ENVIRONMENT CANADA
CONSERVATION AND PROTECTION
ENVIRONMENTAL PROTECTION SERVICE
PACIFIC AND YUKON REGION

COMPLIANCE ASSESSMENT REPORT ON WOOD PROTECTION (ANTI-SAPSTAIN) FACILITIES IN BRITISH COLUMBIA (1984)

Regional Program Report 86-08

By

D.M. Wilson
and
S. Liu

JUNE 1986

ABSTRACT

In 1984, the Environmental Protection Service, Pacific Region, undertook a plant inventory and review of wood protection facilities in British Columbia to determine industry's compliance with a code of practice published by Environment Canada and the B.C. Ministry of Environment in 1983. The purpose of the review was to establish priority sites for remedial actions, to identify specific potential sources of anti-sapstain chemical release to the environment, and to identify use of alternate anti-sapstain chemicals and operational practices.

Seventy-seven plants (sawmills and lumber export terminals) reported use of chlorophenates for wood protection. Seven plants used alternative chemicals (TCMTB, PQ-8, cedar extract), four plants used surface wax treatments only, and sixteen plants were closed at the time of the survey. The number of mills using diptanks declined between 1982 and 1985 with the largest reduction occurring with drive-in dip tanks. However, there was a 47% increase in the number of mills using spray systems between 1982 and 1985.

Most mills had installed containment and recycle systems in mix rooms, on spray units and in dip tank drip areas. Most chemical storage areas were also contained and covered. However, many dip tanks and lumber drip areas were uncovered and few mills provided covered final storage for their treated lumber. The average compliance with all code recommendations was 70%.

Chlorophenate-contaminated woodwastes and sludges were most often disposed by incineration. Volumes of these wastes could not be accurately calculated from the information collected in the survey.

Most chlorophenate spills recorded by EPS between 1972 and 1986 involved dip tank facilities (25 out of 33 major incidents). A few spills have resulted in fish kills and extensive remedial measures were required to clean-up two major chlorophenate releases into the environment.

RÉSUMÉ

Le Service de la protection de l'environnement, région du Pacifique, entreprenait en 1984 de faire un relevé et un examen sur place des éstablissements de préservation du bois en Colombie-Britannique afin d'établir dans quelle mesure l'industrie observait le Code de bonne pratique publié en 1983 par Environnement Canada et le ministère de l'Environnement de la C.-B. L'examen avait pour objet de déterminer les endroits où des mesures correctives devaient être appliquées en priorité, d'établir avec exactitude les sources possibles de déversement dans l'environnement de produits chimiques contre la décoloration de l'aubier et de relever les cas d'emploi d'autres produits ou d'autres procédés pour combattre la décoloration de l'aubier.

Dans soixante-dix-sept (77) usines (scieries et dépôts de bois de construction destiné à l'exportation), on a révélé faire usage de chlorophénates pour la préservation du bois. Dans sept (7) usines, on employait des produits chimiques de remplacement (TCMTB, PQ-8, extrait de cèdre); dans quatre (4) autres, on se limitait à des applications de cire en surface tandis que seize (16) usines étaient fermées au moment de l'enquête. Entre 1982 et 1985, le nombre d'usines où on employait les cuves d'imprégnation a baissé, la réduction la plus notable se faisant sentir du côté des cuves d'imprégnation à rampe d'accès. Par contre, le nombre d'usines où on employait des dispositifs de vaporisation a augmenté, au cours de cette même période, de 47 p. 100.

Dans la plupart des usines, on avait installé des systèmes de rétention et de recyclage dans les salles de mélange, sur les dispositifs de vaporisation et dans les lieux de séchage du bois sorti des cuves d'imprégnation. De même, la plupart des locaux d'entreposage des produits chimiques étaient à l'épreuve des fuites et étaient recouverts. Il y avait toutefois un grand nombre de cuves d'imprégnation et de postes de séchage du bois d'oeuvre qui n'étaient pas couverts et seules quelques usines disposaient d'un bâtiment d'entreposage pour mettre le bois de construction traité. En moyenne, les recommandations du Code sont appliquées à 70 p. 100.

Les déchets de bois et les dépôts de cuve contaminés au chlorophénate étaient, le plus souvent, incinérés; les données recueillies au cours de l'enquête ne permettent cependant pas d'établir preécisément leur volume.

La plupart des déversements de chlorophénate consignés par le SPE entre 1972 et 1986 provenaient de cuves d'imprégnation (dans 25 cas graves sur 33); dans quelques cas, il y a eu destruction de poissons et il a fallu appliquer d'importantes mesures correctives pour nettoyer deux déversements importants de chlorophénate.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CONCLUSIONS

1. Since 1982 there has been a trend to install spray treatment facilities at new or upgraded wood protection operations in British Columbia. The use of dip tanks is declining with the largest reduction occurring with drive-in dip tanks.

2. Containment and recycle systems have been installed in most wood protection operations. Spray facilities appear to be much less prone to chemical releases than dip facilities. Many dip tanks and lumber drip areas were uncovered making these facilities prone to flooding during heavy rainfall periods.

3. Very few mills have provided covered final storage for their anti-sapstain treated lumber. This may result in low-level releases of wood protection chemicals into the environment.

4. The majority of mills using chlorophenates for wood protection dispose of contaminated wood waste and sludge by incineration.

5. The majority of mills continue to use chlorophenates for wood protection. However, a few mills are using alternative chemicals and considerable research is underway to further test and perfect these alternatives for sapstain control.

1 INTRODUCTION

A 1978 study undertaken for the Environmental Protection Service (EPS) identified releases of chlorophenates from wood protection[1] operations in the Fraser River estuary and on the southern east coast of Vancouver Island (Environment Canada, 1979). In 1979 EPS Pacific Region formed a working group with the Waste Management Branch of the B.C. Ministry of Environment to study the use of chlorophenate fungicides as anti-sapstain agents in the forest products industry. The objectives of the working group were to define best practicable technology (BPT) for the use of chlorophenate solutions, develop a code of good practice for wood protection operations, recommend disposal practices for wastes contaminated with chlorophenates, and develop a priority list of plants for implementation of BPT and the code of practice. To meet these objectives a contract study was undertaken in 1980/81 to assess wood protection systems used in the forest products industry, and ultimately to prepare a first draft of a code of good practice that formally expressed design features and operating practices to reduce or eliminate release of chlorophenates into the environment (Konasewich et al. 1981).

In 1981 the working group was re-structured into a task force and representation expanded to include the forest products industry and unions, and other government agencies including the Workers' Compensation Board. Following review of two further drafts by the task force, the code of practice was published in December, 1983 (Environment Canada, B.C. Ministry of Environment, 1983). The code of practice (published as "Chlorophenate Wood Protection-Recommendations for Design and Operation") outlined general practices at wood protection operations and provided recommendations for mill design features and operating practices, transportation of chlorophenate-containing materials, disposal of wastes, and spill contingency planning.

---

[1]Wood protection refers to surface treatments of freshly cut lumber with a chemical agent to prevent growth of sapstain and mould fungi. Sodium tetra- and penta-chlorophenate are the most commonly used chemical agents in British Columbia.

In 1984 the Council of Forest Industries of B.C. conducted a series of seminars with their member companies to review the contents of the code and to promote its adoption for construction of new wood protection facilities and for the upgrading of existing systems. EPS assisted with these seminars and also undertook a plant inventory update of wood protection facilities in British Columbia to determine industry's compliance with the code's recommendations in 1984.

1.1 Industry Operations Questionnaire and Review

The purpose of the plant inventory update was to determine anti-sapstain chemical use patterns and trends or improvements since the 1981 review. The update also will serve to establish priority sites for remedial actions, to identify specific potential sources of anti-sapstain chemical release to the environment, and to identify use of alternate anti-sapstain chemicals and operational practices.

An industry operations questionnaire was sent to sawmills, planer mills, remanufacturers, and lumber export terminals (see Appendix I). Information was also obtained from the B.C. Waste Management Branch, the Council of Forest Industries, and from EPS files, reports, and site inspections. Twenty-eight (28) mills had previously been inspected by EPS. Information collected from these inspections was used to verify questionnaire responses. Support for the plant review was obtained from both the Council of Forest Industries of B.C. and the Cariboo Lumber Manufacturers Association who informed their members of the forthcoming questionnaire.

2 WOOD PROTECTION FACILITY UPDATE (1984)

An estimated 100 facilities in British Columbia used anti-sapstain chemicals from 1978 to 1985. Questionnaires were mailed in August 1984 to 89 current users of anti-sapstain chemicals of which 83 were completed and returned to EPS. Seventy-seven (77) plants indicated use of chlorophenates for wood protection (six mills did not adequately complete the questionnaire reducing useful responses to 71 mills). Seven plants indicated use of alternative chemicals (four plants were also using chlorophenates), and four plants were using surface wax treatments only. Sixteen (16) plants had closed either permanently or temporarily at the time of the questionnaire survey. These numbers provide a reasonably accurate accounting of wood protection facilities for 1984 and 1985. However, the numbers of mills using chlorophenates or alternatives may increase from re-activation of closed plants, or from addition of anti-sapstain chemicals to wax treatments. Figure 1 shows the locations of wood protection facilities in British Columbia for 1985.

The questionnaire survey (Appendix I) requested general information on the mill's process and wood protection operations, information on concentrated chlorophenate chemical storage and handling, details on dip and spray facilities pertaining to the recommendations in the code of practice, and information on waste generation and disposal practices. The data generated from the survey provided an inventory of chemical usage and operational and waste disposal practices for the majority of wood protection operations in British Columbia.

2.1 General Information on Wood Protection Facilities

2.1.1 Chemical Use Patterns. Fifty-one (51) mills reported usage of 1,186,000 litres of concentrated chlorophenate solutions in 1982 representing approximately 291,600 kilograms of tetra- and penta-chlorophenate active ingredients. In 1983, sixty-two (62) mills reported usage of 1,525,000 litres of concentrated chlorophenate solutions representing approximately 374,800 kilograms of tetra- and penta-chlorophenate active

MILL NO.	MILL NAME	MILL NO.	MILL NAME
1	Ainsworth Lumber, 100 Mile House	51	Seaboard Terminal, North Vancouver
2	Balfour - N.O.M., Prince George	52	Squamish Terminal, Squamish
3	Balfour - Polar, Prince George	53	Stadco, Burnaby
4	Balfour - Clear Lake, Prince George	54	Ten Mile Lumber, Terrace
5	BCFP - Boston Bar, Boston Bar	55	Terminal Sawmills, Richmond
6	BCFP - Cowichan, Youbou	56	The Pas Lumber, Prince George
7	BCFP - Vancouver, Vancouver	57	Weldwood - Empire, Squamish
8	BCFP - Victoria, Victoria	58	Weldwood - Timberland, Surrey
9	BCFP - MacKenzie, MacKenzie	59	Weldwood - Merrill & Wagner, Williams Lake
10	BC Millworks Mfg., Langley	60	West Fraser - Skeena, Terrace
11	C & C Lath, Duncan	61	West Langley, Langley
12	CFP - Eburne, Vancouver	62	Westar - Celgar, Castlegar
13	Carrier Lumber, Prince George	63	Westar - Hazelton, South Hazelton
14	CIP - Ladysmith, Ladysmith	64	Westar - Terrace, Terrace
15	CIP - Nanaimo, Nanaimo	65	Westar - Kitwanga, Kitwanga
16	CIP - Hemlock, Tahsis	66	Western Stevedoring, Lynnterm, N. Vanc.
17	CIPA - Nanaimo, Nanaimo	67	WeyerCan - Kamloops, Kamloops
18	Clearwater Timber, Valemount	68	WeyerCan Vavenby, Vavenby
19	CFI - Fraser Mills, Coquitlam	69	WeyerCan - Meritt, Meritt
20	CFI - Elk Falls, Campbell River	70	Whonnock - Holding, Chase
21	Decker Lake, Burns Lake	71	Whonnock - MacKenzie, Surrey
22	Delta Cedar, Surrey	72	Whonnock - Pacific Pine, New West.
23	Doman - Nanoose, Chemainus	73	Whonnock - Bay, Pitt Meadows
24	Doman - Cowichan, Cowichan	74	Whonnock - Silvertree, Vancouver
25	Doman - Duke Point, Nanaimo	75	Whonnock - Whonnock, Whonnock
26	Doman - Ladysmith, Ladysmith	76	Westcoast Cellufibre, Vancouver
27	Doman - New West., New West.	77	Evans - Savona, Savona
28	Dorman Pulp Chips, Nanaimo	78	BCFP - Tilbury, Delta
29	Dunkley Lumber, Hixon	79	Canadian Stevedoring - Fairview Terminal, Pr. Rupert
30	Fraser River Planing, Richmond	80	CIP - Nootka Specialty, Burnaby
31	Gregory - Acorn, Delta	81	Sooke Forest Products, Sooke
32	Gregory - Field, Courtenay	82	Bay Forest Products, Vancouver
33	MB Ltd. - Chemainus, Chemainus	83	Capilano Timber, Surrey
34	MB Ltd. - Alberni, Port Alberni	84	Cinderella Cedar, Surrey
35	MB Ltd. - Harmac, Nanaimo	85	Delview Forest Industry, Delta
36	MB Ltd. - Mainland, New West.	86	Greenwood Forest Products, Penticton
37	MB Ltd. - Powell, Powell River	87	Pan Pacific Planers, Lac La Hache
38	MB Ltd. - Somass, Port Alberni	88	Shawnigan Timber Limited, Duncan
39	Mayo, Nanaimo	89	BCFP, Honeymoon Bay
40	Northwood - Houston, Houston	90	Westar - Plateau Mill, Vanderhoof
41	Northwood - PG, Prince George	91	Fraser Surrey Docks, Surrey
42	Northwood - Shelley, Shelley	92	Drew Sawmills, Malakwa
43	Northwood - UF, Upper Fraser	93	Eurocan, Kitimat
44	Pinewood, Fort St. James	94	L & K Lumber, N. Vanc.
45	Pitt Timber, Port Coquitlam	95	Plumber Bay Sawmills, Victoria
46	PG Wood Preserving, Prince George	96	MB Ltd. - Canadian White Pine, Vanc.
47	Raven Lumber, Campbell River	97	WeyerCan, Kamloops
48	Busted Brothers, Prince George	98	WeyerCan, Okanagan Falls
49	S & R Sawmills, Surrey	99	Crown Forest Industries, Kelowna
50	Schon Timber, Ladysmith	100	Khalsa Enterprises, Williams Lake

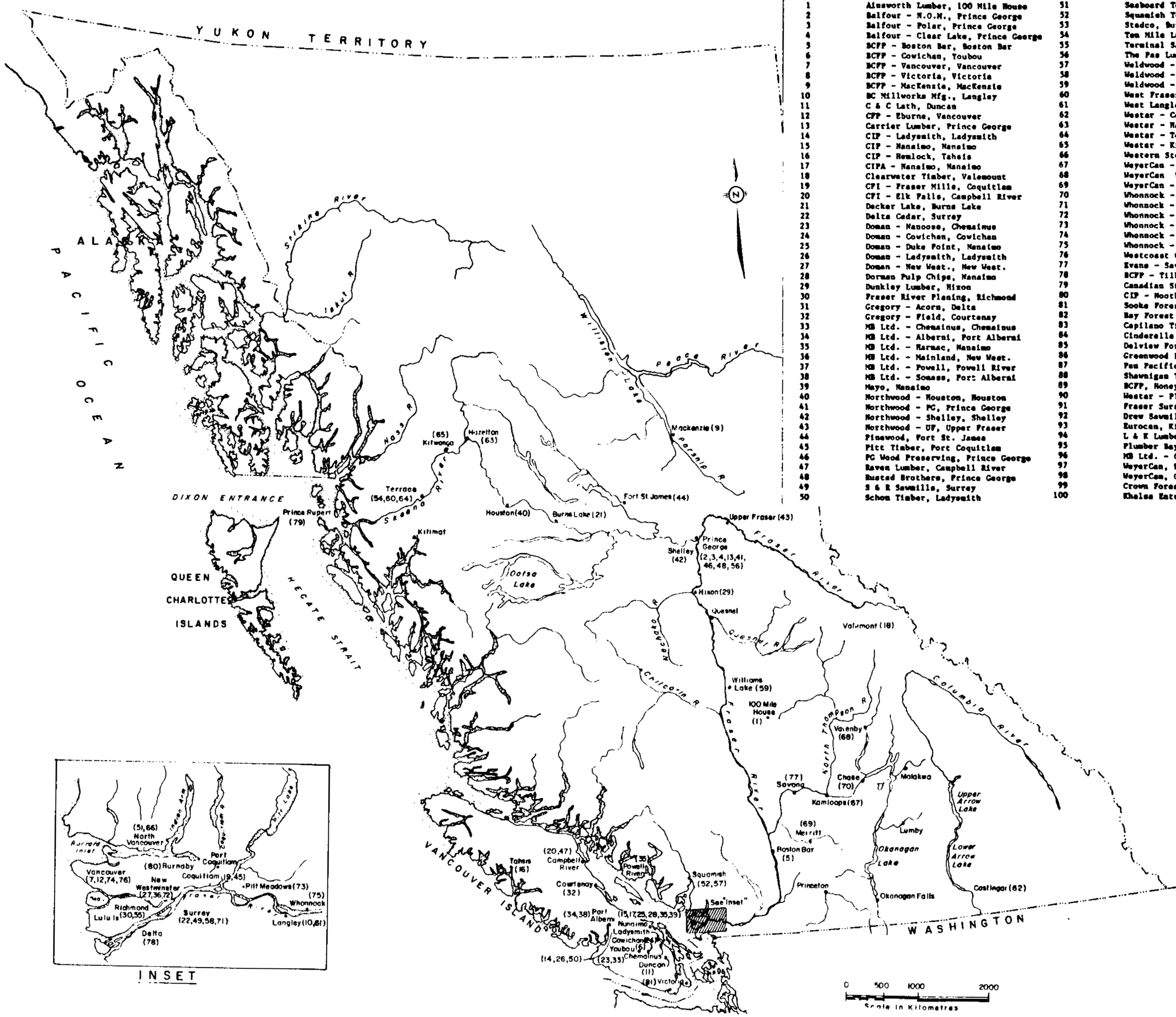


FIGURE I LOCATIONS OF CHLOROPHENATE WOOD PROTECTION FACILITIES IN BRITISH COLUMBIA, 1985 ingredients. Some wood protection operations did not provide data on chlorophenate consumption, however, the amounts quoted for 1983 represent approximately 80% of the actual amounts sold in British Columbia (Environment Canada, Agriculture Canada, 1984).

At the time of the survey, five major commercial chlorophenate products were used in B.C. wood protection operations. Van Waters and Rogers' "Woodbrite-24", Diachem's "Diatox", and Alchem's "4135" were used at both dip and spray facilities and are waxless formulations. Walker Brothers' "Woodsheath" and "Seabrite" are formulated as wax solutions and are used almost exclusively at spray facilities. In 1985, a major supplier of chlorophenates to the B.C. market (Reichhold Chemicals Inc. of Tacoma, Wa.) ceased operations. However, a new chlorophenate supply was secured from the Rhone-Poulenc Co. of France with May and Baker Ltd. of Mississauga, Ont. acting as Canadian sales and distribution agents.

Four mills reported use of Mitrol's "PQ-8" as an alternative to chlorophenates. These mills used 20,400 litres of concentrated solution in 1982 and 9860 litres in 1983. Two mills reported use of Cloverdale Paint and Paper's "Woodblok 30" (TCMTB). A total of 2754 litres of this chemical was used in 1983. The other user of TCMTB found the material to be unsatisfactory and switched to chlorophenates in December, 1984. Finally, one mill reported use of a cedar extract which had been developed in-plant as an alternative to chlorophenates. Rough lumber has been treated with cedar extract since January 1982. The company has applied to Agriculture Canada for registration of the extract for use on planed lumber.

Presently, the use of alternative chemicals for wood protection is minor compared to the use of chlorophenates. However, the Lumber Anti-sapstain Advisory Sub-committee of the Council of Forest Industries will review progress on the development and testing of alternate chemicals, and determine the registration procedures for these products with Agriculture Canada. The objective is to procure the registration of alternatives that are acceptable for protecting lumber from mould and sapstain attack, and that have a lower environmental and potential human health impact than the chlorophenates.

2.1.2 **Types of Wood Protection Treatment Facilities.** Table 1 shows the types of dip and spray facilities used at B.C. wood protection operations between 1982 and 1985. The number of dip tanks has declined over the last three years with the largest reduction (58%) occurring with drive-in dip tanks. There has also been a corresponding decline in the number of mills using dip tanks. However, there was a trend toward the installation of automatic elevator dipping systems inside roofed and heated buildings at new or upgraded mills which opted for a dipping system.

The reduction in drive-in, fork-lift, and sorting-chain dip tanks probably reflects a preference for spray application and automated elevator dip systems in new or upgraded mills. The availability of cross-chain spray systems has also allowed for spray treatment of rough lumber in place of traditional dip treatment. Sorting chain dip tanks are inefficient and consequently their use will probably continue to decline in the future. Drive-in and fork-lift dip tanks have the greatest potential for release of chlorophenates into the environment. Many drive-in and fork-lift facilities are located near fish-bearing water bodies so the reduction in the numbers of these facilities is fortuitous indeed.

There was a 47% increase in both the numbers of spray units and mills using spray systems between 1982 and 1985 (Table 1). This increase was apparently due to overseas lumber buyers' demand for anti-sapstain treated lumber. Most spray systems use wax with the chlorophenate solutions for treating individual pieces of planed lumber. Many of the new spray units in mills with no previous lumber treating facilities are located prior to the lumber grading stations. Many spray units are also located prior to the final trim-sawing station. These lumber trimmings are a source of chlorophenate-contaminated wood waste. However, some mills can control the production of spray-treated lumber thus reducing the amount of contaminated wood waste. Others are designed to treat all lumber production.

2.2 Chemical Handling and Containment Procedures at Wood Protection Facilities

Table 2 summarizes the chemical handling and containment procedures at 74 mills using chlorophenates or alternatives. The types of procedures

TABLE 1 TYPES OF WOOD PROTECTION (ANTI-SAPSTAIN) TREATMENT FACILITIES IN BRITISH COLUMBIA (1982-1985)[1]

TYPE OF UNIT	NUMBERS OF UNITS IN USE				NUMBERS OF MILLS			
	1982	1983	1984[2]	1985[2]	1982	1983	1984[2]	1985[2]
DIP TANKS								
Drive-In Dip Tank	12	10	9	5	12	10	9	5
Fork-Lift Dip Tank	11	11	10	9	11	11	10	9
Elevator Dip Tank	15	16	16	16	14	15	15	15
Sorting-Chain Dip Tank	6	6	5	4	6	6	5	4
Hand Immersion Dip Tank	1	1	1	1	1	1	1	1
TOTAL	45	44	41	35	44	43	40	34
SPRAY UNITS								
Commercial Spray Unit (Walker Bros.)	28	36	39	41	24	28	30	30
Commercial Spray Unit (Diachem)	2	5	9	10	2	5	9	10
Low Pressure Spray Unit (Constructed)	18	22	23	23	11	14	14	14
High Pressure Spray Unit (Constructed)	7	3	3	4	3	3	3	4
Commercial X-Chain Spray Unit (Exco)	0	1	1	4	0	1	1	3
Others[3]	5	6	6	6	4	4	4	4
TOTAL	60	73	81	88	44	55	61	65

[1]Does not include information from four mills which did not answer questionnaire.
[2]1984/85 data was obtained from direct contact with mill personnel.
[3]Other commercial spray units.

TABLE 2 CHEMICAL HANDLING AND CONTAINMENT PROCEDURES AT WOOD PROTECTION (ANTI-SAPSTAIN) TREATMENT FACILITIES IN BRITISH COLUMBIA (1984)

TYPE OF PROCEDURE	NUMBERS OF MILLS (Spray)	NUMBERS OF MILLS (Dip)	NUMBERS OF MILLS (S and D)	NUMBERS OF MILLS (Total)	
Chemical Delivery					
Tank Truck	20	13	17	50	
45 Gallon Drums	7	6	3	16	
Tote Tank	9	1	3	13	
Other	3 (3)			3 (3)	
Chemical Storage					
Dyked	27 [4] (5)	13 [3] (2)	19 [1] (1)	59 [8] (8)	79%
Covered	32 [3] (3)	9 [7] (2)	17p [7] (1)	58 [17] (6)	72%
Spray Units					
Aerosol Control	28 [4] (4)	-	19 [1]	47 [5] (4)	84%
Collection/Recycle	30 [1] (5)		18 [0] (2)	48 [1] (7)	86%
Mix Rooms					
Spill Collection/Recycle	32 [1] (3)	-	14 [1] (5)	46 [2] (8)	82%
Dyked/Sloped	25 [1] (10)		15 [1] (4)	40 [2] (14)	71%
Dip Tanks					
Covered	-	13p [5]	10 [10]	23 [15]	61%
Drip Areas					
Dyked/Sloped	-	13 [5]	18 [2]	31 [7]	82%
Covered	-	10 [8]	8 [12]	18 [20]	47%
Runoff Collection/Recycle	-	16 [1] (1)	17 [1] (2)	33 [2] (3)	87%
Lumber Storage					
Covered	4p [30] (2)	1 [17]	1 [18] (1)	6 [65] (3)	8%
Paved	28 [9] (3)	12 [8] (1)	16 [8] (1)	56 [25] (5)	65%
Chemical Handling Procedures	30 [5] (1)	15 [3]	15 [5]	60 [13] (1)	81%
Spill Plans	28 [6] (2)	13 [5]	12 [8]	53 [19] (2)	72%
					$\bar{x}$ = 70%

[ ] - indicates numbers of facilities where procedure has not been implemented.
( ) - indicates numbers of facilities where implementation of procedure is unknown.
p - partial covering of lumber or a dip tank at one facility out of the total number of mills.
% - percent implementation of procedure.

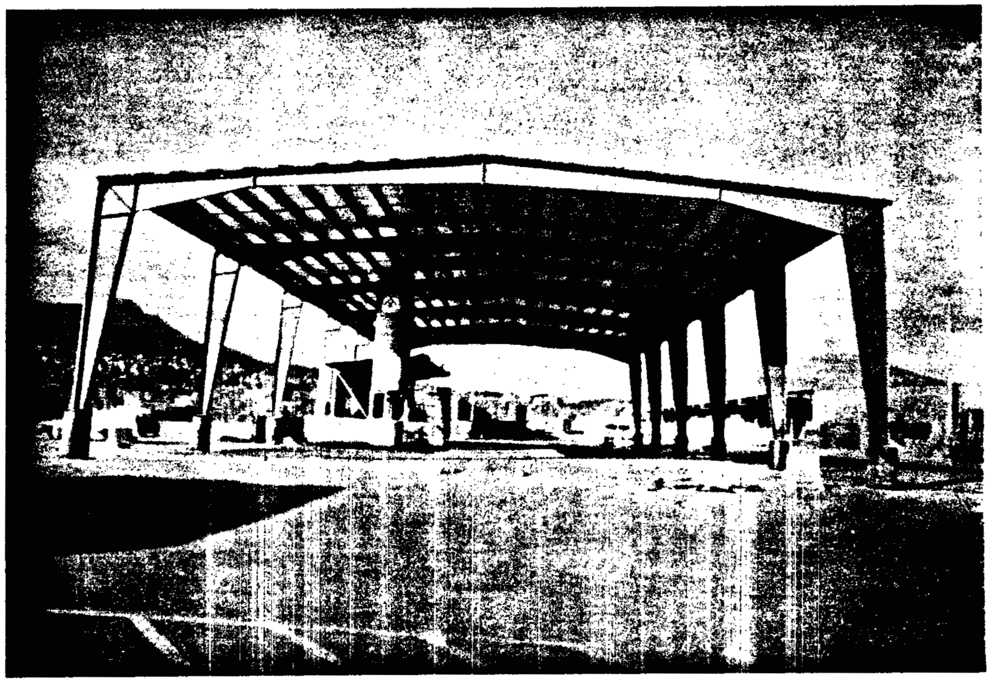
listed in Table 2 are taken from recommendations in the chlorophenate code of practice. The average compliance with all procedures at the 74 mills was 70%.

Concentrated chemicals were stored in covered and dyked areas at most mill sites. However, facilities with dip tanks had a higher incidence of uncovered storage of chemical concentrates. Spray systems at most mills had aerosol control and provisions for collection and recycling of overspray to mix or spray units. New spray units have demisters or scrubbers for aerosol control. Older units exhaust aerosols to the cyclone chip transport. Mixrooms also had provisions for spill containment and chemical collection and recycling.

Many dip tanks and lumber drip areas were uncovered making these facilities prone to flooding during heavy rainfall periods. However, most dripping areas were dyked, curbed, or sloped for recycle of drippage back into the dip tanks. Very few mills provided covered final storage for their anti-sapstain treated lumber. Leaching from treated lumber in storage yards is suspected as a source of low-level releases of wood protection chemicals into the environment. Figure 2 shows two examples of covered storage. Such facilities are very uncommon at this time. Many storage yards are also unpaved which may result in localized soil contamination from stored lumber.

Most mills reported they have detailed wood protection chemical handling procedures and spill contingency plans. These plans have not been reviewed in detail by EPS but it is assumed that they generally provide good information on chemical handling and spill clean-up procedures.

The information in Table 2 was expanded in Table 3 to compare chemical handling and containment procedures at individual dip treatment versus spray treatment facilities in British Columbia. Table 3 again shows the generally lower degree of compliance with code recommendations at dip than at spray treatment facilities. Drive-in and fork-lift dip tanks at some mills require a number of remedial measures such as providing cover for chemical storage, dip tanks, and drip areas. However, because of the potential for spreading contamination to drip and storage areas via lumber transport vehicles, upgrading of these facilities may not achieve a



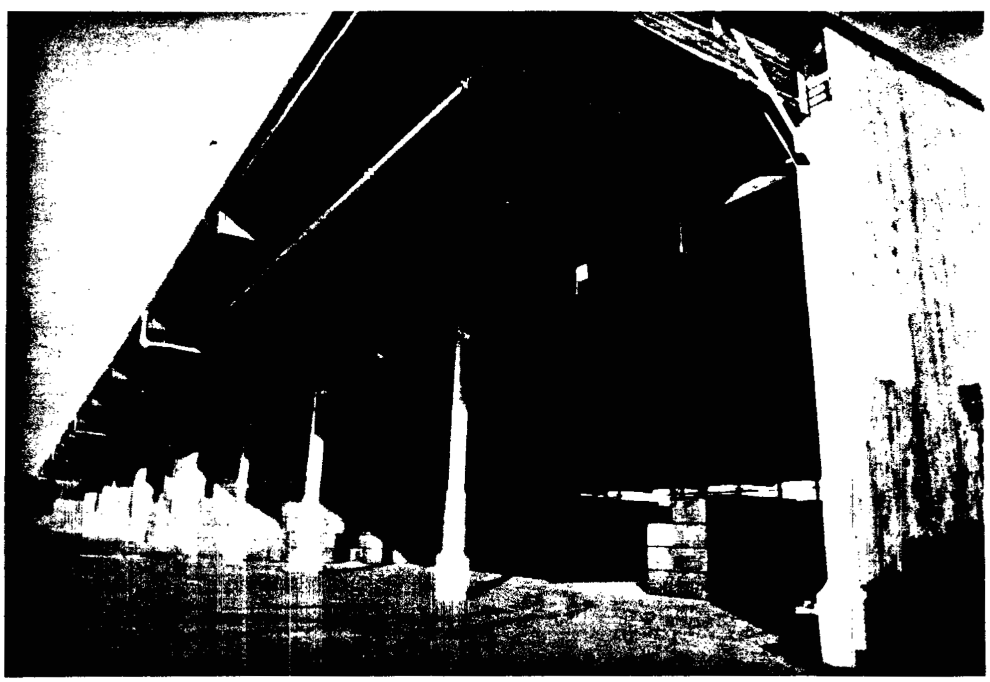


FIGURE 2 EXAMPLES OF COVERED STORAGE OF ANTI-SAPSTAIN TREATED LUMBER

TABLE 3 CHEMICAL HANDLING AND CONTAINMENT PROCEDURES AT INDIVIDUAL DIP TREATMENT FACILITIES VS. SPRAY FACILITIES IN BRITISH COLUMBIA (1984)

TYPE OF PROCEDURE	NUMBERS OF MILLS (Dip)					NUMBER OF MILLS (Spray)
	Drive- In	Fork-Lift	Elevator	Sorting-Chain	Total (Dip)	
Chemical Delivery						
Tank Truck	7	7	11	5		37
45 Gallon Drums	1	5	3			10
Tote Tank	1		1			12
Other						3 (3)
Chemical Storage						
Dyked	7	9 [2]	13 [2]	3 [1] (1)	32 [5] (1) 84%	46 [5] (6) 81%
Covered	5 [4]	5 [6] (1)	13P [3]	2 [2] (1)	25 [15] (2) 60%	49 [10] (4) 78%
Spray Units						
Aerosol Control						47 [5] (4) 84%
Collection/Recycle						48 [1] (7) 86%
Dip Tanks						
Covered	5 [2]	6P [5]	6 [8]	5	22 [15] 58%	
Mix Rooms						
Spill Collection/Recycle						46 [2] (8) 82%
Dyked/Sloped						40 [2] (14) 71%
Drip Areas						
Dyked/Sloped	6 [1]	9 [2]	12 [2]	3 [2]	30 [7] 81%	
Covered	2 [5]	3 [8]	7 [7]	5	17 [20] 46%	
Runoff Collection/Recycle	7	11	12 [2]	2 [1] (2)	32 [3] (2) 86%	
Lumber Storage						
Covered	[7]	[11]	[14]	1 [4]	1 [36] 3%	5 [48] (3) 8%
Paved	7 [4]	9 [4]	10 [6]	2 [3]	28 [17] 62%	44 [17] (4) 68%
Chemical Handling Procedures	5 [2]	10 [1]	13 [1]	2 [3]	30 [7] 81%	45 [10] (1) 80%
Spill Plans	2 [5]	9 [2]	12 [2]	2 [3]	25 [12] 68%	40 [14] (2) 71%
					$\bar{x}$ = 63%	$\bar{x}$ = 71%

[ ] - indicates numbers of facilities where procedure has not been implemented.
( ) - indicates numbers of facilities where implementation of procedure is unknown.
p - partial covering of lumber or a dip tank at one facility out of the total number of mills.
% - percent implementation of procedure.

commensurate reduction in chemical releases to the environment. Roofing of lumber storage areas and dip tanks would appear to be essential if continued use of these facilities occurs in areas subject to heavy rainfall. Automatic elevator dip systems have much better technologies to recover and recycle anti-sapstain solutions and most mills with these facilities have good storage and containment procedures. Upgrading of some mills using elevator dip systems may be required by covering dip tanks and drip areas.

Most spray facilities have good handling, storage, and containment procedures. A few mills may require covered chemical storage, and paving of some lumber storage areas may also be desirable.

Table 2 indicates that only 8% of sawmills and lumber export terminals have covered final storage of treated lumber. As noted earlier, uncovered lumber storage is suspected as a source of low-level releases of chlorophenates into the environment. However, the cost of providing covered storage can be high and this recommendation remains a controversial topic with the forest products industry. EPS and the B.C. Ministry of Environment will undertake a study in 1986 to better define stormwater contamination at selected mills. Releases of chlorophenates in stormwater will be compared at selected dip and spray facilities with and without covered storage of lumber.

Table 4 shows chemical handling and containment procedures at 23 wood protection facilities in the lower Fraser Valley and vicinity. Maintenance of high water quality in the lower Fraser River and estuary is a high priority for both Environment Canada and B.C. Ministry of Environment. Review of lower Fraser wood protection operations is planned for 1986.

The average compliance with all code procedures at the 23 mills was 71%. This was similar to the average for all reporting mills. Procedures at lower Fraser dip tank facilities were generally better than for dip tank facilities in the province as a whole. Most lumber storage areas were uncovered (only one lumber export terminal provided partial covered storage), and many mills did not have covered drip areas or paved lumber storage. The percentages of mills with spill plans and chemical handling procedures were also below the percentages for all reporting mills in the province.

TABLE 4 CHEMICAL HANDLING AND CONTAINMENT PROCEDURES AT WOOD PROTECTION FACILITIES IN THE LOWER FRASER VALLEY AND VICINITY (1984)

TYPE OF PROCEDURE	NUMBERS OF MILLS (Spray)	NUMBERS OF MILLS (Dip)	NUMBERS OF MILLS (S and D)	NUMBERS OF MILLS (Total)	
Chemical Delivery					
Tank Truck	8 (1)	5	7	20 (1)	
45 Gallon Drums	1	2		3	
Tote Tank	1		1	2	
Other					
Chemical Storage					
Dyked	8 [1] (1)	4 (2)	6 (1)	18 [1] (4)	78%
Covered	9 [2] (1)	4 [1] (1)	5P [2] (1)	18 [5] (3)	69%
Spray Units					
Aerosol Control	8 [1] (1)		6 (1)	14 [1] (2)	82%
Collection/Recycle	9 (1)		7	16 (1)	94%
Mix Rooms					
Spill Collection/Recycle	9 (1)		4 (3)	13 (4)	76%
Dyked/Sloped	7 [1] (2)		5 (2)	12 [1] (4)	71%
Dip Tanks	-				
Covered		6P	4 [3]	10 [3]	77%
Drip Areas	-				
Dyked/Sloped		6	6 [1]	12 [1]	92%
Covered		4 [2]	2 [5]	6 [7]	46%
Runoff Collection/Recycle		6	7	13	100%
Lumber Storage					
Covered	[9] (1)	1 [5]	[6] (1)	1 [20] (2)	4%
Paved	8 [2] (1)	5 [2]	5 [3] (1)	18 [7] (2)	67%
Chemical Handling Procedures	8 [1] (1)	5 [1]	3 [4]	16 [6] (1)	70%
Spill Plans	7 [2] (1)	5 [1]	2 [5]	14 [8] (1)	61%
					$\bar{x}$ = 71%

[ ] - indicates numbers of facilities where procedure has not been implemented.
( ) - indicates numbers of facilities where implementation of procedure is unknown.
p - partial covering of lumber or a dip tank at one facility out of the total number of mills.
% - percent implementation of procedure.

2.3 Fate of Contaminated By-Products and Wastes at Wood Protection Facilities

Table 5 summarizes information provided on the fate of contaminated by-products and wastes at wood protection facilities. Most mills reported that up to 1% of their total production of wood wastes (chips, hogfuel, sawdust, shavings) were contaminated with chlorophenates. The contamination probably arises in most cases from the trimmings and shavings of treated rough lumber in planer mills. The volumes of these contaminated wood wastes could not be estimated from the questionnaire responses. However, the volumes may be substantial in some instances.

In 1982, EPS investigated chlorophenate contamination in wood wastes originating from a typical planermill in the lower mainland of British Columbia. Composite samples of planer shavings collected from the end of an overhead cyclone line had an average concentration of 330 micrograms total chlorophenols per gram of dry wood. However, grab samples of planer shavings collected from the floor near the planer had an average concentraton of 776 micrograms total chlorophenols per gram of dry wood. Composite samples of wood waste (end pieces and chips) collected at the trimmer had an average concentration of 151 micrograms total chlorophenols per gram of dry wood. These wood wastes are classified as low-level contaminated solid wastes in the chlorophenate wood protection code of practice.

Table 5 summarizes the fate of wood wastes at B.C. sawmills. Most chips were used as a raw material for pulp and paper mills. Hogfuel, sawdust and shavings were either used as fuel in power boilers, used as raw materials in pulp and paper production, or landfilled. The burning of chlorophenate contaminated wood waste in power boilers is recommended in the code of practice, provided suitable temperatures are achieved. A study of chlorophenol destruction during the incineration of contaminated wood wastes in hogfuel power boilers is currently under discussion with the B.C. Ministry of Environment, the forest products industry, and labour unions.

The volume of dip tank and mix room sludges generated by the industry ranged from 2 to 22 cubic meters per year at each mill generating this type of waste. This estimate was based on information from only seven mills. It was not possible to calculate a total volume because of inadequate

TABLE 5 FATE OF CONTAMINATED BY-PRODUCTS AND WASTES AT WOOD PROTECTION (ANTI-SAPSTAIN) FACILITIES IN BRITISH COLUMBIA (1984)

TYPE OF BY-PRODUCT OR WASTE	PERCENT CONTAMINATION[1]						FATE OF BY-PRODUCTS OR WASTES	
	0-1	2-10	11-20	21-50	51-80	81-100	DISPOSAL METHOD/FATE	NO. OF MILLS
Chips	31[2]	9	5	4	1	-	1. Burned in powerboiler.	1
							2. Export to pulpmills.	45
							3. No chips or uncontaminated chips.	10
							4. Unknown fate.	17
Hogfuel	36	1	-	2	-	-	1. Burned in powerboiler/wood waste burner.	16
							2. Export to pulpmills.	21
							3. Buried in landfill.	6
							4. No hogfuel or uncontaminated hogfuel.	23
							5. Unknown fate.	14
Shavings	18	7	1	-	4	8	1. Burned in powerboiler/wood waste burner.	16
							2. Export to pulpmills.	17
							3. Buried in landfill.	2
							4. No shavings or uncontaminated shavings.	28
							5. Unknown fate.	12
Dip Tank and Mix Room Sludges							1. Burned in powerboiler/wood waste burner.	31
							2. Held in storage.	14
							3. Buried in landfill.	5
							4. Export to pulpmill in hogfuel.	7
							5. Unknown fate.	14
							6. Shipped to U.S.A. for disposal.	4
Yard Runoff							1. To waterbody (river, lake, ocean).	49
							2. To soil/ground.	8
							3. Unknown fate.	13

[1]Percent contamination of the total production of a given by-product with chlorophenates.
[2]Number of mills reporting the indicated range of chlorophenate contamination.

responses in most of the questionnaires. Incineration is the most common disposal method for contaminated sludges (Table 5). This disposal method is generally not recommended in the code of practice because of significant unresolved questions on the formation of toxic combustion products during the incineration of chlorophenate compounds.

A few wood protection operations reported sale of wood wastes to farms and nurseries. One mill reported selling hogfuel to nurseries and farms, three other mills reported selling shavings to farms (one mill was also selling shavings for use in particle board). The levels of chlorophenates in these wood wastes were unknown, but any sale of contaminated wood waste, especially shavings, to farmers is of concern.

Most sawmills and lumber export terminals reported that stormwater runoff from lumber storage yards discharged into a waterbody (Table 5). As noted earlier, contaminated storm runoff is considered a low-level source of chlorophenols to the aquatic environment. EPS and the B.C. Ministry of Environment will undertake a study in 1986 to better define stormwater contamination at selected mills.

2.4 Historical Releases of Chlorophenates into the Environment from Wood Protection Operations

Appendix II summarizes 33 significant chlorophenate releases in British Columbia recorded by EPS between December 1972 and January 1986. Many other spills have been recorded, but these are minor compared to those outlined here. The majority of these incidents involved dip tank facilities (25 out of the 33). Only six incidents occurred with spray facilities and two incidents involved other types of releases.

Chlorophenate releases from dip tanks involved problems of overflow (15 incidents), yard drainage (9 incidents), and one incident of leakage to ground water. As noted earlier, dip tank overflow has been a major problem at facilities with inadequate containment and protection from heavy rainfall, particularly in coastal areas of British Columbia. Many of these same facilities also have had drainage problems from inadequate containment of drip areas. Drippage of concentrated chlorophenate solutions from freshly-treated lumber flowed into storm drains which entered fisheries-sensitive water bodies.

In October 1978, a newly constructed dip tank at an Okanagan sawmill leaked thousands of litres of a 1% chlorophenate working solution to groundwater. The mill was located on native Indian land and the leak potentially threatened both contamination of well water and the Okanagan River adjacent to the mill site. A total of 13.7 million litres of groundwater was treated to remove the chlorophenol contamination.

Incidents at spray facilities involved a variety of equipment malfunctions. Overflow of a recirculation tank resulted in loss of chlorophenate solution into the ground and contamination of surface runoff. A ruptured spray line released chlorophenate solution into storm catchbasins. Chlorophenate working solution was lost to a storm drain from a plugged spray system's vibrating screen. Other releases involved accidents such as leakage from a tote tank during transfer of concentrated chlorophenate solution, and pumping out a collection sump from a treatment area into the stormwater discharge. Most of these releases at spray operations were minor compared to overflow events at dip operations.

The chlorophenate release with greatest impact on the environment occurred in March, 1984 when 41,000 litres of a two percent chlorophenate solution entered Hyland Creek and the Serpentine River from a storage tank on the property of a paint company in Surrey, B.C. Thousands of fish were killed in this incident. Although the chlorophenate release did not occur at a sawmill or lumber export terminal, the incident is illustrative of the consequences of improper storage of large amounts of chlorophenate solution. The tank was not dyked to contain a large liquid release, and there was inadequate security on the tank drainage valves. Sabotage by vandals was the suspected cause of the chlorophenate release. Extensive remedial measures were required to clean-up this spill incident.

2.5 Environmental Monitoring at Wood Protection Facilities 1977-1986

Table 6 summarizes the environmental monitoring studies that have occurred in and adjacent to wood protection operations to date. Surface water and sediments have been most frequently monitored at various mill sites. Air samples were taken by the Workers' Compensation Board of B.C. to determine occupational exposure to aerosols. Very few mill sites have been monitored for potential groundwater contamination.

TABLE 6 SUMMARY OF ENVIRONMENTAL MONITORING FOR CHLOROPHENOLS 1977-1986

YEAR	NUMBER OF MILL SITES AND MEDIA SAMPLED					
	Surface Water[1]	Ground-water[2]	Sediment[3]	Air[4]	Aquatic Biota	Dredge Spoils
1977	1					1
1978	2	2	2			
1979	10		10	1	10	
1980	2			1		
1981	2		1	2	1	1
1982	3	1	1	4		1
1983	9	1	5	3		2
1984	6		2	4		
1985	1		1			
1986	23		23		13	

[1] One additional mill reported annual surface water sampling. Surface water sampling may also have occurred at three additional mill sites but dates are unknown.
[2] One additional mill reported annual groundwater sampling. Groundwater sampling may also have occurred at one additional mill site but date is unknown.
[3] Sediment sampling may also have occurred at four additional mill sites but dates are unknown.
[4] Air sampling may also have occurred at three additional mill sites but dates are unknown.

The most comprehensive surveys for chlorophenol contamination adjacent to wood protection operations occurred in the Fraser River and Southern Vancouver Island (Environment Canada, 1979), and more recently in the Fraser River estuary (Hall et al 1984). In early 1986, the Environmental Protection Service sampled 23 sites in the lower Fraser River for chlorophenate contamination. Surface waters, sediment, and biota were collected at each site. A comprehensive stormwater monitoring program will occur in the fall of 1986 to better characterize releases of chlorophenates from selected mills with varying degrees of compliance with the code of practice.

REFERENCES

Environment Canada, "Monitoring Environmental Contamination from Chlorophenol-Contaminated Wastes Generated in the Wood Preservation Industry, Environmental Protection Service, Regional Program Report 79-24 (1979).

Environment Canada, B.C. Ministry of Environment,"Chlorophenate Wood Protection Recommendations for Design and Operation", 90 pp (1983).

Environment Canada, Agriculture Canada, "Pesticide Registrant Survey Report" (unpublished) (1984).

Hall, K.J., V.K. Gujral, P. Parkinson and T. Ma, "Selected Organic Contaminants in Fish and Sediments from the Fraser River Estuary, B.C.", proceedings of the 11th Annual Aquatic Toxicity Workshop, Delta River Inn, Richmond, B.C., November 13-15, 1984 (1984).

Konasewich, D.E. and E. Gerencher, EVS Consultants Ltd., "Report on Existing Wood Protection Facilities in British Columbia (unpublished) for Environmental Protection Service, Environment Canada (1981).

ACKNOWLEDGEMENTS

We would like to acknowledge the work done by Mr. Gerald Tanner in designing the wood protection questionnaire survey that formed the basis of this report. We also wish to express our thanks to Mr. Ken Wile and Mr. Rick Kussat who provided constructive comments on the first draft of this report.

APPENDICES

APPENDIX I

1984 QUESTIONNAIRE FOR WOOD PROTECTION FACILITIES IN THE FOREST PRODUCTS INDUSTRY OF BRITISH COLUMBIA

1984 QUESTIONNAIRE FOR CHLOROPHENATE USERS FOR ANTI-STAIN / ANTI-MOLD TREATMENT IN THE FOREST PRODUCTS INDUSTRIES OF BRITISH COLUMBIA

FROM: Environment Canada
Environmental Protection Service
3rd floor, Kapilano 100, Park Royal
West Vancouver, B. C.
V7T 1A2
Phone: 666-6711
Contact: Mr. Stanley Liu

Company Name: ____________________

Plant Name (if different): ____________________

ADDRESSES/CONTACTS:

1. Head Office Postal Address: ____________________
____

Contact: ______________, Position: ______________
Phone: ______________

2. Division Postal Address: ____________________
____

Division Mill Address: ____________________
____

Contact: ______________, Position: ______________
Phone: ______________

NAME AND POSITION OF PERSON FILLING OUT QUESTIONNAIRE FORM:

____

ALL DATA REQUESTED ARE FOR 1983 EXCEPT WHEN SPECIFIED OTHERWISE.

Does the mill have an anti-stain/anti-mold treatment operation using chlorophenate solutions? (Yes or No): __________. If Yes, answer the rest of the questionnaire; if no, only answer question 1.8 on page 2.

.....2

1. GENERAL INFORMATION

1.1. Supply a site plan (blueprint or drawing) illustrating mill layout and identify locations of storm drains, ditches, outfalls, streams, burners (teepee, olivine, open pit or boiler), cyclones, treated lumber storage yards, woodwaste piles (chip, hogfuel, etc..), landfill sites (if on mill site) and all chlorophenate facilities (storage tanks, mix-room, spray unit, dip tank, etc..).

1.2. Supply a flow diagram of the mill's process.

1.3. If available, supply photographs of the chlorophenate facilities.

1.4. Does the mill have a detailed chlorophenate handling procedure?
(Yes or No): _________.

1.5. Does the mill have a chlorophenate spill contingency plan?
(Yes or No): _________.

1.6. Has any environmental monitoring been done at the mill to assess total chlorophenols levels in:
a. Sediments? (Yes or No): _________.
b. Surface Waters? (Yes or No): _________.
c. Groundwater? (Yes or No): _________.
d. Air? (Yes or No): _________.

If yes to any of the above, please indicate the monitoring location(s) on the site plan and briefly describe each event (including type of sampling, date and personnel).

1.7. Is a record of chlorophenate consumption kept? (Yes or No): _________.
If yes, how often is the record updated? (Daily, weekly, or specify): _________

1.8. Does the mill have any plans to change, add-on or remove chlorophenate treatment facilities in the near future? (Yes or No): _________. If yes, then describe the plans briefly. Use back of the page if necessary.

1.7 Mill Operations Data:

List Mill Type: (Sawmill, Planermill, etc..)	Production (thousands boardfeet)			
	Total		Treated	
	1982	1983	1982	1983

2. CONCENTRATED CHLOROPHENATE CHEMICAL STORAGE AND HANDLING

2.1. Chemical Type and Useage:

Chemicals Used (brand name)	Used Since (year)	Volume Used (liters)		Delivered to mill by rail, tank truck, steel drums, plastic/fiberglass containers or others (please specify)
		1982	1983	

2. Storage and Containment of Chlorophenate Concentrate:

Concentrate Storage Container					Containment Area			
ype / Material (Specify)	Volume (liters)	Labeled or Signed? (Yes/No)	Type of Level Gauge (Specify)	Storage Location (also specify in the site plan)	Dyking Material (Specify)	Volume (liters)	Covered? (Yes/No)	Spill Detection Equipment (Specify)

2.3. **Briefly describe mill security for concentrated chlorophenate storage facilities.**

- IF THE MILL HAS A DIPPING FACILITY THEN GO TO PAGE 5. IF THE MILL HAS MORE THAN ONE DIPPING FACILITY, PLEASE MAKE ADDITIONAL COPIES OF PAGE 5 AS NECESSARY TO FILL-IN FOR ALL THE DIPPING FACILITIES.
- IF THE MILL HAS A SPRAYING FACILITY THEN GO TO PAGE 6. IF THE MILL HAS MORE THAN ONE SPRAYING FACILITY, PLEASE MAKE ADDITIONAL COPIES OF PAGE 6 AS NECESSARY TO FILL-IN FOR ALL THE SPRAYING FACILITIES.

.....5

3. DIPPING FACILITY

3.1. Identify (as indicated in the site plan) and briefly describe the type of dip tank facility at the mill (drive-in, fork-lift mechanical, automatic elevator, sorting chain or other), please specify.

3.2.

	1982	1983
Volume of lumber treated as rough lumber (thousands boardfeet)		
Volume of lumber treated as planed lumber (thousands boardfeet)		

3.3. Dip Tank Information:

a. Start-up date: ________________.

b. Construction Material: ________________.

c. Covering (indoor, outdoor, roofed, lid, etc..): ________________

________________.

d. Total volume: __________(liters). Operating volume: __________(liters)

e. What concentration is used in the dip tank and how is it measured:

________________.

f. Operational period (daily, weekly, seasonal): ________________.

g. Dip tank is cleaned-out every __________months.

h. If a forklift or straddle carrier is used in the dipping procedure, is it dedicated to this single duty (Yes or No): __________.

3.4. Drip Area Information:

a. Size of dripping area: __________(m^2).

b. Is the dripping area dyked (Yes or No): __________. If yes, specify dyking material: ________________.

c. Is the dripping time fixed or variable? ________________.

Average dripping time is: __________minutes.

d. Is there a roof over the dripping area (Yes or No): __________. If yes, then what percent of the dripping area is roofed? __________%.

e. Briefly describe any other provisions for containment and collection of drip area runoff and indicate fate of runoff (eg. recycled to dip tank, storage tanks, etc..).

.....6

4. SPRAYING FACILITY

4.1. Mix Unit:

a. Mix unit make (brandname or custom-made by whom): ____________
____.

b. Briefly describe the provisions for mix-room containment and collection of spills and the ability to recycle.

4.2. Spray Unit:

a. Identify the spray unit as indicated in the site plan (number or symbol): ____________________________.

b. Start-up date: ____________________________.

c. Spray unit make (tradename or custom-made by whom): ____________
____.

d. Spray pressure (high or low): __________ at __________ KiloPascals. (note that 1 psi = 6.895 KPa)

e. Chlorophenate concentration used: ____________________.

f. Other spray solution additives used (eg. wax, pigments, etc..):
____.

g. Are spray unit aerosols controlled? (Yes or No): __________. If yes, it is controlled by (fan, or specify): ____________________
and the fate of the exhaust is: ____________________.

h. Briefly describe overspray collection facilities and other provisions for chlorophenate containment and collection (eg. drip pans under spray unit, conveyor, stacker, green chain, etc..). Also indicate fate of collected solution (eg. recycled to mix unit, spray unit, etc..).

.....7

5. OTHER CHLOROPHENATE TREATMENT FACILITIES

If facilities other than dip tank or spray unit are in operation, describe the treatment process, equipment and provisions for containment of chlorophenate solutions, etc...

6. FINAL TREATED LUMBER STORAGE AREAS

6.1. Is the treated lumber packaged (eg. strapped, wrapped, end-sealed, etc..) prior to final storage?

6.2. Storage Areas and Fate of Runoffs:

Final Storage Area				Fate of Yard Runoff	
Location (as specified in the site plan)	Size (m^2)	Surface (paved, soil, etc.)	Roofed? (Yes or No)	Immediate (to storm drain, ditch, etc.)	Ultimate (to stream, river, ocean, etc.)

6.3. Describe current and future procedures to contain and/or reduce yard storm water that has been contaminated by chlorophenates leached from treated lumber in the final storage areas.

7. BY-PRODUCTS PRODUCTION AND DISPOSAL

	Production Volume (Units or Specify)	% Production Contaminated with Chlorophenates	* Disposal Method	
			Immediate	Ultimate
Chips				
Hogfuel				
Shavings				

* Immediate disposal method means temporary storage in hopper, bins, etc..
Ultimate disposal method means delivery to other mills, landfilled or to burners.

Note: If data is not available on record, please give estimate if possible.

8. WASTES HANDLING AND DISPOSAL PRACTICES

Outline the immediate and ultimate fates of the following chlorophenate contaminated wastes and include volume (liters/m^3) and weight (units/Kg) where possible.

8.1. Other Contaminated Wood Debris:

8.2. Sludges from Dip Tank and Mix Room:

8.3. Emptied Concentrate Drums (if used in bulk chemical delivery):

8.4. Washwater from Chlorophenate Contaminated Equipment (eg. straddle lumber carrier used in the dip tank):

8.5. Cooling Water Used to Spray Trim Saws Cutting Treated Lumber (if any):

8.6. Other Contaminated Waters (if any):

APPENDIX II

CHLOROPHENATE SPILL INCIDENTS AS RECORDED BY EPS
FROM DECEMBER 1972 TO JANUARY 1986

APPENDIX II CHLOROPHENATE SPILL INCIDENTS AS RECORDED BY EPS FROM DECEMBER 1972 TO JANUARY 1986

DATE	DESCRIPTION OF INCIDENT
Dec./72	Chlorophenate spill into Victoria harbour killed herring.
Apr./73	Overflow from diptank contaminated yard drainage which flowed into Brunette Creek.
Oct./73	Overflow from drive-in diptank flowed into Mamquam Blind Channel and killed juvenile and adult coho salmon.
Apr./76	Overflow from diptank flowed into storm drains which entered Burrard Inlet.
Oct./77	Overflow from diptank contaminated yard drainage which flowed into Fraser River.
Oct./78	Diptank leaked 18,000 litres of 1% chlorophenate solution and contaminated groundwater. Chlorophenol concentrations in the groundwater were as high as 60 ppm.
Apr./79	Chlorophenol contaminated drainage flowed into storm drains and entered Prince Rupert Harbour.
June/79	Overflow of a spray facility recirculation tank resulted in the loss of 900 to 1,400 litres of chlorophenate solution into the ground and contamination of surface runoff.
July/79	Drippage of concentrated solutions from treated lumber flowed into storm drains and entered Burrard Inlet.
Dec./79	Chlorophenol contaminated drainage from sawmill flowed into Cowichan Lake. Chlorophenol concentration in ditch as high as 3700 ppm.
Feb./80	Overflow from dripping area due to failure of recycle pump transferring contaminated water back to dip tank, some flow into Burrard Inlet.
Mar./80	Overflow from diptank during rainfall period flowed into storm drain which entered the Fraser River.

CONTINUED...

APPENDIX II (Continued)

DATE	DESCRIPTION OF INCIDENT
May/80	Small volume of contaminated storm water in dripping area leaked through dyke.
Nov./80	Direct discharge of chlorophenate dripping solution into the Fraser River from the overflow pipe of a drive-in dip tank. Chlorophenol concentration in overflow was 2005 ppm.
Jan./81	Employee accidentally pumped out collection sump from treatment area into the storm water discharge, 11,000 litres of chlorophenol contaminated water was discharged into Northumberland Channel.
Feb./81	On-going problem of discharge of contaminated runoff from the dripping area.
June/81	Drippage from freshly-treated dipped lumber flowed into Burrard Inlet.
Aug./81	Workers discharged 1800 to 2700 litres of chlorophenol contaminated water onto dock area. The contaminated water flowed into Burrard Inlet. Levels as high as 1300 ppm were measured in the water.
Sept./81	Discharge of chlorophenol-contaminated runoff from lumber storage areas into the Fraser River.
Jan./82	Ruptured spray line resulted in loss of 23 to 45 litres of chlorophenate solution into storm catch basins.
Feb./82	Dip tank overflow (4500 litres) contaminated surrounding soil and possibly groundwater.
Apr./82	On-going loss of chlorophenate solutions from dip tank, no containment around dip tank.
Apr./82	Contaminated stormwater discharged to Fraser River.
Feb./83	Application of chlorophenates to lumber using watering cans. Yard runoff to Ladysmith Harbour.

CONTINUED...

APPENDIX II (Continued)

DATE	DESCRIPTION OF INCIDENT
July/83	1100 litres of chlorophenate concentrate leaked from a tote tank during transfer. Some solution entered a storm drain which flowed into the Fraser River.
Nov./83	Overflow from diptank and dyked areas due to recycle pump for drip area being left on during a heavy rainfall. Overflow entered storm drains and Burrard Inlet.
Nov./83	Chlorophenol-contaminated water pumped from unused drip area into storm drain and Burrard Inlet.
Jan./84	Chlorophenol-contaminated water pumped from unused drip area into storm drain and Burrard Inlet.
Mar./84	41,000 litres of a 2% chlorophenate solution entered Hyland Creek and the Serpentine River from a storage tank on a paint companies' property. Sabotage was suspected.
Nov./84	91 litres of chlorophenate working solution lost to storm drain when spray system's vibrating screen was plugged.
June/85	117 litres of concentrated chlorophenate solution lost to storm drain entering Casey Creek and Duncan Bay. Release was caused from overflow of storage tank. Fish and invertebrates killed in Duncan Bay.
Sept./85	Tank with diptank sludge filled with rain and overflowed to ditch.
Jan./86	Overflow of drive-in dip tank from actions of lumber carrier vehicle.