Chemical Treatments – Wood Preservation for Fresh Water Uses
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WOOD PRESERVATION FOR FRESH WATER USES

CHEMICAL TREATMENTS

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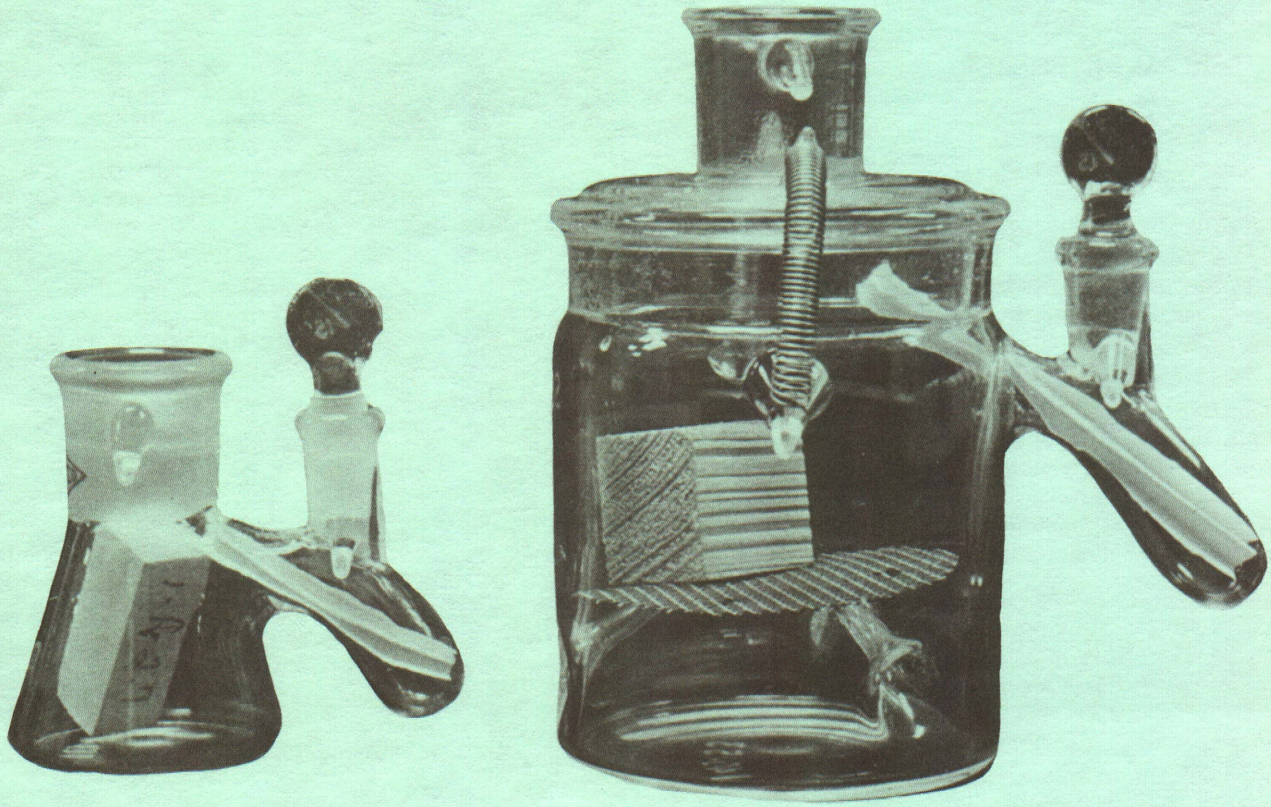

Vessels used in a respirometer to evaluate wood preservatives.

INTRODUCTION

MARINAS, DOCKS, WHARVES and other wooden structures encircle the Great Lakes. But wood exposed to constant dousing is very vulnerable to decay. Consider wood preservation when building wooden structures to use near fresh water.

The four publications in this series describe fungi and insects that attack wood, and they provide information on preservatives and their application, and how to use treated wood.

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IF YOU DETERMINE that treated wood will best protect your dock or other structures from decay and insect damage, what chemical treatment should you choose?

This booklet discusses chemical preservatives commonly used to treat wood and what dangers, if any, they present to people, animals and plants.

Most wood preservatives should: (1) control or prevent attack by destructive organisms; (2) be long lasting; (3) not harm wood and metal fastenings; (4) be free of objectionable handling qualities; (5) not be detrimental to the environment and (6) be economical to use. Preservatives discussed here meet these requirements. Large users of treated wood also usually require that the preservative has been proven effective through testing and use.

New, non-chemical means will continue to be offered to protect wood, but to date they have met with limited success. These include encasing wood in a plastic or rubber "boot," applying nondestructive fungi that fight off decay fungi, and heat treatment.

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If nondurable wood is to be used for beach and waterfront structures or other uses where fungus and insect attack are a threat, wood preservatives, properly applied, provide the most satisfactory protection.

Preservatives may be divided into the following: (1) oil type; (2) oilborne; (3) waterborne; (4) proprietary or patented.

GENERAL PROPERTIES

Oil-Type Creosote

Creosotes are made from wood, lignite, water gas tar, petroleum tar and coal tar. Only coal tar creosote is used to any extent for wood preservation. More creosote is used than any other preservative in the United States. All **creosote** mentioned in this series is coal tar creosote.

Creosote is distilled from tar from bituminous coal. It is composed of hundreds of organic compounds, depending on the source of coal and processing. Creosote is largely a coke byproduct of the steel industry.

Creosote is a dark brown liquid with a distinct, lasting odor. It is an outdoor preservative used extensively to treat poles, piles, cross ties, docks, piers and bridges. It has a 150 year record of success.

Creosote is sold under specifications of the American Wood Preservers' Association (AWPA) and other agencies. Dilution is possible with selected oils. While this is satisfactory for some uses such as cross ties, dilution is usually limited to 70% because many petroleum oils have no preservative value. Black or dark brown color alone does not indicate preservative properties.

Oilborne

Preservatives requiring a solvent other than water for adequate distribution in wood are called **oilborne.** Compounds of this group in commercial use are: pentachlorophenol, copper naphthenate, zinc naphthenate, tributyltinoxide and copper-8-quinolinolate. Pentachlorophenol is used in far greater amounts than all the others combined. Presently, it is the second most used wood preservative in North America.

Pentachlorophenol

Pentachlorophenol, usually referred to as **penta** or **PCP,** is sold to wood preserving plants as flakes, pellets, blocks or in solution (Fig. 1). PCP is a mixture of about 85% pentachlorophenol, 12% tetra and other chlorophenols, and 3% other compounds. Recently, attention has focused on some of the impurities called chlorodibenzodioxins or simply dioxins. Their effect in treated wood is still questionable.

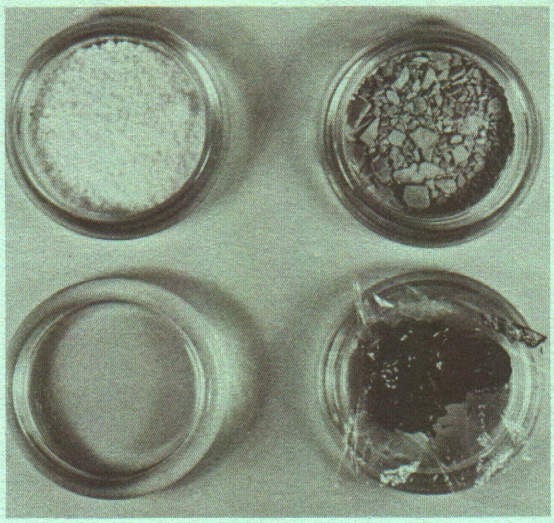


Fig. 1. Pentachlorophenol prills, (upper left) and flakes (upper right) are dissolved in a suitable oil (lower left) to form a 5% solution widely used for lumber, timber and pole treatment. A grease form (lower right) is used to rejuvenate poles below soil line or treat wood in place.

In commercial treating plants, PCP is usually dissolved in a solvent, aromatic gas oil, purchased direct from oil refiners. Treating solutions most often contain 5% by weight. Oil is purchased under an AWPA standard. Suitable oils must dissolve and hold in solution somewhat more than 5% PCP at temperatures down to freezing, and meet other technical restrictions.

Other users purchase PCP in the 5% solution just described or as a concentrated solution with as much as 40% PCP by weight. Concentrates are diluted with diesel fuel or other solvent to 5% PCP solution. Solutions and a grease are also available for specialized uses; these are discussed on page 4.

Copper Naphthenate

Copper naphthenate is used for wood that may come in contact with plant roots like those in greenhouses or flower beds and for general wood preservation. It is easy to see where the dark green solution has been applied. It leaves a lingering odor in wood. Its high cost minimizes copper naphthenate use in pressure treating plants. Most is sold in hardware, paint, garden and marine supply stores.

Zinc Naphthenate

Unlike copper naphthenate, zinc naphthenate in solution is nearly colorless. It controls decay less effectively than the copper compound. Both are made from byproducts of refining crude oil. Zinc naphthenate solutions are sold as proprietary products.

Tributyltinoxide

The most recent oilborne preservative, tributyltinoxide, is an effective preservative if not used in soil contact. Solutions are pale and sold largely as proprietary products. They leave some residual odor in treated wood.

Copper-8-quinolinolate

Sold only as a proprietary solution, copper-8 is unique because it can be used in contact with foods. It is safe to use where it might come in frequent skin contact. However, it is expensive compared with other wood preservatives.

Waterborne

As the name implies, these preservatives are dissolved in water before application. Water is an appealing carrier because it is readily available, costs little and is nontoxic. However, for most applications, water must be removed from treated wood before use, and water freezes.

Table 1 — Waterborne preservatives

Abbreviation	*Trade names*	*Components*
ACC	Celcure	Acid copper chromate
ACA	Chemonite	Ammoniacal copper arsenate
CCA-A	Greensalt, Langwood	Chromated copper arsenate
CCA-B	Boliden CCA	Chromated copper arsenate
CCA-B	Osmose K-33	Chromated copper arsenate
CCA-B	Koppers CCA-B	Chromated copper arsenate
CCA-C	Wolman CCA	Chromated copper arsenate
CCA-C	Wolmanac CCA	Chromated copper arsenate
CCA-C	Chrom-ar-cu (CAC)	Chromated copper arsenate
CCA-C	Koppers CCA-C	Chromated copper arsenate
FCAP	Osmosalts	Fluor chrome arsenate phenol
FCAP	Tanalith	Fluor chrome arsenate phenol
FCAP	Wolman FCAP	Fluor chrome arsenate phenol
FCAP	Wolman FMP	Fluor chrome arsenate phenol
CZC	—	Chromated zinc chloride

Table 1 lists trade names, designating letters, and components of all commercially available waterborne preservatives.

CCA

Today the most widely used waterborne products are those containing copper, arsenic and chromium. They are referred to as CCA (Fig. 2). Chemical reactions between the ingredients and binding-to-wood components transform water soluble compounds into remarkably water insoluble ones.

CCA preservatives have an excellent service record and are almost unleachable from wood. They even add some water repellency.

FCAP

This mixture originated in Europe and has been used in the United States since the early 1920's. The letters stand for fluoride, chromium, arsenic and dinitrophenol. Although an excellent preservative for above ground use, it is not recommended for use in soil contact.

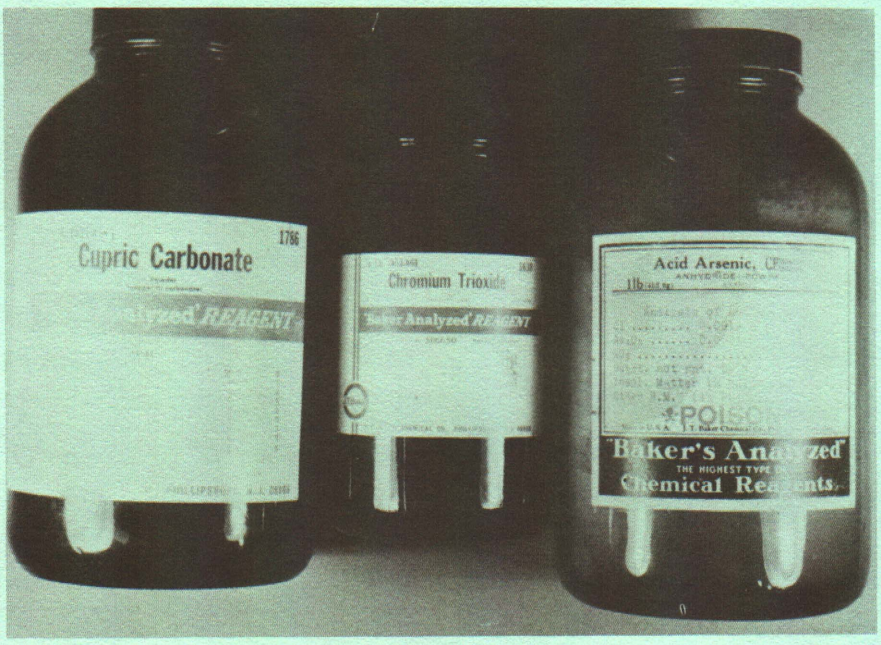


Fig. 2. Chemicals used in one type of CCA preservative.

ACA (Chemonite)

Ammoniacal copper arsenate depends, in part, on evaporation of the ammonia component from the mixture after impregnation. It has a good service record and is most commonly marketed in the western states and Canada.

CZC

Chromated zinc chloride is still used in some areas, largely for above ground use. It has generally been replaced by preservatives discussed previously and may be used where arsenic-containing preservatives are forbidden.

ACC (Celcure)

This mixture of copper sulfate, chromic acid and sodium dichromate is used for both above ground and soil contact applications. It does not contain arsenic and may be used where arsenic and arsenic compounds are restricted, but only for fence posts, grape stakes, plywood and lumber by AWPA standards.

Proprietary

These preservatives are sold to the public under brand names. Most are oil-type or oilborne. Since federal and many state laws require an ingredient statement, there are no "secret" or "wonder" formulas on the market. There are hundreds of branded products, but most fall into a few categories.

Creosote-containing

These products are either all creosote or creosote with some components removed to eliminate solidification in cold weather.

There are also creosote paints, but these are not wood preservatives since there is not enough creosote present to do much good. Furthermore, paints do not penetrate wood deeply enough to preserve it.

Since creosote has a strong, distinctive odor this group can be readily recognized.

Water Repellent Preservatives

Most of these contain pentachlorophenol as the active ingredient, although naphthenates and tributyltinoxide might also be used. In addition, the solution contains other ingredients to add water repellency

to wood. Such mixtures are largely used to treat window sash, doors and frames and are probably the most widely marketed proprietary preservatives in hardware, paint and building supply stores. They are sold to the public in ready-to-use form, but are also available to industry as concentrates.

Oilborne Solutions

Most of these solutions contain PCP as active ingredient, but copper naphthenate, zinc naphthenate, tributyltinoxide and copper-8-quinolinolate also appear in some products.

Concentrated mixtures of PCP are available also. Frequently, one gallon of solution is added to 10 gallons of kerosene, fuel oil or other oil as directed. Purchasing concentrates saves on freight and permits use of locally available solvents.

Thickened Oils and Pastes

These preservatives are intended for after treatment or rejuvenation of treated poles, posts or timbers. They are sold mostly to utilities and not in retail outlets. Some are available in bandage form to apply to the part of the pole below ground. Others are used on tops of poles or piling.

Paste and grease types may contain PCP, creosote, borax, sodium fluoride or potassium dichromate. Inorganic compound pastes are intended for use on moist wood although some PCP greases perform well on moist wood, too.

A gel or thickened oil is sold to pest control operators for use on subfloor frames of houses that were built with untreated wood. It can also be used on poles, piles and industrial structures of wood.

These preservatives are well adapted for use on marinas. Since such a variety of products exists, consult the manufacturer for recommendations.

Water Solutions

A limited number of products are intended for application to cut surfaces of treated lumber which may contain untreated areas. They may be sold by lumber yards or building supply dealers that handle waterborne solution treated wood.

TOXICITY

Wood Degrading Organisms

Any commercial wood preservative must control some or all fungi and insects attacking wood (see F-1247, "Wood Preservation for Fresh Water Use: Wood and Decay"). Since products must be registered with EPA, claims of effectiveness are also necessary. Avoid preservatives of unknown value or undisclosed active ingredients on the market in spite of rules and regulations.

Creosote has a broad spectrum of effectiveness. Creosote-impregnated wood resists attack by fungi, termites and most marine borers (Figs. 3a and b).

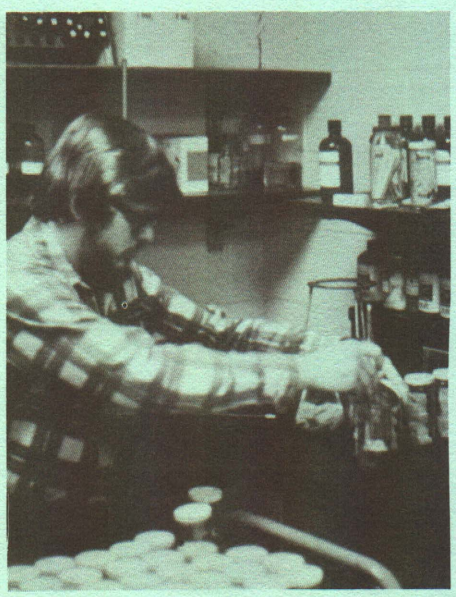
Pentachlorophenol, while effective against fungi and termites, does not give protection in salt water. The effectiveness of PCP solutions for wood preservation partially depends on the oil or solvent used. Higher distilling aromatic oils available only in large quantities to commercial treating plants give a longer lasting preservative than solvents such as No. 2 fuel oil or kerosene. In fact, the latter oils have to be fortified with higher solvent power liquids to dissolve 5% PCP.

When wood is treated by a specialized or patented process using liquified petroleum gas or methylene chloride for a solvent, no solvent remains in the wood. For this type of treatment, solvent does not affect effectiveness. In addition to controlling decay and termites, PCP also inhibits surface molds.

Arsenic containing preservatives like CCA, ACA and FCAP are effective against most fungi and insects. Surface molds will grow on some of the treated wood in high humidity areas; however, no wood strength loss results. These preservatives may not be as effective on some hardwoods as on pine or fir. FCAP is not recommended for soil contact or immersion in fresh water or salt water. CCA and ACA can be used in salt water to protect wood from marine borers.

Aquatic Life

Anyone around salt water harbors has seen barnacles, oysters and other marine organisms on creosoted piles and planks (Fig. 4). This indicates that creosote is not highly toxic to some marine life. In closed environment laboratory experiments, creosote was "moderately toxic" to bluegills, rainbow trout and goldfish.



Figs. 3a and b. Soil block toxicity test on wood preservative. Treated blocks are placed in jars of soil with growing decay fungus.

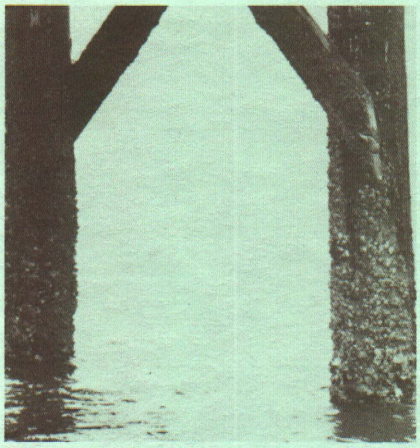


Fig. 4. Barnacles and other marine organisms attached to creosoted piling.

Overall creosote loss from wood is small in treated wood used in water. The dilution factor plus biological and physical factors degrading creosote diminish environmental effects to a minimum.

Pentachlorophenol is more toxic to fresh water fish than creosote. For this reason do not allow the liquid preservative to contaminate waters. Use it to treat cut off piles or sawed lumber in marina construction only with the greatest care. There is little possibility, however, of PCP-treated wood in water losing enough preservative to build up fish killing concentrations unless a badly bleeding pile is placed in a stagnant pool. If PCP does get into water around treated wood, the ultraviolet light in sunshine renders it nontoxic to fish in a short time. There are no recorded fish kills from PCP-treated wood in lakes or rivers.

Two components of CCA, arsenic pentoxide and copper sulfate, are toxic to marine life. However, when CCA mixture is injected into wood it reacts with wood components and within the mixture rendering the ingredients insoluble. There is little chance that CCA-treated piles or lumber immersed in water will harm fish or other aquatic life. Waterborne preservative solutions used to treat sawed ends or bored holes should not drip or spill into water.

Plants, Land Animals and Humans

Creosote has been used safely for over 100 years in treating plants and for treated wood.

Plants sprayed with this contact herbicide will die. However, when used as a wood preservative it has little effect on plants. Do not use recently creosoted wood in structures where roots of living plants will contact the wood. Old, weathered creosoted wood like discarded railroad ties is commonly used for landscaping with little effect on ornamental plants. In a study of a salt water marina area and neighboring marsh containing creosoted wood structures, there was no effect on marsh grass, phytoplankton or bacteria.

Creosote-coal tar solution (60/40), commonly used to treat railroad ties, has a low toxicity to rats, cattle and game birds. Creosote and solutions repel birds and animals, so they are unlikely to eat treated wood.

Creosote is sometimes used to deter cribbing by horses of wooden feed containers.

If the liquid is spilled or wets clothing, remove garments at once and thoroughly launder before reuse. Creosote in contact with bare skin, especially under hot, sunny conditions, is irritating and should be avoided. Use protective clothing and gloves when handling creosoted wood.

Pentachlorophenol solution is also a contact herbicide having been widely used in right-of-way weed killing and as a cotton defoliant and potato vine killer. Keep solutions away from valuable plants. Wood recently treated with PCP damages succulent foliage where it touches. The wood may also cause death or injure plant roots where they contact it, as in greenhouse flats used for starting seedlings. It should not be used inside greenhouses. Once PCP-treated wood has weathered a few years its capacity for this injury diminishes, making it safe to use near tender plants (Fig. 5). Even freshly treated wood does not harm many kinds of plants. For example, there is no apparent injury to lawn grasses and accompanying weeds when PCP-treated wood is used for flower bed borders.

There is no indication that PCP-treated wood causes injury or death of aquatic plants when used in lakes or rivers for piles, sheet piling, docks, piers and the like, although no scientific study has been made. The quantity of PCP entering such waters is minute.

Although PCP has been used for wood preservation in large quantities for more than 35 years, its safety has only recently been questioned. Attention has been focused on accompanying impurities, dioxins, rather than the PCP. This was referred to on page 2.

Fig. 5. Grasses growing adjacent to wood pressure-treated with 5% PCP solution in oil.

Penta is moderately toxic to people and animals, taken orally or through skin absorption. People who work with the solid in manufacturing plants need protective clothing and a respirator. When handling freshly treated lumber, wear vinyl-coated gloves. Remove contaminated clothing promptly and launder before reuse. Wash skin that comes in contact with an oily lumber surface as soon as possible to avoid irritation.

When PCP-treated wood is cut or bored, bury scraps away from water. Do not burn them in open fires, fireplaces or stoves. Do not use PCP freshly pressure treated wood where people or animals can contact it frequently with bare skin.

CCA-treated wood contains no oily liquid as does creosoted or much of the PCP treated wood. There is no contact effect with leaves or stems of plants. Greenhouse flats can be treated with CCA. There is not enough preservative in the soil to harm seedling roots. Studies with CCA-treated grape stakes indicate that none of the elements of the preservative were absorbed and transported into the stems or grapes of vines 3 inches from the stakes. This indicates CCA ingredients are strongly held in wood.

Fig. 6. Cutoffs from treated wood ready to be buried.

CCA-treated wood can be used where animal and human contact is frequent such as decks, walkways, railings and benches.

Rabbits and other animals may chew on CCA-treated wood. It is possible that the CCA form intended for use on electric utility poles will not attract animals.

Tests have been run on CCA-treated wood to measure the quantity removed by a person's hand when rubbed over it. Amounts of arsenic picked up were small, less than in foods such as meat and fish of a daily diet. This does not mean, however, that people handling treated wood should ignore good hygiene. It is best not to smoke, eat or drink until sawdust is removed from clothing and hands are thoroughly washed. Wear a respirator where power tools disperse wood dust into the air.

Do not burn or allow CCA-treated wood sawdust, shavings, boring waste and cut offs to fall into lakes or streams. Bury such wood waste away from habitation and water even though possibility of contamination is slight (Fig. 6).

ALWAYS USE WOOD PRESERVATIVES ONLY AS DIRECTED ON THE LABEL

The United States Environmental Protection Agency is currently reviewing the safety and registration of pentachlorophenol, arsenicals, and creosote/coal tar. These products can continue to be sold and used as wood preservatives until a final decision is made. In some cases that could be four years away.

MICHIGAN SEA GRANT PROGRAM - ADVISORY SERVICE -

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