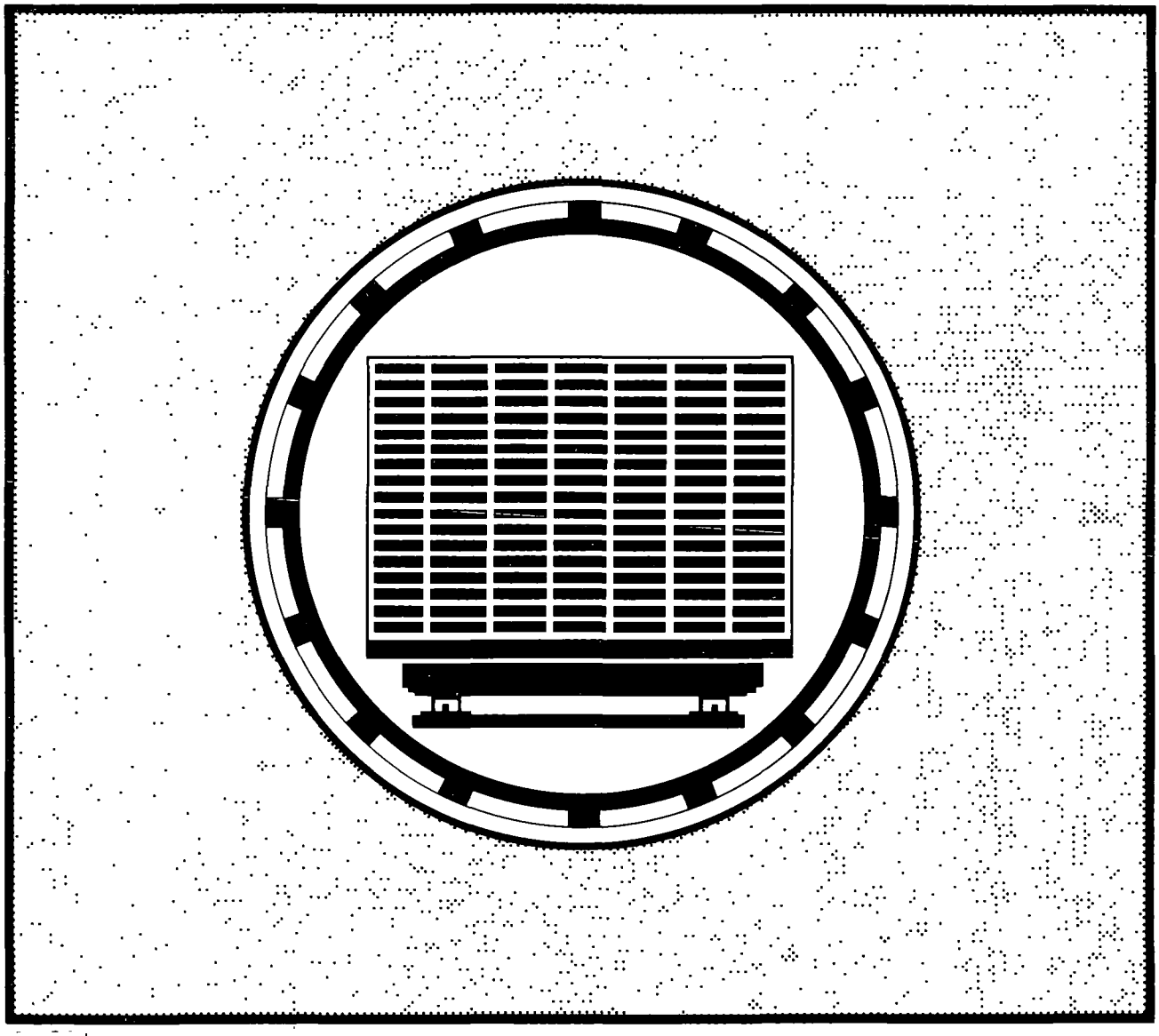
Chromated Copper Arsenate (CCA) Wood Preservation Facilities

Recommendations for Design and Operation

Report EPS 2/WP/3
April 1988



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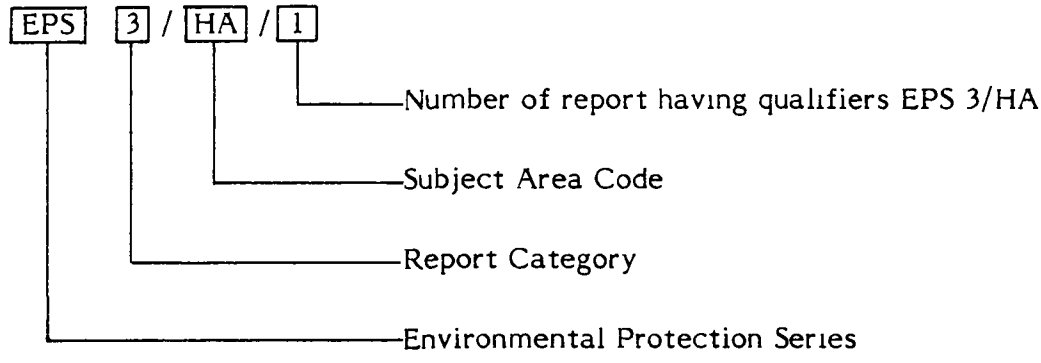

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CHROMATED COPPER ARSENATE WOOD PRESERVATION FACILITIES

Recommendations for Design and Operation

prepared by

D.E. Konasewich and F.A. Henning
Envirochem Services

under the direction of the

Wood Preservation Industry Technical Steering Committee

for

Conservation and Protection
Environment Canada

Report EPS 2/WP/3
April 1988

COMMENTS

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FOREWORD

As part of a federal strategy to protect the environment and human health from potentially toxic commercial chemicals in use in Canada, Environment Canada has evaluated chemical use practices within the wood preservation industry. Envirochem Services was retained to visit and review practices at 19 wood preservation facilities operating in four Canadian provinces, and to document the findings.

In July, 1984, Environment Canada established a Wood Preservation Industry Technical Steering Committee to develop technical recommendations for wood preservation facility design and operational measures which would:

- reduce or eliminate the release of wood preservative chemicals to the environment; and
- minimize the exposure of workers to wood preservation chemicals.

The Steering Committee included representatives of federal and provincial government agencies, wood preservation companies, forest industry labour unions, and worker compensation boards (see page xi).

Envirochem Services was subsequently retained to develop an initial draft technical recommendations document for review by the Steering Committee. During the review, input was also obtained from other experts in both industry and government. This technical recommendations report is the result of this comprehensive development and review process.

The design and operational measures presented are based on current knowledge of existing technology of the physical, chemical and biological properties of chromated-copper-arsenate (CCA). Although the recommendations are not part of any environmental legislation, they reflect the intent of the Federal *Fisheries Act*, and of provincial environmental and worker safety legislation and regulations.

The Steering Committee recommends that new CCA pressure-treatment facilities comply with the objectives in this technical recommendations document. Although methods to achieve those objectives are provided, the Committee fully supports the option of industry to achieve those objectives using other design features or operational procedures which can be shown to be at least equally effective. The Steering Committee recommends that existing facilities modify their operations as much as possible to meet the objectives of the recommendations. Site-specific circumstances will influence the applicability and implementation of specific measures for achieving the objectives recommended in this document for both new and existing facilities. It is

further recognized that the recommendations are based on existing knowledge, and ongoing and future studies may suggest the need for modifying these recommendations. The authors therefore recommend a definitive periodic review of the technical recommendations.

The Technical Steering Committee believes that the proper implementation of the technical recommendations will allow the continued beneficial use of chromated copper arsenate as a wood preservative and will protect both the environment and workers from potential harmful effects.

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ACKNOWLEDGEMENTS

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Dr. J. Ruddick	Canadian Wood Preserver's Association
Mr. D. Wilson	Conservation and Protection

1 THE NEED FOR WOOD PRESERVATION

1.1 Introduction

Wood preservation is the pressure or thermal impregnation of chemicals into wood to a depth that will provide effective long-term resistance to attack by fungi, insects, and marine borers. By extending the service life of available timber, wood preservation reduces the harvest of already stressed forestry resources, reduces operating costs in industries such as utility and railroad companies, and ensures safe working conditions where timbers are used as support structures.

The chemicals predominantly used in Canada for wood preservation are:

- pentachlorophenol,
- creosote, and
- aqueous formulations of arsenic, copper, and chromium or ammonia.

The wood preservation process deposits or fixes these chemicals in the wood, and the toxic nature of the chemicals effectively prevents the attack of living organisms on the wood. Because the chemicals are also toxic in varying degrees to humans and aquatic organisms, their use in industry must be carefully controlled. This document is intended to provide consistent guidelines for the design and operation of wood preservation facilities in a manner that will protect workers and the environment from harmful exposure to wood preservation chemicals.

1.2 Wood Deterioration

Timber is subject to several types of deterioration following its removal from the forest. Wood-decaying fungi and insects drastically reduce the usefulness of unprotected lumber and other forest products. As an example, untreated timbers used in underground workings of mines could have a life-time of no greater than two years because the temperature and moisture conditions in mines favour decay. Another example is the railway cross-ties used in North America, which would have an average life-time five years, without treatment. Protection is also required against wood-boring insects. For example, termites are responsible for extensive damage to wood in storage and in service. Marine structures such as untreated dock pilings along the North American coast can be destroyed by marine borers in less than one year.

The growth of wood-destroying fungi is dependent upon temperature, oxygen levels, the moisture content and nature of the wood. Wood products such as railway ties,

bridge and mine timbers, and utility poles are usually in direct contact with moist soil or in locations where moisture collects and cannot readily evaporate. When there is no practical means of limiting moisture content, oxygen levels or temperature, the option for the protection of such wood products is limited to the application of chemicals which act as agents to limit fungal growth by "poisoning" the wood food source. Simultaneously, the treatment can limit the other wood-destroying organisms such as insects and wood-borers.

1.3 Wood Preservation Chemicals

Historically, the preservation of wood by chemical means can be traced back over 4000 years, to the time when the Egyptians apparently used bitumen to treat wooden dowel-pins in the stonework of temples (1). At the time of the Roman Empire, tar, linseed oil, oil of cedar, and mixtures of garlic and vinegar were used for the preservation of wooden statues. Alexander the Great of Persia is reported to have ordered piles and other timber for bridge building to be covered with olive oil as a precaution against decay (2). Investigations to define alternative wood preservation agents were reported in the late 1600's with escalating efforts during the 1800's. A review of the many chemicals and chemical formulations used historically and currently, can be found in the above references and in texts such as those written by Hunt and Garratt (3) and Wilkensen (4).

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. Wood preservation formulations must:

- 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.

Other factors which determine the selection of wood preservation chemicals or formulations include: fire resistance; colour or odour; paintability; corrosiveness; electrical conductivity; and, leachability from wood.

In Canada the predominant wood preservative chemicals or formulations in use are:

- CCA (chromated copper arsenate). Major CCA-treated products include: fence posts, lumber for patios and landscaping, and foundation lumber and plywood.
- ACA (ammoniacal copper arsenate). Major ACA-treated products include: utility poles and landscaping timbers.
- PCP (pentachlorophenol). Major PCP-treated products include: railway ties and utility poles.
- Creosote. Major uses include treatment of railway ties, utility poles, and marine pilings.

Although other wood preservatives have been used in the past in Canada, these four chemicals or formulations are the only preservatives in use in Canada since 1985. The development of alternative chemicals for wood preservation is the subject of ongoing research. The actual use of alternative chemicals will depend on industry and safety evaluations, and on approval under the Federal *Pest Control Products Act* administered by Agriculture Canada.

1.4 The Value of Wood Preservation

Controlled studies have shown that wood preservation enhances the lifetime utility of wood by a factor of 5 to 15, depending on the wood species, use and efficacy of treatment. It has been estimated that, if in the U.S.A. "untreated wood were used for the applications now employing preservative-treated wood, the added annual cost to the transportation, utility, and construction industries would be over $15 billion dollars. Energy savings, depending on the substitute materials envisioned, are from 19 to 32 million barrels of petroleum per year" (5).

It has also been estimated that if wood were not treated with preservation chemicals, timber requirements would increase by three- to six-fold. Such requirements would have exhausted many timber resources required for railway, utility, construction, and marine industries (3). Wood preservation also enables the use of smaller and faster growing trees such as lodgepole pine. Prior to the wide-spread use of wood preservation, timbers used in structures such as railway bridges were required to be over-sized in order to accommodate a degree of decay.

2 OVERVIEW OF CHROMATED COPPER ARSENATE WOOD PRESERVATION FACILITIES

2.1 Description of Process

Wood preservation requires the deep penetration of chemical agents into the wood (several centimetres). A pressure-treating plant is used to achieve such penetration and subsequent fixation of a wood preservative within wood (Figure 2.1). Chromated copper arsenate (CCA), is normally purchased as a premixed concentrate (50 to 65%) shipped by bulk truck and rail tanker. The concentrate is stored in tankage and diluted with water to a 1.5 to 4.0% strength working solution by means of pumping transfers and recirculation between bulk tanks. The working solution is then applied to the wood in a pressure cylinder which may be up to 45 m long and 2 m in diameter.

The "full-cell treatment process", used to apply the preservative in CCA treatment plants, consists of the following steps (Figure 2.2):

- application of an initial vacuum to remove air from the wood cells;
- flooding with CCA working solution and pressurization (up to 150 psig) until the target CCA retention level is achieved;
- draining of the excess CCA working solution (to the working tank for reuse with subsequent charges); and
- application of a final vacuum.

A "modified full-cell treatment process" may also be used whereby a lesser initial vacuum is applied, and some air remains within the wood cells. The trapped air readily expels excess CCA during the final vacuum, which results in a "drier" product.

The specific treatment times and pressures are dictated by the species of wood, the type of wood product (e.g., plywood or poles) and the moisture content of the wood. A predetermined range of process parameters is defined by the applicable treatment standards (6), and numerous quality control tests are carried out to ensure that a minimum treated product quality is achieved. The treated wood is then withdrawn from the treating cylinder and stored on-site for time periods which generally range from days to months.

2.2 Potential Chemical Discharges

Variability in CCA wood preservation plant design and operational practices may exist, and within each plant there are various potential emission sources which may

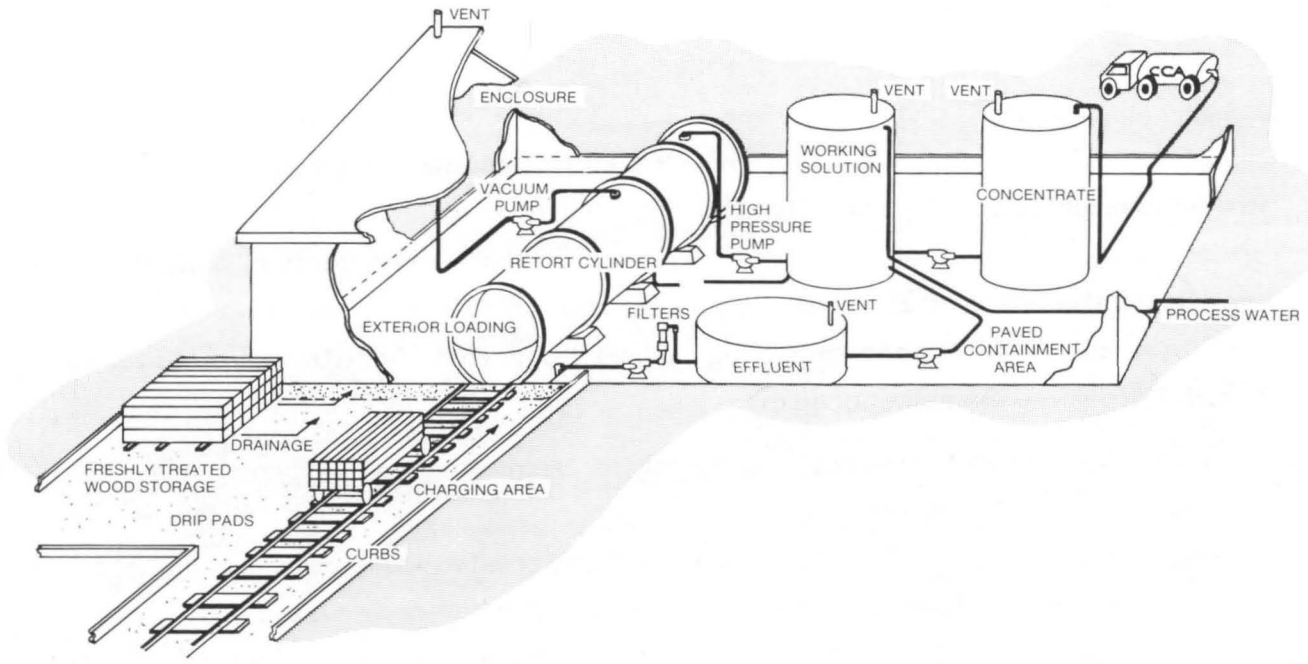

FIGURE 2.1 CONCEPTUAL DIAGRAM OF A CCA PRESSURE-TREATING FACILITY

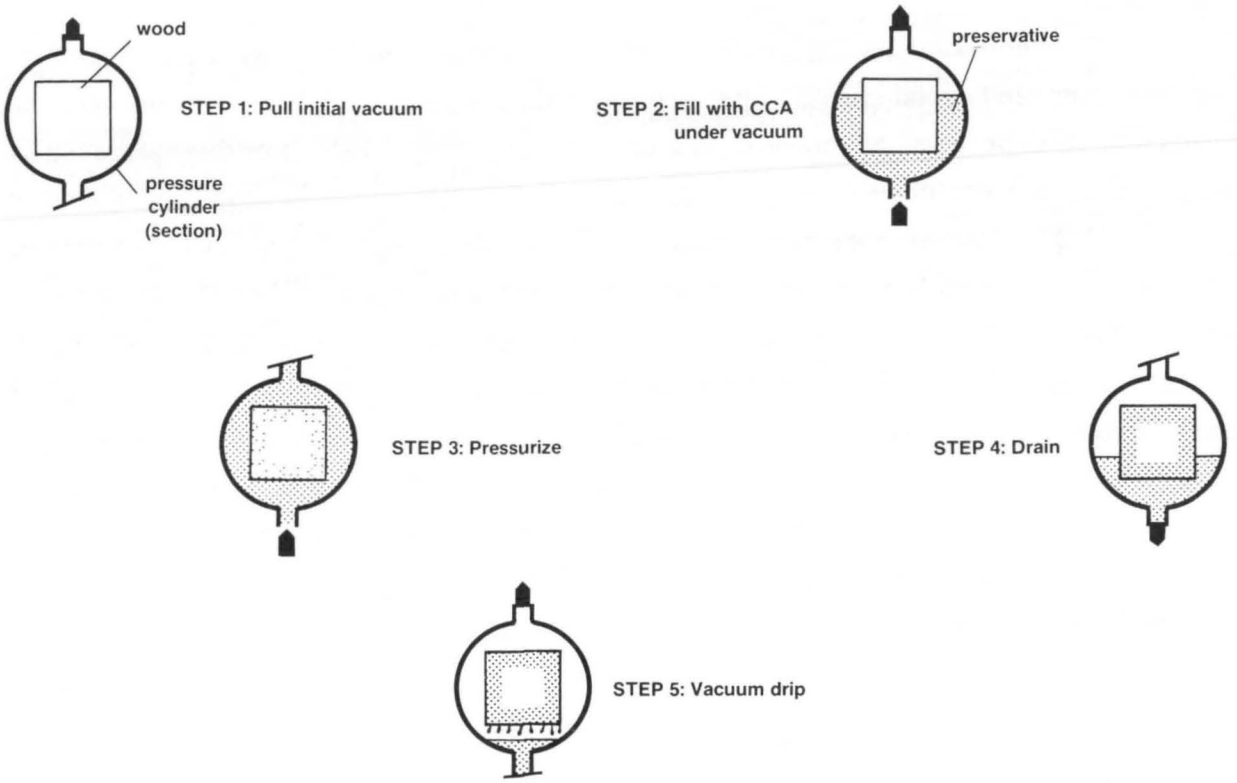

FIGURE 2.2 THE FULL-CELL CCA PRESSURE-TREATING PROCESS

affect the adjacent environment and/or worker health. The potential sources and types of releases are illustrated in Figure 2.3.

2.2.1 Liquid Discharges. The CCA process utilizes waterborne ingredients; therefore, dripped solution or contaminated storm run-off water can be readily reused within the process. The toxicity and high cost of CCA have led the CCA wood preservation industry to utilize closed treatment systems which contain, collect and reuse the chemical mixture to the greatest possible extent. Primary elements that may be used for CCA containment and recycling at well-operated facilities are illustrated in Figure 2.1. These elements include:

- paved containment surfaces and dyking of major process components including the cylinder and CCA tankage;
- containment surfaces for chemical drips from treated wood on the cylinder charging track, in the freshly-treated wood storage area and kiln drying area; and,
- a collection sump to receive residual preservative from the cylinder (following the treatment cycle) and the accumulated contaminated runoff from other containment surfaces.

Contaminated liquids entering the sump are pumped through cartridge filters to remove dust and wood debris. The filtered solution is stored in a holding tank and returned to the process as makeup water for preparing fresh, working preservative solution for subsequent charges.

Under normal operating practices, liquid discharges from a CCA-treatment facility are confined to liquids that are not contained and reused within the process. For example, stormwater runoff from unpaved and unroofed treated-product storage areas is the most common liquid discharge from many CCA-treatment facilities. The quantity of copper, chromium, or arsenic in such waters depends on many factors such as: quantity of precipitation; fixation time and temperature prior to precipitation event; and soil characteristics of the storage yard. Uncontained liquid releases other than stormwater, are generally confined to yard soils with potential for groundwater contamination. Examples include locations where drip pads are not used in charging areas or where kiln drainings are uncontained.

2.2.2 Solid Wastes. Solid waste generation at CCA facilities is usually minimal, and during normal operating conditions is confined to cartridge filters which are used for dust

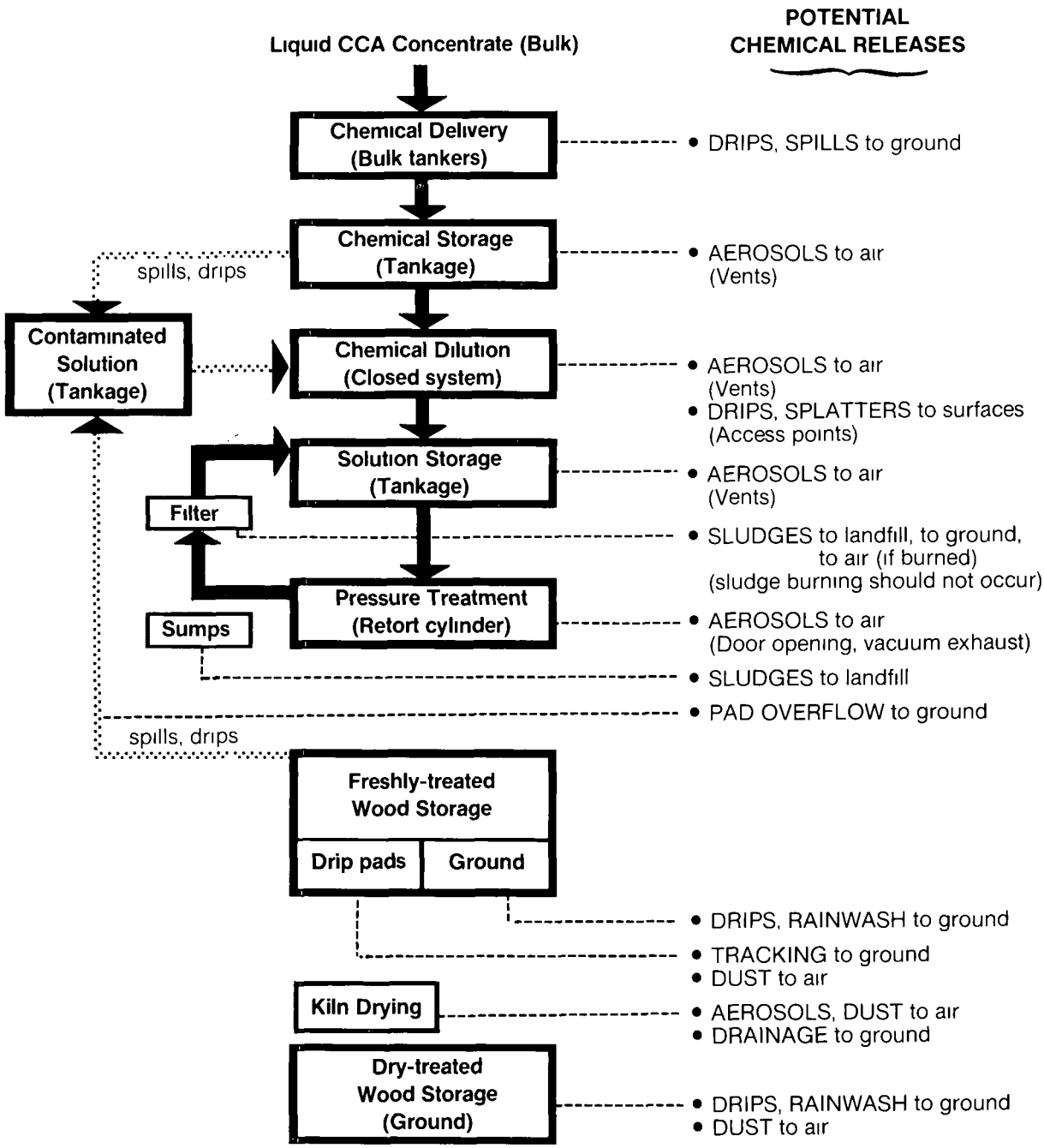

FIGURE 2.3 POTENTIAL CHEMICAL RELEASES FROM CCA PRESSURE-TREATING PLANTS

and debris removal from recycled waters, and debris and sludges which are periodically removed from the sump, cylinder and tanks.

2.2.3 Air Emissions. Potential sources of air emissions include mists from vacuum pump exhaust, cylinder doors, and tank vents. Some preservative chemical may also be entrained in kiln emissions when the treated product is dried following treatment. Several monitoring studies in the vicinity of the above air emission sources have been reported in the literature, and concentrations of copper, chromium and arsenic below existing occupational health limits were reported (7,8).

2.2.4 Potential Effects. The actual impact of any emission depends on many factors, including the location of the wood preservation facility relative to ground or surface waters, the amount associated with the releases, the frequency of releases, and contingency measures in place at the facility.

There have been very few reported environmental assessments of CCA facilities (7) and no documented environmental or worker health effects as a result of "normal" CCA usage at wood preservation facilities. Available data, indicate that improperly designed and/or operated facilities do have the potential to contaminate groundwaters to levels which would disallow use of such groundwaters for drinking purposes (7). Also, surface runoff waters which exceed various regulatory limits have been reported (9).

2.3 Chemical Management at CCA Facilities

Environment Canada sponsored surveys of the Canadian wood preservation industry (7,10,11) indicated that all CCA facilities in Canada purchased CCA which was prepared by three U.S. manufacturers:

- Osmose Wood Preserving Co.,
- Koppers Co., Inc., and
- Mineral Research and Development.

Recently, another U.S. manufacturer (RentoKil) has entered the Canadian market and Osmose Wood Preserving Co. has initiated the formulation of CCA in Ontario.

The Environment Canada surveys indicated that representatives of the manufacturers offer a high level of support services, including facility design, routine safety and quality control inspections, analytical services and consulting expertise on operations, maintenance, and emergency response procedures. The approach provides a generally high level of control over preservative use at most wood preservation facilities

which use CCA. In addition, design and operational guidance from the common suppliers provides a national level of general consistency to the CCA facilities.

The contractors who conducted the Environment Canada survey characterized the industry segment as predominantly responsible and effectively self-regulated with respect to releases of chemical to the workplace and to the environment (11). However differences in uniformity of the implementation of design and operational objectives within the industry were observed (7,10,11), and have subsequently resulted in:

Differences in design aspects, including:

- control of drips from freshly-treated wood,
- control of vacuum and kiln exhausts,
- storage of CCA solutions,
- containment in CCA unloading areas,
- shelter and containment of facilities located in subzero climates,
- containment of surface washoff from dry-treated wood storage areas, and
- prevention of tracking from drip pads.

Differences in operational procedures, including:

- monitoring effectiveness of pollution control measures,
- worker safety precautions (due to variable perceptions on the possible human health effects of CCA-exposure, especially with respect to the toxicity of the forms of chromium and arsenic used), and
- definition of acceptable disposal practices for CCA-containing solid wastes.

The intent of this document is therefore to define objectives and to suggest means of achieving those objectives to ensure consistency within the industry for the protection of the environment and workers from potential harmful effects.

3 CHROMATED COPPER ARSENATE

3.1 Production and Use

Chromated copper arsenate is sold throughout the world as dry mixtures of crystalline powders and pastes, or as liquid concentrates. Hartford (12) describes the mixtures which are prepared in a variety of different ratios of chromium, arsenic, and copper. The most common CCA formulation currently in use in Canada is known internationally as a Type C formulation, which is prepared from copper oxide and, chromic and arsenic acids. The composition of a 50% concentrate Type C formulation (13) and various details of CCA usage in Canada are provided in Table 3.1.

A rapid upward trend for CCA-usage was noted during the time of the 1982-1984 Environment Canada surveys (7,10,11). The ability to paint CCA-treated wood (as well as the ability to mix stains with CCA for production of prestained-treated wood) and the perceived ease of handling treated products, has resulted in widespread acceptance by homeowners of CCA-treated lumber for uses such as patio construction, playground equipment, landscaping, foundation plywood, and fence posts. Other uses of CCA, such as treatment of marine pilings, have been shown to be very effective and it is anticipated the market for CCA-treated products will broaden.

3.2 Physical and Chemical Properties

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 (14). Reaction products include insoluble chromates and insoluble arsenates of copper and chromium (15).

General physical and chemical properties of CCA (50% concentrate) are summarized in Table 3.2. Information was obtained from manufacturers' material safety data sheets. The data indicate that a wide variety of properties must be considered for the safe management of CCA solution.

3.3 Environmental Effects

All wood preservation chemicals are potentially highly toxic to the environment. Both short-term (acute) and long-term (chronic) toxic effects could result

TABLE 3.1 CHROMATED COPPER ARSENATE USAGE IN CANADA

Feature	Characteristics
Delivery format	bulk rail and truck (liquid concentrate to 65%) 125 kg (275 lb) drums (72% concentrate)
Concentration of active ingredients (e.g., 50% concentrate)	23.75% as CrO_3 9.25% as CuO 17.0% as As_2O_5
Suppliers to Canadian facilities	• Timber Specialties Ltd. representing Osmose Wood Corporation, Buffalo, N.Y. (CCA prepared at Memphis, TN and Campbellville, Ontario) • Koppers Canada Ltd. (representing Koppers Company Ltd., Pittsburg, PA) (CCA prepared at Atlanta, GA and Valparaiso, IN) • Woodchem Inc., representing Laporte Inc., Houston TX (CCA prepared at Mineral Research and Development, Gilmar, TX; Augusta, GA; and Charlotte, NC) • Rentokil Inc., Norcross, GA
Estimated use quantity (1984)	Canada - 5000 tonnes (50% concentrate)
Concentration of work solutions	1 to 7% as total oxides 2% solution: 4900 ppm Cr 3000 ppm Cu 4400 ppm As
Typical preservative retention in treated wood	4.0 to 12.8 kg/m^3 treated wood (0.25 to 0.8 lb/ft^3)
Major products treated in Canada	dimensional lumber, foundation lumber and plywood, fence boards, fence posts, shingles and shakes, siding

from the improper release of CCA. Such releases have not been observed within the Canadian environment, because of the generally excellent control aspects of the CCA-industry.

TABLE 3.2 PHYSICAL AND CHEMICAL PROPERTIES OF CCA CONCENTRATE SOLUTION

Identification

Common Synonyms: CCA, Wolmanac, Osmose K-33, Woodchem C

United Nations (U.N.) Number: 1556

Manufacturers:
- Koppers (Atlanta, GA; Valparaiso, IN)
- Osmose (Memphis, TN; Campbellville, Ont.)
- Mineral Research and Development (Charlotte, NC; Gilmar, TX; Augusta, GA)
- Rentokil (Norcross, GA)

Transportation and Storage Information

Shipping State: Liquid Concentrate

Concentration: 50 to 72% by weight

Classification: Poisonous; corrosive; oxidizer

Storage Temperature: Ambient

Inert Atmosphere: No requirement

Venting: No requirement

Containers/Materials: Metal drums, Bulk truck or train

Labels and classification: Check with the Department of Transport

Physical and Chemical Properties

Physical State: Liquid (20°C, 1 Atm)

Solubility: Freely soluble (water)

pH: Strongly acidic (pH 1.6 to 3.0)

Vapour Pressure: Non-volatile

Floatability: Dissolves readily in water

Freezing Point: -30°C

Flash Point: Not flammable

Explosive Limits: Not explosive or flammable

Specific Gravity: 1.64 (50% concentrate)

Appearance: Heavy liquid, dark brown colour

Colour: Dark brown (concentrate) to yellow-green (dilute)

Odour: Odourless

Hazard Data

Fire

Extinguishing Data: Not combustible; common extinguishing agents can be used with fires involving CCA solutions.

Fire Behaviour: Exposure to high temperatures may emit arsenic fumes. Containers may rupture due to chromic acid reactivity. Chromic acid may reduce the combustibility of other materials.

Ignition Temperature: Not combustible

Burning Rate: Not combustible

Reactivity

With Water: No reaction

With Common Materials: Contact with reducing agents (such as aluminum or zinc) may liberate arsine gas (AsH_3, colorless, highly toxic) and/or may cause violent explosions due to chromic acid reactions. Contact with combustible materials (such as acetic acid, acetone, ammonia, alcohol, glycerol, hydrocarbons, hydrogen sulphide, naphthalene, sulphur, and turpentine) may result in violent reactions and subsequent fire and/or explosions.

Stability: Stable

3.3.1 Distribution in the Natural Environment. Copper, chromium, and arsenic, the components of CCA, are natural elements which at normal background concentrations do not have discernable adverse effects on biota (Table 3.3).

Considerable variability in natural concentrations of copper, chromium and arsenic occurs in soils and waters. Therefore it is important to determine background levels immediately prior to operation of a facility, to enable meaningful future assessments of pollution control at the facility.

TABLE 3.3 TYPICAL BACKGROUND LEVELS OF CCA CONSTITUENTS (Copper, Chromium, Arsenic) (16, 17, 18)

	Typical Concentrations in Non-polluted Environments	
Element	Surface Waters (mg/L)	Soils (mg/kg)
Copper (Cu)	<0.001 to 0.04	2 to 100
Chromium (Cr)	0.003 to 0.04	5 to 1000 (50 mg/kg is normal)
Arsenic (As)	<0.001 to 0.01	1 to 50 (up to 500 mg/kg found in sulphide deposits)

3.3.2 Environmental Monitoring. There have been few studies of CCA releases from wood preservation facilities to the adjacent environment. Data compiled for regulatory purposes (7) indicate that when proper precautions are not taken, groundwaters in the immediate vicinity of CCA-facilities may be contaminated to levels which render the groundwaters unsafe for human use. To a limited extent, stormwater runoff waters from CCA-facilities have also been analyzed, and the results indicate the stormwaters may contain at least one of copper, chromium, or arsenic at levels in excess of existing water quality limits (9). The studies also indicated that ratios of copper/chromium/arsenic are not consistent within runoff waters. The inconsistency may be due to differences in the ability of the components to bind to the yard soils or due to different sources within the yards (i.e., stored lumber washoff versus dripped material from freshly treated loads). Additional monitoring studies are required to properly assess the degree of such releases.

Studies of air quality at several CCA facilities have been reported (7,8) and concentrations of arsenic, copper and chromium in those facilities were found to be below regulatory workplace standard action levels. The treatment process requires no external

heat sources (except for kiln drying) and no vapours should be created. Air releases, if any, would be in the form of localized mists. The effect of a normal CCA facility on air quality of the surrounding environment is expected to be non-detectable.

3.3.3 Aquatic Toxicity. Discussions on aquatic toxicity of CCA require recognition that:

- Ratios of copper, chromium and arsenic in soils and runoff waters from CCA facilities are not necessarily consistent with their ratios in the original CCA working solutions. Depending upon various factors, it is possible that only one element may be predominant. As a result the toxicity of each element, in addition to the toxicity of the CCA mixture, should be reviewed.

- Valence changes of arsenic, chromium or copper may occur within the environment, and those changes may reduce or enhance the toxicities of the elements. There have been no studies reported in the literature on valence interconversion of copper, chromium or arsenic in soils, groundwaters, or surface runoff waters at or from CCA facilities. A limited study was carried out for the purposes of this document to assess arsenic speciation. The study indicated that samples of soils and waters in the vicinity of CCA facilities contained at least 97% of the original pentavalent form of arsenic (9).

The observed values of chronic toxicity and acute toxicity of copper, chromium, arsenic and CCA (as a mixture) to salmonid species such as trout and salmon are summarized in Table 3.4. As an illustration of lethality of CCA to fish, the data indicate that 0.26 ppm of 50% concentrate (i.e., a 4 000 000-fold dilution of 50% concentrate) would still be acutely toxic to salmonids. A similar degree of toxicity would be observed with 6.5 ppm of 2% work solution (i.e., a 160 000-fold dilution of 2% work solution). This illustrates that a spill of CCA concentrate or work-solution to a waterway inhabited by fish would have a high potential for environmental impact.

Based on extensive reviews of the literature and unpublished information, regulatory agencies have derived upper limits for many water quality parameters, including copper, chromium and arsenic. As of July 1987, upper limits applicable to Canadian waters include those derived under the auspices of the International Joint Commission (IJC) for application to Great Lakes waters (19), those derived by Health and Welfare Canada as "Canadian Drinking Water Objectives" (20, 21), and the guidelines developed under the auspices of the Canadian Council of Resource and Environmental

TABLE 3.4 AQUATIC TOXICITY OF COPPER, CHROMIUM, ARSENIC AND CCA TO FISH

Element	Concentration (mg/L)	Effect
Chromium (+6)	0.2	- low growth rates, high mortalities after 12 weeks exposure Chinook Salmon (23)
	69	- 96-h LC_{50}* Rainbow trout (23)
Chromium (+3)	0.2	- no effect Rainbow trout (23)
Copper (+2)	0.002	- avoidance Atlantic salmon (24)
	0.006 to 0.015	- cough-frequency increase Brook trout (24)
	0.02 to 0.89 (depends on water hardness)	- 96-h LC_{50}* Rainbow trout (23)
Arsenic (+5)	0.9	- early lifestage effects Fathead minnow (25)
	100	- lethal in 46 minutes Sunfish (26)
	10.8	- 96-h LC_{50}* Rainbow trout (25)
CCA (commercial solution supplied as 50% concentrate)	0.26 (0.13 for 100%)	- 96-h LC_{50}* Rainbow trout (27)

* LC_{50} is defined as that concentration which results in death of 50% of the fish population within 96 hours.

Ministers (22). The recommendations of the IJC which are outlined in Table 3.5 have been generally accepted by the Governments of Canada and the United States for the Great Lakes. The IJC limits which consider background levels in the Great Lakes are based on review of toxicity to freshwater organisms and human health, and are subsequently defined to protect the most sensitive biological species within the Great Lakes ecosystem which could be exposed to the subject contaminant. In the case of arsenic and chromium, the most sensitive species is man. The species most sensitive to copper were alevins of

TABLE 3.5 CANADIAN LIMITATIONS FOR ARSENIC, CHROMIUM, AND COPPER

Element	I.J.C. Recommendations[a] Great Lakes Waters	Canadian Drinking Water Objectives[b]	Canadian Water Quality Guidelines [e]
Arsenic	0.5 mg/L for the protection of human health	Maximum acceptable[c]: 0.05 mg/L Objective[c]: <0.005 mg/L	0.05 mg/L for protection of aquatic life
Chromium	0.05 mg/L for the protection of human health	Maximum Acceptable[c]: 0.05 mg/L Objective[c]: <0.0002 mg/L	0.02 mg/L for protection of fish 0.002 mg/L for protection of the aquatic community including zooplankton and phytoplankton
Copper	0.005 mg/L for the protection of aquatic life	Maximum Acceptable[d]: 1.0 mg/L Objective[d]: <1.0 mg/L	For protection of aquatic life 0.002 mg/L Hardness 0 to 60 mg/L as $CaCO_3$ 0.002 mg/L Hardness 60 to 120 mg/L as $CaCO_3$ 0.004 mg/L Hardness 120 to 180 mg/L as $CaCO_3$ 0.006 mg/L Hardness >180 mg/L as $CaCO_3$

(a) Recommendations of the International Joint Commission to the Governments of Canada and the United States, 1977.

(b) Health and Welfare Canada - Guidelines for Canadian Drinking Water Quality, 1978.
"Maximum Acceptable" is defined by Health and Welfare Canada as: "Drinking water that contains substances in concentrations greater than these limits is either capable of producing deleterious health effects or is aesthetically objectionable".
"Objective" is defined by Health and Welfare Canada as: "This level is interpreted as the ultimate quality goal for both health and aesthetic purposes".

(c) From Health and Welfare Canada "Recommended Limits for Chemical Substances Related to Health", 1978.

(d) From Health and Welfare Canada "Recommended Limits in Substances Related to Aesthetic and Other Considerations", 1978.

(e) Guidelines require consideration of local conditions (e.g., background levels) (22)

brook trout (toxic effects at 0.009 mg copper/L) and the amphipod, *Gammarus pseudolimnaeus* (toxic effects at 0.0046 mg copper/L).

The guidelines developed by a Task Force of The Canadian Council of Resource and Environmental Ministers (22), adopt the Health and Welfare Canada drinking water quality guidelines for "raw water for drinking water supply". However the Council's guidelines for protection of "freshwater aquatic life" are based on an independent review of the literature. The preface of the Council's report "emphasized that these guidelines do not constitute values for uniform national water quality and that their use will require consideration of local conditions" (e.g., background concentrations) (22). All of the guidelines and limitations in Table 3.5 are based on total concentrations of either arsenic, chromium and copper, and reflect the recommended approach of many scientific reviews which indicate that the current state of knowledge does not enable water quality limitations which can be based on either valence state or dissolved fractions in water (19).

3.4 Human Health Concerns

Chromium, copper and arsenic are elements which are found naturally in food, water, and air. Table 3.6 provides estimated daily intakes of these elements by the general population (21). Exposure of human beings to arsenic, copper, and/or chromium at levels which exceed natural concentrations, may lead to adverse health effects.

One safety objective of industrial usage of any chemical (in this case, chromium, copper and arsenic formulations) is to minimize worker exposure ideally so that natural intake levels are not exceeded. If safeguards are not provided or implemented, then a variety of human health effects may occur depending on: the duration and manner of exposure; concentration of chemicals; chemical forms (valence); and varying metabolic sensitivities of individual workers.

On the basis of information from material safety data sheets for CCA (13), and an assessment of existing literature, Table 3.6 outlines the possible human health effects which may result from over-exposure to chromated-copper-arsenate solutions. Extensive reviews of the potential health effects of individual elements are provided in documents by the National Research Council of Canada (16, 17, 18), the World Health Organization (28), and the International Labor Organization (29). The interpretations provided within these reviews are summarized briefly in Table 3.7.

3.4.1 Assessment of Known Health Effects. There is a generally high level of control over preservative use at most facilities which use CCA. The industry has been

TABLE 3.6 THE RANGE OF POSSIBLE EFFECTS FROM EXPOSURE TO CCA SOLUTIONS

Exposure Category	Type of Exposure	Possible Health Effects	
		Short-term Exposure	Long-term Exposure
General population	Estimated daily intake from food, air, water (23)		
• Arsenic (found in foods, especially seafoods)	0.1 mg	None	None
• Copper (an essential element)	3 mg	None	None
• Chromium (in trace quantities in all foods)	0.2 mg	None	None
Properly protected worker	Minimal	None reported	None reported
Exposed worker with significant skin contact	Skin contact with work solutions or concentrates	• Skin irritation • Inflammation (18,29)	• Ulceration (22) • Potential carcinogenic action (29,30)
Exposure to contaminated aerosols	Inhalation of mists, droplets or aerosols of work solutions or concentrates	• Severe irritation to nose and throat (18,29) • Irritation to eyes	• Ulceration and perforation of nasal septum upon long exposure (24) • Potential carcinogenic action (29,30)
Ingestion	Ingestion of work solutions or concentrates	• Nausea, abdominal pain, vomiting, shock, coma • Reported amounts which have resulted in death are: 0.1 to 1 g arsenic (17, 32,34); 0.7 g chromium (+6)(18)	• Possible liver and kidney damage jaundice, reduced white blood cells upon long-term exposure to 0.15 to 0.6 mg arsenic per day (17) • Potential carcinogenic action (29,30)

TABLE 3.7 POTENTIAL HEALTH EFFECTS FROM OVEREXPOSURE TO CHROMIUM, COPPER OR ARSENIC

Element	Effect
Chromium (18)	The form of chromium at CCA facilities is Cr(+6) • Chromium (+3) is the most common naturally occurring form which functions biologically as an essential element in mammals where it maintains efficient glucose, lipid and protein metabolism. • Chromium (+6) is found in nature in minimal amounts; it easily crosses biological membranes, and is highly toxic. • Cr (+6) levels in air <0.05 mg/m^3 are associated with high risk of injury to nasal tissues. Levels as low as 0.01 mg/m^3 Cr (+6) can produce strong irritation in the nose even after short exposures. • Production of chromates from chromite and production of chromate pigments have been associated with occupational respiratory cancer. Workers producing chromate pigment who developed respiratory cancer had an estimated Cr exposure of 0.5 to 1.5 mg/m^3 for 6 to 9 years. • The lethal oral dose of Cr (+6) (single dose basis for humans) is estimated to be 10 mg/kg body weight. • The most common manifestation of Cr (+6) poisoning is kidney damage. • Repeated exposure to Cr components causes dermal sensitization in some workers; such sensitized individuals may react to solutions as dilute at 0.005% $K_2Cr_2O_7$. • Concentrated Cr (+6) solutions (3 to 10% by weight) are corrosive to skin, causing slow-to-heal ulcers.
Copper (29)	The form of copper used at CCA facilities is Cu (+2) • Copper is a natural element and is present in the bivalent form in most living organisms. • Except in instances of ingestion of relatively large amounts or massive over-exposure, most of the world's population is essentially immune to poisoning by copper. However, about 1 of 200 000 individuals inherits a pair of abnormal genes and will ultimately develop Wilson's disease (copper toxicosis). The disease develops slowly with the ingestion of copper at normal levels of dietary intake, and develops more rapidly if industrial exposure to copper occurs. The disease can be fatal if untreated. • The ingestion of large (g) quantities of copper solution may result in nausea, vomiting and death. Skin irritations are rare. Inhalation of dusts and mists of copper salts can cause congestion of the nasal and mucous membranes and ulceration and perforation of the nasal septum.
Arsenic (17,29)	The form of arsenic used at CCA facilities is As (+5) • Arsenic is a natural, low-level constituent of most human tissues. There is no general agreement on what levels reflect normal or excessive exposure to arsenic. One study of background arsenic levels in urine showed concentrations from 5 to 365 µg/L (30). WHO reported that 95% of arsenic in urine background levels would be <80 µg/L. (Consumption of fish or other marine organisms, containing non-toxic organic arsenic compounds, prior to testing may erroneously reflect on actual industrial exposure.) • Methods exist for differentiating inorganic arsenic from organic arsenic in human urine (32) • There is much disagreement in interpretation of biological studies on arsenic poisoning. Many studies did not distinguish the chemical form of arsenic. Also, bioassay results with laboratory animals cannot be readily extrapolated to predict effects on humans. • It is generally stated in the literature that trivalent arsenical substances are more toxic to humans than pentavalent arsenical substances, and inorganic forms are more toxic than organic. However, the toxicity database for As (+5) is poor. The U.S. EPA has taken the position that an adequate database demonstrates the in vivo reduction of arsenate to arsenite. Accordingly, the interconversion justifies the regulation of both chemicals together (i.e., as one entity) rather than as arsenate (As(+5)) and arsenite (As(+3)) separately. • Chronic arsenic intoxication produces: - nervous disorders, - respiratory distress, - skin changes, - heart and occlusive arterial disease, and - liver cirrhosis and cancer. Chronic intoxication may result from an extended period of daily ingestion of 22 to 63 µg As per day. The lowest range of arsenic concentrations in air associated with increased cancer incidence is 0.1 to 150 µg/m^3 (17). • The International Labour Organization recommends that employees exposed to arsenic in their work should not include: those with diabetes, cardiovascular diseases, allergic or other skin diseases, neurological disorders, or hepatic or renal lesions (29). • There is sufficient evidence that inorganic arsenic compounds are carcinogenic in humans (28). However, the occupations in which cancer was associated with arsenic exposure involved the manufacture and use of arsenical substances other than CCA.

generally characterized as "responsible and effectively self-regulated with respect to releases of chemical to the workplace and to the environment" (11).

Biological monitoring of CCA-workers indicates that some absorption of CCA may occur as shown by increased arsenic levels in urine samples from CCA-treating plant operators (30). However, the levels were not in excess of "normal population limits" and were much below regulatory limits. There has been no reported evidence of occupational illnesses due to normal handling of CCA-solutions and CCA-treated products (31). An analytical method is available for differentiating inorganic aresenic from organic arsenic in human urine (32).

Nevertheless, the data in Table 3.7, suggest a potential for the constituent chemicals of CCA to cause adverse effects on human health, particularly at sites where excessive exposure may occur. Suppliers and various investigators, therefore, have suggested that the following protective measures be ensured within the industry:

- the use of clean and undamaged impervious gloves when handling CCA-solutions and fresh-treated CCA products, to reduce potential for dermal exposure (8);
- adequate worker education, and assurance of good practices at all sites (7,11);
- the use of proper eye, skin and respiratory protection (13); and
- the use of biological monitoring for arsenic levels as an index of occupational exposure and for evaluating the effectiveness of measures of reducing exposure (30). Options for biological monitoring include analyses of urine or analyses of hair (see Section 4.3).

4 PERSONNEL PROTECTION

4.1 Precautions and First Aid

The potential hazards of exposure to CCA solutions include immediate and long-term toxic effects from ingestion, skin contact, eye contact, or inhalation (Tables 3.6 and 3.7). A secondary hazard (especially with 50% concentrate) is corrosive damage to eyes or skin upon contact with the strongly acidic CCA solutions. It is emphasized that these potential hazards can be adequately controlled by using proper protective measures.

The severity and speed of damage resulting from direct contact of CCA solutions with the skin or eyes are concentration dependent, and both factors diminish as CCA solutions are diluted. The general rule is the higher the concentration of CCA-solutions to which a worker is exposed, the greater the need for the required protection and immediate response if contact occurs. If in doubt, play it safe and respond as if exposure is to a concentrated solution. First aid procedures are described in Table 4.1 (13, 34). Uncertainty in secondary response actions to ingestion are noted in Table 4.1, and this emphasizes the need for first aid personnel to maintain regular contact with CCA suppliers and/or industrial medical advisors for information on up-to-date response measures.

Specific objectives for an overall worker protection program in a CCA wood preservation facility are outlined in Table 4.2. Means to achieve the objectives are presented within the table; however, the recommendations may not be the sole options available to attain the objectives. There may be alternative approaches that are equally effective or that may be more suitable in view of site-specific conditions. When specific programs are developed for a particular facility, therefore, the recommendations may be modified if it can be demonstrated that an alternative approach, more suitable to plant specific conditions, would be equally effective in attaining the desired objective.

4.2 Regulatory Controls

Specific provincial regulatory limits for worker protection are found in the Appendix. Most regulatory criteria established by worker protection agencies are based upon the "Threshold Limit Values (TLVs) and Biological Exposure Indices", as recommended by the American Conference of Governmental Industrial Hygienists (ACGIH). The ACGIH recommended limits of exposure in the workplace for copper, chromium and arsenic are summarized in Table 4.3 (35).

TABLE 4.1 FIRST AID FOR CHROMATED COPPER ARSENATE EXPOSURE

Exposure	First Action	Second Action
Eye Contact	• Immediately flush eyes with flowing water, occasionally lifting the upper and lower lids. • Flush eyes for at least 15 minutes.	• Use boric acid solution and cortisone ophthalmic drops. • Get medical attention.
Skin Contact	• Flush contaminated area immediately by use of flowing water. • Subsequently remove soaked clothing articles in contact with the skin. • Continue to flush contaminated skin for at least 15 minutes.	• Get prompt medical attention if the skin becomes inflamed (redness, itch or pain).
Inhalation	• Immediately remove the exposed person to fresh air.	• Apply artificial respiration if breathing has stopped. • Keep the affected person warm and quiet. • Get immediate medical attention.
Ingestion	• Promptly drink a large quantity of milk, egg whites, or gelatin solution (or water if the aforementioned are unavailable)(13).* Never give liquids to an unconscious person.	• Call an industrial physician or the Poison Control Centre immediately for subsequent advice.* (Stomach pumping by medical personnel is desirable.)
Chronic Symptoms Requiring Medical Referral	• Ulceration of the skin or mucous membrane (breaks in the skin, disintegration of tissue, pus formation). • Abdominal pains and other persistent symptoms of illness.	

* At the time of this report there was conflicting information regarding the second action (e.g., whether or not to induce vomiting). First aid personnel should obtain updated information from CCA suppliers and/or competent medical advisors for appropriate second actions if medical help cannot be obtained immediately.

TABLE 4.2 SAFETY PRECAUTIONS FOR PERSONNEL WORKING WITH CHROMATED COPPER ARSENATE SOLUTIONS

Objective	Recommendations
General Precautions	
Assure that workers are familiar with all aspects of CCA usage	• Provide documentation and training to educate workers about the chemical properties, hazards of exposure, and emergency procedures associated with CCA use. • Implement preventative measures to minimize ingestion, inhalation, and skin or eye contact with CCA solutions.
Assure that first aid can be applied when required	• Install and regularly check emergency eyewashes and showers. • Provide all required first aid equipment for responses as indicated in Table 4.1. • Ensure that first aid is always available by qualified (trained) personnel. (Trained personnel may include supervisors and managers) • Ensure familarity of first aid personnel with updated emergency procedures. • Identify medical contacts who are readily available during all working hours.
Personal Hygiene	
Encourage personal hygiene practices which minimize potential exposure to CCA	• Do not carry, store or consume food or drink in working areas. (e.g., areas where CCA solutions are stored or used, or where freshly-treated wood is stored). • Do not carry or smoke cigarettes in working areas. • Wash hands thoroughly before leaving working areas and before eating, drinking, smoking, or using the toilet facilities. • Do not expose cuts or abrasions to CCA solutions. • Change contaminated clothing immediately if splashed with CCA solutions. Change clothing daily if any incidental contact with the treatment chemical. Wash contaminated clothing separately from other clothing. • Wear impermeable footwear in all working areas. CCA concentrate may penetrate shoes and leather. Delayed burns may result if CCA concentrate penetrates shoes (13).

TABLE 4.2 SAFETY PRECAUTIONS FOR PERSONNEL WORKING WITH CHROMATED COPPER ARSENATE SOLUTIONS (cont'd)

Specific Precautions During CCA Treatment	
Objective: To outline safe workplace practices for each activity during the treatment process.	
Activity	Recommendations
Unloading bulk CCA concentrate	• Wear protective apparel including chemical goggles or face shields, impermeable gauntlets, coveralls, impermeable aprons, and impermeable shoes or boots. • Prohibit foot or vehicle traffic between the point of delivery and the transport vehicle. • Place "DANGER-CCA UNLOADING" signs at each end of the transport vehicle during unloading operations. • Ensure that at least two individuals trained in handling CCA are present at all times during unloading operations (i.e., at least one person other than the truck driver and may include foremen, supervisors, and management employees). • Ensure that all connections are secure and leak tight. • Provide an emergency eyewash and shower in the immediate unloading area.
Unloading CCA drums	• Wear chemical goggles and impermeable gauntlets. • Prohibit foot or vehicle traffic in the delivery area. • Provide adequate equipment for safe, controlled drum handling. • Do not drop drums.
Preparing CCA work solutions	• Wear full face protection, impermeable gauntlets, coveralls, impermeable aprons, and impermeable shoes or boots for all operations involving direct exposure to CCA concentrates. • Thoroughly clean and hose down the work area following solution preparation. • Dispose of debris and empty containers according to Table 8.1. • Thoroughly clean protective equipment after use. (Reuse all rinse waters for work solution preparation.) • Provide an emergency eyewash and shower in the immediate area.
Sampling Procedures	• Wear eye protection and impermeable gloves when sampling CCA solutions (including full face protection with CCA concentrates). • Wear gauntlets when taking borings from freshly-treated wood. • Wash gauntlets, and goggles immediately after completing sampling. • Wash the outside of sample containers immediately after sampling solutions. • Wash hands thoroughly after all sampling operations.
Cleaning cylinders or storage tanks	• Follow all standard precautions for vessel entry (as per provincial health and safety regulations). • Flush vessels as required to establish safe entry conditions, or use an approved self-contained breathing apparatus prior to entry. • Wear NIOSH approved respirators (or breathing apparatus as above), impermeable gauntlets and aprons (rubber or polyethylene coated) and rubber boots during all vessel entries. Select respirators in consultation with CCA suppliers or provincial work safety agency. • Always have a standby attendant present. • Collect and store contaminated waste material in sealed and labeled drums. • Wash all protective equipment immediately after use (reuse all rinse waters for preparing treating solutions). • Shower after completion of cleanup tasks.
Removing treated charges from cylinders	• Wear gauntlets during door openings and when moving loads of freshly-treated wood. • Avoid breathing preservative mists. Wear an approved respirator if airborne concentrations are unknown or, at or above TLVs*.
Handling treated lumber	• Wear impermeable** gloves. • Wear impermeable** gloves, apron and boots if there is potential for getting wet by CCA solution.

TABLE 4.2 SAFETY PRECAUTIONS FOR PERSONNEL WORKING WITH CHROMATED COPPER ARSENATE SOLUTIONS (cont'd)

Specific Precautions During CCA Treatment (cont'd)	
Objective: To outline definitive workplace practices for each activity during the treatment process.	
Activity	Recommendations
Handling and maintaining contaminated equipment	• Thoroughly flush equipment with water prior to handling. (Reuse rinse waters for preparing work solutions.) • Wear an impermeable** apron and boots if there is potential for getting wet by CCA solution.
Welding	Welding can produce toxic fumes. In addition to the precautions for handling and maintaining contaminated equipment: • Obtain the specific approval of the plant supervisor before welding. • Block or disconnect lines from tanks before initiating welding operations. • Completely drain and thoroughly rinse tanks or lines prior to welding operations. • Ensure that equipment is completely dry from cleaning solvent residues. • Wear a respirator or provide effective, local exhaust ventilation during welding to prevent potential exposure to toxic fumes. • Assure good general ventilation of the work area. • Comply with all additional provincial workplace safety requirements (Appendix).

* An initial workplace monitoring program as suggested in Table 8.3 will have determined the need for respirator use. The results of the program are assumed to be indicative of conditions in subsequent facility operations, unless procedural or design changes have occurred.

** Heavy-duty, lined polyvinyl chloride, vinyl coated, neoprene, NBR, or rubber (13).

TABLE 4.3 LEVELS OF CONCERN FOR CHROMATED COPPER ARSENATE EXPOSURE IN THE WORKPLACE

Route of Entry	Basis for Recommendation	Recommendations/Comment
Skin and eye contact	• CCA is corrosive • Chromium can be absorbed through the skin • Arsenic is a potential dermal carcinogen	• Protective measures should be used by for workers in contact with through CCA concentrate (Table 4.2) • Avoid direct contact of skin and eyes with all CCA solutions (13) • Sensitive individuals (see Table 3.7) should take special care to avoid exposure Comment: Current material safety data sheets should always be readily available to workers
Inhalation	ACGIH Threshold Limit Value Time Weighted Averages (TWA): Arsenic* and soluble compounds: 0.5 mg As/m^3 air Copper (dusts and mists): 1.0 mg/m^3 air Chromium (+6) compounds (water soluble) 0.05 mg Cr/m^3 air Arsine: 0.2 mg/m^3 air (0.05 ppm) * U.S. OSHA has set a limit of 0.01 mg As/m^3 of air	• Full face protection and good ventilation should be used during chemical unloading and open mixing operations • Provide respiratory protection, eye protection and good ventilation: - when welding contaminated equipment; - during any activity which might generate arsenic vapours (e.g., from exposure of CCA to reducing agents); and - when CCA mist or spray is present • Self-contained breathing apparatus should be used for fire-fighting activities where CCA is present Comments: - permissible concentrations of arsenic and chromium refers to vapors: both could occur in air as aerosols; - arsenic vapours can be formed from exposure of arsenic salts or CCA to reducing agents; and - current material safety data sheets describing safety precautions should always be readily available to workers.
Ingestion	The literature reports an arsenic lethal dose range of 0.1 to 1 g for adults. The lowest reported lethal dose of 0.1 g (26) is equivalent to 1 g of 50% CCA solution.	• Prevent the ingestion of any quantity of CCA solutions.

Skin and eye contact. Chromated copper arsenate, as such, is not discussed by the ACGIH. With reference to skin and eye contact, the ACGIH provides the following conclusions in its support rationale (36) for TLV levels for individual components of CCA:

- copper salts act as irritants which may produce itchy eczema on skin, and conjunctivitis or ulceration of the eye; and
- hexavalent chromium may cause contact dermatitis, skin ulcers, and may be absorbed through skin to cause kidney damage.

Nonetheless, ACGIH recommended limits for copper, chromium, and arsenic are based only upon "inhalation" TLVs which are discussed later in this section. These limits may not adequately take into account routes of exposure other than inhalation and the ACGIH has suggested that in such cases "biological exposure indices may be useful as a guide to safe exposure" (36).

Inhalation. The ACGIH has defined "Threshold Limit Values" for many substances based on exposure by inhalation and/or by skin exposure. The ACGIH limits for copper, chromium and arsenic are based solely on exposure by inhalation. The TLVs are stipulated by the ACGIH as those "airborne concentrations of substances to which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effects." The TLVs for copper, chromium and arsenic (35) are defined in Table 4.3 with the following provisos of the ACGIH:

- "The limits are intended for use in the practice of industrial hygiene as guidelines for good practices or recommendations in the control of potential health hazards and for no other use" (i.e., proof or disproof of the cause of an existing disease or physical condition).
- "The limits are not fine lines between safe and dangerous concentration".
- "In spite of the fact that serious injury is not believed likely as a result of exposure to the Threshold Limit concentrations, the best practice is to maintain concentrations of all atmospheric contaminants as low as is practical."
- "When two or more hazardous substances, which act upon the same organ system, are present, their combined effect, rather than that of either individually, should be given primary consideration."

Since CCA wood preservation facilities exclusively use CCA water solutions, the limits as defined by the ACGIH would apply primarily to suspended aerosols, dusts, or to gases generated during welding. Generally, aerosols are not generated in CCA facilities

at quantities which would cause worker health problems. Incidents of aerosol exposure would be more probable at improperly maintained facilities (e.g., from leaking seals) or at inadequately designed facilities (e.g., from vacuum pump discharges to work area). Dust generation is most probable during cleaning operations, and the International Labor Organization strongly suggests the use of wet or vacuum methods for cleaning of chromium solution spills, to prevent dispersion as airborne dust.

Ingestion. Oral intake of CCA must be avoided. Ingestion of CCA-containing liquids is unlikely if workers follow the precautions outlined in Table 4.2. Acceptable limits of ingestion are not prescribed by regulation since it is generally expected that any such intake will not occur. Reported fatal single dose levels for components of CCA, include:

- 0.7 g Cr as Cr(+6) assuming a 70 kg body weight (18); and,
- 14 g Cu as Cu(+2). (33)

Oral toxicity values of As(+5) to man are not defined. Reported fatal doses for "arsenic" and "arsenic (+3)" have ranged from 20 to 300 mg (17, 34). The Registry of Toxic Effects(32) suggests that As(+5) is more acutely toxic to rats than As(+3); however, it is known that laboratory animals react to arsenic differently than do humans. An absolute lethal dose to man of As(+5) as used in CCA, therefore, cannot be derived from animal data and remains unknown.

The impact of ingested CCA upon an individual would depend on many factors, such as body weight and initial health of the individual. Without accounting for additive effects and in the absence of arsenic (+5) toxicity data, a calculation based solely on chromium toxicity data indicates that ingestion of as little as 5 g of 50% CCA solution can be potentially fatal to an adult worker.

4.3 Biological Monitoring of Exposed Workers

Routine biological monitoring of workers exposed to CCA can be achieved by various means including:

- determination of arsenic in urine (30); and
- elemental analysis of hair for arsenic, chromium, and copper concentrations (37,38).

It is important that any biological monitoring program be carried out and interpreted by appropriately qualified occupational hygienists or physicians. If there is concern for confidentiality and/or sample handling procedures, it is suggested that these concerns be addressed and resolved by use of a joint management-worker committee.

5 SITE SELECTION

5.1 Purpose

Preliminary assessment of an industrial site involves both an evaluation of technical site characteristics (e.g., hydrogeology, topography and soils) and socio-geographic factors (e.g., land use and availability and proximity to transportation routes). Technical features that should be considered during site selection for a CCA wood preservation facility for the purposes of environmental protection are highlighted in this section. It is recognized that in most cases, certain site characteristics may have constraining technical features. Early recognition of less desirable site features will enable the development of a compensating facility design and subsequently facilitate site approval.

Criteria for site assessment discussed in this section may also indicate the aspects of existing treatment plant facilities that need to be modified or changed to assure protection of human health and the environment.

5.2 Assessment Factors

Use of CCA treatment chemicals at a plant site introduces the potential for contamination of groundwaters and surface waters. The extent of potential contamination is, in turn, dependent on the chemical, physical and biological properties of the treatment chemical, plant design and operating practices as well as site-specific characteristics including: soil type, geology, hydrology, climate, topography and drainage.

Environmentally important site characteristics and how those site characteristics can affect the eventual impact of a chemical release are described in this section. These factors are important in designing features of a wood preservation plant that will:

a) minimize the possibility of off-site contamination via groundwater and surface waters; and
b) minimize chronic on-site contamination to protect worker health during operation and to make decommissioning efforts easier in the event of partial or complete facility closure.

The assessment factors for preliminary site evaluation rely upon readily available information.

5.2.1 Regional Geology. Geologic information about many areas of Canada may be obtained from federal and provincial surveys. Information that should be obtained includes:

- Texture of unconsolidated material - Fine-grained material is more likely to retain chemical contaminants than coarse material.
- Depth to bedrock - Shallow soils imply a limited ability to retain spilled chemicals.
- Aquifer recharge and discharge zones - Potential for hydraulic connections to regional groundwater flow patterns and discharge to sensitive surface waterbodies should be considered.
- Discontinuities such as faults, fissures, joints, fractures - Discontinuities may cause "short-circuiting" of a contaminant plume.

5.2.2 Soils. Soil properties should be assessed to evaluate the potential for leaching and retention of treatment chemical constituents. Physical and chemical characteristics of soil to consider are: depth, permeability, texture, water-holding capacity, shrink-swell potential, chemical properties such as cation exchange capacity (CEC) and anion exchange capacity (AEC). Soil depth and soil types are routinely indicated on soil maps (and often on geology maps). Although the available maps may not indicate the exact soil composition of a small site (e.g., 2 ha), they can be used for preliminary assessment purposes.

In addition to the soil evaluation parameters described, the evaluation should consider that soils with high anion exchange capacities, high levels of iron and aluminum oxides, and/or high levels of calcium compounds will enhance the retention of arsenate and chromate anions. High cation exchange capacity, high clay content, and high organic matter content will enhance the retention of the copper cation.

5.2.3 Geotechnical Description (including subsurface hydrology and water table data). Subsurface hydrogeology can be inferred from regional geologic and soil technical maps and reports. This information is adequate at the preliminary site assessment stage. Site specific hydrologic data will be required if one or more of the following conditions is identified during preconstruction assessment:

a) The site is located over a shallow unconfined aquifer.
b) The site is located over an aquifer used for a potable or irrigation water supply.
c) The aquifer has hydrologic connections with other aquifers in the area and/or regional groundwater flow patterns.

The type and specificity of additional information required will have to be defined in consultation with the appropriate regulatory agency.

5.2.4 Topography. Topographical information is easily obtained from published government maps. In general, steep sites should be avoided due to runoff problems and erosion; however, topography can be modified by facility design. Slope gradients between 1 to 10% should present few problems.

Upland flat and terraced landforms are desirable locations for treatment facilities. Floodplains are acceptable if they lie above the 100-year flood level, otherwise special design provisions must be implemented.

5.2.5 Climate. Climatic variables such as precipitation (form, historical 1-hour and 24-hour maxima, and annual total amount), temperature regime and wind patterns influence both chemical loss during storage of treated wood and leaching in the subsurface. Information for such variables is generally available from Environment Canada. However, definitive criteria are difficult to evaluate for rating climatic influences. Precipitation is an indicator for leaching potential in soils, but this parameter can also be alleviated by selection of sites with soils of low permeability.

5.2.6 Proximity to Sensitive Uses. Sites located adjacent to waterbodies (e.g., lakes, rivers, marine waters) or above aquifers used for drinking or irrigation water supplies, food manufacturing plants and beverage processing plants, should be cautiously considered for use by the wood preservation industry. If such a site is selected, then exceptional design requirements and operational and monitoring procedures will be required. Desirable minimal distances of CCA facilities from sensitive waterbodies depend on factors such as: soil type, regional geology, topography and climate. If a selected site is adjacent to waterbodies used by migratory fish, then the intended plans will have to be reviewed by Environment Canada and Fisheries and Oceans Canada.

5.3 Selection Procedures

Following a compilation of data for various potential sites, the developer is then faced with a decision-making process for site selection.

Site selection on the basis of environmental protection will also depend on economic evaluations. Based solely on economic factors, a less environmentally acceptable site might be most desirable. However, recognition of those less acceptable environmental features will suggest the need for additional design and operational

considerations which must be added to the cost of locating a wood preservation facility at the site.

All the technical site factors previously described should be considered in the assessment. Various techniques may be used for the selection of sites of the basis of environmental acceptability (e.g., criteria ranking, matrices, decision trees, or mathematical modelling). Assessment techniques among regulatory agencies may vary considerably, necessitating consultation with local and provincial regulatory agencies, as well as federal agencies if required.

Examples of site characteristics requiring very little environmental mitigation as well as those requiring significant environmental mitigation are listed in Table 5.1. Deviations from the most desirable characteristics, suggest various degrees of mitigating design/operational measures:

- Slight mitigating design/operational measures are those site features which are well suited to the location of a treatment facility. The site will require only low cost maintenance and monitoring to assure environmental protection.
- Moderate mitigating design/operational measures present more of a problem to environmental protection, but in general are acceptable with appropriate design modifications and thorough monitoring efforts.
- Severe degree of mitigating design/operational measures will require special innovative designs which may partially overcome these constraints. Design costs are likely to be high. Extensive monitoring efforts will be required adding to the cost of locating a treatment facility at such a site.
- Very severe mitigating/operational measures pose such a threat to environmental protection that modifications of the constrainting factors may be economically impractical.

Site features and the extreme degrees of mitigating design/operational measures as shown in Table 5.1 were selected on the basis of siting criteria suggested by various investigators (39,40). The site features and their possible constraints should be considered during preliminary site assessment. The methodology for comparative assessment of sites, and the selection of a site should be made in consultation with the appropriate regulatory and planning agencies.

TABLE 5.1 SITE FEATURES THAT AFFECT THE DESIGN OF A CHROMATED COPPER ARSENATE PRESSURE TREATMENT FACILITY

	Suggested Degree of Mitigating Design/Operational Measures	
Site Features	Slight	Severe
Soil Texture	loam, silt loam, silty clay loam, clay loam, sandy clay	gravel
Permeability (cm/h)	<0.5	>50
Topography (% slope)	0-9	>30
Soil Depth to Bedrock (cm)	>200	<60
Depth to Ground-water (cm)	>200	<60
Flooding	None	Frequent (>once/20 years)
Drainage	Slow	Very rapid
Distance to surface waterbody (lake or river)	Depends on interaction with other site features (e.g., permeability of soil)	Directly adjacent

6 DESIGN

Approaches for the design and operation of CCA-wood preservation facilities for protection of workers and the environment from harmful exposure to CCA are suggested in this section. Recommendations are based on "best practices" currently in use. The design aspects are intended to achieve the following general objectives:

a) to prevent or reduce direct contact of personnel with CCA-wood preservative chemicals;
b) to reduce releases of CCA to the environment to the greatest degree possible by providing secure containment of CCA-solutions; and
c) to enable prompt response and effective corrective measures to assure worker safety and environmental protection after abnormal events (e.g., tank rupture).

Figure 6.1 presents an overview of the subject areas covered by the design objectives.

Means of achieving these design objectives at CCA-wood preservation facilities are presented in Tables 6.1 to 6.7. The recommended design features in these tables may not be the sole options available to attain the stated objectives. Alternative approaches may exist which would be equally effective or more suitable to site-specific conditions. If a more suitable alternative approach can be demonstrated to be equally effective in attaining the desired objective, an appropriate design feature that has not been included in the recommendations could be used at a specific facility.

Figure 6.1 is based on the handling and use of CCA at wood preservation facilities, and is cross-referenced to indicate the appropriate table for each subject area. It is intended that all new wood preservation facilities be designed to achieve the specific objectives listed in Tables 6.1 to 6.7. Existing facilities should review their abilities to comply with the objectives and gaps, if present, should be addressed using the suggested features or alternative but similarly effective features.

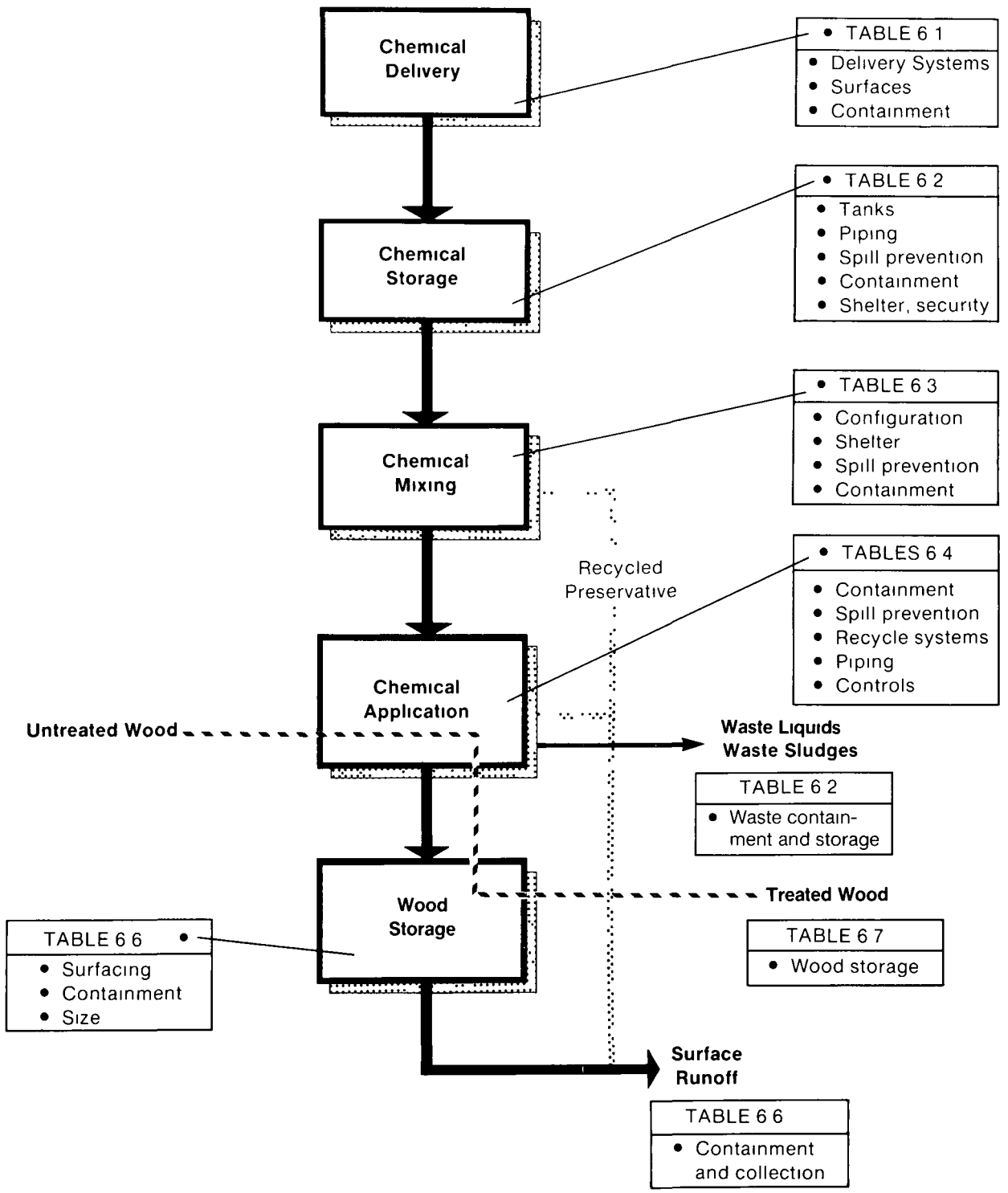

FIGURE 6.1 OVERVIEW OF DESIGN RECOMMENDATIONS FOR CCA FACILITIES

TABLE 6.1 RECOMMENDED DESIGN FEATURES FOR CHEMICAL DELIVERY AREAS

Delivery Format	Design Feature	Recommendation
Bulk Liquid ° CCA concentrate (delivered by Truck, or Rail Tanker)	**Objective:** To provide an off-loading area that enhances spill prevention and containment.	
	Off-loading Pad	• Provide an impervious pad which drains to a containment area. • Design to prevent settling or cracking of the pad.
	Surfaces	• Seal surfaces to enhance cleanability.
	Joints	• Provide liquid tight joints (if applicable).
	Drip Control	• Provide local drip catchment to minimize contamination of the containment system. • Provide for wash down of minor drips or spills with recovery of washwater (or infiltrating precipitation) for reuse.
	Access	• Locate off-loading area away from high yard traffic routes. • Restrict access during delivery.
	Delivery System Piping	• Install permanent delivery systems with rigid, accessible, visible delivery lines (not buried). • Protect delivery systems from mechanical damage. • Provide mechanically secure connections between the tanker and delivery hookup point. • Clearly identify all delivery lines. • Use top delivery to concentrate storage tanks.
	Backflow Prevention	• Install backflow preventors on delivery lines.
	Security	• Install locking valves on delivery lines; restrict access.
	Overflow Prevention	• Provide maximum visibility of the delivery system from the point of off-loading. • If visibility is limited, use audible alarms to detect tank overflow during delivery.
	Emergency Response	• Provide accessible storage for spill response equipment, absorbant (lime) and personnel protection equipment. • Install a phone or manual alarm switch near the off-loading area.
Containerized Liquid ° CCA concentrate (drums)	**Objective:** To provide an off-loading area that enhances spill prevention and containment.	
	Off-loading pad/Shelter **Containment**	• Provide an off-loading area near the storage area. • Ensure containment for a worst event spill (e.g., 4 drums or 1 pallet load).
	Surfaces	• Select an off-loading site with low surface permeability or provide a sealed surface.
	Container Handling	• Design for safe manipulation of containers.
	Emergency Response	• As for bulk off-loading areas.

TABLE 6.2 RECOMMENDED DESIGN FEATURES FOR CHEMICAL STORAGE AREAS

Storage Format	Design Feature	Recommendation
Bulk CCA Liquids ° Concentrates ° Working solutions ° Contaminated surface runoff ° Drip return	**Objectives:**	• To provide positive spill prevention features. • To provide spill containment capability for 150% of the largest on-site bulk storage tank (in multiple tank containment areas) or 100% plus 15-cm additional containing wall for single tanks in isolated containment.
	Tanks	• Engineer materials of construction, dimensions in consultation with chemical suppliers. • Provide tanks in sound physical condition, with no rust or serious physical damage. • Mount tanks on containment pad surfaces. • Mount tanks in stable positions and anchor securely. • Locate tanks within a dyked area. • Shelter from the weather and protect from mechanical impact, vandalism. • Protect against freezing (as required for external tanks). • Provide inspection points for detecting leaks in insulated tanks. • Vent tanks to the exterior (never vent to the workplace); - protect vents against release of entrained liquids or overflow (e.g., direct overflow piping to sumps or containment areas).
	Spill Containment	• Install, impervious, structurally sound floors. • Provide structurally sound dykes, seal all joints. • Provide a dyked containment volume • Engineer containment for long-term integrity (leak-proof for infiltration and exfiltration). • Consider providing means for detecting subsurface leakage from containment systems (where warranted by site-specific conditions; e.g., where the site overlays sensitive groundwater systems). • Provide for directing all spills, washes and infiltrating water to tankage (contaminated liquids must be treated to applicable limit before discharge). • Provide effective capability for transferring spilled liquids from containment areas. • Provide surface drainage to prevent pooling of minor spills and washdowns. • Design to minimize tracking of fluids from containment surfaces.

TABLE 6.2 RECOMMENDED DESIGN FEATURES FOR CHEMICAL STORAGE AREAS (Cont'd)

Storage Format	Design Feature	Recommendation
Bulk CCA Liquids (cont'd) ° Concentrates ° Working solutions ° Contaminated surface runoff ° Drip return	**Piping**	• Design according to applicable codes. • Use rigid, permanent piping throughout. • Provide visible, accessible piping with a simple layout (to facilitate early leak detection and easy repair). • Maximize above floor piping or open containment channels for subgrade piping. • Properly engineer piping systems for material, dimensions (do not use brass or aluminum fittings). • Identify piping systems and valves (e.g., by labelling and/or colour coding). • Provide mechanical impact protection for vulnerable exposed piping. • Provide freezing protection for piping (as required).
	Drip containment	• Provide local collection/containment (isolated from larger containment areas) at drip points (e.g., under pumps, valves, flanges, etc.).
	Spill Prevention/ Detection	• Install reliable, accurate level indicators on all tanks. • Provide mechanical impact protection on glass sight gauges (including provision for containing and stopping release from broken gauge tubes). • Install shut-off valves on all rupturable lines and tank gauges. • Install permanent overflow piping from tanks directly to a definitive contained area. • Install reliable, independent high-level alarms on tanks (visual and audible alarm). • Interlock high-level alarms to tank feed pumps (auto shut-off). • Consider installation of 24-hour monitoring alarms (with remote) for immediate detection of major spills. • Install manual alarm buttons (call for help) at potential major spill points.
	Backflow prevention	• Install backflow preventors on all waterlines at plant entry. • Use top entry of waterlines to tanks (as secondary backflow protection). • Waterlines must comply with all applicable local codes. • Design to protect against inadvertent transfers to/ from interconnected tanks.

TABLE 6.2 RECOMMENDED DESIGN FEATURES FOR CHEMICAL STORAGE AREAS (Cont'd)

Storage Format	Design Feature	Recommendation
Bulk CCA Liquids (cont'd) ° Concentrates ° Working solutions ° Contaminated surface runoff ° Drip return	**Shelter**	• The preferred location for CCA tankage (all solutions) is in an interior centralized process area. • If possible, roof exterior tank farms to minimize the quantity of infiltrating precipitation.
	Security	• Provide security precautions to prevent vandalism or access by unauthorized persons.
	Emergency Response	• Provide accessible storage for spill response equipment, absorbants (lime for concentrate; sawdust for work solutions, drip return, runoff) and personnel protection equipment. • Provide appropriate measures for rapid, effective fire control with containment of liquid fire-fighting residues and treatment to required limits before discharge. • Install a phone and manual alarm switch near the off-loading area.
Drummed Liquids ° CCA concentrate	**Objective:** To provide secure storage with containment for the worst-event spill.	
	Location	• Provide safe, easy access to the mixing area
	Shelter	• Provide storage in an enclosed, secure area, segregated from other chemicals
	Ventilation	• Provide adequate ventilation for both routine and also emergency requirements
	Containment	• Store in a paved, curbed or dyked area with no floor drains - provide containment capacity for the worst-event spill (no less than 4 drums) - provide for effective cleanup (including recovery of washdown water) if a spill were to occur
	Surfaces	• Seal surfaces and joints to facilitate cleanability and surface impermeability
	Emergency response	• Provide accessible storage for spill response equipment, absorbants and personnel protection equipment
Drummed Wastes ° Filter cartridges ° Sludges ° Contaminated debris	**Shelter/Containment**	• Provide a paved area for storing all drummed wastes pending removal to approved disposal (Section 8.1) • Provide a covered area or tarps for drummed wastes

TABLE 6.3 RECOMMENDED DESIGN FEATURES FOR CHEMICAL MIXING SYSTEMS

Chemical Form	Design Feature	Recommendation
CCA ° Bulk concentrate	**Objectives:**	• To provide a mixing system with effective spill prevention features. • To provide a mixing system which minimizes worker contact with CCA.
	Configuration	• Use permanent, closed systems (rigidly piped, tank to tank).
	Location/Shelter (mixing and working solution tanks)	• Locate in an enclosed, heated area, particularly if sub-freezing temperatures are encountered during operation.
	Spill Prevention	• Install high-level alarms to prevent mixing tank overflow. • Interlock high-level alarms to tank feed pumps.
	Spill Containment	• Provide all applicable features for "spill containment of bulk liquids" (Chemical Storage Area Table 6.2).
	Drip Containment	• Provide local drip collection at all potential drip points.
	Splash Protection	• Discourage open transfer operations, if unavoidable, provide reliable splash protection.
	Emergency Response	• Provide features described in "Emergency Response" (Table 6.1).
CCA ° Drummed concentrate	**Location/Shelter** (mixing and working solution tanks)	• Locate in an enclosed area. • Heat the area if operations occur in sub-freezing weather.
	Configuration (drum pumping)	• Provide a paved, contained pumping pad with mechanical securement of open drums (during pumping) to prevent tipping or spillage. • Provide for controlled fluid transfer (for example, by displacement with air or water via leak proof bung-mounted concentric inlet/outlet piping or, by use of peristaltic or positive displacement pumps). • Provide reliable splash protection for all operations involving open transfers.
	Configuration (balance of system)	• Use permanent, closed systems (rigidly piped, tank to tank).

TABLE 6.4 RECOMMENDED DESIGN FEATURES FOR TREATMENT PROCESS SYSTEMS: GENERAL REQUIREMENTS

Design Feature	Recommendation
Objectives: • To minimize and contain all releases of CCA. • To recover and recycle releases that occur.	
Spill Containment	• Provide spill containment capability for 150% of the largest on-site bulk storage tank or cylinder (in multiple vessel containment areas) or 100% plus 15-cm additional containing wall for single vessels in isolated containment. • Locate treatment cylinders and process tanks in an area with: - continuous, structurally sound paved floors or, slabs or sections with sealed joints - sealed surfaces for cleanability and impermeability - reinforced dyke walls and sealed joints - graded surfaces for ready drainage of wetted surfaces - walkway grates (or alternative design) to minimize worker exposure and prevent tracking of chemicals from containment areas • Engineer containment for long-term integrity (leak-proof for infiltration and exfiltration). • Provide permanent, isolated drainage/transfer systems to direct all spills, washes and infiltrating water to tankage. Treat contaminated liquids to applicable limits before discharge. • Isolate control and transfer equipment to avoid damage from spilled liquids in containment areas.
Process Control Area	• Segregate the operator control area from retort and tank spill containment areas. • Locate the process control area for maximum visibility of treatment systems.
Process Emissions to Air	• Provide control equipment for any air emissions vented to the interior including tank and any emissions subject to environmental controls. - install additional control equipment as required to comply with applicable air emission limits (see Section 8.1.5) - provide traps to remove entrained liquids
Fire Controls	• Provide fire controls as decided on site-specific basis in consultation with the local fire department.

TABLE 6.5 RECOMMENDED DESIGN FEATURES FOR TREATMENT PROCESS SYSTEMS

Design Feature	Recommendation
Objectives:	• To provide fail-safe operation of the treatment system. • To minimize the potential for CCA spills.
Treating Cylinder	• Treatment cylinder and pressurized components must meet all pressure vessel certifications required by the provincial ministry responsible for such certification. • Install an effective protection device to prevent door openings when the cylinder is pressurized or filled with preservative. - provide independent backup protection - install independent indication/alarm/interlocks between the cylinder door and the control point (where the door is not visible from the control point) • Design to facilitate drainage of excess preservative.
Piping and Recycle Systems	• Design an overall system which is effective at containing and recycling all chemicals with minimum potential for release and dispersal and minimum infiltration of water. • Select and install piping as per Table 6.2.
Sumps	• Provide leakproof design (e.g., impermeable surfaces, sealed joints). • Provide overflow protection if sump is not in containment area (e.g., install independent high-level alarms).
Process Controls	• Design for simple, unambiguous operation (regardless of the degree of automation). • Establish a clear relationship betweeen process controls and process functions in order to minimize operator error.

TABLE 6.6 RECOMMENDED DESIGN FEATURES FOR FRESHLY TREATED WOOD DRIP AREAS

Design Feature	Recommendation
Objective:	• To minimize losses of preservative chemicals from treated wood by: - providing proper conditions for preservative fixation in freshly-treated wood, and - controlling the generation and disposal of contaminated runoff waters.
General Design	• Integrate consideration of design requirements for: - shelter from precipitation, dust, debris - efficient drip and runoff collection and containment - surface drainage and return of fluids to process with minimum dispersal from tracking by personnel and vehicles
Fixation Time*	• Provide for sufficient storage area to hold all freshly-treated wood for a minimum of 48 hours under cover or 96 hours in specially designated uncovered area, with assured recovery of dripped material and precipitation.
Containment	• Provide for paved charge unloading and drip areas, sloped to enable collection and storage of all runoff and infiltrating precipitation (for reuse or controlled discharge under terms of existing regulatory standards). • Where storage of runoff waters would be difficult, roofing would be a consideration.

* Fixation is temperature sensitive and can require from several hours at 45°C to two months at 5°C. At 21°C, 95% is fixed after 4 days (14).

TABLE 6.7 RECOMMENDED DESIGN FEATURES FOR DRY TREATED WOOD STORAGE AREAS

Design Feature	Recommendation
Objective:	• To minimize and control releases of contaminated surface waters from treated wood storage areas.
Storage Areas	• Where practical, store all dry-treated wood under roof or wrap. • Segregate treated wood storage areas from others and segregate contaminated from uncontaminated runoff water to minimize the need for water treatment and/or recycling. • Locate unsurfaced ground storage areas away from surface waterbodies. • Routinely monitor contaminant levels in storage area runoff.

7 OPERATION

In addition to the design objectives described in Section 6, a CCA facility should develop operating procedures to protect both workers and the environment from harmful exposure to CCA solutions. The operating procedures would:

a) minimize direct contact of personnel with wood-preserving chemicals;
b) minimize releases of wood-preserving chemicals to the environment; and
c) facilitate clear and accurate definition of responsibility and action when emergency response is required.

Recommended operating practices are presented in Tables 7.1 to 7.4 and include:

- General practices (Table 7.1),
- Procedures for handling and storing wood preservation chemicals (Table 7.2),
- Practices for operating process systems (Table 7.3), and
- Practices for maintenance, cleanout, and shutdown of preservation systems (Table 7.4).

The recommendations provided in these tables may not be the sole options available to attain the objectives. Alternative approaches may be equally effective or more suitable in view of site-specific conditions. When programs are developed for a particular facility, the specific recommendations may be modified if it can be demonstrated that an alternative approach, more suitable to plant-specific conditions, would be equally effective in attaining the desired objective.

Consistent with the stated intent of this document, it is recommended that all existing and new wood preservation facilities meet the objectives outlined in Tables 7.1 to 7.4, by implementing the recommended practices or their equivalents. Detailed operating procedures for each facility should be incorporated into a written operations manual that is available to all affected personnel. Responsibility and accountability for implementing procedures should be clearly assigned to supervisory personnel and to workers.

TABLE 7.1 RECOMMENDED GENERAL PRACTICES FOR OPERATING CHROMATED COPPER ARSENATE PRESSURE TREATMENT FACILITIES

Operation	Recommendation
Personnel	**Objective:** To enhance worker protection by providing education and medical surveillance.
	• Train all foremen, on-scene supervisors, operators, and handlers in good work practices.
	• Provide pre-employment medical check-up and annual on-going medical surveillance (see Section 4).
	• Provide periodic review and update of education and training.
Procedures	**Objective:** To assure that worker responsibilities are well understood, and that site-specific procedures are available in hardcopy for reference.
	• Prepare (and have readily available) explicit written instructions for all aspects of chemical use, facility operation, maintenance and emergency response.
	• Identify and communicate precautions for all other on-site handlers of treated wood (including quality control personnel, sorters, and transporters).
Signing	**Objective:** To assure clear and accurate signing in all wood preservation use areas.
	• Identify the contents of all tanks.
	• Identify the function of each tank (e.g., "concentrate tank", "work tank").
	• Prominently display personnel safety precautions and first aid procedures.
	• Prominently display emergency response procedures.
	• Prominently display emergency telephone numbers for medical aid, facility management, local environmental control agencies.
Personal Hygiene and Safety Precautions	• Follow precautions outlined in Section 4 (Table 4.2).
Housekeeping	**Objective:** To maintain a clean, orderly site.
	• Define and practice regular housekeeping standards (suggest daily). - contain all contaminated debris - do not accumulate empty drums and containers (provide secure designated storage or dispose of according to Table 8.1)
	• Visually inspect for, record and report leaks routinely as defined in the facility's procedure manual.
	• Contain and repair all leaks.

TABLE 7.1 RECOMMENDED GENERAL PRACTICES FOR OPERATING CHROMATED COPPER ARSENATE PRESSURE TREATMENT FACILITIES (Cont'd)

Operation	Recommendation
Record Keeping	**Objective:** • To provide a secondary level of control for chemical losses. • To enable a rapid assessment of potential hazards, in the event of a catastrophic incident (e.g., tank rupture, fire).
	• Maintain accurate daily records for: - chemical delivery, use and inventory - equipment condition and maintenance • Record and compare bulk tank volumes before and after facility shutdowns in excess of two days. - if changes in volume are apparent, check for tank leaks and/or irregular practices • At some CCA facilities it is a practice to compare actual versus estimated chemical retention by wood. (If actual exceeds estimated quantities, efforts are made to determine if leaks or poor operating practices exist.)
Spill Response	**Objective:** Maintain a state of readiness to implement the plan in case of a chemical spill.
	• Establish a spill contingency plan (Section 10).
Fire Fighting	**Objective:** To maintain a state of readiness in case of fire emergency.
	• Establish a fire contingency plan (Section 10) and undertake action to maintain a state of readiness to implement the plan in case of fire emergency (including routine checks of the pressure and proper function of firefighting equipment and drills with all affected personnel). • Liaise with the local fire department, with regard to chemicals in storage and use, and emergency procedures. • When a fire alarm call is made, notify firefighters of chemical quantities in stock and verify the status quo of storage locations. • Require self-contained breathing apparatus for all personnel exposed to smoke (Only trained fire-fighting personnel should be allowed at the fire scene). • Make advance preparation to contain and properly dispose of contaminated fire residues, to the greatest degree possible. - runoff water, soot and ash from fire areas are presumed to be contaminated and provision should be made to contain as much as possible. - dispose of contaminated firefighting waters as "contaminated runoff" (Table 8.1). - dispose of solid treated wood fire residues as "contaminated solid wastes" (Table 8.1).

TABLE 7.2 RECOMMENDED OPERATING PRACTICES FOR CHEMICAL HANDLING AND STORAGE

Operation	Recommendation
Unloading Chemicals	**Objective:** To assure that unloading of CCA concentrate occurs in a safe manner.
	• Assure that the delivery of preservation chemicals is undertaken by personnel who are trained in emergency response procedures (as required by Transport of Dangerous Goods Regulations (TDGR)). • Assure that personnel with recognized first aid training are present during the unloading procedure (personnel can include the truck driver). • Assure that ready access to emergency advice and aid is available during all chemical unloading periods. • Restrict access to the unloading area during chemical transfer operations. Prohibit nearby pedestrian or vehicle traffic.
Preparation of Wood Preservation Solutions	**Objective:** To assure worker safety during handling of CCA concentrate and work solutions.
	• Follow the personnel safety precautions for all procedures (Table 4.2) • Avoid inhalation, ingestion or skin or eye contact with CCA concentrate or work solutions. • Thoroughly rinse empty CCA concentrate containers (if applicable) - recycle rinse water - return containers to suppliers or reuse sound containers for storage of wastes - dispose of unusable containers only in landfills specifically approved for such disposal (Section 8.1)
Storage of Wood Preservation Chemicals	**Objective:** To assure that CCA solutions are safely stored.
	• Assign responsibility for storage areas to trained personnel. • Label storage tanks with the identification of contents by chemical name, type of solution, and concentration (e.g., CCA concentrate (50%), CCA Work Solution (1 to 4%)). • Place chemical identity placards, fire or spill emergency response procedures, personnel safety precautions and first aid procedures at storage room entrances. • Check and maintain the integrity of storage tanks and storage containers. - clean up all leaks or spills and implement remedial actions immediately • Prevent contact of CCA concentrate with reducing agents (including aluminum, brass, and zinc) or with organic combustibles (i.e., gasoline, kerosine, oil). • Provide secure storage areas; restrict access to authorized personnel only.

TABLE 7.3 RECOMMENDED OPERATING PRACTICES FOR PROCESS SYSTEMS

Operation	Recommendation
Routine Checks	**Objective:** *To define procedural practices which will enhance environmental and worker safety.*
Work Solutions	• Regularly check and record quantities of treatment solution in storage.
	• Test and record solution strengths at regular intervals.
All Process Components	• Visually check the complete system for leaks.
	- take immediate action to stop leaks
	• Check sludge levels in retorts.
	- clean out as required, in accordance with facility policy - observe personnel safety precautions (see Table 4.2)
Tank Vents	• Test tank vents to assure the absence of blockage (suggest once/month).
Charges	• Secure loads to avoid uncontrolled floating.
	• Stack loads to allow good drainage of preservative from all wood surfaces after treatment.
Treating Cylinder	• Check door seals for damage.
	- replace door seals at regular intervals or as required if damaged
	• Check cylinder doors for proper seal after loading charges.
	- ensure that all bolts on doors are securely fastened or that the hydraulic collar has moved to its regular endpoint
Recycle Systems	• Check filters.
	- clean or replace if necessary
Trams	• Clean soil and debris from trams to prevent contamination of the preservative.
	• Thoroughly clean trams if alternative preservative treatments are used.
Checks During Treating	**Objective:** To monitor the treatment system to quickly identify potential/actual problems.
System Integrity	• Closely monitor process systems for leaks during initial stages of treatment.
	• Check for leaks or abnormal conditions throughout pressurized system.
	• Compare recording instrument readings with indicating gauges and thermometers.
	• Note malfunctions of recording devices, thermometers, gauges (including level floats) and arrange for prompt repairs.
	• Carefully observe pressures during treatment to make certain that maximum limits are not exceeded (maintain records of treatment cycles, tank gauge readings and chemical consumption).
	• Define (in writing) operator actions for abnormal situations of concern (e.g. response to equipment breakdown).

TABLE 7.3 RECOMMENDED OPERATING PRACTICES FOR PROCESS SYSTEMS (Cont'd)

Operation	Recommendation
Post-treating Checks	**Objective:** To prevent worker contact with treatment solution and with freshly charged loads.
Retort Opening	• Ensure that retorts cannot be opened when liquid and/or pressure remains • Avoid breathing preservative mists. If airborne concentrations are unknown or, at or above TLVs, wear an approved respirator. • Wear goggles during retort door openings.
Charge Removal	• Wear impermeable gauntlets during handling of freshly treated charges. • Pull charges only when the superficial excess preservative has sufficiently drained.
Load Jams	• Follow standard regulatory safety procedures for tank entry. • Do not enter retorts until purged with fresh air. - if retort TLV levels exceed regulatory values or the concentration is unknown, then the attendant must wear a self-contained full-face respirator mask, impermeable coveralls, boots and gauntlets - if TLV levels are less than regulatory limits, wear NIOSH approved respirator, impermeable coveralls, rubber boots and gauntlets (select respirator in consultation with CCA supplier or provincial labor agency) • Assure presence of and constant communication with a standby attendant. • Shower immediately after tank entry.

TABLE 7.4 RECOMMENDED OPERATING PRACTICES FOR MAINTENANCE, CLEANOUT AND SHUTDOWN OF TREATMENT SYSTEMS

Operation	Recommendation
Equipment Maintenance	**Objective:** To assure that equipment is maintained in a manner that will minimize releases of CCA solution and minimize worker exposure to CCA and its by products.
	• Maintain all equipment in good operating condition. • Prepare explicit written maintenance procedures with assigned responsibility and accountability. • Follow all personnel safety precautions during maintenance procedures (Table 4.2). • Drain and/or clean wood preservation chemicals from equipment prior to maintenance. - Equipment should be flushed thoroughly with water, with reuse of the water for work solution preparation. • Use extreme caution if contaminated equipment must be welded (toxic fumes can be generated). - Thoroughly clean surfaces to be welded. - Wear an approved belt-mounted respirator when welding arsenicals. - Provide good ventilation in the work area. - Contain all sparks and remove flammable materials from the repair area.
Cleanout	**Objective:** • To prevent accumulation of CCA solutions and sludges within the treatment system. • To assure worker safety during clean out operations.
	• Observe personnel safety precautions during all procedures (Table 4.2). • Wash down drip pads at regular intervals to prevent accumulation of CCA. (The washdown frequency should be determined by site-specific factors including the probability of worker exposure, vehicle traffic, and washdown by rain. - reuse wash water for work solution preparation • Routinely inspect sludge levels in storage and mix tanks and cleanout if required. determine sludge levels of concern (requiring removal) in consultation with CCA suppliers. - during cleanup, inspect gauge floats or similar equipment within tanks • Routinely inspect treatment cylinders for sludge accumulation and clean if required. - Purge cylinders with fresh air sufficiently to permit entry. - If airborne concentrations are unknown, at, or above TLVs, the attendant must wear self-contained breathing apparatus, gloves, rubber boots and impermeable coveralls. - A standby attendant must always be present and continuous communication must be provided. - Follow standard safety procedures for entry of confined spaces. - Prevent skin contact with sludges. - Remove sludges with equipment used only for cleanout purposes. - Collect, drain, and store contaminated material in sealed drums pending disposal (Table 8.1). - The attendant should shower immediately after cleaning retorts or tanks.

TABLE 7.4 RECOMMENDED OPERATING PRACTICES FOR MAINTENANCE, CLEANOUT AND SHUTDOWN OF TREATMENT SYSTEMS (Cont'd)

Operation	Recommendation
Alarms	• Test all alarms and safety devices at regular intervals (or as specified by the manufacturer).
Long-term Shutdown	**Objective:** To assure orderly shutdown prior to long-term closure.
	• Thoroughly clean all equipment which has been in contact with waterborne solutions.
	• Collect all wash waters generated by cleanup operations (Table 8.1).
	• Hold solutions in closed tanks for prolonged shutdown. - Drain all open tanks or sumps. - Assure that temperatures in storage areas are above freezing levels or provide adequate freezing protection for all stored liquids.
	• In case of permanent shutdown, reuse of treatment solutions at another facility is preferred to disposal.

8 PROCESS EMISSIONS

8.1 Control, Treatment, and Disposal

Potential process emission sources from CCA-wood preservation facilities are described in Section 2.2 and Figure 2.3 of this document. The main categories of process wastes or emissions which may be encountered at CCA facilities, and recommended disposal methods are presented in Table 8.1.

8.1.1 Liquids Containing CCA.

Liquid Process Wastes - Liquid process wastes (i.e., >1% total oxides) are not normally discharged from CCA plants. Liquid solutions (such as drips and washwaters) containing CCA are routinely collected and reused as make-up in preparing new treatment solutions. If unusual circumstances (such as prolonged plant shutdown) prevent on-site reuse, transport to another CCA facility (for reuse) should be arranged and disposal should be considered only as a last alternative.

If disposal is unavoidable, specific approval must be obtained from the appropriate regulatory agency. If no suitable means of disposal are readily available, then the solutions should be sealed in leakproof metal containers, labelled and stored in a secure area.

Contaminated Storm Runoff - Contaminated storm runoff should be minimized. Various approaches can be used including: assurance of proper final vacuum to remove any excess CCA solution from treated wood; use of roofed areas for treated product storage; assurance of proper fixation times prior to storage in the open environment; and, containment and process use of storm runoff waters. In areas of high rainfall, complete containment may not be economically feasible. If the release of CCA-contaminated runoff is required, guidance (and possibly specific approval) should be obtained from the appropriate provincial environmental regulatory agency. Control specifications may depend on factors such as the volume and frequency of the discharge and the sensitivity of the receiving environment. The discharge of CCA-contaminated runoff into waters inhabited by fish is subject to the provisions of Section 33(2) of the Federal *Fisheries Act*, because CCA is considered to be a deleterious substance in this case (Appendix).

8.1.2 Solids with High CCA Concentrations. For the purposes of this document, solids with "high CCA concentrations" are defined as those which include sludges from sumps and cylinders, and disposable cartridge filters which are used to filter recycled

TABLE 8.1 RECOMMENDED DISPOSAL PRACTICES FOR WASTES CONTAMINATED WITH CHROMATED COPPER ARSENATE

Waste Category	Examples	Recommendation
Liquid CCA Solutions	• CCA concentrates CCA work solutions • Drips from freshly-treated lumber. • Wash waters.	• Reuse as make-up for work solutions standard practice at CCA plants).
Contaminated Solid Wastes	• Debris and bottom sludge from storage tanks and sumps. • Debris and sludges from recycle filters. • Any wood waste or wood debris which has contacted CCA concentrate.	• Drain, drum and dispose of in a secure chemical landfill with prior approval of the regulatory agency. • Do not burn CCA-contaminated wastes toxic gases may be formed).
Miscellaneous Solid Wastes	• Empty concentrate drums. • Scraps, cuttings and shavings from CCA treated lumber. • Solid fire residues.	• Rinse thoroughly and dispose of in designated sanitary landfills subject to approval by the regulatory agency. • Dispose of in sanitary landfills (subject to approval by the provincial regulatory agency).
Contaminated Storm Runoff	• Any storm runoff or contaminated liquid discharge which contains arsenic at concentrations exceeding 0.5 mg/L or whose discharge results in concentrations of arsenic in the receiving environment exceeding 0.05 mg/L or whose discharge results in concentrations of copper in the receiving environment exceeding 0.005 mg/L.	• Prevent or minimize contamination of storm runoff. • Contain and reuse contaminated runoff as make-up for work solutions (to the greatest possible extent). • Monitor surface water discharges (in consultation with the provincial regulatory agency to assess contaminant concentrations.
Fire-fighting Water Runoff	• As above (contaminated storm runoff).	• Contain and reuse contaminated runoff as make-up for work solutions (to the greatest possible extent). • If reuse is not practical, consult with the provincial regulatory agency to determine acceptable disposal.

waters. Recovery of the components (copper, chromium, arsenic) represents an ideal option which is not commercially feasible in Canada at this time. The preferred means of disposal for CCA-contaminated sludges and cartridge filters is solidification and burial in an approved, secure (hydrogeologically isolated) chemical landfill. It is the responsibility of the waste generator to obtain and comply with approvals required by the jurisdiction in which the disposal site/facility is located.

Solids with high concentrations of CCA should be drained and stored in leakproof containers while awaiting disposal. Large quantities of highly contaminated solids should be stored in a specifically designed area which is curbed and lined with impermeable material. The area should be roofed or covered by a plastic leakproof tarpaulin to protect the wastes from precipitation. Any seepage or leachate generated at the site should be contained.

Incineration of CCA-contaminated materials is not recommended because of formation of toxic combustion by-products.

8.1.3 Miscellaneous Solid Wastes. Miscellaneous solid wastes (e.g., empty concentrate drums, cuttings from CCA-treated lumber) from CCA-wood preservative plants may be disposed at designated sanitary landfills as approved by the provincial regulatory agency. Chromated copper arsenate concentrate drums should be rinsed with water prior to disposal, and the rinse water should be used for the preparation of working solutions.

8.1.4 Air Emissions. Air emissions at CCA facilities are normally localized; effects, if any, would be restricted to workers at the facilities. Air emissions from CCA facilities include:

- exhaust from kilns,
- exhaust from tank vents,
- mists from vacuum pump discharge, and
- mists from opening of retort cylinder doors.

Monitoring of mists (8) in the vicinity of several CCA retort cylinder door openings has shown that at the studied sites arsenic, chromium and copper concentrations were below published ACGIH Threshold Limit Values (34). Emissions from vacuum pump discharges have not been evaluated. However, evidence of CCA releases from such discharges were reported in an Environment Canada study (7). Some facilities discharge vacuum pumps through simple traps to condense and collect emissions (7).

A study on air emissions from kilns treating CCA-impregnated wood indicated that releases of chromium, copper, and arsenic were frequently below detection limits (41).

8.2 Emission and Site Monitoring

Site monitoring and assessment is required at CCA facilities, in accordance with the design and operating objectives described in this document, to verify that wood preservative chemicals are being properly managed at the site and to ensure environmental and worker health protection. Furthermore, archiving of the assessment records will provide an orderly evaluation of site decommissioning activities, if plant shutdown does occur.

Environmental monitoring requirements for most CCA-facilities would normally be developed in consultation with the appropriate provincial environmental regulatory agency. Additional consultation with Environment Canada would be required if the facilities were to effect federally managed resources (e.g., facilities located on or adjacent to Indian lands, or facilities located adjacent to waters used by anadromous fish such as salmon). Worker health monitoring requirements would be developed in consultation with a provincial Workers' Compensation Board and/or Department of Labour.

The level of detail and scope of these monitoring activities depends on the characterization of the site, facility design, and the requirements of the regulatory agencies. Components of a site environmental and worker health monitoring program are suggested in Tables 8.2 and 8.3.

TABLE 8.2 RECOMMENDED ROUTINE ENVIRONMENTAL MONITORING

Item	Recommendation
Authority/Reporting	• Develop a site-specific monitoring plan in consultation with the appropriate regulatory agency. • Define reporting requirements. • Re-evaluate the plan if the facility expands or changes design or operating practices.
Soils	• Consider implementing a soil monitoring program (with emphasis on unsurfaced grounds) including: - all areas where preservative chemical is routinely stored, processed or handled - all freshly-treated lumber storage areas - all treated wood storage areas - drainage ditches or areas exposed to surface runoff (including overflow from drip pads and paved areas) • Define sampling frequency (e.g., annual), sample type (e.g., surface, core), and required analyses (e.g., constituents, detection levels, quality control) in consultation with the regulatory agency.
Surface Waters	• Consider implementing a monitoring program for adjacent water bodies: - define monitoring frequencies and required analyses (e.g., constituents, detection level, quality control) in consultation with the regulatory agency - define concentrations of concern
Groundwaters	• Consider implementing a groundwater monitoring program using permanent monitoring points down-gradient of unpaved process areas and treated lumber storage areas. - define well construction - define sampling frequencies and required analyses (e.g., constituents, detection levels, quality control) • Give special attention to on-site wells used for drinking water.
Air Emissions	• Identify air emission sources by use of data provided in workplace exposure study (Table 8.3). • Monitor air emissions as required by air local emission permits.
Liquid Waste Streams	• Identify liquid waste discharges (including stormwater runoff) and determine: - concentrations of preservative constituents - estimations of total mass rates of emissions are suggested • Thereafter, monitor as required for all discharges governed by permits.
Solid Wastes, Sludges	• Maintain current and complete records for all solid wastes stored on-site (pending disposal). • Undertake all reporting and disposal activities in accordance with applicable regulations.

TABLE 8.3 RECOMMENDED ROUTINE WORKPLACE MONITORING

Item	Recommendation
Authority/Reporting	• Develop a facility-specific plan in consultation with the Regional Workers' Compensation Board Office. • Define reporting requirements.
Contact Exposure	• Identify existing and potential sources of skin exposure by periodic walk-through inspections.
Air Inhalation Exposure	• In consultation with the regulatory agency responsible for worker safety, define the design of an initial monitoring program (e.g., sampling techniques, frequency of sampling, etc.). • For the purpose of defining worker health protection measures, provide an initial evaluation of peak and average levels of preservative constituents in air at significant points of worker exposure including areas such as: - cylinder doors (openings), - kiln interiors, - all vents to exhausts which discharge to enclosed work areas, - receiving areas for all vents/exhausts which discharge to areas frequented by personnel, - all enclosed preservative process areas, and - areas adjacent to freshly-treated wood storage. • Provide for subsequent monitoring if required by regulatory agency. • Make personnel samplers available for spot monitoring (as required) if high emission levels are suspected.
Biological Monitoring	• Conduct initial screening medical exams to identify sensitive individuals (Section 4). • In consultation with the regulatory agency, define a schedule for: - medical exams to confirm the absence of symptoms or signs of exposure to preservative constituents, and - biological monitoring of workers for preservative constituents (e.g., arsenic concentration in urine).

9 TRANSPORTATION OF CHROMATED COPPER ARSENATE SOLUTIONS AND WASTES

The transportation of CCA solutions (and wastes generated by their use) is regulated under the federal *Transportation of Dangerous Goods Act* (TDG). The Act does not apply to the transportation of lumber and forest products treated with preservatives (42). The regulation of intra-provincial movement of dangerous goods is a provincial responsibility.

Transported dangerous goods must be classified according to the regulations. Regulatory requirements for aspects such as shipping, documentation, placarding and personnel training were published in the February 6, 1985 *Canada Gazette* (43). A brief overview of the regulatory aspects is provided in Table 9.1. More specific transport procedures for CCA based on good operating practice and complementing the 1985 Transport of Dangerous Goods Regulations are suggested in Table 9.2. It is the intent of these control measures to minimize the potential for accidental release in transit and to provide an effective mechanism for safely managing spills if they occur.

TABLE 9.1 TDGA REGULATIONS FOR CHROMATED COPPER ARSENATE TRANSPORT

TDGA Reference*	Subject	Brief Description
4.4, 4.8	**Shipping Documentation**	Shipping document to be prepared which indicates (in part): primary classification number; special instructions for safe handling, transportation, and storage; 24-hour telephone number for information concerning damaged or defective containers; placard requirements.
4.9	**Identification of Active Constituents**	Where dangerous goods are a systemic poison, the technical name of the active constituents shall be included.
4.15 - 4.18	**Shipments of Wastes**	A manifest is required for the shipment of more than 5 kg of solid wastes or more than 5 L of liquid wastes.
4.19	**Empty Containers/Vessels**	Cleaning and purifying of residues from containers and vessels is required until "no hazard exists", containers and vessels to be signed as "empty-last contained CCA".
4.22	**Rail Transport**	Railway crews to be notified of the position within the train of vehicles containing dangerous goods.
4.23	**Location of Documentation during transport**	i.e., documents to be in cab door of truck.
4.24 - 4.26	**Delivery of Dangerous Goods**	Provision of consignee with documentation.
4.27	**Retention of documentation**	Document to be retained for two years.
5.2	**U.S. - Canada shipments**	Compliance with all aspects of the TDGA is required.
5.5 - 5.15	**Labels**	Label requirements are specified.
5.16 - 5.3	**Placards**	Placard requirements are specified.
7.4	**Incompatibility**	Shipment with incompatible goods is not allowed.
7.14	**Transborder consignment of wastes**	Imports and exports require notice in writing to the Director General, TDGD, Transport Canada.
7.16	**Emergency response planning**	Schedule XI is applicable "Poisonous" liquid, N.O.S.
9.2 - 9.3	**Personnel Training**	Handling, transport only by trained personnel.
9.8	**Registration**	Each importer of dangerous goods must register with the Director General, TDGD, Transport Canada.
9.13 - 9.14	**Dangerous Occurrence Reporting**	Dangerous occurrences (e.g., spills) with more than 5 kg or 5 L of solids, solutions or wastes must be reported immediately (see Appendix for reporting authority).

* Transport of Dangerous Goods Act Section No. (6 February, 1985)

TABLE 9.2 RECOMMENDED TRANSPORTATION PRACTICES FOR CCA-CONTAINING SOLUTIONS OR WASTES

Feature	Recommendation
Container Specifications	• Drums or tanks for transporting CCA containing materials must be free from mechanical defects.
Container Labelling	• The Transportation of Dangerous Goods Act stipulates specific label requirements. • Affix the proper labels depending on classifications to each container. • Label each container on at least two sides.
Vehicle Placarding	• Affix the proper placards to vehicles carrying 500 kg or more of any material (solutions or wastes) containing CCA.
Securing Vehicle Loads (i.e., drummed concentrates and wastes)	• Replace drum spouts with leak-proof bungs prior to transit. • Strap drums vertically to pallets. • Strap drums horizontally to each other. • Brace or tie down loads to prevent shifting (do not rely on the vehicle floor or sides to prevent shifting). • Ensure a stable load consistent with the vehicle floor strength. • Secure other load items to prevent drum punctures.

Responsibilities of Truck Driver, Ship Captain or Railroad Crew	• Know the nature of the load.
	• Carry suitable emergency equipment and be trained in its proper use.
	• Know and follow correct procedures for the reporting of accidents or spills.
	  - immediately telephone the 24-hour contact identified in the shipping manifest;
	  - if more than 5 kg is spilled, also telephone the emergency contact identified in the Appendix;
	  - know and comply with any other requirements of the shipper/ manufacturer.
	• Immediately replace lost or damaged placards or labels (carry spares).
	• Notify the receiver of goods that CCA materials are in transit. (Note: some provinces allow only licensed carriers to transport hazardous wastes).

Loading Procedures	• Ensure that personnel have the means and ability to transfer bulk liquid and move containers safely. • Set vehicle handbrakes securely and place wheel blocks prior to unloading. • Require the presence of a person who knows the hazards of CCA and who is trained and prepared to respond to spills and other emergencies. • If leakage or spillage occurs, decontaminate the vehicle prior to returning it to service. • Dispose of absorbants and spill cleanup materials as per Table 8.1.
Manifest Requirements	• Transport of Dangerous Goods Regulations require a manifest. See Table 9.1 and the 6 February 1985 Canada Gazette for specific details. • The transportation of wastes requires a manifest and regulatory approval (Table 9.1).

10 SPILL AND FIRE CONTINGENCY PLANNING

It is recommended that facilities which use CCA prepare a detailed contingency plan to ensure that response to spills and fires is safe, rapid and effective. Details of a contingency plan would be facility-specific and the following sections outline the contents which should be found within a typical spill contingency plan. It is recommended that the individual facility plan be filed with the authority having jurisdiction.

10.1 Spill Contingency Planning

10.1.1 General Requirements. A contingency plan should:

1. Have policy, purpose and organizational structure.
2. Be geared to the most probable spill size.
3. Address the following phases of spill response:
   - discovery and notification,
   - evaluation and initiation of action,
   - containment and countermeasures,
   - cleanup, mitigation, and disposal,
   - documentation and cost accounting.
4. Clearly assign duties and roles to responsible personnel and organizations.
5. Outline equipment requirements for spill control.
6. Have procedures for updating the plan on a scheduled basis.
7. Outline training requirements for plant personnel in prevention and response.
8. Co-ordinate with other chemical spill prevention plans and procedures if appropriate.
9. Be submitted to chemical suppliers and the clean-up contractor or consultant for review.
10. Subsequently be submitted to appropriate government agencies including the local fire department and police, for review.

10.1.2 Implementation Capability. A contingency plan should:

1. Describe location, capability, and limitations of cleanup and containment equipment.
2. Pre-arrange for use of the best available cleanup and containment equipment.

3. Identify detailed response options and strategies.
4. Provide for training programs and regular practice sessions.
5. Detail how communications will be maintained among all parties during response operations.
6. Consider its degree of implementation as a normal prevention procedure (i.e., detail steps to be taken as a routine precaution against spills).
7. Address human safety issues.
8. Assign selected personnel to respond to public and media calls.

10.1.3 Environmental Protection and Liability Risks. A contingency plan should:

1. Identify high-risk areas and operations.
2. Discuss expected behaviour of spill materials.
3. Identify critical environments for protection and place in order of priority.
4. Detail specific actions planned for minimizing damage to resources.
5. Have explicit standards spelling out what constitutes effective cleanup.
6. Have provisions for responding to spills under all anticipated weather conditions.
7. Pre-arrange all response capability needed for the estimated "worst-case" spill.

10.1.4 Examples of Action Steps. Safety of people is of prime concern. If a spill occurs:

1. Stop the flow of CCA;
    - use common sense,
    - act quickly,
    - shut off pumps, close valves, etc.,
    - if applicable, shut down mechanical production systems first (for example, lumber movement) to prevent injury.
2. Warn people in immediate vicinity;
    - do not allow unauthorized personnel to enter the area,
    - provide proper protective equipment for on-site personnel,
    - avoid any contact of skin, eyes, clothing or shoes.
3. Contain the spill;
    - act promptly,
    - block off drains, culverts and ditches,

- surround spilled material with earth, peat, straw, sand, booms, or commercial sorbents,
- use liquid recovery type vacuum cleaner (or use of empty cylinder and vacuum pump) for recovery of pools.

4. Obtain required assistance from:

- company personnel (advise at earliest opportunity),
- chemical suppliers,
- fire/police/public works/highways department/contractors (as required).

5. Notify applicable government agencies;

- prompt notification is especially important for spills which have entered or may enter receiving waters,
- spills to marine waters require contact with Environmental Protection,
- spills to water bodies with anadromous fish, or spills on or adjacent to Indian lands require contact with Environmental Protection and Provincial Emergency Program,
- for all other spills, contact Provincial Emergency Program as identified in the Appendix.

6. Commence recovery, cleanup, restoration action;

- recover pools by use of vacuum systems, and contain recovered liquid for re-use,
- use an inert absorbent to complete cleanup,
- neutralize contaminated sawdust with lime before cleanup efforts begin (use a ratio of 91 kg lime per 227L (200 lb/50 gal.) CCA 50% concentration),
- carry out cleanup and disposal in consultation with provincial and federal regulatory personnel.

10.2 Fire Contingency Planning

Components of CCA and CCA-solutions are not flammable. Tests comparing toxicity of combustion products of CCA-treated wood versus untreated wood showed no differences in acute toxicity (44).

However, precautions should be taken in the event that a fire may occur in the vicinity of CCA solutions. One of the components, chromic acid, is a strong oxidizer, and may increase fire threat upon dispersal on wood floors, pallets, cotton packagings or paper

cartons. Arsenic acid, another component of CCA, may be converted to more toxic reduced forms of arsenic upon exposure to high temperatures.

It is important, therefore, that CCA-wood preservation facilities devise an adequate contingency plan for fire protection.

10.2.1 General Requirements. A fire contingency plan should:

1. Initially develop contact and consult with local fire authorities.
2. Have policy, purpose and organizational structure.
3. Be geared to the most probably affected area.
4. Address the following phases of fire response:
   - discovery and notification,
   - evaluation and initiation of action,
   - clean-up, mitigation and disposal, and
   - documentation and cost accounting.
5. Clearly assign duties and roles to responsible personnel and organizations.
6. Have procedures for updating the plan on a scheduled basis.
7. Co-ordinate with other fire prevention plans and programs as appropriate.
8. Submit to local fire department for review.

10.2.2 Action Steps. Fire contingency plans and defined action steps would be site specific. Nonetheless an overall strategy should include:

1. Use of water blanket area.
2. Use of water spray to suppress toxic dust and gases, and to keep temperatures of other oxidizable materials below that for ignition.
3. Use any fire protection agents except soda-acid.
4. Protection for fire-fighters if exposed to dust or if material is heated to gaseous state.
5. Containment for contaminated runoff waters.
6. Notification of Provincial Emergency Program if runoff waters may have entered receiving waters.

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APPENDIX

LEGISLATIVE SUMMARY

APPENDIX LEGISLATIVE SUMMARY

This section describes the principal federal and provincial legislation (Acts and Regulations) which addresses the use, transportation, and disposal of chromium, copper and arsenic compounds.

Federal Acts

1) Fisheries Act
2) Environmental Contaminants Act
3) Pest Control Products Act
4) Ocean Dumping Control Act
5) Transportation of Dangerous Goods Act
6) Clean Air Act

Provincial Acts

Alberta	1) Clean Water Act 2) Clean Air Act 3) Hazardous Chemicals Act
British Columbia	1) Waste Management Act 2) Pesticide Control Act 3) Workers' Compensation Act 4) Environmental Management Act
Manitoba	1) Dangerous Goods Handling and Transportation Act 2) Clean Environment Act 3) Workplace Safety and Health Act
New Brunswick	Clean Environment Act
Newfoundland	Department of Environment Act
Nova Scotia	1) Environmental Protection Act, SNS, 1973 2) Dangerous Goods and Hazardous Wastes Management Act, SNS, 1986
Ontario	1) Dangerous Goods Transportation Act 2) Environmental Protection Act 3) Health Protection and Promotion Act 4) Lakes and Rivers Improvement Act 5) Ontario Water Resources Act 6) Pesticides Act 7) Occupational Health and Safety Act

Quebec

1) Loi sur la qualité de l'environnement (Environmental Protection Act)
2) Loi sur la santé et la sécurité du travail (Occupational Health and Safety Act)
3) Code de la sécurité routière (Road Safety Code)

Saskatchewan

The province has no legislation specific to the use and disposal of chemicals used in the wood preservation industry. The uncontrolled release of chlorophenols is reportable under the Environmental Spill Control Regulations, 1981, and disposal in municipal landfills is prohibited by the Municipal Refuse Management Regulations, 1986. CCA products are regulated on provincial highways by the Dangerous Goods Transportation Regulations, 1986. Hazardous Substances and Industrial and Hazardous Waste Management Regulations which will address the storage, treatment and disposal of these wastes by industry are in preparation. These regulations should be in place by 1988.

Figure A.1 provides a schematic overview of regulatory agencies and their responsibilities with respect to CCA wood preservation facilities. Table A.1 presents a brief review of the pertinent sections of the Acts and any Regulations that have been promulgated under those acts. Table A.2 provides emergency contact in cases of contraventions of the above Acts, and additional contacts to provide clarification of requirements under the Acts are provided in Table A.3.

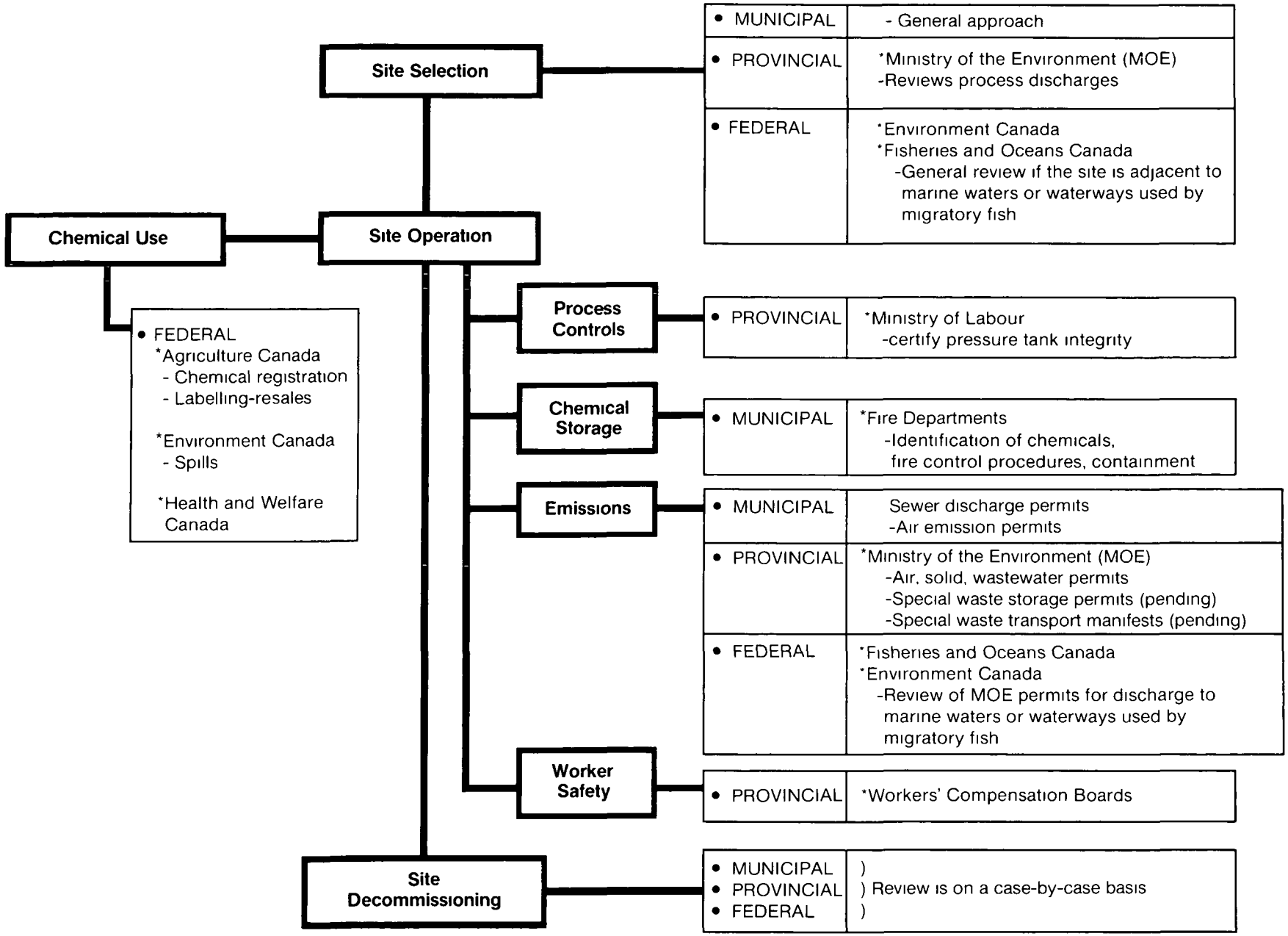

FIGURE A.1 OVERVIEW OF AGENCY MANDATES FOR REGULATING WOOD PRESERVATION FACILITIES

TABLE A.1 SUMMARY OF LEGISLATION REGULATING THE USE OF CHROMATED COPPER ARSENATE

Legislative Act (Responsible Agency)	Relevant Sections	Comments
1. Federal		
1.1 Fisheries Act (Environment Canada - Fisheries and Oceans)	Section 33(1)	If a proposed facility has potential to impact on federally managed resources, then EC has the authority to review plans for operations and works, to recommend modifications and if necessary, to prohibit construction.
	Section 33(2)	Application of this Section focuses on the protection of anadromous fish species in marine and fresh waters. This Section of the Act is used by EC and DFO for the prohibition of the discharge of deleterious substances into waterways frequented by fish. Copper, chromium, and arsenic are deleterious to fish and their habitat. Other subsections of the Act may have application if regulations are developed or if specific information is requested.
1.2 Environmental Contaminants Act (Environment Canada, Health and Welfare, Canada)	Section 4(1)	The Act gives the federal government the authority to investigate and collect information on commercial chemicals pertaining to all facts of production, use, and release in the environment. Arsenic compounds are currently being investigated to determine the nature and extent of the danger that they pose to human health and the environment.
	Section 8	Pursuant to Section 8 the federal government may develop regulations prescribing the maximum quantity of a substance which may be released and the conditions under which the substance may not be imported, manufactured, processed, offered for sale or used.
1.3 Pest Control Products Act and Pest Control Regulations (Agriculture Canada)	Section 5	The Act regulates products used for the control of pests and organic functions of plants and animals. Examples of such products are insecticides, fungicides, molluscicides and herbicides. The Act requires that an importer exporter, manufacturer and distributor of a control product must register that product with Agriculture Canada. The Regulations prescribe the registration procedures, the information required to be submitted with an application and they define restrictions on the formulation and composition of the products, packing and labelling, product distribution and product use.
		CCA wood preservation products are fungicides and must be registered with Agriculture Canada.
1.4 Ocean Dumping Control Act Ocean Dumping Regulations	The Act Section 5	The Act provides the federal government the authority to restrict the dumping of scheduled substances into Ocean waters.
(Environment Canada)	The Regulations Section 5	Arsenic and its compounds would be included under the category of "Restricted Substances" (pesticides and their by-products not included in Schedule 1). Such substances are considered to be potentially harmful and require special care when dumped into the marine environment.

TABLE A.1 SUMMARY OF LEGISLATION REGULATING THE USE OF CHROMATED COPPER ARSENATE (Cont'd)

Legislative Act (Responsible Agency)	Relevant Sections	Comments
1.5 Transportation of Dangerous Goods Act and Regulations (Transport Canada)	Section 4 Section 5 Section 26	The Act was proclaimed in 1980 in order to promote public safety in the transport of dangerous goods, such as explosives, flammable materials and toxic chemicals. Sections 4 and 5 define the offences under the Act and Section 26 provides the federal government the authority to develop regulations and standards. Regulations published in 1985 identify specific requirements for documentation (manifests and waybills), packaging and labelling for nine classes of dangerous goods and wastes.
1.6 Clean Air Act (Environment Canada)	Section 7(1) Section 31	An Act relating to ambient air quality and the control of air pollution. No specific regulations for arsenic.
2. Provincial		
2.1 Alberta		
2.1.1 Clean Water Act (Alberta Environment)		Act provides the legislative basis for the protection of surface and fresh groundwater.
2.1.2 Clean Air Act (Alberta Environment)		Act provides the legislative basis for the protection of ambient air quality and control of air pollution.
2.1.3 Hazardous Chemicals Act Table 3 Hazardous Waste Regulations (Alberta Environment)		The disposal of hazardous waste is controlled under this Act and Regulations.
2.2 British Columbia		
2.2.1 Waste Management Act (Waste Management Branch of the B.C. Ministry of Environment)	The Act Section 3	The Act provides the Waste Management Branch with the legislative basis for the overall management of industrial wastes for the protection of the environment. The Act was passed in 1982, however, as of 1987 no regulations were promulgated.
		The company requires a permit or approval issued by the Waste Management Branch in order to discharge a waste into the environment (applies to liquid effluent discharges, air emissions and solid wastes).
	Section 4	The storage of "special wastes" in excess of specified quantities must be authorized by a permit.
	Section 5	The generator or owner of a waste must complete a manifest form and meet other requirements before transporting special wastes.
	Section 10 Section 22	All industries which handle hazardous materials may be required to prepare a contingency plan. The Waste Management Branch can issue an "order" for a company to carry out investigation to determine the risk to the environment posed by its handling of a polluting substance, the environmental effects of a spill, or to carry out remedial and abatement measures after a spill.
2.2.2 Environmental Management Act - B.C. Section 6	The Act Section 5	Declaration of environmental emergency Recovery of costs associated with environmental emergency.

TABLE A.1 SUMMARY OF LEGISLATION REGULATING THE USE OF CHROMATED COPPER ARSENATE (Cont'd)

Legislative Act (Responsible Agency)	Relevant Sections	Comments
2.2.3 Pesticide Control Act and Regulations (Pesticide Control Branch of the B.C. Ministry of Environment)	The Act	The Act and Regulations are designed to ensure that pesticides are sold and used safely according to label directions in a manner that will not produce an unreasonable adverse effect to the environment.
	The Regulations Section 4	The application of a pesticide on public land must be conducted by a certified pesticide applicator. A certified pesticide applicator is a person who has successfully completed a course and examination in a speciality field conducted by the Pesticide Control Branch.
	Section 28	There are no specific regulations for the control of CCA at wood preservation facilities.
2.2.4 Workers' Compensation Act Industrial Health and Safety Regulations - B.C. (Workers' Compensation Board (WCB))		The Act designates the WCB to be the agency responsible for the prevention of injuries and industrial diseases to workers at their place of employment. The Act empowers the WCB to make regulations which may apply to employers, workers and all persons working in or contributing to the production of any industry within the scope of the Act.
	8.18*	Adequate direction and instruction of workers.
	8.20	Supervisors are responsible for the proper instruction of workers under their direction. The supervisor must ensure that the work is performed without undue risk to the worker.
	12.01	Signs indicating the presence of hazardous chemicals at facilities.
	12.03	Storage of hazardous chemicals and design and labelling of containers.
	12.05	Emergency wash facilities.
	13.01	Exposure to airborne arsenic, copper and chromium, and measures to mitigate excessive exposure.
	13.05, 13.07	Tests to determine unsafe conditions.
	13.09	Protective measures where workers are in a confined space with unsafe atmosphere.
	13.07	Ventilation and testing requirements for confined areas.
	13.37	Design of ventilation systems.
	13.43	Location of exhaust ventilation systems.
	13.47, 13.49	Restrictions on the recirculation of contaminated exhaust air.
	14.16, 14.18, 14.21	Protective equipment for workers handling treatment chemicals or treated lumber.
	14.23	Provisions for respiratory protective equipment.
	68.46	Special procedures for dealing with fires involving arsenic compounds.
	76.29	Chemical spills shall be cleaned up under the supervision of persons who are knowledgeable in the hazards and the precautions to be taken.

* Only certain regulations are highlighted. Many other regulations are applicable, including 8.02, 8.04, 8.22, 8.32, 8.52, 8.58, 8.72, 8.74, 8.84, 12.11, 13.41, 13.57, 14.01, 17.03, 17.05.

TABLE A.1 SUMMARY OF LEGISLATION REGULATING THE USE OF CHROMATED COPPER ARSENATE (Cont'd)

Legislative Act (Responsible Agency)	Relevant Sections	Comments
2.3 Manitoba		
2.3.1 Dangerous Goods Handling and Transportation Act and Regulations (Environment and Workplace Safety and Health)	Section 8 Section 9 Section 12 Section 31 Section 32 Section 40	The Act was proclaimed August 1984 and provides the legislative basis covering all aspects of handling dangerous goods including manufacture, use, storage, transportation and disposal. Sections 31 and 32 cover penalty provisions and offences. Section 40 provides the provincial government the authority to develop regulations.
2.3.2 Clean Environment Act and Regulations - Environment and Workplace Safety and Health	Section 14	A proposal must be filed with the department for the establishment of any operation that will release contaminants into the air, water or soil. Subsequently, the operation will receive a Clean Environment Commission order setting out limits, terms and conditions for the process. In the absence of a central hazardous waste management system and facility, such an order will be required for the operation of a wood protection facility in Manitoba. NOTE: This legislation is in the process of change - but approval will still be required.
2.4 Ontario		
2.4.1 Dangerous Goods Transportation Act (Ministry of Transportation and Communications)		The Act permits the Ministry to enact regulations to supplement those promulgated under the Federal Transportation of Dangerous Goods Act.
2.4.2 Environmental Protection Act (Ministry of the Environment)		The Act provides the legislative basis for the protection of the environment.
	Sections 12 and 14	The Ministry of the Environment must be notified if a discharge is greater than the permitted level, or is likely to harm the environment.
	Sections 80 and 81	Spills likely to harm the environment must be reported to the Ministry, the municipality and company management. Remedial action must be taken.
	Section 84	Disposal of spilled material may be regulated by the Ministry.
	Section 136 (1)	The Ministry may regulate the discharge of a contaminant or the modification of waste treatment facilities.
	Section 136 (7)	Any occurrence in compliance with the Ontario Water Resources Act or the Pesticides Act is not a "spill".
Air Pollution (Control) Regulations	Section 9	The Ministry must be consulted if a process upset results in excessive emissions.
	Section 10 Also Section 6	The use of treated wood wastes in a boiler is legally questionable.
Spills Regulations		Sets out procedures for compensation of persons affected by a spill; but only if the Pesticides Act and other applicable federal, provincial and municipal legislation has not been complied with.

TABLE A.1 SUMMARY OF LEGISLATION REGULATING THE USE OF CHROMATED COPPER ARSENATE (Cont'd)

Legislative Act (Responsible Agency)	Relevant Sections	Comments
Waste Management General Regulation	Section 15	Generators of waste must be registered with the Ministry.
	Section 16, 20-23	Waste must be properly disposed of, and all prescribed manifests kept.
	Schedules 1 and 2	Sludge from the effluent treatment plant is a hazardous industrial waste.
Guidelines for Environmental Protection Measures at Chemical Storage Facilities		Code of good practice for storage tanks.
2.4.3 Health Protection and Promotion Act (Ministry of Health)		The medical officer of health may inspect, receive complaints and issue orders or directions in case of a health hazard.
2.4.4 Lakes and Rivers Improvement Act (Ministry of Natural Resources)		The Act provides for the protection of water bodies and for their equitable public and private use.
	Sections 37 and 38	The Ministry of Natural Resources may order a mill not to discharge any refuse, sawdust, chemical, etc.
	Also Section 39	
2.4.5 Ontario Water Resources Act (Ministry of the Environment)		The Act provides for the preservation of water purity, and governs the operation of water and sewage works.
	Sections 14-16	Discharge of any substance that may impair water quality is prohibited, and an ex parte injunction may be obtained against it.
	Section 18	The Minister may order the maintenance of equipment or chemicals necessary to alleviate impairment of water quality.
2.4.6 Pesticides Act (Ministry of the Environment)		The Act regulates the elimination of pests, and all use and handling of pesticides.
	Section 4	The use of a pesticide such that excessive harm is caused to the environment is prohibited.
	Section 28	Provides for the enactment of regulations governing the transportation, handling, storage and use of pesticides, the type, labelling and disposal of containers, and decontamination.
	Also Sections 20, 21 and 23	
Pesticides (General) Regulations	Section 24	A pesticide must be kept in the proper container, which must be properly labelled.
	Sections 25 and 26	Empty pesticide containers must be properly disposed of, damage containers must be replaced or disposed of and spillage cleaned up.
	Section 27	If a pesticide is involved in a fire, theft or other unusual occurrence, the Director must be notified.

TABLE A.1 SUMMARY OF LEGISLATION REGULATING THE USE OF CHROMATED COPPER ARSENATE (Cont'd)

Legislative Act (Responsible Agency)	Relevant Sections	Comments
	Section 98	Pesticides must be kept away from human or animal food.
	Section 99	Schedule 1, 2 and 5 pesticides must be stored in a room vented to the outside, with doors marked "Chemical Storage - Authorized Persons Only" and accessible only to authorized persons.
	Also Sections 105 and 106	
2.4.7 Occupational Health and Safety Act (Ministry of Labour)		The Act governs protection of health and safety in the work place.
	Sections 14-17	Employer shall provide necessary equipment, educate workers, disclose all hazards, maintain occupational health service, keep records of chemicals used, including exposure records. The use of new chemicals must be reported, the levels of chemicals must be monitored and kept below a prescribed level. Supervisor must ensure that workers comply with health and safety procedures. Workers must use protective equipment provided, and inform the employer of any unsafe situations.
	Section 20	The Ministry may regulate the use of, and exposure to, any toxic substances.
	Section 41 (1) and (2)	Provides for the specific regulation of exposure to chemicals.
	Also Sections 23, 24, and 28-33	
Industrial Establishments Regulations	Section 66 (1)	Piping containing a hazardous substance shall be labelled at valves, fittings, etc.
	Sections 83, 85 and 88	Workers must be provided with equipment protecting them from skin or eye injury and be trained in its use.
	Sections 128 and 129	Eyewash fountains and deluge showers must be provided.
	Sections 131 and 132	Work place must be adequately ventilated.
	Sections 134 and 135	Workers shall be trained in the use of chemicals, use of protective equipment and emergency procedures. Food, drink and tobacco not permitted near poisonous substances.
	Section 145	All measures necessary to prevent exposure to toxic substances shall be taken.
	Also Sections 14, 15, 26, 27, 71-74, 139, 141(b), and 142	
Regulations Concerning Exposure to Chemical and Biological Agents		

TABLE A.1 SUMMARY OF LEGISLATION REGULATING THE USE OF CHROMATED COPPER ARSENATE (Cont'd)

Legislative Act (Responsible Agency)	Relevant Sections	Comments
2.5 Quebec		
2.5.1 Loi sur la qualité de l'environnement (Environmental Protection Act) (Ministry of Environment)	Article 1	Contaminants are defined in the following manner: a solid liquid or gas, or any combination of these that could alter in some manner the quality of the environment.
	Article 20	This article states that no person may emit, dispose of, release or discharge, or permit the emission, disposal, release or discharge, into the environment of a contaminant that could affect human life, health, safety, security, welfare or comfort, or cause damage or otherwise compromise the quality of soil, vegetation, wildlife or property.
	Article 21	The Deputy Minister of the Environment must be notified immediately of any incident that causes the presence of a contaminant in the environment.
	Hazardous Wastes Regulation (A.C. 1000-85)	This regulation defines bottom sediment sludges from the treatment of wastewaters from wood preserving processes that use creosote, pentachlorophenol or inorganic components containing arsenic, as being a category of hazardous wastes.
	Solid Waste Regulations- (R.R.Q.1981,	Any leachate containing contaminants (chromium, copper, phenolic compounds) above the standards prescribed must not be discharged into the hydrographic surface network or into a storm water sewer.
2.5.2 Loi sur la santé et la sécurité du travail (Occupational Health and Safety Commission) (L.R.Q., chap. S-2.1)		This act establishes mechanisms to permit the participation of workers and employers in the elimination of causes of accidents and occupational illnesses. The act gives to workers the right to take leave if exposure to a contaminant poses a danger to them, as evidenced bysigns of health effects.
	Industrial and Commercial Establishments Regulation (R.R.Q. 1981, chap. S-2.1 r.9)	This regulation prescribes general standards of health and safety for industrial and commercial premises. scope of application includes the state of workplaces, working conditions such as ventilation, lighting, noise and vibration, the control of hazardous substances and radiation, equipment and individual protection.
	Regulation on the Quality of the Workplace (R.R.Q.1981, chap. S-2.1, r.15)	This regulation applies to the presence of dust, gases, fumes and vapours, lighting, temperature, noise, ventilation.
2.5.3 Code de la sécurité (Highway Safety Code) (Ministry of Transport)	Transport of Dangerous Substances Regulation (C-24.1, r.19.01)	This regulation protects the public during the transport of dangerous goods. Documentation, packing, and signing for dangerous goods are specified.

TABLE A.2 EMERGENCY CONTACTS (CCA Treatment Facilities)

Emergency Incident	**Emergency Contact**
Spills to marine waters	Environment Canada - Local office
Spills to freshwaters containing anadromous fish (e.g., salmon) or Spills on federal or Indian lands	Environment Canada - Local office and Provincial Emergency Program - Local office
Spills to land during transport (more than 5 kg or 5 L of CCA or CCA wastes)	Provincial Emergency Program - Local office
Ingestion of CCA or exposure to high concentrations of CCA	Local Hospital and Poison Control Centre (additional) information)
Fire	Local Fire Department
Emergency response information	CCA Suppliers * Koppers Company (412) 227-2457 * Osmose (404) 228-8434 (716) 882-9505 * Mineral Research and Development (704) 525-2771

TABLE A.3 GENERAL INFORMATION CONTACTS (CCA Treatment Facilities)

Subject	**Contact**
Compliance with Federal Environmental Legislation	Environment Canada - Local office
Transport of Dangerous Goods Act (questions of consignors, manufacturers, consignees, warehousers, freight forwarders, brokers, etc.)	Local Regional Inspector Transport of Dangerous Goods Transport Canada
Railway Transport	Local Dangerous Goods Coordinator and Chief, Operations Railway Transport Committee
Transport of Dangerous Goods Road Transport	Local Director, Administrator and Road Safety Motor Vehicle Department