released, thereby forcing some preservative out of the cells and eliminating overloading.

- The end result is that many cells are “lined” with preservative rather than “filled.”

- Mainly used for treating wood with creosote, creosote/PCP mixtures and PCP preservatives.
Treating Schedule of the Rueping (empty cell) Process

- Similar to Lowry process.
- An air pressure higher than atmospheric is first applied to the closed cylinder and its charge of wood.
- A typical pressure used is 4 to 5 times atmospheric (about 60 psi).
- Treatment then continues as the Lowry process.
- Mainly used with creosote, creosote/PCP mixtures and PCP preservatives.
- The final weight of treated wood is reduced compared to full cell treatment.
- A cost saving is realized from the use of less preservative chemical and carrier liquid.
Treating schedule of the Rueping (empty cell) process.

**Rueping (Empty Cell) Process**

A. Partially pressurize cylinder
B. Fill cylinder with preservative
C. Continue pressurizing to maximum and hold until retention is reached
D. Release pressure
E. Apply final vacuum
F. Release final vacuum

Fig. 5.4 and 5.5 adapted from Nicholas, Darrel D. 1973. *Wood Deterioration and Its Prevention by Preservative Treatments*. Vol. 2. Syracuse University Press, Syracuse, NY.

*The Preservation of Wood*
Conceptual Diagram of CCA Pressure-Treating Facility

- The major item of a pressure-treating plant is the treating cylinder or retort, which can vary in size but is commonly 4 to 8 feet in diameter and 30 to 150 feet long.
- Auxiliary equipment usually includes a boiler, dry kiln, pumps, tanks, gauges, thermometers, controller, and valves.
- Before wood cells can accept sufficient preservative liquid to satisfy preservation standards, the product must meet certain conditions: No bark, inner bark, paint, or varnish; Air dried or kiln dried to an average moisture content of 25% or less; Incising “difficult to treat” species to increase surface penetration and retentions.
Safer Alternatives.

The quest for safer wood preservatives has led to two very promising new products:

- Neither contain the EPA classed hazardous chemicals arsenic and chromium, so they are both more environmentally sound than CCA.
- Both protect wood from decay and insect attack as effectively as CCA, according to their manufacturers.
- Both remain effective from 30 – 60 years or 5 – 10 times longer than untreated wood.

Chemical Specialties, Inc.

- Introduced ammonia cal copper quaternary compound (ACQ) in the early 1990s and markets it nationwide as ACQ Preserve.
- Wood treated with it is a light green color and accepts stains readily.
- Hot dipped galvanized or stainless steel nails, fasteners, and fittings are recommended because preservative chemicals are corrosive to standard hardware.

Kodak, Inc.

- Produces and markets wood that is pressure-treated with copper dimethyl-dithiocarbamate (CDDC).
- Treated wood is brown rather than greenish like CCA- and ACQ- treated wood.
- Protects wood as well as the others, but it supposedly less corrosive to fasteners.

Two other CCA manufacturers, Hickson and Osmose Corp.

- Have developed copper-based CCA alternatives.
- However, they are not marketing these actively in the US.

Both ACQ & CDDC- treated woods cost more than CCA-treated wood and are not yet available in all areas.

**Safety precautions.**

- Always wear gloves when applying a preservative, or when working with pressure-treated wood.
- Wear a dust mask to prevent inhaling sawdust.
- After treating cut ends with paintable preservative, wipe away any residue or precipitate that is visible.
- Never burn scraps or sawdust of treated wood, and only dispose of waste wood at landfills.