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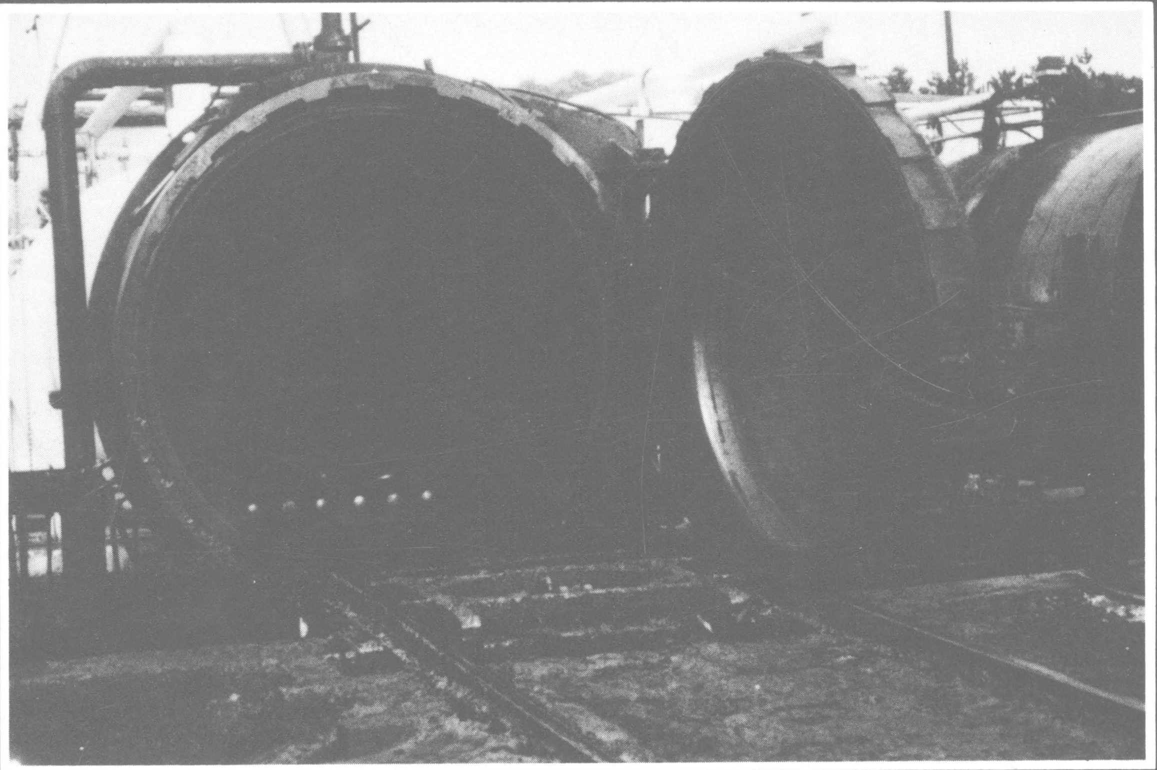
WOOD PRESERVING CHEMICALS AND PROCEDURES



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WOOD PRESERVING CHEMICALS AND PROCEDURES

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For Sale Publication

Cover photo: Pressure treating in a cylinder is the most effective way to apply preservative chemicals.

This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The authors and the Ohio Cooperative Extension Service assume no liability resulting from the use of these recommendations.

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Cooperative Extension Service
The Ohio State University

Wood products are among our most important building materials. Proper treatment of wood products for a long and useful service life requires a basic knowledge of wood structure and properties. Some applications make it necessary to treat the wood with chemicals that are classified as pesticides. Federal regulations establish standards that must be met before one can legally use some of these materials.

This training manual is one of many publications you may wish to study while preparing to meet the requirements of the Environmental Protection Agency and the state of Ohio.

LESSON I: WOOD STRUCTURE

Understanding the minute structure of wood helps one explain the action of wood decay fungi and the impregnation of wood with preservative chemicals. Some basic similarities are found in all wood species and some striking differences are present in certain individual species. Only those characteristics that have a bearing on decay and treatment will be discussed here.

THE BASIC WOOD CELL

Even though wood may seem to be a solid material, it is plant material made of plant cells. The basic wood cell is often referred to as a fiber or a longitudinal tracheid. Pinch a soda straw at both ends and you will have a model of what this wood fiber looks like. It is long, slender and hollow. The thickness of the cell wall varies, as does the size of the cell cavity. Early wood or spring wood cells usually have thin walls and large cavities. Late wood or summer wood cells usually have thick walls and small cavities. Each growing season produces both early wood and late wood. Each new annual growth ring is formed just beneath the bark of the tree.

CELLULOSE, HEMICELLULOSE AND LIGNIN

The cell walls of wood fibers are made up of small bits of cellulose imbedded in a matrix of hemicellulose. A thin layer of lignin cements all of these wood fibers together, much like the mortar in a brick wall. All three of these constituents are sugars formed from carbon, hydrogen and oxygen.

PITS

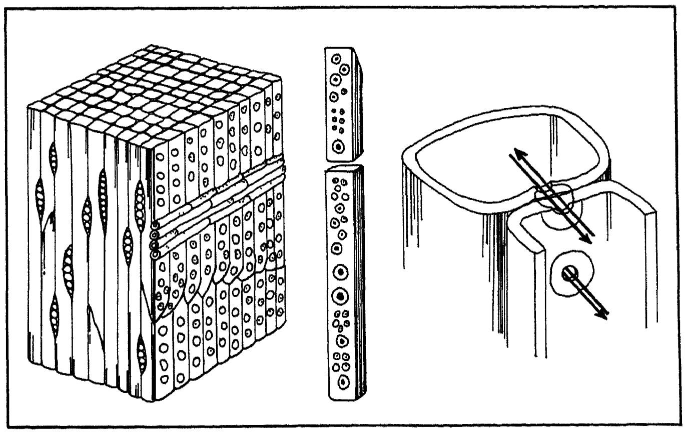
The cavities of adjacent cells are interconnected by minute passageways called pits. While these pits often act as simple holes through adjacent cell walls, their structure is more complicated and they are sometimes obstructed. Water in the living tree moves from cell to cell by means of these pits. The movement of water in drying lumber or utility poles is often helped along by these pits. In a like manner, the impregnation of wood with chemical solutions or oils is aided by the presence of these pits.

RAYS

All wood species have small tissues called rays that weave their way between the longitudinal fibers from the bark toward the pith. Rays are conductive structures that are situated in a radial direction at right angles to the annual rings. In most wood species, the rays are barely visible to the naked eye. Oak, beech, maple and sycamore are hardwoods that have larger rays.

VESSELS AND PORES

Hardwoods have vessels but softwoods do not. The open ends of vessels are often called pores. Hardwoods are sometimes called porous woods because of these vessels. Several specialized longitudinal cells are joined together end to end in each vessel. The diameter and distribution of the vessels vary among the woods. Oak, elm and ash have large vessels in the early wood portion of each annual ring. Poplar, maple and gum have smaller vessels distributed evenly throughout the wood.



Wood cells are long, hollow and interconnected by pits.

SOFTWOODS AND HARDWOODS

Tree species with needles and cones such as the pines, spruces, true firs and Douglas fir are called softwoods. The broadleaf tree species such as the oaks, maples, gum and yellow poplar are called hardwoods. The wood of the softwood species is made up mostly of longitudinal fibers with a small percentage of rays. The wood of the hardwood species usually has larger rays and contains a significant volume of vessels.

Douglas fir and southern pine are the principal softwood species used for preservative treatment. This includes construction lumber and round timbers. Oak and gum are the most commonly used hardwoods with most of these in the form of rail ties.

SAPWOOD AND HEARTWOOD

Each new growth ring is formed between the bark and the wood of the previous season. This new wood is superimposed upon the wood of the previous season. This new wood will live and function as conductive tissue for about 15 years. It is called sapwood because its function is conducting water from the root system to the crown.

Annual rings that have served their time and are covered by 15 or so newer layers of wood die. There follows a period of transformation from sapwood to heartwood. The new heartwood becomes a disposal area for waste products of respiration carried on in other parts of the tree. Rays seem to be a means of transporting these waste products into the heartwood. The nature of these chemicals varies from one tree species to another. Color, odor and toxicity to decay fungi are the variables.

The principal significance of sapwood and heartwood to the wood preserving industry is that heartwood is difficult or impossible to treat. The dry sapwood of southern pine is relatively easy to impregnate with preservative solutions. The heartwood segment of these same timbers or lumber is difficult or impossible to impregnate. This pattern follows with other species also, except that the ease of treating the sapwood diminishes.

NATURAL DECAY RESISTANCE

Heartwoods of black locust, redwood and western red cedar have a reputation of being decay resistant. Heartwood of other tree species may exhibit lesser amounts of toxicity to decay fungi. The sapwood of all species is without this natural decay resistance.

LESSON II: DECAY AND INSECTS

WOOD DECAY

Wood decay is caused by the growth of fungi. Fungus is a form of plant life and has some similarities to other plants. Since the fungus has no food producing capability, it feeds on the sugars of the wood cell wall. Fungal growth initiates from a tiny airborne spore that germinates much like the seeds of other plants. Continued growth is dependent on favorable conditions of moisture and temperature. Cold temperatures or dry wood prevent the growth of fungi. When favorable temperatures and moisture contents return, the growth of the fungus resumes. Impregnating the wood with toxic chemicals that prevent the growth of the fungus is the basis for the wood preserving industry.

Germination of the spore soon leads to the development of microscopic, threadlike roots that penetrate the wood. Enzymes are produced by these minute growing strands. The enzymes dissolve the cell wall sugars, thus producing a myriad of holes throughout the wood. Detection of this initial infection requires microscopic examination of the wood. Advanced growth of the fungus changes the nature of the wood, greatly reducing its strength. Fruiting structures appear on the surface of the decaying wood during the advanced stages of fungal growth. New spores are produced by these external conks, bracts or mushrooms. Eventually the wood crumbles and is no longer useful. The degradation of fallen trees, limbs and stumps in the forest is accomplished in this same manner and is considered beneficial.

INSECTS

Termites are the best known and most feared group of wood destroying insects. The most common forms of termites live both in the soil and in the wooden structure they are attacking. Construction methods that place untreated wood in contact with the soil provide an open invitation to these insects. Untreated wood members that are in close proximity to the soil may be invaded by termites building shelter tubes. Treating wood with toxic chemicals provides an effective barrier to termites. Today's residential construction industry often uses chromated copper arsenate treated lumber as protection against termites more than as a decay preventative.

Other types of insects also may invade wooden structures for food and shelter. Their attacks are less common and more difficult to guard against. Preservative treatment of the wood is not often used as a preventative measure against these other insects. Carpenter bees sometimes bore holes in the protected area under eaves. Powder post beetles may be found inside barns where they produce small holes and tunnels. Larvae of the longhorn beetles sometimes damage wooden structures but are most often found in the forest.

Marine borers and shipworms are other forms of animal life that constitute a menace to wood structures built in salt water. Heavy treatments with creosote are used to discourage the activity of these destructive pests.

CONTROL OF DECAY AND INSECTS

The most common method of protecting wood against decay is to keep the moisture content below 20 percent, the accepted threshold for fungal growth. Keeping wood dry is no protection against termites and other insects. Some applications of wood products make it necessary to use a chemical treatment for satisfactory service life. Discussion of these treatments and the safety precautions that must accompany their use is the subject of this publication.

LESSON III: THE CHEMICAL PRESERVATIVES

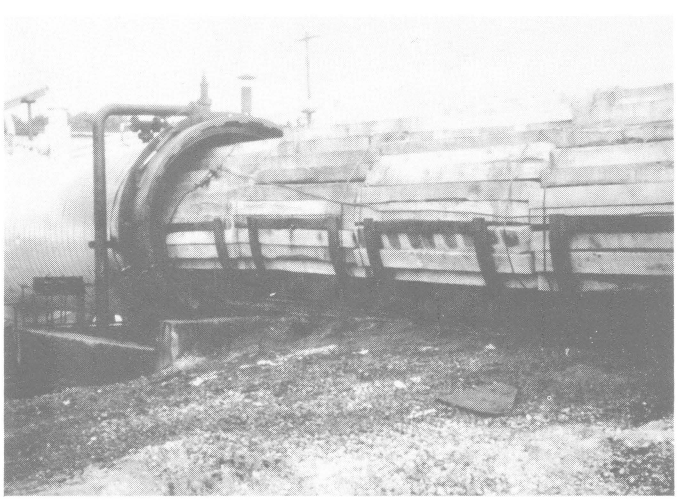
Wood preserving chemicals can be classified into three groups. Creosote is a toxic oil derived from coal and has been the original benchmark preservative for more than 100 years. Pentachlorophenol is a manufactured salt that is soluble in oil and has been used since the 1950s. The third group consists of several water soluble salts, the most commonly used one being chromated copper arsenate.

CREOSOTE

Creosote often is called coal tar creosote because of its close relationship to toluene, benzene and tar. These materials are condensed from the distillation of coal as it is converted to coke. The steel industry uses this process to obtain the carbon (coke) for steel making. Creosote is that fraction that condenses within certain temperature limits set by the American Wood Preservers Association. It is highly toxic to decay fungi and insects. It is relatively insoluble in water and its oily nature helps protect wood against weathering.

Because creosote is condensed over a range of temperatures, some fractions are more volatile then others. Freshly creosoted poles and timbers give off vapors which have a strong odor and may produce a sunburn-like rash on human skin. This happens more during warm summer days and will cease after a few years of service. Creosote soils clothing and is difficult to impossible to paint over satisfactorily. The odor of creosote is unpleasant to some people.

Precipitation and groundwater will not leach creosote from the wood of utility poles and other outdoor applications. Permanence and excellent toxicity to decay fungi and insects have made creosote a favorite wood preservative for railroads and port authorities. Railroad ties are often treated with a solution of creosote and coal tar. This leaves a surface coating that is sticky and helps to seal the wood against weathering. Solutions of creosote and petroleum oils were once used to reduce costs and extend the supply of creosote. Experience has shown this to be a mistake in that service life was seriously shortened.



Railroad ties are usually treated with creosote.

PENTACHLOROPHENOL

The name of this manufactured salt is usually shortened to the first five letters, penta. It is relatively insoluble in water but dissolves readily in several petroleum oils. Treating solutions accepted as equal to creosote are made by dissolving five percent penta salt in petroleum oil. It is also used in liquified petroleum gas and methylene chloride when the wood must have a natural look. Penta-petroleum treating solutions were popular during the post World War II years but have been widely replaced by the waterborne salts in recent years. The age of environmentalism placed serious doubt in the minds of many regarding the health hazards of penta. Spectacular increases in the cost of petroleum oil also played an important role in the shift to waterborne salts.

CHROMATED COPPER ARSENATE

This waterborne salt is a green color and has several names. It is formulated from chromium trioxide, copper oxide and arsenic pentoxide. Three distinct mixtures of these ingredients are used by the treating industry and various trade names are applied to each. In all cases, the toxic salt is carried into the wood cells by means of water. Following impregnation, the chemicals react with the wood sugars and become insoluble. The water is dried from the wood, leaving the salt behind. These chemicals have become popular for the treatment of lumber and plywood for retail sale to the public. They also are used for utility poles, guard rail posts and landscape timbers.

OTHER WATERBORNE PRESERVATIVE SALTS

Several other waterborne preservative salts have been used by the wood preserving industry. A few of these will be mentioned here. It should be noted that almost all of the waterborne preservative treatments used today are of the chromated copper arsenate type. Acid copper chromate contains about 32% copper oxide and 68% chromic acid. Ammoniacal copper arsenate contains about 50% copper oxide and 50% arsenic pentoxide. Chromated zinc chloride contains 80% zinc oxide and 20% chromium trioxide. Fluor-chrome-arsenate-phenol contains 22% fluoride, 37% chromium trioxide, 25% arsenic pentoxide and 16% dinitrophenol. Leaching by precipitation and groundwater is a problem with most of these materials.

LESSON IV: HOW PRESERVATIVES ARE APPLIED

Methods for applying wood preservatives can be classified as pressure and nonpressure. The nonpressure procedures can be by brush, spray, dip or soak. These are usually less effective than the pressure treatments that are performed in a special cylinder. The Environmental Protection Agency has examined wood preservatives and methods of application through their Rebuttable Presumption Against Registration procedure. This has required several years and the outcome has been the removal of most do-it-yourself treating chemicals. Nearly all of the treating being done today is by pressure processes in special retorts at treating plants.

The basic principle of pressure treating is to place the lumber, poles, piling, posts or other wood products in a closed retort and immerse it in a preservative under pressure. The pressure processes give a deeper and more uniform penetration of the wood cells than do the nonpressure methods. Immersing freshly sawed lumber or timbers in an open tank at atmospheric pressure provides very little preservative treatment. Pressure treating also allows better control of the preservative retention in the wood. The details of the treating cycle vary with the product and the preservative. The size of the treating cylinder and the complexity of associated equipment differs among the many companies doing this work.

The best way to condition wood prior to treating is to dry it.

CONDITIONING THE WOOD

Freshly cut wood products that have not been seasoned give very poor treating results. Both the penetration and the retention will be far below expectations.

The most common method of preparing wood products for treatment is drying. This removes the water from cell cavities, making space for the treating solution in the wood. Drying causes wood to shrink, thus developing checks along the grain. It is important to have this happen before the treating solution is applied. The seasoning checks help achieve thorough treatment. Seasoning checks that develop after treatment may provide an avenue to untreated wood and result in early failure.

Railroad ties, utility poles and foundation piling may be stacked in the open air for weeks and months to achieve a satisfactory moisture content. It is common to season oak ties for nine months or more. Some tie plants use an incising machine to open small slits along the grain and induce a pattern of many small seasoning checks rather than one or two large ones. Southern pine utility poles will dry enough in 60 days of favorable weather. Careful inventory control is necessary to guard against decay and insect attacks in the drying yard. Drying southern pine poles in a kiln has become common practice at the larger treating plants. Buying kiln dried southern pine lumber from the open market is the usual practice among the new generation of CCA treating plants.

West Coast plants sometimes condition Douglas fir timbers, poles and piling by holding them under vacuum while submersed in hot creosote or penta-petroleum. This conditioning process is done in the treating cylinder. The pressure impregnation cycle follows immediately without removing the charge of wood from the cylinder. Some tie treating plants follow a similar procedure to dry green ties in the treating cylinder. A low boiling point solvent is used in this vapor drying process.

Douglas fir timbers, poles and piling are usually incised to improve the depth of penetration. The incising machine has hundreds of teeth that resemble the pointed end of a heavy pocket knife. These are forced into the wood parallel to the grain. A similar incising procedure is used on western red cedar poles.

TREATING CYLINDERS

These treating retorts are built to withstand great working pressures. They have thick steel walls and are usually six or eight feet in diameter. The length varies from 40 feet to well over 100 feet. The new generation of CCA treating plants uses six foot cylinders that are 40 to 60 feet long. The lumber and plywood are stacked on small trams that run on a short length of track, half of it being inside the cylinder. The door of the cylinder is closed by removing a short section of the track. A lift truck is used to push the charge into the cylinder and pull it out after treatment is complete. Treated lumber can be removed and another charge made ready for treating in minutes.

The traditional creosoting plant where utility poles, foundation piling, bridge timbers and railroad ties are produced is a much larger operation. Treating cylinders are eight feet in diameter and 100 or more feet long. The trams run on a standard gauge railroad track that serves the entire yard, including the shipping department. Trams are loaded and unloaded by diesel powered cranes that also run on the track. A company owned switch engine moves loaded trams from the framing yard to the treating cylinders. All machining such as trimming ends and boring holes is completed prior to loading the wood products on trams. No machining is done after treatment.

Creosote and penta-petroleum solutions are used at 150°F or more. The preservative is stored in heated tanks and the treating cylinder has steam coils beneath the trams. Preservative pressure inside the cylinder may exceed 150 pounds per square inch (psi). This pressure is most often achieved by means of a pump in the pipeline between the cylinder and the measuring tank. Because compressed air is often part of the treating process, a heavy duty air compressor is part of the associated machinery. A vacuum system is also necessary. Some plants pull the vacuum by means of a pump while others prefer a steam jet and condenser system. Steam is used in several ways. Wood scrap, bark and sawdust often constitute the fuel supply for steam generation. The measuring tank is a calibrated vessel that holds enough preservative to treat the charge of wood after the cylinder has been filled. Measurements are recorded before and after the charge of wood is impregnated. A working storage tank is usually mounted above the cylinder and is used to fill the cylinder with preservative just before the pressure segment of the treating cycle.

EMPTY CELL TREATMENTS WITH CREOSOTE OR PENTA

The typical empty cell treatment is used for utility poles. This procedure is also used with posts of all sizes, sawed timbers and heavy construction lumber. The preservative is usually creosote or penta-petroleum. The principal advantage of the empty cell treatment is that less preservative is retained in the wood cells. This provides a cleaner and more acceptable product. At the same time, it lowers the costs of the treatment. Some customers specify eight pounds per cubic foot for northern states where the risk of decay and termites is less. More often the customer will specify 10 pounds per cubic foot. Gulf states customers may feel the need for 12 pounds per cubic foot, but it should be noted that this borders on becoming a full cell treatment.

Empty cell treatments must be done in the cylinder where compressed air and vacuum are available. The cycle begins by pushing the trams of dry poles into the cylinder and securing the door. Newer cylinders are equipped with quick closing doors which rotate to lock into position. Older cylinders have a series of heavy bolts around the perimeter of the door. Some treating operators prefer to give the charge a short period of steam to heat the wood surface and improve the appearance of the finished product.

The first essential step is the addition of compressed air. It is by means of the initial air pressure that the excess preservative will be pulled out of the wood cells. Thirty psi of air pressure is average. Greater air pressure translates to less preservative retention. Similarly, less air pressure would mean more preservative retention. Other factors such as the nature of the poles themselves have an effect on retention. The treating operator must make a judgment regarding the exact amount of air pressure to use.

The second essential step is to fill the cylinder with preservative while holding the initial air pressure on the charge. The surest way to accomplish this is by means of the storage tank mounted above the cylinder. The associated system of pipes and valves can be arranged so that preservative drains by gravity into the cylinder while the displaced air moves to the top of the storage tank. Another less desirable way is to bleed air off the cylinder while pumping preservative into the cylinder. The result of this step is to trap air in the wood cells while immersing the wood in preservative.

The third step in this process begins when the cylinder is completely full of preservative and the pressure pump is started. Valves to the storage tank above the cylinder are closed. The pump will move preservative from the measuring tank into the cylinder. The pressure will build to approximately 150 psi and continue until the treating operator chooses to stop. Penetration of the preservative into the sapwood is the key issue at this point. As the preservative is forced into the wood, the air is compressed ahead of it. Much of the air is able to penetrate the heartwood where the preservative will not go. The goal should be 100 percent penetration of the sapwood. Because the treating operator has no way to see that this has been accomplished, it is a matter of judgment as to when to stop the pressure period. The experienced operator can rely on the results of similar charges in making this decision.

The pressure pump is stopped and the pressure on the cylinder is relieved by opening a valve to the storage tank above. Preservative from the cylinder will be returned to the storage tank until it is filled as it was at the start. The remaining preservative will be pumped back into the measuring tank.

Now the cylinder has returned to atmospheric pressure and the air in the poles is expanding. Preservative is forced outward ahead of the air. The next step is to close all valves, isolating the cylinder, and start the vacuum pump. A system of steam jets and condensers is often used in place of the vacuum pump. The vacuum on the cylinder usually reaches 26 inches of mercury and may be held for 30 minutes or more. Initial air, which was previously compressed into the heartwood, is now pulled from the wood by the vacuum. As a result, preservative comes out ahead of the air and accumulates in the bottom of the cylinder. The length and amount of this vacuum period is a factor in determining final retention of preservative.

The vacuum is broken and the cylinder returned to atmospheric pressure. The preservative in the bottom of the cylinder is then pumped to the measuring tank. The operator compares the initial reading of the measuring tank to the final reading to determine the amount of preservative retained by the charge. A tally of poles in the charge tells how many cubic feet of wood were treated. Now the operator is able to calculate the pounds per cubic foot of final retention.

Twenty increment borings are taken from each charge to check for penetration. The increment borer is a hollow tube with a sharp cutting edge at one end. It also has threads to pull itself into the wood. By turning the handle, the borer can be forced through the sapwood and into the heartwood. A sample core of wood is removed from inside the tool. This shows the penetration of preservative.

FULL CELL TREATMENTS WITH CREOSOTE

Full cell retentions are exactly what the name implies. Cell cavities of the wood are left full of the preservative. These treatments are necessary only in extreme exposures such as marine piling and timbers. The principal difference in achieving full cell retention is the absence of initial air pressure and a final vacuum. The work is done in the same treating cylinder discussed in the section on empty cell treatments.

A charge of dry piling is placed in the cylinder and the door secured. The first method is to fill the retort at atmospheric pressure, venting the air as the creosote is pumped in. When the cylinder is full, pressure is applied and pumping continues until the operator feels that the sapwood has been completely penetrated. Pumping is stopped and the remaining creosote is returned to the pressure measure tank. The charge is removed from the cylinder.

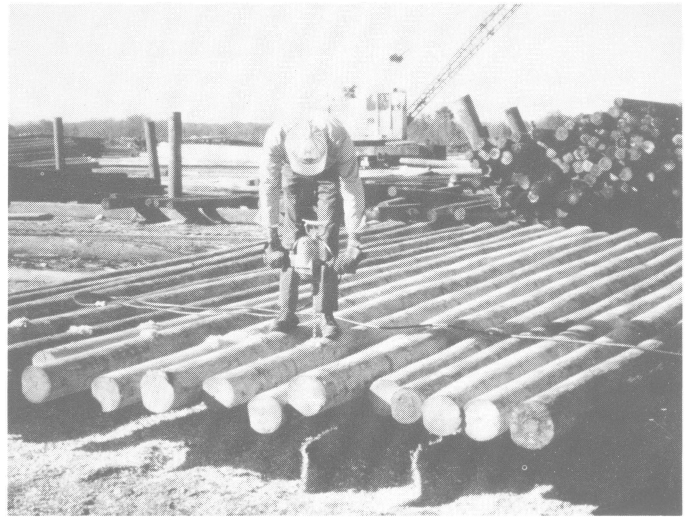
A second method, which provides even more retention, begins with a vacuum on the charge of piling. Evacuating air from the cylinder also removes some of the air from the wood cells. The task of filling the cylinder begins by opening the valves that admit the creosote. Preservative is sucked into the retort as the vacuum diminishes. Pumping then fills the cylinder and pressure builds up. Pressure is continued to refusal. When the charge will not accept any more preservative, pumping is discontinued.

FULL CELL TREATMENTS WITH WATERBORNE SALTS

Chromated copper arsenate is the most common of the waterborne salts in use today. Several proprietary brand names are applied to these formulations. Kiln dried southern pine lumber is the most common product being treated. After treatment, the water evaporates from the wood, leaving the salt to react with the wood substance and become insoluble. Southern pine is easy to treat and has very good strength properties. The kiln dried condition assures that it is ready to treat when received from the sawmill. Some treating companies prefer to use Ponderosa pine.

The treating process is relatively simple. The charge of lumber is placed in the cylinder and the door secured. After filling the cylinder with preservative solution, pressure is applied. Past experience tells the operator when the desired penetration has been achieved. Pressure is terminated at that point and the treating solution is pumped back into the measuring tank. Then the charge is pulled from the cylinder and allowed to drip. A cement apron catches the treating solution and returns it to a sump for recovery.

Various levels of salt retention in the wood are required for the different applications of this product. Concentration of salt in the treating solution is one variable that may be used to attain the desired result. Small amounts of initial air pressure or an initial vacuum are other variables used by the treating plant operator.



All sawing, drilling and other framing work should be done prior to treating the wood.

SPECIFICATIONS AND QUALITY CONTROL

Well informed users will be interested in the quality of the product being treated, the depth of preservative penetration and the amount of preservative retained in the wood. The American Wood Preserver's Association (AWPA) publishes a manual that contains the industry standards for treating methods and results. Most large consumers of treated wood products such as electric utility companies provide their own inspection. The American Wood Preserver's Bureau (AWPB) operates a three-tier system of quality control inspection for the small consumer such as the home builder or the do-it-yourself home owner. Small plastic tags on the ends of treated lumber or rubber stamp marking on the wide face are the most common evidence of this system at work.

Under the AWPB system, each treating plant has employees who are designated as quality control inspectors. The work of these plant employees is supervised by AWPB registered control agencies. Frequent inspections and laboratory analyses are used to police this activity. The tags or stamps provide essential information concerning preservative retention and intended use.

Preservative retentions are expressed in terms of pounds per cubic foot of wood. CCA salt treatments range from .25 pound per cubic foot for aboveground applications and .40 pound per cubic foot for ground contact applications to .60 pound per cubic foot for permanent wood foundations. Creosote and penta-petroleum retentions range from 8 to 16 pounds per cubic foot.

PERSONAL SAFETY AND ENVIRONMENTAL CONCERNS

On September 30, 1978 the Environmental Protection Agency initiated a special review called a Rebuttable Presumption Against Registration for the wood preserving chemicals. The review was completed seven years later and the Federal Register of January 10, 1986, contained the notice of restrictions to be placed on the use of creosote, pentachlorophenol and the inorganic arsenicals. One of the most important restrictions is that treating plant operators are classified as pesticide applicators and must pass a state licensing examination. Personal safety measures such as protective clothing, respirators and air monitoring will be required at the treating plant. Consumer Information Sheets for distribution at the retail store level are also required. Details of these requirements are included in the appendices.

APPENDIX A

PERSONAL SAFETY MEASURES

PROTECTIVE CLOTHING
Protective clothing, including overalls, jacket, gloves and boots impervious to CCA (vinyl, polyvinyl chloride, neoprene, NBR (Buna-N), rubber and polyethylene are all acceptable materials) must be worn by individuals who enter treatment cylinders and related equipment that is contaminated with CCA. All applicators must wear gloves impervious to the wood treatment formulation whenever dermal contact with the treating solution is expected (e.g., handling freshly treated wood and manually opening cylinder doors).

RESPIRATORS
Properly fitting, well-maintained, high efficiency filter respirators that are MSHA/NIOSH approved for inorganic arsenic must be worn by employees whenever the arsenic level is unknown or exceeds 10 ug/m^3 on an 8 hour time weighted average basis.

AIR MONITORING
If airborne concentrations of arsenic exceed 10 ug/m^3, all exposed employees must wear respirators; if levels are between 5 and 10 ug/m^3, re-monitoring must be conducted at least once every six months; if levels are below 5 ug/m^3, no respirators or re-monitoring is required. All employers conducting monitoring must complete a PEL checklist at least once every year.

APPLICATOR TRAINING
All pressure treatment uses of CCA, pentachlorophenol and creosote will be restricted use only. Chemicals for these uses will be available only "for sale to and use by certified applicators or by persons under their direct supervision and only for those uses covered by the certified applicators certification."

CONSUMER AWARENESS PROGRAM (CAP)
Treaters are required to:
1. Attach one Consumer Information Sheet (CIS) to each bundle or batch of treated wood that leaves the plant;
2. Attach one CIS to each invoice;
3. Make an adequate quantity available to retailers, wholesalers and distributors for distribution to consumers.

APPENDIX B

INORGANIC ARSENICAL PRESSURE-TREATED WOOD (Including: CCA, ACA and ACZA)

Consumer Information

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

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

Use Site Precautions

Wood pressure-treated with waterborne arsenical preservatives may be used inside residences as long as all sawdust and construction debris are cleaned up and disposed of after construction.

Do not use treated wood under circumstances where the preservative may become a component of food or animal feed. Examples of such sites would be structures or containers for storing silage or food.

Do not use treated wood for cutting boards or countertops.

Only treated wood that is visibly clear and free of surface residue should be used for patios, decks and walkways.

Do not use treated wood for construction of those portions of beehives which may come into contact with the honey.

Treated wood should not be used where it may come into direct or indirect contact with public drinking water, except for uses involving incidental contact such as docks and bridges.

Handling Precautions

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

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

When power-sawing and machining, wear goggles to protect eyes from flying particles.

After working with the wood, and before eating, drinking and use of tobacco products, wash exposed areas thoroughly.

If preservatives or sawdust accumulate on clothes, launder before reuse. Wash work clothes separately from other household clothing.

(Consumer Information Sheet Approved by the U.S. Environmental Protection Agency)

APPENDIX C

PENTACHLOROPHENOL PRESSURE-TREATED WOOD

Consumer Information

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

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

Use Site Precautions

Logs treated with pentachlorophenol should not be used for log homes.

Wood treated with pentachlorophenol should not be used where it will be in frequent or prolonged contact with bare skin (e.g., chairs and other outdoor furniture) unless an effective sealer has been applied.

Pentachlorophenol-treated wood should not be used in residential, industrial or commercial interiors except for laminated beams or building components which are in ground contact and are subject to decay or insect infestation and where two coats of an appropriate sealer are applied. Sealers may be applied at the installation site. Urethane, shellac, latex epoxy enamel and varnish are acceptable sealers for pentachlorophenol-treated wood.

Wood treated with pentachlorophenol should not be used in the interiors of farm buildings where there may be direct contact with domestic animals or livestock which may crib (bite) or lick the wood.
In interiors of farm buildings where domestic animals or livestock are unlikely to crib (bite) or lick the wood, pentachlorophenol-treated wood may be used for building components which are in ground contact and are subject to decay or insect infestation and where two coats of an appropriate sealer are applied. Sealers may be applied at the installation site.

Do not use pentachlorophenol-treated wood for farrowing or brooding facilities.

Do not use treated wood under circumstances where the preservative may become a component of food or animal feed. Examples of such sites would be structures or containers for storing silage or food.

Do not use treated wood for cutting boards or countertops.

Only treated wood that is visibly clean and free of surface residue should be used for patios, decks and walkways.

Do not use treated wood for construction of those portions of beehives which may come into contact with the honey.

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

Do not use pentachlorophenol-treated wood where it may come into direct or indirect contact with drinking water for domestic animals or livestock, except for uses involving incidental contact such as docks and bridges.

Handling Precautions

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

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

Avoid frequent or prolonged skin contact with pentachlorophenol-treated wood. When handling the treated wood, wear long-sleeved shirts and long pants and use gloves impervious to the chemicals (for example, gloves that are vinyl-coated).

When power-sawing and machining, wear goggles to protect eyes from flying particles.

After working with the wood, and before eating, drinking and use of tobacco products, wash exposed areas thoroughly.

If oily preservatives or sawdust accumulate on clothes, launder before reuse. Wash work clothes separately from other household clothing.

(Consumer Information Sheet Approved by the U.S. Environmental Protection Agency)

APPENDIX D

CREOSOTE PRESSURE-TREATED WOOD

Consumer Information

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

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

Use Site Precautions

Wood treated with creosote should not be used where it will be in frequent or prolonged contact with bare skin (e.g., chairs and other outdoor furniture) unless an effective sealer has been applied.

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

Wood treated with creosote should not be used in the interiors of farm buildings where there may be direct contact with domestic animals or livestock which may crib (bite) or lick the wood.

In interiors of farm buildings where domestic animals or livestock are unlikely to crib (bite) or lick the wood, creosote-treated wood may be used for building components which are in ground contact and are subject to decay or insect infestation if two coats of an effective sealer are applied. Sealers may be applied at the installation site. Coal tar pitch and coal tar pitch emulsion are effective sealers for creosote-treated wood-block flooring. Urethane, epoxy and shellac are acceptable sealers for all creosote-treated wood.

Do not use creosote-treated wood for farrowing or brooding facilities.

Do not use treated wood under circumstances where the preservative may become a component of food or animal feed. Examples of such use would be structures or containers for storing silage or food.

Do not use treated wood for cutting boards or countertops.

Only treated wood that is visibly clean and free of surface residues should be used for patios, decks and walkways.

Do not use treated wood for construction of those portions of beehives which may come into contact with the honey.

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

Do not use creosote-treated wood where it may come into direct or indirect contact with drinking water for domestic animals or livestock, except for uses involving incidental contact such as docks and bridges.

Handling Precautions

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

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

Avoid frequent or prolonged skin contact with creosote-treated wood; when handling the treated wood, wear long-sleeved shirts and long pants and use gloves impervious to the chemicals (for example, gloves that are vinyl-coated).

When power-sawing and machining, wear goggles to protect eyes from flying particles.

After working with the wood, and before eating, drinking and use of tobacco products, wash exposed area thoroughly.

If oily preservative or sawdust accumulate on clothes, launder before reuse. Wash work clothes separately from other household clothing.

(Consumer Information Sheet Approved by the U.S. Environmental Protection Agency)