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Mill Characterization:

Crown Zellerbach, Elk Falls Company Ltd. April 1974.

Manuscript Report - 74-5

Pacific Region

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MILL CHARACTERIZATION:

CROWN ZELLERBACH CANADA LIMITED

ELK FALLS COMPANY LIMITED

April, 1974

by

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and

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Environment Canada
Environmental Protection Service
Pollution Abatement Branch
Pacific Region

Manuscript Report - 74-5
September 1974

ABSTRACT

This report was prepared from technical data provided by Crown Zellerbach Canada Limited, Elk Falls Company Limited. 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.

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1. INTRODUCTION

The following assessment of Crown Zellerbach's Elk Falls Mill was carried out in April, 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 the Mill personnel involved in water pollution abatement programs.

2. MILL DESCRIPTION

2.1 Location

The Elk Falls Mill is located at Duncan Bay approximately two miles north of Campbell River. Effluent is discharged directly into Discovery Passage. Solid waste is discharged to a site located near the mouth of Casey Creek. The registered description of this complex is Lot 109, Sayward Land District.

2.2 Organizational Structure

Mill Manager: Mr. J.L. Christensen
General Superintendent: Mr. A.D. Leighton
Technical Supervisor: Mr. E.L. MacKay

Dave Leighton acts as Environmental Coordinator. However, all effluent testing is carried out by the Technical Department. Within this group two technicians are devoted to air emission testing, while one technician, Milo Vejan, is devoted full time to effluent testing. A union-management pollution committee has not been established.

2.3 Operation Information

2.3.1 Production. Elk Falls Mill produces newsprint, bleached kraft pulp, and kraft paper. Table 1 shows 1973 average production data.

Table 1. Production.

Products	ADT/D
Newsprint	674
Bleached Kraft Pulp	455
Kraft Paper	245
Noodle Pulp	175
Total Production	1,549

2.3.2 Water Supply. Process water is drawn from the Campbell River about one-half mile downstream from John Hart Dam. The intake is protected with stop logs and by a travelling screen (0.096 inch openings). Fixed screens are added during the downstream migration of young salmon.

Raw water is chlorinated before use in the process to give a 0.3 mg/ℓ residual. Boiler feed water is prepared by passing raw water through ion exchange columns. Caustic regeneration chemical and acid rinse effluent are sewered.

The 1973 average Mill water usage was 54 x 10^6 USGPD or 35,200 USG/ADT.

2.3.3 Mill Processes. A complete description of mill processes is shown in Appendix I. The following is a brief characterization of major processes.

(a) Wood Mill

The wood mill mainly produces blocks for the groundwood mill. Production over 1973 averaged 564 cunits per day (705 ODT/day). The wood species composition to the Groundwood Mill (1973 average) is shown in Table 2.

Table 2. Wood Species to Groundwood.

Species	% Groundwood
Hemlock	56
Fir	0
Balsam	15
Spruce	12
Cottonwood	17

Debarking is carried out by means of a 48 inch Simons hydraulic debarker or by means of a 72 inch Bellingham type hydraulic debarker.

Four 4 ft. x 8 ft. Tyroc bark dewatering screens (40 mesh) treat the hydraulic debarker effluent. The total wood mill effluent flow is reused in the block flume.

(b) Pulping

Approximately 85% of the mill's chip supply is purchased. The 1973 average composition of wood furnish to the digesters is shown in Table 3.

Table 3. Wood Species to Digesters.

Wood Species	% Pulp
Hemlock	51
Fir	22
Balsam	0
Spruce	10
Cedar	4
Cypress	13

Four types of digesters are used at Elk Falls. These have been summarized in Table 4.

Table 4. Digesters.

Digester Type	Number	Rated Capacity	1973 Av. Production	K. No.
Batch	8	4630 ft^3 ea. 10.5 ADT/cook	442 ADT/D	25.9
Kamyr Continuous (Internal Washing)	1	350 ADT/D	390 ADT/D	27.3
A.D. (Sawdust)	1	100 ADT/D	81 ADT/D	19.2
M and D (Sawdust)	1	250 ADT/D	220 ADT/D	18.8

(c) Washing

Brown stock from the various digesters maintains its integrity over the brown stock washers. Washer details are shown in Table 5.

Table 5. Brown Stock Washers.

Stock	Brown Stock Washer	Average (1973) Soda Loss, lb. Na_2SO_4/ADT
Batch	One. Dorr Oliver Long 3 stage washer. Drum size, 11.5 ft. dia. x 18 ft. long	26
Kamyr	One. Dorr Oliver Long 2 stage washer. Drum size, 11.5 ft. dia. x 16 ft. long	28
M and D	One. Dorr Oliver Long 3 stage washer. Drum size, 8 ft. dia. x 12 ft. long	21
A and D	One. Impco 2 stage washer. Drum size 9.5 ft. dia. x 16 ft. long	31

(d) Recovery and Steam Plant

Oxidation of the Weak Black Liquor (W.B.L.) from the Brown Stock Washers is carried out by a B.C. Research Council (B.C.R.C.) oxidation tower system. Tower efficiency, as measured immediately after oxidation, is about 40%. However, W.B.L. oxidation efficiency is only about 9% (average of last 14 measurements) if the sample is taken as the W.B.L. enters the evaporators. Strong Black Liquor (S.B.L.) oxidation is carried out in an air sparger tank (4 hour retention). 90 to 95% oxidation efficiencies are achieved. Liquor storage facilities in this area are summarized in Table 6.

Table 6. Liquor Storage.

Liquor	Tanks	Capacity (each) USG
W.B.L.	3	215,800
S.B.L.	1	127,160
S.B. Oxidation Chamber	1	220,500

Major equipment in the Recovery and Steam Plant areas is listed below.

No. 1 Evaporators.

Number of Effects - Sextuple
Type - Lundberg Allen

No. 2 Evaporators.

Number of Effects - Septuple
Type - Swenson
Capacity - 467,000 lb. H_2O/hr.

No. 1 Recovery

Type - B and W
Capacity - 1.25 x 10^6 lb. B.L.S./day

No. 2 Recovery

Type - B and W
Capacity - 2.40 x 10^6 lb. B.L.S./day

Power Boilers

Number - 4
Fuel - Hog or Oil, one on Hog only
Steam Production - 1,000,000 lb./hr.

A 4 ft. x 4 ft. (40 mesh) Tyroc screen separates the Multicone discharge. Large size material is reburned. The underflow goes to two flyash settling basins. The basins are 35 ft. x 40 ft. x 7 ft. each and are operated alternately.

(e) Recausticizing Area

Major equipment in the Recausticizing area is listed below.

No. 1 Kiln

Type - Traylor
Size - 9 ft. dia. x 250 ft.
Scrubber - Traylor dust chamber and Peabody scrubber

No. 2 Kiln

Type - Allis Chalmers
Size - 10.5 ft. dia. x 256 ft.
Scrubber - Airpol Venturi Scrubber

Dregs Filter

Type - Dorr Oliver Long
Size - 6 ft. dia. x 6 ft.
Approximately 6 BDT/D dregs are produced.

Liquor storage in the Recaust area is summarized in Table 7.

Table 7. Liquor Storage.

Liquor	Tanks	Capacity (each) USG
WL or GL	5	148,120
Weak Wash	1	148,120
GL (Clarifier)	1	297,360
WL (Clarifier)	1	220,660

(f) Bleach Plants

Various grades of bleached kraft pulp are produced at Elk Falls (Table 8).

Table 8. Bleached Kraft Pulp Grades.

Grade	G.E. Brightness	%
Semi bleach	65	64
Full bleach	83-85	20
Extra full bleach	>88	16

Major equipment in the Bleach Plant is summarized below.

No. 1 Bleach Plant (chemical pulp furnished for groundwood)

Sequence - C.E.H.H.
Production (1973) - 230 ADT/D

No. 2 Bleach Plant

Sequence - C.E.H.D.E.D.
Production (1973) - 425 ADT/D

(g) Ground Wood and Sheet Formation.

Grinding is accomplished by 14 Waterous Great Northern Grinders. Average YTD production = 508 ADT/D. Sodium Hydrosulfite generated by the Borol process is used for Goundwood brightening.

A summary of the major equipment used in sheet formation is shown in Table 9.

Table 9. Sheet Formation.

Machine	No. 1	No. 2	No. 3 Flakt	No. 4
Product	Newsprint	Newsprint	Bleached Kraft Pulp	Kraft Paper
Size	287 inch wire width, 2800 fpm	266 inch wire width, 2700 fpm	455 ADT/D	188 inch wire width, 1250 fpm, 245 ADT/D

A sherbrooke valveless vacuum filter (9.5 ft. dia. x 16 ft.) is used as a Saveall on the No. 2 machine.

2.3.4 Water Reuse. No. 1 evaporator condensate is reused in the recausticizing process.

(a) wash water on dregs filter
(b) kiln stack scrubbers
(c) wash water on mud filter
(d) dregs washer
(e) underflow on W.L. clarifier
(f) underflow on G.L. clarifier

The No. 2 evaporator condensate and digester condensates are passed through Rosenblad heat exchangers and then sewered. The clean hot water generated in the process is used on the brown stock washers and on the noodle pulp machine. No. 1 and No. 2 evaporator foul condensates are sewered.

Woodmill effluent is totally reused on the block flume. The caustic extraction stage effluent from the No. 2 bleach plant is recycled to the Recovery scrubber before being sewered. For water reuse in the News area, see page 31

2.3.5 Chemical Usage. (a) MBT slimicide is used on the News machines. YTD average usage: 33.4 lb./day. Consumption is expected to increase due to the replacement of zinc hydrosulfite brightening. The major additives on No. 4 Paper Machine are as follows:

Wheat Starch	- 2,160 lb./day (YTD)
Rosin	- 1,700 lb./day
Alum	- 8,230 lb./day

(b) Sodium hydrosulfite is used in the groundwood brightening process. The year to date average consumption is 17 lb./ADT.

(c) Lime Makeup (1973 average). Lime usage in the recausticizing process averaged 24 lb. $CaCO_3$ per ADT.

Calcium hypochlorite for the Hypo bleach stages is not manufactured at the Mill.

(d) Saltcake Makeup (1973 average).

Na_2SO_4 consumed = 19,122,442 lb. per year
Kraft production = 274,000 ADT per year
Saltcake makeup = 70 lb. Na_2SO_4 per ADT.

3. SEWER SYSTEM AND EFFLUENT CHARACTERISTICS

3.1 Sewer Layout

A layout of the sewer system is shown in Figure 1. In brief, "A" sewer contains groundwood, news and woodmill effluent. "B" sewer contains acid bleach effluent, while "D" sewer contains only No. 4 pulp machine wastes.

3.2 Spill Detection

Continuous pH monitors are located on the A, B, C, and D sewers. High level alarms are located on many liquor and stock storage tanks. Also many of the tributary sewers are equipped with conductivity alarms. A complete list of high level alarms and conductivity meters is shown in Appendix II.

3.3 Sewer Sampling

Vacuum type automatic samplers (not flow proportional) are located throughout the Mill (Figure 1). Sample tubes are maintained at least 1.5 inches from the sewer bottom. Samples are drawn once every two to five minutes. A description of the sample sites as shown in Figure 1 is given below (Table 10).

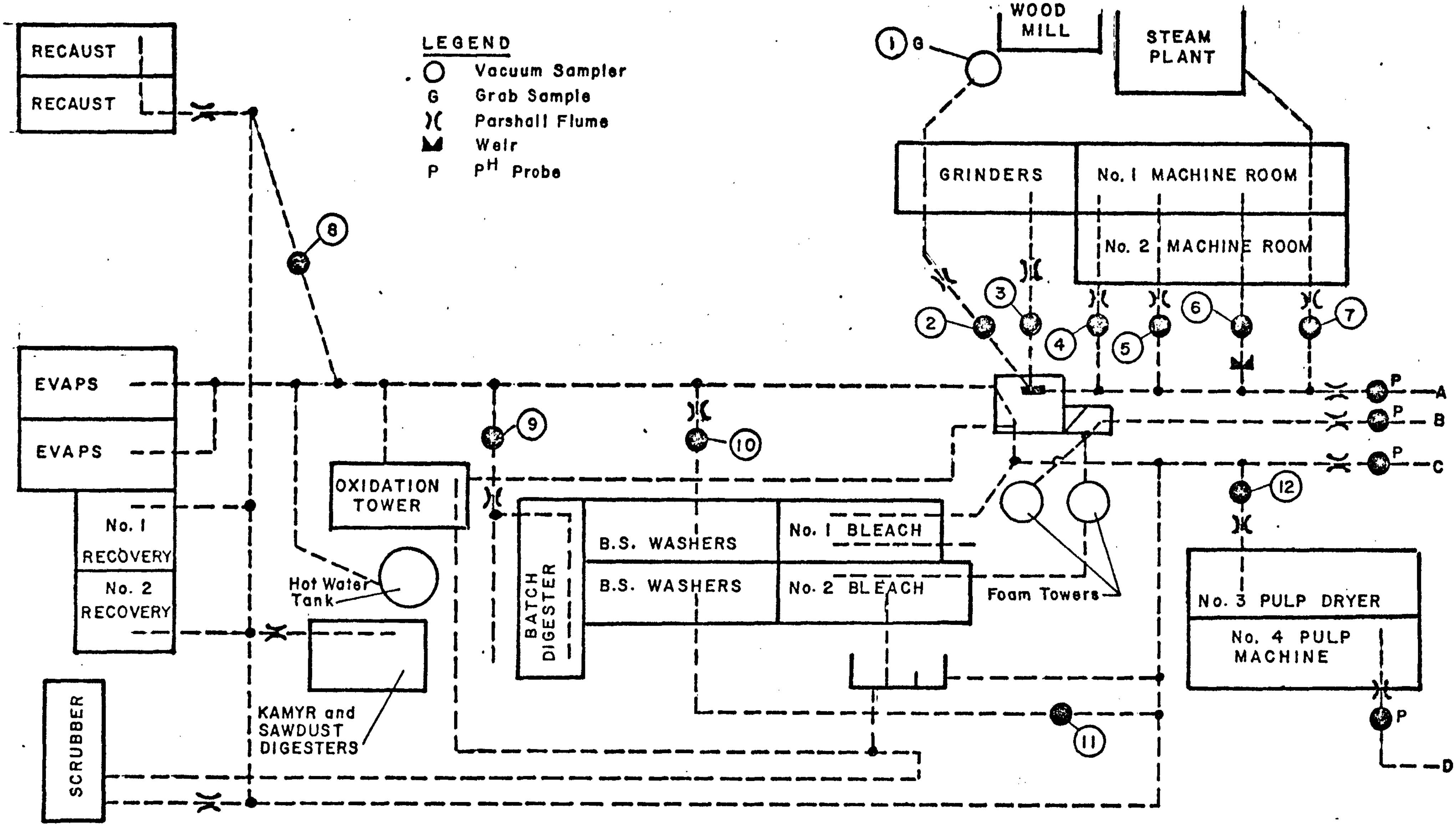

FIGURE I SEWER LAYOUT

Table 10. Sewer Description.

Sewer Designation	Description
A (Sewer 1 to 7)	News, Groundwood, Wood Mill, Steam Plant
B	Acid Bleach
C (Sewer 8 to 12)	Kraft Area, Recaust, Recovery, Caustic Extraction
D	No. 4 Paper Machine
1	Wood Mill effluent (after screens)
2	Groundwood III, Pascal coarse screen effluent, Block flume overflow
3	Groundwood II, Block flume overflow
4	Groundwood I, GWD Whitewater chest overflow, Pascal coarse screen effluent
5	News Machine wet end effluent
6	News Machine press water
7	Steam Plant effluent
8	Recausticizing
9	Batch Blow slab
10	Seal Slab and Kraft unbleached whitewater overflow from White Water tank No. 67 and Drainers
11	Kraft Unbleached White Water (overflow from W.W. tank No. 5), Kraft washers
12	No. 3 Pulp Machine effluent

All samplers are routinely inspected by the Effluent Technician. Samples are collected daily from each of the sewers and Suspended Solids determinations are carried out. Calcium and sodium measurements are carried out on A, B, C, and D effluents only. Such daily measurements are required for process control purposes.

Effluent testing is carried out once per week on samples collected at A, B, C, and D Sites. 24 hour composites are collected and the following parameters are measured.

Temperature
Total Solids
Suspended Solids
Volatile Suspended Solids
Floatable Solids
Settlable Solids
Volatile Settlable Solids
Colour
BOD_5
Total Sulphides
Resin Acid
Flow
pH (Low/mean/high)
Toxicity (At present, toxicity is measured quarterly, up until 1974 toxicity was being tested on a monthly basis.)

3.4 Final Effluent Discharge

3.4.1 Provincial and Federal Effluent Quality Requirements. Elk Falls was issued a Pollution Control Branch effluent discharge permit in August 1973 (PE 1164). The effluent Characteristics stipulated are shown in Table 11.

As an existing mill, the Federal Pulp and Paper Effluent Regulations stipulate that Elk Falls Division would be required to meet standards more stringent than those outlined in PE 1164 for suspended solids and toxicity. The Federal requirements for the mill's effluent discharge are shown in Table 12.

Table 11. Provincial Pulp and Paper Effluent Requirements.

(a) Kraft and Groundwood Pulping.

Qualtity of Effluent: 51,300,000 IGPD

The characteristics of the effluent shall be equivalent to or better than:

Total suspended solids	- 30 lb./ADT
Settlable solids	- 2.5 ml/ℓ
Floatable solids	- negligible
BOD_5	- 53 lbs./ADT
pH Range	- 6.5 to 8.5 (within 15 ft. of diffuser)
Toxicity (Tlm_{96})	- 50% survival @ 12.5% v/v over 96 hrs.
Temperature	- $95^{o}F$
Mercaptans	- <2.0 mg/ℓ
Sulphides	- <1.0 mg/ℓ
Residual Chlorine	- <0.1 mg/ℓ

(b) Woodmill Hydraulic Debarker.

Quantity of effluent: 3,600,000 IGPD

Total suspended solids	- 4.0 lbs./cunit
Settlable solids	- 2.5 ml/ℓ
BOD_5	- 4.0 lb./cunit
Floatable solids	- negligible
pH Range	- 6.5 to 8.5 (within 15 ft. of diffuser)
Toxicity	- 50% survival @ 12.5% v/v over 96 hrs.

(c) Solid Waste.

100 yd^3/day of industrial refuse consisting of slakergrits, green liquor dregs, cinders, sand and dredged material.

Table 12. Federal Requirements

Process	Allowable S.S.	Allowable BOD_5
Hydraulic Debarking	5 lb./ODT of wood	
Kraft Pulping	7 lb./ADT	64 lb./ADT
Kraft Bleaching	6 lb./ADT	27 lb./ADT
Kraft Sheet Formation	2 lb./ADT	
Groundwood Pulp Sheet Formation (Newsprint)	3 lb./Product Ton of Chemical Pulp 5 lb./Product Ton of Mechanical Pulp	
Groundwood Pulping	13 lb./ADT	
Groundwood Brightening	2 lb./ADT	
Kraft Paper Making	6 lb./ADT	

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

3.4.2 Current Elk Falls Final Effluent Discharge.

(a) BOD_5 and S.S. BOD_5 and S.S. determinations are performed on composite samples from A, B, C and D sewers. The total mill discharge is then calculated as the sum of losses in the main sewers.

Woodmill effluent is included in the A sewer. Because separate regulations exist for hydraulic debarker discharges, separate BOD_5 and S.S. output of the Mill and Woodmill have been shown in Table 13.

Table 13. 1973 Average BOD_5 and S.S. Discharge for Elk Falls Mill and for Woodmill

	Elk Falls Mill Discharge (Including Woodmill)	Federal Allowable	P.C.B. Level B
S.S.	77,000 lb/day, 50.2 lb/ADT	28,129 lb/day	48,726 lb/day
BOD_5	109,000 lb/day, 70.6 lb/ADT	No specification	79,460 lb/day

Table 13 (cont'd). 1973 Average BOD_5 and S.S. Discharge for Elk Falls Mill and for Woodmill.

	Woodmill Discharge	Federal Allowable	P.C.B. Level B
S.S.	4,645 lb/day, 6.6 lb/ODT	3,525 lb/day, 5 lb/ODT	2,256 lb/day, 4 lb/cunit
BOD_5	2,299 lb/day, 3.3 lb/ODT		2,256 lb/day, 4 lb/cunit

It should be noted that the above discharge figures represent the mathematical sum of the losses from A, B, C and D sewers. Elk Falls data suggests that the BOD_5 of the mixed effluent is significantly greater than the sum of the BOD_5's of the individual streams. Eight trials carried out in February and March, 1974 showed that the sum of the BOD_5's of the A, B, C and D sewers averaged 152,000 lb/day ± 21,200 lb/day, while the BOD_5 of the mixed effluents averaged 182,000 ± 31,800 lb/day. It should also be realized that the S.S. values shown in Table 13 have been carried out once per week on a daily composite sample. Federal regulations require S.S. determinations to be made once per day on daily composites.

The woodmill discharge does not receive clarification. In light of this fact, the value reported in Table 13 seems very low. This might be the result of sampling error. The woodmill discharge is sampled after it has been reused on the block flume and has become mixed with Groundwood sewers II and III. A better sample could be obtained directly after the Tyroc screens. The low results might also be due to inflated estimations of Woodmill throughput (ODT). Production is calculated from the following formula.

$$ODT = \frac{\text{ADT/D Gwd} \times 0.9}{0.96 \text{ Yield Gwd}} + \frac{\text{ADT/D Kraft} \times 0.9 \times 0.15}{0.44 \text{ Yield Kraft}} \quad \frac{\text{Debarked Kraft}}{\text{Total Kraft}}$$

This assumes that 15% of the kraft chip supply is generated at the Woodmill. A more direct measure of production would be desirable.

The total mill BOD_5 output has shown a marked increase over the last two years, while the S.S. output has decreased (Figure 2). The decrease in S.S. is understandable in light of the improvements in the News area. The increase in BOD_5 is probably related to a number of factors.

(1) In June, 1973 the BOD_5 measurement procedure was changed. From February, 1971 to June, 1973 the seed had been acclimated to A sewer effluent only. Previously to this, seed had been acclimated to a mixture of A, B, C and D effluent. In June, 1973 this seed acclimation procedure was reestablished. The data shown in Figure 3 suggests that this change resulted in an increase in BOD_5 of the A, B, and C sewers. Figure 3 shows plots of BOD_5 results (mg/ℓ) over the October, 1969 to September, 1973 period. This change in BOD_5 procedure was probably one of the factors responsible for the marked increase in BOD_5 output.

(2) Recently a non-condensible Gas Burning System has been put into operation at Elk Falls. The increased condensing capacity, introduced as a part of this new system, has probably resulted in enrichment of sewered contaminated hot water. For example, with improved condensing capacity, turpentine that was being vented to atmosphere would now tend to be condensed and sewered with the contaminated hot water.

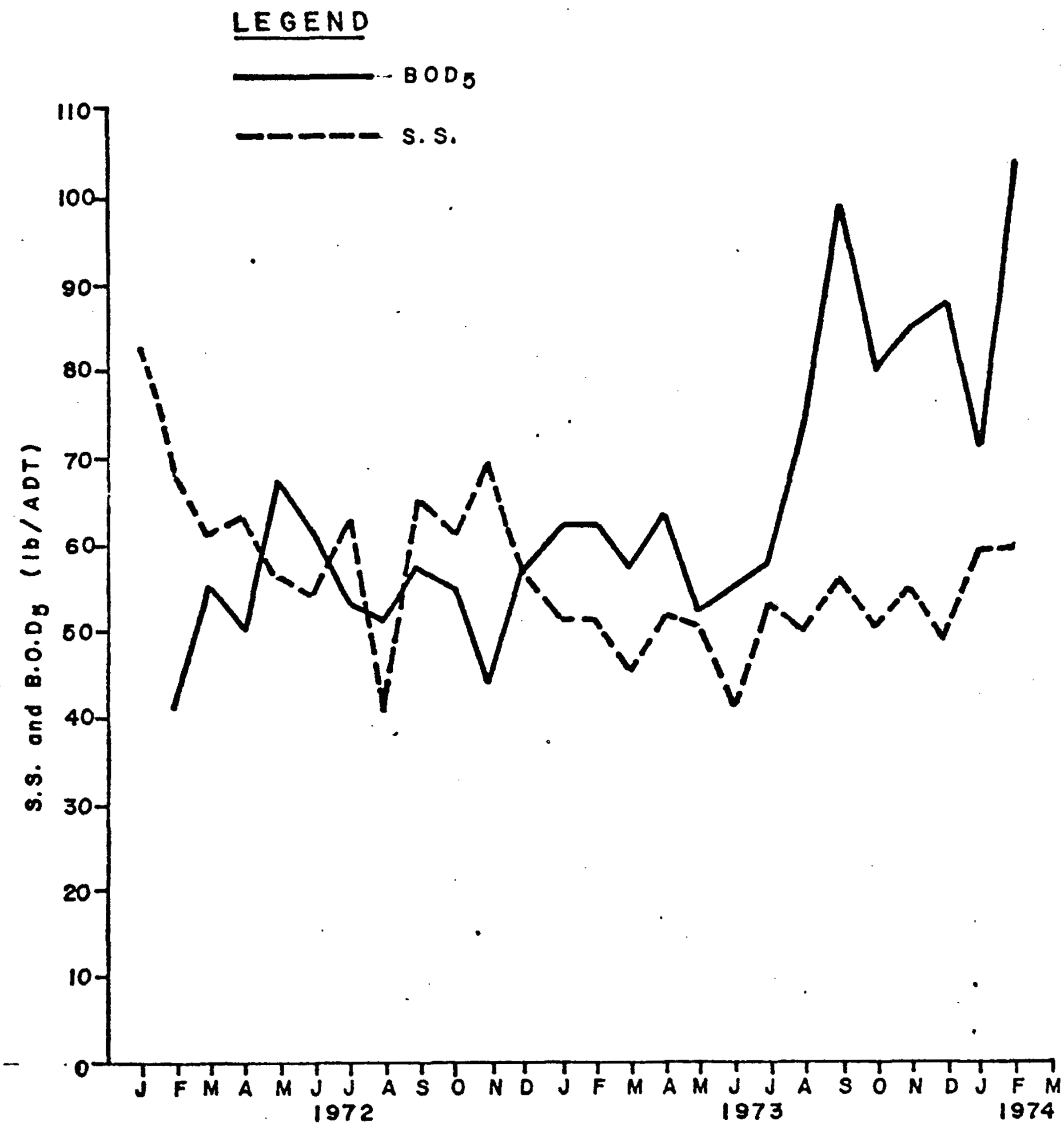

FIGURE 2 BOD_5 AND S.S. VARIATIONS (1972-74)

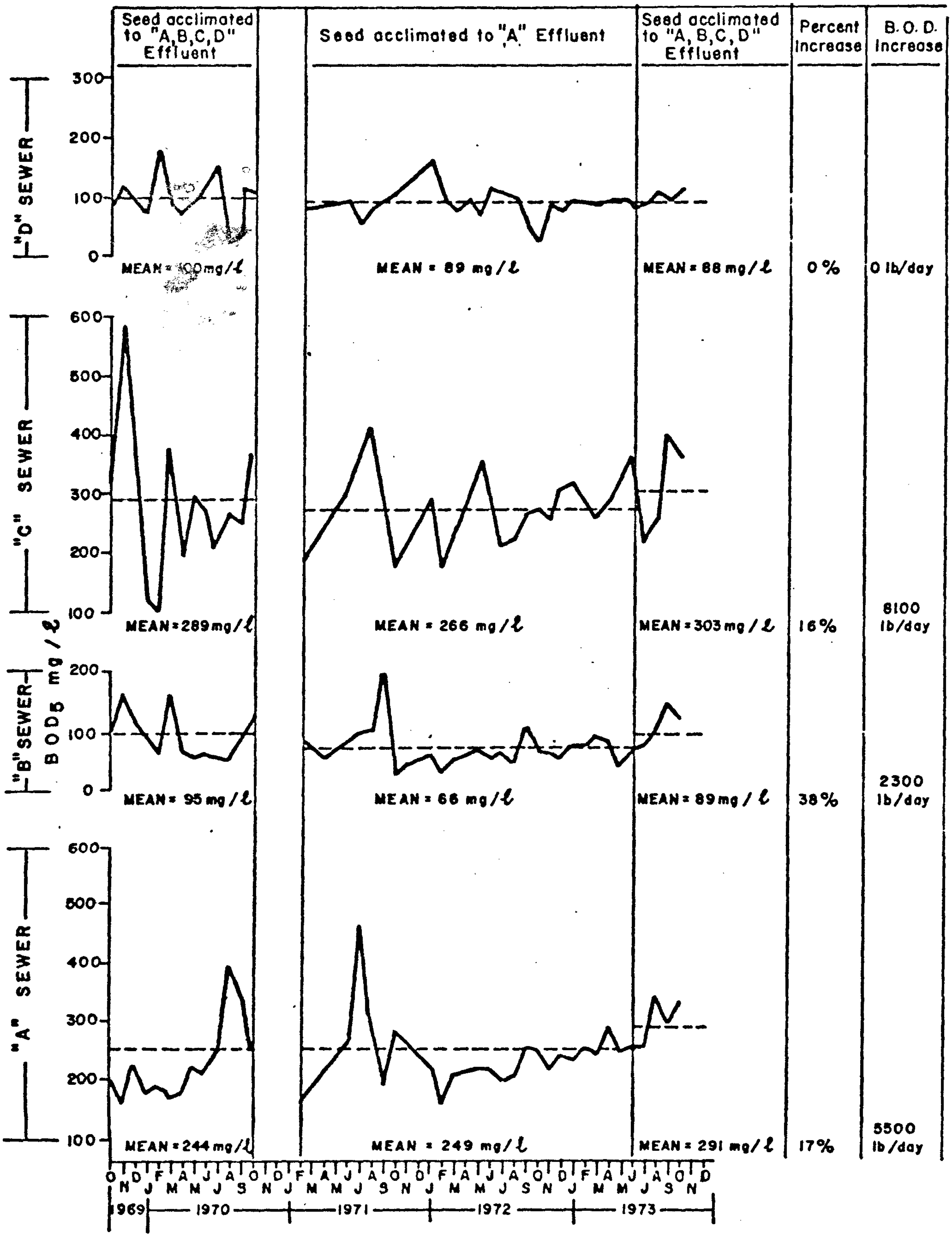

FIGURE 3 BOD_5 CHANGE VS. SEED ACCLIMATION PROCEDURE

(3) The worldwide shortage of makeup caustic coupled with the reduction of liquor and chemical losses in the Mill has resulted in a marked increase in liquor sulphidity over the past few months (Figure 4). This has likely resulted in an increase in the degree of contamination of the Evaporator condensate streams and consequently an increased BOD_5 output of the C sewer. This situation might be further aggravated by the low weak black liquor oxidation efficiency that results in the B.C.R.C. towers.

The effluent technician is presently engaged in a project designed to track down the source of this significant increase in BOD_5 output.

(b) Toxicity. Effluent toxicity determinations are carried out regularly at B.C. Research. Data available from 1972 to 1974 has been presented in Appendix III.The bioassays are conducted at 12.5% v/v concentrations. The pH is unadjusted, the test is run at the pH of the diluted effluent. In the past, both salt and fresh water have been used as dilutants. It was expected that the switch to sodium hydrosulphite brightening would reduce the toxicity of the A sewer. However, the bioassay employed is designed only to show whether the mill discharge meets the PCB level "B" toxicity standard. This makes assessment of toxicity changes in particular streams difficult. Data shown in Table 14 has been taken from Appendix III and applies only to the A sewer. Although the data is insufficient for firm conclusions, it appears that a reduction in toxicity has occurred when fresh water is used as dilutant. The October 12 sample, taken during the powdered sodium hydro trial maintained 100% survival after 96 hours. This had never been achieved with A sewer effluent when Zn hydro brightening agent was

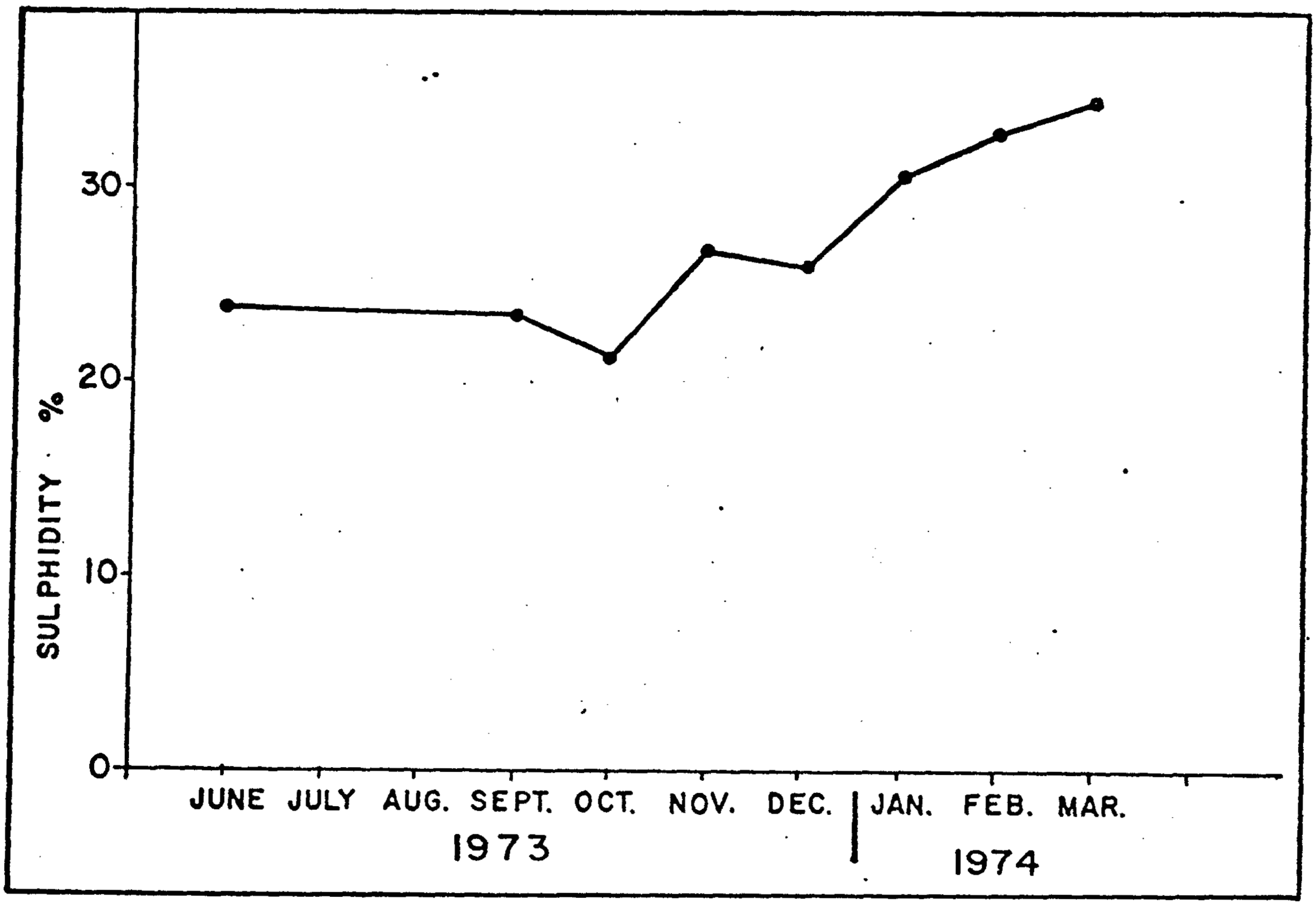

Figure 4. SULPHIDITY INCREASE

in use. It is unfortunate that a series of Tlm or MST values before and after the Na hydro conversion had not been obtained.

Table 14. Effect of Groundwood Brightening on Effluent Toxicity.

A Sewer: Fresh water used as dilutant. 12.5% v/v.

Na hydro brightening

Trial	% Survival 24	48	72	96 hr.
Oct. 12/73 (Comp.)	100	100	100	100
Oct. 12/73 (Grab)	100	100	100	100

Zn hydro brightening

Trial	% Survival 24	48	72	96 hr.
Mar.23/72	0	0		0
Apr.12/72	0	0		0
May 4/72	100	90		60
May 31/72	0	0		0
Jun.23.72	10	0		0
Jul.14/72	60	0		0
Jul.31/72	0	0		0
Oct. 4/72	0	0		0
Nov.29/73	100	80	80	80

A Sewer: Salt water used as dilutant. 12.5% v/v.

Na hydro brightening

Trial	% Survival 24	48	72	96
Sep.24/73	100	100	100	100
Oct.12/73	100	100	100	100
Jan.24/74	100	100	80	80
Apr.26/74	100	100	100	100
also at 45%	100	100	100	100

Zn hydro brightening

Trial	% Survival 24	48	72	96
Jan.25/72	100	100		100
Jan. 9/73	100	90		90
Jul.11/73	40	40	30	30
Dec.27/73	100	100	100	100

(c) Miscellaneous effluent characteristics are shown in Table 15. The data presented are year to date averages.

Table 15. Miscellaneous Effluent Characteristics.

Sewer	Mean pH	Colour Co-Pt Units	Temp °F.
A	6.9	127	83
B	3.0	418	57
C	10.7	1,500	77
D	6.9	28	93

3.4.3 Solid Waste. The mill operation generates solid waste, which is trucked to landfill. Combustible material is kept separate from the rest of the solid waste and goes to hog fuel. Slaker grits, green liquor dregs, flyash, cinders, etc., goes to the waste disposal site (about 60 yd^3. per day).Dredgate from the log pond and chip barge area also goes to the solid waste site. This material is generated at the rate of about two scow loads per week (scow dimensions 91 ft. x 34 ft. x 10 ft.) during the summer months (April to September). This amounts to about 300 yd^3. per day. The solid waste site is approximately six acres in area and is situated above the Casey Creek mud flats. A rock dyke separates the beach area from the solid waste site. A trench runs parallel to the dyke and directs leachate to the discharge point. Mill personnel have installed a weir in the trench and have monitored the discharge routinely. Table 16 shows average leachate characteristics.

Table 16. LEACHATE CHARACTERISTICS. Nov. 2, 1973 to Jan. 21, 1974.

	Flow USGPM	Toxicity LC_{50}	Total S.S. (mg/l)	pH	Colour CoC6 Units	BOD_5 (mg/l)
Average	154	2.4%	169	9.4	3280	290
Range	45 - 340		26.4-487.0	8.9-10.4	2160-4500	226-370
No. of Samples	20	1	28	28	28	7

3.4.4 Inplant Balances

The following data has been compiled from inplant measurements. The contribution of the various sewers to flow SS and BOD is shown in Table 17.

Environment Canada has carried out some inplant toxicity determinations (Table 18). All samples were taken before the conversion to sodium hydro brightening. This data may be useful in assessing the affects of the conversion on the toxicity of particular groundwood streams.

Table 17. SEWER BALANCE (page 24)

TABLE 17

(See Figure 1)	1973 Average Flow USGPM	1973 Average S.S. lb/day	1973 Average BOD lb/day	Feb. 1974 Average Flow USEPM	Feb. 1974 Average S.S. lb/day	Feb. 1974 Average BOD lb/day
1. WoodMill	3000	6000				
2. Groundwood III	2318	4330		2118	2320	
3. Groundwood II	1800	3680		1558	2730	
4. Groundwood I	2916	14400		2929	22700	
5. News	2680	19700		2670	19700	
6. News Press	343	1020		316	820	
7. Steam Plant	1832	2340		1757	1910	
A Sewer						
- sum 1 to 7	11,889	45,470		11,348	50,180	
- measured	10,909	44,300	37,200	11,357	49,200	39,600
B Sewer	7,728	3,440	8,250	8,733	4,620	13,400
8. Recaust	2,070	7,900		2,999	6,340	
9. Batch Blow Slab	1,831	1,140		914	1,310	
10. Batch Seal Slab	678	3,840		1,060	5,200	
11. Kraft U.W.W.	4,026	5,750		4,662	6,330	
12. No. 3 Pulp Machine	918	2,120		1,428	2,040	
C Sewer						
- sum 8 to 12	9,523	20,750		11,063	21,220	
- measured	16,007	23,000	57,900	17,007	24,900	103,000
D Sewer	2,598	5,850	2,960	2,858	13,300	5,930
Mill Total, sum of A + B + C + D:	37,242	76,600	106,310	39,955	92,020	161,930
Mill Total, measured:	37,242	98,010	138,996	39,955	105,002	197,058

NOTE:

1. The wood Mill stream is included in 2 and 3.
2. The lack of a flow balance in the C. sewer arises from the fact that the Recovery and Caustic Extraction streams are not included.

Table 18. Inplant Toxicity Determinations.

Date	Stream	96 Hr. Tlm
Feb. 5/73	Paper Machine W.W.	2.4%
Dec. 12/72	" " "	1.3%
Dec. 12/72	Groundwood W.W.	4.6%
Feb. 5/73	" "	8.6%
Feb. 5/73	" "	12.%
Feb. 5/73	Groundwood Washer	0.86%
Feb. 5/73	" "	1.35%
Dec. 12/72	" "	0.8%

Fresh water was used as dilutant.

Inplant sodium and calcium loss measurements are made routinely. Table 19 summarizes losses over 1973.

Table 19. Sodium and Calcium Losses.

	SEWER					
	A	B	C	D	Recaust	Total
Sodium (lb Na_2SO_4 per day)	8,650	14,800	59,200	1,370		84,320
Calcium (lb $CaCO_3$ per day)					7,900	

3.5 Effluent Testing Procedures

Detailed procedures for suspended solids, dissolved solids, settleable solids, volatile solids and BOD_5 have been presented in Appendix III. The essential features of the procedures have been summarized below.

3.5.1 Solids Determinations

All weighings are carried out on a Sartorius Analytical balance.

(a) Suspended Solids

- Sample Volume, 500 ml
- Media, 12.5 cm. Whatman GF/A glass fiber disc.

The filter is dryed at 105° ± 2° C. until a constant weight is achieved. The effluent technician has tested GF/A disc against GF/C media and found it to be equivalent for Elk Falls whole mill effluent.

(b) Volatile Suspended Solids

The residue collected on GF/A media is ignited in a muffle furnace at 550° C. for 30 minutes and the weight loss is measured. GF/A disks have been found to be adequate under these conditions. No melting has been noticed.

3.5.2 Colour

The sample pH is adjusted to 7.00 ± 0.05 using 5% NaOH or 5% H_2SO_4. After filtration through Whatman 42 filter paper, the transmittance at 350 mu on a Bausch and Lomb Spectronic 20 is measured. This value is compared to a standard plot of transmittance vs. colour units. A colour unit is defined as the colour produced by a solution of distilled water containing 1 mg/l of $CoCl_2 \cdot 6H_2O$.

3.5.3 BOD_5

(a) Dilution water

Distilled water is prepared in a Corning AG-1 glass electric still. Dilution water is prepared

3.5.3. by adding 1 ml of phosphate buffer, magnesium sulfate, calcium chloride, ferric chloride and seed per liter of distilled water. A 3 hour aeration period prepares the dilution water for use.

A D.O. depletion check is carried out on the distilled water with every batch of tests. Depletions are usually about 0.1 mg/l.

(b) $\underline{BOD_5}$ Calculation

The contribution of the seed to the total depletion is calculated from the seed control sample. The seed control is prepared so that activity is 40 to 50% (either 3 ml or 6 ml of seed is used). The BODs of the sample calculated from:

$$BOD_5 = \frac{(B_1 - B_2) - (D_1 - D_2)\,F}{P}$$

where B_1 = D.O. of diluted seeded sample is minutes after preparation.

B_2 = D.O. of diluted seeded sample after 5 days incubation.

D_1 = D.O. of seed control 15 minures after preparation.

D_2 = D.O. of seed control after 5 days incubation.

$$F = \frac{\%\text{ seed in } B_1}{\%\text{ seed in } D_1}$$

$$P = \frac{\text{Vol. of sample}}{\text{Total Vol.}}$$

Seed is prepared by acclimating domestic sewage to a neutralized mixture of A, B, C, and D effluents in a seed preparation tank (Appendix II). Neutralized effluent is dripped to one side of an aeration tank at a rate of about 30 ml/hour. Every week 10 to 15 mls of activated sewage sludge are added.

A glucose glutamic acid standard (BOD_5 = 220 ± 10 mg/l) is run with every batch of tests. The last 20 glucose determinations averaged 206 mg/l with a standard deviation of ± 19 mg/l.

4. POLLUTION ABATEMENT FACILITIES

4.1 Groundwood

(a) Approximately 40% of the coarse screen rejects go to hog fuel. The remaining 60% pass through a shredder and are recycled back to the coarse screen stock chest.

(b) Secondary screen rejects are rerouted to the raw stock chest and the high consistency refiner system (H.C.R.). This stock is introduced back into the system at the coarse screen stock chest (Figure 5).

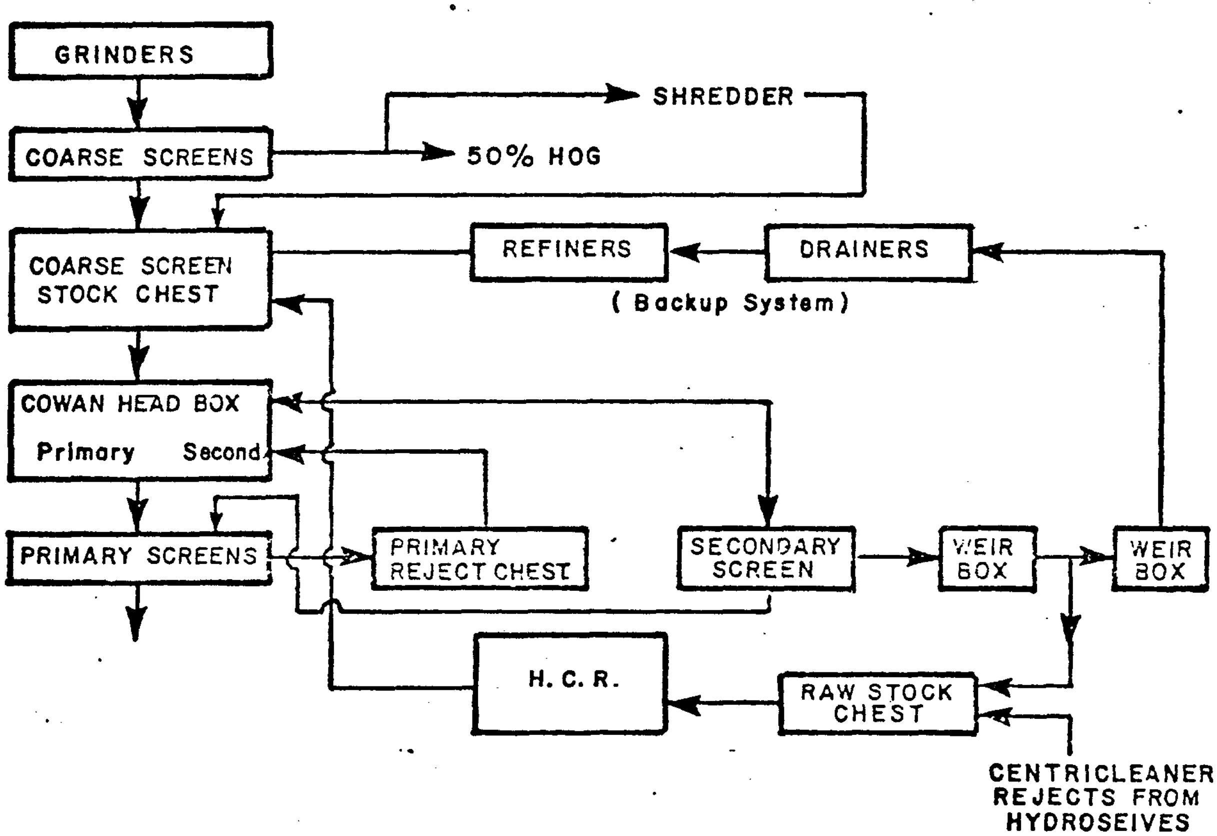

FIGURE 5 SECONDARY SCREEN REJECT SYSTEM

4.1 (c) Since converting to sodium hydrosulphite brightening, washing is not necessary. Therefore the washers are used only when there is an excess of No. 1 Paper Machine Whitewater. W.W. has a consistency of about 0.12% and is used as shower water. Since the washer filtrate has a consistency of about 0.02% the washers are acting as Save-alls. Normally only one out of three washers is in operation.

4.2 <u>No. 1 Paper Machine Stock Preparation</u>

(a) Excess W.W. is used as shower water on the Groundwood washers.

(b) No. 1 W.W. is reused on the Broke beater, No. 2 Paper Machine repulper and on the Proportioners.

(c) Centricleaner rejects from both No. 1 P.M. and No. 2 P.M. stock preparation go to the H. C. R. system. (Figure 6.)

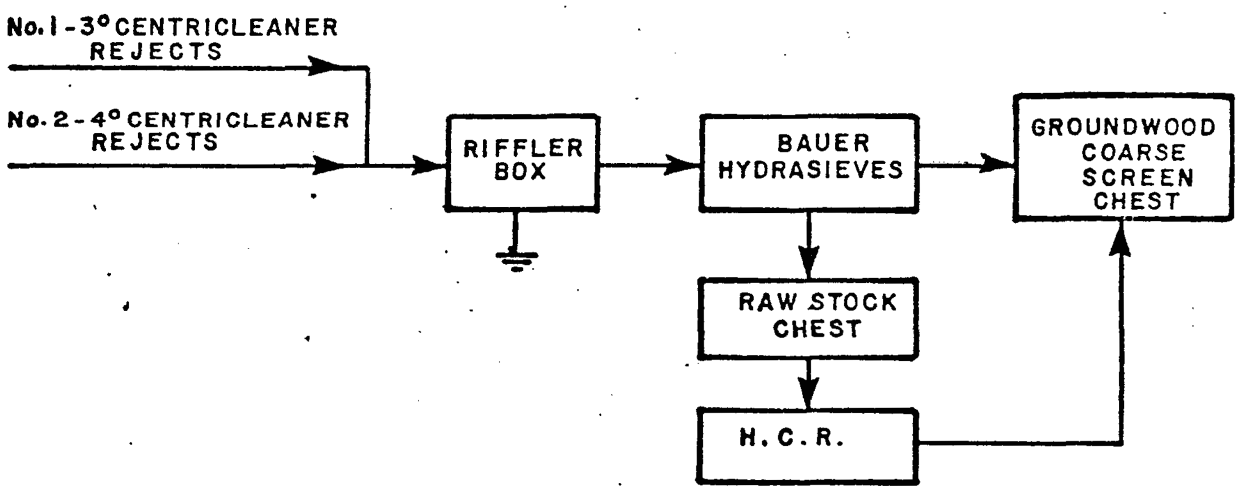

FIGURE 6 HIGH CONSISTENCY REFINER SYSTEM

The riffler box is emptied to sewer once every 4 hours.

4.3 No. 2 Paper Machine Stock Preparation

(a) No. 2 P.M. W.W. chest overflow, the couch pit overflow and the No. 3 Pulp Machine Cleaner Rejects go to a save-all system (Figure 7.) The stock is sweetened with S.B.K. to achieve better fiber removal.

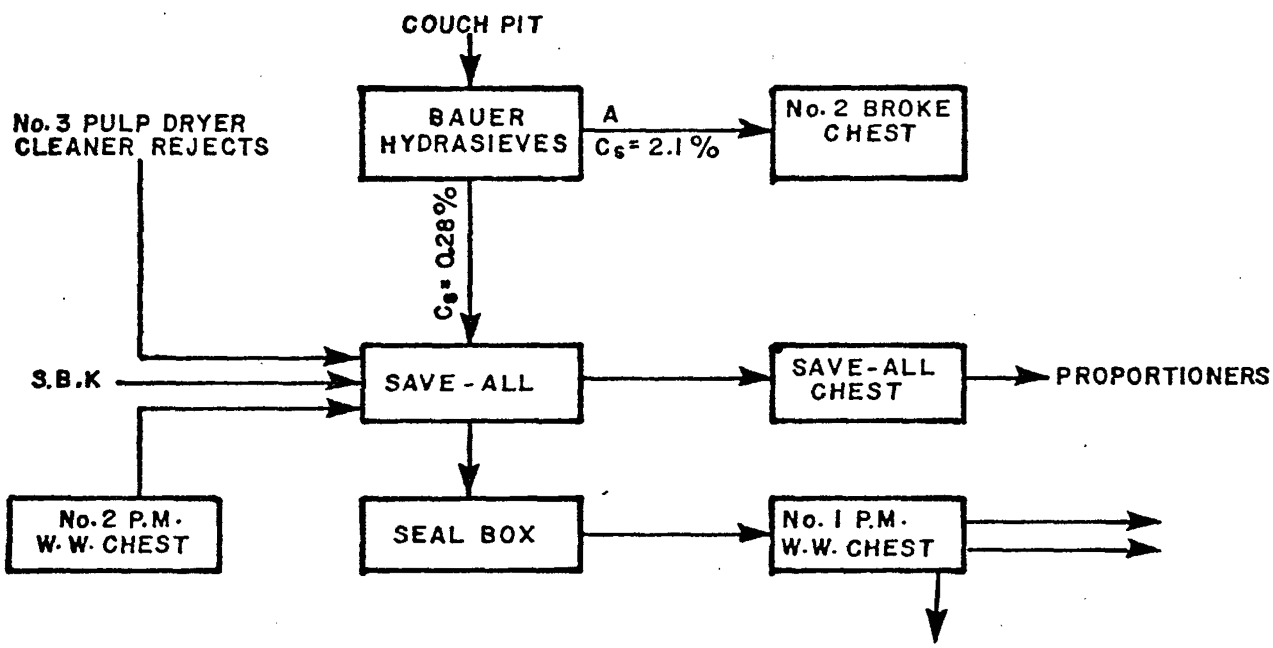

FIGURE 7 SAVE-ALL SYSTEM

The Save-all filtrate overflows to the No. 1 P.M. W.W. Chest at a flow of about 1950 g.p.m. and a consistency of 0.025% (3 BDT/day).

These changes in the News and Groundwood areas have brought about a reduction in the Suspended Solids discharged. According to Mill personnel, losses to "A" sewer averaged about 5% of the News production before 1971. At present, losses average about 2.5% of production.

4.4 Flyash is sluiced to a 4 ft. x 8 ft. Tyroc vibrating screen (40 mesh Ton-Cap). Separated material is recycled to Hog. The underflow goes to a flyash settling pond. The settling system consists of two 35 ft. x 40 ft. x 7 ft. ponds operated alternately. The ponds achieve about an 80% suspended solid removal. The settled material is trucked to landfill.

4.5 A dregs filter removes green liquor dregs from the recaust sewer. This material (6 BDT/D, Cs = 40%) is trucked to landfill.

4.6 Lime mud spills from Lime Storage to Casey Creek have been eliminated. A reversible screw has been installed between the mud filter and the kiln. During kiln shutdowns mud can be filtered and trucked to landfill at a consistency of about 70%.

4.7 A Malodorous Gas Burning System has recently been installed at Elk Falls. This system picks up gases from

- M.D. blow and relief
- A.D. blow
- Kamyr blow, No. 2 flash tank, chip steaming vessel
- batch blow and relief
- 2 multiple-effect evaporator seal tanks
- 2 points in sewer system service the evaporator contaminated condensates

The gases are passed through a large surface condenser and a tertiary direct contact condenser before being directed to the Kiln for burning. The main flows are summarized in Figure 6. A complete description of the system is presented in Appendix III.

4.7 Due to increased condensing capacity it is suspected that the contaminated Hot Water Accumulator discharge has increased in BOD and toxicity. The effects of this system on effluent quality, BOD in particular, are presently being investigated.

4.8 Domestic sewage has been separated from mill effluent streams. This stream is directed to an activated sludge treatment system. The system is designed for an influent of 30,000 U.S. gal./day and a BOD of 60 lb/day (240 mg/l). At this loading the effluent BOD is 50 mg/l. The system is operated near the design rating. Effluent overflows to the "A" sewer.

4.9 Both the 10,000 BbL and 50,000 BbL Bunker C Oil Storage Tanks are surrounded by moats. Plans are underway to acquire oil containment booms and sorboil sticks for light oil spills. Collection of tug bilge water is also planned.

4.10 Four Tyroc vibrating screens (4 ft. x 8 ft. each, 42 mesh) treat the Hydraulic Debarker effluent (1973 average flow 4,119 g.p.m.). Separated material goes to Hog fuel, while the underflow is reused in the block flume. A 70% suspended solid removal efficiency is achieved. Block flume effluent overflows to the Groundwood II and III sewers.

APPENDIX I. An up to date description of Mill Processes can be found in the Ker, Priestman, Keenan and Associates Ltd. report "Pollution Control Review and Program for Elk Falls Company Ltd." Feb. 1970. A copy of the report can be found in the Elk Falls Pulp and Paper file.

APPENDIX II. An up to date list of conductivity probes and high level alarms can be found in the Elk Falls Pulp and Paper file.

APPENDIX III. Bioassay Results.

DATE	SAMPLE	CONC.	V.V.	pH on Dilution	% Survival 24 hr.	48 hr.	72 hr.	96 hr.
Jan.25/72	A	12.5%	S.W.	7.4	100	100		100
	B	"	"	7.3	100	100		100
	C	"	"	8.3	100	100		100
	D	"	"	7.8	100	100		100
	2.5C:1B	"	"	8.2	100	100		100
Mar.23/72	A	12.5%	F.W.	6.4	0	0		0
	B	"	"	3.1	0	0		0
	C	"	"	9.7	100	100		100
	D	"	"	8.6	100	100		100
Apr.12/72	A	12.5%	F.W.	6.5	0	0		0
	B	"	"	3.1	0	0		0
May 4/72	A	12.5%	F.W.	6.7	100	90		60
	B	"	"	3.2	0	0		0
	1C:0.6B:0.7A	"	"	5.9	100	100		90
	1C:0.7A:0.6B:0.2D	"	"	5.8	100	90		80

DATE	SAMPLE	CONC.	V.V.	pH on Dilution	24 Hr.	48 Hr.	72 Hr.	96 Hr.
Jan.9/73	A	12.5%	S.W.	7.3	100	90		90
	B	"	"	7.1	90	70		70
	C	"	"	7.8	100	100		70
	D	"	"	7.3	100	100		100
Jan.9/73	B & C	12.5%	S.W.	7.3	100	100		100
(cont.)	A & B & C	"	"	7.3	100	100		100
	Sanitary Sewer	"	"	7.2	100	100		100
Jly.11/73	A	12.5%	S.W.	7.2	40	40	30	30
	B	"	"	5.4	0	0	0	0
	C	"	"	8.1	20	10	0	0
	D	"	"	7.6	80	70	70	60
	Untreated leachate	"	"	7.6	100	100	100	90
Sep.24/73	A* (Zn=0.33 mg/l)	12.5%	S.W.	7.1	100	100	100	100
	B	"	"	6.0	100	100	0	0
	C	"	"	7.2	100	100	20	0
	D	"	"	7.1	100	100	100	100
	* Powdered Na Hydro							
Nov.29/73	A	12.5%	F.W.	7.0	100	80	80	80
		45.%	F.W.	6.8	0	0	0	0
	B	12.5%	"	5.3	100	100	100	100
	C	12.5%	"	7.4	100	100	100	100
	D	12.5%	"	7.2	100	100	100	100
Dec.27/73	A(Zn=10.2mg/l)	12.5%	S.W.	7.7	100	100	100	100
	A	45%	S.W.	7.7	100	90	30	30
	C	12.5%	S.W.	8.3	100	100	90	30
	C	2.5%	S.W.	6.8	100	100	80	80

DATE	SAMPLE	CONC.	V.V.	pH on Dilution	% Survival 24 hr.	48 hr.	72 hr.	96 hr.
May 31/72	A	12.5%	F.W.	6.3	0	0		0
	B	"	"	3.0	0	0		0
	C	"	"	9.6	100	60		40
	1C:0.48B	"	"	6.4	100	100		100
	1C:0.48B:0.67A	"	"	6.2	100	100		100
June 23/72	A	12.5%	F.W.	6.5	10	0		0
	B	"	"	3.0	0	0		0
	C	"	"	9.5	100	70		70
	1.6C:1B	"	"	5.4	100	100		90
	1.6C:1B:1.2A	"	"	5.6	100	60		40
Jly.14/72	A	12.5%	F.W.	6.4	60	0		0
	B	"	"	2.7	0	0		0
	C	"	"	8.7	80	80		80
	2C:1B	"	"	3.4	0	0		0
	2C:1B:1.4A	"	"	3.6	0	0		0
Jly.31/72	A(Zn=17mg/l)	12.5%	F.W.	5.8	0	0		0
	B	"	"	2.7	0	0		0
	C	"	"	9.3	100	100		100
	2C:1B	"	"	5.2	100	100		100
	2C:1B:1.4A	"	"	5.3	100	100		100
Oct.4/72	A(Zn=33.4mg/l)	12.5%	F.W.	6.9	0	0		0
	B	"	"	5.1	0	0		0
	C	"	"	10.6	100	100		100
	1.26C:1B	"	"	5.7	100	100		100
	1.26C:1B:1A	"	"	5.8	100	100		100

DATE	SAMPLE	CONC.	V.V.	pH on Dilution	24 Hr.	48 Hr.	72 Hr.	96 Hr.
Jan. 24/74	A * (Zn=0.35 mg/l)	45.%	S.W.	7.1	20	20	20	20
	100% seawater				100	100	100	100
	* Boral Process							
Feb.25/74	Combined Effluent	12.5%	S.W.	7.3	100	100	100	100
	" "	.45%	S.W.	7.3	80	0	0	0
	* Boral Process							

APPENDIX IV — A detailed list of testing procedures is included in the Elk Falls Pulp and Paper file.

APPENDIX V — The technical report "Non Condensible Gas Burning for Kraft Mill Odour Control" by D. W. Herschmiller and R. A. Mitchell is included in the Elk Falls Pulp and Paper file.