Policy Directive:
Guidelines for Treated Utility Poles in Water Supply Areas

Division: Water Resources	P.D. W.R. 93-01
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Subject:
Treated Utility Poles in Water Supply Areas

Objectives:
To minimize the impacts of treated poles on drinking water quality.

1.0 BACKGROUND

Chemical treatment of wood is a common practice to preserve its structural integrity, extend its lifetime and protect its appearance. The treatment certainly extends the lifetime of wood, but its use may also result in adverse public health and environmental related hazards, especially if the wood in not properly used and handled. The degree and extent of hazard will largely depend on location, soil types, climatic conditions and the chemical composition of the wood preservative. The proper use and handling of is, therefore, extremely important to prevent negative impacts on public health and the environment.

Chemical treated wood has been a favorite building material or many years and its most common uses are in utility poles, railway ties, bridges, dams, retaining walls, guardrails, fences, foundation piling and marine installations. Some of these uses, especially utility poles in water supply areas, have generated increasing level of concern, controversy and debate amongst public environmental protection agencies and utility companies. Anomalous leaching or dislodging characteristics of wood preservatives, diffusion and solubilizing processes under decreased pH, and the presence of organic acids, salts and fertilizers in leached water have further aggravated the already existing concern and controversy. The climate and the surface water characteristics (low pH and presence of humic acids) in Newfoundland are a most favourable host environment for leaching of chemicals used in different types of wood preservatives.

In recent years, the use of treated timber utility poles in this province has become an issue of increasing public concern especially in protected water supply areas. Section 26 of the *Department of Environment and Lands Act* prohibits all activities in a protected water supply area which have potential to impair water quality. However, presently there are no specific regulations and guidelines to regulate the use of treated poles in protected water supply areas. In response to public concern and requests from the utility companies, policy guidelines have been proposed under the provisions (see Sections 5.0 - 5.3) of the *Department of Environment and Lands Act* for application in protected water supply areas. These guidelines are designed minimize the adverse impact of treated poles on drinking water quality, and they will be in place until such time when comprehensive regulations are developed under Section 26 of the *Department of Environment and Lands Act*.

2.0 WOOD PRESERVATIVES

Controlled studies have shown that wood preservation enhances the lifetime of wood by a factor of 5 to 15, depending an the wood species and the efficacy of treatment. It has also been estimated that if wood were not treated with preservation chemicals, timber requirements (in some industrial applications) would increase by three-to six-fold (Konasewich and Henning, 1988).

The value of wood preservation is generally measured in three ways:

1. The preservation of forest resources;
2. The cost effectiveness associated with less frequent utility pole replacement; and
3. Less immediate damage to the environment during replacement of poles and transmission lines.

Unfortunately, long-term environmental and public health hazards associated with the use of treated wood have not been considered in assessing the value of wood preservation.

The wood preservation process deposits or fixes chemicals in the wood, and the toxic nature of the chemicals effectively prevents the attack of living organisms on the wood. The choice of wood preservatives depends upon the character of the wood to be treated, the required service, and the properties of the chemical or formulation. In general the wood preservation formulations must meet the following requirements:

- be toxic to attacking organisms;
- be able to penetrate wood;
- be chemically stable;
- be safe to handle;
- be economical to use;
- not weaken the structural strength of the wood; and
- not cause significant dimensional changes within the wood.

The chemicals used for wood treatment are generally divided into two major groups: (i) organics - these are oil-born chemical formulations, consisting of an organic preservative dissolved in a suitable petroleum oil carrier and (ii) inorganics - these are water-borne chemical formulations, consisting of inorganic compounds dissolved in a water as a carrier. In Canada, the registered chemicals most often used for wood preservation are:

- PCP (Pentachlorophenol);
- Creosote;
- CCA (Chromated Copper Arsenate); and
- ACA (Ammonical Copper Arsenate).

The first two chemicals belong to the organic group and the remaining two to the inorganic group. Other major chemicals used commercially for wood protection in Canada include: Sodium-tetra and -Pentachlorophenate, copper-8-quinolinolate (Cu-8) and 2-(thiocyanomethylthio) benzothiazole (TCMTB).

Although other wood preservatives have been used in the past in Canada, the first four chemicals or formulations (PCP, creosote, CCA and ACA) are the only preservatives in use in Canada since 1985 (Konasewich and Henning, 1988). Some of the main characteristics of these preservatives are briefly outlined below:

2.1 Inorganic Wood Preservatives

The most widely used chemicals are CCA and ACA.

CCA

The "*Wolmanized*" branded CCA pressure treated wood products are most popular. "*Wolmanized*" and "*Wolman*" are registered trade marks of Koppers Company, Inc., licenced to many plants in Canada. The components of CCA (copper, chromium, and arsenic) were selected for wood preservation use because of their biocidal properties and their ability to be retained within the wood for long-term protection. The fixation mechanism of CCA within wood is complex and the reactions involved depend on the preservative formulation and concentration, wood species, and temperature (Konasewich and Henning, 1988).

According to producers, the waterborne CCA preservative is permanently fixed in the wood by the full-cell pressure treatment process and soon after treatment, the chemicals are highly leach resistant, non-toxic to human and warm-blooded animals and vegetation if properly used. However, leach resistant and non-toxic characteristics of CCA treated wood is an issue of controversy and debate due to unknown impacts of typical low-level exposure in drinking water on human health.

ACA

Copper and arsenic, two active components of ACA, are used because of their biocidal properties's and their ability to be retained by wood for long-term protection. Ammonium hydroxide is used as a solvent carrier for copper arsenate and once the ammonia evaporates from the wood the copper arsenate precipitates in the wood cells. The resultant precipitate is reported to be highly resistant to leaching (Konasewich and Henning, 1988).

There is increasing concern about possible environmental contamination from leaching losses of chromium, copper and arsenic constituents from treated wood. It has been reported that solubilizing and diffusion processes are highly temperature and moisture dependent. Thus, the climatic conditions of an area will have a great effect on leaching losses. The solubility of the fixed CCA and ACA components is also reported to increase with increased acidity (decreased pH) of the leaching water which implies that wood exposed to high rainfall under moderate annual temperature conditions will leach more than wood in colder and drier climates. The presence of other organic acids, such as humic acids and salt content or fertilizers in surface water in significant quantities, has also caused anomalous leaching effects. In most of the cases, losses are highest during the initial years of installation.

2.2 Organic Wood Preservatives

The organic compounds commonly used as wood preservatives include pentachlorophenol and creosote.

PCP

PCP is prepared by reacting chlorine with phenol in the presence of a catalyst at high temperatures. Petroleum oils are used as carriers for PCP. PCP-oil mixtures are used for pressure treatment of wood products, such as telephone and other utility poles, railroad ties, posts and construction timbers. In addition to functioning as a carrier of PCP, the oil also provides extra protection against moisture-content changes, providing more stability and resistance to splitting (Konasewich and Henning, 1988).

PCP, sold under the trade name Penta, is a registered commercial fungicide and bactericide produced by a few manufacturers worldwide. Commercial preparations of pentachlorophenol contain varying percentages of related chlorophenols such as tetrachlorophenol and a range of chlorinated compounds including dibenzo-P-dioxins and dibenzo-furan micro-contaminants, some of which are highly toxic. There are potentially serious problems associated with dioxin contamination in the chlorinated phenols and creosote. Dioxins accumulate in the food chain, are slow to decay, cause reproductive problems in animals and are suspected of inducing cancer in humans. The most common use of PCP in Canada includes treatment of utility poles and unseasoned lumber.

CREOSOTE

Creosote is one of the oldest types of preservatives used for the protection of wood against all forms of wood destroying agents. Creosote is a distillate of coal tar produced by high temperature carbonization of bituminous coal. Containing over 160 compounds, creosote is primarily composed of liquid and solid aromatic hydrocarbons as well as some tar acids and tar bases which provides protection against destructive insects and organisms. Used in a mixture, creosote is blended with petroleum oil.

Creosotes are traditionally specified by their physical properties (density, water content, distillation intervals, etc.) mainly because their complex chemical composition and variation makes detailed chemical specification almost impossible. Creosote, a commercial product which contains several hundred chemical components, and creosote treated wood are commonly used in marine installations, utility poles, railway ties, bridges, dams, retaining walls, guardrails, fences and foundation pilings. The complex chemical composition of creosote and its widespread use as a building material is of course an issue of serious concern to environmental protection authorities. Leaching and bleeding of creosote, especially in hot weather, is a particular problem noticeable as oil films on affected water bodies and by the odour.

3.0 HAZARDS OF WOOD PRESERVATIVES

Many wood treatment chemicals will leach from treated wood products and will result in both short-term and long-term environmental and human health hazards. The rate of leaching of chemicals and its impact will depend on many factors such as soil, temperature, precipitation dosage received and the route of exposure. The possible short and long-term health and environmental effects of chemicals used in wood treatment are listed below:

Chromated copper arsenate (CCA) and ammoniacal copper arsenate (ACA)
Although low levels of chromium, copper and arsenic occur naturally in food, they are dangerous at higher concentrations. The known effects of CCA and ACA include skin irritation and nausea from short-term exposure and death may occur following ingestion. Liver and kidney damage can arise from long-term exposure.

The environmental effects of copper, chromium and arsenic have been studied and it has shown that in aquatic systems chromium is toxic to species of Daphnia and is accumulated in marine oysters; arsenic causes toxic symptoms in algae and in Daphnia; and copper has been found to be extremely harmful causing lethal effects to various organisms at very low concentration levels (0.08 mg/l). It is also suggested that leachate from wood preserved with arsenic, chromium and copper compounds in aquatic systems is toxic to algae and zooplankton and may pose a hazard to humans.

The above reported public health and environment related hazards of CCA treated wood are not proven, however, because there are not enough available data about the effects of these chemicals in the form or combination in which they occur in the arsenical wood treatment mixes.

Pentachlorophenol and chlorophenates
Short-term exposure through dermal contact and inhalation result in skin, eye

and upper respiratory system irritation; long-term exposure of a similar nature can cause weight loss and damage to internal organs and the nervous system. Long-term ingestion can be fatal to human health. Pentachlorophenol, tetrachlorophenol and their salts are readily absorbed by ingestion, inhalation or skin contact. The higher chlorinated phenols are only slightly soluble in water, but the sodium salts of these compounds, as used in wood protection, are highly soluble in water.

It has been reported that pentachlorophenols or tetrachlorophenols or their salts are potentially fetotoxic and carcinogenic Products. Animal studies have shown that penta and tetrachlorophenols can cause birth defects or other adverse effects in the offspring of laboratory animals. They also adversely affect fish reproduction and growth and are persistent in the environment. However, similar types of data on humans are not available.

Creosote

A coal derivative and carcinogen in laboratory animals, creosote can cause skin and eye irritation, sweating, nausea, and subsequent convulsions or coma from repeated or prolonged contact, and if ingested in high concentrations, death.

Creosote has been reported to cause cancer in laboratory animals and has also been associated with skin cancer in some workers occupationally exposed to creosote. No consistent data on low level exposure effects to humans are available.

Creosote contains phenolic compounds. Phenols in water are known to cause bad taste in fish for human consumption at concentrations of 1-10 mg/L. Effects on drinking waters which is chlorinated are also evident even at a concentration around 0.001 mg phenol per liter. Some chemicals in creosote, such as the tar acids and the napthalenes, are biodegradable and will soon be decomposed and assimilated by microflora. Other fractions of creosote, including flourine, chrysene and pyrene are biodegraded very slowly. The harmful effects these compounds on a natural microflora in soil close to treated poles are therefore likely to last for a longer period of time.

4.0 WATER QUALITY GUIDELINES

The inorganic elements and chemical compounds used in the formulation of wood preservatives are toxic carcinogenic and mutagenic in nature and reported to cause serious problems to our ecosystem if their concentrations levels exceed the maximum permissible levels recommended by health and environmental protection agencies. Some of these inorganic elements such as chromium and copper, are found naturally in the environment at various background levels. Other elements such as arsenic and ammonia, while also natural, are typically found in the environment only in the presence of other key elements or compounds. In both cases, background levels of these parameters are usually very low or undetectable, and elevated levels, if detected, are generally associated with anthropogenic sources. Weathering and leaching of soils and rocks and leaching from treated timber utility poles, retaining walls foundation, piling, etc. are some of the natural and anthropogenic sources responsible for increased levels of these chemicals in our environment. Among organic chemicals, benzo (a) pyrene and phenols are components and by-products of many hydrocarbons and could, therefore, be detected in the environment but pentaachlorophenol and others are not natural compounds and their concentration levels in the environment should normally be undetectable.

Considering the toxic carcinogenic and mutagenic nature of the aforementioned inorganic elements and organic compounds and their adverse impacts on our system, every effort must be made to prevent the man-made addition of such chemicals into our drinking water sources. The maximum permissible levels recommended by Health and Welfare Canada and Canadian Drinking Water Quality Guidelines for major component of wood preservatives are presented below:

PRESERVATIVE	**MAJOR COMPONENTS**	**LIMIT**	**REFERENCE**
CCA	Chromium Copper Arsenic	0.05 mg/l </= 1.0 mg/l 0.05 mg/l	a a a
ACA	Ammonia Cooper Arsenic	< 0.1 mg/l (N) </= 1.0 mg/l 0/05 mg/l	b a a
PCP	Pentachlorophenol	</= 0.03 mg/l	a
CREOSOTE	Benzo(a)pyrene Phenols	0.01 ug/l < 2.0 ug/l	a b

a: Health and Welfare Canada, 1989
b: Canadian Council of Resource and Environment Ministers, 1987

Our drinking water supply sources must not exceed the above recommended maximum permissible levels.

5.0 POLICY GUIDELINES

The Department of Environment and Lands requires that the following guidelines be followed by all utility companies in this province in order to minimize the risk of water quality impairment and possible impact on public health.

5.1 Existing poles

1. Existing treated wooden utility poles will be permitted to remain as long as they are not located within the high water mark of the intake pond, or in the case of a river intake, within one kilometre upstream of the intake provided they are not impacting water quality.

2. Existing treated wooden utility poles which are located within the high water mark shall be replaced with untreated wooden, concrete steel structures.

3. The above guidelines shall also apply to anchor boxes used to stabilize poles and/or guy wire.

5.2 New Poles

During the design of any new transmission line, or the placement of any new poles, the following options shall apply in decreasing order of preference:

Option 1. avoid crossing any protected water supply area entirely through re-routing;

Option 2. use untreated wood poles, or steel or concrete structures; or

Option 3. use chromated copper arsenate (CCA) or ammoniacal copper arsenate (ACA) or copper napthanate (CuNap) pressure treated poles. If this option is approved, poles shall not be placed within the following buffer zones from the high water mark of any body of water:

Water Body	Width of Buffer Zone
Intake pond/lake	150 m
River intake	150 m for distance of one km upstream and 100 m downstream
Main river channel	75 m
Major tributaries/lakes/ponds	50 m
Other water bodies	30 m

If the poles in question cannot be located outside the above specified buffer zones, then only treated wood (steel or concrete) poles be used.

The above shall also apply to anchor boxes used to stabilize poles and/or guy wires.

5.3 Approval Required

The utility companies are required to submit a detailed plan for any new transmission line, or the placement of new poles to be located in a water supply area, to this department for approval before undertaking any work. The plan should also include a written letter of consent from the concerned council(s) that they have no objection to the proposed work.

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