WOOD PRESERVING

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Prepared by
JRB Associates, Inc.
8400 Westpark Drive
McLean, Virginia 22102

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
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8400 Westpark Drive,
McLean, Virginia 22101

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The major chemicals and processes used to preserve wood, the facilities involved in the industry, and the extent of occupational exposure are reviewed. Tar oil, organic solvent, and water bone preservatives used in treating wood are discussed and advantages and disadvantages of their use are described. Categories of wood preserving processes described include the pressure and nonpressure methods and those used to treat unseasoned timber. The advantages of pressure over nonpressure treatments are discussed, and applications appropriate for each process are described. The nature and extent of workers exposure are discussed in terms of the chemicals and processes used. A listing of wood processing facilities and types of products treated is provided.

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CHAPTER 1. INTRODUCTION

As a building material, wood has many desirable properties: it is resistant to mild chemicals, it insulates against electricity; it is the best thermal insulator of all known building materials; it can easily be worked with tools and machines; and it is a renewable resource. Unfortunately, wood also burns; it is susceptible to attacks by insects, fungi, and marine borers; and it shrinks and swells with changes in humidity. However, these undesirable properties of wood can be overcome my impregnating it with preservatives to guard against biological attacks, treating it with flame retardants to protect against fire, and applying chemcials to reduce shrinking and swelling (Wilkinson 1979).

Some species of wood are more resistant to decay than are other species, but all are rapidly attacked when used in contact with soil or water, or when exposed to high relative humidities without adequate air circulation.

The use of preservatives can increase the service life of wood from 5- to 15-fold, depending upon the conditions of treatment and the nature of service (Kent 1974). As a result, preserving timber will provide economic and social benefits: naturally nondurable species can be used, the cost and manpower for replacement will be reduced, and forests will be conserved, allowing ample time for renewal of this valuable and aesthetic resource.

The preservation of wood has been carried out in some manner for over 4,000 years. Noah is said to have treated the Ark with pitch. Archeologic excavations of buildings have shown that timbers were often charred in an attempt to preserve them. Ancient civilizations used various natural oils to preserve wooden statues, boats, and dwellings. The Greeks bored holes and poured in oils to achieve deep penetration. The Romans used alum to keep wooden towers from burning (Wilkinson 1979).

Scientific wood preservation began in the 1800's. At that time, there wan an economic need for an effective process, the construction materials were available, and the technology was well established. In 1838, John Bethell invented a practical process for impregnating timber with preservative under pressure. The primary chemical preservatives used then were creosote oil and zinc chloride. Several other major processes and chemicals have come into industrial use since that time. These include the Rueping and the Lowry processes, both invented in the early 1900's, and the use of pentachlorophenol and inorganic arsenicals as preservatives (Hunt 1967, Wilkinson 1979).

Biologic decay of wood is caused by fungi, insects, marine animals, and bacteria. Fungi produce rot, particularly at ground level where the timber remains moist and there is sufficient food, oxygen, and warmth. Fungi are also responsible for surface mold and stains, which do not prevent use of the wood but do affect its appearance and reduce its value.

At any stage of their existence, trees provide food and shelter for insects. Some insects only infest bark, some prefer hardwoods rather than softwoods, some only attack seasoned wood. Of the wood-destroying insects, subterranean termites cause the greatest amount of damage. There are also two other types of wood-destroying termites: drywood and dampwood termites. Termites feed on almost any species of wood and many preservatives are not effective against them. Over 250,000 species of beetles exist, divided into six families: Lyctidae, which primarily infest hardwood timber and attack the sapwood; Anobiidae, which infest both hardwoods and softwoods and attack both the sapwood and the heartwood; Cerambycidae, of which only a few species attack seasoned timber; Bostrichidae, which attack the sapwood of hardwoods after the trees have been felled and during seasoning; and Platypodidae and Scolytidae, which attack any kind of unseasoned timber.

Marine borers attack any timber in sea or brackish water. There are two types of borers: molluscs and crustaceans. Molluscan borers are active in tropical waters, and marine pilings are particularly affected. The outside of the wood may display no signs of damage yet half the weight of the structure may be gone. Crustacean borers are surface borers, causing the wood to have a spongelike appearance. They attack only a localized area of marine pilings, often between half-tide and low-tide levels.

Bacteria only attack wood when it is extremely wet, eg, when it is stored in logging ponds or rivers, buried in soil, used in marine pilings, or used in mines (Wilkinson 1979).

This report discusses the major chemicals and processes used today for the preservation of timber and represents the first step in JRB's approach to gathering and evaluating data from plant visits. The material developed in this report will be used to identify and contact those plants and organizations that represent useful sources for information on the preservation process, on potential employee health hazards, and on control of these hazards, including sampling techniques, medical surveillance programs, engineering controls, work practices, personal protective devices, trining programs, and other methods.

CHAPTER 2. WOOD PRESERVING CHEMICALS

The properties desired in a commercial wood preservative include: toxicity to wood destroyers, permanence, penetration, safety of handling and use, harmlessness to wood and metal, inexpensiveness, and economy of application. Depending upon the end use of the wood treated, the preservative may also need to be clean, colorless, odorless, paintable, nonswelling, fire resistant, and/or moisture repellent. Currently, no one preservative exists that meets all of these requirements. The properties required will depend upon the character of the wood to be treated and the intended use (Hunt 1967).

Thousands of chemicals have been tried as wood preservatives during the last 2,000 years (Wilkinson 1979). By the 1850's most of the ineffective substances had been rejected. During this period creosote and certain cooper, zinc, arsenic, and mercury compounds became widely available and were shown to be highly effective. Since that time many new chemicals and mixtures have been proposed and tested. Although it might appear that hundreds of chemicals are being marketed, many are just different formulations of the same compounds.

There are three main types of wood preservatives: tar oil preservatives, which are primarily creosote and creosote combinations, organic solvent preservatives, primarily pentachlorophenol dissolved in an organic solvent; and water-borne preservatives, primarily inorganic arsenic salts. Each of these types will be discussed in the following sections.

2.1. TAR OIL PRESERVATIVES

Coal tar creosote is the most important and most widely used tar oil preservative. Other tar oils include those made from peat, shale, and wood (Wilkinson 1979). The widespread use of coal tar creosote began in 1838 with the development of the Bethell process for wood preserving, although creosote's preservative properties were known as early as 1681.

Today creosote is used alone or in mixtures with coal tar or petroleum oils; as much as 50% of these oils will be added. These creosote mixtures are made primarily to reduce the cost of the preservative. The mixtures are less toxic than creosote alone (Hunt 1967).

Creosote is the tar oil distillation fraction that boils off at temperatures of 200 to 400°C; the components boiling above 355°C are called the residue (Wilkinson 1979). All creosote oils contain hundreds of compounds, most of which are hydrocarbons with some tar acids and tar bases. Therefore, specifications of the various grades are based on certain physical properties, such as specific gravity and distillation fraction boiling points. Creosote is termed light-oil creosote when it contains only a small proportion of the higher boiling components, and heavy-oil creosote when it contains a high proportion. The type of creosote used depends upon the use of the end product. The American Wood Preservers' Association (AWPA) sets standards for the composition of the various grades of creosote, creosote-coal tar, and creosote-petroleum mixtures. The properties of creosote include: marked toxicity to wood destroyers; insolubility in water, which makes it resistant to leaching; ease of application and penetration; noncorrosiveness to metals; protection against weathering and splitting; high electrical resistance; and ready availability in different grades (Hunt 1967, Wilkinson 1979). Usually heavy oils are used in either full- or empty-cell processes (See Chapter 3) for treating railway ties, marine pilings, and utility poles, which are exposed to severe weather and must have long service lives. The lighter oils are used for materials such as fencing and farm buildings, which are exposed to less severe conditions. Light oils are usually applied by either the empty-cell pressure process or by dipping, spraying, or brushing procedures (Wilkinson 1979).

Creosote is unsuitable for use in food containers or building interiors, because it gives off an odor. In addition, creosote is unsuitable for timbers that need to be painted or coated because it does not result in a clean, dry surface. Creosote properties can be improved by better blending and with the addition of other chemicals, depending upon the end use of the products (Wilkinson 1979).

2.2. ORGANIC SOLVENT PRESERVATIVES

Organic solvent preservatives consist of an insecticide and/or fungicide dissolved in an organic solvent such as petroleum distillate. This type of preservative has been in use commercially since the 1920's. The most important and widely used fungicide is pentachlorophenol (PCP). The primary insecticides used in organic solvent preservatives are: solubilized copper-8-quinolinolate, copper naphthenate, and bis (tri-n-butyl tin) oxide. Other compounds used in the past included the organochlorines, particularly lindane and dieldrin; however, the use of many organochlorines has been banned in the United States. They have largely been replaced with organophosphorous compounds, but these compounds are not used in wood preservation as yet (Hunt 1967, Wilkinson 1979) probably due to their chemical lability. Two advantages of the organic solvent preservatives are: ability to control and analyze the concentration of active chemicals accurately and the ability to select the most suitable solvent for both the active chemicals used and for the end use of the product. In addition, these preservatives can be selected so as to leave the wood surface clean, odorless, and paintable.

PCP is the most widely used active chemical in organic solvent preservatives. The disadvantages of this chemical are: limited solubility in organic solvents and crystallization, or blooming, of PCP on the wood surface. These disadvantages can be overcome by adding co-solvents, and waxes and resins (known as anti-blooming agents) to the solvent.

The AWPA standards specify that the solution must contain not less than 5% PCP by weight (Hunt 1967). The preservative value of PCP will depend in part on the solvent used. Solvents used include heavy petroleum oils, kerosene, diesel fuel, mineral spirits, and liquified petroleum gas. In addition, PCP can be added to standard coal tar creosote (not less than 2% by weight); this results in a preservative more effective than creosote alone.

The advantages of using PCP include: extreme toxicity to fungi, insolubility in water to resist leaching, non-volatility, noncorrosiveness to metals, and, depending upon the solvent used, provision of a clean surface that can be painted or glued as soon as the solvent has evaporated. PCP is used primarily in the treatment of poles and sawn timbers. It is also used extensively for joinery treatments.

Commercial grade PCP contains at least 95% chlorinated phenols, of which approximately 83-85% is PCP, 6% is tetrachlorophenol, and the remainder is other chlorinated compounds (Hunt 1967, Wilkinson 1979). Potential toxic contaminants of commercial PCP include chlorinated dibenzo-P-dioxins and dibenzofurans. PCP is known to be irritating to the skin and mucous membranes, and precautions should be taken when using it.

Solubilized copper-8-quinolinolate preservative is a condensation product of copper-8-quinolinolate and nickel-2-ethylhexoate. It is a green liquid that is toxic to wood destroyers, but relatively non-toxic to plants and animals, including humans. The Food and Drug Administration has approved its use for treating wood used in food containers. It is also used in seed boxes and greenhouse timbers (Hunt 1967, Wilkinson 1979).

Copper naphthenate is a mixture of naphthenic acids, which are produced as byproducts of petroleum refining, and soluble copper salts. It is sold as a concentrate containing 60-80% copper naphthenate, the equivalent of 6-8% copper metal. The primary use of copper naphthenate is as a brush-on, antifouling preservative for boat maintenance. One of the disadvantages of using it is that it leaves a dark-green waxy surface which precludes over-painting. Zinc naphthenate is used for colorless applications, but is not as effective a preservative (Hunt 1967, Wilkinson 1979).

2.3. WATER-BORNE PRESERVATIVES

Water-borne preservatives have the advantages of being cheap, available, penetrative, and free from fire and explosion hazards. In addition, they leave a surface that is clean, odorless, nonoily, nonpoisonous to animals, safe to handle, and paintable. The early water-borne preservatives were simple water-soluble metal salts that were easily leached from the wood.

The leaching problem was solved by adding large amounts of chromium, which made the salts insoluble and fixed them inside the wood. Today, the AWPA recommends five water-borne preservatives in several different formulations. These are: copper/chrome/arsenate (CCA), acid copper chromate (ACC), chromated zinc chloride (CZC) fluor/chrome/arsenate/phenol (FCAP or Wolman salts), and ammoniacal copper arsenate (ACA). Of these five, CCA is the one most widely used (Wilkinson 1979).

CCA's are available as dry mixtures of crystalline powders, pastes, or liquid concentrates. They are also available as salt-containing formulations and salt-free, oxide, or O-type formulations. The AWPA specifications classify CCA preservatives into three types: A, B, and C, which correspond to proportionately high, low, and intermediate amounts of arsenic. Relative proportions of ingredients are expressed as "active oxides," eg, amounts of copper oxide, chromic oxide, and arsenic pentoxide (Wilkinson 1979).

Preservative solutions are made by mixing the CCA concentrate with water, and are applied by the full-cell process. The solutions are odorless, non-corrosive to metals, and chemically stable at normal temperatures (up to 50°C). The preservatives are highly effective and resistant to leaching. For most purposes CCA preservatives are considered equal to creosote in their preservative ability. The treated wood needs to be dried prior to use, but the treatment leaves a clean, nonoily, and paintable surface (Wilkinson 1979).

During the drying period, it is possible for small amounts of preservative to be leached from the wood by rain. In addition, strong sunlight can cause the wood to develop a striped green appearance, which can be prevented by covering the wood. The CCA treated wood is harder but less resistant to abrasion than untreated wood (Wilkinson 1979).

ACC, another water-borne preservative, is used primarily on building timbers except in termite areas. Its volume of use is approximately one-tenth that of CCA.

ACA is made up at the treatment plant by dissolving copper and arsenic compounds in acetic acid with the aid of ammonia gas or solution. The ammonia evaporates after treatment, fixing insoluble copper arsenite in the wood. Because the ammonia attacks copper alloys, alternative materials must be used for valves and fittings. ACA gives good service in ground contact and marine use (Wilkinson 1979).

FCAP, Wolman-type preservatives, are mixtures of sodium fluoride and chromate, sodium arsenate and 2,4-dinitrophenol (a highly toxic compound). Recently, the dinitrophenol has been replaced by sodium pentachlorophenate to prevent yellowing of the timber (Wilkinson 1979, Hunter 1974).

CZC has replaced pure zinc chloride, as it is more resistant to leaching. Although CZC was previously used in substantial quantities, its recent use has dropped due to use of the other water-borne preservatives (Wilkinson 1979).

The major problem with the use of water-borne arsenate preservatives is their high toxicity to human and animal life. Additionally, as reported in the NIOSH criteria document on inorganic arsenic (New Criteria - 1975) some forms of inorganic arsenic are suspected of being human carcinogens.

Several other preservatives are currently in use or are being tested in other countries. These include copper/chrome/boron, copper/chrome/fluorine, copper/chrome/phosphorous, and boron compounds, such as disodium octaborate tetrahydrate. The boron and fluorine are not fixed in the wood and will leach out. Water-borne preservatives based on amine compounds, known as AAC's, are being tested in New Zealand (Wilkinson 1979).

CHAPTER 3. WOOD PRESERVING PROCESSES

The practice of preserving wood has been going on for over 4,000 years. The use of modern industrial methods for preserving wood began in 1938, with the invention of a practical process for impregnating timber with preservatives under pressure (Wilkinson 1979). The basic principles of operation remain the same today.

The processes in use today can be divided into two main categories: pressure and non-pressure treatments. There is a third category of miscellaneous processes and processes used to treat unseasoned or green wood. More than 85% of the wood preservation done in the United States is done by pressure processes (Todd 1978).

3.1 PRESSURE PROCESSES

Pressure processes involve enclosing the timber in a steel pressure vessel and forcing preservative into the wood cells, using hydraulic pressure. There are several variations of this process that involve the application of a vacuum or air pressure (Wilkinson 1979). The processes can be categorized further as full-cell (Bethell) or empty-cell (Rueping or Lowry) processes. These three processes are the primary ones used, although several others are also in use.

The advantages of pressure over non-pressure treatments include: deeper, more uniform penetration, and higher absorption of preservative. In addition, pressure treatment is a more effective use of preservative, because treatment conditions can be controlled better, and retention and penetration can be varied according to the requirements of service (Hunt 1967).

3.1.1. Full-Cell Process

This process was invented by John Bethell in 1838, and although the machinery has improved over the last 150 years, the basic operating principles are still the same (Wilkinson 1979). The purpose of the treatment is to fill the cells of the wood with the maximum amount of preservative. This process is used for almost all water-borne preservatives. It is used for creosote only when high preservative retentions are required, because wood cells full of creosote tend to 'bleed' surplus preservative from the wood. When creosote is used it must be heated to 65-100°C during the pressure period.

The full-cell process has five distinct stages (Wilkinson 1979). First, an initial vacuum of 125 mm Hg (1.67×10^4 Pa) is applied for 15 minutes to 1 hour, in order to pull air from the wood cells. Second, the vessel is flooded with preservative while the initial vacuum is maintained. Third, the vacuum is released and pressure is applied gradually until it reaches 150-200 psi ($1.03\text{-}1.38 \times 10^6$ Pa). This pressure is maintained for either a specified amount of time or until the required amount of preservative has been forced into the wood. This period usually ranges from 1 to 6 hours. Then the pressure is released, and 5 to 15% of the preservative is forced out of the timber due to expansion of the small amount of our compressed in the cells. This is known as "kick-back." Fourth, the remaining preservative is drained from the vessel. Fifth, a final vacuum of 125 mm Hg (1.67×10^4 Pa) is applied and either released immediately or maintained for 10-15 minutes. This is done to lessen dripping from the treated timber as it leaves the vessel. A flow diagram of the full-cell process is presented in Figure 3-1.

3.1.2. Empty-Cell Processes

There are two types of empty-cell processes: the Rueping process, invented by Max Rueping in 1902; and the Lowry process, invented by Cuthbert Lowry in 1906 (Wilkinson 1979). The processes are the same except for the initial step. In both processes most of the preservative is expelled from the wood, leaving the cells empty but the cell walls

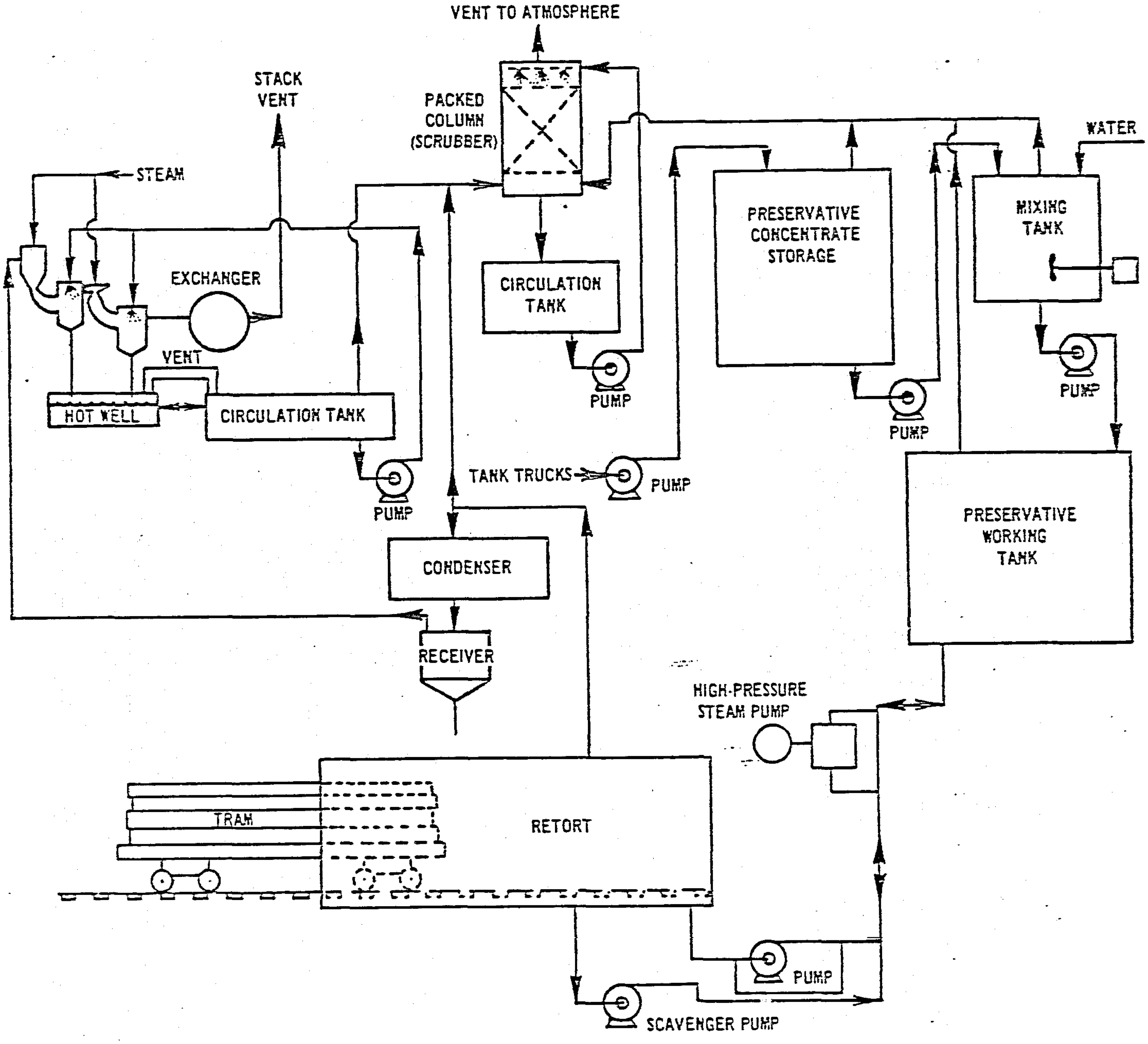

Figure 3-1 Flow Diagram for the Full-Cell Pressure Process

Source: Danielson (1973)

thoroughly treated. This reduces the amount of preservative needed, and thereby the cost, while ensuring deep penetration. These processes are used almost exclusively for creosote and pentachlorophenol in heavy oil.

As with the full-cell treatment, there are five stages in the empty-cell process. First, in the Rueping process, compressed air is injected into the pressure vessel until a pressure of 60 psi (4.1×10^5 Pa) is reached. This forces air into the wood cells and compresses the air already present. In the Lowry process this first step is omitted. Second, the vessel is flooded with preservative. In the Rueping process this is done while maintaining air pressure, to ensure that the injected air is trapped in the wood cells. This can be done either 1) by forcing preservative in through the bottom while air escapes through vents in the top, or 2) letting preservative flow by gravity from an overhead Rueping tank that is kept at the same pressure as the pressure vessel while displaced air passes up to the space in the overhead tank. In the Lowry process the preservative is loaded against atmospheric pressure in the treating vessel. If the preservative used in either process is creosote, it must be heated to between 65 and 100°C. The first two stages take approximately 30 minutes. Third, pressure is raised gradually to 150-200 psi ($1.03 - 1.38 \times 10^6$ Pa). The hydraulic pressure forces preservative into the wood cells and further compresses the trapped air. Pressure is maintained until the required absorption is obtained. The pressure is released, and the compressed air in the cells expands, forcing out as much as 60% of the preservative (kick-back). In the Lowry process less preservative is forced out than with the Rueping process, but more preservative is recovered than with the full-cell process. Fourth, the surplus preservative is drained out of the vessel and returned to the storage tanks. Fifth, a final vacuum is applied to prevent dripping from the treated wood as it leaves the vessel (Wilkinson 1979). A flow diagram of the empty-cell process is shown in Figure 3-2.

A new variation of the Rueping process that fixes copper/chrome/arsenic (CCA) salts in the timber before kick-back occurs has been developed recently; however, it is not being done on a commercial scale. This is

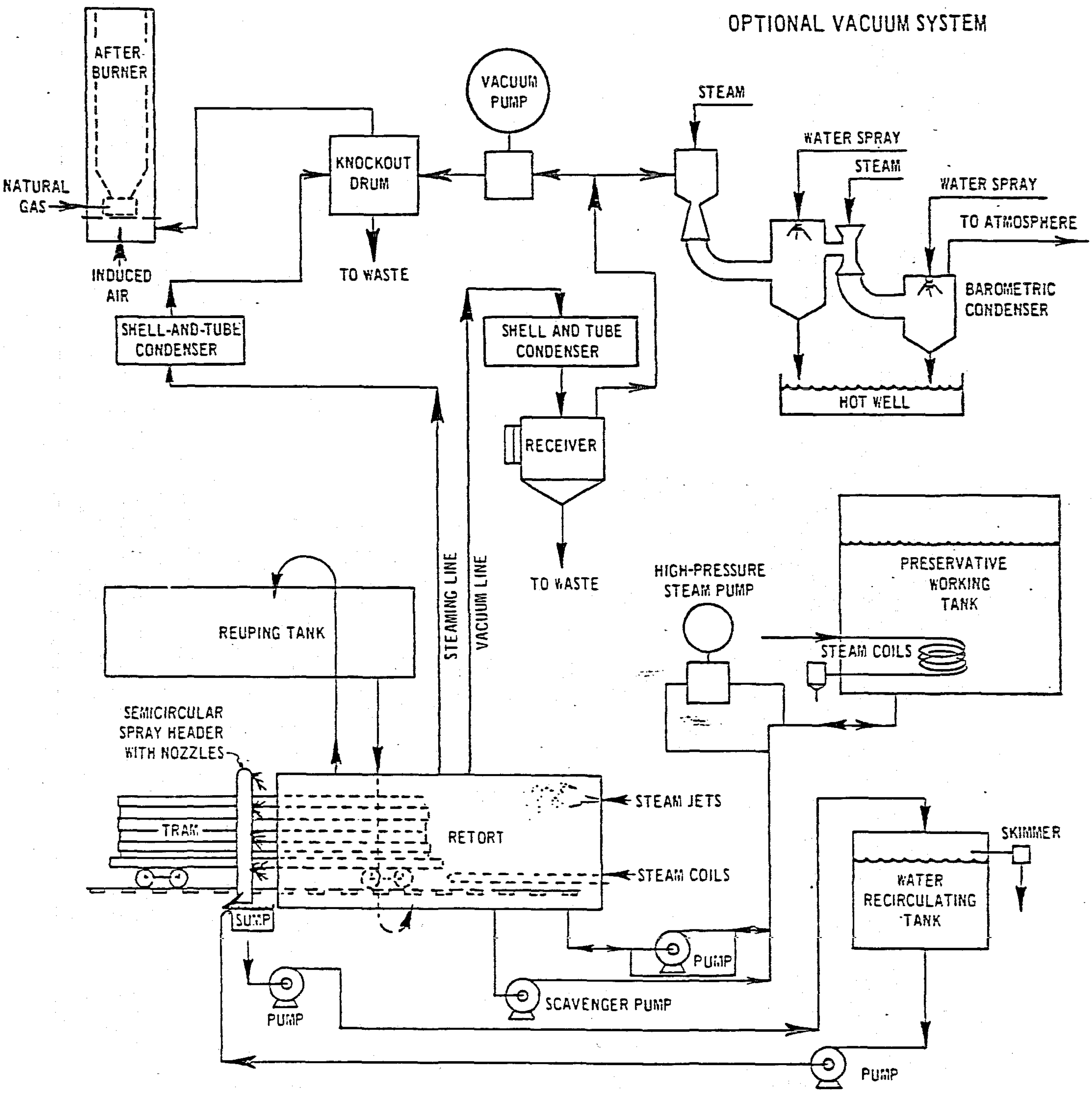

Figure 3-2 Flow Diagram for the Empty-Cell Pressure Process

Source: Danielson 1973

the only use of an empty-cell process for a water-borne preservative (Wilkinson 1979).

3.1.3. Other Pressure Processes

Several other pressure processes are in use throughout the world. Only those processes in use in the United States will be discussed. The double vacuum system uses the operating principles of the full-cell process (discussed previously in Section 3.1.1.); however, the pressures are approximately one-tenth of those used in a vacuum/pressure treatment. Because the pressures are less, the treatment vessels can have either a rectangular or circular cross-section. The five stages are the same as in the full-cell process, except that: 1) an initial vacuum of 135-510 mm Hg ($1.80-6.80 \times 10^4$ Pa) is applied for 3-10 minutes; 2) during the pressure period 15-30 psi ($1.0-2.1 \times 10^5$ Pa) is applied, and 3) a final vacuum of 260 mm Hg (3.47×10^4 Pa) is applied. The preservative used in this treatment is usually a light petroleum fraction organic solvent containing a fungicide and/or insecticide. The advantage of this process is that the timber comes out of the treatment vessel almost dry enough to touch and can be glued, painted, or glazed in a matter of days (Wilkinson 1979).

The other pressure process in use in the United States is the solvent recovery process, which uses an organic solvent to carry the preservative into the wood then the solvent is recovered. The method currently in use employs a liquified petroleum gas (LPG) as the solvent. The LPG solvent is usually isobutane or butane with a co-solvent (either isopropyl ether or a polyethylene glycol) containing 2-4% pentachlorophenol (PCP). The solution must be stored under pressure or the solvent will escape as a gas. Six stages are involved in the process. First, an initial vacuum of 260 mm Hg (3.47×10^4 Pa) is applied; then the pressure vessel is flushed with an inert gas. This prevents the development of an explosive mixture. Second, a vacuum of 160 mm Hg (2.13×10^4 Pa) is drawn. Third, treating solution is flooded into the vessel and a pressure of 25-40 psi ($1.4-2.8 \times 10^5$ Pa) is maintained. Fourth, the pressure is raised to 100-150 psi ($6.89-10.3 \times 10^5$ Pa), and the solution is heated to 20-30°C. Fifth, the solution is returned to storage, and the remaining solvent is evaporated from the wood by reducing pressure to a final vacuum of 160 mm Hg (2.13×10^4 Pa). Then the vapor is collected and condensed in a separate vessel and returned to storage. Sixth, the vessel is flushed again with insert gas. The advantages of this treatment are: a dry product is available in a short amount of time; deeper, more even penetration is achieved; and there is no blooming of pentachlorophenol crystals on the wood surface. Disadvantages include high capital and operating costs, as well as the danger in handling the highly flammable LPG solvent (Wilkinson 1979).

3.2. NON-PRESSURE PROCESSES

There is a wide variety of processes for treating wood that do not invovle the use of a pressure vessel (Wilkinson 1979). Only a very small percentage of the commercially treated wood is treated with these non-pressure methods. Brushing and spraying are the simplest of these methods and are used to apply small amounts of preservative. These two methods are also the only way to treat wood already erected. The usual preservatives used are creosote and organic solvent types. In the brushing and spraying methods, preservative penetration and retention are much lower than with pressure methods. For the most part, this is due to the natural resistance of wood to penetration (Hunt 1967, Wilkinson 1979). In using these methods, preservative should be flooded over the surface of the wood and allowed to soak into the wood as much as possible. The two methods are most effective when applied to end-grain surfaces, because preservatives penetrate much more readily in the direction of the grain.

When the immersion or dipping processes are used, the wood is immersed or dipped into a bath of preservative for a few seconds or minutes. (Hunt 1967, Wilkinson 1979). The immersion time is adjusted depending on the species of wood and the end use of the product. These processes require more equipment and larger amounts of preservative than do the spraying or brushing procedures. Immersion or dipping involves longer contact between wood and preservative, and ensures more adequate penetration of openings; however, the degree of protection obtained is not greatly superior to that resulting from a thorough brush or spray treatment (Hunt 1967). The dipping and immersion treatments are used primarily to treat joinery components because good penetration can be obtained at joints and other places where the end grain of wood is exposed.

Longer periods of immersion are known as cold soaking, steeping, and Kyanising. In these methods the wood is submerged in a tank of preservative for several days or even weeks. Preservative usually is kept at ambient temperatures, although heating would allow more rapid penetration (Hunt 1967). These processes were used extensively in the past but are no longer practicable; they are almost obsolete (Wilkinson 1979). Their chief remaining use is for farm and estate timbers, and the preservatives used are either oil-based solutions containing PCP, or dipping grade creosote.

The hot and cold open tank process, also known as the boiling and cooling method or thermal process, was patented by Charles Seely in 1867 (Hunt 1967, Wilkinson 1979). This could be considered a pressure method because preservative is forced into the wood by a pressure change due to a change of temperature, although the use of a pressure vessel is not required. In this process the timber is immersed in a hot preservative, usually creosote, at 88-113°C for at least 6 hours. This causes air to be expelled from the cells due to thermal expansion and heating of the water in the wood. The hot bath is followed immediately by a cold bath. The rapid change from hot liquid to cold creates a partial vacuum, and atmospheric pressure forces the preservative into the wood cells. The greater the cooling, the higher the amount of absorption. The cold bath is kept at the coolest temperature possible that will still allow the preservative to remain in a thoroughly liquid state; this temperature is usually around 38°C for creosote. Timber remains in the cold bath for at least 2 hours. The bath temperatures and soaking times are specified in the AWPA standards. The change in baths can be accomplished either by transferring the heated wood to a separate tank of cool preservative; by quickly draining the hot preservative from the tank and pumping in cool preservative; or by removing the heat and allowing the hot preservative and wood to cool together. The first method, transferring the wood, is used only rarely, because of increased capital outlay and handling requirements (Hunt 1967, Wilkinson 1979).

Water-borne preservatives also can be applied by this method; however, preservative oils have the advantage of providing better protection. Oils can be heated to the desired temperatures in open tanks without excessive loss by evaporation, whereas temperatures of water-borne preservative baths must be kept lower to avoid excessive loss of water by evaporation and to prevent precipitation of part of the salts out of the solution (Hunt 1967).

For woods that are impregnated easily, a hot soak after the cold soak may be necessary to avoid excessive retention of preservative. Excessive retention may cause preservative to bleed from the wood at a later time. Shortening the time spent in the cold soak and then replacing the wood in the hot soak will allow for good penetration without excessive retention (Hunt 1967).

The hot and cold open tank process is used primarily for the preservation of poles and fence posts. There is relatively little commercial use of this method. The process is used mainly on farms where it is easy for a farmer to preserve fence posts by using 55-gallon drums for the tanks (Hunt 1967). There are numerous variations of the hot and cold process, but the basic principles are the same.

3.3. PROCESSES FOR TREATING UNSEASONED TIMBER

In order for the processes discussed previously to be effective, the timber must be prepared correctly. Usually, logs must be debarked, cut into appropriate end-use sizes, seasoned, and, if necessary, conditioned, to allow for good penetration of preservative. The removal of moisture from green wood changes the properties of the wood to such an extent that the resultant timber is called 'seasoned' rather than dried (Wilkinson 1979).

Several preservation processes exist that can be used to treat green or unseasoned timber. These can be divided into two types: diffusion and sap-displacement.

3.3.1. Diffusion Processes

Diffusion processes work on the principle that highly water-soluble preservatives applied in concentrated form to the surface of wet timber tend to dilute themselves automatically in the water of the wood cells and then sink in gradually (Wilkinson 1979). The preservatives must be highly soluble in water, and therefore, the borate preservatives are the ones usually used on a commercial scale. Usually, the diffusion processes are carried out at sawmills on newly sawn timber (timber sawn within 7 to 30 days). Treatment can be done in several ways. In the immersion process, the timber is dipped into a large open tank of preservative, at concentrations of 25-40% and 30-65°C temperature, for approximately 5 minutes. When the steam and cold quench method is used, timber is steamed at 80°C, the condensed water is drained, and a cool 2% treating solution is pumped in rapidly. Steaming takes 7 hours, and the entire process, 24 hours. After treatment by either method, the wood is stacked solidly, stored under tarpaulins, and allowed to dry slowly so that diffusion can occur. This takes 1 to 3 months, depending on the thickness of the timbers. After the entire process is complete, the wood can be seasoned. The disadvantage of the diffusion processes is that the preservative is not fixed in the wood and can be leached out in wet conditions (Wilkinson 1979).

The Osmose process consists of applying the preservative, a fluoride-phenol mixture, in paste or cream form to the surface of debarked wood, then stacking the wood in solid piles, covering it with a tarpaulin, and letting it dry for 30 days. This process has been used primarily for fence posts and mine timbers, and for groundline treatment of standing poles. For standing poles, the paste is brushed onto the pole and then wrapped with a protective bandage. The method is much less prominent today than in the past (Hunt 1967).

3.3.2. Sap Displacement Processes

In these processes, the sap in freshly felled timber is replaced by preservative. Currently, this is done by one of two methods (Wilkinson 1979). In the Gewecke pressure and suction method, the logs are debarked and placed on trams. Then the top ends are fitted with suction caps, which have been connected to a pipe running through the pressure vessel. The tram is sealed inside the vessel. Then, a CCA preservative is forced into the poles at 120-145 psi (8.27-10.0 x 10^5 Pa), while the sap is sucked out of the top end.

In the slurry seal process, debarked poles are loaded into a pressure vessel. A dosing tank containing a 1:1 slurry of fine sand and preservative is located above the vessel, near the end that has a door. The door has a filter and a perforated plate. The vessel is flooded, and preservative escapes through the door. Slurry is run into the vessel and carried by the escaping solution to the outlet. The sand is trapped by the filter and builds up a seal at the ends of the poles. A hydraulic pressure of 200 psi (1.38 x 10^6 Pa) is applied to the preservative; the pressure tightens the seal and forces the preservative to flow through the poles, the path of least resistance, displacing the sap. Preservative retention is controlled by adjusting the concentration of the solution. Poles made out of some species of wood can be treated in as little as 2 hours by this method, whereas conventional pressure treatments may take 32 hours. Full-scale treatment by this method is possible, but is not being done on a commercial scale as of yet (Wilkinson 1979).

CHAPTER 4. EXTENT OF EXPOSURE TO WOOD PRESERVATIVES

The wood preserving method used influences the extent of worker exposure. Wood preservatives are applied using either pressure or non-pressure processes, as was described in Chapter 3. The process and equipment used determine the number of workers needed, and when considered with the properties of the preservative used, determine the potential for worker exposure.

An unpublished draft of a United States Department of Agriculture (USDA) study indicates that there are 631 wood preserving plants in the United States. Of 601 plants that responded to a questionnaire, 27 plants (5%) have both pressure and non-pressure treating capabilities, and 495 (82%) have only pressure treating facilities. The remaining 79 plants (13%) are classified as non-pressure wood preservers.

In all of the pressure treatment processes, worker exposure is limited because much of the procedure is automated and enclosed. Wood items treated under pressure are generally too large to be handled manually and thus require mechanical handling, which reduces the potential for skin contact. An estimated 18 workers can complete a pressure treatment procedure involving the generally accepted maximum of six pressure vessels (Todd 1978).

The points of potential exposure are common to all types of pressure processes and preservatives. Exposures can occur during mixing and blending operations, when equipment leaks, when a pressure vessel is opened in the absence of a steam purge, when a tram is withdrawn from a pressure vessel without proper cooling of the treated wood, if preservative runoff occurs as trams are withdrawn, during equipment maintenance, and when treated wood is stored before being shipped.

Non-pressure treatment is a less enclosed process requiring more worker involvement than pressure treatment, and thus presenting a greater potential for worker exposure to preservatives. Non-pressure processes generally involve wood items that are small enough to permit manual handling, so skin contact with treated wood is much more likely than when mechanical handling devices are used. In addition, splashes or spills at any point in the non-pressure process could cause skin contact. Vaporization of preservatives also increases the potential for worker exposure. These hazards are discussed in more detail in the following paragraphs.

Tar oil preservatives are the primary wood preservatives used in the United States. According to the USDA, 134 million gallons of creosote or creosote-based preservatives were used in 1976. The USDA report estimated 98% of all tar-oil treatment is done in pressure processes and that 4,000 workers are exposed to creosote-compounds. Some of these workers are exposed to occasional high amounts of these preservatives. Skin contact can cause chemical burns, dermatitis, and possibly skin cancer. Inhalation of vapors or mists may increase the risk of lung cancer (Todd 1978).

In the United States, approximately 100 workers are involved in commercial non-pressure treatment of wood with tar oils (USDA undated). Some of these workers may inhale vapors or mists from heated creosote as they spray, dip, or brush on the compounds. Ingestion of mists and droplets may also occur as mentioned previously, these workers involved in this process usually handle the treated wood, and thus skin contact with creosote may occur. Skin contact may also result from preservatives splashing or spilling.

The greatest number of people exposed to creosote, estimated to be 50,000, are carpenters, farmers, and homeowners (USDA undated). In this group, the potential for skin contact with or inhalation of preservatives may be high on occasion, but is comparatively infrequent. These users purchase 0.2% of the creosote produced, or about 2 million pounds (USDA undated), as shown in Table 4-1.

Of the organic solvent preservatives, pentachlorophenol (PCP) is used in the greatest quantities. In 1976, 39 million pounds were used in wood preservation (Todd 1978). PCP can be used in every solvent but water, in every process but steeping, and in the treatment of all wood products. It is marketed in 50-pound bags, and in 1,000- and 2,000-pound blocks. About 90% of PCP is applied using pressure methods, which minimize worker contact. According to the USDA, 4,400 production workers and 800 non-production personnel encounter some degree of exposure to PCP in the 295 United States pressure treatment plants that use this preservative.

In the United States, approximately 4 million pounds of PCP were applied using non-pressure methods in 1978 (USDA undated). The thermal and dip processes used involve open tanks, increasing the risk of dermal contact with and inhalation or ingestion of preservative. PCP is readily absorbed through human skin, and has been involved in many cases of poisoning after worker inhalation of the dust or dermal absorption. PCP is also fetotoxic and teratogenic. Severe dermatitis and neurologic disturbances have been noted after long-term, low-level exposure (Todd 1978). Approximately 750 production workers and 100 non-production wood preservers may be exposed to PCP in the United States (USDA undated).

Approximately 5 million pounds of the PCP produced is used for production of sodium pentachlorophenate, a water-borne wood preservative (Todd 1978). The USDA estimates that 20,000 production and 4,000 non-production personnel may encounter some degree of exposure to this preservative during commercial dip treatment of wood. Absorbtion of sodium pentachlorophenate is most likely to occur via the dermal route because of the low volatility of the compound.

Other water-borne wood preservatives include the inorganic arsenicals. Inorganic arsenic health effects are well known, and include eczymatous contact dermatitis, cardiotoxicity, and possible increased risk of cancer. Inorganic arsenicals are the primary preservatives used for lumber and are applied by approximately 325 plants in the United States (USDA undated). A total of 2,000 workers of all types are employed in these plants (USDA undated), but those involved with arsenical application are estimated to be fewer than that number because 104 of the plants also treat wood with other preservatives. The arsenicals are used under pressure, so there is less potential worker exposure. Of all of the workers potentially exposed to arsenicals, pressure vessel operators and wood unloaders and stackers experience the greatest degree of exposure because wood items are usually still wet when removed from the pressure vessel. However, USDA researchers consider such exposures to be minimal.

Table 4-1 lists other less commonly used wood preservatives and pertinent information, when available.

TABLE 4-1

<u>WOOD PRESERVATIVE USAGE</u> (mixed 1976 and 1978 data)

Wood Preservative	Industrial Usage							Non-Industrial Usage		
	Pressure Method			Non-Pressure Method						
	Plants	Amount Applied	Workers	Plants	Amount Applied	Workers	Wood Preserved (ft^3)	Amount Sold	Users	Total Amount Used (year)
Tar-Oil Types	188	134 million gal	4,000		3 million gal	100		2 million lb	50,000	137 million gal (1976)
creosote		41.5 million gal			0.5 million gal					
creosote-coal tar		62.6 million gal								
creosote/petroleum		29.9 million gal								
Organic-Solvent-Borne										
copper-8-quinolinolate		32,500 lb								32,500 lb (1974)
pentachlorophenol	295	39 million lb	5,200		4 million lb	1,150		1.5 million lb	1 million	44.5 million lb (1977)
Water-Borne	325		2,000							
acid copper chromate										710,000 lb (1976)
chromated copper arsenate							6 million			17 million lb (1975)
chromated zinc chloride							879,000			510,000 lb (1975)
fluorchrome arsenate phenol							842,000			250,000 lb (1975)
sodium pentachlorophenate					1.2 million lb	24,000				5 million lb (1977)
Total	522			79			327 million			

Sources: US Department of Agriculture (undated)
Todd (1978)

CHAPTER 5. WOOD PRESERVING PLANTS

The Standard Industrial Classification (SIC) Code for wood preserving is 2491. Examples of the products treated by industries classified under this SIC code are given in Table 5-1.

In 1978, 631 plants treated over 327 million cubic feet of wood products. Out of 601 plants responding to a questionnaire, 522 do pressure treating, 52 do non-pressure treating, and 27 do both types of treating. Of those 601 plants, 325 use water-borne preservatives, 295 use organic solvent (pentachlorophenol) preservatives, and 188 use tar-oil (creosote) preservatives; 424 plants use only one type of preservative, while the remaining 177 use more than one type. In 1976, 134 million gallons of creosote preservatives were used. Production and use figures for 1974-75 show that approximately 50 million pounds of active chemicals were used for organic solvent preservatives, and approximately 22 million pounds of water-borne preservatives were used.

Table 5-2 is a list of wood preserving plants in the United States. Each company listed will be contacted to determine what types of processes and preservatives it uses. A representative sample will be chosen for site visits. A sample contact letter used for requesting information is shown in Figure 5-1.

TABLE 5-1. PRODUCTS TREATED UNDER SIC CODE 2491

Bridges and trestles, wood

Crossties

Flooring, wood block

Millwork

Mine props

Piles, foundation and marine construction

Piling, wood

Poles and pole crossarms

Poles, cutting and preserving

Posts, wood

Railroad cross bridge and switch ties

Structural lumber and timber

Vehicle lumber

TABLE 5-2. WOOD PRESERVING PLANTS IN THE UNITED STATES

Acme Wood Preserving, Inc.
Princeton, WV

Alabama-George Wood Preserving Co.
LaFayette, AL

Albermarle Wood Preserving Plant
Albermarle, NC

Algoma Hardwoods, Inc.
(formerly U.S. Plywood)
Algoma, WI

American Can Co., Sanders Lumber Products
Meridian, MS

American Creosote Works, Inc.
Pensacola, FL (HQ)
Jackson, TN
Louisville, MS

American Crossarm and Conduit Co.
Chehalis, WA

Americus Wood Preserving Co.
Americus, GA

Angelina Hardwood Sales Co.
Lufkin, TX

Appalachian Timber Services, Inc.
Charleston, WV (HQ)
Sutton, WV
White Plains, KY

Arant, D B, Inc.
New Bern, NC

Arnold Lumber Co.
Caryville, FL

Atchison, Topeka, and Santa Fe Railway Co.
Chicago, IL

Atlantic Creosoting Co., Inc.
Portsmouth, VA (HQ)
Hainesport, NJ (HQ)
Savannah, GA (HQ)
Vidalia, GA

Atlantic Lumber Co.
Pompano Beach, FL

Atlantic Wood Industries, Inc.
Savannah, GA (HQ)
Portsmouth, VA
Hainesport, NJ
Vidalia, GA
Athens, NY
Fruitland, MD

Augusta Wood Preserving Co.
Augusta, GA

Baldwin Pole and Piling Co.
Bay Minette, AL

Barnes Lumber Corporation
Charlottesville, VA

Baxter, J H & Co.
San Mateo, CA (HQ)
The Dalles, OR
Eugene, OR
Long Beach, CA
Renton, WA
Weed, CA
Laramie, WY
Arlington, WA

Olon Belcher Lumber Co.
Brent, AL

Bell Lumber and Pole Co.
New Brighton, MN

Benton Creosoting Div., Kennedy Saw Mills, Inc.
Shreveport, LA (HQ)
Benton, LA

Biewer, John A, Co., Inc.
St. Clair, MI

Birmingham Wood Preserving Corp.
Birmingham, AL

Bladen Lakes State Forest
Elizabethtown, NC

Boricua Wood Preserving, Inc.
Bayamon, PR

Bouma Post Yards
Choteau, MT

Broderick Wood Products Co.
Denver, CO

Burke-Parsons-Bowlby Corp.
Spencer, WV (HQ)
Billings, WV
Goshen, VA
Stanton, KY
DuBois, PA

Burlington Northern, Inc.
St. Paul, MN (HQ)
Brainerd, MN
Paradise, MT

Butcher Wood Preserving
Sandpoint, ID

Cahaba Lumber Co.
Centreville, AL

Cahaba Pressure Treated
Brierfield, AL

Caradco Corp.
Rantoul, IL

Carbolineum Wood Preserving Co.
Milwaukee, WI

Carney, B J & Co.
Spokane, WA (HQ)
Madera, CA

Carolina Creosote Corp., Inc.
Leland, NC

Carolina Wood Preserving Co., Inc.
Scotland Neck, NC

Cascade Pole Co.
Tacoma, WA

Cass County Treating Co.
Lindon, TX

Casswood Treated Products Co.
Beardstown, Il

Central Forest Products, Inc.
Shawnee Mission, KA (HQ)
Hugo, OK

Central Wood Preserving, Inc.
Slaughter, LA

Champion Building Products
East Point, GA

Chicago Flameproof and Wood Preserving Co.
Chicago, IL

Chistiansen, C M, Co.
Phelps, WI

Cleveland Wood Preserving Co.
Independence, OH

Coleman-Evans Wood Preserving Co.
Jacksonville, FL (HQ)
Whitehouse, FL

Collum's Lumber Mill, Inc.
Allendale, SC

The Colwood Co., Inc.
Columbia, SC

The Colwood Co., Inc.
(former Greenville Wood Preserving)
Greenville, SC

Conrad, W J, Lumber Co., Inc.
Coos Bay, OR

Conroe Creosoting Company
Conroe, TX

Continental Wood Preservers, Inc.
Detroit, MI

Cook, E D, Lumber Co.
Lockhart, FL (HQ)
Orlando, FL
Tampa, FL
West Palm Beach, FL

Cove Creek Industries
Covesville, VA

Cowboy Timber Treating, Inc.
Manderson, WY

Cox Wood Preserving Co.
Orangeburg, SC

Crosby Lumber Co., Inc.
Bay Minette, AL
Crown Zellerbach Treated Wood Products
Gulfport, MS (HQ)
Urania, LA
Mobile, AL

Culpepper Wood Preservers
Culpepper, VA

Cant and Russell, Inc.
Portland, OR (HQ)
North Planes, OR

D & D Wood Preserving
Albany, GA

David Timber Co., Inc.
Hattiesburg, MS

Dayton Flameproof and Preserving Co.
Dayton, OH

Duke City Lumber Co.
Livingston, TX

Durable Wood Preservers, Inc.
Charlotte, NC

East Texas Wood Treating Co., Inc.
Nacogdoches, TX

Elco Forest Products
Lake Charles, LA (HQ)
Opelousas, LA

El Dorad Pole and Piling Co., Inc.
El Dorado, AR

Elijay Lumber Co.
Elijay, GA

Engelien Wood Preserving, Inc.
Tomah, WI

Escambia Treating Co.
Pensacola, FL (HQ)
Brunswick, GA
Camilla, GA

Everdure, Inc.
Orange, VA

Evr-Wood Treating Co., Inc.
Jennings, LA

Fernwood Industries
Fernwood, MS

Florida Fence Post Co., Inc.
Ona, FL

Follen Wood Preserving Co.
Jackson, MS (HQ)
Elliott, MS

Forest Products Pressure Treating and Freming, Inc. (HQ)
Smelterville, ID (HQ)

Frank Brooks Manufacturing Co.
Billingham, WA

Garland Creosoting Co.
Longview, Tx

Gateway Forest Products, Inc.
Mather, PA

Georgia Wood Preserving Co., Inc.
Crawfordville, GA

Garrity Co., Inc.
Readville, MA

Glacier Park Co., Somers Lumber Div.
Somers, MT

Glennville Wood Preserving Co., Inc.
Glennville, GA

Godwin's, E W, Sons, Inc.
Wilmington, NC

Great Southern Wood Preserving, Inc.
Abbeville, AL

Gulf Treating Co.
Mobile, AL

Haley, R G, International Corp., Inc.
Bellingham, WA

Hallman, Fred M., Lumber Co.
Centreville, AL

Hart Creosoting Co.
Jasper, TX

Hatheway and Patterson Co., Inc.
Mansfield, MA

Hatheway-Patterson Corp.
Houston, TX

Hawaii Wood Preserving, Inc.
Honolulu, HI (HQ)
Kahului, Maui

Hill-Behen Lumber Co.
Haraham, LA (HQ)
New Orleans, LA

Hixon Lumber Sales
Pine Bluff, AR

Holbrook Warehouse Corp.
Albany, NY

Holcomb Creosote Co.
Yadkinville, NC

Hoosier Wood Preservers, Inc.
Indianapolis, IN

Hoover Universal
(formerly Dixiewood)
Pine Bluff, AR

Hoover Universal Wood Preserving Div.
Thomson, GA

Houston Chemical Service, Inc.
Houston, TX

Huffman Wood Preserving Inc.
Broken Bow, OK

Hughes Brothers, Inc.
Seward, NB

Idaho Pole Co.
Bozeman, MT

International Paper Co., Wood Preser. Div.
De Ridder, LA (HQ)
Joplin, MO (HQ)
Longview, WA (HQ)
Navasota, TX (HQ)

International Paper Co.
Wiggins, MS

ITT Rayonier, Inc., Wadsworth Lumber Div.
Bunnell, FL

Jasper Creosoting Co.
Jasper, TX

Jennison-Wright Corp.
Toledo, OH (HQ)
Granite City, IL

Jordan Companies, The
Memphis, TN

Joseph Forest Products, Inc.
Joseph, OR

Joslyn Mfg. and Supply Co.
Minneapolis, MN (HQ)
Woodstock, IL (HQ)
Portland, OR (HQ)

Julian Lumber Co.
Rattan, OK

Kalispell Pole and Timber Co.
Kalispell, MT

Kellogg Transfer, Inc.
Kingston, ID (HQ)
Enaville, ID

Kentucky Lumber Co.
Crestwood, KY

Kentucky Wood Preserving
Winchester, KY

Kerr-McGee Chemical Corp., Forest Products Div.
Oklahoma City, OK (HQ)
Avoca, PA
Indianapolis, IN
Kansas City, MO
Madison, IL
Meridian, MS
Milwaukee, WI
Bossier City, LA
Springfield, MO
Texarkana, TX

Kilfoyle Krafts and Tamping Co., Inc.
Price, UT

Kirby Forest Industries, Inc.
Houston, TX (HQ)
Silsbee, TX

Koppers Co., Inc., Forest Products Div.
Pittsburgh, PA (HQ)
Baltimore, MD
Carbondale, IL
Charleston, SC
Denver, CO
Florence, SC
Fort Newark, NJ
Gainesville, FL
Galesburg, Il
Green Spring, WV
Grenada, MS
Guthrie, KY
Houston, TX
Kansas City, MO
Montgomery, AL
Montgomery, PA
Nashua, NH
North Little Rock, AR
Ontario, CA
Orrville, OH
Richmond, VA
Salem, VA
Salisbury, MD
Superior, WI

Land O Lakes Wood Preserving Co.
Tenstrike, MN

Langdale Co., The
Valdosta, CA

Laurence Smith Plymill
Orchard Hill, GA

Leon Wood Preserving Co., Inc.
Tallahassee, FL

Lewis, Lumber and Mfg. Co.
Cove, AR

Lilie-Hoffman Cooling Towers, Inc.
Plainview, TX

Lufkin Creosoting Co., Inc.
Lufkin, TX

MacGillis and Gibbs Co.
Milwaukee, WI (HQ)
New Brighton, MN

Macon Creosote and Wood Preservers, Inc.
Macon, MS

Madison Wood Preservers, Inc.
Madison, VA

Marion Pressure Treating Co.
Marion, LA

Masonite Corp.
Hattiesburg, MS

McArthur Lumber and Post Co., Inc.
McArthur, OH

McCormick and Baxter Creosoting Co.
Portland, OR (HQ)
Stockton, CA

McCreanie Bros. Wood Preserving Co.
Willacoochee, CA

McFarland, L D, Co.
Sandpoint, ID (HQ)
Eugene, OR

Mellott Wood Preserving Co.
Needmore, PA

Meredith, W C, Co., Inc.
East Point, GA

Miami Wood Treating Co., Inc.
Coral Gables, FL

Mid-Atlantic Wood Preservers
Harmans, MD

Mid-City Lumber and Supply Co.
Milwaukee, WI

Miller, T R, Mill Co., Inc.
Brewton, AL

Mississippi Wood Preserving Co.
Brookhaven, MS

Missouri Wood Treating Co.
Raymondville, MO

Mixon Bros. Wood Preserving, Inc.
Idabel, OK

Montana Pole and Treating Plant
Butte, MT

Bert Morsch Lumber Co.
Jacksonville, FL

Mountain Gravel and Construction Co.
Dolores, CO

Mt. Pine Pressure Treating Co., Inc.
Plainview, AR

National Wood Preservers, Inc.
Havertown, PA

New South Forest Industries
(formerly Coastal Carolina Wood
Pres. Co.)
Conway, SC (HQ)
Red Hill, SC

Olinkraft Corp.
Shreveport, LA

Olivet Treated Products, Co., Inc.
Hammond, LA

Oliver-Celcure Wood Preserving Corp.
(formerly Celcure Wood Preserving Corp.)
New Orleans, LA

Ouachita-Nevada Testing Co.
Chidester, AR (HQ)
Reader, AR

Pearl River Wood Preserving Corp.
Picayune, MS

Penta Wood Products, Inc.
Siren, WI

Perma Wood, Inc.
Cincinnati, OH

Pitch Pine Lumber Company
Tampa, FL

Pitts Lumber Co., Inc.
Saluda, VA

Plainview Lumber Co., Inc.
Plainview, AR

Poles, Inc.
Bellevue, WA (HQ)
Newport, WA

Portsmouth Lumber Treating Co.
Portsmouth, VA

Pressure Treated Timber Co.
Boise, ID

Quality Wood Treating Co.
Prairie du Chien, WI (HQ)
Jonesville, WI

R & K Creosote Co., Inc.
Natalbany, LA

Red River Treating Co., Inc.
Powhatan, LA

Rhodes-Buck Building Supply Co.
Charleston, SC

Richardson Brothers Wood Preservers
Northport, AL

Ridge Lumber Industries, Inc.
Lakeland, FL

Robbins Manufacturing Co.
Tampa, FL

Rocky Top Treating Co.
Rocky Mount, VA

Rodman Industries, Inc.
Rock Island, IL

Salem Pine Pole and Post Co.
Salem, MO

Salt Wood Products, Inc.
Cove City, NC

Santa Fe Çentralized Tie Plant
Somerville, TX

Saunders Supply Co.
Suffolk, VA

Sawyer-Stoll Wood Preserving Co.
Ishpeming, MI

Scotch Lumber Co.
Fulton, AL

Seaman Timber Company, Inc.
Montevallo, AL

Selma Pressure Treating Co., Inc.
Selma, CA

Sentinel Wood Treating, Inc.
Ashland, MO (HQ)
Ava, MO
Calico, AR
Heber Springs, AR

Shearouse Lumber Co.
Pooler, GA

Shepard Morse Lumber
Syracuse, NY

Sheridan Forest Products Corp.
Sheridan, WY

Sherwood Treating Co.
Winston-Salem, NC

Shollenbarger Wood Treating
Bernallico, NM

Smith-Evans Lumber Co.
Rome, GA

Smith, W J, Wood Preserving Co.
Denison, TX

Southern California Edison Co.
Alhambra, CA

Southern Wood Piedmont Co.
Spartanburg, SC (HQ)
Augusta, GA
Baldwin, FL
Chattanooga, TN
East Point, GA
Gulf, NC
Macon, GA
Spartanburg, SC
Waverly, OH
Wilmington, NC

Southwest Forest Industries, Inc.
Prescott, AZ

Spokane Tribal Wood Products
Wellpinit, WA

Stallworth Timber Co., Inc.
Beatrice, AL

Standard Wood Preservers of
Shreveport, Inc.
Shreveport, LA

Steinkamp Warehouses, Inc.
Huntingburg, IN

Stewart, G M, Wholesale Lumber Co.
Minneapolis, MN

St. Louis Flameproof and Wood
Preserving Co.
St. Louis, MO

Storey, S I, Lumber Co., Inc.
Armuchee, GA (HQ)
Crystal Springs, GA

St. Regis Paper Co.
Cass Lake, MN

Straits Aggregate and Equipment Co.
Tawas City, MI

Structural Woods Preserving Co.
Coleridge, NC

Suwannee Lumber Mfg. Co., Inc.
Cross City, FL (HQ)
Shamrock, FL

Sweeney Wood Products
Ft. Duschene, UT (HQ)
Lapoint, UT

Swift Lumber Co.
Atmore, AL

John C. Taylor Lumber Sales
Sheridan, OR

TMA Forest Products Group
Lockhart, AL

Tarheel Wood Treating Co.
Morrisville, NC

Temple Eastex, Inc.
Diboll, TX

RN Templeman Lumber Co.
New Orleans, LA

Texarkana Wood Pres. Co.
Texarkana, TX

Texas County Post Co., Inc.
Raymondville, MO

Texas Electric Cooperatives, Inc.
Jasper, TX

Thomas Lumber and Timber Co.
Folkston, GA

Timbercraft Products Co.
Hayden Lake, ID

Tolleson Lumber Co., Inc.
Perry, GA

Tomco Lumber Mills, Inc.
Indianapolis, IN

Tri-State Lumber Co., Inc.
Fulton, MS

Unadilla Silo Co., Inc.
Unadilla, NY

United States Steel Corp.
Leckrone, PA

Utah Power & Light
Salt Lake City, UT

Virginia Wood Preserv. Div.,
Rentokil, Inc.
Richmond, VA (HQ)
Laurel, VA

Walker-Williams Lumber Co., Inc.
Hatchechubbee, AL

Watkins Lumber Co.
Albany, GA

Webster Wood Preserving Co.
Wayzata, MN
Bangor, WI

West Elizabeth Lumber Co.
West Elizabeth, PA

Western Tar Products Corp.
Terre Haute, IN

Western Wood Preserving Co.
Summer, WA

Weyerhaeuser Co.
De Queen, AR

Whitewood Post & Pole Co., Inc.
Whitewood, SD

Wood Preservers, Inc.
Warsaw, VA

Wood Products, Inc.
Oakland, MD

Wood Protection of Jax
Jacksonville, FL

Wood Treaters of Buffalo
Buffalo, NY

Wood Treating Corp. of Philadelphia
Philadelphia, PA

Woods Run Forest Products
Colfax, WI

Wyckoff Co.
Seattle, WA (HQ)
Eagle Harbor, WA

FIGURE 5-1. SAMPLE INFORMATION REQUEST LETTER FOR PLANTS

(name)
(address)

(salutation):

The Occupational Safety and Health Act of 1970 authorizes the Department of Health, Education, and Welfare through the National Institute for Occupational Safety and Health (NIOSH) to develop recommended standards to protect workers occupationally exposed to chemical or physical hazards. After reviewing all available data and consulting with health professionals from industry, organized labor, and academia, NIOSH makes recommendations in the form of criteria documents. These criteria documents are sent to the Occupational Safety and Health Administration in the Department of Labor for review and consideration as Federal standards.

NIOSH is currently preparing a criteria document on wood preserving. On April 11, 1978, NIOSH published notices in the Federal Register (vol 43, pages 15197-15198) that outlined the areas to be included in the criteria document and requested additional pertinent information. Enclosed is a copy of this notice.

Please review the notice, particularly items 1, 3, 7, and 9, and send any information or comments that may help us to prepare a more thorough and accurate document on wood preserving. This information may be in the form of published or unpublished studies, personal communications from workers or others concerning the occupational hazard in question, and personal observations that you would like us to consider while developing the document.

JRB Associates, Inc. (JRB), is assisting NIOSH in the development of this criteria document. JRB will be visiting several plants to gather information on innovative control procedures and safe work practices. If you would be willing to allow a visit to your plant, please make this known in your reply, and JRB will contact you.

Plant visits are conducted in accordance with NIOSH regulations as specified in the Code of Federal Regulations (42 CFR, Part 85a, October 14, 1976). If NIOSH and JRB were to visit your plant, we would prepare a report and send it to you so you may review it for technical accuracy and ensure that it does not disclose any proprietary information. After your review, information contained in the report may then be included in the criteria document.

FIGURE 5-1. SAMPLE INFORMATION REQUEST LETTER FOR PLANTS (CONTINUED)

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Please send your comments relative to the enclosed request for information to NIOSH and identify your response with the term "wood preserving" so that we can process it rapidly. The 60-day deadline for submitting information listed in the enclosed Federal Register notice does not apply to your response to this letter.

Let me thank you in advance for your cooperation in this important activity.

Sincerely yours,

Irwin P. Baumel, Ph.D.
Acting Director
Division of Criteria Documentation
and Standards Development

Enclosures

CHAPTER 6. ORGANIZATIONS

In addition to contacting the plants that do wood preserving, JRB will contact trade associations, professional societies, unions, and other organizations with expertise or interest in the subject. These organizations are listed in Table 6-1. A sample of the contact letter requesting information from these organizations is shown in Figure 6-1.

TABLE 6-1. TRADE ASSOCIATIONS, PROFESSIONAL SOCIETIES, AND UNIONS FOR WOOD PRESERVING

American Forest Institute
1619 Massachusetts Avenue, NW
Washington, DC 20036
202/ 797-4500

American Institute of Timber Construction
333 West Hampden Avenue
Englewood, CO 80110
303/ 761-3212

American Railway Engineering Association
59 East Van Buren Street
Chicago, IL 60605
312/ 939-0780

American Wood Council
1619 Massachusetts Avenue, NW
Washington, DC 20036
202/ 265-7766

American Wood-Preservers' Association
Suite 4444
7735 Old Georgetown Road
Bethesda, MD 20014
301/ 652-3109

American Wood Preservers Bureau
Box 6085
2772 South Randolph Street
Arlington, VA 22206
703/ 931-8180

American Wood Preservers Institute
1651 Old Meadow Road
McLean, VA 22102
703/ 893-4005

Forest Products Research Society
2801 Marshall Court
Madison, WI 53705
608/ 231-1361

Forest Products Safety Conference
Weyerhauser Co.
Box 188
Longview, WA 98632
206/ 425-2150

International Woodworkers of America
1622 North Lombard Street
Portland, OR 97217
503/ 285-5281

National Forest Products Association
1619 Massachusetts Avenue, NW
Washington, DC 20036
202/ 797-5800

National Hardwood Lumber Association
Box 34518
Memphis, TN 38134
901/ 377-1818

National Lumber and Building Material Dealers Association
1990 M Street, NW
Washington, DC 20036
202/ 872-8860

National Wholesale Lumber Distributing Yard Association, Inc.
Suite 401
1730 Rhode Island Avenue, NW
Washington, DC 20036
202/ 223-4860

North American Wholesale Lumber
Association, Inc.
218 Terminal Sales Building
Portland, OR 97205
503/ 226-6075

Northeastern Lumber Manufacturers
Association, Inc.
4 Fundy Road
Falmouth, ME 04105
207/ 781-2252

Northeastern Retail Lumberman's
Association
339 East Avenue
Rochester, NY 14604
716/ 325-1626

Northern Hardwood & Pine Manufacturers
Association, Inc.
501 Northern Building
305 East Walnut Street
Green Bay, WI 54301
414/ 432-9161

Northwest Hardwood Association
1303 Terminal Sales Building
Portland, OR 97205
503/ 243-2094

The Railway Tie Association
314 North Broadway
St. Louis, MO 63102
314/ 231-8099

Society of American Wood Preservers,
Inc.
Suite 205
1401 Wilson Boulevard
Arlington, VA 22209
703/ 841-1500

Southern Forest Institute
Suite 380
3395 Northeast Expressway
Atlanta, GA 30341
404/ 451-7106

Southern Forest Products Association
Box 52468
New Orleans, LA 70152
504/ 443-4464

Timber Products Manufacturers
951 East Third Avenue
Spokane, WA 99202
509/ 535-4646

Western Forest Industries Association
1500 South West Taylor Street
Portland, OR 97205
503/ 224-5455

Western Wood Products Association
1500 Yeon Building
Portland, OR 97204
503/ 224-3930

FIGURE 6-1. SAMPLE INFORMATION REQUEST LETTER FOR ORGANIZATIONS

(name)
(address)

(salutation):

On April 11, 1978, the National Institute for Occupational Safety and Health (NIOSH) published in the Federal Register (vol 43, pages 15197-15198) a notice which requested information concerning the development of a criteria document and a recommended occupational health standard for wood preserving. Enclosed is a copy of the notice as it appeared in the Federal Register.

The Federal Register notice outlines the areas of information to be included in the criteria document. I would appreciate your consideration of all the listed areas, and in particular items numbered 1, 3, and 7, and your forwarding any information you have which will allow us to prepare a thorough document. This information can be in the form of published or unpublished studies conducted by your organization, or communications received from your workers or other organizations, or simply personal observations which you would like considered during the document development.

JRB Associates, Inc., is assuming a major role in assisting us in the development of these criteria documents. As part of its project, JRB is also required to conduct several plant visits to ascertain what consitutes good work practices. These plant visits are conducted in accordance with the regulations identified in 42 CFR Part 85a. Information gathered during such visits will be compiled in a report which will be sent to you for review of technical accuracy and to prevent inadvertent release of proprietary information. Information from the report may then be included in the criteria document. If your firm would be receptive to such an information-gathering visit, please make this known in your reply. The person at JRB who has been given project responsibility for the wood preserving criteria document is Eileen Pearlman. I would appreciate, as part of our common interests in occupational safety and health, your cooperation with JRB in the fulfillment of its tasks.

FIGURE 6-1. SAMPLE INFORMATION REQUEST LETTER FOR ORGANIZATIONS (CONTINUED)

Page two

Please submit your comments relative to the enclosed request for information to NIOSH. Identifying your response with the term "wood preserving" will accelerate its processing. Please note that the 60-day submission deadline listed in the Federal Register notice does not apply to your response.

Sincerely yours,

Irwin P. Baumel, Ph.D.
Acting Director
Division of Criteria Documentation
and Standards Development

Enclosure

CHAPTER 7. REFERENCES

Biological Assessment of Pentachlorophenol, Inorganic Arsenicals, and Creosote, Draft Report of the USDA-States-EPA Peservative Chemical RPAR Assessment Team. (unpublished)

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Findlay WPK: The Preservation of Timber. London, A and C Black, Ltd., 1962, 162 pp

Hunt GM, Garrett GA: Wood Preservation. New York, McGraw-Hill, 1967, 433 pp

Jahn EC, Strauss RW: Industrial chemistry of wood, in Kent JA (ed.): Riegel's Handbook of Industrial Chemistry ed 7. New York, Van Nostrand Reinhold Company, 1974, pp 435-487

Maloney JP, Pagliai LJ: Wood preservation statistics 1978, in Proceedings of the Seventy-Fifth Annual Meeting of the American Wood-Preservers' Association. 75:241-279, 1979

Wood preserving, in Profiles on Occupational Hazards for Criteria Document Priorities. Cincinnati, US Dept of Health, Education and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, 1973, 3 pp (NTIS, PB-274073)

Todd AS, Villaume JE, Darby GH: Industrial Hygiene Assessment of New Agents—III. Study Proposal, Phase I. Cincinnati, US Dept of Health, Education and Welfare, Public Health Service, Center for Disease Control, National Institute for Occupational Safety and Health, 1978, 100 pp