Environment Canada | Environnement Canada

Environmental Protection | Protection de l'environnement

Mill Characterization:

Rayonier Canada Limited Woodfibre Pulp Mill May 1974

74-7

Manuscript Report 74-7
Pacific Region

ENVIRONMENTAL PROTECTION SERVICE REPORT SERIES

Manuscript Reports are of local interest only. They describe a part of a larger program or list results only without discussion or conclusions, or in some way do not qualify for national E.P.S. publications categories.

Other categories in the E.P.S. series include such groups as Regulations, Codes and Protocols, Policy and Planning, Technical Appraisal, Technology Development, Surveillance, and Reprints of Published Papers.

Inquiries pertaining to Environmental Protection Service Reports should be directed to the Environmental Protection Service, Department of the Environment, Kapilano 100, Park Royal, West Vancouver, B.C. V7T 1A2.

MILL CHARACTERIZATION:

RAYONIER CANADA LIMITED

WOODFIBRE PULP MILL

May, 1974

by

William E. McLean

and

Gerald C. Tanner

Environment Canada
Environmental Protection Service
Pollution Abatement Branch
Pacific Region

Manuscript Report - 74-7
September 1974

ABSTRACT

This report was prepared from technical data provided by Rayonier Canada Limited, Woodfibre Pulp mill. The report provides supplemental information for establishing a water pollution abatement program to meet the requirements of the Federal Pulp and Paper Effluent Regulations. The report will be used as a guide when determining the progress and changes made by the mill to achieve the requirements of the Federal Pulp and Paper Effluent Regulations.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

The following assessment of Woodfibre Pulp Mill (Rayonier Canada Ltd.) was carried out in May, 1974. This project was initiated with a number of purposes in mind. Firstly, an attempt was made to become familiar with individual Mill processes in order to gain insight into sources of particular effluent streams. Also, an up-to-date inventory of sampling methods, testing techniques and abatement facilities was compiled. During this period a good working relationship was established with Mill personnel involved in water pollution abatement programs.

2. MILL DESCRIPTION

2.1 History

Woodfibre began operation in 1912 as an unbleached sulphite mill. In 1958 the mill was shut down and construction of the present bleached sulphate mill was started. Operation of 5 batch digesters (250 T/D) commenced in 1961. In 1965 a 350 T/D Kamry continuous digester was installed; bringing the mill to its present 600 T/D capacity.

2.2 Location

Woodfibre Division is located near the head of Howe Sound; approximately 3 miles south of the Squamish River estuary. The registered description is Lot 2351, Group I, New Westminster District.

2.3 Organizational Structure

Mill Manager	Mr. W. Francis
Technical Superintendent	Mr. W. Rempel
Environmental Engineer	Mr. F.S. Sherriff

Environmental problems are the responsibility of the Technical Department. Within this group an Environmental

Engineer and one technician, Bob Antille, are devoted full time to air and water monitoring and abatement projects. A union pollution committee has not been formed.

2.4 Operation Information

2.4.1 Products. A wide range of kraft pulp grades are manufactured at Woodfibre. The two major grades, Cedanier and W.B.S., account for about 97% of the yearly production. They are defined accordingly to furnish (Table 1).

TABLE 1. MAJOR PULP GRADES

	Hem.-Bal.	Spr.	Cedar	Fir
Cedanier	30	10	60	-
W.B.S. (Woodfibre Bleached Sulphate)	51	-	29	20
Fiberfate	37	-	-	63

Within these grades different brightness levels can be achieved, depending on demand. The total production of bleached and semibleached kraft pulp (1973) averaged 535 ADT/D.

2.4.2 Wood Supply. Approximately 33% of the chips required are manufactuered on site. The remainder are purchased from Rayonier's three sawmills on the Fraser River. The approximate composition of the chip supply is shown in Table 2.

Table 2. CHIP SUPPLY

Wood Species	Proportion (%)
Hemlock Balsam	55
Cedar	29
Fir	11
Spruce	5

2.4.3 Water Supply. Mill process water is obtained from Mill Creek and Cedar Creek. The mill water supply undergoes primary treatment (down flow filtration) before it is used in the process. Backwash water flows to the "Y" sewer. Water usage

over 1973 averaged 33.8 x 10^6 U.S.G.P.D. or 63,300 U.S.G. per ADT.

Boiler feed water is prepared by passing filtered creek water through ion exchange columns. The caustic and acid rinses go to sewer.

2.4.4 Mill Processes; Unit Operations and Major Equipment. A detailed equipment list is provided in Appendix I. The following is a brief characterization of major processes.

2.4.4.1 Woodmill. Total Production (1973 average):
- 159,970 cunits
or 569 ODT/D

The large wood plant handles logs up to 42 inches in diameter; 1973 average production: 49,175 cunits (approx. 200 ODT/D). Debarking is carried out by a Bellingham hydraulic debarker. Dewatering of the debarker effluent is accomplished by a D.S.M. screen. Dewatered bark goes to hog.

The small Woodplant and Chip and Saw handles logs up to 22 inches in diameter. This unit produces rough lumber and chips. 1973 average production: 369 ODT/d. Debarking is carried out by a Nicholson Wig Wag hydraulic debarker, while a Dillon (Tyler Ton-Cap screen plate) vibrating screen is used for dewatering the effluent. Dewatered bark goes to hog.

During 1973 the Mill consumed 92,000 Tons of Hog. 18,000 Tons was manufactured on site while 74,000 Tons were purchased. Slightly more than one half of the electricity consumed was purchased from B.C. Hydro (64,000 MKWHr.) while 51,000 MKWHr was generated at the mill.

2.4.4.2 Pulping. Pulp is cooked to a P.No. of 19.0 (1973 average). Major equipment involved in the pulping and washing processes is shown in Table 3.

TABLE 3. PULPING AND WASHING EQUIPMENT

	A Side	B Side
Digesters	5 Batch	1 Kamry Continuous
Total Maximum Production	250 T.P.D.	350 T.P.D.
Brown Stock Washers	3 Stages	2 Stages plus Internal
Tank Volumes		
- No. 1 Filtrate	67,000 U.S.G.	94,500 U.S.G.
- No. 2 Filtrate	67,000 U.S.G.	94,500 U.S.G.
- No. 3 Filtrate	67,000 U.S.G.	---
- Foam Tank	67,000 U.S.G.	22,400 U.S.G.
- Cont. Tank Water Accumulator	113,000 U.S.G.	---
- Knot Tank	21,000 U.S.G.	---

Brown Stock Washer soda losses depend on the grade produced. Average 1973 losses are shown below.

Cedanier X: 23.7 lb. Na_2SO_4 per ADT.
W.B.S. : 27.8 lb. Na_2SO_4 per ADT.

2.4.4.3 Recovery. Oxidation of the Weak Black Liquor (W.B.L.) is accomplished by two B.C. Research Council (B.C.R.C.) oxidation towers. Average tower efficiency (1973) is 90%. Major equipment in the Recovery area is summarized in Table 4.

TABLE 4. RECOVERY EQUIPMENT

	A Side	B Side
Evaporator		
- Effects	4	4
- Input	500 gpm @ 17.0%	650 gpm @ 17.0%
- Output	42%	42%
- Capacity	164,000 lb H_2O/hr.	262,000 lb H_2O/hr.
Recovery Boilers		
- type	B and W	B and W
- capacity	855,000 lb. B.L.S/day	1,300,000 lb B.L.S./day

Storage

- unoxidized W.B.L.: 2 Tanks 123,000 U.S.G. ea.
- oxidized W.B.L. : 288,000 U.S.G.
- S.B.L. : 2 Tanks, 57,500 U.S.G. and 70,000 U.S.G.

2.4.4.4 Recausticizing. This process is also divided into Side A and Side B. Each process line has its own kiln, slaker, mud storage etc. Chemical Storage in the Recaust area is summarized in Table 5.

TABLE 5. RECAUST STORAGE

	A Side	B Side
W.L. Clarifier	103,000 U.S.G.	103,000 U.S.G.
G.L. Clarifier	148,000	148,000
Lime Mud Storage	139,500	139,500
Lime Mud Washer	139,500	139,500
G.L. Storage	106,000	106,000
Weak Wash Storage	54,000	55,200
C.H.W. Tank	27,500 (common)	
W.L. Storage	Tank 1. 131,702	
	Tank 2. 144,000	
Dump Tank	144,000	

2.4.4.5 Bleach Plant.

A Bleach Sequence - CEHDED

B Bleach Sequence - CEHDED

ClO_2 is generated on site by the Matheson Process. Spent Liquor is recycled to the black liquor system.

2.4.4.6 Pulp Machine. See Appendix I.

2.4.5 Water Reuse. Evaporator foul condensate from the stream ejectors is sewered. Normal evaporator condensate is partially reused in the recausticizing process (on the dregs washers, mud washers and peabody showers). The exact degree of reuse is not known but a genral opinion is that about 50% of the condensate is reused, the remainder is sewered. Digester condensates are sewered in the Accumulator overflow.

On the average, 35-40% of the shower water in the "B" Bleach plant is recycled from the Seal Tanks. No. 6 Seal Tank effluent is reused on the No. 4 washer and the No. 5 Seal Tank effluent is reused on the No. 3 washer. The degree of recycling can be increased to 50% if No. 3 Seal Tank effluent is reused on the No. 2 washer. This is carried out part of the time.

2.4.6 Chemical Usage.

2.4.6.1 Lime usage. Lime addition during the Recausticizing process averaged 75 lb $CaCO_3$ per ADT over 1973. Lime usage at present (April 1974) is about 160 lb $CaCO_3$ per ADT.

2.4.6.2 Sodium Usage. Sodium addition during the Recovery process averaged 97 lb Na_2O per ADT (220 lb Na_2SO_4 per ADT) over 1973.

Wood fiber is (on a temporary basis) reducing the quantity of saltcake required as make up by utilizing Vanallin Black Liquor (V.B.L.). This substance is a waste product of a Vanallin extraction plant is Seattle. It is barged (800,000 U.S.G. per barge) to Woodfiber at about 20% solids. V.B.L. is bled slowly to W.B.L. storage at about 25 gpm. In this way only about 5% of the Evaporator capacity is required. V.B.L. is used mainly

for sodium make up as it is about 6% sodium and only 1% sulfur. V.B.L. is being used on a trial basis. The long term effects on the Liquor System are unknown.

3. SEWER SYSTEM AND EFFLUENT CHARACTERISTICS

3.1 Sewer Layout

A layout of the sewer system is shown in Figure 1. Descriptions of the various sewers are provided in Table 6. It should be pointed out that the M. L and K sewers are to be combined this summer.

3.2 Spill Detection

Level control charts and alarms exist on the following tanks:

A and B Dissolving Tanks
A White Liquor Clarifier
A Weak Wash (Temp. probe)
A Lime and Storage
A Green Liquor Storage - overflow to Weak Wash
White Liquor Storage
B Green Liquor Storage - overflows to W.W.
B Lime mud storage

Also, 3 conductivity alarms have been installed on the Kamur Liquor heaters. Within the next few months the following spill detection items will be installed:

A Causticizers Sump - Temp. probe and alarm chart
B Casuticizers Sump - Temp. probe and alarm chart
W.L. Clarifier Sump - temp. probe and alarm chart
Recovery sewer - conductivity probe and alarm chart
Recaust sewer - conductivity probe and alarm chart

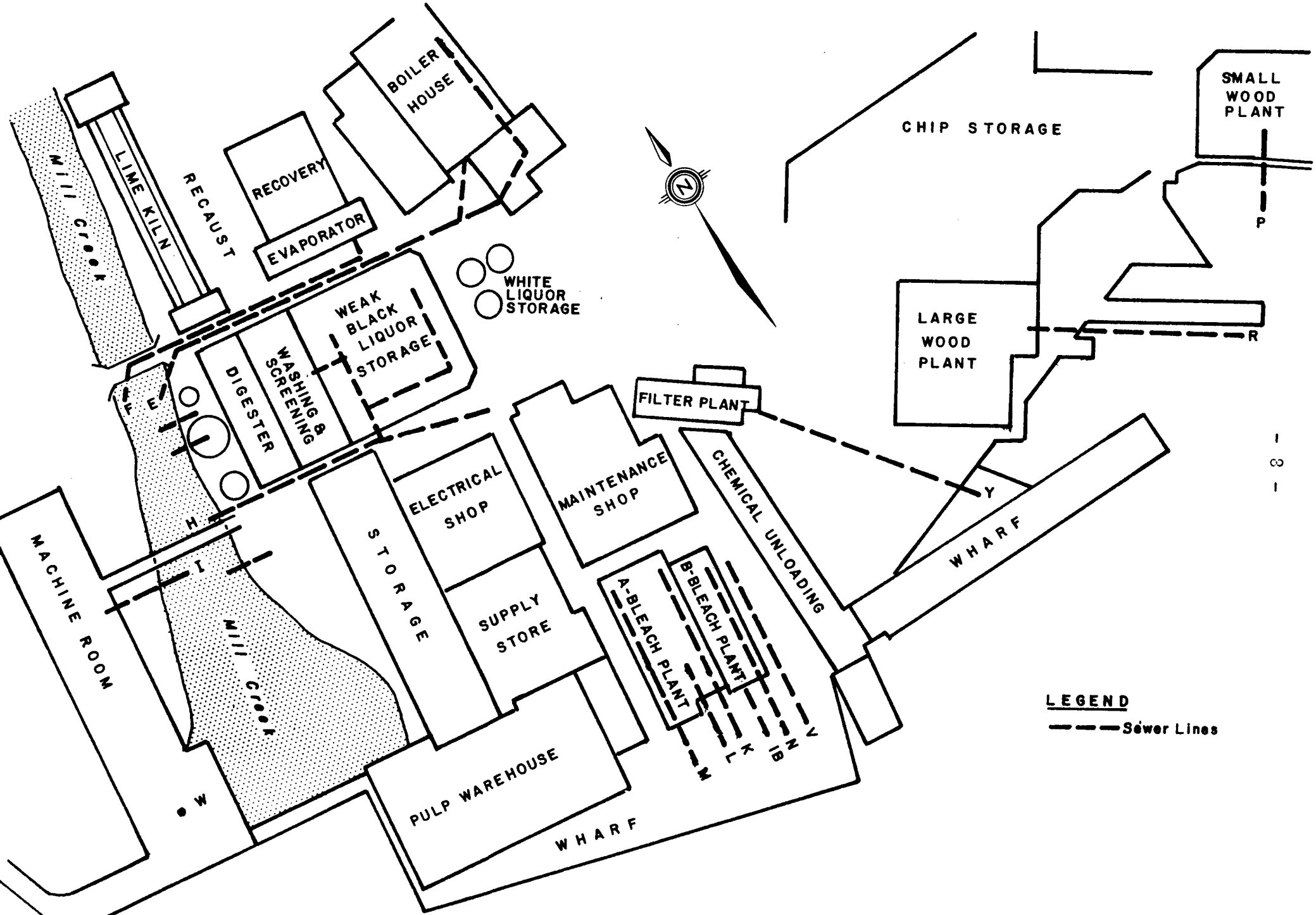


FIGURE I SEWER LAYOUT

TABLE 6. SEWER DESCRIPTIONS

SEWER	DESCRIPTION
E	Recaust (including dregs), Recovery Power Boiler (flyash after screening)
F	M.E. Evaporator condensates
H	Digester area washdowns, screen room (UWW) B.S. Washing overflows, seal tank overflows.
I	Pulp Machine
W	Broke Pulper Tank overflow
1.	Peabody Scrubber Sump overflow
2.	Accumulator overflow
3.	Accumulator shower water overflow
4.	Surface Drain
M	A Bleach 6th stage (ClO_2) effluent
L	A Bleach 4th stage (ClO_2) effluent
K	A Bleach 1st, 2nd, 3rd, 5th stages effluents (Chlorination, Extraction, Hypo, Extraction)
1B	B Bleach 1st stage (Chlorination) effluent
N	B Bleach (2nd to 6th) stage effluent
V	Washdown and surface drain sewer
Y	Filter Plant overflow and Back Wash effluent
R	Large Wood Plant
P	Small Wood Plant (Chip and Saw)

3.3 Sewer Sampling

Sewers are sampled by one of the following methods:

(a) Grab samples

(b) Continuous chain samplers

(c) Unimec peristaltic pump continous samplers.

This device provides a small constant flow to the sample container. Because the tube diameter is about 3/8 of an inch, the sampler is not suitable for high suspended solid streams. A list of sewer samplers is shown in Table 7.

TABLE 7. SAMPLERS

SEWER	SAMPLER
F	Unimec
I	Unimec
N	Unimec
1B	Grab
M	Not Sampled
L	Not Sampled
K	Not Sampled
E	Chain
H	Chain
P	Chain
R	Not Sampled

The remainder of the outfalls are not sampled regularly. When M. L and K sewers are combined a Unimec sampler will be installed. Also, when changes in the Large Wood plant have been completed a chain sampler will be installed. Samples (1/2 gal.) are collected daily from the various sewers. The samples are stored outside the laboratory in plastic barrels. On Friday weekly composites are made and the effluent technician carries out suspended solids, settleable solids, total solids, dissolved solids, colour, pH, and dissolved oxygen determinations. $B.O.D._5$ analysis is only carried out on Friday grab samples. The lab is equipped to do Resin Acids, Sulfides, Mercuptans and Residual Chlorine analysis, however, these tests are not done routinely.

Fiber, soda and lime loss analysis can be carried out on a daily basis for in-plant use.

There are no direct flow measurement devices on the sewers. All "pound per day" effluent figures are calculated from flows based on water use records.

3.4 Final Effluent Discharge

3.4.1 Provincial and Federal Effluent Quality Requirements.

Woodfibre Pulp Division has applied to the Pollution Control Board for an effluent discharge permit (Level B). The effluent characteristics stipulated in the Level B permit are shown in Table 8.

As an existing mill, the Federal Pulp and Paper Effluent Regulations stipulate that Woodfibre Division would be required to meet standards more stringent that those outlined in Level B for suspended solids and toxicity. The Federal requirements for effluent discharge are shown in Table 9.

TABLE 8. P.C.B. OBJECTIVES

(a) P.C.B. LEVEL "B" OBJECTIVES FOR CHEMICAL PULPING WITH MARINE DISCHARGE

Effluent Characteristic	Value
pH Range	6.5 - 8.5
Temperature	95°F
Floatable Solids	negligible
Total Suspended Solids	30 lb/ADT
Settleable Solids	2.5 mℓ/ℓ
$B.O.D._5$	60 lb/ADT
Toxicity (Tℓm 96)	12.5%
Mercaptans	>2.0 mg/ℓ
Sulphides	<1.0 mg/ℓ
Dissolved Oxygen	>2.0 mg/ℓ
Residual Chlorine	<0.1 mg/ℓ

(b) P.C.B. LEVEL "B" OBJECTIVES FOR HYDRAULIC DEBARKING WITH MARINE DISCHARGE

Effluent Characteristic	Value
Total Suspended Solids	4.0 lb/cunit
Total Settleable Solids	2.5 mℓ/ℓ
$B.O.D._5$	4.0 lb/cunit
Floatable Solids	Negligible
Toxicity (Tℓm 96)	12.5%
pH Range	6.5 - 8.5

TABLE 9. FEDERAL REQUIREMENTS

Process	Allowable Discharge	
	S.S.	$B.O.D._5$
Hydraulic Debarking		
Hydraulic Debarking	5 lb/ODT of wood	
Kraft Pulping	7 lb/ADT	64 lb/ADT
Kraft Bleaching	6 lb/ADT	27 lb/ADT
Pulp Sheet Formation	2 lb/ADT	

Toxicity - 80% survival at 65% v/v concentration over 96 hours.

3.4.2 Current Woodfibre Final Effluent Discharge.

3.4.2.1 $B.O.D._5$ and S.S. $B.O.D._5$ and S.S. results for the E, H, F, N, I and 1B sewers are mathematically added to give the total kraft Mill S.S. and $B.O.D._5$ discharge. Average Mill discharge over 1973 is shown below:

	WOODFIBRE TOTAL DISCHARGE	FED. ALLOWABLE	PCB LEVEL B
S.S.	59,600 lb/day; 110.6 lb/ADT	8312 lb/day	16,050 lb/day 30 lb/ADT
$B.O.D._5$	35,000 lb/day 65.4 lb/ADT	51,309 lb/day	32,100 lb/day 60 lb/ADT

TABLE 10 - B.C. RESEARCH BIOASSAY RESULTS

May 2, 1973

Sewer	pH		% Survival in 12.5% (V/V) Effluent			
	Before Dilution	After Dilution	24 hr.	48 hr.	72 hr.	96 hr.
Mill Composite (plus Woodmill	6.4	6.5	100	100	100	100
Mill Composite (minus Woodmill)	6.5	6.5	100	100	100	100
P, (Small Wood-plant)	6.2	6.5	100	100	100	100
H (U.W.W.)	8.4	6.9	100	100	100	100
F (Evaps.)	8.0	6.8	100	100	100	100
May 9, 1973						
Mill Composite (plus Woodmill)	3.2	4.4	0	0	0	0
Mill Composite (minus Woodmill)	2.9	4.2	50	20	0	0
P (Small Wood-plant)	5.0	5.7	0	0	0	0
H (U.W.W.)	8.7	6.7	100	100	100	100
F (Evaps)	7.3	6.6	10	0	0	0

It should be pointed out the accumulator overflow is not tested and is, therefore, not included in the above totals. Also, the above discharge figures involve a high degree of uncertainty because flows have not been directly measured.

The total Wood Mill discharge can be calculated by adding the individual discharges of the P and R sewers. The 1973 (average) discharge is shown below:

	WOOD MILL	FED. ALLOWABLE	PCB, lvB
S.S.	8960 lb/day; 17.2 lb/ODT	2610 lb/day; 5 lb/ODT	1821 lb/day
BOD_5	2190 lb/day; 4.2 lb/ODT		1821 lb/day

3.4.2.2 Toxicity. A limited amount of toxicity testing has been carried out on Woodfibre effluent streams by B.C. Research. Two tests were conducted in May, 1973. The results have been presented in Table 10. Dilution was carried out with fresh water. Olympic Research Division(ORD) of I.T.T. has also carried out toxicity tests at Woodfibre. The Report published on this subject, "Toxicity, BOD_5 and Pearl Benson Index of Woodfibre effluents", has been presented in Appendix II. Briefly, LC_{50} and LC_{20} determinations were carried out on individual effluent streams and on the composited effluents. Rainbow trout were used in the test at a load density of 0.22 gm/liter. Fresh water was used for dilution. The results are summarized in Table 11.

TABLE 11 - O.R.D. BIOASSAY RESULTS

Effluent Streams	Toxicity	
	$LC_{50\%}$	$LC_{20\%}$
Causticizing and Recovery	53	40
Washing and Screening	7	2.5
Evap. Condensates	1.9	1.2
Unit A Bleach Plant	44	35
Barker/Woodplant	<20	<20
Drying Machine	94	56
Composite	<65	<65
Standard Toxicant	2.4	1.8

LC_{50} = Concentration (V/V) at which 50% mortality occurs over four days.

LC_{20} = Concentration (V/V) at which 20% mortality occurs over four days.

3.4.3 Solid Waste. The mill generates solid waste in the form of slaker grits, contaminated Hog fuel, butt ends, cinders, etc. This material is trucked to two waste dump sites. Combustible material is not removed. The mill has a P.C.B. permit to dump 49 yd^3 per day to each site.

Solid waste is also generated in mill dredging operations. Dredging is carried out at the following locations and is disposed of at sea.

(a) Mouth of Mill Creek - In recent years dredging has been carried out at the mouth of Mill Creek twice per year. On each occasion about 3 scow loads per day are removed over a period of five days. About 4,000 to 5,000 yd^3 of dredgate is generated during this operation. Dredgate produced = 8,000 to 10,000 yd^3/year.

(b) Chip Dock - Every two years dredging is carried out near the Chip Dock. Over the two day dredging period, 600 to 800 yd^3 of dredgate is produced. Dredgate produced = 300 to 400 yd^3/year

(c) Log Pond - Every 3 to 4 months dredging is carried out in the log pond. About six scow loads (about 2000 yd^3) of material are removed from this area per year. Dredgate produced = 2,000 yd^3/year.

3.4.4 Inplant Balances. The distribution of sewer flows, S.S. and BOD loadings has been shown in Table 12 and Figure 2. All flow data has been taken from water use records. Because the R, M, L, K, Y, and V sewers are not sampled routinely, the BOD and S.S. values presented are only probable values, based on grab samples taken over a relatively short period of time. The rest of the sewers are routinely sampled. Values have been arrived at by averaging over March, 1974 data. pH ranges have been taken from long term averages.

TABLE 12 - SEWER CHARACTERISTICS

Sewer	Flow USG/PM	S.S. lb/day	BOD lb/day	pH
E	4330	39,600	6,200	10.3 - 11.0
F	417	-	3,390	7.7 - 10.0
H	2600	18,600	3,390	9.0 - 10.4
I	1250	565	565	6.6 - 8.7
W	Normally 0	-	-	7.0
M	834	270	440	2.5 - 6.0
L	834	270	440	2.4 - 4.0
K	5330	2,680	8,960	3.0 - 5.0
N (lb)	8330	3,100	8,350	2.4 - 3.2
V	500	-	-	6.0
Y	1330	-	-	7.0
R	1080	5,820	640	7.0
P	1200	3,480	1,010	7.0

COD and BOD_5 determinations were carried out at Woodfibre during the period November 17 to November 30, 1968 and also from September 15 to September 30, 1969. The ratio of COD to BOD (COD/BOD) for the various sewers was calculated average valves are shown in Table 13.

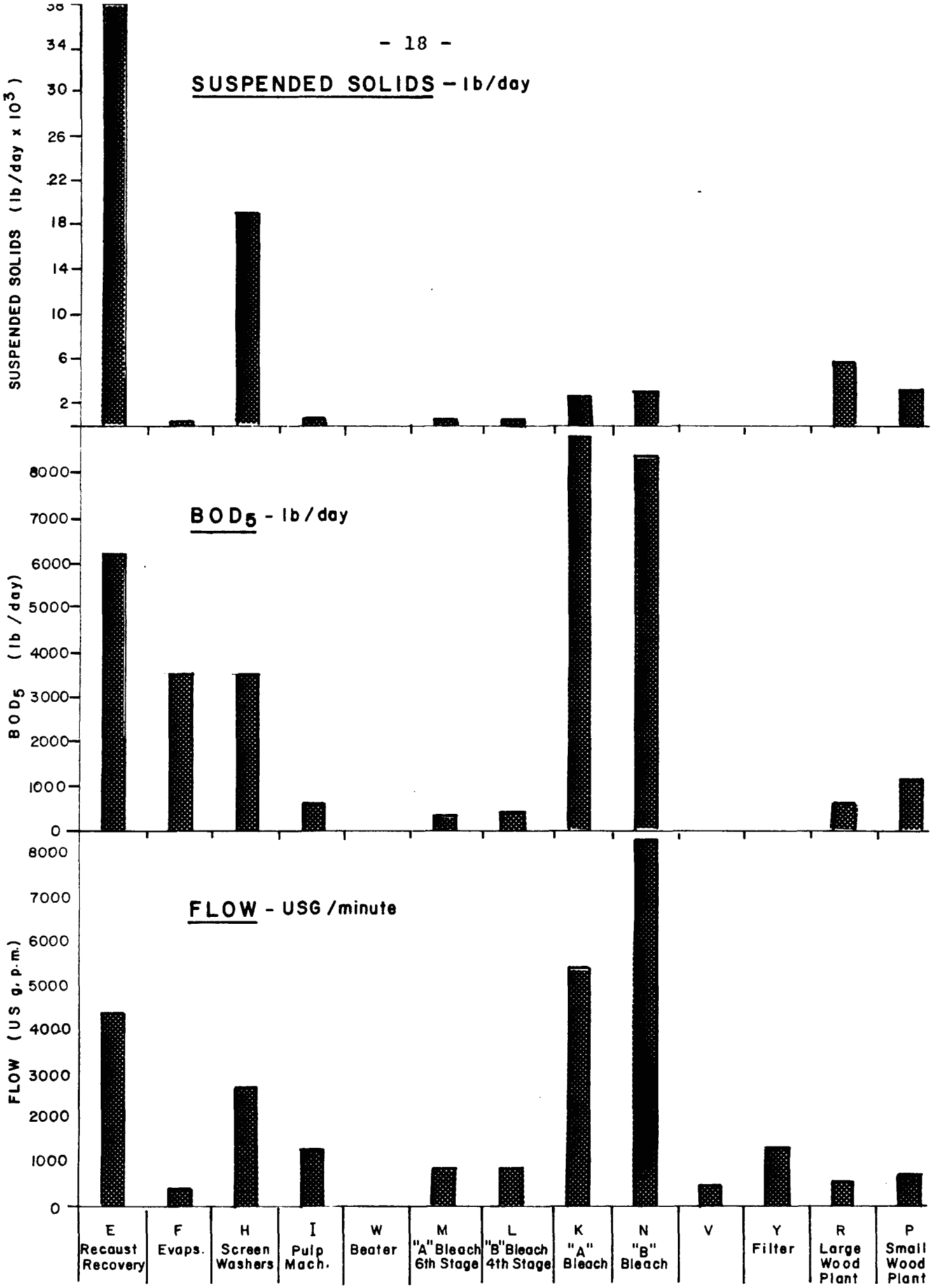


FIGURE 2 SEWER CHARACTERISTICS

TABLE 13 - COD/BOD VALUES FOR VARIOUS SEWERS

Sewer	Average COD/BOD	No. of Samples
E* (Recaust, Recovery)	2.6	27
H (Screen, Washers)	4.3	27
F (Evaps.)	2.2	23
Peabody Scrubber	1.7	22
N (B Bleach)	4.2	17
I (Pulp Machine)	1.5	17

* E Sewer contained Woodmill effluent at that time.

These ratio's allow a rough estimation of the COD output of the various sewers.

Sewer Sodium losses are not measured on a routine basis. However, based on a 1969 survey, a rough distribution of soda losses can be obtained (Table 14).

TABLE 14 - SODIUM LOSS

Sewer	Loss (lb Na as Na O per day)
E	17,700
H	20,860
F	0.8
N	21,100
Machine Room	46

Lime losses are measured routinely

3.5 Effluent Testing Procedures

3.5.1 Solids.

3.5.1.1 Suspended Solids. Media, 12.5 cm. Whatman 40 Sample volume 100 ml.

In May, 1974 the S.S. procedure was modified. At present Woodfibre uses 2.4 cm. Reeve Angel 934AH and a 100 ml sample. Effluents with filtration times greater than 10 minutes are filtered through Reeve Angel glass Fiber disks with a preformed asbestos mat. This procedure is based on the Report published by Olympic Research Division entitled "Determination of S.S. In Wastewaters" (Appendix III). This method has given problems. Long filtration times (even with the asbestos mat) have resulted in Woodfibre considering the use of larger diameter Reeve Angel filter disks.

A firm decision on a combination of filter media and sample volume will not be made until tests have been standardized across the province. A Sauter Analytical balance is used for all weight measurements. Samples are dryed at 105°C for one hour. Dessication is carried out for 30 minutes before weighing.

3.5.1.2 Settleable Solids. This test is carried out according to standard methods. Results are reported in ml/l.

3.5.1.3 Total Solids. A 100 ml sample is evaporated to dryness at 105°C over a 24 hour period.

3.5.2 Colour. The sample is initially filtered through Whatman 40 filter paper. The pH is then adjusted to pH 7 with NaOH or HCl. Absorbance is measured on a B. and L. Spectronic 20 spectrophotometer at 565 mu. Standard cobalt platinum color units are used in preparation of the standard curve.

3.5.3 BOD_5.

3.5.3.1 Dissolved Oxygen Measurement. All D.O.'s are determined by the azide modification of the Winkler method. Thio-

sulfate normality occurred over a year.

3.5.3.2. Distilled Water. Distilled water is prepared using a Consolidated G-10 water still. Tap water is used as feed water. The still uses steam as a heat source and is tin lined. Oxygen depletion checks are not carried out on the distilled water.

3.5.3.3 Dilution Water. Distilled water is aerated with mill air the day before use. It is placed (loosely stopered) in a 20°C incubator overnight. The following morning standard BOD nutrient chemicals and seed (1 ml. per liter) are added to the dilution water.

3.5.3.4 BOD Calculation. Samples are not neutralized prior to dilution. The following dilution ratios are normally used in preparing samples for incubation.

$$\text{Dilution Ratio (P)} = \frac{\text{Vol. of sample (m}\ell\text{)}}{300\ \text{m}\ell}$$

Sample	Sample Volume	Dilution Ratio (P)
E (Recaust, Recovery	5 mℓ	1/60
H (Screen)	5	1/60
F (Evaps.)	2	1/150
WoodMill	10	1/30
Bleach	5	1/60
I (Machine)	10	1/30

The initial dissolved oxygen, D_1, is measured 15 minutes after the sample and the dilution water are mixed. The diluted sample is incubated for five days at 20°C, after which the final dissolved oxygen, D_2 is measured.

The oxygen depletion of the seed is measured by incubating a seeded dilution water sample. Depletions are typically 0.2 to 0.5 mg/ℓ. The contribution to the seeded sample is calculated as follows:

Sample depletion due to seed = $f\ (B_2 - B_1)$

where:

B_2 = D.O. of seeded dilution water after five days.

B_1 = initial D.O. of seeded dilution water

f = factor = $\frac{\text{\% seed in seeded sample}}{\text{\% seed in dilution water}}$

"f" values for three common sample sizes are shown below:

Sample Volume (ml)	"f"
2	1.00
5	0.97
10	0.97

The sample BOD_5 is calculated as follows:

$$BOD = \frac{(D_2 - D_1 - f\ (B_2 - B_1)}{P}$$

where:

$D_2 - D_1$ = depletion of seeded sample after five days

$B_2 - B_1$ = depletion of seeded dilution water after five days

P = dilution ratio

f = ratio

3.5.3.5 Miscellaneous. For the last 13 weeks fresh seed has been collected weekly from the Squamish Sewage treatment plant. Seed is not acclimated prior to use. The BOD of a glucose glutamic acid standard (220 mg/ℓ) is determined routinely. Results for the past 13 weeks show an average BOD value of 206 mg/ℓ with a standard deviation of $\pm$ 12 mg/ℓ. Prior to using sewage seed, sea water was collected weekly and used as a seeding material. Low glucose values resulted in the use of domestic sewage seed.

3.5.4 Sulphides and Mercaptans. The Woodfibre lab is equipped to carry out sulphide and methyl mercaptan determinations routinely. The sample is made alkaline with NaOH and then

titrated potentiometrically with $AgNO_3$. The titration is followed with a mv. reading pH meter equipped with a silver silver sulphide electrode combination.

3.5.5 Resin Acids and Residual Chlorine. These tests are not carried out routinely.

4. POLLUTION ABATEMENT FACILITIES

4.1 Slaker Grits

Up until two years ago slaker grits were going to sewer. Removal to land fill has reduced suspended solids levels by about 2 T/D.

4.2 Knot Tank

Installation of a 21,000 us gal. knot tank in 1971 resulted in knots being recycled to the digesters. This led to a suspended solids reduction of about 7 T/D.

4.3 Unbleached Rejects

Unbleached secondary cowan screen rejects are passed over a sidehill screen (DSM, 0.35 mm slit opening) which sits directly on top of the Knot tank. The dewatered rejects go to the knot tank where they can be recycled to the digesters. Accepts from the secondary cowan screens go to hydrodone cleaners. Rejects from this system are sewered. The rejects system is shown in Figure 3.

Secondary cowan screen rejects are generated at about 17 lb/ADT. With a DSM screen in operation, about 16 lb/ADT (95% efficiency) are returned to the system and 1 lb/ADT are sewered. Hydroclone losses depend on the pulp grade. On W.B.S. furnish the losses are about 1 lb/ADT, where as with Fiberfate, losses are as high as 4 lb/ADT.

Assuming hydroclone losses of about 1 lb/ADT, it would be expected that this system would reduce losses from 17 lb/ADT (5 T/D) to about 2 - 3 lb/ADT (3/4 TD). Thus suspended solid losses would be reduced by 14 to 15 lb/ADT (4.5 T/D).

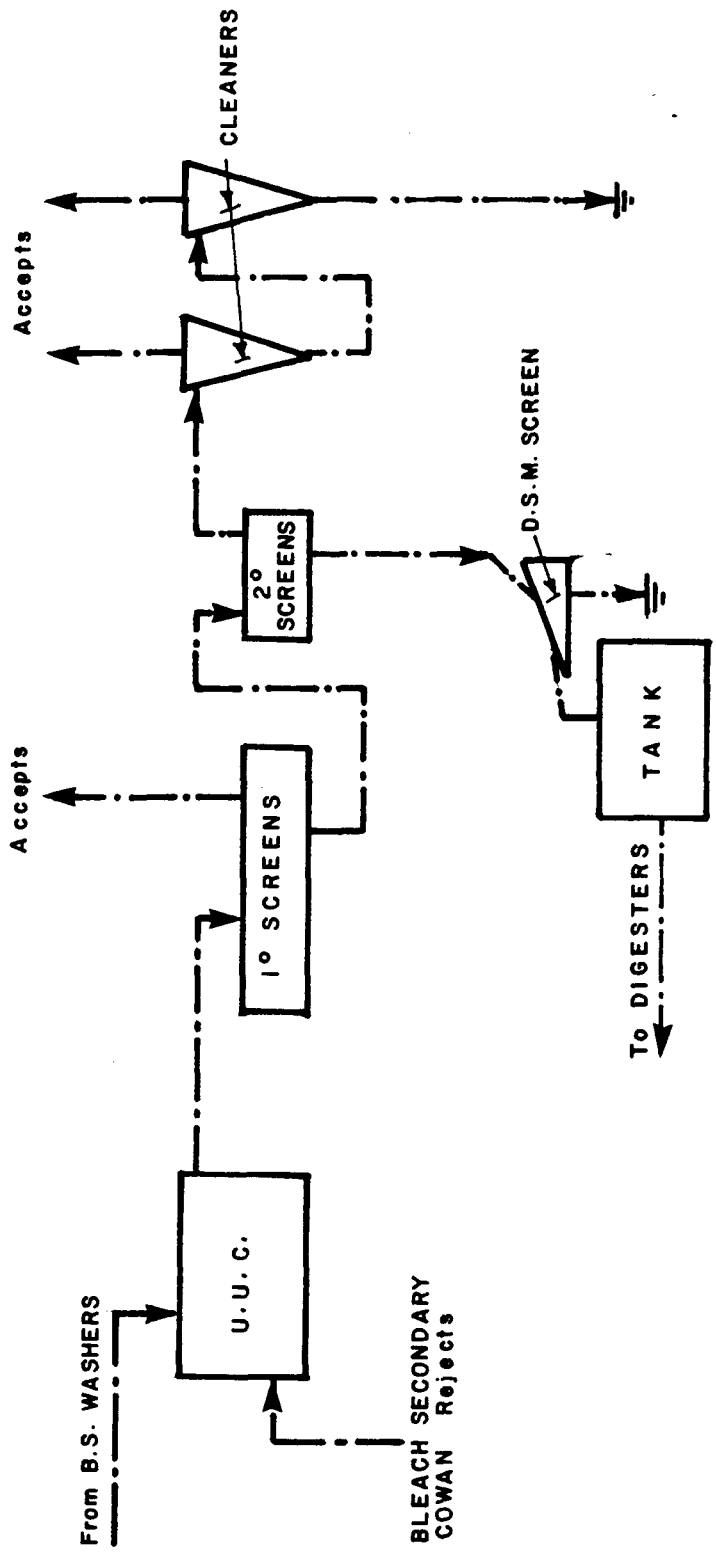


FIGURE 3 UNBLEACHED REJECT SYSTEM

At present this system is not in operation. Secondary screen rejects are being sewered. The system will not be operational until a drainer has been installed between the DSM screen and the knot tank. The DSM screen is not dewatering sufficiently.

4.4 Bleach Rejects

The Bleach secondary screen rejects are recycled to the unbleached, unscreened stock chest (U.U.C.). Bleach centricleaner rejects are sewered (2 - 3 T/D sand, grit and fiber).

4.5 Recaust Dump Tank (144,000 usg.)

This tank is available for the collection of planned spills (shutdowns, etc.). It is linked to the White Liquor Clarifier Green Liquor Clarifier and the mud washers. It can also be used for storage of excess S.B.L.

4.6 Flyash

Power Boiler flyash is sluiced from the muticones to two 6 ft. DSM screens (0.35 mm slit opening) at the rate of about 14,400 lb/day. The screens remove about 45% of the flyash (6,500 lb/day), passing the remainder to sewer (7,900 lb/d). Previously the screened accepts were being recycled to the boiler. At present they are being sewered, plans are underway to truck the separated flyash to landfill.

4.7 Large Wood Plant

Hydraulic debarker effluent passes over one 6 ft. DSM screen (0.35 mm openings). A 45 minute continuous test showed that the screen was achieving an 85% removal efficiency.

Input = 12,800 lb/d

Removed to Hog = 10,900 lb/d

Sewered = 1,900 lb/d

However, this screen was undersigned (Design: 600 gpm, actual: 1000 gpm) consequently clogging is a problem and almost continual attention is required.

At present the screen is not used. The Large Woodplant has a serious solid waste problem. Conveyor spills and leaks around the debarker due to lack of maintenance have resulted in an accumulation of floor wastes.

4.8 Small Wood Plant

Hydraulic debarker wastes pass over a Tyroc Ton Cap Vibrating screen. 76% removal efficiences are achieved.

Input = 13,100 lb/d
Removed to Hog = 10,120 lb/d
Sewered = 3,180 lb/d

Ton Cap Screen

openings - 0.034 inch widths
% open area - 45.7%

4.9 Kiln Scrubber Sump

At present the Lime Kiln peabody scrubber dust collection sump is continually overflowing. E flume losses at present average about 60 lb/APT. With the sump overflow bypassed directly to Mill Creek, E sewer losses dropped by almost (20 lb/ADT).

A significant reduction in the S.S. discharge (approx. 12,000 lb/d) should result when the automatic level control installation is completed on the dust collection sump.

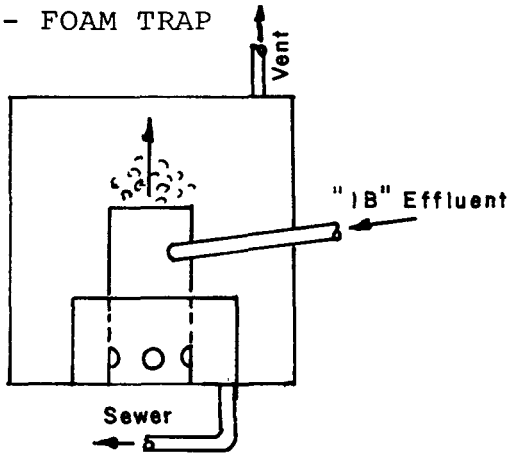
4.10 Foam Control

Bleach plant outfalls are located under the dock (Fig. 1). A log boom has been place around the discharge area. Also, a sprinkler system has been installed under the dock to collapse foam. This is not in operation at present.

Because large quantities of foam escapes to Howe Sound, Woodfibre has carried out several foam control trials.

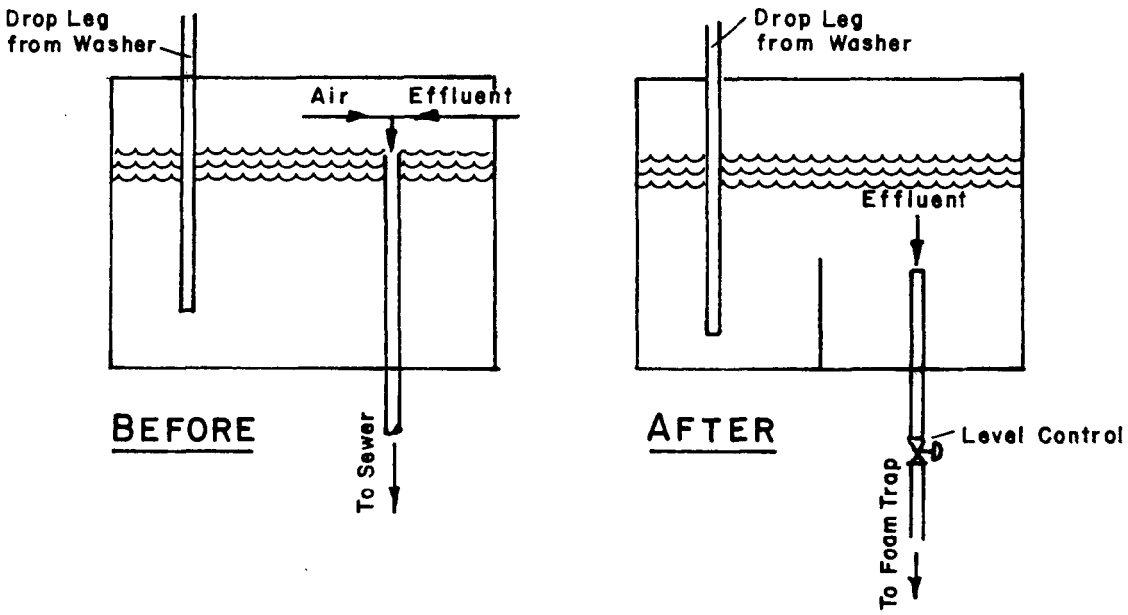
a) The chlorination effluent of B Bleach plant (1B sewer) was introduced into a foam trap (Fig. 4). Basically, the effluent is introduced tangetially into the central column. The vortex created assists in the separation of the foam bubbles. The foam accumulates in the top of the tank and eventually collapses. The defoamed effluent flow to sewer.

FIGURE 4 - FOAM TRAP



b) An attempt was also made to prevent air entrailment by modifying the chlorination stage seal tank, (Fig.5). The effluent line was shortened, a 4 ft. baffle was installed and a control valve was placed between the seal tank and the foam tank. These modifications, in conjunction with the Foam Trap, apparently caused a reduction in chlorination stage foaming (although this system was not quantitatively assessed). However, the level control device caused a severe back up of foam in the Bleach Plant. At present the level control is not used. The foam tank is being re-painted and will be put back on line at earliest opportunity.

FIGURE 5 - SEAL TANK MODIFICATIONS



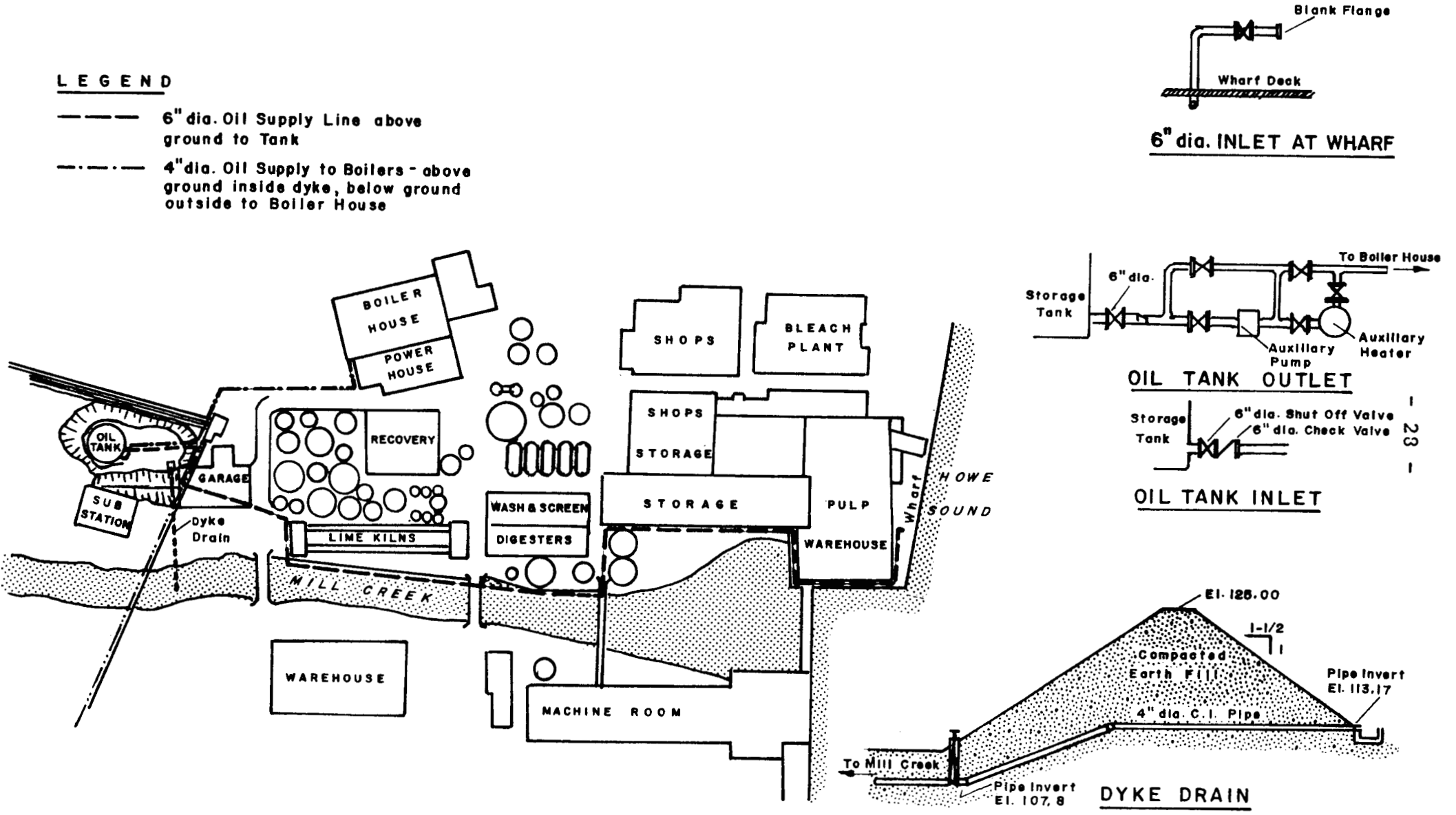


FIGURE 6 OIL STORAGE

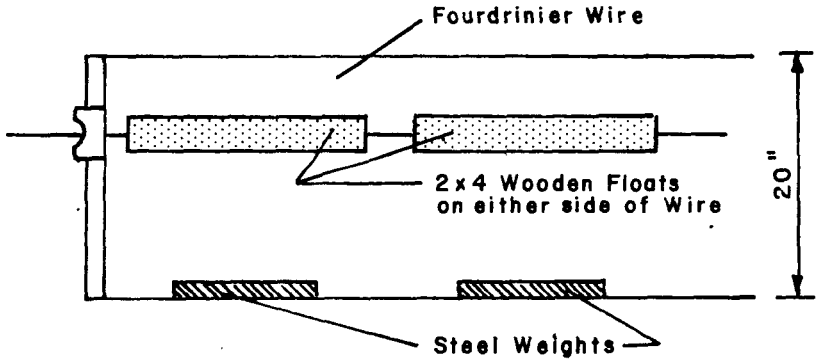
4.11 Domestic Sewer

Most of the mill domestic sewers are linked with the old townsite sewers and are, therefore, separate from Mill effluent lines. Sewers enter the ocean at about 10 separate outfalls. Plans are underway to collect the sewers south of Mill Creek and install either a septic tank or a small treatment plant.

4.12 Oil Storage

A layout of Bunker C Oil storage tanks and supply lines is shown in Figure (6). An oil spill contingency plan has been established (Appendix IV). Also, a 3,400 ft. oil containment boom is presently being construced. This boom is being made from Fourdrinier wire (polypropylene). Figure (7).

FIGURE 7 - OIL CONTAINMENT BOOM (104 ft. lengths)



APPENDIX I

A detailed equipment list (November 1971) can be found in the Woodfibre Pulp and Paper file.

APPENDIX II

The Olympic Research Division report "Toxicity, BODs and Pearl Benson Index of Woodfibre effluents" by E. Tokar and J. Penison (March 19, 1974) has been included in the Woodfibre Pulp and Paper file.

APPENDIX III

The Olympic Research Division report "Determination of Suspended Solids in Wastewater: I.A Modified Filbration Method for Mill Effluents" (January, 1974) has been included in the Woodfibre Pulp and Paper File.

APPENDIX IV

The Woodfibre Division report "Contingency Plans for Emergencies" can be found in the Woodfibre Pulp and Paper file.