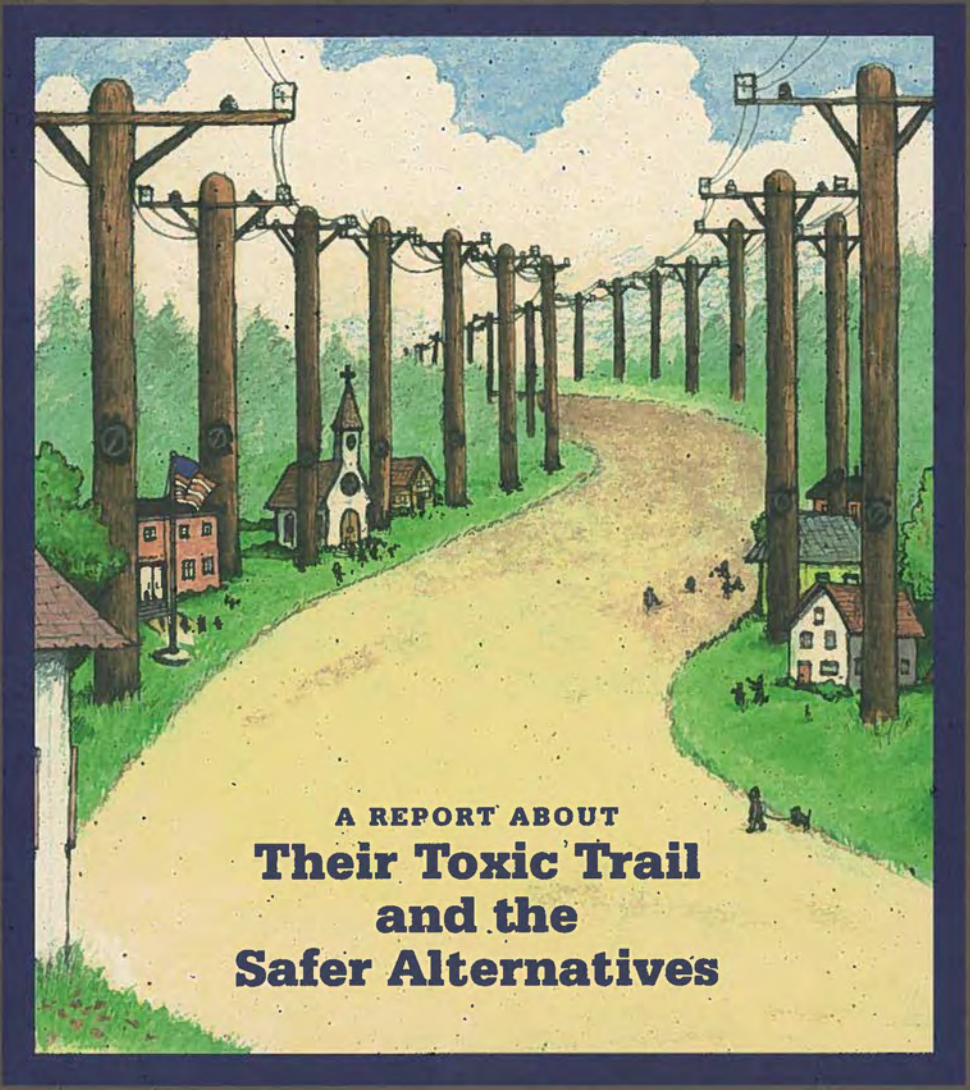
POISON POLES



A REPORT ABOUT

Their Toxic Trail and the Safer Alternatives

NATIONAL COALITION AGAINST THE MISUSE OF PESTICIDES

National Coalition Against the Misuse of Pesticides

The National Coalition Against the Misuse of Pesticides (NCAMP), formed in 1981, is a national, nonprofit membership organization of groups and individuals that serves as a national network committed to the adoption of alternative pest management practices and policies which reduce or eliminate dependencies on toxic chemicals. NCAMP takes a two-pronged approach to the pesticide problem by identifying hazards of conventional pest management practices and promoting nonchemical and least toxic management alternatives.

The organization's primary goal is to effect change through local action, assisting individuals and community-based organizations to stimulate discussions on the hazards of toxic pesticides, while providing information on safer alternatives. NCAMP provides useful information on pesticides and alternatives through its clearinghouse, monthly *Technical Report*, and quarterly magazine, *Pesticides and You*. The organization also publishes a wide variety of other materials, including the reports *Safety At Home*, *Unnecessary Risks*, *A Failure to Protect*, and *Voices for Pesticide Reform*. NCAMP believes people must have an informed voice in ensuring the safety of their land, air, water and food.

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POISON POLES

A REPORT ABOUT

Their Toxic Trail and the Safer Alternatives

Jay Feldman, M.A. and Terry Shistar, Ph.D.

NATIONAL COALITION AGAINST THE MISUSE OF PESTICIDES

DEDICATION

To a future without unnecessary pesticide poisons when concerns about health and safety and environmental protection are put first and when we embrace zero tolerance for harming our children through practices that contaminate the earth.

ACKNOWLEDGMENTS

The authors would like to acknowledge all those who provided invaluable assistance in preparing this report. NCAMP staff Sarah Sullivan, Operations Director, provided writing and research assistance as did Kristen Lacijan, Program Associate. They both went beyond the call of duty in meeting tight deadlines. Rick Shafer helped develop information for the report and lent his computer knowledge to the effort. Elizabeth Mendis assisted greatly with her artistic talent. NCAMP board members, particularly NCAMP's president, Liza Prior Lucy, and board member, Terry Shistar, provided important support in taking on this project.

NCAMP thanks its institutional donors and member supporters for making this report possible. It takes the support of NCAMP members and contributors to allow NCAMP its independent voice.

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PREFACE

The chemicals used as wood preservatives are among the most hazardous pesticides known to humankind. At the same time, wood preservatives are the largest group of pesticides out of the two billion pound of pesticides used in the United States every year, accounting for over one-third of all pesticide use. These include some of the most hazardous contaminants, such as dioxin, furans and hexachlorobenzene. The effects of these chemicals range from cancer, birth defects, reproductive problems to endocrine system disruption.

Despite this, the wood preservatives are everywhere. They are pumped into wood utility poles —as many as 135 million— that line our streets and backyards. Wood preserving plants dot the American landscape and have contributed to hundreds of hazardous waste sites. A Florida community has to be relocated because of contamination from a wood preserving facility. Wood treatment plant workers and those handling the wood are at high risk. Use of the treated wood and disposal of wood waste result in human health and environmental hazards.

Why is this report on wood preservatives and wood utility poles needed?

> One of the worst chemicals on record, pentachlorophenol, while banned for most uses, continues to be used as a wood preservative on utility poles, with nearly half of all utility poles still being treated with this toxic material. The alternative chemicals are extremely hazardous as well.
>
> EPA has been negligent in its attention to wood preservatives. Its special review process has been undermined by political compromise, with each of its proposals for regulations being weakened throughout the process. While Canada has begun to look at the issue recently, EPA has it on the backburner.
>
> EPA has neglected to consider, as is its practice, the viability of alternatives to treated wood poles, such as steel, concrete and fiberglass.
>
> Hazardous waste laws have exempted or neglected to require that treated wood waste be managed as hazardous. Wood plants have gone unregulated. Preservative-treated wood is ending up in municipal landfills.

Wood preservatives are a problem with a solution. They are also a problem with a powerful industry behind it. The American Wood Preservers Institute and the Society of American Wood Preservers, in concert with the chemical and utility industry, have kept these products on the market and circumvented virtually all standards of safety.

It will take an active public to push for the adoption of alternatives and a more aggressive regulatory climate to provide improved protection of public health and the environment.

Jay Feldman
Executive Director
National Coalition Against the Misuse of Pesticides

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ABOUT WOOD PRESERVATIVES AND POLES

Most electric utilities use wood poles treated with wood preservatives for their electric distribution lines. Since a wood pole is potentially a food source or living quarters for organisms ranging from bacteria and fungi to insects and birds, it must be treated with a broad-spectrum poison in order to protect it. Furthermore, utilities expect poles to last 35 to 50 years. The poison must be persistent.

The chemicals produced by the wood preserving industry meet these requirements. They are toxic to virtually everything, including people. They persist a long time in the environment. The same qualities that make them effective for protecting exposed wood from pests also make them dangerous to all other life. The toxicity and persistence of wood preservative chemicals have produced hundreds of Superfund toxic waste sites.

The wood preservative chemicals have other qualities in common. They are all toxic soups —complex combinations of chemicals, whose precise identity is generally unknown. Although other pesticides contain secret ingredients whose identity is known only to the manufacturers and EPA, wood preservatives go beyond secrecy. Pentachlorophenol, for example, is manufactured by a process that necessarily results in substantial contamination with dioxins, hexachlorobenzene, furans and other very toxic chemicals. Creosote is merely a fraction of coal tar that contains hundred of different chemicals, in different proportions according to the source. Copper naphthenate contains naphthenic acids which are derived in a similar way from petroleum. The arsenicals contain mixtures of salts of metals. Copper chromated arsenic, for example, contains salts of copper, chromium, arsenic, and other contaminants, including lead. It also turns out that the toxic effects of each of these soups are synergistic —that is, the combined effects of the soup is greater than the sum of the effects of the individual ingredients.

ABOUT ALTERNATIVES

There are alternatives to preservative treated wood poles. Although an alternative treatment of a wooden pole is doomed to be broadly toxic and persistent, it is not necessary for utility poles to be made of wood. Poles made of concrete and of steel are used in some places. Some are competitive in price with wood, even without taking into account their longer lifespan. Although there are environmental problems connected with the manufacture of steel and concrete poles, the intrinsic problems are not as great as those associated with wood poles.

ABOUT UTILITIES

In the United States, utilities come in four varieties: investor owned utilities, municipal utilities, rural electrification associations, and public power districts. While there are more municipal utilities than any other type, the bulk of the profits go to investor owned utilities. Different types of utilities have different motivations for choosing pole types.

ABOUT REGULATION

Currently, regulation provides huge incentives for polluting practices in the utility and wood preserving industries. This has been mostly the result of agencies abandoning the public interest in favor of protecting the interests of the regulated industries. The regulations that supposedly restrict the profiteering of investor owned utilities encourage utilities to accumulate capital —which may be in the form of nuclear power plants and may be in the form of poles— and discourage utilities from trimming costs by realizing long-term savings.

EPA's administration of the pesticide and hazardous waste laws has served to protect the wood preserving industry from any real restrictions on their activities. The companies that manufacture and use wood preservatives have managed to avoid data requirements under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) and disposal restrictions under the Resource Conservation and Recovery Act (RCRA) by loopholes, delays, and exemptions created by EPA.

RECOMMENDATIONS

This report recommends that the current regulatory incentives be reversed:

1. Public utility commissions should find more direct ways of protecting the environment.
2. EPA should examine the hazards of wood preservatives and the alternatives to using any form of wood in applications where treated wood has been deemed necessary.
3. Wood preservative manufacturers should be required to disclose all the ingredients (active, "inert," contaminants, and degradation products) of all of their products. They should test the entire formulation, and every time the formulation changes, they should test the new formulation.
4. Wood preservatives and treated wood should no longer be exempted from regulation as hazardous waste.

INTRODUCTION

Chemical wood preservatives account for the single largest pesticide use in the United States and pose a tremendous threat to public health and the environment. The hazards associated with these chemicals and the use, storage and disposal of the preservative-treated products are unnecessary, given that alternative materials to treated wood are available for many uses.

Wood preservatives—used to extend the life of wood products that are subject to fungus, insects and decay—and their contaminants are found in hundreds of hazardous waste sites across the country. They are subject to expensive cleanup efforts by government and the very industries that continue to introduce them into the environment at a rate of nearly one billion pounds a year.

This report focuses on wood preservative-treated utility poles —a problem that could be reduced significantly and eventually eliminated through the adoption of alternative pole materials and approaches. It is estimated that there are between 80 and 135 million wood utility poles in the U.S., with at least three percent, or three million of these, replaced every year.[1]

But there is more to the story than the pole that meets the eye on the street or in many backyards. The conventional wood pole leaves a trail of poisoning and contamination from cradle to grave, beginning with the forestry practices used to grow the trees, to the production of the chemicals, to the wood treating facility, to the installation, use, storage and disposal of the treated wood.

Despite the fact that wood preservatives are some of the most dangerous, ubiquitous and persistent chemicals known to the human race, the producers of these chemicals, treaters of the wood and end users of the treated wood products have all fought successfully to limit restrictions over a two-decade period beginning in the late 1970's. As a result, wood preservatives account for over one-third of the two billion pounds of pesticides used in the U.S. on an annual basis, according to the Environmental Protection Agency (EPA).[2] This number, however, may vastly underestimate the actual amount of wood preservatives used because EPA relies on wood preserving industry data that does not include all facilities. Taking into account all wood preservative solutions and solvents, over 1.6 billion pounds of wood preservatives were used in 1995, accounting for more pesticide use than all other pesticide uses combined.[3]

The major wood preservatives, including pentachlorophenol (penta or PCP), creosote, and arsenicals, are ranked among the most potent cancer agents, promoters of birth defects and reproductive problems, and nervous system toxicants. They contain chemicals that in other contexts are labeled hazardous waste because of the dioxin, furan and hexachlorobenzene contaminants that are found in them. Penta is used to treat 45 percent of wood poles in the U.S. Treatment of utility poles represents 93 percent of the remaining uses of pentachlorophenol. After crossties, poles are the largest wood product still treated with creosote. Forty-two percent of wood poles are treated with inorganic arsenicals and 13 percent are treated with creosote.[4]

The wood preserving chemicals cause cancer, birth defects and genetic damage.

The sole purpose of these chemicals is to preserve by killing living organisms. Because they easily move in air, water and soil, they threaten human life. In addition to causing both short- and long- term health effects — from extreme irritation to nerve damage to spontaneous abortions to death, penta and creosote are linked to disruption of the endocrine system. This means that they can disrupt the basic messages of life, affecting sexual traits, fertility, reproduction and the functioning of the nervous and immune systems. These estrogen mimics have been linked to breast cancer and prostate cancer. Regarding environmental impacts, these chemicals contaminate the soil, leach into groundwater and move through the air. Because of these effects, in many contexts the use of these chemicals is severely restricted or banned in the U.S. Twenty-six countries around the world have prohibited the use of penta.

Chemically-treated poles are used in virtually every community in the U.S. Nearly 12 percent of all wood preservatives are used to treat utility poles.[5] The rest is used on lumber and timber, plywood, fence posts, crossties and switch and bridge ties. In most cases, the poles, soaked in wood preservatives, are placed adjacent to property lines, or in backyards, front yards and playgrounds.

The utility or telephone poles coated with a dark brown or oily substance —penta or creosote— give off a petroleum odor. Other poles appear lighter, sometimes greenish, in color with no odor. These are treated with arsenicals. To maintain preservation of a pole over time, they are often pumped full of fresh chemicals, especially at the base where the wood meets the soil.

Companies should take a new path and look for safer alternatives to chemically-treated wood.

There are at least 795 wood preserving plants in the U.S.[6] Hundreds of sites across the country are listed on the National Priority List under the Environmental Protection Agency's (EPA) Superfund[7] program because of contamination with pentachlorophenol, creosote and arsenicals. These sites are identified by the federal government as representing a serious risk to human health and the environment in the communities where the chemical has been produced or used. EPA has slated these sites among those with the highest priority for cleanup. In the U.S."[8] and Canada,[9] pole storage sites, as well, have been identified as contaminated.

This report also tells of government inaction, of long delays dating back nearly 20 years, and of political pressure from the chemical and wood preserving industry, which generates $3.65 billion in gross sales annually.[10] When EPA concluded its benefits assessment of these chemicals in 1986, the agency limited its evaluation to alternative chemicals. However, EPA disregarded cost competitive alternative materials and has no plans to revisit its benefits analysis. It was the benefits analysis and finding of "non-substitutability"[11] of wood preservatives that allowed EPA to rationalize continued public and environmental exposure. Today, despite being the largest pesticide use, EPA has put wood preservatives on the backburner because it does not fall under its high priority food use pesticide category.

While the environmental and public health problems associated with wood preservatives escalate and government fails to adequately regulate these highly toxic substances, the annual utility pole replacement rate of over three million poles is generating a disposal problem that can not be controlled.

The largest purchasers of wood poles are utility and telephone companies. In the U.S., there are 3,013 utility companies of which 198 are Investor Owned Utilities (IOUs), 1,818 are Municipal Utilities (MUNIs), 922 are Rural Electrification Associations (REAs) and 75 are Public Utility Districts (PUDs).[12] The IOUs, smallest in number, are the largest in size and therefore the largest purchasers of poles.

A dramatic shift away from the dependency on toxic wood preservatives is long overdue. This report looks at a range of alternatives to treated wood poles, principally steel, concrete, fiberglass, and burying lines and the competitive costs of each. There is also the possibility of utilizing other types of wood that are naturally resistant.

Regulators and utilities urgently need to begin a transition toward utility poles made of alternative materials. The commonly used chemicals and treated wood products discussed in this report leave a toxic trail from manufacture, to use, storage and disposal that is unacceptable because of its public health and environmental consequences. This report questions the U.S. utility industry's reliance on some of the most hazardous toxic chemicals known to humankind when alternative materials for utility poles are available. In the past, the argument has been made that there are no economically viable alternatives to chemically-treated wood poles. This study finds that this position is not valid.

Across the land, we have allowed the creation of mini-toxic waste sites through a lack of foresight and perhaps incomplete knowledge of the environmental and human health consequences of the use of toxic chemicals. Under, around, in and on every preservative-treated utility pole is a toxic site that poses a real threat to clean air, water and land. At that site sits dioxin, furans and hexachlorobenzene which create an unacceptable and unnecessary hazard to public health and the environment. It is time to stop adding to the poisoning and contamination problem. This can be done through the utilization of alternative pole materials. In the end, it is unreasonable to perpetuate the toxic threat of wood preservatives when alternatives are available.

Utility companies play a central role in either continuing or stopping the poisoning and contamination of the environment, their communities and ultimately their customers. Utility companies in the U.S. and worldwide can and should take a new path and look for safer alternatives to chemically-treated wood.

THE TOXIC TRAIL

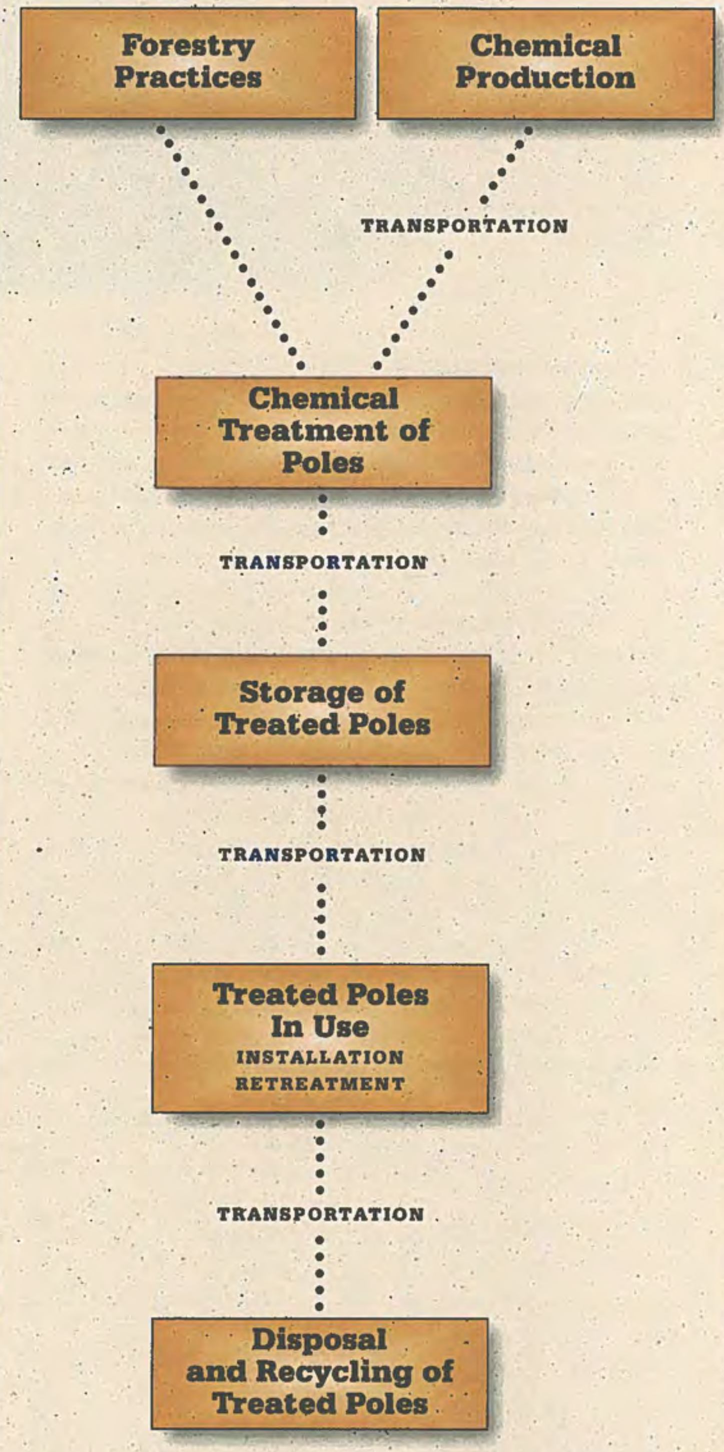
The Toxic Impact of Wood Utility Poles from Cradle to Grave

In order to fully illustrate the human health and environmental impact of wood preservatives, it is critical to understand how a tree becomes a pole or another treated wood product and the production process of the chemicals used to preserve wood.

It is not enough to evaluate the hazards associated with the use of wood preservatives, although their use alone creates severe hazards. The toxic trail of treated wood, from cradle to grave, must be considered. At each step, from the planting and growing of trees to the production of wood preservatives to the treatment of poles to their disposal, there are serious health and environmental hazards that must be considered. There have been several scientific attempts at conducting a life cycle analysis of utility poles. The different cycle phases have been identified as (i) raw material, (ii) processing, (iii) operation and service, (iv) destruction, and (v) reuse.[1]

Overview of Cradle-to-Grave Process

Wood poles start out as premium trees, higher quality than those usually used for lumber. Trees are stripped down to a uniform size, dried, then treated with preservatives. Wood preservatives must be highly toxic and persistent biocides to stop the natural process of decay. Some are derived from petroleum or coal tar, others from minerals. Chemically-treated poles are widely distributed, bringing a mini-Superfund site to virtually everyone's backyard. After the use life of approximately 40 years, the poles are casually discarded. Some go to landfills, some are reused after modifications, and some are recycled into fence posts or landscape material. Meanwhile, the emissions and waste from chemical manufacturing and wood treatment facilities bring high toxic burdens to communities across the country.



Forestry Practices

Growing trees for poles

Resource Extraction

Wood poles are made from several different species of conifers. Plantation grown Southern Yellow Pine predominates in the eastern U.S., plantation grown Red Pine in eastern Canada and northeastern U.S., and Western Red Cedar and Douglas Fir in western North America.

Ecological impact

Forestry has grown into a multimillion dollar industry, but at what cost to the environment? Pesticides are commonly used in forestry to prevent broadleaved weeds, grasses, and hardwood shrubs from overtaking the profitable lumber trees. In its Final Environmental Impact Statement, the United States Department of Agriculture (USDA) assessed the risk of 16 pesticides proposed for use in the Pacific Northwest. Fourteen of the 16 were missing cancer information which could "significantly change (the) assessment," and only one had reproductive or neurological data that was not considered "inadequate information for evaluating toxicity." USDA states; "The (16) herbicides may cause lower level immediate effects, such as nausea, dizziness, or reversible neuropathy. Longer term effects might include permanent nervous system damage; effects on reproductive success; damage to the liver, kidneys, or other organs; damage to the function of the immune system; and cancer."[2]

In the Pacific Northwest, the following 13 pesticides have been approved for use in vegetation management in the 1988 Final Environmental Impact Statement: asulam, atrazine, bromacil, dalapon, dicamba, glyphosate, hexazinone, imazapyr, picloram, simazine, tebuthiuron, triclopyr, and 2,4-D.[3] In the Southeast, the Coastal/Piedmont Region's Final Environmental Impact Statement recommended the use of dicamba, fosamine, glyphosate, hexazinone, imazapyr, picloram, sulfometuron methyl, tebuthiuron, and 2,4-D.[4]

Adverse Health and Environmental Effects of Major Forestry Pesticides

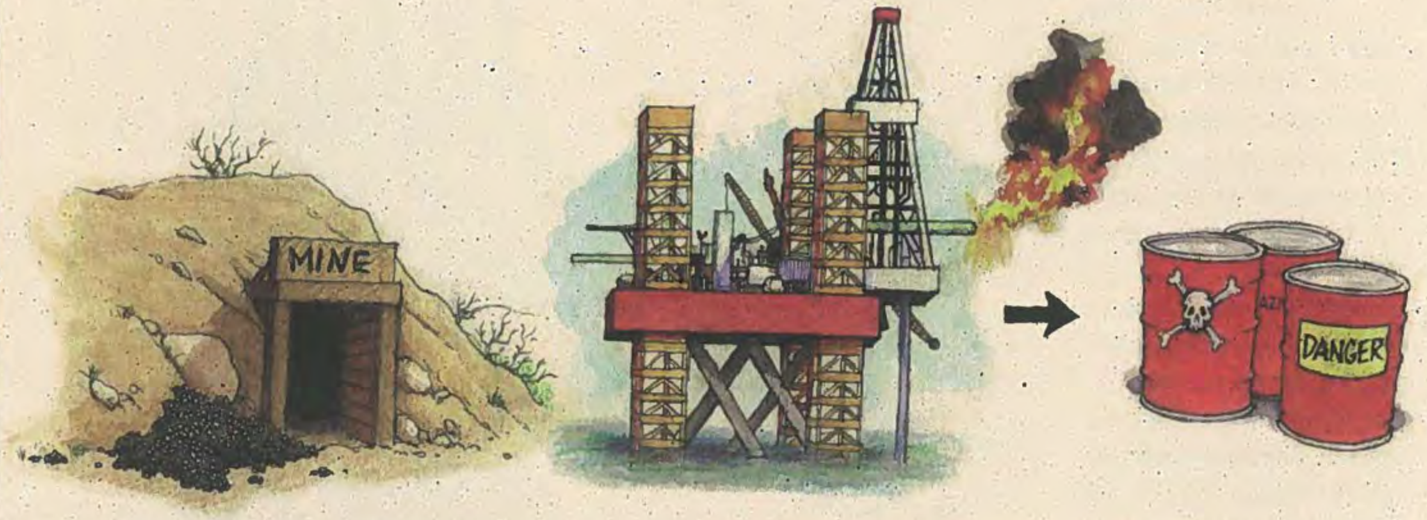
	Cancer	Birth Defects	Reproductive Effects	Neurotoxic	Kidney Liver Damage	Sensitizer Irritant	Detected in Groundwater	Potential Leacher	Toxic to Birds	Toxic to Fish	Toxic to Bees
2,4-D	●*	●	●	●	●	●	●	●	●	●	●
Atrazine	■	●		●	●	●	●			●	
Bromacil	■	●	●	●	●	●	●	●	●	●	
Dicamba			●		●	●	●			●	●
Glyphosate			●		●	●	●	●		●	●
Simazine	▲		●		●	●	●	●	●	●	●
Triclopyr			●	●	●	●	●	●	●	●	

● Adverse Health Effect ■ Possible Human Carcinogen ●* Adverse Health effect based on National Cancer Institute ▲ Quantifiable Carcinogen

Source: Environmental Protection Agency, 1996.

Chemical Production

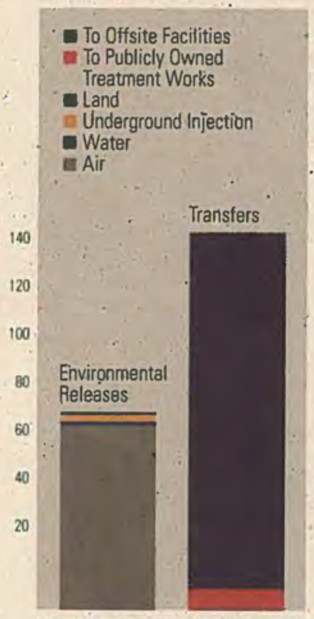
The production of chemicals used to treat wood



Petroleum-based chemicals

Penta, creosote, and naphthalene are all organic chemicals derived from oil and coal. The construction of oil wells and mining of coal also produce serious environmental damage. Drilled oil must be transported to a facility where it is refined. Shipment by oil tanker has resulted in some of the largest environmental disasters in recent history. Even more oil travels through mostly unregulated pipelines, leaking about 13 million gallons per year.[5] Creosote is distilled from coal tars, which are by-products of the carbonization of coal to produce coke or natural gas.

Total TRI Releases from Petroleum Refining, 1994



EPA, 1996. Toxic Release Inventory, 1994.

Metal-based chemicals

The most commonly used metal-based wood preservative is copper chromated arsenate (CCA), made up of copper, chromium and arsenic compounds. Copper mining and smelting are among the most environmentally destructive activities in several western states. Copper metal is the source of copper in most commercial copper compounds.[8] Arsenic is present in ores containing other metals, including copper. Chromium compounds are derived from sodium chromate and dichromate, which are produced by roasting chromite ore with soda ash. Chromite ore has not been mined in the U.S. since 1961. In 1988, the main sources of chromite ore imports were South Africa, Zimbabwe, and Turkey.

Toxic releases from manufacturing sites

Air tests at and around sites where chromium compounds are manufactured record high levels of the extremely toxic chromium (VI)."[7] Vulcan Chemical Company in Wichita, KS, the sole remaining U.S. producer of pentachlorophenol, releases millions of pounds of toxic chemicals every year into the Kansas environment, in addition to the thousands of pounds of chlorine and chlorine-containing compounds that are released accidentally. In 1994, Vulcan reported releases of four million pounds of toxic chemicals and accidently released 18,000 pounds of chlorine and chlorine-containing compounds.[8] These chemicals are also stored at manufacturing and wood treatment facilities, often in large quantities. In 1994, Vulcan reported storing nine toxic chemicals in quantities of one to ten million pounds. Seventeen more different toxic chemicals were stored in quantities exceeding 10,000 pounds each.[9]

Fires and explosions at pesticide storage sites are common. On April 6, 1991, a Royster Company warehouse in St. Louis, MO burned

> **"In March 1980, a 32-year old Mississippi man died soon after going to work at a penta plant near Jackson. An autopsy showed that he had high levels of penta in his liver, kidneys and lungs and had blood levels of 16 parts per million —or hundreds of times more than normal. The probable cause of death, according to the autopsy report: 'intoxication by pentachlorophenol.'"**
>
> The Kansas City Star, June 1984.

> **"A Vancouver-based company is abandoning plans to build Canada's only pentachlorophenol production plant after unsuccessful attempts in B.C. and Alberta. Arnold Hean, president of Bradbury Industrial up, Inc., said the decision was based on federal plans to make companies show their chemicals are not hazardous to health and to not allow Bradbury to purchase the product label from a company that use to produce chlorophenols in Canada."**
>
> The Vancouver Sun, January 16, 1987.

down. There were over 50,000 pounds of more than 60 different pesticides in the warehouse. The fire's toxic fumes caused at least $1.4 million of property damage. Cleanup costs were estimated at $500,000.[10]

Fish tissue sampled from streams affected by runoff from Vulcan show residues of pentachloroanisole (a carcinogenic metabolite of penta) and hexachlorobenzene (a carcinogenic contaminant of penta).[11] Levels of hexachlorobenzene are as high as 180 parts per billion, which is a concentration at which any fish consumption would lead to exceeding the one in a million risk level set as acceptable by EPA.

Worker exposure

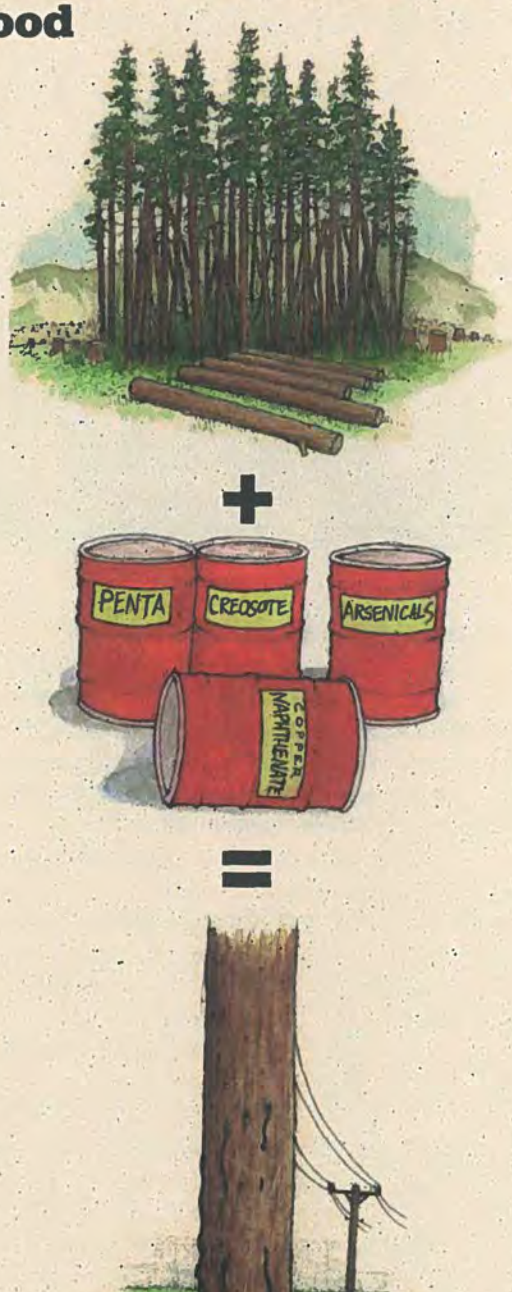
Workers on oil rigs and in coal mines are exposed to toxic chemicals in mines and from crude oil used in the production of wood preservatives. Workers involved in the production of coal tars that go into creosote are exposed to polycyclic aromatic hydrocarbons (PAHs) and other toxic by-products.[12] Workers employed in the manufacturing of wood preservatives are exposed to multiple toxic chemicals.

Chemicals Spills

Toxic chemicals must be transported from their manufacturing facility to the site where they are used. On average, there are five hazardous materials accidents each day in the U.S., three during transportation.[13]

On July 14, 1991, a rail tank car derailed in northern California, spilling 19,500 gallons of the fumigant metam sodium, commonly used to retreat utility poles, into the Sacramento River. The chemical sterilized 45 miles of river, and made its way to Lake Shasta, which provides drinking water for millions of people in California. It was not until three weeks after the spill that EPA discovered (from files in the agency's possession for four years) that metam sodium is highly fetotoxic (toxic to the fetus) and teratogenic (causes birth defects). The same stretch of rail suffered 41 accidents over a period of 15 years.[14]

Chemical Treatment of Wood



According to the American Wood Preservers Institute (AWPI), wood treatment "extends the service life of wood products by decades."[15] Sixty-nine percent of the wood treatment industry principally uses Southern Yellow Pine, although in the northwest both Douglas Fir and Western Red Cedar are used.[16] As AWPI acknowledges, the wood used is "subject to attack by insects, microorganisms and fungi."[17] Wood preservatives protect against fungi, insects, bacteria and marine organisms.[18] Most of the naturally resistant woods are considered too expensive to produce and when they are

Amount of Treated Wood Produced by Type of Preservative

Creosote Solutions[21]	91,751,000 cubic feet	(15.9%)
Oilborne Solutions[22]	32,764,000 cubic feet	(5.7%)
Inorganic arsenicals/ Waterborne Solutions[23]	450,596,000 cubic feet	(77.8%)
Fire Retardants	3,763,000 cubic feet	(0.6%)
Total	**578,874,000 cubic feet**	

How many poles are treated with which chemicals?

Preservative	Treated Poles (in 1,000 cubic ft)	Percent
Penta/Oil	30,617	45
Arsenicals	29,215	42
Creosote	8,941	13
TOTAL	68,773	100

Source: American Wood Preservers Institute, 1996.

used, as is the case of Western Red Cedar in the northwest, they are always chemically-treated at the submerged base portion and often full length treated.

In 1995, the wood preserving industry reported $3,65 billion in annual gross sales. In the same year, total volume of treated wood produced reached 578,874,000 cubic feet.[19]

The largest use of pentachlorophenol and other oilborne solutions is in the treatment of utility poles. Of the 32,764,000 cubic feet of all wood treated with penta and oilborne solutions, 93 percent, or 30,617,000 cubic feet, is used in the production of utility poles. Of the 450,596,000 cubic feet of all wood treated with arsenicals, six percent, or 29,215,000 cubic feet, go into utility poles. In other words, the vast majority of pentachlorophenol is used on utility poles.[20] Nevertheless, the treatment of utility poles are almost evenly split between penta and CCA, with 45 percent treated with penta, 42 percent with CCA and 13 percent with creosote.

Treatment process

Poles must be prepared before the chemical is applied. The preparation may include peeling, drying, conditioning, incising, cutting, and framing. These processes enable the preservative to penetrate the wood better. The different types of wood treating plants, including pressure treating and thermal non-pressure treating, use varying degrees of pressure, vacuum and temperature.[24]

The pressure-treating process involves placing the wood in a pressure-treating vessel where it is immersed in the preservative and then subjected to applied pressure. The excess penta is vacuumed from the vessel and the treated wood is removed, inspected, stored, and shipped. In the non-pressure process, which is used for short-term wood protection in construction where the wood will be protected from exposure to soil or weather through brick or cement barriers, penta is applied to the surface of wood by spraying, brushing, dipping, and soaking. This process is also used to control sapstain fungi by passing green lumber through a spray tunnel or by dipping the wood.[25]

> **"The Environmental Protection Agency plans to spend $18 million relocating people from 158 houses and 200 apartments in Pensacola, FL. The homes are neighbors with the Escambia Treating Company, where the logs, telephone poles in the making, were dripping chemical preservatives, first creosote, then pentachlorophenol. In 1991, long after the company went bankrupt, an emergency team from the EPA dug up the toxic mess, piled it into a 60-foot high mound laced with dioxin and other chemicals, and stored it tight under a polyethylene cover. Mr. Kaufman, EPA engineer, suggested that 'common sense' justified the relocation. 'Very few people are going to keel over and die because of a Superfund site,' he said. 'It's the long term health risks that are the problem.'"**
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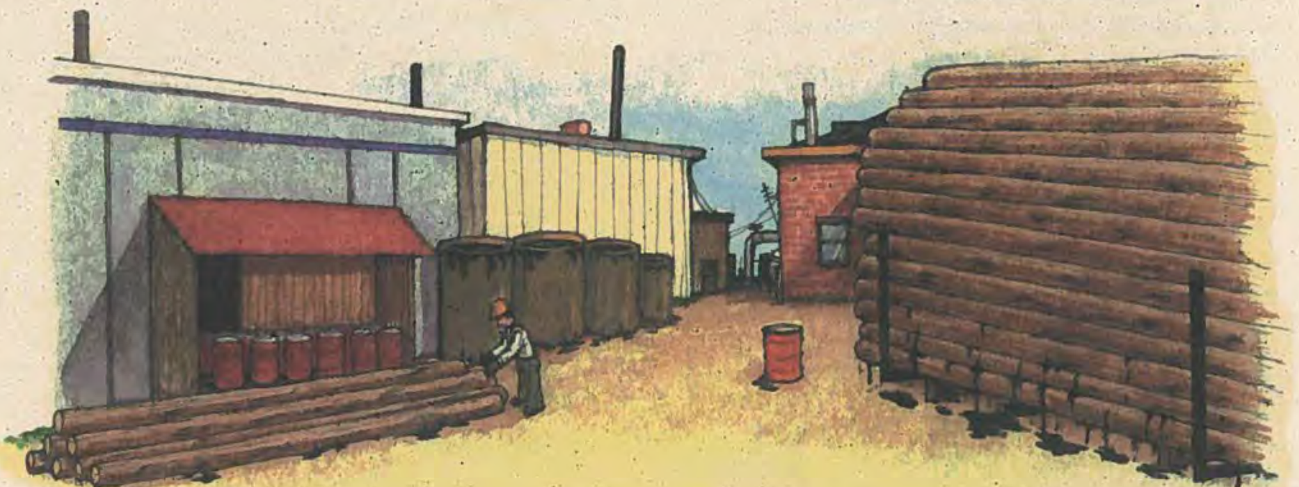
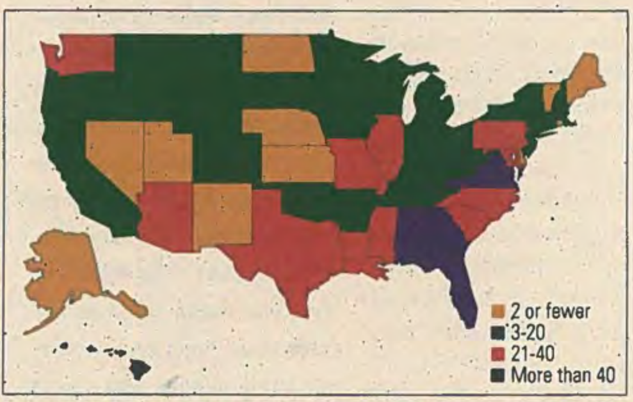
> The New York Times, October 21, 1996.



> **"Tim Skaggs died on October 17, 1991 at the age of 41 from acute lymphoblastic leukemia. Tim worked for Simpson Lumber Company at its Arcata mill starting at age 21. His initial employment as a night shift laborer resulted in his working at various jobs, including assignments to the paint line department where he handled and sawed lumber treated with Woodlife, a penta wood preservative manufactured and sold to Simpson by Champion. Tim's exposure to this dangerous and defective chemical during the period 1971 through late 1972 caused Tim's leukemia and that of his co-workers at the Arcata mill. The diagnosis of leukemia in Tim some 17 years after being exposed to this known carcinogen was consistent with the latency period for this type of chemically induced cancer. The California State Department of Health's report of that investigation documented three leukemias, including Timothy Skaggs, and one non-Hodgkins lymphoma at the Arcata plant."**

Richard Alexander, Dioxin in pentachlorophenol: A case study of cancer deaths in the lumber industry, 1996, citing "Evaluation of a Potential Cluster of Hematopoietic Cancers Among Workers in a Wood Manufacturing Mill in California," California Department of Health Services, Berkeley, April 12, 1990. URL:http://seamless. com/alexanderlaw/article/lumber.shtml.

Wood Preserving Plants (number per state)



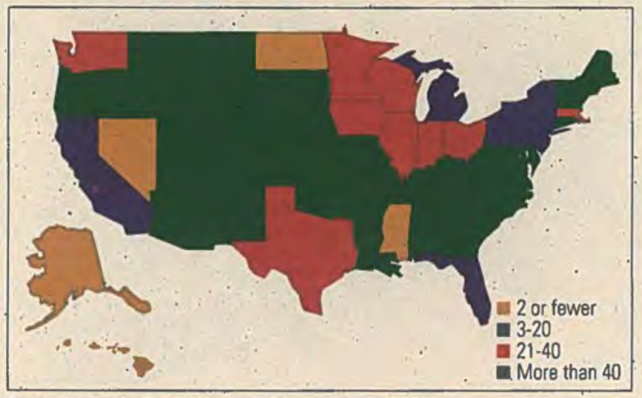
Source: EPA Finds Database, 1996 identifies at least 795 wood preserving plants in the U.S.

Toxic releases from treatment sites

Wood preservative treatment facilities have contributed greatly to the ranks of Superfund cleanup sites. On the National Priority List (NPL) of sites identified by EPA:

- Arsenic has been found in at least 781 NPL sites;[26]
- Penta has been found in at least 314 NPL sites;[27]
- Chromium has been found in at least 386 hazardous waste sites on the NPL;[28]
- Copper has been found in at least 210 NPL sites; and,[29]
- Creosote has been found in at least 38 of NPL sites;[30]

National Priority List Sites (number per state)
Contaminated with Penta, Creosote, Chromium or Arsenic
[Wood treatment sites and other sites]



Source: Agency for Toxic Substances Disease registry, 1996.

Depending on the process used by the treatment plant, wastes from plants include debris from clean-out of pressure cylinders and sumps, filters and removed from bag filters, sludge and wastewater, and used personal protection equipment such as respirator filters. In a survey conducted for a Canadian government study, volumes of penta waste in treatment plants using the chemical varied from 0.03 to 0.94 kg solid wastes/m3 (solid wastes per cubic meter of) treated wood.[31] The study assumes a 6% concentration of penta in solid waste from treatment facilities.[32] The study's analysis of the content of solid wastes from CCA treatment facilities establishes a range of toxic material content: for arsenic 2.0 to 5.7%; chromium from 0.7 to 1.7%; and, copper from 1.0 to 1.6%.[33]

Drip residues is considered "one of the major potential sources of air-borne CCA components in treatment plants."[34] Penta treated wood, "particularly immediately after treatment, emits PCP to the air and the wood may exude excess preservative."[35]

Worker exposure

Exposure to wood preservative chemicals is highest among workers at wood treatment facilities.[36] So much illness has resulted from worker exposure to pentachlorophenol that it is seen as a significant source of income for attorneys pursuing toxic torts.[37] One study found that mean pentachlorophenol levels in the blood of workers using penta ranged from 83 to 57,600 parts per billion.[38] Exposure to pentachlorophenol at maximum air concentrations allowed by Occupational Safety and Health Administration (OSHA) are estimated to produce blood levels one hundredth as high as the maximum found in this study.[39] EPA estimated the lifetime cancer risk of a worker in a wood treatment plant using inorganic arsenicals as ranging from two in 100 to more than one in ten. Cancer risk for workers using penta were based on the dioxin contaminant, rather than all the ingredients. Nevertheless, cancer risk was estimated to range from seven in 1,000 to more than one in 100. EPA did not perform a quantitative risk assessment for workers exposed to creosote.[40]

Wood Preserving Facilities and Contamination Sites by State

State	Number of Wood Preserving Facilities	Total NPL Sites Contaminated with Penta, Creosote, Arsenic, or Chromium	NPL Sites Contaminated with Penta	NPL Sites Contaminated with Creosote	NPL Sites Contaminated with Arsenic	NPL Sites Contaminated with Chromium VI
AK	0	1	0	0	1	0
AL	62	8	1	0	8	1
AR	33	11	7	2	10	1
AZ	4	8	0	0	8	1
CA	20	57	13	4	52	13
CO	5	18	5	1	17	4
CT	4	9	1	0	7	1
DC	0	0	0	0	0	0
DE	1	15	4	1	14	0
FL	56	42	20	0	38	5
GA	70	11	5	1	9	0
HI	10	0	0	0	0	0
IA	6	21	1	0	19	3
ID	6	9	2	0	8	0
IL	23	30	9	1	30	1
IN	14	27	8	1	27	1
KS	1	10	2	0	9	2
KY	16	17	4	0	17	1
LA	31	13	7	1	12	0
MA	7	25	3	1	25	0
MD	17	12	3	0	11	2
ME	1	11	2	0	11	3
MI	13	57	17	0	51	13
MN	11	33	9	4	29	1
MO	27	13	6	0	9	2
MS	35	2	2	1	2	0
MT	8	11	5	1	9	1
NC	31	15	3	3	13	1
ND	1	2	0	0	2	0
NE	2	4	1	0	4	0
NH	3	14	1	0	14	1
NJ	7	76	22	0	73	2
NM	1	11	1	0	11	1
NV	1	1	0	0	1	0
NY	10	59	15	1	51	8
OH	15	27	9	1	27	4
OK	10	13	2	0	13	1
OR	18	10	3	0	10	3
PA	23	60	18	0	57	2
PR	6	7	1	0	7	0
RI	1	8	1	0	7	0
SC	21	19	5	1	18	3
SD	3	3	0	0	3	0
TN	19	11	1	1	10	1
TX	36	29	11	3	25	2
UT	2	15	4	0	14	4
VA	45	20	6	1	19	4
VI	0	1	0	0	1	0
VT	0	4	1	1	3	0
WA	27	42	17	3	40	7
WI	17	28	5	1	26	4
WV	10	5	2	0	4	0
WY	5	3	3	0	2	0

Source: EPA Finds Database, 1996; Agency for Toxic Substances Disease Registry, 1996.

Storage of Treated Poles

Toxic releases and worker exposure

Treated poles act as leaky containers for toxic chemicals. When many poles are stored at a single location, their contents can add up to a lot of toxic material. Some have found that the most significant contamination sites are storage and distribution yards which have been reported widely.[41]

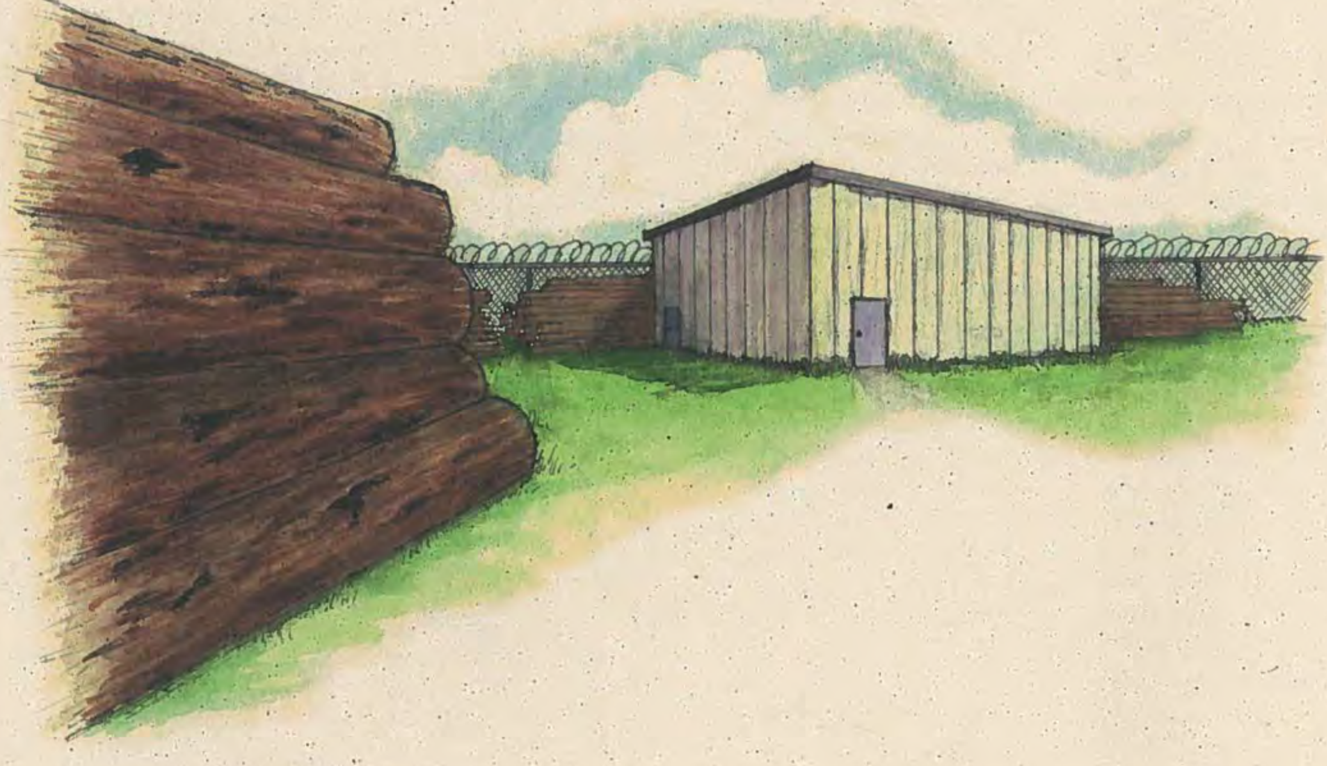
Bell Canada has about 90 pole storage facilities in Quebec and Ontario, each containing 10-400 poles. These sites not only pose a serious threat to workers, but to the surrounding community and the environment.

Bell Canada uses mostly CCA-treated poles in Ontario and penta-treated poles in Quebec. The company tested soil and groundwater at 14 pole storage sites in Quebec and 14 in Ontario. It found:

- Groundwater and surface soil concentrations of wood preservative chemicals exceeded the Provincial clean-up criteria at 9 sites by factors of 2 to 10.
- In Quebec, clean-up criteria were exceeded by factors as high as 100 at 10 sites.[42]

The most significant contamination sites are storage and distribution yards

> **"There was an enforcement case at the San Diego Naval Station in 1993 where the Navy stored treated wood pilings on the ground without a roof for several years. As a result of rain [which has a low average in San Diego], the chemicals of arsenic and creosote — acenaphthene, anthracene, benzopyrene, benzo-fluorathene, chrysene, fluoranthene, fluorene, pyrene, and dibenzofuran — from the pilings dripped and seeped into the soil. The soil sample analysis showed hazardous levels of these chemicals.**
>
> **The Department of Toxic Substance Control [California] made a finding that the poles were not subject to the requirements under [one section of state law] because the poles were not considered a waste. However, the site may still be subject to [other state law] for site cleanup of a hazardous waste contamination. This enforcement case supports the need for consumer awareness of the proper handling and in this case storage of treated wood. Hazardous waste contaminated soils can be hazardous to the environment and costly to mitigate."[43]**
>
> California Department of Toxic Substance Control, 1996



Treated Poles In Use

Installation

Toxic releases to the general public and worker exposure.

Since utility poles are virtually everywhere, public exposure to them is widespread.[44] Preservative depletion while a pole is in service represents the most significant release reported in the literature, although it is acknowledged that there has not been adequate research.[45] The main modes of chemical depletion in poles are gravity migration, bio-, photo- and chemical degradation, evaporation and leaching.[46] Dermal exposure poses a significant risk to utility workers who install and climb poles. Splinters from the pole can also carry toxic materials directly into the bloodstream. Workers who handled CCA-treated wood have been awarded compensation by the courts.[47]

Toxic chemicals can seep out of poles, resulting in concentrations of highly contaminated soil, or pooled liquid residue at the base of poles. Many of these poles are in cities, parks, playgrounds and backyards. The bare ground around a pole in a backyard may provide the pet cat's favorite place to find loose soil. The pole may provide the backrest at the baseball field for a child waiting for the next game. It may be "base" for a game of tag.

Ecological effects

The toxic chemicals in treated poles seep out when poles are in place. The chemicals can be carried into both surface and groundwater in concentrations that can contaminate drinking water and impact the life of aquatic organisms. Three poles treated with penta and located adjacent to drinking water wells caused water contamination.[50]

Purchasers of Utility Poles in the U.S.

Type	Number	Total Estimated Annual Purchase Volumes Mile	% Pole
IOUs	198	3,100,000	44
MUNIs	1,818	1,450,000	15
REA/PUDs	997	2,280,000	41

Investor Owned Utilities = IOUs
Municipal Utilities = MUNIs
Rural Electrification Associations = REAs
Public Utility Districts = PUDs

Source: McGraw Hill, 1994.

Retreatment

Retreatment processes and chemicals

Treated wood poles have a life expectancy of about 40 years, with considerable variability depending on tree species, treatment method, and climate. Although many utilities routinely replace poles as needed, many now conduct inspections to identify poles that can be retreated and/or repaired.[51]

Utility companies vary in their approaches to retreatment. A utility in Oregon reported a ten-year retreatment cycle as preventive maintenance; a Washington state utility conducts a periodic inspection and retreatment on an as-needed basis. Other utilities have discontinued their inspection and retreatment programs, in one case for budgetary reasons.[52]

Retreatments may be applied either externally or internally. External treatments are used mostly with Southern or Ponderosa Pine and sometimes with Douglas Fir and Lodgepole Pine treated with penta. They are applied below the groundline using formulations of copper naphthenate (which provides good surface protection but does not migrate very deeply into the pole) and/or boron or sodium fluoride, which can penetrate more deeply.[53]

CHLOROPICRIN: A DEADLY RETREATMENT CHEMICAL

Chloropicrin is extremely toxic. The probable oral lethal dose in a human weighing 150 pounds (70 kg) is 5-50 mg/kg or between seven drops and one teaspoonful.[55] Chloropicrin may be fatal if inhaled, swallowed or absorbed through the skin. Contact may cause burns to skin and eyes. Runoff from fire control or dilution water may cause pollution.[56] It is not flammable.[57] Very short exposure to this chemical could cause death or major residual injury even though prompt medical treatment is given.[58]

EPA required labeling includes the following precautionary statements:
Hazards to Humans and Domestic Animals; This pesticide is toxic to fish and wildlife. Do not contaminate water by cleaning equipment or disposal of wastes.[59]

Threshold concentrations cause immediate burning of the eyes, spasmodic winking, tearing and pain but no tissue damage. Permanent eye injury is unlikely except following exposure to very high concentrations of chloracetopheonone. Bronchospasm and laryngospasm may occur shortly following exposure due to the irritant effects. Pulmonary edema may be noted up to 12 to 24 hours after exposure. Chloropicrin can cause nausea, vomiting, skin irritation. Hypersensitivity reactions have been reported.[60]

In the atmosphere, chloropicrin will photodegrade with a half-life of 20 days, forming phosgene and nitrosyl chloride. Chloropicrin is washed out of the atmosphere by rain. If chloropicrin is spilled, it will volatilize and leach into the groundwater where its fate is unknown. In water it will volatilize (half-life 7.4 hours from a typical river) and photodegrade (half-life 3 days). It would not be expected to adsorb to sediment or bioconcentrate in fish. Although its use as a fumigant, fungicide, insecticide, tear gas and war chemical has a high potential for exposure, no occupational or ambient air concentration levels could be located. Chloropicrin is a contaminant in drinking water of several U.S. cities which may result from direct contamination of the water supply or from chlorination of other contaminants.[61]

> **"A United States Department of Agriculture employee who experienced internal bleeding and vomiting followed by complete disability after building picnic tables in an unventilated shop received a total of $767,000 from CCA manufacturers in 1987. Evidence introduced during the trial included a memo from Koppers, Inc. [a CCA manufacturer] indicating that they had reports of illness from workers sawing treated wood as early as 1968.[48] In 1990, an employee of the Whatcom County (Washington) parks and Recreation District whose nervous system was damaged during the installation of bridges constructed of CCA-treated wood was awarded $450,000 in compensatory damages."[49]**
>
> From Journal of Pesticide Reform, 1991.

Internal applications include:[54]

- Void treatments, in which an oil-based preservative such as copper naphthenate, with or without an insecticide such as chlorpyrifos, is forced into the pole through an inspection hole under pressure.
- Fumigation, in which a volatile liquid or solid is placed into an inspection hole, which is plugged. The fumigant—chloropicrin, methyl isothiocyanate, and metam sodium (which decomposes to methyl isothiocyanate)—vaporizes and moves through the wood.
- Water diffusible systems, which use moisture in the pole to carry the active ingredient—sodium octaborate tetrahydrate or copper naphthenate—through the pole.

Retreatment chemicals expand the number of hazardous chemicals associated with the use of chemically treated wood poles. Chloropicrin is an example of an extremely toxic chemical used for retreatment. (see box)

Environmental and health hazards

Almost all retreatment chemicals are highly toxic. The fumigants pose a high risk to workers using them. Since these materials are designed to migrate through the pole quickly, they also pose a threat of environmental contamination. Metam sodium is not recommended for use in areas near surface waters.[62] Some of the fumigants require the use of a respirator to protect the applicator. They could also pose an acute health risk if used in populated areas.[63]

The Number of Poles in Use

The toxic trail of wood utility poles runs from coast to coast. Below are tables which show the concentration of utility "pole miles" by state and by the service area of America's 100 largest utilities. Because every toxic wood pole has been treated, and often times retreated, with highly toxic wood preservatives, each of these poles serves as a mini-toxic waste site. This means, in addition to the hundreds of EPA Superfunds sites that are created as a result of producing these poles, using a pole distribution formula explained below, there are well over 116 million mini-waste sites in backyards, school yards, along rivers and lakes, and up and down roadsides across the country. Out of the over 3,000 electric utilities in the U.S., over one-half of these toxic poles are put in place by the 100 largest utilities. That translates to more than one toxic pole per household.

The state of Texas shows the highest number of poles with 395,752 pole miles and over 11 million poles. West Virginia shows the least number of poles with just under 89,000.

American Electric Power, an investor-owned utility based in Columbus, Ohio has close to 3.3 million utility poles in its service area. The second highest concentration of poles is in California's Pacific Gas and Electric Company service area. Their utility poles number almost 2.8 million.

Based on information compiled from utility companies, and assuming a total of 135 million utility poles nationwide, there are 28.5 treated wood poles per mile. This is based on a weighted avarage of 22 poles per mile in REAs/PUDs (representing 41% of utilities) and 33 poles per mile in IOUs/MUNIs (representing 59% of utlities). For the top 100 utilties ranked by distribution of pole miles, there are an average of 32 poles per miles based on IOUs/ MUNIS comprising 89% of the total and REAs/PUDs comprising 11%.

Estimate of Pole Miles and Distribution Poles by State

State	Overhead Distribution Pole Miles[1]	Estimated Number of Distribution Poles[2]	State Rank
TX	395,752	11,278,938	1
OH	234,884	6,694,185	2
NC	179,617	5,119,098	3
CA	161,009	4,588,762	4
GA	156,226	4,452,448	5
MO	148,065	4,219,848	6
NY	144,467	4,117,310	7
PA	137,931	3,931,021	8
AL	129,140	3,680,502	9
OK	127,954	3,646,676	10
FL	127,411	3,631,223	11
IL	121,123	3,451,995	12
TN	117,267	3,342,114	13
VA	114,811	3,272,115	14
MI	114,338	3,258,628	15
MN	104,088	2,966,510	16
IA	101,705	2,898,604	17
WI	100,064	2,851,831	18
MS	96,870	2,760,804	19
IN	94,258	2,686,360	20
KY	93,263	2,657,995	21
KS	90,995	2,593,371	22
NE	78,826	2,246,550	23
OR	77,721	2,215,059	24
LA	74,213	2,115,063	25
CO	71,114	2,026,737	26
SC	67,214	1,915,586	27
AR	53,985	1,538,573	28
WA	53,741	1,531,622	29
MA	53,548	1,526,119	30
SD	50,394	1,436,241	31
MT	49,272	1,404,255	32
NM	43,326	1,234,777	33
ND	41,672	1,187,645	34
AZ	40,255	1,147,264	35
NJ	35,636	1,015,640	36
MD	32,085	914,413	37
ID	28,728	818,757	38
ME	22,767	648,871	39
CT	21,951	625,617	40
WY	20,829	593,640	41
NV	16,235	462,711	42
VT	14,964	426,477	43
NH	13,244	377,456	44
AK	7,768	221,379	45
UT	6,152	175,323	46
RI	5,668	161,531	47
HI	5,515	157,178	48
DC	4,485	127,822	49
DE	3,164	90,163	50
WV	3,105	88,482	51
Totals	**4,088,817**	**116,531,291**	

1. Pole miles for Arkansas Power & Light (AR), Interstate Power (IA), and Niagara Mohawk Power (NY) obtained from other sources since data not available in UDI database.
2. Based on information compiled from utility and industry sources, the number of distribution poles was estimated using a weighted average of 28.5 poles/pole mile.

Source: Utility Data Institute's U.S. Electric Power Business Directory and database, 1996

Top 100 U.S. Utilities Ranked by Distribution Pole Miles

Utility	State	Utility Type	Overhead Distribution Pole Miles	Estimated Number of Distribution Poles[2]	Utility Rank
American Electric Power Co.	OH	IOU	103,625	3,294,239	1
Pacific Gas and Electric Co.	CA	IOU	87,492	2,781,371	2
Duke Power Co.	NC	IOU	61,500	1,955,085	3
Alabama Power Co.	AL	IOU	61,341	1,950,030	4
Texas Utilities Electric Co.	TX	IOU	60,492	1,923,041	5
Pennsylvania Power & Light Co.	PA	IOU	54,962	1,747,242	6
Consumers Power Co.	MI	IOU	50,853	1,616,617	7
Niagara Mohawk Power Corp.[1]	NY	IOU	48,000	1,525,920	8
PacifiCorp	OR	IOU	44,900	1,427,371	9
Carolina Power & Light Co.	NC	IOU	44,149	1,403,496	10
Appalachian Power Co.	VA	IOU	42,679	1,356,760	11
Southern California Edison Co.	CA	IOU	42,621	1,354,912	12
Georgia Power Co.	GA	IOU	41,067	1305,520	13
Virginia Electric and Power Co.	VA	IOU	38,767	1232,395	14
Florida Power & Light Co.	FL	IOU	38,311	1217,907	15
Commonwealth Edison Co	IL	IOU	37,790	1201,344	16
Arkansas Power & Light Co.[1]	AR	IOU	34,713	1103,526	17
New York State Electric & Gas Corp.	NY	IOU	33,606	1068,335	18
Consolidated Edison Co. of New York	NY	IOU	32,255	1025,386	19
Detroit Edison Co.	MI	IOU	31,566	1003,483	20
Union Electric Co.	MO	IOU	26,227	833,756	21
Central Power & Light Co.	TX	IOU	25,287	803,874	22
Oklahoma Gas and Electric Co.	OK	IOU	23,467	746,016	23
Wisconsin Electric Power Co.	WI	IOU	23,004	731,297	24
Gulf States Utilities Co.	TX	IOU	21,817	693,562	25
Ohio Power Co.	OH	IOU	21,782	692,438	26
MidAmerican Energy Co.	IA	IOU	21,005	667,760	27
Western Resources Inc.	KS	IOU	20,746	659,502	28
Louisiana Power & Light Co.	LA	IOU	20,363	647,340	29
West Penn Power Co.	PA	IOU	19,910	632,946	30
Central Maine Power Co.	ME	IOU	18,967	602,961	31
Illinois Power Co.	IL	IOU	18,963	602,834	32
Houston Lighting & Power Co.	TX	IOU	18,477	587,393	33
Connecticut Light & Power Co.	CT	IOU	18,065	574,294	34
Idaho Power Co.	ID	IOU	17,881	568,449	35
Wisconsin Public Service Corp.	WI	IOU	17,828	566,743	36
Florida Power Corp.	FL	IOU	17,499	556,293	37
Northern States Power Co.	MN	IOU	17,112	544,002	38
PSI Energy, Inc.	IN	IOU	16,455	523,104	39
Potomac Edison Co.	MD	IOU	16,141	513,131	40
Wisconsin Power and Light Co.	WI	IOU	15,823	503,013	41
Jersey Central Power & Light Co.	NJ	IOU	15,649	497,485	42
South Carolina Electric & Gas Co.	SC	IOU	15,596	495,808	43
Indiana Michigan Power Co.	IN	IOU	15,399	489,542	44
Commonwealth Electric Co.	MA	IOU	14,636	465,278	45
Duquesne Light Co.	PA	IOU	14,602	464,198	46
Boston Edison Co.	MA	IOU	14,561	462,894	47
Public Service Co. of Oklahoma	OK	IOU	14,150	449,828	48
IES Utilities, Inc	IA	IOU	13,796	438,575	49
Kentucky Utilities Co.	KY	IOU	13,754	437,240	50

[1] Pole miles for Arkansas Power & Light (AR), Interstate Power (IA), and Niagara Mohawk Power (NY) obtained from other sources since data not included in UDI database.

[2] Based on information compiled from utility and industry sources, the number of distribution poles was estimated using a weighted average of 31.79 poles/pole mile.

Utility	State	Utility Type	Overhead Distribution Pole Miles	Estimated Number of Distribution Poles[2]	Utility Rank
Montana Power Co.	MT	IOU	13,333	423,847	51
Mississippi Power & Light Co.	MS	IOU	13,016	413,766	52
Public Service Co. of Colorado	CO	IOU	12,927	410,949	53
Cleveland Electric Illuminating Co.	OH	IOU	12,804	407,049	54
Massachusetts Electric Co.	MA	IOU	12,645	401,980	55
Interstate Power Co.[1]	IA	IOU	12,500	397,375	56
Ohio Edison Co.	OH	IOU	12,392	393,942	57
Columbus Southern Power Co.	OH	IOU	11,950	379,900	58
Dayton Power & Light Co.	OH	IOU	11,782	374,548	59
PECO Energy Co.	PA	IOU	11,764	373,990	60
Arizona Public Service Co.	AZ	IOU	10,930	347,465	61
Puget Sound Power & Light Co.	WA	IOU	10,503	333,886	62
Cincinnati Gas & Electric Co.	OH	IOU	9,972	317,010	63
Bluebonnet Electric Cooperative, Inc.	TX	REA	9,524	302,768	64
Baltimore Gas & Electric Co.	MD	IOU	9,428	299,716	65
Clay County Electric Cooperative	FL	REA	9,369	297,831	66
Central Louisiana Electric Co., Inc.	LA	IOU	9,359	297,531	67
Atlantic City Electric Co.	NJ	IOU	9,189	292,120	68
Central Illinois Public Service Co.	IL	IOU	9,068	288,288	69
Southern Pine Electric Power Association	MS	REA	8,951	284552	70
Kansas City Power & Light Co.	MO	IOU	8,949	284,481	71
Tucson Electric Power Co.	AZ	IOU	8,737	277,749	72
Kentucky Power Co.	KY	IOU	8,731	277,565	73
Portland General Electric Co.	OR	IOU	8,717	277,113	74
South Central Power Co.	OH	REA	8,634	274,475	75
Public Service Electric and Gas Co.	NJ	IOU	8,531	271,200	76
Sierra Pacific Power Co.	NV	IOU	8,491	269,929	77
Rio Grande Electric Cooperative, Inc.	TX	REA	8,473	269,357	78
Long Island Lighting Co.	NY	IOU	8,337	265,033	79
Texas-New Mexico Power Co.	TX	IOU	8,240	261,938	80
West Texas Utilities Co.	TX	IOU	8,142	258,834	81
Northern Indiana Public Service Co.	IN	IOU	8,111	257,849	82
Volunteer Electric Cooperative	TN	REA	7,949	252,699	83
Central Illinois Light Co.	IL	IOU	7,804	248,100	84
Northern States Power Co. of Wisconsin	WI	IOU	7,801	248,001	85
Cap Rock Electric Cooperative, Inc.	TX	REA	7,800	247,962	86
Medina Electric Cooperative, Inc.	TX	REA	7,688	244,402	87
Midwest Energy, Inc.	KS	REA	7,620	242,240	88
First Electric Cooperative Corp.	AR	REA	7,480	237,789	89
Washington Water Power Co.	WA	IOU	7,463	237,264	90
San Diego Gas & Electric Co.	CA	IOU	7,362	234,038	91
Central Vermont Public Service Corp.	VT	IOU	7,228	229,763	92
Los Angeles Dept. of Water & Power	CA	MUNI/STATE	7,188	228,507	93
Toledo Edison Co.	OH	IOU	7,031	223,515	94
Omaha Public Power District	NE	MUNI/STATE	6,916	219,860	95
Rochester Gas and Electric Corp.	NY	IOU	6,886	218,906	96
WestPlains Energy	CO	IOU	6,827	217,030	97
Southwest Louisiana Electric Membership Corp.	LA	REA	6,822	216,871	98
Tampa Electric Co.	FL	IOU	6,822	216,871	99
Central Hudson Gas & Electric Corp.	NY	IOU	6,575	209,019	100
Totals			**1,994,414**	**63,402,405**	

Source: Utility Data Institute's U.S. Electric Power Business Directory and database, 1996.

Alphabetical Listing of Top 100 U.S. Utilities

Utility	State	Utility Rank
Alabama Power Co.	AL	4
American Electric Power Co.	OH	1
Appalachian Power Co.	VA	11
Arizona Public Service Co.	AZ	61
Arkansas Power & Light Co.	AR	17
Atlantic City Electric Co.	NJ	68
Baltimore Gas & Electric Co.	MD	65
Bluebonnet Electric Cooperative, Inc.	TX	64
Boston Edison Co.	MA	47
Cap Rock Electric Cooperative, Inc.	TX	86
Carolina Power & Light Co.	NC	10
Central Hudson Gas & Electric Corp.	NY	100
Central Illinois Light Co.	IL	84
Central Illinois Public Service Co.	IL	69
Central Louisiana Electric Co., Inc	LA	67
Central Maine Power Co.	ME	31
Central Power & Light Co.	TX	22
Central Vermont Public Service Corp.	VT	92
Cincinnati Gas & Electric Co.	OH	63
Clay County Electric Cooperative	FL	66
Cleveland Electric Illuminating Co.	OH	54
Columbus Southern Power Co.	OH	58
Commonwealth Edison Co	IL	16
Commonwealth Electric Co.	MA	45
Connecticut Light & Power Co.	CT	34
Consolidated Edison Co. of New York	NY	19
Consumers Power Co.	MI	7
Dayton Power & Light Co.	OH	59
Detroit Edison Co.	MI	20
Duke Power Co.	NC	3
Duquesne Light Co.	PA	46
First Electric Cooperative Corp.	AR	89
Florida Power & Light Co.	FL	15
Florida Power Corp.	FL	37
Georgia Power Co.	GA	13
Gulf States Utilities Co.	TX	25
Houston Lighting & Power Co.	TX	33
Idaho Power Co.	ID	35
IES Utilities, Inc.	IA	49
Illinois Power Co.	IL	32
Indiana Michigan Power Co.	IN	44
Interstate Power Co.	IA	56
Jersey Central Power & Light Co.	NJ	42
Kansas City Power & Light Co.	MO	71
Kentucky Power Co.	KY	73
Kentucky Utilities Co.	KY	50
Long Island Lighting Co.	NY	79
Los Angeles Dept. of Water & Power	CA	93
Louisiana Power & Light Co.	LA	29
Massachusetts Electric Co.	MA	55
Medina Electric Cooperative, Inc.	TX	87
MidAmerican Energy Co.	IA	27
Midwest Energy, Inc.	KS	88
Mississippi Power & Light Co.	MS	52
Montana Power Co.	MT	51
New York State Electric & Gas Corp.	NY	18
Niagara Mohawk Power Corp.	NY	8
Northern Indiana Public Service Co.	IN	82
Northern States Power Co.	MN	38
Northern States Power Co. of Wisconsin	WI	85
Ohio Edison Co.	OH	57
Ohio Power Co.	OH	26
Oklahoma Gas and Electric Co.	OK	23
Omaha Public Power District	NE	95
Pacific Gas and Electric Co.	CA	2
PacifiCorp	OR	9
PECO Energy Co.	PA	60
Pennsylvania Power & Light Co.	PA	6
Portland General Electric Co.	OR	74
Potomac Edison Co.	MD	40
PSI Energy, Inc.	IN	39
Public Service Co. of Colorado	CO	53
Public Service Co. of Oklahoma	OK	48
Public Service Electric and Gas Co.	NJ	76
Puget Sound Power & Light Co.	WA	62
Rio Grande Electric Cooperative, Inc.	TX	78
Rochester Gas and Electric Corp.	NY	96
San Diego Gas & Electric Co.	CA	91
Sierra Pacific Power Co.	NV	77
South Carolina Electric & Gas Co.	SC	43
South Central Power Co.	OH	75
Southern California Edison Co.	CA	12
Southern Pine Electric Power Ass'n	MS	70
Southwest Louisiana Electric Memb.	LA	98
Tampa Electric Co.	FL	99
Texas-New Mexico Power Co.	TX	80
Texas Utilities Electric Co.	TX	5
Toledo Edison Co.	OH	94
Tucson Electric Power Co.	AZ	72
Union Electric Co.	MO	21
Virginia Electric and Power Co.	VA	14
Volunteer Electric Cooperative	TN	83
Washington Water Power Co.	WA	90
West Penn Power Co.	PA	30
West Texas Utilities Co.	TX	81
Western Resources Inc.	KS	28
WestPlains Energy	CO	97
Wisconsin Electric Power Co.	WI	24
Wisconsin Power and Light Co.	WI	41
Wisconsin Public Service Corp.	WI	36

Source: Utility Data Institute's U.S. Electric Power Business Directory and database, 1996.

Disposal and Recycling

The lifespan of treated poles depends on factors such as the type of wood, climate, and type of treatment. The average expected useful life is 30-50 years, but the turnover in urban areas is more rapid because of changes in pole location due to changing utility service or street repair and modification.[64]

Disposal methods

In excess of three million poles are removed from service each year.[65] Largely due to intense lobbying by the wood preserving industry, there are very few restrictions on the disposal of chemically-treated wood poles. Treated wood is not considered a pesticide and therefore not subject to the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA). Reused wood is not a waste and therefore not subject to the Resource Conservation and Recovery Act (RCRA.) Treated wood that is no longer usable is waste, but has not been listed as hazardous waste.[66] Therefore, several different disposal methods are available nationwide.

Landfill

Treated wood is eligible for disposal in municipal landfills and a great deal is sent to them.[67]

Incineration

Treated wood poles are burned for their energy value in co-generation facilities permitted for burning treated wood, in hazardous waste incinerators, and in the fireplaces and wood stoves of scavengers.[68] Burning of penta-treated wood releases dioxins into the air. Arsenic and chromium VI are released in the burning of CCA.

Disposal in hazardous waste facilities

So far, disposal as hazardous waste is an option that has been avoided. While this represents an out-of-pocket savings for the utility industry in the short-term, it represents a real hazard to communities with associated long-term cleanup costs. The Electrical Power Research Institute estimates that "by avoiding the hazardous waste designation, the utility industry will save $15 billion between 1989 and 1993."[69] For example, despite classifying the wood preserving chemicals as hazardous waste in levels often found in used poles, the state of California has exempted Pacific Gas & Electric (PG&E) from disposing poles in hazardous waste landfills. The long-term impacts of this decision could be vast.

Reuse and recycling

Many poles are reused by farmers or others who receive them from utility companies. At least one company recycles poles for reuse by shaving them down, recovering wood preservative from the shavings, retreating them as smaller poles, and selling the processed shavings for a filler for asphalt shingles.[70]

Chemical recovery/bioremediation

Processes for removing and/or reclaiming wood preservatives from unusable poles are being researched, but not used commercially, except in the pole recycling operation cited above.[71]

Risks of disposal and reuse

Every method of disposing of treated wood poles in general use poses substantial risks. The reuse of poles by people who are not familiar with the risks associated with exposure to the toxic chemicals is very likely to lead to problems. Often poles are used for landscaping, for building—dwellings, animal shelters, and even children's play equipment—and for fence posts. Children can be exposed directly or through contaminated soil. Poisons can be picked up by vegetables, by farm animals or by pets.

Wood preservatives are known to migrate away from poles in service in concentrations that are high enough to be toxic to aquatic organisms. In landfills, many poles may be disposed of together, so the concentration may be even higher.

Burning is particularly hazardous, since extremely toxic compounds may be carried great distances, to be breathed directly or concentrated in other organisms after falling to the ground.

Transportation

Throughout the cradle to grave life of a utility pole, there is a repeating toxic threat when transporting the chemicals. Transportation is necessary at virtually all stages of the life of a pole.

Transportation of toxic chemicals is necessary:
- from chemical manufacturer to wilderness for use in forestry practices;
- in treated poles from wood treatment plants to storage sites;
- in treated poles from storage sites to installation;
- from chemical manufacturer to location of pole in use
- for retreatment; and,
- in treated poles from in use location to disposal.

Throughout the life cycle of a pole, these chemicals are transported from the manufacturer just as chemicals or as part of the utility pole after it has been treated. Whenever these chemicals are transported there is risk. There is risk to workers handling the chemicals or treated poles and the potential risks of transportation accidents.

THE CHEMICAL ACTORS

Three chemical mixtures are common to wood preservation— pentachlorophenol, creosote, and arsenicals (primarily copper chromium arsenate or CCA). A fourth, copper naphthenate, is commonly regarded as an alternative These chemicals all have serious adverse impacts on human health and the environment.

The chemicals and their toxicology

In order for a chemical to protect wood poles from insects and fungi for 40 years or more, it must be toxic to a wide range of organisms and very persistent to all living organisms. Unfortunately, those very characteristics make these chemicals dangerous when released into the environment.

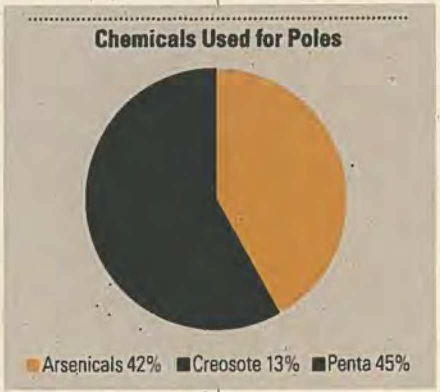
Pentachlorophenol (penta) is a chlorinated aromatic hydrocarbon closely related to other chlorophenols, hexachlorobenzene, polychlorinated dibenzo-p-dioxins and furans. All of these elements are found in commercial grade penta, along with secret "inert" (but biologically and chemically active) ingredients.

Creosote is a complex and variable mixture consisting of approximately 75% polycyclic aromatic hydrocarbon derivatives of coal tar, including anthracene, naphthalene, phenanthrene, acenaphthene, fluorine, and pyridine.

Arsenicals are mixtures of metallic salts, including arsenic pentoxide. For example, Copper Chromium Arsenate (CCA) is a mixture of arsenic pentoxide, chromic acid, and copper or cupric oxide, plus secret "inert" ingredients, in proportions that vary with the particular product. The chromium in CCA occurs in the more toxic hexavalent, or chromium (VI), form.

Copper Naphthenate contains about 20% copper salts of naphthenic acids—which consist of an unknown mixture of certain petroleum by-products and contaminants—and about 80% unknown secret ingredients.

Chemicals Used for Poles



The chemicals' affect on human health

Absorption

The oil-based wood preservatives, pentachlorophenol, creosote, and copper naphthenate are all easily absorbed through the skin, as well as through inhalation. The arsenicals are less easily absorbed through the skin, but are readily absorbed by inhalation of dusts or smoke from burning treated wood. Children may ingest all of the chemicals in soil contaminated by leaching from poles.

Acute health effects—Effects of short term exposures to large quantities

All wood preservatives used to treat poles have high acute toxicity. They all attack the skin and nervous system. They may all cause nausea and vomiting. They can all be fatal in single large doses.

Chronic health effects—Effects of long term exposures to small quantities

Wood preservatives are known to cause a variety of chronic health effects, though copper naphthenate is mostly untested. Some of the known health effects are:

- Impair the immune system:
  penta, creosote, arsenicals.
- Interfere with reproduction:
  penta, creosote, arsenicals.
- Cause birth defects:
  penta, arsenicals.
- Cause cancer (EPA's cancer classification):
  penta (B2—probable human carcinogen),
  creosote (B1—probable human carcinogen),
  arsenicals (A—known human carcinogen).
- Cause genetic mutations:
  penta, creosote, arsenicals,copper naphthenate.
- Interfere with hormone function:
  penta, creosote.

Synergism

Synergism refers to a greater-than-additive impact when a person is exposed to more than one chemical at a time. This can be thought of as teamwork among the chemical actors. If, in order to cause cancer, you need to cause a mutation in a cell and cause the mutated cell to grow fast, then a chemical that just causes mutations or one that just causes precancerous cells to grow faster will not cause many cancers alone. Together, however, they will add up to a potent carcinogen.

This teamwork is particularly important in the case of wood preservatives, which are all complex mixtures of toxic ingredients. Some ways that wood preservative ingredients act synergistically are known:

- The toxicity of CCA to water fleas and algae has been found to be greater than what would be predicted from the toxicity of the individual metals.[1]

- Several of polycyclic aromatic hydrocarbon constituents of creosote are more potent carcinogens when present together than alone.[2]
- The mechanism by which dioxins cause cancer is known to be one that promotes growth of cells containing a mutation.[3] Therefore, it is most potent when in combination with a material that causes mutations. Among such materials are penta and its metabolites.[4]
- Creosote may be synergistic with other chemicals that cause photosensitivity.[5]
- A number of researchers have found that arsenic compounds tend to reduce the effects of selenium.[6] Selenium plays a role in copper homeostasis and detoxification.[7] So arsenic probably increases the toxicity of copper.
- Exposure to pentachlorophenol makes hexachlorobenzene more potent in producing porphyria (liver disease).[8]
- Hexachlorobenezene increases the potential for the thymic atrophy (immune system damage) and body weight loss (wasting) caused by dioxin.[9]

Ecological Effects

Persistence/bioaccumulation/bioconcentration potential

Persistence refers to the length of time a chemical remains in the environment before it breaks down into other chemicals. It may break down by chemical action, with the help of the sun's energy, or through biological decomposition. Some chemicals break down into more toxic chemicals, so lack of persistence does not always mean that the toxic effects disappear. Bioconcentration refers to the way certain chemicals become more concentrated in biological tissues than in their surrounding environment. This is particularly important for aquatic organisms which live in polluted water—if they take in a chemical faster than they can excrete or metabolize it, it will concentrate in them. Bioaccumulation refers to the accumulation of a chemical in higher and higher concentrations from one step in a food chain to the next.

Although small amounts of toxic metals are excreted by organisms, doses of arsenic and associated metals that are found in some environments as a result of contamination from wood preservatives are high enough to accumulate in plants and animals. Arsenic bioconcentrates in aquatic organisms—in freshwater organisms up to 17 times background levels, and in marine oysters 350 times background levels.[34]

Some components of creosote have been found to bioaccumulate and bioconcentrate in aquatic and terrestrial systems.[35]

The dioxin contaminants in penta are persistent and bioaccumulative. The only known process by which

Continued on Page 28

The Endocrine Disruptors

Chemicals that disrupt the endocrine system wreak havoc

Hormones are chemicals made by the body that help control the body's functions. They are present in minute quantities. Certain other chemicals may be mistaken for hormones by the body, and disrupt the systems controlled by the hormones. In particular, some chemicals are mistaken for the female hormone estrogen. These estrogen mimics interfere with the reproductive system, causing infertility, malformed sexual organs, and cancer of sensitive organs. Creosote and penta interfere with hormone function. Creosote contains ingredients, benzo(a)pyrene and higher phenols, considered to be endocrine disruptors.[10]

Although many chemicals, including pentachlorophenol and its contaminants—polychlorinated dibenzo-p-dioxins, dibenzofurans, and hexachlorobenzene—are considered endocrine disruptors,[11] evidence is rarely as strong for most chemicals as it is for penta. Exposure to penta may result in adverse reproductive effects that are associated with changes in the endocrine gland function and immunological dysfunction. A number of women with histories of spontaneous abortion, unexplained infertility and menstrual disorders had elevated levels of pentachlorophenol and/or lindane in their blood.[12]

Cancer

Some chemicals can increase the chance of cancer in humans by causing changes in cells that may lead to cancer, by facilitating the growth of cancer cells, or by inhibiting immune responses that arrest the growth of precancerous cells. Because of the way cancer starts and progresses, any quantity of a cancer-causing substance increases the chance that the exposed person will get cancer. EPA assigns ratings to substances that cause cancer ranging from A (human carcinogen) to E (evidence of non-carcinogenicity). Creosote, penta, and the arsenicals all cause cancer. EPA's cancer classifications are as follows: creosote—B1 (probable human carcinogen), penta—B2 (probable human carcinogen), arsenicals—A (human carcinogen).

An increased risk for cancer has been demonstrated in animals exposed to coal-tar creosote. The International Agency for Research on Cancer has determined that creosote is probably carcinogenic to humans (Group 2A).[13] EPA has determined that cresols are possible human carcinogens.[14] Animal studies show that cresols, a component of creosote, may increase the ability of some carcinogenic chemicals to cause tumors.[15] Dermal exposure to creosote can increase the risk of cancer from other agents.[16]

The studies indicating that human exposure to pentachlorophenol products causes cancer go back to 1978.[17] They include studies of occupational exposure in the lumber and sawmill industry linking penta with acute leukemias, Hodgkin's and non-Hodgkin's lymphomas and multiple myelomas.[18]

EPA classifies pentachlorophenol as a probable human carcinogen (B2). It finds the sole human study examined by the agency to be inadequate. EPA bases the B2 classification on animal studies that find that two different preparations of pentachlorophenol cause statistically significant increases in incidences of biologically significant tumor types in both male and female mice: hepatocellular adenomas and carcinomas, adrenal medulla pheochromocytomas and malignant pheochromocytomas, hemangiosarcomas, and hemangiomas. Other animal tests and reviews by other agencies support the conclusion of carcinogenicity.[19]

The hexachlorobenzene and hexachlorodibenzo-p-dioxin contaminants in penta are also carcinogens. Agriculture Canada has concluded that the combined evidence from epidemiological studies on humans with mixed exposures to chlorophenols, dioxins, or pesticides contaminated with these chemicals suggest that occupational exposure to chlorophenols or phenoxy herbicides increases the risk of three kinds of cancer: soft tissue sarcoma, Hodgkin's lymphoma, and non-Hodgkin's lymphoma.[20] National Toxicology Program studies showed the penta metabolite pentachloroanisole to be carcinogenic in rats and mice.[21] EPA classifies arsenic as a class A, or known human carcinogen. Arsenic ingestion or inhalation has been reported to increase the risk of cancer, especially in the liver, bladder, kidney, and lung.[22] Chromium (VI), found in some arsenicals (such as CCA) is also classified as a known human carcinogen.[23]

Effects on the Immune & Nervous System

When a chemical interferes with the body's immune system, it makes a person more susceptible to disease. Creosote, penta, and the arsenicals all interfere with the body's defenses against disease.

Laboratory studies find that technical grade penta causes immune suppression in animals, which has been linked to dioxins contained in penta.[24]

Evidence in both animals and humans suggests that arsenic suppresses the immune system.[25] Neurotoxic chemicals affect the nervous system in various ways.

Both arsenic exposure and penta exposure are associated with disturbances and degeneration of nerves in the peripheral nervous system—causing, for example, numbness and a sensation of "pins and needles".[26]

Reproductive Toxicity and Teratogenicity

Chemicals may interfere with reproduction in different ways—by causing infertility, death of the fetus (fetotoxicity), low birth weights, or birth defects. Creosote, penta, and the arsenicals all interfere with reproduction, and/or cause birth defects.

Mice fed benzo(a)pyrene, one of the components of coal tar creosote, during pregnancy had difficulty reproducing, and so did their offspring.[27]

Experiments in rats and mice have shown creosote to be teratogenic.[28] Birth defects have been seen in livestock exposed to wood treated with coal-tar creosote.[29]

Animal experiments indicate that chronic exposure to pure pentachlorophenol affects reproduction and induces birth defects.[30] EPA has concluded that penta and possibly its hexachlorodibenzo-p-dioxin (HxCDD) contaminants cause birth defects and fetotoxic effects in test animals.[31] Reported adverse effects in fetuses from penta exposure include distorted sex ratios, increased incidences of resorbed embryos, skeletal anomalies, subcutaneous edema (excessive fluid), reduced survival, and reduced growth. Several studies of rats and mice have shown birth defects due to the penta contaminant HCB, including changes in rib development and cleft palate formation in rats. Kidney malformations and decreased body weight were also noted.[32]

Spontaneous abortion rates were increased among workers exposed to arsenic, compared to controls. In rodent tests, arsenic increased fetal mortality and birth defects, and increased the ratio of males to females in mice.[33]

dioxins break down in the environment is photolysis (photodegradation).[36] Dioxins are strongly partitioned into the organic components of the environment. In other words, if there are living things in water contaminated with dioxin, the dioxin will be rapidly taken up by living tissue. In fact, sampling for dioxin in aquatic systems uses fish as concentrators of the toxics.[37]

Leaching potential and environmental fate

The way a chemical moves in the environment affects the likelihood of being exposed to it. Some chemicals attach themselves to soil particles and are more likely to be carried by heavy runoff into streams than to leach into groundwater. Some dissolve in water and leach quickly through the soil. Others may be found only in organic matter. Often the behavior of chemicals depends on certain aspects of the environment, especially acidity (pH) of the soil or water.

Studies on the movement of wood preservatives from poles have found that they move from poles into soil and from the soil into aquatic ecosystems. The mechanisms by which the various chemicals move are different. Some of the materials are water soluble and are transported as dissolved salts. Others are adsorbed onto soil particles and are carried into streams as suspended particles in heavy rainfall. Once in an aquatic setting, the soil particles provide a steady source of contaminant.[38]

The degree to which arsenicals leach is strongly dependent on pH. Much more chemical leaches into acid water than into neutral or basic water. Therefore, we should expect arsenicals to leach more in environments high in soil humic acids or where acid precipitation has affected the pH of the soil.[39] Penta, on the other hand, is more mobile in neutral-to-basic soils.[40]

WHAT'S IN A PESTICIDE?

Normally, a pesticide is thought of as a product that can be purchased in stores or used as part of a service to kill pests—the insecticide, weed killer, fungicide or wood preservative. Unfortunately, these chemicals are not that simple. Pesticide products, particularly wood preservatives, contain a number of different toxic materials, some of which are secret because they are considered confidential business information.

ACTIVE

Active ingredients are by nature biologically and chemically active against the target pest, be it an insect or fungus. By definition, these materials kill living things.

INERT

Inert ingredients are often as toxic as the active ingredient, although the law defines these materials as "secret business information." Inerts, often petrochemicals like benzene, toluene or xylene, generally make up the largest percentage of the ingredients of a pesticide product. They form the solution, dust, or granule in which the active ingredient is mixed.

CONTAMINANTS

Contaminants and impurities are often a part of the pesticide product and are responsible for the product hazards. Dioxin is a contaminant in pentachlorophenol, created as a function of the production process.

METABOLITES

Metabolites, often more hazardous than the active ingredients, are breakdown products which form when the pesticide mixes with air, water, soil or living organisms.

REGULATORY HISTORY

Inadequate chemical restrictions and failure to consider alternative materials

The history of U.S. regulatory action on wood preservatives is best characterized by a series of missteps and backpedaling. The risk-benefit standard in the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) empowers the U.S. Environmental Protection Agency (EPA) to allow high levels of risk based on assumptions about a chemical's benefit.

At the same time, the federal Resource Conservation and Recovery Act (RCRA) regulates wood preserving plants and treated wood waste with a series of exemptions and standards that allow for high levels of contamination.

Environmental Stewardship

Meanwhile, EPA's Office of Pesticide Programs has launched a Pesticide Environmental Stewardship program. In participation with federal agencies, "groups or companies agree that environmental stewardship is an integral part of pest management practices."[1] Although a number of utility companies have agreed to a set of principles with non-specific risk reduction goals and undefined Integrated Pest Management (IPM) management of power line rights-of way, no attention has been focused on the utilities as a major user of wood preservative-treated utility poles.

The Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)

Because EPA does not operate with a "bright line" standard of unacceptable hazards and attributes benefits to chemicals without fully evaluating the availability of nonchemical strategies, the agency is constantly putting the public at unnecessary risk. Furthermore, because EPA does not consider the full range of adverse effects from a chemical's cradle to grave, from manufacturing to use to disposal, the full extent of the chemical's hazards are not analyzed.

It was 1978 when EPA began its review of wood preservatives because of serious concerns about the public health and environmental threat that these chemicals represent. At that time, the agency put the chemicals into a special review process, then Rebuttable Presumption Against Registration (RPAR). Only chemicals that trigger serious health and environmental concerns are placed into this faster track review. However, instead of moving expeditiously to begin removing uses of these chemicals from the market, the agency delayed. A review timeline set by EPA at four years in 1978 was extended to over eight years ending in 1986. Over that period, EPA reversed itself and softened its approach under tremendous pressure and legal challenges from the chemical and wood preserving industry. The original proposals for chemical restriction became progressively weaker over the years.

When EPA completed its review and negotiations with the wood preserving and chemical industry in 1986, it did not specifically regulate wood poles, but did regulate the use of wood preservatives. Moreover, as a part of this review, EPA did not evaluate the cradle to grave considerations.

1978

Because EPA identified extraordinarily high risk to human health from the most widely used wood preservatives, the agency began a regulatory review process which evaluated the acceptability of their continued use. The agency on October 18, 1978 initiated what at the time was called a Rebuttable Presumption Against Registration,[2] now called Special Review. This is a process during which EPA evaluates the risks and the benefits of the pesticides in question. EPA initiated action based on the following health triggers:

- **creosote** - for oncogenicity (cancer) and mutagenicity (genetic damage);
- **pentachlorophenol** (or its contaminants) - for oncogenicity, teratogenicity (birth defects) and fetotoxicity; and,
- **inorganic arsenicals** (including copper chromated arsenate) - for oncogenicity, mutagenicity, reproductive effects and fetotoxicity.

EPA set a timetable in which it announced an expected final regulatory decision by the middle of 1980. However, the process did not conclude until six years after that date and major issues are still not resolved.

When EPA began its review process in 1978, it began an evaluation of wood preservative benefits that assumed the need for these chemicals because of their widespread use. As a result, the review process lacked credibility because it did not evaluate the viability of alternatives, including alternative materials to treated wood. The National Coalition Against the Misuse of Pesticides'

(NCAMP) review of the Special Review process in *Unnecessary Risks* resulted in an indictment of the benefits review process. The process assumes the benefits of poisons that are routinely and widely used, like wood preservatives, despite significant risk to human life and the environment and regardless of safer alternatives.[3] Furthermore, EPA does not have a process to revisit the issue of new, safer alternative technologies, materials or approaches that emerge, thus challenging assumptions of the need for a chemical.

The National Research Council of the National Academy of Sciences notes that:

> **Formal benefits assessments are conducted only during this [Special] review and do not generally contain detailed economic analyses of alternative nonchemical or IPM [Integrated Pest Management] strategies. The effect of this practice is to assume that the economic value of nonchemical or integrated control strategies is near zero. Consequently, the benefits assessments tend to overstate the economic benefits of the individual pesticide under review as well as the impact of pesticide cancellation.[4]**

1981

EPA issued a preliminary notice of determination concluding the RPAR for the wood preservatives in 1981.[5] In this document, EPA proposed to adopt what it called "risk-reduction measures which are cost effective and which will reduce risk by a significant amount."[6] Here again, the agency attributed irreplaceable benefits to wood preservatives, almost across-the-board, that rationalized continued use. In its position document, EPA wrote, "Due to the non-substitutability of the wood preservative compounds and the lack of acceptable nonwood or other chemical alternatives for many use situations, the economic impact which would result from an across-the-board cancellation would be immense."[7] The agency does not reference alternative materials, just alternative chemicals. According to EPA,

> **The data base for the alternative wood preservatives is so deficient as to disallow a definitive assessment of the risks associated with the use of the alternative wood preservatives. However, there is suggestive evidence to indicate that the acute toxicity of TBTO and Cu-8 may be unacceptable for unrestricted use. Similarly, the data for CZC, ACC, Cu-8, 2,4,5-TCP, 2,4,6-TCP and 2,3,4,6-Tetra indicate potential long term adverse effects. The toxicological potential of copper napthenate and zinc naphthenate cannot be assessed on the basis of a few acute toxicology studies in which LD_{50} [lethal effects that kills half the test population] values could not be determined. In conclusion, from a safety point of view, the alternatives do not appear to be preferable to the RPAR wood preservatives.[8]**

The agency's proposed risk-reduction measures would have changed the terms and conditions of the chemicals' registration in the following ways:

- cancel spray penta products available for retail sale in concentrations of 5% or less.
- classify some products for restricted use (only available to certified applicators or those operating under their supervision);
- require protective clothing and equipment;
- prohibit eating, drinking, and smoking while applying wood preservatives;
- require proper care and disposal of work clothing and equipment;
- require a closed mixing and a closed emptying system for all prilled (granular) formulations of penta, powder and prilled (granular) formulations of sodium penta and the powder formulations of the inorganic arsenicals;
- prohibit indoor applications of the wood preservatives;
- prohibit the use of pesticide-treated wood indoors, except for a few low exposure uses;
- prohibit applications of the wood preservative pesticides in a manner which may result in direct exposure to domestic animals or livestock, or in the contamination of food, feed, or drinking an irrigation water; and,
- require control technologies to reduce arsenic surface residues on the treated wood.

1984

EPA announced final action in 1984, now six years into its process of review, deliberation and negotiation.[9] Despite all this effort, the action was immediately challenged by wood preservation trade associations and user groups, who requested an administrative hearing. As a result, EPA action was enjoined for another year.

The notice proposed the following:

- restricts sale and use of wood preservatives to certified applicators;
- starts a mandatory consumer awareness program;
- requires Consumer Information Sheets to accompany pressure-treated wood;
- requires gloves, protective clothing, and respirators (when entering cylinders or opening cylinder doors), dust masks for high levels of inorganic arsenicals;
- limits immediately the level of dioxin contamination in penta to 15 ppm [parts per million], and to one ppm within 18 months; and,
- label changes, to include protective clothing statements, can't be applied inside or to wood intended to be inside, no eating, drinking, or smoking while applying.

1985

During the period July, 1984 to September, 1985, EPA negotiated with the trade and user groups, resulting in a weakening of the original final action.[10]

Changes in the settlement include:

- mandatory consumer awareness program was shifted to voluntary consumer awareness program;
- under this voluntary program, an annual survey will be conducted by American Wood Preservers Institute (AWPI) and Society of American Wood Preservers (SAWP), not EPA, as originally proposed; and,
- EPA has the right to inspect the survey records for two years.

This settlement agreement finalized EPA action on wood preservatives, "except that registrants of penta wood preservative products . . . reserved the right to request a hearing on the Agency's requirements for maximum certified limits for HxCCD [dioxin] and other contaminants or on the requirements for verification of such limitations set forth in the amended Notice."[11]

Where in the World is Pentachlorophenol Banned?*

All uses prohibited by final regulatory action due to health or environmental hazards

Austria
Benin
Columbia
Costa Rica
Denmark
Dominican Republic
Egypt
Germany
Guatemala
Hong Kong
India
Indonesia
Italy
Jamaica
Korea
Liechtenstein
Luxembourg
Malaysia
Moldova
Netherlands
Nicaragua
Panama
Paraguay
Sweden
Taiwan
Yemen

1986

The EPA proposal to limit dioxin contamination in penta was challenged by chemical manufacturers following the agency's issuance of the July, 1984 Notice of Intent to Cancel, which included an allowable 1 ppm (parts per million) of dioxin contamination. The two companies involved in this proceeding included Vulcan Materials Company and Idacon, Inc. Under pressure, EPA agreed to raise the dioxin levels by four times to 4 ppm in some cases.[12] EPA reached a settlement on November 7, 1986 which accomplished the following:

- changes the levels of hexachlorodibenzo-p-dioxin (HxCDD) from the original notice (lower the level to 15 ppm immediately, 1 ppm in 18 months) to:
    - immediately 15 ppm;
    - in one year, no batch will contain more than 6 ppm, but the average will not exceed 3 ppm; and,
    - in 2 years, no batch will exceed 4 ppm, average will not exceed 2 ppm
- results must be analyzed and reported to EPA monthly.

EPA has not acted on the use of wood preservatives since 1986. According to EPA staff, although the wood preservatives are undergoing reregistration along with hundreds of other pesticides, the issue has been "backburnered" as EPA focuses on food use pesticides.

1987

In announcing its January 2, 1987 Final Determination and Notice of Intent to Cancel and Deny Application for Registrations of Pesticide Products Containing Pentachlorophenol (including but not limited to its salts and esters) for Nonwood Uses, EPA said,

> **The Agency is concerned about the ubiquity of pentachlorophenol, its persistence in the environment, its fetotoxic and teratogenic properties, its presence in human tissues, and its oncogenic risks from the presence of dioxins in the technical material.**[13]

Failure to Consider the Alternatives to Treated Wood Poles

EPA allows the continued use of these hazardous materials despite the availability of alternatives to wood poles. The range of economically viable alternatives include recycled steel, concrete, and fiberglass poles, and burying lines.

In 1995, Canada took up the issue of wood preservative use with the establishment of a Strategic Options Process (SOP) for the Wood Preservation Sector. Environment Canada recognized that the availability of alternatives may have changed since this issue was evaluated in the 1980s and therefore launched a study to "rank the feasible alternatives to products that are made from creosote-, CCA-, ACA-, or pentachlorophenol-treated wood."[14] According to a memorandum describing the review, "Alternative products may be wood treated with other pesticides, products made from materials other than wood, or alternative practices." Alternatives to be considered include steel, concrete, aluminum, fiberglass, plastics and composites.

The Resource Conservation and Resource Recovery Act (RCRA)

Under RCRA, arsenical treated wood waste has been exempted from the hazardous waste designation and creosote or pentachlorophenol levels in waste wood fall below the agency's defined hazard threshold, known as the Toxicity Characteristic. As a result, treated wood waste circumvents regulations that would require disposal in hazardous waste landfills. This means that unless a state government acts, the treated wood may end up in an unprotected municipal landfill.

The state of California has set levels for residues of wood preservatives in wood that are more stringent

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* From Pesticide Action Network, "1995 Demise of the Dirty Dozen," and United Nations, "Consolidated List of Products Whose Consumption and/or Sale Have Been Banned, Withdrawn, Severely Restricted or Not Approved By Governments," Fifth Issue, 1994.

than the federal government. According to the state, tests have shown that wood preserved with pentachlorophenol, arsenic, chromium and copper fail the states Total Threshold Limit Concentration (TTLC), making the wood hazardous waste. However, a 1995 state law, AB 1965, specially exempts treated wood waste removed from electric, gas, or telephone service. While the treated wood waste is defined as hazardous, the law exempts it from being managed as hazardous waste if certain disposal management practices are used. Even prior to this law, the state had issued variances for the major utility in the state, PG&E, allowing the reuse, handling, and disposal of treated wood poles as nonhazardous waste, and permitting disposal in non-Class I hazardous waste landfills. Nevertheless, the state requires the disposal for wood wastes treated with creosote, penta and arsenicals in municipal landfills that:

- contain a composite-lined portion;
- are approved by the Regional Water Quality Control Board;
- do not allow scavenging of the waste; and,
- prohibit burning of such waste.[15]

PG&E says it saves $500,000 a year by sidestepping the hazardous waste management designation.[16] The costs associated with managing hazardous waste include: filing a notice of hazardous waste generation or an application to store, treat and dispose of hazardous waste if material is held for more than 90 days; a manifest or recordkeeping system; the use of only registered haulers; and, possible standards testing.

Other states have adopted similar laws to California. Both Washington and Oregon, while defining the treated wood waste as hazardous, have excluded it from hazardous waste management requirements with stipulations that the disposal occurs in landfills with leachate collection systems.

Regarding waste generated by wood treatment plants, EPA is currently working on Land Disposal Restrictions which will regulate wastes, such as sludge and other wastes from wood preserving plants, as hazardous waste. Regulations are due out by April, 1997. A similar effort by regulators in California was stopped by legislators in that state.

THE ECONOMICS OF REGULATED IOUs

Investor-owned utilities, (IOUs) believe it or not, have an incentive to maximize certain certain costs. Public utilities are, in general, private companies that are given a monopoly market. In order to ensure that public utilities do not use the monopoly to profit greatly at the public's expense, their profits are limited to a certain percentage of their utility rate base, which consists of their capital holdings. Other things being equal, if the value of their capital holdings —including power plant, substations, and poles— goes up, then their profits go up. This is one reason utilities have invested in expensive nuclear power plants.

Suppose that in 1996, two utility companies each have the same allowable 10 percent profit margin and the same rate base. Company A's 100,000 poles are all new steel poles, estimated to last 80 years. Company B's 100,000 poles are all new treated wood poles, estimated to last 40 years. The poles cost the same when they were new.

In 2036, Company A's poles are still going. Company B's poles need to be replaced. They are replaced with new poles, which now cost an additional $40 each. By replacing the poles (again with treated wood poles), Company B, assuming a 10 percent profit rate, has just made a $400,000 profit. The fact that there are costs associated with buying, installing, and disposing of poles is irrelevant to the power company, which is allowed to pass on those costs to the consumer.

There is another twist to this: Utilities are granted a depreciation allowance —allowable surcharge to help them set aside money to replace capital holdings. This depreciation means that the differential between new and old poles is even greater.

There has been something of a move to introduce competition to utilities, but it is unlikely to change the critical aspects here.

From Bob Eye, former Chief Counsel, Kansas Department of Health and Environment; attorney representing citizens in utility cases, November, 1996.

ALTERNATIVES TO WOOD POLES

The justification for poisoning people and contaminating the environment must be evaluated against the availability of alternative materials and approaches that may be safer. In the case of the hazardous materials used to treat utility poles, alternative materials do exist. But, what are the hazards of these alternative materials and do they offer a better approach?

The differences in adverse impacts of materials is often difficult to compare. In some cases, one material may represent a threat to air quality while another represents a threat to water quality. In conducting life cycle analyses, researchers have consistently focused on energy consumption associated with the production of various materials. However, the analyses typically fall short of evaluating the total toxic trail associated with the materials and practices that go into the production of the end product —in this case, a utility pole.

No comparative analysis of products would be complete without consideration of the cost differential among them. Sometimes the analysis is skewed by its failure to consider the differential in the life span of a product. It is also biased by a failure to consider external pollution costs relating to chemical cleanup and health care associated with a wood preservative-induced illness.

In the case of wood, the utility industry expects 40 to 50 years of service (although it has been found that a bad batch of wood can yield less than 35 years of service). The steel, concrete and fiberglass alternatives yield a lifespan of 80 to 100 years. There are differences in maintenance costs associated with different materials. Wood may require retreatment, as some utilities do on a set cycle, while steel, concrete and fiberglass do not. In addition, disposal costs for chemicals used in wood treatment are high and growing, while steel is recycled.

Below is a discussion of the major alternative materials to chemically treated wood utility poles. It is important to consider these issues in the context of making a choice that is better for the environment and public health.

Recycled Steel

Steel has been cited as the most common alternative utility pole material in a Swedish report.[1] The same is true in the United States, although steel and all the alternatives represent a small but growing alternative when compared with the use of treated wood utility poles.

The steel industry identifies steel as "the world's, as well as North America's, most recycled material, and in the United States alone, over 70 million tons of steel were recycled in 1995, resulting in an overall recycling rate of 68.5 percent."[2] The industry says that two out of every three pounds of new steel are produced from old steel. Two processes are used. The basic oxygen furnace (BOF) process or blast furnace, which uses 28 percent scrap steel, and the electric arc furnace (EAF) process, which uses 100 percent scrap metal. The steel for utility poles are made with the electric arc furnace.[3] According to the industry, when one ton of steel is recycled the following is conserved: 2,500 pounds of iron ore, 1,400 pounds of coal and 120 pounds of limestone.[4]

The Swedish report indicates that air pollution associated with the processing phase of steel is the predominant type of pollution in the processing life cycle phase.[5] The report identifies a drastic reduction in air pollution from 1970 to 1988. Emissions to the air dropped in the following ways: dust, containing a number of metals, such as lead, copper and cadmium, went from 150,000 ton/year to 5,000; sulphur dioxide from 32,000 to 8,000 ton/year; nitrogen oxide from 4,400 to 3,700 a year and carbon dioxide from $8.0x10^{-6}$ to $4.4 x 10^{-6}$. While steel production has been cleaned up considerably over the past decade, environmental concerns focus on air and water pollution. The electric arc furnace, a cleaner process than the oxygen furnace, still produces dust contaminated with metals that are classified and disposed as hazardous waste. The production process also produces a sludge that can be landfilled and discharge water that can be sent to a municipal water treatment facility. Nucor, which uses EAF technology to produce new steel from recycled scrap metal for at least two steel pole manufacturers, released less than 100 pounds of lead in 1995 in producing approximately 1.5 million tons of steel.[6] While little research has been done on U.S. steel plants, there have been European studies that find airborne dioxin emissions associated with steel production in iron sintering plants, which are adjuncts to blast furnace operations. The contaminants are tied to the use of chlorinated lubricants in the operations and could be eliminated with changes in practices.[7]

The Swedish report credits steel poles with a life of approximately 80 years and indicates that the reuse rate "almost reaches 100 percent, resulting in a reduced energy utilization in the processing phase from 10,000 kWh/ton to 1,700 kWh/ton.[8] The steel utility poles are either galvanized or coated with a sealant.

International Utility Structures, Inc. (IUSI) in Batesville, AR and Valmont Industries in Valley, NE have gotten into the steel utility pole business in the last several years. For a 40 foot, class 3 pole, they both have competitive pricing with IUSI pricing at $265[9] and Valmont at $315[10] (exclusive of freight). Valmont's 40 foot, class 4 pole, which has a thinner diameter than the class 3, is approximately $260.[11] IUSI produces a 40 foot, class 5 pole and charges $215.[12] The material is lighter in weight than wood and the installation is similar.

Concrete

Reinforced concrete is also identified as an alternative material to treated wood poles. Centrifugal casting is used to produce concrete poles with natural gravel or crushed stone and steel reinforcement. The environmental issues related to cement, the "glue" that holds concrete together, raises serious environmental issues that must be added to the concerns about steel raised above. The material's longevity ranges from 80 to 100 years.[13]

Cement is produced in kilns that often burn hazardous waste. By 1994, 37 facilities out of 111 plants in the U.S. were permitted to use hazardous waste as a fuel to replace some or all of the large amounts of fuel required.[14]

Cement is made by heating limestone, clay, and other materials to very high temperatures to form "clinker," which is cooled and ground with gypsum to make cement. This is accomplished by circulating the combustion gas around raw materials in a kiln. Many of the constituents of the vapor become part of the clinker or cement kiln dust.[15]

About 60 percent of the five million tons of hazardous waste incinerated annually is burned in boilers and industrial furnaces, almost all of the cement kilns or lightweight aggregate kilns. About 90 percent of all commercially incinerated liquid hazardous waste in the U.S., as well as a growing percentage of solid hazardous waste, is burned in cement kilns.[16]

Some of the wastes burned in cement kilns are destroyed, but some are indestructible (heavy metals) and some are transformed into more toxic chemicals like chlorinated benzenes and dioxins. Everything which is not destroyed is released into the environment in some way. Some is released through fugitive emissions from the stacks in gaseous particulate form. Some is adsorbed to cement kiln dust, which is typically piled on the ground before being taken to conventional landfills. Some is left in the ash, which also goes to landfills. And some becomes part of the cement—to be breathed daily by those living near "ready-mix" plants, and to be slowly released into the environment from concrete.[17]

The disposal of hazardous waste into the environment through the various products of cement kilns results directly from incentives established by EPA. By delaying regulations, writing loopholes into regulations, and failing to apply its regulations, the agency has made cement kiln incineration an attractive, cheap alternative to disposing of hazardous waste in controlled facilities or reducing the production of hazardous wastes.[18]

Therefore, while concrete poles are an alternative that may be preferable to wood in many cases, the current practice of producing cement through the burning of hazardous waste raises serious environmental pollution problems. Furthermore, concrete construction material is normally not used as a raw material for another product, although techniques exist for reuse.

StressCrete, a company based in Burlington, Ontario, Canada (with a plant in Tuscaloosa, AL) is a major producer of cement utility poles. It charges $375 for a 40 foot, class 3 pole and $350 for a 40 foot, class 4 pole (exclusive of freight). Because of its weight, its installation costs tend to be higher than other alternatives. However, its durability is proven, having a track record of surviving hurricanes in the southeastern U.S.[19]

Other Alternatives

There are a number of other materials that are available for poles as well as the option of burying utility lines underground. The other pole material that most commonly surfaces is made from fiberglass reinforced composite (FRC). The manufacturing process is described by the major manufacturer of the product, Shakespeare, in Newberry, South Carolina, as follows:

> **These new fiberglass reinforced composite utility poles are manufactured using the filament winding process. . . Filament winding is accomplished on a machine which winds glass fibers onto a mandrel in a prescribed pattern to form the desired finished shape. . .For filament winding, fiberglass is purchased in a yarn-like form called roving. This roving is routed through a bath of liquid, catalyzed, pigmented, polyester resin before it reaches the mandrel. After the fiberglass and resin are in place, a surface of resin impregnated non-woven polyester fabric is applied. Heat is then applied to initiate cross linking (hardening) of the resin. After hardening, the tube is removed from the mandrel. . .After the tube is removed from the mandrel, it is trimmed to length and any required holes are drilled. . .the final step is the application of a pigmented polyurethane topcoat.[20]**

Burying utility lines is often considered an option for aesthetic reasons or in areas with utility or telephone companies are trying to avoid severe weather conditions. Although cost is a major consideration, the burying of lines is currently accompanied by the use of chemical treatments to protect lines from decay and pest problems. In fact the only remaining use of the insecticide chlordane is underground power transformers. This chemical was banned for agricultural uses in the 1970's along with DDT and other organochlorine pesticides and had its remaining uses forbidden, with this exception, in the later 1980's.[21] The use of this and other chemicals buried along rights of ways, over water tables and in sensitive areas, represents a serious threat to environmental protection.

Shakespeare prices its 40 foot, class 4 poles at $900.[22]

Electromagnetic Field

The jury may still be out on the dangers associated with electromagnetic fields (EMFs), but there is sufficient evidence that the EMFs generated by utility lines are hazardous enough to cause utilities to consider options that increase the distance between the lines and human habitation. Among those options are burying lines and increasing the height of poles. Both options —which compare differently in different situations— favor moving away from treated wood wood poles. Steel poles are more easily upgraded to taller poles by inserting a new section.

Cost Comparisons

It is difficult to compare costs of treated wood poles and the principal competition, steel, because of a number of factors that vary, including the type of wood utilized, maintenance practices, and length of service. Although Southern Yellow Pine is the most common wood utilized, Douglas Fir and Western Red Cedar are used in the west. Utilities use different average size poles, most in the range of 40 foot poles with differing thickness that are generally either class 3 or class 4. In addition, pole prices vary according to a number of factors including volume purchases, contract agreements and volatility of the market.

Nonetheless, the purpose of this section is to generate a cost comparison between chemically treated wood poles to provide a context for evaluating the competitiveness of the alternatives.

TILLAMOOK PEOPLE'S UTILITY DISTRICT

Tillamook, OR 97141[23]

This utility service area covers 60 miles of Pacific coastline and 24,000 poles. The utility uses coastal Douglas Fir, with an average pole size of 40 foot, class 4. It pays $271 for its penta-treated wood poles and approximately $70 more for steel poles. The utility district is purchasing steel poles currently for aesthetic reasons and to use in high traffic areas where it is expected that they will have less maintenance requirements. The utility indicates that there is some maintenance savings associated with the steel poles because it can discontinue the wood pole retreatment program which cost the utility $30 to $35 a pole. The utility retreats poles on a ten-year rotational cycle, treating the poles with additional chemicals (chloropicrin) as a preventive measure to stop decay before it starts. The utility believes that steel provides a long-term savings because its lifespan, estimated at 80 years, is double that of wood. The utility bases this estimate on its experience with galvanized steel substations, transmission towers and fences. The utility also believes that it will recoup some of the cost of the steel pole through salvage at the end of the life of the pole.

PUBLIC UTILITY DISTRICT OF DOUGLAS COUNTY

East Wenatchee, WA 98802[24]

This utility services north central Washington state. The utility uses on average a 40 foot, class 3, Western Red Cedar pole that is treated with penta only on the portion of the pole that is submerged underground. The cedar is naturally resistant to insects and decay. An inspection program is conducted on a 10-year cycle with treatment on an as needed basis. The utility has begun using steel poles. It pays $360 for wood poles and $383 for steel.

EASTERN UTILITY ASSOCIATION

West Bridgewater, MA 02379[25]

The utility covers a 599 square mile area in Massachusetts. The utility uses on average a 40 foot, class 4, Southern Yellow Pine pole, full length treated with pentachlorophenol. It pays on average $213 a pole and does not purchase any other alternative materials.

PENNSYLVANIA POWER & LIGHT

Allentown, PA 18101[26]

This public utility has a service area that includes 23 counties in northeastern Pennsylvania, 10,000 square miles and 54,000 miles in its distribution system. The company uses full length creosote-treated Southern Yellow Pine poles. It pays $249 for its standard 45 foot, class 3 pole. The utility discontinued its retreatment program as part of a budgetary move. However, previously the utility conducted a pole retreatment program every five years, treating poles from three feet above groundline to the base.

CITY OF ALLIANCE
Alliance, NE 69301[27]

This municipal utility covers 140 square miles in west central Nebraska. The area takes in 250 miles of primary distribution line. The utility is currently using full length penta-treated Douglas Fir for which it is paying $312 for its average 40 foot class 3 pole. It also uses full length penta treated Western Red Cedar, depending on the price. The company does not have a retreatment program.

Conclusion

From a cost perspective, alternatives to treated wood poles have become more competitive in recent years. Steel and concrete appear to be more cost competitive at this time than fiberglass. Longer transportation distances for wood pole alternatives add an additional front end cost to the alternative materials. However, savings in maintenance, longer in-service lifespan and salvage value (of steel in particular) levels the cost playing field over the long-term.

Cost issues aside, there are numerous compelling reasons for shifting away from the hazardous chemicals used in treating utility poles and moving to alternative pole materials. While there are a range of considerations that should be brought into play, as indicated in this chapter, there is every reason to begin moving away from the use of pentachlorophenol, creosote, copper chromated arsenate and other chemical wood preservatives.

CONCLUSIONS & RECOMMENDATIONS

This report documents the fact that the use of treated wood utility poles poses serious threats to health and the environment. The contributing industries are among the most hazardous, polluting, and under-regulated in the world. Furthermore, there are safer, less polluting alternatives readily available.

The reason these alternatives are not used is plainly that every regulatory agency involved promotes the dangerous and polluting choice over the safer and environmentally sound choice, reinforcing the status quo in the marketplace.

The regulation of investor-owned utilities has given incentives for utility companies to choose an option that does not save rate payers money or protect their health and safety, but increases the profits of the investors. That option, in the case of utility poles, is choosing wood poles whose price increases on a regular basis. Economics, in the sense that most people view it, is contrary to the best interest of regulated investor-owned utilities.

EPA fails to apply its mandate to the regulation of wood preservatives. Risks to workers using wood preservatives are unreasonable in the extreme —with cancer risks in the range of one in ten or higher. And those are the known risks. As with most pesticide formulations, the identity of the bulk of wood preservative products — called "inert," but biologically active, and labeled trade secret—is kept secret from the people who are exposed to them. However, in the case of wood preservatives, the problem is much worse. Even the identity of the active ingredients (that portion of the formulation that attacks the target pest) is unknown —and unknowable— to EPA. Wood preservatives are literally toxic soups of unknown composition. However, it is known that some of the ingredients cause cancer, birth defects and genetic damage. There is strong evidence that other ingredients cause these effects as well. Yet EPA's regulation consists mainly of voluntary safety practices, urging industry to voluntarily provide information to consumers.

In addition, EPA fails to perform its duty under the Resource Conservation and Recovery Act to regulate the disposal of wood preserving wastes and treated wood in a way that protects the environment. Through a combination of delays and specially-created loopholes, the agency has allowed these dangerous wastes to be disposed of in the most dangerous ways possible.

Furthermore, it is generous to say that regulators have allowed these bad things to happen. In fact, they have encouraged them. All of these regulatory practices have established a system of incentives that promote the use of treated wood poles over more environmentally friendly alternatives. If wood preservative manufactures were forced to control the manufacturing process to create a known product, and perform adequate tests on these products, then their products would become more expensive. If EPA considered alternatives beyond other (unknown) wood preservative chemicals, and weighed risks as heavily as it does corporate profits, then most wood preservatives would be banned. Even if EPA failed to regulate wood preservatives as pesticides but placed adequate consumer warnings on products and regulated the hazardous wastes produced by the industry as hazardous wastes, wood preserving would become too costly to perform on such a large scale.

And on the other side, we have seen that one alternative to treated wood poles has been made more hazardous by EPA's action. EPA encourages the incineration of hazardous wastes in cement kilns, leading to the dispersal of those wastes in the environment (but especially in the neighborhood of cement kilns and ready-mix plants) and the contamination of concrete products.

There are more lessons to be learned from this examination of treated wood poles.

Synergy

Wood preservative chemicals provide an excellent example of why risk assessment is doomed to fail in protecting human health. Each of these formulations — penta, creosote and copper chromated arsenic— is composed of a number of toxic ingredients —sometimes by design, sometimes by happenstance. Unlike most pesticides, though, we happen to know something about the interactions of some of the ingredients in wood preservatives, and we know that the effects are synergistic —the potency of the combination is greater than the sum of the effects of the individual ingredients. Risk assessments performed on individual ingredients cannot predict the effects of the entire formulation when ingredients are synergistic.

Chemical management over prevention

We have seen that utility regulators and EPA combine to promote the use of utility poles treated with toxic chemicals. The regulatory agency is overwhelmed with vested interests that are financially tied to the status-quo. The public interest mandate is lost to the special interests. Regulators do not look around in an effort to promote reasonable approaches that prevent the very problems we are always trying to control fruitlessly. In so doing, government does not provide a climate for innovation and ecologically sound alternatives because it promotes existing practices that pollute. When combined with a regulatory agency that habitually underestimates risks and assumes benefits based on regulatory politics rather than scientific practice, the net effect is a powerful incentive to use pesticides to eradicate instead of ecology to mitigate pest problems —all at a cost of dispersing powerful toxic materials throughout the environment.

The nexus for change is in communities

With a failed regulatory system co-opted by politics and special corporate interests, the focus of action must shift to local communities and the marketplace in which utility companies operate. On a basic level, the line staff people interviewed for this report are becoming aware of the hazards associated with treated wood poles. Many have begun to consider alternative pole materials. But the process of change must be more widespread and at a pace that suggests a greater understanding of the urgency surrounding the environmental degradation and human health effects of wood preservatives. The public can and must lead the way as EPA puts critical health and safety questions on the proverbial backburner. There is enough evidence in this report and in the extensive list of resources cited to justify a swift and concerted effort to phase out the purchase and use of preservative-treated wood poles.

TAKE ACTION

What community groups can do:

- **CONTACT** your local utility and arrange for a meeting with the chief executive officer.
- **PRESENT** the findings of this report.
- **MAKE** a formal request that the utility consider and adopt a policy to stop purchasing treated wood poles and begin purchasing the alternatives.
- **ASK** for a formal response by a specific date.
- **BEGIN** a community drive for the changes you are requesting if the utility is unresponsive.
- **CIRCULATE** a petition to community and civic organizations, through religious institutions, school groups and local environmental and social groups to generate support for changes.
- **ENLIST** local leaders, such as politicians, clergy, educators and others.
- **IDENTIFY** potential wood preservative problems in your community or nearby communities.
- **NOTIFY** the local media (newspaper, television and radio) about the campaign and your concerns.
- **HOLD** a public forum and invite the community and engage the utilities in debate on the subject.

Keep at it. Persistence pays off.

Beyond the need for local action, the public should make government work on its behalf

The regulatory process must change to represent the public interest. Contact the Environmental Protection Agency (EPA) headquarters to let environmental officials know that you are dissatisfied with the level of protection provided by the agency. [Write Carol Browner, Administrator, U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460]

Tell EPA that you are concerned about the continued use of these hazardous wood preservatives, that these chemicals should be removed from the market and that the situation calls for the following policy changes to prevent the agency's continued failure to regulate chemicals as hazardous as these:

- **PROHIBIT** mixtures of pesticides for which EPA cannot identify the constituent ingredients, their contaminants and breakdown products.
- **DISCLOSE** all chemicals on the product label, as well as contaminants and breakdown products.
- **STOP** the use of risk assessments, especially in cases where the agency does not have full information on the product ingredients, contaminants and break down products and their cumulative, aggregate and synergistic effects.
- **CONDUCT** an analysis of the nonchemical alternatives for the pest management issues related to the pesticide registration in question. If safer, cost-effective (taking into account long-term and secondary costs) are available, stop the use of the pesticide, finding that its hazards are not reasonable in light of the availability of alternatives.
- **STOP NEGOTIATING** with the chemical industry and compromising health and safety and environmental protection for voluntary industry action, like the wood preservative action, that does not protect the public. Provide for public right-to-know when and where pesticides are being used and where they are contained in other products, such as wood products. Require posting and notification and advance warning before and when pesticides are used.
- **AGGRESSIVELY PROMOTE** nonchemical solutions to problems and stop using terms like pesticide risk reduction and Integrated Pest Management without clear definitions and quantitative measurements for what will be accomplished to protect public health and the environment.

Join with the National Coalition Against the Misuse of Pesticides

Stay informed about what you can do on an ongoing basis to protect yourself, your family and community from hazardous pesticides and promote safe alternatives. Contact NCAMP at:
701 E Street, SE
Washington, DC 20003

Penta

IDENTITY AND USES

Ingredients, including contaminants, inerts, and by-products

Pentachlorophenol (penta) is a chlorinated aromatic hydrocarbon, closely related to other chlorophenols, hexachlorobenzene (HCB), polychlorinated dibenzo-p-dioxins and furans, all of which are found in commercial grade penta, along with secret "inert" ingredients. Pure pentachlorophenol can be produced in a laboratory, but the commercial products contain these contaminants. It is addressed here penta as it exists in the environment—with contaminants.

Trade names

Penta, Penchlorol, Chlorophen, Pentacon, Penwar are some of penta's trade names.

Usage

In 1995: 39,734,000 gallons (8,588,000 gallons concentrate and 31,146,000 gallons solvent)[1]; 30,617,000 cubic feet of treated poles; 32,764,000 cubic feet of treated wood.[2]

TOXICOLOGY

Absorption

Pentachlorophenol is readily absorbed by lung, skin and stomach.[3] Workers handling penta or penta-treated wood receive the most significant exposure first through skin contact and second through the air.[4]

Clearing, detoxification, and metabolism

While much of it is excreted in urine, it accumulates in tissues, particularly muscle, bone marrow, and fat.[5]

Acute toxicity

Pentachlorophenol is very toxic, and is labeled with the signal word DANGER. There are about 50 known cases of poisoning from penta products, 30 of which have resulted in death. Immersion of a man's hand in a 0.4 percent penta solution for 10 minutes caused pain and inflammation.[6] Symptoms of mild penta poisoning include stuffy nose, scratchy throat, and tears in the eyes. Skin contact can produce contact dermatitis and chloracne. A person experiencing systemic poisoning by penta would show symptoms of profuse sweating and intense thirst, rapid breathing and heart rate, fever, abdominal pain, nausea, weakness, lack or coordination, dizziness, anorexia, and coma.[7]

Critical doses

The exact dose required to produce illness in humans is not known. It is a short jump from the "no effect" level to the "lethal" dose of pentachlorophenol. For example, at a dose of 80 milligrams per kilogram, no experimental animals died. At a dose of 100 milligrams 83% died and at 110 milligrams 100% died.[8]

Chronic health effects

The first report of chronic poisoning from pentachlorophenol was reported in California Health in June, 1970 in the case of a woman who had moved into a newly constructed home which had been treated with penta. She experienced rapid weight loss, weakening and tightening in her chest, and symptoms which were suspected to be asthma and bronchitis, which were relieved after she moved from the house.[9] Exposure to penta has also been associated with aplastic anemia, leukemia, and other blood disorders.[10]

Organ damage

Penta targets the liver, kidneys and central nervous system, with toxic effects occurring at low doses. Autopsies of victims of fatal exposures revealed changes in the brain, heart, kidneys, lungs, and liver.[11] Liver damage has been documented in people living in homes treated with pentachlorophenol.[12] Chronic exposure to pure pentachlorophenol causes acne and other skin diseases.[13]

Neurotoxicity

Penta exposure is associated with peripheral neuropathy and other nerve damage.[14]

Reproductive toxicity and teratogenicity

Animal experiments indicate that chronic exposure to pure pentachlorophenol affects reproduction and induces birth defects.[15] EPA has concluded that penta and possibly its hexachlorodibenzo-p-dioxin (HxCDD) contaminants cause birth defects and fetotoxic effects in test animals.[16] Reported adverse effects in fetuses from penta exposure include distorted sex ratios, increased incidences of resorbed embryos, skeletal anomalies, subcutaneous edema (excessive fluid), reduced survival, and reduced growth. Several studies with rats and mice have shown birth defects due to the penta contaminant HCB, including changes in rib development and cleft palate formation in rats. Kidney malformations and decreased body weight were also noted.[17]

Immunotoxicity

Laboratory studies find that technical grade penta causes immune suppression in animals, which has been linked to dioxins contained in penta.[18]

Critical doses

EPA has established a RfD (reference dose for noncancerous adverse effects) for penta of $3X10^{-2}$ mg/kg/day, based on a NOAEL (no observable adverse effect level) of 3 mg/kg/day and LOAEL (least observed adverse effect) of 10 mg/kg/day and an uncertainty factor of 100 to account for intra- and interspecies variability. These data are from the sole study EPA located for effects of chronic exposure. Liver and kidney pathology were the reported effects.[19]

Cancer

The studies indicating that human exposure to pentachlorophenol products causes cancer go back to 1978.[20] They include studies of occupational exposure in the lumber and sawmill industry linking penta with acute leukemias, Hodgkin's and non-Hodgkin's lymphomas and multiple myelomas.[21] EPA classifies pentachlorophenol as a probable human carcinogen (B2). The agency finds the sole human study examined by the agency to be inadequate. EPA bases the B2 classification on animal studies that find that two different preparations of pentachlorophenol cause statistically significant increases in incidences of biologically significant tumor types in both male and female mice: hepatocellular adenomas and carcinomas, adrenal medulla pheochromocytomas and malignant pheochromocytomas, hemangiosarcomas, and hemangiomas. Other animal tests and reviews by other agencies support the conclusion of carcinogenicity.[22] EPA estimates a cancer potency (slope factor) of 1.2X10^{-1} (mg/kg/day) based on the incidence of hemangiosarcomas and pheochromocytomas in female mice.[23] The hexachlorobenzene and hexachlorodibenzo-p-dioxin contaminants in penta are also carcinogens. Agriculture Canada has concluded that the combined evidence from epidemiological studies on human with mixed exposures to chlorophenols, dioxins, or pesticides contaminated with these chemicals suggest that occupational exposure to chlorophenols or phenoxy herbicides increases the risk of three kinds of cancer: soft tissue sarcoma, Hodgkin's lymphoma, and non-Hodgkin's lymphoma.[24] National Toxicology Program studies showed the metabolite pentachloroanisole to be carcinogenic in rats and mice.[25]

Mutations

Some tests have indicated that pentachlorophenol and tetrachlorophenol can damage genes. A penta metabolite, tetrachlorohydroquinone, has also been shown to damage genes.[26]

Endocrine disruption

Exposure to penta may result in adverse reproductive effects that are associated with changes in the endocrine gland function and immunological dysfunction. A number of women with histories of spontaneous abortion, unexplained infertility and menstrual disorders had elevated levels of pentachlorophenol and/or lindane in their blood.[27]

ECOLOGICAL EFFECTS

Pentachlorophenol and the contaminants found in penta products have immense ecological impacts.

Bioaccumulation/bioconcentration potential

Under conditions of constant exposure as in aquatic organisms living in contaminated water, pentachlorophenol bioaccumulates as much as 10,000 times the background level.[28] It may be taken up by plants from soil.[29] In mammals, it may accumulate in the liver, kidneys, plasma protein, brain, spleen, and fat, until it is excreted unchanged in the urine.[30] Pentachlorophenol is not expected to concentrate as it moves up the food chain,[31] but the dioxin and dibenzofuran contaminants in penta products do bioconcentrate and bioaccumulate in the environment. Most of these contaminants found in an ecological system will be in animal fat. Dioxin contaminants may concentrate to 100,000 times the environmental level.[32]

Leaching potential and environmental fate

Most wood treated with PCP solutions will "bleed", or move from the interior to the surface of the wood. Penta may evaporate from the surface of the wood into the air while some of the contaminants may not.[33] About 48% of Pentachlorophenol will eventually end up in terrestrial soil; about 45% will end up in aquatic sediments; about 5.3% will end up in water; and about 1.4% will end up in air.[34] After reaching soil, PCP is broken down by sunlight and bacteria, and can leave the upper soil layer by evaporation and leaching into groundwater. PCP degrades most rapidly anaerobic soils.[35] Pentachlorophenol is moderately soluble in water. Concentrations of 1 to 1,000 milligrams will dissolve in a liter of water.[36] Pentachlorophenol concentrations in natural waters may be higher, however, due to the presence of suspended solids.[37] These solids provide a source of penta that continues to leach into water.[38] Pentachlorophenol is moderately persistent in water.[39] It may be degraded by sunlight or microorganisms or bind to sediments and suspended particles and does not evaporate to a significant degree. In water, biodegradation occurs with a half-life ranging from hours to days, with most biodegradation occurring at the surface.[40] Penta has measured in the air of two towns up to 0.93 and 7.8 ppt (parts per trillion).[41] PCP has been detected at very low levels in rivers and streams (0.01-16 ppb), surface water systems (1.3-12 ppb), and seawater (0.02-11 ppt). The compound has also been found in ground water in California, Oregon and Minnesota at concentrations ranging from 0.06 ppt to 0.64 ppb and in well water in Japan and Canada.[41] It was found in a concentration that exceeded EPA's maximum contaminant level (MCL) in a public water supply well in the state of Washington.[43] The HCB contaminant of penta was found to completely degrade to pentchlorophenol in hydrosoil samples. Evaporation was rapid on soil surfaces, but less so when it is mixed into the soil. Hexachlorobenzene has been found in well water in several states at concentrations ranging from 1 ppb to 5.6 ppb.[44] It bioaccumulates to 570 times the ambient level in algae.[45] The dioxin contaminants are extremely stable and resistant to degradation.[46]

Ecotoxicity

Acute ecological effects include the death of animals, birds, or fish, and death or reduced growth rate in plants. Penta may kill or defoliate plants and reduce germination of seeds.[47] Pentachlorophenol has high acute toxicity to aquatic life, which increases as the pH of the water decreases.[48] Chronic ecological effects of penta include reduced lifespan, reproductive problems, lower fertility, and changes in appearance or behavior. Cattle and other farm animals have ingested pentachlorophenol by chewing and licking outdoor wood structures, or from being housed in wooden pens that were treated with penta, causing sickness and death in some animals. In late 1976, about 100 Michigan dairy farms had herd health problems due to contact with penta-treated wood. Penta and contaminants were detected in the milk of two herds.[49] Pentachlorophenol has high chronic toxicity to aquatic life.[50] Penta is chronically highly toxic to cold and warm water fish and moderately toxic to other freshwater and marine organisms. Concentrations detected in rivers, streams, or surface water systems have been generally below lethal levels. Lethal levels have been exceeded during accidental spills.[51] Japanese quail tolerated diets containing 200 ppm HCB, but had an LC_{50} (lethal concentration to kill 50% of the test population) of 568 ppm with the onset of signs at 3 days, indicating that moderate toxicity to the quail. In pullets, more than half of the residue was excreted in egg yolks within a months time.[52] Hexachlorobenzene is slightly toxic to fish, which bioaccumulates rapidly in aquatic organism.[53] Fish are the most sensitive organisms to the dioxin contaminants in penta—concentrations in parts per quadrillion (pg/l) to parts per trillion (ng/l) TCDD are acutely toxic to freshwater fish. Significant adverse effects are present at levels of 0.6 pg/l TCDD.[54] The hepta- and hexachlorodibenzo-p-dioxins found in penta are considered to be 0.01 to 0.1 times as toxic as TCDD.[55] Available data also indicate that the dioxins are extremely toxic to both birds and mammals.[56]

Arsenicals

IDENTITY AND USES

Ingredients, including contaminants, inerts, and by-products

Arsenicals contain a mixture of ingredients, including arsenic. The most commonly used arsenical is copper chromium arsenate (CCA), which is a mixture of arsenic pentoxide, chromic acid, and copper or cupric oxide, plus secret "inert" ingredients, in proportions that vary with the particular product. The chromium in CCA occurs in the more toxic hexavalent, or chromium (VI), form. Although all the active ingredients are toxic to a broad range of organisms, the effects are mostly dominated by the arsenic component.

Trade names

CCA is used under the names Osmose and Wolman among others.

Usage

In 1995: 138,470,000 pounds[1]; 29,215,000 cubic feet of treated poles; 450,596,000 cubic feet of treated wood.[2]

TOXICOLOGY

Absorption

Arsenic is readily absorbed through ingestion and inhalation. It is absorbed to a lesser extent through the skin.[3]

Clearing, detoxification, and metabolism

If arsenic is consumed in very small amounts, most will be metabolized by the liver and excreted.[4]

Acute toxicity

Ingestion or inhalation of high doses of arsenic can produce pain, nausea, vomiting, and diarrhea. It can also produce characteristic skin lesions, decreased production of red and white blood cells, abnormal heart function, blood vessel damage, liver and/or kidney injury, impaired nerve function causing a "pins-and-needles" feeling in the feet and hands, and damage to a developing fetus.[5]

Critical doses

The lethal oral dose of arsenic for an adult human is 1 to 25 mg arsenic per kg body weight.[6]

Chronic health effects

Organ damage

Arsenic poisoning damages mucous membranes, irritates eyes, causes darkening and lesions of the skin, liver inflammation and damage, abnormal heart function, and hearing loss.[7]

Neurotoxicity

Arsenic produces disturbances and degeneration of the peripheral nervous system.[8]

Reproductive toxicity and teratogenicity

Spontaneous abortion rates were increased among exposed workers compared to controls. In rodent tests, arsenic increased fetal mortality and birth defects and increased the ratio of males to females in mice.[9]

Immunotoxicity

Evidence in both animals and humans suggests that arsenic suppresses the immune system.[10]

Critical doses

While some humans can ingest over 150 ug/kg/day without any apparent ill-effects, more sensitive individuals in exposed populations often begin to display one or more of the characteristic signs of arsenic toxicity at oral doses of around 20 ug/kg/day (about 1000 to 1500 ug/day for an adult). Doses of 600 to 700 ug/kg/day (around 50,000 ug/day in an adult or 3,000 ug/day in an infant) have caused death in some cases.[11]

Cancer

EPA classifies arsenic as a class A, or known human carcinogen. Arsenic ingestion or inhalation has been reported to increase the risk of cancer, especially in the liver, bladder, kidney, and lung.[12]

Mutations

Arsenic exposure has been found to increase the frequency of chromosomal abnormalities in highly exposed people.[13]

Endocrine disruption

The arsenicals are not known to disrupt the endocrine system.

ECOLOGICAL EFFECTS

Bioaccumulation/bioconcentration potential

Although small amounts of toxic metals are excreted by organisms, doses of arsenic and associated metals that are found in some environments as a result of contamination from wood preservative are high enough to accumulate in plants and animals. Arsenic bioconcentrates in aquatic organisms (freshwater BCFs 0-17, marine oysters 350).[14]

Leaching potential and environmental fate

Studies on the movement of arsenic-based wood preservatives from poles have found that they move from poles into soil and from the soil into aquatic ecosystems. The degree to which arsenicals leach is strongly dependent on pH. Much more chemical leaches into acid water than into neutral or basic water. Therefore, we should expect arsenicals to leach more in environments high in soil humic acids or where acid precipitation has affected the pH of the soil.[15]

Ecotoxicity

Many terrestrial animals are more tolerant of arsenic than humans. However, aquatic organisms are sensitive. Bluegills are the most sensitive fish, with a 48-hour LC_{50} (lethal concentration to kill 50% of the test population) of 0.5 ppm, and channel catfish are the most tolerant, with a 24-hour LC_{50} of 47.9 ppm. Arsenic produced reproductive impairment of the water flea at concentrations 7% as high as the LC_{50} and weight loss occurred at 14% the LC_{50}. The water flea is more sensitive to copper than arsenic, but the combined effects of the CCA formulation are still higher.[16]

Creosote

IDENTITY AND USES

Ingredients, including contaminants, inerts, and by-products

Creosote is a complex mixture of many chemicals. There are three kinds of creosote. One type results from high-temperature treatment of coal (coal tar creosote), one results from high-temperature treatment of beech and other woods (beechwood creosote), and one comes from the resin of the creosote bush (creosote bush resin). Coal-tar creosote is the most widely used wood preservative in the United States. About 300 chemicals have been identified in coal-tar creosote, and there may be 10,000 other chemicals present in the mixture. The major chemicals in coal-tar creosote that can cause harmful health effects are polycyclic aromatic hydrocarbons (PAHs), phenol, and cresols.[1] Coal-tar creosote is usually a heavy, oily, liquid containing mainly alkylnaphthalenes, naphthalene, diphenyl, acenaphthalene, fluorene, plus small amounts of higher phenols, diphenylene oxide, quinoline base and indole. It is typically amber to brown in color, burns easily, but does not dissolve readily in water.[2] Some parts of the creosote mixture can enter groundwater or change into other substances while other parts persist in treated wood products for decades.[3]

Trade names

P1/P13 Creosote, Timberlife Wood Preserving Compound

Usage

In 1995: 92,000,000 gallons;[4] 8,941,000 cubic feet of treated poles; 91,751,000 cubic feet of treated wood.[5]

TOXICOLOGY

Absorption

Creosote can enter the body through the lungs as a contaminant of air, through the stomach and intestines after eating contaminated food or drinking contaminated water, or through the skin. Many of the components of the creosote mixture (for example, PAHs) are rapidly absorbed through the lungs, stomach and the intestines. Eating soil contaminated with coal-tar creosote can also provide a source of exposure. Chemicals in coal-tar creosote appear to accumulate in the body, particularly in fat tissue.[6]

Clearing, detoxification, and metabolism

Most of the chemicals in creosote that are taken into the body are not stored in the body tissues, and leave in the feces within a few days.[7]

Acute toxicity

Reports describing coal-tar creosote poisoning in workers or accidental or intentional ingestion of coal-tar creosote indicate that brief exposures to large amounts of coal-tar creosote can cause harmful effects on the skin, eyes, nervous system, and kidneys; produce abdominal pain and vomiting, heart damage, anemia, and can result in death. Skin contact with a few drops of coal-tar creosote irritates and burns the skin and eyes. Coal-tar creosote also makes the skin more sensitive to the effects of the sun. These effects include burning, irritation and swelling.[6 9] When heated to decomposition it emits acrid smoke and fumes, which may cause irritation of eyes, nose and throat.[10]

Critical doses

A single dose of 1/2 gram per kilogram body weight killed half of the test population of mice (LD_{50} 433 (female) and LD_{50} 525 (male) mg/kg). One-third of a gram per kilogram body weight caused convulsions.

Chronic health effects

Short-term and long-term studies with animals have shown similar effects from exposure to cresols.[11]

Organ damage

Longer-term exposure to lower levels of coal- tar creosote can also result in damage to skin, such as reddening, blistering or peeling. The major organs or systems affected by longer-term exposure to lower levels of coal-tar creosote in animals are the skin and lungs.[12]

Reproductive toxicity and teratogenicity

Experiments in rats and mice have shown creosote to be teratogenic.[13] Birth defects have been seen in livestock exposed to wood treated with coal-tar creosote.[14]

Critical doses

A dose of 143 milligrams per kilograms per day results in an increase in relative brain weight in rats

Cancer

An increased risk for cancer has been demonstrated in animals exposed to coal-tar creosote. The International Agency for Research on Cancer has determined that creosote is probably carcinogenic to humans (Group 2A).[15] The Environmental Protection Agency (EPA) has determined that cresols are possible human carcinogens.[16] Animal studies show that cresols may increase the ability of some carcinogenic chemicals to cause tumors.[17] Dermal exposure to creosote can increase the risk of cancer from other agents.[18]

Mutations

Creosote has been shown to be mutagenic in human studies.[19]

Endocrine disruption

Creosote contains ingredients, benzo(a)pyrene and higher phenols, considered to be endocrine disruptors.[20]

ECOLOGICAL EFFECTS

The major source of creosote in surface waters and groundwater is waste water from wood preserving facilities.[21]

Bioaccumulation/bioconcentration potential

Some creosote components are taken up by plants to a limited extent. More commonly, they adsorb to plant roots. Both terrestrial and aquatic animals have been observed to bioconcentrate creosote components.[22]

Leaching potential and environmental fate

Some components of creosote (for example, phenols and nitrogenous bases such as aniline, toluidines and xylidines) are water soluble. They migrate easily from contaminated soils or poles. Usually polycyclic aromatic hydrocarbons are strongly attached to soil particles (and may move with sediments into streams) or remain part of a tarlike mass, but they may move into groundwater in sandy soils low in organic matter. The remaining phenolic and heterocyclic components, as well as lighter polycyclic aromatic hydrocarbons, near the soil surface are generally volatilized, oxidized, or biodegraded. While many components are biodegraded, the high molecular weight polycyclic aromatic hydrocarbons that remain are bioaccumulative and carcinogenic.[23]

Ecotoxicity

Hepatic lesions and neoplasms in fish have been associated with exposure to creosote contaminated water.[24]

Copper Naphthenate

IDENTITY AND USES

Copper naphthenate is a copper salt of naphthenic acid. Naphthenic acid is a complex natural mixture of fatty acids found in petroleum. It is a byproduct of petroleum refining and has a variable composition.[1]

Ingredients, including contaminants, inerts, and byproducts

A typical copper naphthenate product would be about 19% copper naphthenate and 81% secret ingredients.[2] The copper naphthenate portion is itself poorly characterized. Its composition depends on the composition of the source petroleum. The naphthenic acids may contain such constituents as cyclopentylacetic acid, alkyl-substituted cyclopentylacetic acids, fused chains of cyclopentylacetic acids, cyclohexylacetic acids, cyclopentanoic acids, and various low-molecular-weight fatty acids.[3] It may also be contaminated up to 25% with hydrocarbons such as benzene from the petroleum source.[4]

Trade names

Cuprinol, Wittox-C, Osmose Cop-R-Nap.

Usage in pounds per year

US production in 1988 was 3.4 million pounds.[5] 900,000 pounds were used in wood preservation in 1975.[6]

TOXICOLOGY

The toxicology of copper naphthenate has not been well documented. EPA reports that little of the required data has been submitted—very little acute toxicity data, no chronic toxicity data, and no inhalation data. Similarly, the Canadian Centre for Occupational Health and Safety has no information for most health effects of copper naphthenate.[7]

Absorption

Little is reported. However, one study of a family living in a home with a foundation treated with copper naphthenate speculated that the increased blood levels of copper may have arisen from copper volatilized by the copper naphthenate formulation.[8]

Clearing, detoxification, and metabolism

Copper is generally cleared from the body unless in acutely toxic quantities. It is stored in the liver and marrow.[9]

Acute toxicity

Inhalation of copper salts in dusts can lead to congestion of nasal membranes, congestion of the upper digestive, and perforation of the nasal septum. Very high concentrations can cause extreme symptoms of irritation.[10] Very little information is available about the toxicity of naphthenic acids. Although as much as 25% of copper naphthenate may be hydrocarbon contaminants from petroleum, very little is known about these contaminants, except that they are variable in identity and quantity. Petroleum does contain many acutely toxic, chronically toxic, and carcinogenic compounds such as benzene, however, and it must be assumed that some of them are present in copper naphthenate.

Critical doses

EPA does not have enough information to establish a LD_{50} (lethal dose for half of the test population).

Chronic health effects

Chronic exposure to copper salts may result in anemia.[11] Exposure to naphthenic acids increases the permeability of membranes, which could increase uptake of other toxic substances.[12] Although as much as 25% of copper naphthenate may be hydrocarbon contaminants from petroleum, very little is known about these contaminants, except that they are variable in identity and quantity. Petroleum does contain many acutely toxic, chronically toxic, and carcinogenic compounds such as benzene, however, and we must assume that some of them are present in copper naphthenate. Nothing is known to the public about the effects of the secret ingredients that make up 80% of copper naphthenate products.

Organ damage

Both copper salts and naphthenic acids are skin irritants.

Neurotoxicity

Exposure to naphthenic acids increases the permeability of membranes to potassium, which could affect nerve transmission.[13] Although as much as 25% of copper naphthenate may be hydrocarbon contaminants from petroleum, we know very little about these contaminants, except that they are variable in identity and quantity. Petroleum does contain neurotoxic compounds such as benzene, however, and it must be assumed that some of them are present in copper naphthenate.

Reproductive toxicity and teratogenicity

No data available.

Immunotoxicity

No data available.

Cancer

Chronic exposure to copper salts has produced lung and liver damage which sometimes progressed to cancer.[14]

Mutations

Tests submitted to EPA found copper naphthenate induces DNA damage.[15]

Endocrine disruption

No data available.

Critical doses

EPA has not set levels because of inadequate information.

ECOLOGICAL EFFECTS

Bioaccumulation/bioconcentration potential

Except in extreme exposure conditions, excess copper is cleared from organisms. Mollusks accumulate more naphthenic acids than less toxic components of oil.[16]

Leaching potential and environmental fate

Copper salts have been found to leach from wood treatment sites. More leaches under acidic conditions.[17] No data is available on the environmental fate of naphthenic acids.

Ecotoxicity

Copper naphthenate is toxic to a wide variety of organisms. It kills microorganisms, fungi, and plants.[18] It is toxic to aquatic life—including invertebrates, algae, and fish—in very low concentrations.[19] Naphthenic acids reduced the fertility of sturgeon roe and the survivability of adults.[20]

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