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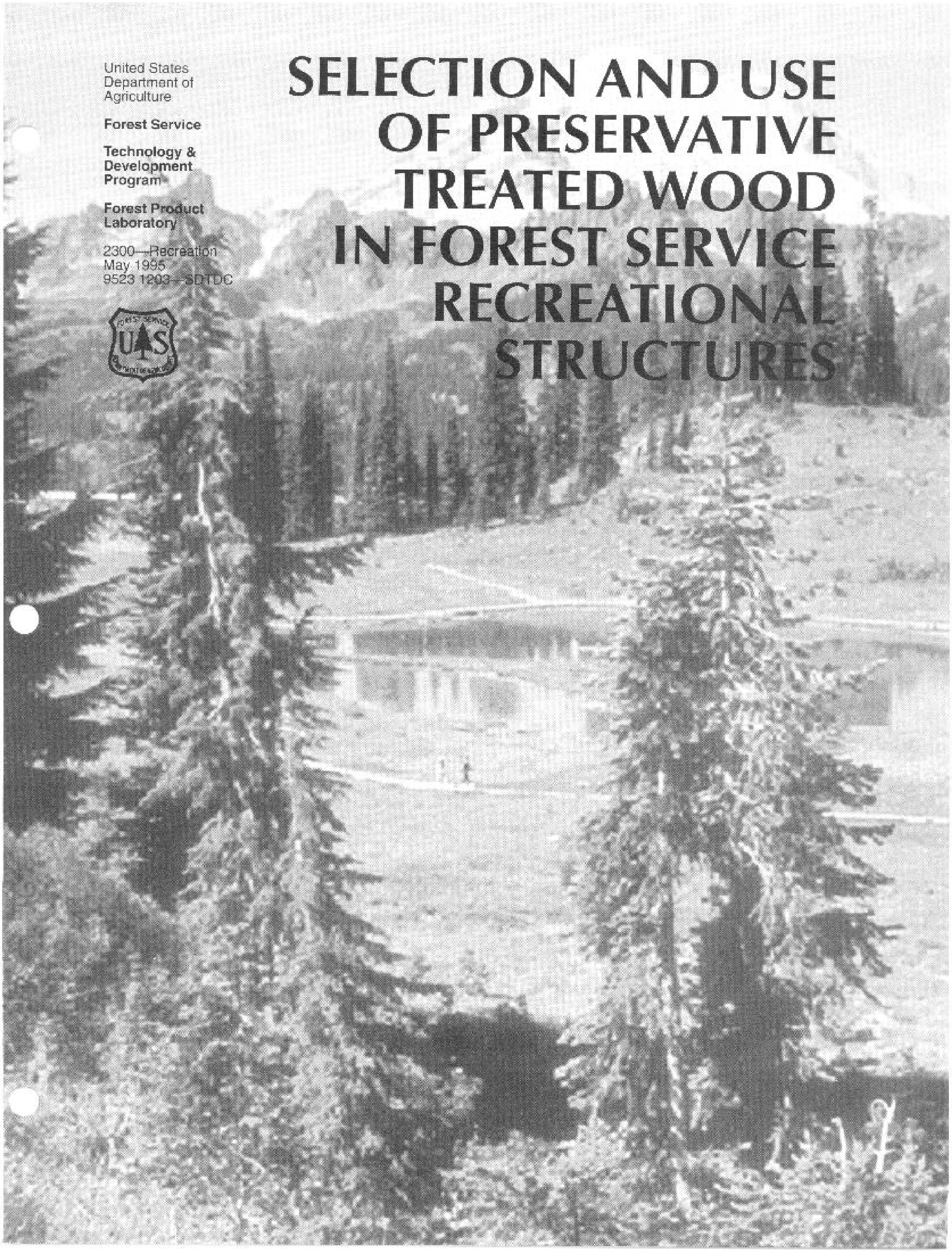
SELECTION AND USE OF PRESERVATIVE TREATED WOOD IN FOREST SERVICE RECREATIONAL STRUCTURES



SELECTION AND USE OF PRESERVATIVE TREATED WOOD IN FOREST SERVICE RECREATIONAL STRUCTURES

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BACKGROUND

Preservative treated wood is an economical, durable and aesthetically pleasing building material, and is a natural choice for many construction projects in the National Forests. The purpose of treating wood with preservatives is to protect the wood from wood-destroying fungi and insects. Treating wood with preservative chemicals can increase the service life of wood by a factor of 5 times or more. Wood treated with commonly used wood preservatives can last 40 years or more in service.

Many field applications place treated wood in sensitive ecosystems where contamination by significant amounts of preservative compounds could negatively affect the environment. There is increasing pressure to reduce, restrict, or eliminate the use of wood preservatives for fear toxic components may leach from the treated wood. This article is intended to give the reader an overview of preservative systems, aid in understanding the level of risk and status of the science, and provide some guidelines for using the products.

TYPES OF WOOD PRESERVATIVES

Wood preservatives have been used for over a hundred years. They are broadly classified as either waterborne or oil-type, based on the chemical composition of the preservative and the carrier used during the treating process.

Oil-Type

The common oil-type preservatives are creosote, pentachlorophenol, and copper naphthenate. Oil-type preservatives, such as creosote and pentachlorophenol solutions have largely been confined to uses that do not involve frequent human contact. The exception is copper napthenate, a more recent and less widely used oil-type wood preservative. Oil-type preservatives may be visually oily, or oily to the touch, and sometimes have a noticeable odor. However, using the oil or solvent as carriers makes the wood less susceptible to cracks and checking and therefore more suitable for treatment of glu-lam stringers for bridges where cracks could alter the structural integrity. (See figure 1).

Creosote

Creosote is a chemically complex mixture of organic molecules derived from coal tar produced by carbonization of coal. The active ingredients are the polycyclic aromatic hydrocarbons (PAH's) which are toxic to fungi, insects, and marine borers if present in sufficient concentrations. It has been widely used for bridge timbers railroad ties, utility poles, and pilings in aquatic

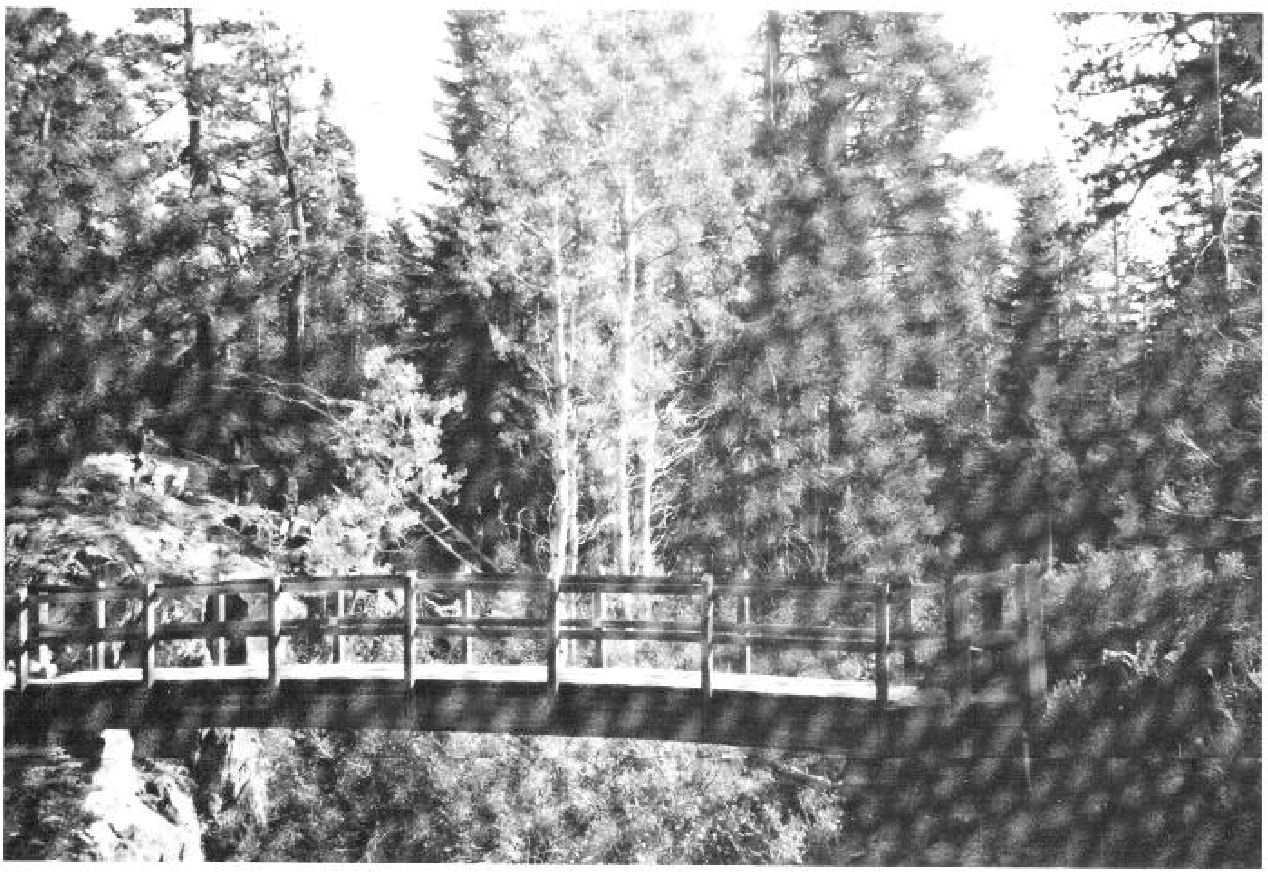

Figure 1. Glu-lam trail bridge.

environments. Creosote remains in the wood due to its low volatility and low solubility in water, but does have a tendency to "ooze or bleed" from the wood, especially in hot weather or direct sun. It has a dark brown/black color with an oily surface and strong odor. It is not recommended for use in recreational areas where it is subject to frequent public contact. Information on the availability of creosote treated wood can be obtained by contacting the appropriate trade association listed on the last page.

Pentachlorophenol

Pentachlorophenol is a crystalline solid that is typically dissolved in a petroleum solvent to form a five percent solution. This preservative is effective against fungi and insects, but does not protect well against marine borers. Pentachlorophenol is widely used for utility poles and crossarm applications, guardrail posts, and laminated bridge timber constructions. The properties of the treated wood depend greatly on the type of solvent used. Light, volatile solvents produce a light brown color and a relatively clean surface; heavier solvents produce characteristics similar to those of creosote treated wood. Pentachlorophenol is odorless, but the odor of the solvent may be detectable, especially in freshly treated wood. As with other oil-type preservatives, permanence in the wood results from low water solubility and low volatility. Although pentachlorophenol treated wood is often used in recreational structures, it is not recommended for hand-rails where it is subject to frequent public contact. Information on the availability of pentachlorophenol treated wood can be obtained by contacting the appropriate trade association listed on the last page.

Copper naphthenate

Copper naphthenate is a mixture of napthenic acids and copper salts dissolved in a petroleum solvent. It is effective against decay and insects, but is not recommended for use in marine applications. Like pentachlorophenol, its properties are influenced by the type of carrier solvent used. The most commonly used carrier solvents are fuel oil and mineral spirits. Although copper naphthenate has little odor, the odor of oil or solvent may make this treatment less acceptable in some trail applications. Color ranges from light green to dark brown depending on the treating process, the solvent, and the treating temperature. Unlike creosote and pentachlorophenol, copper naphthenate is not a restricted-use pesticide, and thus is widely used for field treatment of cuts made during construction. For information on availability of copper naphthenate treated wood see appropriate trade association listed on the last page.

Waterborne

Chromated copper arsenate, ammoniacal copper arsenate, ammoniacal copper zinc arsenate, ammoniacal copper citrate, alkaline copper quaternary compounds, and copper bis(dimethyldithocarbamate) are waterborne preservatives which react with or precipitate in the wood substrate and become "fixed" (the preservative compounds in the solutions are fixed in the wood in an insoluble state.) Borates are another type of waterborne preservative; however, current borate preservatives do not "fix" in the wood and are readily leached if exposed to rain or wet soil.

Chromated copper arsenate (CCA)

CCA contains hexavalent chromium, copper, and arsenic. The chromium is the fixation agent and reacts chemically with the copper and arsenic fixing them in the wood. During this process the chromium is reduced to the trivalent state. Copper protects against fungi and arsenic protects against insects and copper-tolerant fungi. It is the most widely used wood preservative, favored for lumber treatment because it is inexpensive, leaves a dry, paintable surface, and binds to the wood to become relatively leach-resistant. However, it is difficult to achieve adequate penetration with CCA when treating less porous woods such as the heartwood of Douglas fir. Color is olive green which weathers to driftwood gray. CCA treated wood is readily available in all parts of the continental United States.

Ammoniacal copper zinc arsenate (ACZA)

ACZA contains copper, zinc, and arsenic. The ingredients are dissolved in a solution of ammonia (NH_3) in water. Ammonia is the fixation agent which evaporates causing the preservatives to precipitate in solid form within the wood structure. Copper and zinc protect against fungi; and arsenic protects against insects and copper tolerant fungi. Until recently this was the only waterborne pressure treatment available to penetrate Douglas fir and assure compliance with American Wood Preservers Association (AWPA) standards. Color is olive to bluish-green which weathers to driftwood gray. ACZA is a further refinement on the original formulation, ACA. For information on the availability of this product call J.H. Baxter and Company, San Mateo, CA 1-415-573-3311.

Ammoniacal copper arsenate (ACA)

ACA contains copper and arsenic. It is similar to ACZA, except that it contains more arsenic and no zinc. ACA has been replaced by ACZA in the United States, but is still used in Canada. Research indicates that ACZA is superior to ACA in leach-resistance and performance.

Alkaline copper quaternary (ACQ) Compounds

ACQ contains copper and quaternary ammonium compounds (didecyldimethylammonium chlorides). Two types of ACQ are commercially available. ACQ-B uses ammonia as a solvent, which allows it to penetrate wood such as Douglas fir heartwood (although incising is still recommended). ACQ-D uses an amine solvent. It does not penetrate the wood as well as ACQ-B, but has a nicer surface appearance. Both copper and quat protect against fungi. Neither type of ACQ contains arsenic or chromium. Although ACQ formulations are newer preservatives with less time in service than conventional preservatives, they have been tested by accelerated testing methods including soil block, soil bed exposure and field stake tests. ACQ varies in color from brown to deep green depending on wood species, chemical retention and heartwood. It will weather to a brown tone over time as exposed to sunlight. For information on the availability of ACQ treated wood call Chemical Specialities Inc., Harrisburg, NC 1-800-421-8661.

Ammoniacal copper citrate (CC)

CC contains copper oxide and citric acid dissolved in a solution of ammonium, carbon dioxide, and water. As with other ammoniacal systems, this preservative is more effective than CCA in achieving adequate penetration of difficult to treat species. Incising is recommended for treatment of Douglas fir. The copper protects against fungi and insects, while the citric acid aids in the distribution of the copper within the wood. Although CC is a new preservative with less time in service than conventional preservatives, it has been tested with accelerated methods such as soil blocks, field stakes, and pole stubs. This preservative does not contain chromium or arsenic. The appearance of the treated wood varies from light green to dark brown. Due to its recent development, this preservative may not be readily available in all areas of the country. Information about the availability of this type of preservative treated wood can be obtained by calling:

Osmose Wood Reserving, Griffin, GA
West Coast: 1-800-786-3325
East Coast: 1-800-241-0240

Copper bis(dimethyldithiocarbamate) (CDDC)

CDDC is a reaction product formed within the wood after treatment with two different treating solutions. The first treating solution contains copper ethanolamine, and the second solution contains sodium dimethyldithiocarbamate. The reaction product protects the wood against attack by fungi and insects. This preservative does not contain chromium or arsenic. CDDC may not penetrate difficult to treat species such as Douglas fir as easily as systems that are formulated with ammoniacal solvents. Although CDDC is a newly developed preservative and has less time in service than conventional preservatives, it has been tested by accelerated methods such as soil blocks and field stakes. Due to its recent development, this preservative may not be readily available in all areas of the country. Information about the availability of this preservative can be obtained by calling: ISK Biosciences, Memphis, TN 1-800-556-3425.

Borates

Borate preservatives are salts such as sodium octaborate, sodium tetraborate, and sodium pentaborate that are dissolved in water. Borates are effective preservatives against both decay fungi and insects. Borate preservatives are diffusible, and with proper treating practices they can achieve excellent penetration in species that are difficult to treat with other preservatives. Borate preservatives also present a very low hazard to construction personnel and the public. The borate in treated wood remains water soluble. Therefore, this preservative is only recommended for applications where the wood is kept free from rain water or standing water and out of ground contact. An example of such use is in the construction of wooden buildings in areas of high termite hazard.

IMPORTANT NOTICE: DO NOT USE BORATE PRESERVATIVES WHERE THERE IS CONTACT WITH SOIL, RAIN, OR STANDING WATER.

CURRENT KNOWLEDGE OF LEACHING AND EFFECTS ON THE ENVIRONMENT

All wood preservative treatments consist of active ingredients that protect the wood from deterioration by insects and fungi and ingredients that "fix" the active ingredients to the wood to minimize leaching. Past studies indicate that a small percentage of the active ingredients of all types of wood preservatives do leach out of the wood during service. However, these studies have been primarily conducted in the laboratory, and it is difficult to extrapolate their findings to in-service conditions. This is because factors such as fixation conditions, retention in the wood, product size and shape, type of exposure, and years in service can all influence the rate of leaching. These factors have also caused somewhat conflicting results in those studies that have attempted to determine leaching rates in service.

The biological impacts of the small amounts of chemical leached from treated wood have not been well-studied under field conditions. Ingredients in all preservatives are clearly toxic to a variety of organisms in high concentrations, although laboratory studies indicate that the levels leached from the wood are generally too low to create a biological hazard. The environmental mobility of metals used in wood preservatives appears to be fairly limited, as they readily to bind to soil or sediment constituents within close proximity to the wood. The organic components leached from oil-type preservatives tend to decompose in the environment. However, factors such as soil and water pH, soil composition, presence of microorganisms, and rate of water flow can influence the environmental mobility of leached preservative components. These factors have complex and intertwined roles in the leaching and subsequent mobility of preservative components. This may explain, at least in part, the conflicting results of previous studies. It is apparent that more information is needed on leaching and biological impacts of wood preservatives under in-service conditions. Studies of the aquatic toxicology of some of these wood preservatives, sponsored by the treating industry, are currently in progress, and Forest Service personnel are beginning to study the leaching and biological impacts of wood preservatives in typical Forest Service applications.

The conditions presenting the greatest potential for impacting the ecosystem will be those that present both a high potential for leaching and the potential for accumulation of metallic components in the environment. Within Forest Service applications, these conditions are most likely to be found where treated wood is used in boggy or marshy areas with little water exchange. These types of sites provide a severe leaching exposure because of the low pH and high organic acid content of the water. In addition, the stagnant water conditions would prevent rapid dispersal of any leached components, allowing them to accumulate in soil, sediments, and organisms near the treated wood.

Generally, habitats most sensitive to the effects of in-service losses of components of wood preservatives are ecologically unique and/or provide essential habitat for key species during a critical period of the species' life cycle. Riparian zones, wetlands, meadows, and fish spawning and rearing habitats are the most common. Boardwalks and fishing platforms are commonly used in these areas. Determination of which habitats are sensitive needs to be made based on local conditions. The challenge is to utilize the most durable, aesthetically pleasing, cost effective materials available while protecting sensitive ecosystems.

Figure 2. Bridge walkway.

RECOMMENDED GUIDELINES

Selection of a Wood Preservative

The type of preservative that is most appropriate for use depends on the wood species to be treated, type of structure, cost, treated wood availability, and the particular sensitivities of specific ecosystems.

Wood Species

Generally, hem-fir and southern pine can be adequately treated with any of the commercial wood preservatives, although copper napthenate has not been standardized for use with hem-fir. CCA is not recommended for treatment of Douglas fir. Douglas fir is more readily treated with oil-type or ammoniacal preservatives. CCA is also not recommended for treatment of hardwoods that will be placed in ground contact.

Figure 3. Boardwalk in sensitive habitat.

Typeof Structure

Although not a major concern in many applications, the appearance of wood treated with ammoniacal copper preservatives (ACZA, CC, ACQ-B) may not be as uniform and esthetically pleasing as the other water-borne preservatives. Conversely, these ammoniacal preservatives allow better penetration and treatment of larger dimension material such as piling and timbers, especially with Douglas fir. Large glu-lam timbers such as used in bridge supports are often treated with an oil-type preservative such as pentachlorophenol and copper napthenate to reduce problems with checking and cracking. Laminated members should not be treated with waterborne preservatives. However, the surface characteristic odor and appearance of oil-borne preservatives may make them less desirable for uses in areas of frequent human contact, such as hand rails or sunbathing decks.

In marine construction, or brackish water such as ocean estuaries, only creosote, CCA, ACZA, and CC are approved for use. In such areas south of San Francisco or in Virginia, dual treatments of creosote and one of the waterborne treatments may be needed to prevent attack by all types of marine borers.

Cost and Availability

The relative cost and availability of the different wood preservatives varies. The phone contacts listed above, and on the last page, for each type of preservative can supply such information.

Ecosystem Sensitivities

Although largely undocumented, it is possible that some preservatives are more appropriate than others for use in sensitive ecosystems. For example, CCA has a much lower copper content than other waterborne preservatives (except the borates), and thus may pose less of a threat to copper-sensitive aquatic ecosystems.

(NOTE: There is no evidence at this time to suggest that any of the wood preservatives leach sufficient copper to harm terrestrial or freshwater ecosystems). Similarly, preservatives without arsenic may pose less of a threat to mammals (such as construction personnel) than those that do not contain arsenic. (Once again, however, there is no evidence that arsenic containing wood preservatives, if used as intended, cause any harm to people or other mammals). Oilborne preservatives often produce an oily surface sheen when installed in stagnant fresh-water applications. This may be unacceptable in situations where appearance is important and waterborne preservatives may be more appropriate when extensive contact with fresh water is required. As more information is obtained about in-service leaching rates and biological impacts, it will be possible to make more informed decisions about the appropriate use of wood preservatives in sensitive ecosystems. The wood treating industry is currently developing a model to assist in this decision-making process in aquatic ecosystems.

Purchase of a Treated Wood Product

Regardless of the type of preservative, care should be taken to ensure that the wood is properly treated and allowed to adequately "fix" before it is placed in service.

Treatment

Purchasers of treated wood should require that the wood is treated in accordance with American Wood Preserver's Standard C1 (all products) and other standards as shown:

Standard C2: Lumber, timbers, bridge ties, and mine ties
Standard C3: Piling
Standard C4: Poles
Standard C5: Posts
Standard C9: Plywood
Standard C14 Bridges
Standard C18: Material in Marine Construction
Standard C28: Structural Glued Laminated Members and Laminations before Gluing

Treated material that has met these standards will have the stamp or tag of an American Lumber Standards Committee (ALSC) accredited inspection agency, (see figure 4). These standards describe acceptable treating methods and require that the wood is sufficiently penetrated with adequate amounts of preservative for various exposure environments. Avoid wood that is purported to be "treated to refusal".

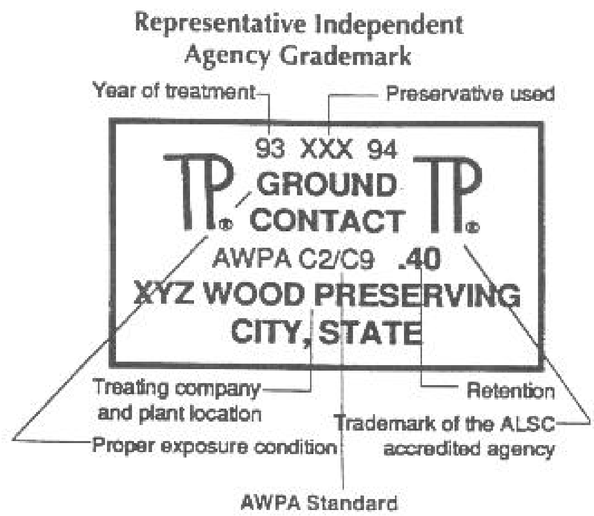

Figure 4. Stamp of Accredited Inspection Agency. Courtesy of Western Wood Preservers' Institute.

Incising is a technique that is used to increase preservative penetration and retention in species such as Douglas fir. Douglas fir should be incised regardless of the type of preservative used. Incising is especially important in larger dimension material such as timbers that are in ground contact load bearing applications. Smaller dimension material that is not in contact with ground or water, such as decking, may perform adequately without incising in some applications. Although not required by

AWPA Standards, incising of southern pine is beneficial when larger dimension material, such as timbers, is treated. These larger pieces often have at least one heartwood face that is poorly penetrated by preservatives. Availability of incised southern pine is limited.

Fixation and Surface Cleanliness

Laboratory studies indicate that wood preservative leaching is greatly increased if proper techniques are not used to prevent surface residues and allow adequate fixation. Meeting these conditions is primarily the responsibility of the commercial treater, but treated wood purchasers should also take measures to ensure that the wood will have minimal leaching.

Purchasers should specify and require assurance that the material be produced in compliance with the "Best Management Practices For The Use Of Treated Wood In Aquatic Environments", a publication of the Western Wood Preservers' Institute and Canadian Institute for Treated Wood, USA Version, revised January 1995. (For information or to obtain a copy of this booklet, call The Western Wood Preservers' Institute, 206-693-9958). Although these BMP's have not yet been adopted by the industry in areas other than on the west coast, purchasers in other areas can require that these practices be used. In brief, these BMP's describe the following procedures to ensure adequate fixation:

CCA

Following treatment, the wood should be either air seasoned, kiln dried, steamed, or subjected to a hot water bath. It should then be evaluated with the chromotropic acid test (AWPA Standard A3-11, 1992) to ensure that fixation is complete. Since the fixation process is temperature dependent with air seasoning (the most common fixation method) fixation may take several weeks to complete in winter conditions.

ACZA and ACQ-B

The key to achieving fixation with these preservatives is to allow volatilization of the ammonia. This can be accomplished by air or kiln-drying. The BMP's state that air drying shall be conducted for a minimum of three weeks at a temperature above 16°C (60°F). This time can be reduced to one week if the material is conditioned in the treating cylinder. At lower temperatures a heat source or kiln drying should be used. There is currently no commonly used method to ensure fixation in ACZA and ACQ-B, although wood that has been thoroughly dried is acceptable. However, if the wood releases a strong ammonia odor, fixation is not complete. Although CC has not yet been included in the BMP's, the same fixation conditions will apply.

ACQ-D, and CDDC

These newer formulations have not yet been included in the BMP's. As a general rule, however, wood that has been thoroughly re-dried after treatment is properly fixed.

Pentachlorophenol, creosote, and copper naphthenate

With oil-type preservatives, the primary concern is surface cleanliness and ensuring that excess preservative does not "bleed" or ooze back out of the wood. Accordingly, the BMP's require that treatment techniques such as expansion baths and steaming be used to produce a clean surface.

The purchaser can take steps to ensure that he wood will be produced according to the BMP's described above. It is important to realize that proper fixation may take time. Thus, material should be ordered well before it is needed so that the treater can hold the wood for the necessary time. Similarly, if the wood is ordered in advance, the purchaser may be able to store it under cover, allowing further drying and fixation to occur. In general,

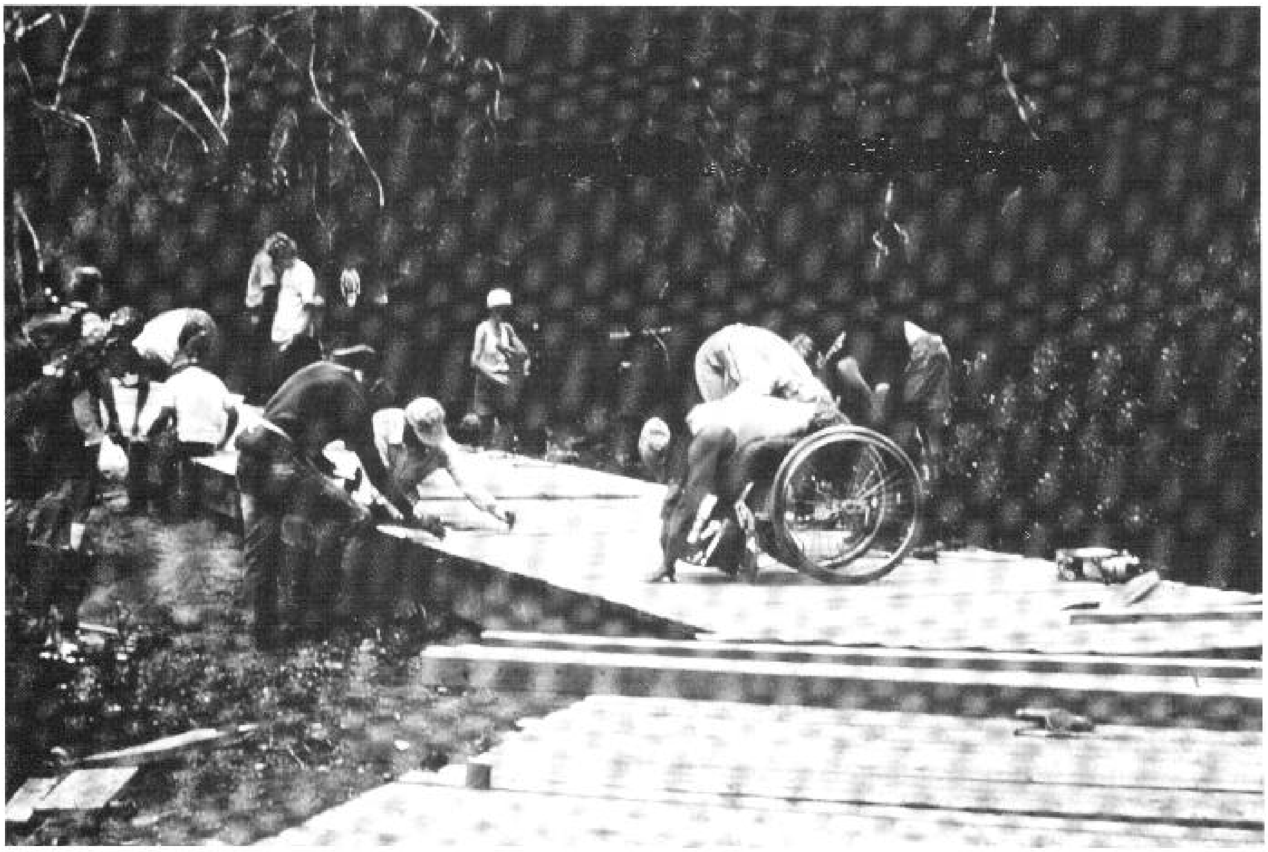

Figure 5. Worksite

allowing the material to air dry before use is a good practice for ensuring fixation, minimizing leaching, and reducing risk to construction personnel. With all the preservatives, inspect the wood for surface residue; it is important that wood with excessive surface residue not be placed in service.

Use of a Treated Wood Product

Site selection, construction and handling practices can help to ensure that the risks of using preservative treated wood products are minimized.

Site Selection

1. Stay as far away from surface water as possible since contaminants move less freely in soil than water.

2. Place trail crossings of sensitive ecosystems at their narrowest points

3. Minimize number of stream crossings

4. Review available guidelines for specific sensitive species.

Construction and Handling

Purchasers of treated wood should be supplied with a consumer information sheet that describes safe handling practices. The handling practices described should be followed. In general, whenever working with treated wood (and even untreated wood), it is important that construction personnel take precautions to avoid frequent or prolonged inhalation of sawdust by wearing a dust mask or respirator. If the wood appears wet when cutting, water-proof gloves should be worn. In any case, hands should be washed before eating, drinking, or using tobacco products.

During construction, any holes or cuts that penetrate into untreated wood should be field-treated with preservative. Typically, copper napthenate is used for this application. However, care should be taken that preservative is not allowed to drip or spill into the environment. Whenever possible, field treat the exposed surface prior to assembly of the structure in a sensitive area. Do not place the field-treated wood into water or soil until all excess preservative has been either wiped-off or soaked into the wood.

Care should be taken during construction that sawdust and other wood waste does not enter the environment. It should be collected and removed from the site. Treated wood for disposal is not listed as a hazardous waste under federal law and can be disposed of in any waste management facility authorized under sate and local law to manage the material.

IMPORTANT NOTICE! STATE AND LOCAL JURISDICTIONS MAY REGULATE THE USE, REUSE AND DISPOSAL OF TREATED WOOD AND TREATED WOOD CONSTRUCTION WASTE. USERS SHOULD CHECK WITH STATE AND LOCAL AUTHORITIES FOR ANY SPECIAL REGULATIONS RELATING TO TREATED WOODS.

INFORMATION ABOUT REGULATIONS IN SOME AREAS CAN ALSO BE OBTAINED BY CONTACTING THE WESTERN WOOD PRESERVERS' INSTITUTE OR AMERICAN WOOD PRESERVERS' INSTITUTE.

SOURCES OF INFORMATION

Technical

US Forest Products Laboratory
One Gifford Pinchot Drive
Madison, WI 53705-2398
Telephone: 608-231-9200
Fax: 608-231-9592

Standards

American Wood Preservers' Association
PO Box 286
Woodstock, MD 21163-0286
Telephone: 410-465-3169
Fax: 410-465-3195

SOURCES OF SUPPLY AND ENVIRONMENTAL REGULATIONS

American Wood Preservers' Institute
1945 Old Gallows Rd., Suite 550
Vienna, VA 22812
Telephone: 703-893-400
Fax: 703-893-8492

Western Wood Preservers' Institute
601 Main Street, Suite 401
Vancouver, WA 98660
Telephone: 360-693-9958
Fax: 360-693-9967

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