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special report

NATIONAL COUNCIL OF THE PAPER INDUSTRY FOR AIR AND STREAM IMPROVEMENT, INC., 260 MADISON AVENUE, NEW YORK, N.Y. 10016

A COMPILATION OF DATA ON THE NATURE AND PERFORMANCE OF WASTEWATER MANAGEMENT SYSTEMS IN THE PULP AND PAPER INDUSTRY

SPECIAL REPORT NO. 83-09

AUGUST 1983

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Historically, the National Council has collected and organized information on the (a) extent of control technology applications, (b) effectiveness of those control technologies on individual sources, and (c) trends in effluent and emission control as reflected in load reduction in the forest products industry. The attached special report prepared by Mr. William J. Gillespie, Control Technology Program Manager represents a compilation of data on the nature and performance of wastewater management systems in the pulp and paper industry. It draws upon two NCASI Water Quality Protection Accomplishment Surveys, one carried out in 1976 and one in 1980 as primary sources of information. The third data base is an assembly of information organized by EPA from the discharge monitoring reports submitted by individual mills as part of the NPDES program.

The report covers the subjects of water use and raw waste loads and the extent of industry use of publicly owned treatment works. It then discusses final effluent quality of direct dischargers, the extent and nature of in-place effluent management practices before external treatment and then describes the external treatment technologies now in place. The report goes further to describe in some detail the sludge dewatering and disposal practices in use by the pulp and paper industry and the methods used for disposal of solid wastes from manufacturing.

The report shows a continuing trend of reduced water use per ton of product, and raw waste loads were indicated to be declining. The BOD load discharged per unit of production were found in 1979 to be about 40 percent of those in 1975, while similar reductions in the amount of suspended solids discharged were observed.

The contents of this special report should be of particular benefit for use in company and other industry information programs as well as to companies involved in NPDES permit condition development. Your questions and comments on this special report should be directed to me or Mr. Gillespie at the telephone number or address above.

Yours very truly,

Russell O. Blosser
Technical Director

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Attach.

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A COMPILATION OF DATA ON THE NATURE AND PERFORMANCE OF WASTEWATER MANAGEMENT SYSTEMS IN THE PULP AND PAPER INDUSTRY

I INTRODUCTION

A. Background

Throughout the history of the NCASI technical studies program, a major effort has been devoted to the development and study of control technologies useful to the industry in its environmental protection effort. This effort has included a number of activities aimed at documenting the performance capabilities of broadly applied technologies for reducing atmospheric emissions and wastewater discharge levels.

With regard to the performance of wastewater treatment systems, this documentation effort has been viewed as serving two primary purposes. The first of these is providing a sound data base for use by member companies in making decisions regarding control programs for individual mills. The second involves providing an independent information resource to be used in checking the validity of interpretation of the capabilities of control technologies made by regulatory agencies.

In recent years, the second motivating factor has had rather more emphasis because (a) the vast majority of mills have had treatment in place designed to meet the EPA 1977 Effluent Guidelines since at least the mid-seventies, and (b) EPA has been engaged in a major review of its Effluent Limitation Guidelines for the pulp and paper industry. The current guidelines review program began in 1977 and as of this writing is still not completed.

B. Sources of Information Presented in this Report

As part of its ongoing efforts, NCASI conducts occasional surveys of waste treatment practices and performance in the industry. Results of earlier surveys have been published in Special Reports 71-02 and 73-01. A major survey of the industry was carried out in 1976 (data for calendar year 1975) and again in 1980 (data for calendar year 1979). These surveys are referred to in this report as the 1975 and 1979 Accomplishment Surveys and constitute the major sources of data used in this report.

In the course of its Effluent Guidelines review activity EPA conducted a major survey of treatment practices in the industry under the authority of Section 308 of the Clean Water Act. Information from EPA's "308" survey, supplied to NCASI by cooperating companies, was examined for its utility in supplementing the information on treatment practices from NCASI's surveys. Since most mills that supplied "308" data also answered the NCASI solicitations, little if any additional information was found. Since the "308" questionnaires covered a period that fell between the two NCASI Surveys, it was decided to rely solely on the NCASI surveys for descriptions of treatment practices.

EPA also assembled extensive data on final effluent discharge levels from the information supplied by mills in their "Discharge Monitoring Reports" (DMR). Since these reports are required under the NPDES program as administered by EPA regions and most states, a rather complete data base was assembled. Summaries of this data base are presented and discussed in this report to the extent that they supplement the data from the NCASI surveys.

In its support of the industry's efforts to review and comment on the Effluent Guidelines review process NCASI drew heavily on the data from both Accomplishment Surveys. To answer certain specific questions that were not addressed in the broader Accomplishment Surveys, NCASI also conducted numerous "ad hoc" data solicitations. To the extent possible the results from the solicitation have been incorporated into the findings presented herein.

C. Method of Presentation of Results

In general, performance data from various sources are grouped into units that relate to their order of occurrence in the waste management scheme. First, the overall response to the various surveys is summarized. This is followed by sections dealing with (a) overall water usage, (b) raw waste characteristics and variability, and (c) final effluent chacterization and variability. A separate section presents practices and performance among users of publicly owned treatment systems.

Following the sections dealing with performance data are sections which summarize industry practices regarding (a) inplant load control measures, (b) external treatment system configurations, (c) sludge dewatering system configurations, and (d) disposal methods for sludges and manufacturing-derived solid wastes. The sections dealing with sludge and solid wastes also contain data on the quantity of these materials generated.

II SURVEY RESULTS - OVERALL RESPONSE, WATER USE AND RAW WASTE LOADS

A. Overall Response to NCASI Surveys and Contents of EPA's Discharge Monitoring Reports Data Base

Table 1 summarizes the "Production Classification" (PC) Codes used in both the 1975 and 1979 NCASI Accomplishment Surveys. The PCs represent NCASI's version of a classification scheme for mills in the primary production segment (i.e. stand-alone converting plants are not included). The PC classification scheme incorporates EPA's "pure mill" subcategories but goes beyond in recognizing several of the more common types of mixed mills. This was done to avoid large groupings of "miscellaneous" mills and should not be interpreted as meaning that such mills should be grouped for effluent guidelines purposes.

Table 2 presents the number of mills for each PC which responded to the 1975 and 1979 Accomplishment Surveys along with the total production for mills responding in each PC. The 1975 Survey had responses from 275 mills producing a total of nearly 140,000 tpd while the 1979 Survey received responses from 307 mills producing nearly 167,000 tpd. Comparing the reported production figures to API total paper and paperboard production shows that the surveys represent 96 and 90% of total production for the industry in 1975 and 1979, respectively.

Table 3 presents the number of mills, by EPA subcategory, for which the agency was able to obtain Discharge Monitoring Report (DMR) data. Consequently, this listing should reflect only direct discharging mills in each subcategory. Counts in various subcategories will not match those in NCASI PCs with similar names because (a) NCASI data includes indirect dischargers, (b) the NCASI breakdown is more detailed, and (c) the lack of complete response to NCASI's solicitation. The EPA data suggest that there are some 358 direct discharging mills in the U.S. DMR data supplied to NCASI did not include production data so this information cannot be summarized for the DMR data. Complete DMR data, as supplied to NCASI is presented in Appendix A.

B. Current Levels and Historical Trends in Water Use

(1) Current Water Use Levels - Table 4 summarizes results from the 1979 Accomplishment Survey concerning final effluent discharge volumes and cooling water usage. The column headed "Mills Responding" reflects the total number of mills in each PC responding to the 1979 Survey, while the two columns headed "No." reflect the number of mills providing final effluent flow or cooling water flow, respectively. The remaining columns

TABLE 1

NCASI PRODUCTION CLASSIFICATION CODES

Code	Production Classification Description
BKM	Bleached Kraft/Market Pulp
BKF	Bleached Kraft/Fine Papers
BKC	Bleached Kraft/Coarse Papers, Board or Tissue
XRC	Unbleached Kraft Plus NSSC (Cross Recovery Mills)
UBK	Unbleached Kraft/Bag Paper or Paperboard
S3F	Sulfite/Fine Papers
S3D	Sulfite/Dissolving Pulp
SCH	Semi-Chemical Pulp/Paperboard
SOD	Soda/Fine Paper
GWC	Groundwood/Coarse Paper or Molded Products
GWF	Groundwood/Fine Papers
GWN	Groundwood/Newsprint or Tissue
TMP	Thermomechanical Pulp/Newsprint
DIF	Deinked Pulp/Fine Paper
DIT	Deinked Pulp/Tissue Paper
DIN	Deinked Pulp/Newsprint
LWT	Nonintegrated Light Weight Papers
FLT	Nonintegrated Filter Papers or Nonwoven Products
SPE	Specialty Fibre (e.g. rag)/Fine or Specialty Paper
NIT	Nonintegrated Tissue Papers
NIF	Nonintegrated Fine Papers
WPT	Tissue from Wastepaper
WPB	Paperboard from Wastepaper
BKG	Bleached Kraft and Groundwood
UBG	Bleached and Unbleached Kraft Plus Groundwood
BUB	Bleached and Unbleached Kraft
BMO	Bleached Kraft/Market Pulp and Other Products
BDO	Bleached Kraft/Dissolving Pulp and Other Products
S3O	Sulfite/Fine Paper and Other Products
KPO	Kraft Plus Other Pulping Processes (not listed above)
SPB	Specialty Board Products
BLD	Builders Paper and Board
OTH	Other

TABLE 2

SUMMARY OF MILL RESPONSES TO 1975 AND 1979 ACCOMPLISHMENT SURVEYS

Mill Type	1975 Survey No.	1975 Survey Daily Production (tpd)	1979 Survey No.	1979 Survey Daily Production (tpd)
Bl. Kr. Market	6	3,846	8	5,124
Bl. Kr. Fine	10	6,752	14	12,054
BK Coarse/Tissue	9	11,483	9	9,105
BK Mkt./Other	8	6,308	6	6,202
BK Diss./Other	3	3,204	2	2,374
Bl./Unbl. Kraft	9	10,826	12	15,047
Bl. Kr. & Gwd.	9	9,796	9	11,041
Bl./Unbl. Kr. & Gwd.	4	4,883	3	3,456
Unbl. Kr. Board/Paper	24	22,211	27	26,845
UBK + NSSC	8	11,460	10	16,533
Kraft plus other	4	4,915	6	7,573
Soda/Fine Paper	2	1,095	2	1,219
Semi-Chem	12	6,528	12	6,570
Sulfite/Paper	12	3,875	8	2,766
Sulfite and Other Pulp	4	3,392	3	1,930
Sulfite Diss.	-	-	7	3,604
Gwd./Coarse or Molded	6	2,351	1	53
Gwd./News or Tissue	9	3,988	1	98
Gwd./Fine Paper	-	-	9	5,008
TMP	2	200	3	898
Specialty Fibre	9	722	6	643
Deink Tissue or Fine	8	1,949	14	2,723
Deink News	-	-	3	1,302
Defib./Insulation	6	1,854	-	-
Gwd. or Parch/Roofing	4	659	-	-
Paperboard from WP	52	9,637	60	12,134
Tissue from WP	6	464	4	209
Non-integ. Tissue	6	936	7	2,020
Non-integ. Fine	41	5,609	34	7,311
Specialty Board	-	-	5	358
Non-Int. Lt. Wt.	-	-	10	929
Non-Int. Filt. & NW			6	156
Other	2	914	6	1,618
Totals	275	139,860	307	166,903

TABLE 3

NUMBERS OF MILLS CONTAINED IN EPA'S DMR DATA BASE

Subcategory	No. of Mills Reported
BK Dissolving	3
BK Market	10
BK BCT	8
Alk. Fine	16
UBK Linerboard	16
UBK BAG	11
Semi-Chemical	18
UBK Plus Semi-Chemical	9
Dissolving Sulfite	6
Papergrade Sulfite	13
Gwd.-TMP	3
Gwd.-CMN	4
Gwd.-Fine	7
Integrated Misc.	69
Deink Fine	3
Deink News	1
Deink Tissue	11
Tissue from Wastepaper	11
Paperboard from Wastepaper	41
Wastepaper Molded Pulp	4
Builders Paper & Roofing Felt	5
Secondary Fibre Misc.	7
Nonintegrated Fine	16
Nonintegrated Fine - Cotton Fibre	5
Nonintegrated Tissue	14
Nonintegrated Lightweight	10
Nonintegrated Electrical	4
Nonintegrated Filter & Nonwoven	4
Nonintegrated Paperboard	6
Nonintegrated Miscellaneous	23
Total	358

TABLE 4

PROCESS WATER USE AND COOLING WATER USE

1979 ACCOMPLISHMENT SURVEY

Prod. Class.	Mills Responding	Final Effluent Discharge 1000 gal/ton				Cooling Water Use 1000 gal/ton			
		No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum
BKM	8	8	13.49	34.42	62.04	1	9.19	9.19	9.19
BKF	14	14	5.76	26.36	45.95	5	0.88	11.35	23.56
BKC	9	9	3.47	31.17	54.19	1	1.44	1.44	1.44
XRC	10	10	9.02	14.14	27.65	3	12.66	16.69	23.60
UBK	27	27	1.97	15.60	45.10	14	0.86	8.60	33.53
S3F	8	8	10.70	32.14	64.00	4	8.51	15.08	30.64
S3D	7	6	32.44	57.36	87.33	0	0.00	0.00	0.00
SCH	12	12	1.39	5.52	14.02	7	1.31	5.17	16.23
SOD	2	2	16.72	23.03	29.33	2	1.47	10.84	20.21
GWC	1	1	28.09	28.09	28.09	0	0.00	0.00	0.00
GWF	9	9	7.78	15.04	21.70	4	0.74	12.67	19.35
GWN	1	1	21.79	21.79	21.79	0	0.00	0.00	0.00
TMP	3	3	8.22	13.41	19.74	1	12.24	12.24	12.24
DIF	9	9	7.50	17.81	24.27	2	0.14	2.81	5.47
LWT	10	10	0.66	44.01	172.58	1	23.01	23.01	23.01
FLT	6	6	7.46	48.08	74.35	1	6.14	6.14	6.14
DIT	5	4	13.20	82.48	275.02	0	0.00	0.00	0.00
DIN	3	3	8.66	11.84	14.79	1	0.80	0.80	0.80
SPE	6	5	11.33	49.61	167.02	0	0.00	0.00	0.00
NIT	7	7	9.21	17.20	24.27	3	0.87	0.91	0.94
NIF	34	30	4.32	37.67	280.12	11	0.27	20.65	80.25
WPT	4	4	6.76	15.41	24.11	1	0.23	0.23	0.23
WPB	60	47	0.05	4.83	16.77	15	0.40	4.55	21.76
BKG	9	9	15.38	24.08	41.97	3	9.27	11.64	16.05

TABLE 4 (Cont.)

PROCESS WATER USE AND COOLING WATER USE

1979 ACCOMPLISHMENT SURVEY

		Final Effluent Discharge 1000 gal/ton				Cooling Water Use 1000 gal/ton			
Prod. Class.	Mills Responding	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum
UBG	3	3	9.24	18.31	33.44	0	0.00	0.00	0.00
BUB	12	11	10.05	26.52	39.47	3	0.17	5.51	11.63
BMO	6	6	24.69	33.49	39.14	1	9.84	9.84	9.84
BDO	2	2	34.77	44.02	53.26	0	0.00	0.00	0.00
S30	3	3	17.35	35.08	67.24	0	0.00	0.00	0.00
KPO	6	6	19.80	33.44	57.77	3	0.99	6.61	10.45
OTH	6	6	9.55	28.39	92.79	2	5.31	12.83	20.35
SPB	5	5	1.38	18.48	38.70	0	0.00	0.00	0.00

Note: See Table 1 for Production Classification Codes present the minimum, maximum and average unit flow (in kgal/ton) for each PC for both process effluent and cooling water.

Final effluent flow was chosen as the best indicator of total water use because responses to this inquiry were generally more complete than those for raw waste flows. The 1979 Survey did request data specifically for process water use but results were spotty and often inconsistent with effluent data indicating that the question may have been poorly understood. There was also considerable evidence that many mills reported cooling water flows separately even though the cooling water was included in the measured final effluent flow. For these reasons, the average of the reported final effluent flows for each PC were considered to be the best representation of total water use.

It should also be noted that Table 4 reflects data from both direct and indirect dischargers. This approach was chosen because it gave the largest data base for water usage across many PCs. Separate data on direct and indirect dischargers are presented in later sections.

Other data on raw waste flows and final effluent flows from the 1975 Accomplishment Survey and the EPA DMR data base are presented in later sections of this report dealing with raw waste and final effluent characteristics.

(2) Water Use Trends - Data from earlier NCASI Accomplishment Surveys (see Special Reports 71-02 and 73-01) and other historical references have been compiled in order to examine the trend in process and cooling water use over the years. The results are summarized in Table 5. These data reflect a weighted average flow per ton of product across the whole primary production segment of the industry. The weighted average flows were calculated by multiplying the average flow per ton for each PC by the estimated total production for each PC. The sum of these products was then divided by the total production of all PCs to yield the weighted average discharge for each year.

Table 5 also presents the estimated total discharge by the entire industry over the years. The results show that while total discharge has declined sporadically over the years in response to production growth, the trend in water used per ton of product has been clearly and dramatically downward, and in 1979 was 40 percent of the unit production use in 1959 or 22,800 gal/ton paper and paperboard.

C. Raw Waste Characteristics

(1) Average Raw Waste Characteristics - Table 6 presents data on raw waste characteristics from the 1979 Accomplishment Survey.

TABLE 5

HISTORICAL WATER USE TRENDS IN THE PULP AND PAPER INDUSTRY

A. Unit Flows

Year	Process Water Use 1,000 gal/ton	Total Water Use 1,000 gal/ton
1959	36.0	57.0
1969	28.0	37.0
1971	27.7	34.8
1975	22.5	26.5
1977	20.7 (1)	-
1979	-	22.8

(1) estimated from December 1980 EPA Proposed Development Document Data

B. Total Flows

Year	Total Production 1000 tons per day (2)	Total Water Use Billion gallons per day
1959	96.4	5.49
1969	151.0	5.59
1971	152.0	5.29
1975	146.0	3.87
1977	172.0	4.23 (3)
1979	185.0	4.07

(2) From API Statistics of Pulp and Paper - Total Paper and Board Production, divided by 350 production days per year, rounded to 3 significant figures.
(3) Interpolated from 1975 and 1979 unit flow data.

TABLE 6

RAW WASTE CHARACTERISTICS - 1979 ACCOMPLISHMENT SURVEY

		BOD lb/ton				TSS lb/ton				FLOW kgal/ton			
Prod. Class.	Mills Responding	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum
BKM	8	8	37.04	61.25	88.68	7	17.75	59.79	187.00	8	13.49	33.00	62.04
BKF	14	13	18.66	68.20	130.03	12	35.19	132.27	330.94	13	5.76	26.41	47.02
BKC	9	9	9.32	71.26	102.83	7	41.33	118.88	263.12	7	11.99	28.25	45.54
XRC	10	9	22.24	38.14	68.83	8	15.66	58.17	187.02	8	9.48	12.86	22.19
UBK	27	24	2.43	35.39	68.95	23	1.06	53.43	188.01	24	1.97	15.98	45.10
S3F	8	8	69.71	129.76	208.52	8	29.95	106.36	208.76	7	10.38	33.33	64.00
S3D	7	3	-	273.19	-	2	-	119.92	-	3	40.75	47.99	56.77
SCH	12	10	24.84	38.15	66.76	10	8.73	47.66	170.50	11	1.51	5.41	14.33
SOD	2	2	-	105.21	-	2	-	186.10	-	1	-	-	-
GWC	1	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0	0.00	0.00	0.00
GWF	9	8	21.59	32.40	55.12	8	60.99	126.58	262.24	8	7.55	14.56	20.45
GWN	1	1	-	-	-	1	-	-	-	1	-	-	-
TMP	3	2	-	70.08	-	2	-	80.03	-	2	-	13.99	-
DIF	9	8	23.16	74.91	136.08	8	125.17	247.40	361.31	8	8.83	18.37	24.27
LWT	10	7	3.02	62.17	190.59	7	7.00	201.90	472.25	7	3.94	57.78	174.19
FLT	6	6	9.73	26.66	61.11	6	49.06	81.46	113.16	6	7.46	48.08	74.35
DIT	5	3	-	365.91	-	3	-	250.66	-	3	-	103.92	-
DIN	3	0	0.00	0.00	0.00	0	0.00	0.00	0.00	1	-	-	-
SPE	6	3	-	146.52	-	3	-	168.11	-	3	-	69.37	-
NIT	7	5	9.33	24.45	34.78	6	50.38	97.59	184.43	6	14.39	19.89	32.48
NIF	34	20	2.05	31.47	119.88	22	7.08	117.31	640.35	24	5.27	46.72	377.19
WPT	4	3	-	39.70	-	3	-	63.93	-	3	-	16.68	-
WPB	60	19	1.87	62.04	826.50	21	1.14	33.62	174.45	22	0.46	5.44	16.77
BKG	9	8	22.51	63.30	110.34	8	59.89	161.02	479.55	8	15.51	24.00	39.88

TABLE 6 (Cont.)

RAW WASTE CHARACTERISTICS - 1979 ACCOMPLISHMENT SURVEY

		B O D lb/ton				T S S lb/ton				F L O W kgal/ton			
Prod. Class.	Mills Responding	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum
UBG	3	2	-	45.05	-	2	-	59.58	-	2	-	23.18	-
BUB	12	11	37.80	53.52	70.80	9	14.45	81.28	189.23	11	10.06	24.30	37.50
BMO	6	6	51.35	65.28	97.49	6	22.60	81.76	210.07	6	24.65	33.26	39.14
BDO	2	2	-	120.26	-	2	-	158.25	-	2	-	43.74	-
S30	3	3	-	93.26	-	3	-	97.57	-	3	-	35.15	-
KPO	6	6	42.50	90.80	127.95	6	93.45	107.73	134.87	6	19.80	33.34	58.63
OTH	6	5	8.50	60.40	185.35	5	52.26	120.69	271.59	5	9.55	29.19	92.79
SPB	5	4	8.90	25.57	34.67	4	44.30	81.58	166.83	3	-	25.84	-

Note: Reported results are omitted where they would indicate single mill responses.

See Table 1 for Production Class Codes

E. Total Organic Matter

Total organic matter can be satisfactorily estimated by calculations involving total organic carbon in the soil. In order to obtain the information necessary to determine the proportion of total organic matter attributable to organic carbon, both measurements should be made at the initiation of the program. With this data in hand, annual measurements of organic carbon using the Walkley-Black Method discussed later on can be used to calculate total organic matter based on conversion factors appropriate to the composition of organic materials at each site.

Soil organic matter can be estimated directly by (a) oxidation with potassium dichromate, (b) H_2O_2 oxidation, and (c) loss-on-ignition. Originally, we recommended the procedure of Nelson and Sommers (4) for the direct estimation of organic matter. A few reviewers commented on this method with the most important points being that (a) the cumbersome apparatus required to measure the CO_2 evolved is a highly undesirable aspect, and (b) the oxidation with potassium dichromate method has been met with good success where used. While these points are true, clearly the best method for measuring this parameter is the one originally selected and presented in the Appendix. In some companies, it may prove most efficient to have this measurement made by an outside laboratory which routinely carries out this determination.

F. Soil Morphology

At each sampling location, a soil pit should be excavated and soil morphology described using the standard methods outlined in the Soil Survey Manual (6) with revisions to these procedures as issued in May 1981 (430-V-SSM). This will provide information on soil horizons such as depth, color, horizon boundaries, structure, consistency, drainage, mottling, root distribution, and the presence of pans or impermeable layers. While this information might be inferred from soil surveys available for an area, verification and refinement of the existing data are necessary for each location at the time of soil sensitivity site establishment. All measurements should be metric (e.g. depth as cm). This information could also be used to identify the appropriate soil series at each location. A reviewer comment on this item which should be mentioned here was the strong suggestion that the experience and expertise of Soil Conservation Service personnel should be enlisted as much as possible in the soil description process during initial program establishment.

TABLE 7

RAW WASTE CHARACTERISTICS OF MILLS PROVIDING SELF-OWNED TREATMENT IN 1975

Prod. Class	NO.*	FLOW (k gal/ton)			BOD (lbs/ton)			TSS (lbs/ton)		
		Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.
BKM	6	38	20	33	80	38	58	80	38	56
BKF	9	39	17	28	97	38	58	387	32	132
BKC	8	48	13	30	108	27	69	189	23	92
XRC	8	29	8	15	68	34	41	77	18	49
UBK	19	49	9	16	80	24	38	125	9	42
S3F	4	35	14	24	243	22	123	241	5	85
SCH	11	25	4	10	116	3	52	56	1	36
SOD	2	-	-	28	-	-	66	-	-	234
GWC	3	-	-	24	-	-	57			185
GWN	8	22	5	17	28	10	23	113	5	81
TMP	2	-	-	42	-	-	127	-	-	83
DI(T or F)	4	32	13	22	177	92	124	670	214	384
SPE	7	115	1	71	200	24	98	273	65	167
NIT	5	35	16	24	52	11	31	105	38	74
NIF	28	73	2	26	100	3	21	360	5	80
WPT	6	72	12	43	182	22	102	456	133	283
WPB	28	20	1	9	145	3	38	126	10	42
BKG	8	41	21	30	124	23	71	190	32	121
UBG	3	-	-	17	-	-	30	-	-	74
BUB	7	94	7	32	138	20	69	149	10	51
BMO	6	41	33	36	127	30	78	233	25	110
BDO	2	-	-	46	-	-	163	-	-	134
S3O	5	67	18	33	251	107	150	103	21	50
KPO	4	34	12	23	50	36	42	245	26	100
S3O	3	-	-	47	-	-	395	-	-	125
	204									

*Number reporting a minimum of flow; BOD and TSS may be from smaller sample of mills.

See Table 1 for Production Class Codes

TABLE 8

RAW WASTE VARIABILITY - 1979 ACCOMPLISHMENT SURVEY

		BOD RAW WASTE VARIABILITY Max. Mo./Ann. Avg.				TSS RAW WASTE VARIABILITY Max. Mo./Ann. Avg.				FLOW RAW WASTE VARIABILITY Max. Mo./Ann. Avg			
Prod. Class.	Mills Responding	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum
BKM	8	8	1.14	1.25	1.42	7	1.19	1.60	1.99	8	1.05	1.11	1.20
BKF	14	13	1.09	1.26	1.45	12	1.11	1.47	2.71	13	1.03	1.09	1.31
BKC	9	9	1.12	1.23	1.42	7	1.25	1.52	1.90	7	1.03	1.12	1.29
XRC	10	9	1.08	1.27	1.52	8	1.15	1.52	1.98	9	1.03	1.11	1.26
UBK	27	24	1.11	1.37	2.17	23	1.08	1.47	2.92	24	1.04	1.12	1.40
S3F	8	8	1.10	1.31	1.63	8	1.10	1.41	1.98	8	1.04	1.12	1.28
S3D	7	3	1.09	1.16	1.26	1	-	-	-	2	-	1.15	-
SCH	12	10	1.20	1.39	2.25	10	1.22	1.61	2.45	11	1.10	1.20	1.32
SOD	2	2	-	1.17	-	2	1.24	1.31	1.37	2	-	1.14	-
GWC	1	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0	0.00	0.00	0.00
GWF	9	8	1.07	1.29	1.52	8	1.13	1.37	1.63	8	1.05	1.12	1.22
GWN	1	1	1.13	1.13	1.13	1	-	-	-	1	-	-	-
TMP	3	2	-	1.20	-	2	-	1.42	-	2	-	1.15	-
DIF	9	8	1.12	1.36	1.58	8	1.21	1.53	2.59	8	1.07	1.15	1.23
LWT	10	7	1.39	1.58	2.04	7	1.32	1.47	1.80	7	1.00	1.09	1.14
FLT	6	6	1.28	1.89	2.82	6	1.20	1.71	2.53	6	1.07	1.23	1.65
DIT	5	3	-	1.20	-	3	-	1.28	-	3	-	1.10	-
DIN	3	0	0.00	0.00	0.00	0	0.00	0.00	0.00	1	-	-	-
SPE	6	3	-	1.45	-	3	-	1.33	-	3	-	1.25	-
NIT	7	5	1.31	1.59	1.90	6	1.18	1.27	1.47	6	1.07	1.11	1.20
NIF	34	20	1.12	1.36	1.88	22	1.11	1.43	2.54	26	1.05	1.49	10.55
WPT	4	3	-	1.55	-	3	-	1.60	-	3	-	1.39	-
WPB	60	19	1.05	1.31	1.72	21	1.07	1.69	3.48	24	1.00	1.23	1.71
BKG	9	8	1.13	1.24	1.60	8	1.11	1.25	1.63	8	1.04	1.08	1.13

TABLE 8 (Cont.)

RAW WASTE VARIABILITY - 1979 ACCOMPLISHMENT SURVEY

Prod. Class.	Mills Responding	BOD RAW WASTE VARIABILITY Max. Mo./Ann. Avg. No.	Minimum	Average	Maximum	TSS RAW WASTE VARIABILITY Max. Mo./Ann. Avg. No.	Minimum	Average	Maximum	FLOW RAW WASTE VARIABILITY Max. Mo./Ann. Avg No.	Minimum	Average	Maximum
UBG	3	2	1.09	1.11	1.13	2	-	1.19	-	2	-	1.08	-
BUB	12	11	1.12	1.19	1.33	9	1.22	1.51	1.73	11	1.02	1.07	1.13
BMO	6	6	1.12	1.22	1.30	6	1.16	1.39	1.84	6	1.04	1.10	1.18
BDO	2	2	-	1.23	-	2	-	1.42	-	2	-	1.05	-
S30	3	3	-	1.15	-	3	-	1.51	-	3	-	1.10	-
KPO	6	6	1.13	1.21	1.25	6	1.24	1.33	1.53	6	1.08	1.12	1.26
STO	0	0	0.00	0.00	0.00	0	0.00	0.00	0.00	0	0.00	0.00	0.00
OTH	6	5	1.26	1.52	2.40	5	1.20	1.29	1.48	5	1.09	1.12	1.17
SPB	5	4	1.32	1.41	1.52	4	1.43	1.50	1.65	4	1.13	1.20	1.24

Note: Reported results are omitted where they would indicate an individual mill's response.

See Table 1 for Production Class Codes

ranging from 1.2 to 1.7. Most data for single PCs tend to be very tightly clustered with the minimum to maximum range tending to fall at 80 to 120% of the average value.

It is also interesting to note that BOD variability factors are universally higher than flow variability factors, suggesting that there are variations in raw waste BOD concentrations which cause wider swings in BOD loads than would be accounted for by variations in flow alone. This in turn gives some measure of the variation in raw waste load that is caused by intermittent strong waste losses.

III SURVEY RESULTS - INDIRECT DISCHARGERS

A. Extent of Use of Publicly Owned Treatment Works by the Pulp and Paper Industry

(1) Number and Production of Mills Using POTWs - Table 9 summarizes the number and total production of mills reporting discharge to publicly owned treatment works (POTWs) in both the 1975 and 1979 Accomplishment Surveys. While the numbers are slightly smaller for 1979, this should not be taken as an indication that POTW usage declined over the intervening years. The difference is attributable to a difference in survey response.

Table 10 presents an estimate of the total population of POTW users among pulp and paper mills. This data was assembled from available published information (industry directories, etc.) and public information from EPA's Effluent Guidelines administrative record. This information will be used in this section to extrapolate the total load discharged to POTWs by the industry.

(2) Characteristics of Wastewaters Discharged to POTWs - Table 11 presents data on the average characteristics of wastewaters discharged to POTWs among mills responding to the 1979 Accomplishment Survey. The results are, in general, comparable to the raw waste data shown in Table 6 but are influenced to some extent by pretreatment practices discussed in a later section. These results are also used, in part, to extrapolate the total discharge to POTWs.

(3) Estimated Total Discharge to POTWs by the Pulp and Paper Industry - Table 12 presents the estimated total discharge to POTWs by the primary production segment of the pulp and paper industry. The estimate is based on the estimated number and production of indirect discharging mills given in Table 10 and the wastewater characteristics presented in Table 11. When the 1979 Accomplishment Survey did not yield a meaningful sample of wastewater characteristics for a given PC, average raw waste data

TABLE 9

EXTENT OF USE OF POTWS FROM NCASI ACCOMPLISHMENT SURVEYS

	1975 Survey		1979 Survey	
Prod. Class.	No. of Mills Reporting	Total Production (tpd)	No. of Mills Reporting	Total Production (tpd)
BKF	2	1,384	4	3,512
BKC	0	0	1	-
UBK	1	-	2	2,821
S3F	0	0	1	-
SCH	1	-	1	-
SOD	1	-	1	-
GWC	2	437	1	-
GWF	1	-	2	2,355
TMP	0	0	1	-
DI (F,T or N)	4	1,084	7	1,865
SPE	5	1,434	3	105
NIF	19	1,524	9	1,953
NIT	0	0	1	-
WPT	1	-	1	-
WPB	21	3,952	27	5,736
BLD	4	659	0	0
UBG	1	-	0	0
BUB	1	-	1	-
BMO	2	1,614	0	0
S3O	1	-	0	0
SPB	0	0	1	-
OTH	0	0	1	-
Totals	67	18,750	65	18,349

Notes: 1) See Table 1 for Production Codes.

2) Production figures are not reported where they reflect a single mill's production. The production of these mills is however included in the totals.

TABLE 10

ESTIMATED TOTAL NUMBER AND PRODUCTION OF DISCHARGERS TO POTWS

Prod. Class.	No. of Mills	Total Production (tpd)
BKD	0	0
BKM	0	0
BKF	4	3,510
BKC	1	1,100
XRC	0	0
UBK	3	2,800
S3F	1	400
S3D	0	0
SOD	1	790
GWC	1	50
GWF	3	2.350
GWN	0	0
TMP	1	220
DIF	3	770
DIT	4	790
DIN	2	880
SPE	10	800
NIT	9	1,600
NIF	14	2,300
WPT	2	180
WPB	53	9,200
BKG	0	0
UBG	0	0
BUB	1	1,080
BMO	0	0
BDO	0	0
S30	0	0
KPO	0	0
SPB	11	1,200
LWT	7	380
FLT	2	60
BLD	17	2,000
OTH	4	260
SCH	4	1,340
Totals	158	34,060

See Table 1 for Production Class Codes

TABLE 11

CHARACTERISTICS OF WASTEWATERS DISCHARGED TO POTWS

1979 ACCOMPLISHMENT SURVEY

	Flow to POTW k gal/ton		BOD to POTW lb/ton		TSS to POTW lb/ton	
Prod. Class.	No.	Average	No.	Average	No.	Average
BKF	4	32.42	4	97.56	3	147.63
BKC	1	11.99	1	41.59	1	17.74
UBK	2	10.73	3	23.60	2	21.02
S3F	1	9.99	1	107.14	1	44.33
SCH	1	4.67	0	0.00	1	92.43
SOD	1	29.33	1	150.41	1	110.32
GWC	1	28.09	1	58.61	1	223.03
GWF	2	14.22	2	19.46	2	125.97
TMP	1	12.28	1	115.05	1	45.03
DIF	3	21.38	3	48.60	3	137.33
LWT	1	7.10	0	0.00	0	0.00
FLT	2	29.76	2	39.99	2	101.54
DIT	2	16.44	1	29.21	2	87.89
DIN	2	11.73	1	18.90	2	201.51
SPE	3	68.87	2	205.68	3	210.12
NIT	1	18.45	1	12.42	1	31.06
NIF	9	29.99	6	14.54	7	44.56
WPT	1	6.76	1	60.32	1	52.67
WPB	27	4.36	21	16.23	27	21.25
BUB	1	29.03	1	45.32	1	59.69
OTH	2	16.96	1	23.31	2	48.43
SPB	1	1.38	1	11.45	1	5.93

See Table 1 for Production Codes

TABLE 12

ESTIMATED TOTAL DISCHARGE TO POTWS BY PULP AND PAPER MILLS

Prod. Class.	Total Production (tpd)	Average Unit Discharge Flow kgal/t	Average Unit Discharge BOD lb/t	Average Unit Discharge TSS lb/t	Total Discharge Flow mgd	Total Discharge BOD klb/d	Total Discharge TSS klb/d
BKD	0	-	-	-	0	0	0
BKM	0	-	-	-	0	0	0
BKF	3,510	32.4	97.6	147.6	114	343	518
BKC	1,100	12	41.6	17.7	13	46	19
XRC	0	-	-	-	0	0	0
UBK	2,800	10.7	23.6	21.0	30	66	59
S3F	400	10	107.1	44.3	4	43	18
S3D	0	-	-	-	0	0	0
SCH	1,340	7.4	51.6	92.4	10	69	124
SOD	790	29.3	150.4	110.3	23	119	87
GWC	50	28.1	58.6	223	1	3	11
GWF	2,350	14.2	19.5	126.0	33	46	296
GWN	0	-	-	-	0	0	0
TMP	220	12.3	115.1	45.0	3	25	10
DIF	770	21.4	48.6	137.3	16	37	106
DIT	790	16.4	29.2	87.9	13	23	69
DIN	880	11.7	18.9	201.5	10	17	177
LWT (1)	386	18.5	12.4	31.1	7	5	12
FLT	60	29.8	40.0	101.5	2	2	6
SPE	800	68.9	205.7	210.1	55	165	168
NIT	1,600	18.5	12.4	31.1	30	20	50
NIF	2,300	30.0	14.5	44.6	69	33	103
WPT	180	6.8	60.3	52.7	1	11	9
WPB	9,200	4.4	16.2	21.3	40	149	196
BKG	0	-	-	-	0	0	0
UBG	0	-	-	-	0	0	0
BUB	1,080	29.0	45.3	59.7	31	49	64
BMO	0	-	-	-	0	0	0
BDO	0	-	-	-	0	0	0
S30	0	-	-	-	0	0	0
KPO	0	-	-	-	0	0	0
SPB	1,200	1.4	11.5	6.0	2	14	7
BLD (2)	2,000	4.4	16.2	21.3	9	32	43
OTH	260	17.0	23.3	48.4	4	6	13
Totals					522	1,322	2,165

(1) used NIT average unit discharge figures
(2) used WPB average unit discharge figures
(3) see Table 1 for Production Class Codes

from Table 6 were substituted. The sum of the individual PC estimates indicate a total discharge to POTWs of 522 mgd containing 1.32 million lb/day of BOD and 2.17 million lb/day of TSS.

Comparing these figures with data from EPA's 1978 "Needs Survey" indicates that mills in the primary production segment of the pulp and paper industry contribute approximately 1.8% of the flow to the nation's existing POTW systems. BOD and TSS loadings from the industry average approximately 3.6% and 5.2%, respectively of the total load to POTWs in 1978.

B. Load Reduction Accomplished by Pretreatment Among Indirect Dischargers

The 1979 Accomplishment Survey solicited data on both raw waste loads and loads discharged to POTWs. This made it possible to calculate the removal achieved by pretreatment practices among mills responding to both question areas. Such responses were relatively few generally because of a lack of data concerning waste loads prior to pretreatment.

Table 13 presents average reductions in flow, BOD and TSS by PC. Omitted from the table are PCs where no data was available. In most cases, the response reflects only one mill per PC, so caution should be used in interpreting the data as reflective of an entire PC. The results are calculated from average daily values for the respective variables according to the following formula: (Raw waste - POTW discharge)/Raw Waste.

TABLE 13

LOAD REDUCTION ACCOMPLISHED BY PRETREATMENT PRACTICES

Production Classification	Average Reported Flow Reduction Percent	Average Reported BOD Reduction Percent	Average Reported TSS Reduction Percent
BKF	-	21	84
BKC	-	25	60
UBK	16	54	-
S3F	66	19	59
SCH	-	-	46
SOD	-	13	42
GWF	-	53	-
DIT	2	25	83
NIT	1	-	72
NIF	-	40	77
WPB	33	43	90

The results do show a general trend toward higher reductions of TSS as compared to BOD or flow reductions. This trend probably reflects the extensive use of fibre recovery systems that have little effect on soluble BOD or flow.

IV SURVEY RESULTS - DIRECT DISCHARGERS

A. Direct Discharge Final Effluent Characteristics

There are three sources of data available to characterize final effluent characteristics from direct dischargers. These are (a) NCASI's 1975 Accomplishment Survey, (b) NCASI's 1979 Accomplishment Survey, and (c) EPA's Discharge Monitoring Report (DMR) data base. There are several differences between these data sets which should be identified before the actual data is considered.

The 1975 Accomplishment Survey data reflect only operating data for the calendar year 1975. Judgments on the calculation of unit discharge values (i.e. lb/ton or kgal/ton values) were made by the NCASI staff and generally reflect the use of total machine production as the divisor. Since this survey predates EPA's latest revision of its subcategorization scheme for the industry, certain of the new groupings (primarily the specialty groups) are not reflected. Consequently, some mills may be "forced" into other groupings, affecting the calculated values for that grouping. Further, the 1975 Accomplishment Survey results include certain common groupings of mixed production which are not considered by EPA. Finally, it should be remembered that the 1975 data reflects performance in a period that predates the statutory requirement for compliance with BPT effluent limitations. Hence, the average values for that period reflect substantial, but not universal application of secondary treatment.

The 1979 Accomplishment Survey data are similar to the 1975 data in many, but not all, ways. The 1979 data reflect a single year's performance and were handled by NCASI staff in a manner essentially the same as the 1975 data. The 1979 data breakdown does reflect some (but not all) of the newer, specialty, subcategories created by EPA. Differences in the number of each type of mill responding to each survey may affect calculated results for many PCs. Since 1979 was later than the required compliance date, data from that year should reflect virtually complete compliance with NPDES permit conditions which were based on either BPT limitations or water quality requirements.

The EPA DMR data base generally reflects 24 to 44 months of data from each mill with a median level on the order of 36 months. In most cases, the period of record begins in mid 1977 and extends through 1980. Many records show data to mid 1981. Consequently, the EPA data reflect performance from just after the required date for BPT compliance through at least 1 year after the period reflected in the 1979 Accomplishment Survey. This means that the EPA data represent some sort of average performance over a period that undoubtedly involved the fine tuning of BPT level treatment systems. By the same token, the EPA data span would tend to "average out" any shorter term abberations in the data (such as an unusually cold winter).

Taken together, these differences mean that there are some seemingly inexplicable variations between performance data figures for certain subcategories as indicated in the various data sets. The 1979 Accomplishment Survey data and the EPA data are more reflective of performance in the post BPT compliance period. EPA data are probably more reflective of longer term average performance for "pure" mills only.

Tables 14, 15, and 16 present a summary of the 1975 Accomplishment Survey, the 1979 Accomplishment Survey and the EPA DMR data, respectively. Details on the DMR data base are given in Appendix A. The Appendix A information is reproduced in content as supplied by EPA but retyped for readability. NCASI also assembled the maximum, minimum and average data for each subcategory. This information was carefully checked but, since the EPA reproduction was of poor quality, errors are possible.

In the tables presenting the NCASI Survey Data, maxima and minima are withheld whenever fewer than 4 mills responded in a given PC. Likewise, if only one mill responded in a given PC, that PC is omitted from the tables. These steps were taken to protect the confidentiality of single mill responses.

The NCASI 1979 data and the EPA data are in fairly good agreement except for the types of aberrations discussed earlier. Comparison of these two sets with the 1975 NCASI data indicates a substantial reduction in final effluent BOD and TSS levels over the intervening time period.

B. Final Effluent Variability

Tables 17 and 18 present, respectively, the results of calculating maximum month and maximum day variability factors for each PC, based on data from the 1979 Accomplishment Survey. A maximum, average and minimum figure is presented for each PC. In each case, the variability factors for individual mills were calculated by dividing the maximum monthly average discharge (or maximum daily discharge) by the annual average discharge. Results for each PC were then summarized as shown in the tables.

TABLE 14

FINAL EFFLUENT CHARACTERISTICS OF DIRECT DISCHARGING MILLS DURING 1975

		B O D lb/ton			T S S lb/ton		
Category	No.*	Maximum	Minimum	Average	Maximum	Minimum	Average
BKM	6	79	10	41	80	8	35
BKF	5	53	1	16	87	6	37
BKC	9	15	2	8	60	3	19
XRC	8	33	3	12	33	2	12
UBK	20	45	1	11	22	1	10
S3F	6	130	17	61	78	18	39
SCH	9	44	1	10	24	1	13
SOD	2	-	-	36	-	-	48
GWC	3	-	-	19	-	-	7
GWN	8	43	2	16	23	4	10
TMP	2	-	-	36	-	-	60
DI (F or T)	4	177	36	94	666	10	187
SPE	7	200	22	65	257	9	80
NIT	6	73	1	21	30	2	19
NIF	29	100	1	11	200	1	20
WPT	4	35	2	16	23	2	9
WPB	22	26	1	8	59	1	8
BKG	8	71	2	24	139	5	36
UBG	2	-	-	3	-	-	11
BUB	7	32	2	12	38	2	13
BMO	6	34	2	10	21	3	11
BDO	2	-	-	107	-	-	68
S30	5	252	22	105	31	7	20
KPO	4	43	4	21	15	1	10
S30	3	-	-	129	-	-	34

*Number reporting a minimum of BOD

See Table 1 for Category Codes

TABLE 15

ANNUAL AVERAGE FINAL EFFLUENT CHARACTERISTICS FOR DIRECT DISCHARGERS - 1979 ACCOMPLISHMENT SURVEY

		FLOW kgal/ton				BOD lb/ton				TSS lb/ton			
Prod. Class.	Mills Responding	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum
BKM	8	8	13.49	34.42	62.04	8	3.28	21.89	66.89	8	4.47	15.72	28.86
BKF	14	10	5.76	23.94	45.95	10	1.33	3.95	9.97	10	0.89	9.68	21.15
BKC	9	8	3.47	33.56	54.19	8	1.78	6.62	10.81	8	4.42	8.52	14.64
XRC	10	10	9.02	14.14	27.65	10	3.00	5.99	10.83	10	3.23	9.53	19.60
UBK	27	25	1.97	15.99	45.10	25	0.45	3.91	8.07	25	0.61	6.88	14.41
S3F	8	8	10.70	30.89	64.00	8	3.05	21.84	65.37	8	3.15	19.93	32.86
S3D	7	6	32.44	57.36	87.33	6	26.97	103.95	283.52*	6	12.88	49.99	88.91
SCH	12	11	1.39	5.60	14.02	11	1.58	5.44	14.28	11	0.39	7.45	17.94
GWF	9	7	7.78	15.27	21.70	7	0.37	3.10	8.11	7	0.74	4.59	6.89
TMP	3	2	8.22	13.98	19.74	2	8.88	15.43	21.98	2	13.08	14.56	16.04
DIF	9	6	7.50	16.03	23.57	6	2.72	5.90	11.43	6	5.44	7.67	9.28
LWT	10	9	0.66	48.12	172.58	9	0.04	6.30	18.82	9	0.04	5.41	23.53
FLT	6	4	49.56	57.24	74.35	4	2.65	5.97	10.38	4	2.52	6.12	7.96
DIT	5	2	13.20	17.62	22.04	2	6.01	6.38	6.77	2	7.10	7.60	8.09
SPE	6	2	14.57	22.17	29.76	2	7.89	8.49	9.08	2	3.47	12.12	20.76
NIT	7	6	9.21	16.99	24.27	6	0.42	3.65	6.60	6	1.28	3.14	6.79
NIF	34	21	6.19	40.97	280.12	21	0.46	10.94	91.26	21	0.80	11.37	149.25
WPT	4	3	11.59	18.29	24.11	3	8.21	10.50	11.68	3	3.63	5.62	9.38
WPB	60	21	0.05	5.20	16.77	22	0.14	3.02	26.07	22	0.07	3.46	39.33
BKG	9	9	15.38	24.08	41.97	9	1.63	9.38	18.12	9	5.14	15.61	28.98

TABLE 15 (Cont.)

ANNUAL AVERAGE FINAL EFFLUENT CHARACTERISTICS FOR DIRECT DISCHARGERS - 1979 ACCOMPLISHMENT SURVEY

		FLOW kgal/ton				BOD lb/ton				TSS lb/ton			
Prod. Class.	Mills Responding	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum
UBG	3	3	9.24	18.31	33.44	2	2.07	4.37	6.66	2	4.86	10.97	17.07
BUB	12	10	10.05	26.27	39.47	10	2.27	5.83	9.17	10	3.16	11.90	21.98
BMO	6	6	24.69	33.49	39.14	6	4.55	7.36	13.87	6	5.56	15.04	39.60
BDO	2	2	-	44.02	-	2	-	20.90	-	2	-	32.90	-
S30	3	3	17.35	35.08	67.24	3	6.39	14.47	27.78	3	6.50	22.68	42.12
KPO	6	6	19.80	33.44	57.77	6	4.10	10.31	16.51	6	5.94	18.35	25.62
OTH	6	4	12.00	34.10	92.79	4	4.61	11.44	23.45	4	2.77	15.75	29.55
SPB	5	4	7.32	22.76	38.70	4	3.53	5.30	7.37	4	2.68	3.97	5.41

* Data reflects the application of secondary treatment during the last two months of the year only.

See Table 1 for Production Class. Codes

TABLE 16

SUMMARY OF EPA DMR FINAL EFFLUENT DATA

Subcategory	No. of Mills	FLOW kgal/ton Maximum	FLOW kgal/ton Average	FLOW kgal/ton Minimum	BOD lb/ton Maximum	BOD lb/ton Average	BOD lb/ton Minimum	TSS lb/ton Maximum	TSS lb/ton Average	TSS lb/ton Minimum
Diss. Kr.	3	59.5	44.7	29.9	11.8	10.1	7.5	38.8	26.8	11.7
Bl. Kr. Mkt.	9	67.6	33.5	10.3	12.4	8.1	3.1	39.0	14.6	5.2
Bl. Kr. BCT	7	49.8	35.8	29	10.7	8.1	4.9	17.2	9.9	8.5
Alk. Fine	16	59.3	28.3	15.2	63.6	10.2	1.3	50.3	17.4	4.2
Unbl. Kr.Liner	16	26.7	12.3	5.2	8.5	3.8	1.1	12.0	5.1	0.8
Unbl. Kr. Bag	11	40.5	21.5	10.3	6.8	3.9	2.0	13.4	7.7	4.9
Semi Chem.	17	11.9	6.4	2.7	22.1	5.8	0.7	23.7	8.1	1.3
Unbl. Kr. + SC	9	13.5	10.7	8.7	9.6	5.2	1.7	10.4	7.2	3.2
Diss. Sulfite	5	95.1	70.4	53.6	95.2	76.3	52.8	103.3	56.5	23.7
PG Sulfite	13	73.2	32.9	9.6	29.9	13.8	2.9	50.8	19.2	3.5
GW-TMP	2	21.1	14.6	8.1	7.3	5.2	3.1	12.3	8.9	5.5
GW-CMN	3	26.9	73.2	16.5	7.7	4.1	2.0	10.4	6.8	4.4
GW-Fine	7	18.9	12.5	8.5	4.5	1.8	0.6	6.1	4.0	0.7
DI-Fine	3	13.3	10.8	7.5	5.5	4.6	4.0	8.0	7.3	6.4
DI-News	1	-	13.4	-	-	2.8	-	-	2.2	-
DI Tissue	11	32.2	16.7	1.9	24.8	11.5	3.9	30.8	10.3	2.8
Tissue FWP	11	54.4	18.2	0.9	70.0	11.2	1.2	212.2	24.1	0.6
WP Board	41	16.3	4.2	0.2	9.8	2.2	0.2	5.6	1.8	0.1
WP Molded	4	341.0	99.8	11.6	24.0	8.9	1.4	26.5	10.7	1.4
Builders	5	27.7	7.6	0.1	3.1	4.7	0.1	3.3	1.1	0.1
NI Fine	16	41.8	14.9	5.4	26.7	8.4	0.9	57.9	11.6	1.3
NI Fine Cotton	5	40.6	29.4	16.2	21.4	11.5	4.0	58.6	15.1	1.6
NI Tissue	14	32.1	17.5	2.7	9.7	4.4	0.4	15.2	4.2	0.4
NI Ltwt	10	105.9	36.1	8.6	19.5	5.8	1.3	17.7	4.6	0.7
NI Elec	4	162.5	118.6	100.0	20.1	14.2	7.4	6.8	6.3	6.2
NI Filter	4	59.9	47.5	40.3	7.5	4.2	2.9	5.8	4.5	2.2
NI Board	6	57.0	22.4	4.8	11.0	4.8	0.6	5.3	2.7	0.5

TABLE 17

FINAL EFFLUENT VARIABILITY FOR DIRECT DISCHARGERS - MAXIMUM MONTH

1979 ACCOMPLISHMENT SURVEY

Prod. Class.	FINAL EFFLUENT BOD VARIABILITY Max. Month/Ann. Avg.				FINAL EFFLUENT TSS VARIABILITY Max. Month/Ann. Avg.				FINAL EFFLUENT FLOW VARIABILITY Max. Month/Ann. Avg.			
	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum
BKM	8	1.16	1.67	2.68	8	1.19	1.63	3.04	8	1.05	1.24	1.82
BKF	10	1.39	1.88	3.80	10	1.34	1.93	4.06	10	1.05	1.46	3.89
BKC	8	1.36	1.66	2.37	8	1.24	2.15	5.02	8	1.03	1.28	2.27
XRC	10	1.14	1.83	2.70	10	1.18	1.62	2.11	10	1.01	1.13	1.34
UBK	25	1.16	1.64	2.30	25	1.15	1.58	2.61	25	1.04	1.19	1.58
S3F	8	1.19	1.46	1.69	8	1.27	1.41	1.69	8	1.04	1.13	1.24
S3D	6	1.08	1.51	2.01	6	1.59	2.05	2.39	6	1.05	1.07	1.12
SCH	11	1.24	1.73	2.36	11	1.18	1.49	1.82	11	1.14	1.31	1.56
SOD	1	1.45	1.45	1.45	1	1.20	1.20	1.20	1	1.16	1.16	1.16
GWF	7	1.40	1.85	2.53	7	1.31	2.07	3.22	7	1.05	1.13	1.22
GWN	1	1.28	1.28	1.28	1	1.69	1.69	1.69	1	1.23	1.23	1.23
TMP	2	1.27	1.36	1.45	2	1.31	1.47	1.63	2	1.14	1.15	1.16
DIF	6	1.49	1.94	2.83	6	1.54	1.85	2.10	6	1.11	1.18	1.28
LWT	9	1.33	1.79	4.00	9	1.19	1.91	4.00	9	1.01	1.22	2.27
FLT	4	1.36	1.92	2.41	4	1.86	2.27	2.50	4	1.07	1.13	1.19
DIT	2	1.24	1.46	1.67	2	1.34	1.74	2.13	2	1.06	1.12	1.18
DIN	1	2.04	2.04	2.04	1	2.54	2.54	2.54	1	1.20	1.20	1.20
SPE	2	1.21	1.85	2.48	2	1.30	1.45	1.59	2	1.06	1.09	1.12

TABLE 17 (Cont.)

FINAL EFFLUENT VARIABILITY FOR DIRECT DISCHARGERS - MAXIMUM MONTH

1979 ACCOMPLISHMENT SURVEY

Prod. Class.	FINAL EFFLUENT BOD VARIABILITY Max. Month/Ann. Avg.				FINAL EFFLUENT TSS VARIABILITY Max. Month/Ann. Avg.				FINAL EFFLUENT FLOW VARIABILITY Max. Month/Ann. Avg.			
	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum
NIT	6	1.21	1.52	2.11	6	1.27	1.73	2.38	6	1.04	1.19	1.56
NIF	21	1.11	2.05	9.43	21	1.00	2.11	9.47	21	1.00	1.68	12.17
WPT	3	1.46	1.51	1.60	3	1.52	1.90	2.13	3	1.22	1.33	1.38
WPB	22	1.05	1.80	2.67	22	1.07	1.91	5.00	21	1.00	1.38	4.12
BKG	9	1.31	1.63	2.35	9	1.12	1.71	2.38	9	1.06	1.17	1.39
UBG	2	1.48	1.73	1.97	2	1.44	1.56	1.67	3	1.07	1.08	1.08
BUB	10	1.36	1.63	2.71	10	1.12	1.53	2.37	10	1.03	1.14	1.26
BMO	6	1.21	1.53	1.98	6	1.21	1.57	2.33	6	1.04	1.11	1.18
BDO	2	1.76	2.07	2.37	2	1.26	1.41	1.56	2	1.04	1.05	1.06
S30	3	1.25	1.35	1.52	3	1.18	1.35	1.61	3	1.08	1.09	1.10
KPO	6	1.24	1.41	1.75	6	1.25	1.34	1.54	6	1.08	1.14	1.26
OTH	4	1.56	2.22	2.76	4	1.19	1.53	1.82	4	1.09	1.12	1.17
SPB	4	1.50	1.73	2.07	4	1.42	1.82	2.25	4	1.13	1.20	1.24

TABLE 18

FINAL EFFLUENT VARIABILITY FOR DIRECT DISCHARGERS - MAXIMUM DAY

1979 ACCOMPLISHMENT SURVEY

	FINAL EFFLUENT BOD VARIABILITY Max. Day/Ann. Avg.				FINAL EFFLUENT TSS VARIABILITY Max. Mon/Ann. Avg.				FINAL EFFLUENT FLOW VARIABILITY Max. Day/Ann. Avg.			
Prod. Class.	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum
BKM	8	1.63	3.36	6.94	8	2.23	3.59	4.78	8	1.15	1.73	3.49
BKF	10	2.13	4.75	10.98	10	2.65	6.16	9.86	10	1.15	1.76	4.58
BKC	8	1.63	2.90	5.67	8	0.74	3.23	6.89	8	1.09	1.77	4.05
XRC	9	2.15	5.40	14.23	9	2.59	3.94	6.07	9	1.18	1.47	2.33
UBK	25	1.70	3.22	5.28	25	2.05	3.64	12.49	23	1.16	1.84	4.42
S3F	8	1.85	2.80	4.07	8	1.28	3.62	6.37	8	1.15	1.32	1.68
S3D	6	1.80	2.77	4.70	6	2.41	5.35	7.53	6	1.13	1.26	1.48
SCH	11	2.23	3.79	8.78	11	1.94	4.38	13.14	11	1.27	1.83	2.61
SOD	1	3.36	3.36	3.36	1	2.04	2.04	2.04	1	1.53	1.53	1.53
GWF	7	1.82	3.32	6.96	7	1.98	13.03	40.15	5	1.17	1.31	1.43
GWN	1	2.00	2.00	2.00	1	3.73	3.73	3.73	1	1.67	1.67	1.67
TMP	2	2.08	3.53	4.98	2	3.73	6.63	9.53	2	1.36	1.45	1.53
DIF	6	2.41	5.15	12.09	6	3.18	5.10	10.03	5	1.36	1.62	2.03
LWT	7	1.40	4.60	16.00	7	2.13	5.17	8.00	7	1.03	2.03	6.33
FLT	3	2.18	3.34	3.95	3	3.57	6.21	8.18	3	1.38	1.45	1.56
DIT	2	1.83	3.23	4.64	2	2.22	3.52	4.82	2	1.17	1.38	1.59
DIN	1	2.61	2.61	2.61	1	2.74	2.74	2.74	1	1.75	1.75	1.75
SPE	2	1.74	4.71	7.68	2	3.77	5.20	6.62	2	1.35	1.40	1.44

See Table 1 for Production Class. Codes

TABLE 18 (Cont.)

FINAL EFFLUENT VARIABILITY FOR DIRECT DISCHARGERS - MAXIMUM DAY

1979 ACCOMPLISHMENT SURVEY

	FINAL EFFLUENT BOD VARIABILITY Max. Day/Ann. Avg.				FINAL EFFLUENT TSS VARIABILITY Max. Day/Ann. Avg.				FINAL EFFLUENT FLOW VARIABILITY Max. Day/Ann. Avg.			
Prod. Class.	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum	No.	Minimum	Average	Maximum
NIT	6	1.53	2.20	2.98	6	2.80	5.07	13.25	6	1.04	1.46	1.92
NIF	20	1.63	4.25	25.66	20	2.11	5.65	26.32	20	0.03	1.36	2.03
WPT	3	2.00	2.17	2.35	3	2.88	3.72	4.28	3	1.65	1.78	1.92
WPB	20	2.12	4.34	18.00	20	1.77	7.26	26.00	20	1.18	2.63	7.00
BKG	9	2.12	3.30	4.91	9	2.15	4.05	9.05	9	1.19	1.65	3.26
UBG	2	7.60	9.81	12.02	2	3.07	5.72	8.37	2	1.20	1.24	1.28
BUB	10	1.81	5.86	30.52	10	1.95	4.54	12.56	10	1.14	1.56	2.80
BMO	6	2.00	2.52	3.75	5	2.21	2.54	2.93	6	1.08	1.48	2.25
BDO	2	2.66	4.45	6.23	2	2.52	3.27	4.02	2	1.25	1.35	1.45
S30	3	2.14	2.31	2.62	3	1.92	2.37	2.72	3	1.18	1.25	1.35
KPO	6	2.61	3.70	5.21	6	2.39	3.50	6.11	6	1.19	1.35	1.61
OTH	4	2.25	5.26	11.64	4	2.07	7.12	19.70	4	1.21	1.36	1.68
SPB	4	2.25	3.67	5.24	4	2.31	6.20	13.63	4	1.40	1.51	1.65

See Table 1 for Production Class Codes

The procedure used by NCASI is somewhat different from that used by EPA in calculating the variability factors used in the development of its Effluent Guideline Limitations. Where NCASI used actual maxima from one year's performance as the numerator in the calculation, EPA used a nonparametric statistical estimate of maxima in its calculations.

It is therefore interesting to note that many of the maxima (as well as average) values for various PCs exceed EPA's calculated values (1.78 and 1.82 for maximum month BOD and TSS, respectively and 3.0 for maximum day BOD and TSS). It is also of interest to note the rather wide range in average variability factors displayed by individual PCs. These two observations call into question, yet again, the magnitude of the factors used by EPA as well as the wisdom of selecting a single factor to represent all subcategories.

C. Extrapolation of Total Industry Final Effluent Direct Discharge

Table 19 presents an extrapolation of data whose purpose is the estimation of the total flow, BOD and TSS discharged by direct discharging mills in the primary production segments of the industry. For each PC the annual average unit discharge levels from Table 14 were multiplied by the estimated total production of direct dischargers for the PC. The results yielded are estimates of the total flow BOD and TSS directly discharged by that PC. The estimated totals for each PC were then summed to yield the grand totals given at the bottom of the table.

It will be noted that the total of the productions for all PCs exceeds API's production figure for 1979. There are two reasons for this apparent discrepancy. First, the NCASI procedure counts the production of market and dissolving pulp subcategories where API's total paper and board figures do not. Second, the total production for direct dischargers in each PC was estimated (by NCASI) from data from various sources including industry directories, etc. Hence the production figures used for some mills reflect capacity rather than actual 1979 production.

The extrapolation is based primarily on the annual average effluent loadings from Table 14. Where insufficient data was received for a given PC, effluent data from other sources (e.g. EPA data or NCASI file information) were substituted. This was also the case where only a few, non-representative mills in a PC responded to the 1979 survey.

The estimates indicated that for 1979, direct discharging mills in the primary production segment of the industry discharged a total of over 4.1 billion gallons per day containing

TABLE 19

EXTRAPOLATION OF TOTAL INDUSTRY FINAL EFFLUENT DIRECT DISCHARGE LOADS

SUBCAT.	TOTAL PRODN. tpd	AVG. EFF. FLOW KGAL/T	AVG. EFF. BOD LB/T	AVG. EFF. TSS LB/T	EST'D. TOTAL FLOW mgd	EST'D. TOTAL BOD KLB/D	EST'D. TOTAL TSS KLB/D
BKM	9,086	34.42	21.89	15.72	313	199	143
BKF	10,603	23.94	3.95	9.68	254	42	103
BKC	9,006	33.56	6.62	8.52	302	60	77
XRC	14,908	14.14	5.99	9.53	211	89	142
UBK	31,798	15.99	3.91	6.88	508	124	219
S3F	4,278	30.89	21.84	19.93	132	93	85
S3D	2,465	70.40	76.30	56.50	174	188	139
SCH	9,013	5.60	5.44	7.45	50	49	67
SOD	691	16.72	4.72	16.66	12	3	12
GWC	434	23.20	4.10	6.80	32	2	3
GWF	6,475	15.27	3.10	4.59	99	20	30
GWN	1,081	21.79	9.57	7.54	24	10	8
TMP	1,838	13.98	15.43	14.56	26	28	27
DIF	1,186	10.80	4.60	7.30	13	5	9
DIT	1,821	16.70	11.50	10.30	30	21	19
DIN	514	12.08	3.54	5.27	6	2	3
LWT	1,319	48.12	6.30	5.41	63	8	7
FLT	377	57.24	5.97	6.12	22	2	2
SPE	628	22.17	8.49	12.12	14	5	8
NIT	2,168	16.99	3.65	3.14	37	8	7
NIF	6,274	14.90	8.40	11.60	93	53	73
WPT	258	18.29	10.50	5.62	5	3	1
WPB	9,249	5.20	3.02	3.46	48	28	32
BKG	12,349	24.08	9.38	15.61	297	116	193
UBG	6,955	18.31	4.37	10.97	127	30	76
BUB	16,653	26.27	5.83	11.90	437	97	198
BMO	7,482	33.49	7.36	15.04	251	55	113
BDO	2,374	44.02	20.90	32.90	105	50	78
S30	3,061	35.08	14.47	22.68	107	44	69
KPO	9,966	33.44	10.31	18.35	333	103	183
SPB	929	22.76	5.30	3.97	21	5	4
BLD	1,941	5.20	3.02	3.46	10	6	7
OTH	1,060	34.10	11.44	15.75	36	12	17
SUM	188.24×10^3 TPD (65.88×10^6 TPY)				4192	1562	2151
					22.16 kgal/t	8.30 lb/t	11.43 lb/t

1.56 million pounds per day of BOD and 2.15 million pounds per day of TSS. Dividing by the estimated total production of all PCs indicates that the overall average discharge for the industry is 22.2 Kgal/ton with 8.3 lb BOD/ton and 11.4 lb TSS/ton. For BOD this corresponds to 210, 94, 68, 50 and 21 lb BOD/ton of production respectively for the years 1943, 1959, 1969, 1972 and 1975. For TSS this corresponds to 61, 45 and 42 respectively for the years 1965, 1969 and 1972.

V EFFLUENT MANAGEMENT PRACTICES PRIOR TO EXTERNAL TREATMENT

A. Systems for Detecting and Recapturing Intermittent Losses of Spent Pulping Liquors or Other Strong Wastes

The 1979 Accomplishment Survey solicited information on the presence of systems for detecting and recapturing liquor losses or intermittent losses of other strong wastes. The results are summarized in Table 20.

TABLE 20

Type of Mill	No. Having Strong Waste Detection and Recapture System	No. Having Storage Facilities Solely for Recyle to Process
Kraft	62	50
Sulfite	3	3
Groundwood	3	2
Secondary Fibre	5	4
Nonintegrated	7	5

These results show that strong waste detection and recapture systems are most prevalent among chemical pulp mills. It was somewhat surprising to note that the vast majority of mills that report having such systems also report having storage facilities for recovered strong wastes that route wastes solely back to the process. The remaining mills report having storage faciities than can discharge in a controlled manner to treatment or storage facilities that can route waste to either process or treatment. Many mills reported having more than one type of storage facility. The 62 kraft mills that report having strong waste recapture systems represent nearly half the kraft mills in the United States.

B. Flow Equalization Facilities Prior to Treatment

Similarly, the 1979 Survey asked for data on facilities used to equalize the hydraulic load being introduced to treatment systems. Naturally, this type of facility is used predominantly with activated sludge treatment systems. The results are summarized in Table 21.

TABLE 21

Type of Mill	No. Having Flow Equalization	Median Volume Million Gal.
Kraft	9	2
Sulfite	1	8
Secondary Fibre	6	0.5
Nonintegrated	4	--

Among the kraft mills responding, the range in volume of equilization facilities was 20 thousand to 8 million gallons. It should be noted that the total response does not include post-aeration holding facilities or systems with built in equilization such as aerated stabilization basins.

C. Effluent pH Adjustment Prior to Treatment

Information from mills indicating the extent to which raw waste pH adjustment was practiced is summarized in Table 22.

TABLE 22

Type of Mill	No. Practicing pH Adjustment Prior to Treatment
Kraft	42
Sulfite	7
Groundwood	4
Secondary Fibre	4
Nonintegrated	25

Among the chemical pulp mills responding the majority indicated that pH adjustment was practiced on specific process effluents. Responses to a question dealing with the amount and type of chemical added were spotty and no meaningful trends can be extracted. Among nonintegrated and secondary fibre mills the majority adjusted the pH of the entire waste stream.

D. Effluent Cooling Prior to Treatment

A total of eleven mills reported that they cooled effluents prior to treatment (8 kraft, 1 sulfite, and 2 groundwood). Of the eight kraft mills, 5 reported that cooling was practiced on a seasonal basis. Reported effluent temperatures before cooling ranged from 105 to 120°F with a median of 110°. Again, effluent cooling was used predominantly with activated sludge systems.

In summary, the response to this section of the 1979 Survey indicated that strong waste management and pH adjustment are fairly common practices, particularly among chemical pulp mills. Effluent precooling is still a rare practice but may become more common as water use economies raise raw waste temperatures.

VI EXTERNAL TREATMENT PRACTICES

A. Sources of Information

Both the 1975 and 1979 Accomplishment Survey solicited information on the type of treatment systems employed at mills. The response to these surveys constitutes the basic core of the data presented in this section. However, since the response to both surveys from small companies was very incomplete, an attempt was made to supplement the data base where possible. Information on treatment system type was gathered from NCASI file data, EPA records, and industry directories. Where production data was not available from other sources, capacity information from industry directories was used. Hence the "production" figures used in the remainder of this section are actually a mixture of production and capacity data. In all, data was assembled for 266 direct discharging mills which reflect over 95% of the estimated direct discharging paper and board poduction of the industry.

B. Data Analysis

When considered at the level of individual design features and operating characteristics, there are as many types of treatment systems in the industry as there are direct discharging mills. Treatment systems can, however, be divided into broad classifications for purposes of generalization. Such procedures nearly always involve some "judgement calls" on the part of the classifier. While apologies are extended in advance to readers who can identify their systems as having been misclassified, the following is presented as a reasonably accurate method of summarizing the industry's overall collection of treatment approaches.

The vast majority of mills indicated the use of some type of primary treatment. Where the indication was not accompanied by any indication of the presence of a biological treatment system, the mill was classified as having "primary treatment only". It sould be emphasized that many of the mills in this group are achieving discharges equal to or less than Effluent Guidelines limitations by virtue of internal controls or other measures. Gravity settling and flotation systems, with or without chemical assistance, are among the types of systems reported among mills classified as "primary only".

Where a mill reported having some type of biological treatment it was generally classified according to the unit process which occurred immediately after the primary system in its treatment train. Thus, a mill which reported having an aerated stabilization basin and a quiescent basin would be recorded as having "ASB + QSB" in the following analysis. An exception to this occurs where any form of activated sludge was reported as part of the treatment train. In these cases the mill was reported as having "activated sludge plus other biotreatment" regardless of the order of occurrence in the treatment train.

Adaptations of the activated sludge system such as pure oxygen or two stage systems are fairly self-explanatory. NCASI defined "modified activated sludge" as systems with two to four days retention time and having secondary clarifiction with sludge recycling. The analysis did not "double count" any system. Thus, for example, mills with "ASB + QSB" systems are not counted among those with ASB, the latter being reserved for mills using ASB's only.

C. Findings

Table 23 summarizes the distribution of treatment types throughout the direct discharging population of the primary production segment of the industry. The aerated stabilization basin remains the most widely applied form of treatment. Aerated basins with or without subsequent steps serve a known total of 140 mills with a total production of over 104,000 tpd. This represents 60% of the total identified production of direct discharging mills. These figures do not include any ASB systems used in conjunction with activated sludge treatment.

A total of 82 activated sludge type systems were identified (counting conventional, modified, oxygen and two-stage with or without supplemental biotreatment). The 82 mills served have a total production of over 53,000 tpd or 31% of the total.

Eight mills were identified which practice biological treatment followed by a tertiary step (chemically assisted clarification or filtration). The available data do not permit drawing a distinction between the systems which are a full time part of the treatment train and those which are used only to deal with upset conditions.

A detailed array showing treatment systems demployed vs. mill type is given in Appendix B (Table B-1).

TABLE 23

TREATMENT SYSTEMS EMPLOYED BY THE PULP AND PAPER INDUSTRY

Type of Treatment System	Number of Mills Using	Total Production Served tpd
Primary only (Clarification with or without chemicals)	15	4,300
Quiescent Stabilization Basin (QSB)	9	4,120
QSB plus Controlled Discharge (CD)	2	997
Aerated Stabilization Basin (ASB)	58	35,526
ASB + QSB	47	31,000
ASB + CD	30	35,375
ASB + QSB + CD	1	1,054
ASB + Mechanical Solids Reduction (Filter or final clarifier)	2	174
ASB + Land Application	2	1,445
Conventional Activated Sludge (CAS)	34	22,526
CAS + Other Biotreatment	7	6,698
Modified Activated Sludge (MAS)	20	9,571
MAS + Other Biotreatment	3	1,680
Oxygen Activated Sludge (OAS)	11	9,971
OAS + Other Biotreatment	2	1,683
Two Stage Activated Sludge	5	1,173
Trickling Filter	3	509
Anaerobic Plus Other Biotreatment	1	450
Rotating Biological Surface	1	350
Any Biotreatment Plus Chemically Assisted Clarification	7	2,592
Any Biotreatment Plus Filtration	1	275
Spray Irrigation or Ground Infiltration	4	428
Overland Flow	1	2,050
Totals	266	173,937

VII SLUDGE DEWATERING PRACTICES AND SOLID WASTE DISPOSAL PRACTICES

A. Sludge Dewatering Practices

The 1979 Accomplishment Survey solicited information as to which unit processes were employed for sludge dewatering at individual mills. Respondents were asked to indicate if the unit process was used to dewater (a) primary sludge only, (b) mixed sludge, or (c) secondary biological sludge alone. Since only a few mills indicated that secondary sludge was dewatered alone, the results are discussed only in terms of primary sludge alone or mixed sludges.

The 1979 Survey did not request data on the quantity of sludge dewatering using each process. Sludge quantities were solicited as part of the disposal information (which is discussed in a later part of this section). Consequently, the patterns of use of various dewatering technologies are presented in terms of the number of mills employing a given practice.

The number of mills using various combinations of preconditioning steps and dewatering technologies for primary sludge is given in Table 24. These responses show that mechancial dewatering using no preconditioning step or gravity thickening alone is by far the most common practice in the industry. The 1979 Survey form did not explicitly differentiate between thickening in the clarifier (through managed sludge withdrawal) and thickening in separate facilities. It is therefore possible that mills which practice in-clarifier thickening may have indicated either "none" or "gravity thickening" as a response.

No preconditioning and gravity thickening alone accounted for 45% and 39% of the responses respectively. Nine percent of the responses indicated the use of chemical conditioning without gravity thickening while 7 percent indicated chemical conditioning plus thickening.

The use of storage basins continues to play a large role in the industry's primary sludge dewatering and disposal practices. Twenty-seven mills indicated that drying beds or basins were employed while 28 indicated that disposal basins were used. The survey form differentiated between basin drying and basin disposal on the basis of whether or not the basin was designed for removal of sludge. Together, these two practices accounted for 32% of the responses.

Among mechanical dewatering devices, vacuum filters appear to enjoy the greatest popularity for primary sludge dewatering. Forty-five mills (26%) indicated the use of this type of device as contrasted to 18 (10%) for centrifuges, 20 (12%) for belt presses and 11 (6%) for pressure filters. Four mills indicated the use of mechanical presses (without prior mechanical dewatering) and twenty reported the use of no primary sludge dewatering.

TABLE 24

NUMBERS OF MILLS FOLLOWING VARIOUS APPROACHES TO SLUDGE DEWATERING

- PRIMARY SLUDGES ONLY -

Dewatering Technology	Number of Mills Reporting Use of Preconditioning Step: None	Gravity Thickening	Chemical Conditioning	Thickening Plus Chemicals	Total
None	--	19	0	1	20
Centrifuge	8	4	4	2	18
Vacuum Filter	21	19	4	1	45
Belt Press	9	3	3	5	20
Pressure Filter	3	6	1	1	11
Mech. Press (only)	0	2	2	0	4
Basin Drying	16	8	2	1	27
Basin Disposal	20	7	0	1	28
Total	77	68	16	12	173

Table 25 presents similar information on dewatering practices used for mixed primary and secondary sludges. Fewer overall responses (66 vs. 173 for primary alone) probably reflect the extensive use of treatment technologies that do not generate excess biological solids. Not surprisingly, chemical conditioning plays a larger role in mixed sludge dewatering programs. A total of 38 mills (58%) report the use of chemicals with or without gravity thickening. Twenty-four mills (36%) reported dewatering mixed sludges with no preconditioning.

Again, vacuum filters enjoyed the greatest use among mechanical devices, followed closely by the belt presses. The relatively frequent use of belt filters for both types of sludge is of interest because responses to the 1975 survey indicated that none of these devices were used by the industry at that time. It is also of interest to note that very few mills (less than 14%) use either basin drying or basin disposal for mixed sludges.

TABLE 25

NUMBERS OF MILLS FOLLOWING VARIOUS APPROACHES TO SLUDGE DEWATERING

- MIXED SLUDGES -

Dewatering Technology	Number of Mills Reporting Use of Preconditioning Step: None	Gravity Thickening	Chemical Conditioning	Thickening Plus Chemicals	Total
None	--	1	0	0	1
Centrifuge	2	0	3	0	5
Vacuum Filter	10	3	6	5	24
Belt Press	3	0	11	7	21
Pressure Filter	0	0	4	1	5
Mech. Press only	0	0	0	1	1
Basin Drying	7	0	0	0	7
Basin Disposal	2	0	0	0	2
Total	24	4	24	14	66

A detailed array showing the number of mills in each PC using each type of dewatering technology is given in Appendix B

B. Combinations of Dewatering and Disposal Practices

Since the 1979 Survey solicited data on both dewatering and disposal practices, it was decided that the data should be arrayed in a manner that would indicate whether the method of ultimate disposal exerted any influence on the choice of dewatering technology. Ultimate disposal methods were divided among those involving (a) incineration, (b) land application, and (c) landfill. Dewatering technology was grouped according to (a) gravity thickening only, (b) mechanical dewatering, (c) dewatering plus supplemental pressing, and (d) basin drying. The responses are arrayed according to this scheme for both primary and mixed sludges, in Table 26.

TABLE 26

COMBINATIONS OF SLUDGE DEWATERING AND DISPOSAL PRACTICES USED BY MILLS IN THE UNITED STATES
(based on responses to the 1979 Accomplishment Survey)

(Units are number of mills reporting use)

	Incineration		Land Application		Landfill	
	Primary	Mixed	Primary	Mixed	Primary	Mixed
Gravity Thickening Only	1	0	0	0	9	0
Mechanical Dewatering	4	2	3	3	40	34
Dewatering Plus Supplemental Pressing	14	8	1	2	19	9
Basin Drying	--	--	3	0	13	7
Total	19	10	7	5	81	50
Percent of Total Reporting	11	6	4	3	47	29

The results show that among mills practicing incineration there is a fairly strong tendency to employ more intensive dewatering methods, presumably to obtain dryer sludge cake and to minimize the energy impact of burning in combination fuel boilers. Among mills using landfill disposal, the prevalent tendency seems to be the application of no more than mechanical dewatering or basin drying, even though a significant number of mills do employ supplemental pressing. The response regarding land application was too small to allow observation of any meaningful trends. The above conclusions regarding the influence of disposal on the choice of dewatering method apply to both mixed and primary sludges. Mechanical dewatering and landfill disposal are the most popular choices for both types of sludge.

C. Sludge Disposal Practices

Information on sludge disposal practices from the 1975 Survey is summarized in Table 27. The data show that landfill, lagooning and land placement together accounted for nearly 80% of the total dry weight of sludge reported. Ten percent of the total dry sludge weight was disposed of by incineration.

TABLE 27

DISPOSAL OF PAPERMILL SLUDGES IN 1975

Method	Number of Mills	Dry Weight, Ton/Day	Percent of Total
Incineration	19	291	10
Landfilled	40	943	33
Landplaced	53	1,118	39
Incineration + landfilled	4	74	3
Incineration + landplaced	4	62	2
Recycled	5	28	1
Sold	3	5	--
Lagoon	13	200	7
Muncipal/contractor	3	5	--
Municipal + landplaced	7	23	1
Municipal + landfilled	3	10	--
Other	9	87	4
Totals	163	2,846	100

Table 28 presents data on sludge disposal by landfill from the 1979 Survey. The table arrays the data by type of sludge and ownership of the disposal site. By far the majority of sludge is unmixed primary disposed of on company owned property. Mills using company owned property outnumber those using property owned by others by nearly three to one.

The total dry weight of sludge disposed of by landfill was 6260 tons per day or 86% of the total weight reported for all disposal methods. The difference between this percentage and that reported for 1975 is not considered to reflect a significant increase in reliance on land disposal techniques. Very few mills dispose of very little secondary sludge that is not admixed with primary sludge.

TABLE 28

SLUDGE DISPOSAL BY LANDFILL - 1979 ACCOMPLISHMENT SURVEY

	On Company Owned Property	On Property Owned by Others
No. of Mills Practicing Landfill Disposal of:		
Primary Sludge	84	26
Secondary Sludge	7	2
Mixed Sludge	36	17
Total No. of Mills Responding to this section*	120	74
Total Dry Weight of Sludge Disposed of:		
Primary (tpd)	2,870	460
Secondary (tpd)	190	150
Mixed (tpd)	1,800	790

* Column sums do not agree with total number of mills because some mills report disposing of more than one kind of sludge by landfill

Solids Content of Sludge Disposed of to Landfill

	Percent Bone Dry Solids		No. of Observ.
	Mean	Stnd. Dev.	
Primary	25	16	106
Secondary	19	11	9
Mixed	23	11	52

Table 28 also presents data on the solids content of landfill disposed sludge. Not surprisingly, the mean solids content of primary sludge was the highest at 25%. Mixed sludge averaged 23% while secondary sludges averaged 19%.

Data on sludge disposal by other than landfill (also from the 1979 Survey) is summarized in Table 29. Among these other methods incineration is by far the most frequent choice, with 35 mills incinerating over 800 tpd of dry solids, mostly of primary sludge origin. The largest portion of sludge is burned in bark boilers as opposed to separate incinerators. Land application is the second most frequent choice, with 14 mills disposing of nearly 150 tpd. The relative proportion of land application systems would appear to have declined as compared to the 1975 Survey.

Table 29 also presents data on the solids content of sludges disposed of by other than landfill. Mixed sludges tend to average somewhat higher than unmixed primary sludges, but the sample size for mixed sludges is rather small. Consequently, the difference may not be meaningful. The solids content data were also analyzed for only those mills using either form of incineration. The mean solids content for the various types of sludges did not differ significantly from those reported in Table 29.

TABLE 29

SLUDGE DISPOSAL BY OTHER THAN LANDFILL - 1979 ACCOMPLISHMENT SURVEY

	No. of Mills Using				Weight of Dry Sludge Solids		
Disposal Method	For Prim.	For 2ndary	For Mixed	Total Resp.*	Prim.	2ndary	Mixed
Incineration in Power Boilers	20	1	11	31	433	3	285
Incineration in Separate Incinerators	4	0	0	4	103	0	0
Composting	0	0	1	1	0	0	4
Sale to Others	2	0	2	4	16	0	24
Land Application	7	7	1	14	85	44	20

* Sum of number of mills does not always equal the total response because some mills report disposing of more than one type of sludge by a given method

Solids Content of Sludges Disposed of by Other Than Landfill

	Percent Bone Dry Solids		No. of Observ.
	Mean	Std. Dev.	
Primary	29	15	27
Secondary	11	11	9
Mixed	34	10	9

D. Disposal Practices for Solid Wastes from Manufacturing

Table 30 summarizes data from the 1979 Survey concerning disposal methods for solid wastes resulting from general manufacturing operations (as opposed to wastewater treatment sludges). A large number of small mills have general manufacturing residues disposed of by others, presumably at municipal facilities or by private haulers. The greatest weight of manufacturing residue is disposed of in company owned landfills. Very few mills incinerate these residues. Boiler ash is also disposed of primarily in company owned landfills. A significant fraction, however, is reported disposed of by others.

TABLE 30

DISPOSAL METHODS FOR SOLID WASTES FROM MANUFACTURING

	No. of Mills Practicing	Total Weight Disposed of (tpd)
General Manufacturing Residue		
Disposed of by Others	137	1,553
Hauled to Company Owned Landfill	82	3,140
Incinerated		
On-site	2	31
By others	5	27
Boiler Ash		
Disposed of by Others	19	443
Hauled to Company Owned Landfill	77	2,611
Wood Residues		
Disposed of by Others	19	443
Hauled to Company Owned Landfill	44	1,603
Burned by Others	12	3,965
Burned on-site (1)		
Large	9	3,563
Small	8	153

Total No. of Mills Responding to this Section (2) 257

Notes:

(1) The nine "Large" wood waste burning operations probably represent conventional bark boiler operations and should not be considered a legitimate part of this response. This may also be true for some of the wood residue reported burned by others.

(2) Column may not total because of multiple disposal practice use at individual mills.

The results for wood residue disposal are somewhat confused. It is assumed that the wording of the solicitation form was not sufficiently concise so that respondents confused normal bark burning operations with wood residue disposal. For example, nine mills reported burning a total of over 3500 tpd of wood residues on site, which seems a rather large volume of miscellaneous wood residues. The data reported for disposal by others and hauling to company owned landfills are probably reliable. However, the data regarding burning either on site or by others should be interpreted with great caution.

VIII SUMMARY

(1) This report draws upon information from two NCASI Accomplishment Surveys and data developed by EPA to provide a comprehensive data base and information on effluent management practices, water use, solid waste handling and solid waste disposal practices. While portions of the data have been used for various purposes, particularly in development of effluent guidelines, this is the first assembly of the information in a format which would serve an array of information needs of individual companies and broader industry information needs.

(2) The data in this report show a continuing trend of reduced water use per ton of product which is now 22,800 gal/ton paper and paperboard, and 40 percent of that used in 1959. Raw waste load was also indicated to be declining from 1975 to 1979. Reductions in discharged loads have been more dramatic, with those for BOD in 1979 being about 16 percent and 40 percent on a lb/ton production basis of those for the years 1972 and 1975 respectively. Total suspended solids discharge load reductions have followed a similar pattern, now being about 25 percent of those in 1972 on a lb/ton production basis. These benefits have been achieved with an expenditure of 2.9 billion dollars.

(3) Among mills treating their own wastewaters, the vast majority employ some form of biological treatment and accomplish BOD and TSS removal efficiencies that exceed those specified for secondary treatment at POTWs. Data from other NCASI studies have shown that these same systems accomplish substantial removal of compounds which exhibit biological activity.

APPENDIX A

EPA DISCHARGE MONITORING REPORTS DATA SUMMARIES

TABLE A-1

DMR DATA SUMMARY
DISSOLVING KRAFT SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1		32003	59.48	11.80	20.95	01/78	38	38	38
2		32001	29.94	10.92	38.81	12/79	13	13	13
3		32002	44.74	7.47	11.71	07/77	45	45	45
		Max.	59.5	11.8	38.8				
		Avg.	44.7	10.1	26.8				
		Min.	29.9	7.5	11.7				

TABLE A-2

DMR DATA SUMMARY
MARKET BLEACHED KRAFT SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1		30009	18.32	12.40	9.66	01/78	39	39	39
2		30012	28.52	11.60	19.03	01/78	36	36	36
2	J	30042	11.41	.90	3.10	09/79	18	18	18
2		666666	20.59	5.16	13.57	02/79	23	23	23
2		777777	32.46	3.08	12.98	07/79	16	16	16
3		30005	14.68	9.65	9.97	08/78	29	29	29
3		30028	54.18	8.55	15.65	08/78	31	31	31
3		30030	36.36	5.41	7.37	01/78	38	38	38
3		30031	67.53	8.94	18.01	07/77	33	43	43
3		900074	29.13	7.94	5.16	09/78	31	31	31
		Max.	67.6	12.4	39.0				
		Avg.	33.5	8.1	14.6				
		Min.	14.7	3.1	3.1				

TABLE A-3

DMR DATA SUMMARY BCT BLEACHED KRAFT SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1		30010	40.95	4.92	8.69	07/77	43	43	43
1		30026	32.59	9.73	17.26	07/77	42	44	41
1		30032	25.60	5.09	8.95	01/78	38	38	38
1		900010	29.02	9.03	9.03	06/78	31	31	31
3		30004	49.84	9.18	8.49	10/78	28	28	28
3		30022	35.94	7.81	3.54	01/78	39	39	39
3		30047	36.35	10.73	8.56	10/78	25	25	25
36	J	30024(1)	17.75	14.13	11.46	01/79	28	28	28
		Max.	49.8	10.7	17.2				
		Avg.	35.8	8.1	9.3				
		Min.	29.0	4.9	3.5				

(1) The final effluent from this joint treatment system is not proratable.

TABLE A-4

DMR DATA SUMMARY ALKALINE-FINE SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1		130002	16.81	4.56	17.00	07/78	18	18	18
2		30001	25.69	5.47	21.82	11/78	26	27	27
2		30013	33.17	5.36	17.08	01/78	27	35	34
2		30027	15.20	1.34	4.20	04/78	33	33	33
2		30033	35.24	13.68	42.73	01/78	35	35	35
2		30048	26.44	11.48	26.89	01/78	36	36	36
2	J	30051	21.41	2.95	9.66	09/79	21	21	21
3		30020	26.92	2.65	5.03	12/78	24	24	24
3		30046	32.97	4.13	6.29	07/77	27	27	27
3		30052	30.59	6.16	7.58	01/80	12	12	12
3		30058	29.72	8.23	14.76	07/77	33	33	33
6	J	30037	20.47	11.77	16.05	01/78	21	21	21
7		30057	27.37	14.24	11.55	07/77	44	43	43
12		30059	34.37	5.31	22.34	05/78	36	36	36
14		30060	59.32	63.60	50.28	02/78	33	32	33
41		30034	16.67	2.02	5.33	10/79	18	18	18
		Max.	59.3	63.6	50.3				
		Avg.	28.3	10.2	17.4				
		Min.	15.2	1.3	4.2				

TABLE A-5

DMR DATA SUMMARY UNBLEACHED KRAFT-LINERBOARD SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
1	10081	11.12	3.50	6.14	01/78	36	36	36
1	10019	11.93	2.29	5.47	09/77	36	36	36
1	10038	26.66	7.21	11.98	01/78	40	40	40
2	10063	7.03	5.23	10.54	06/78	34	34	34
3	10002	12.64	2.88	5.44	07/78	33	33	33
3	10040	14.93	2.54	2.20	10/78	25	25	25
3	10064	5.19	3.54	6.02	01/78	35	38	38
4	10032	14.74	4.99	4.30	01/78	6	32	32
5	10057	10.27	8.46	5.24	07/77	36	35	35
6	10025	10.31	1.06	1.11	09/78	31	31	31
6	10033	16.32	3.83	0.77	07/77	29	29	29
7	10018	13.13	6.13	6.97	10/78	11	11	11
7	10020	19.41	2.21	1.99	09/78	13	13	13
7	10046	7.97	2.65	1.69	07/77	29	36	35
7	10047	5.28	3.73	1.81	07/77	38	38	38
11	10043	10.20	1.33	9.91	06/79	20	22	22
	Max.	26.7	8.5	12.0				
	Avg.	12.3	3.8	5.1				
	Min.	5.2	1.1	0.8				

TABLE A-6

DMR DATA SUMMARY UNBLEACHED KRAFT-BAG SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
1	10003	12.56	4.01	8.77	12/78	25	25	25
1	10005	15.35	4.20	6.51	06/79	22	22	22
1	10028	35.61	3.83	7.50	03/79	23	23	23
2	10008	10.37	2.02	4.93	07/77	23	39	39
2	10035	40.48	6.80	13.35	12/78	27	28	28
3	10034	20.31	4.64	6.71	01/78	37	37	37
3	10044	13.76	3.19	10.88	09/78	24	24	24
3	10055	10.28	3.00	4.85	06/80	7	7	7
3	10062	32.60	4.92	7.67	07/77	45	45	45
4	10006	13.07	3.98	5.95	07/77	42	42	42
19	10048	32.28	2.72	7.22	02/80	16	16	16
	Max.	40.5	6.8	13.4				
	Avg.	21.5	3.9	7.7				
	Min.	10.3	2.0	4.9				

TABLE A-7

DMR DATA SUMMARY SEMI-CHEMICAL SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1		20010	5.65	3.94	6.51	10/78	30	30	30
2		20003	9.71	0.71	2.95	04/78	25	25	25
2		20012	7.55	7.46	12.76	07/77	44	43	43
2		60004	8.85	2.53	2.61	10/78	27	27	27
2		900011	11.94	8.54	12.85	08/77	33	31	31
3		20002	6.08	6.88	7.49	07/78	29	29	29
3		20006	3.26	5.41	8.89	05/78	36	36	36
3		20009	6.84	3.80	6.75	10/78	27	26	27
3	J	20011	4.22	1.93	3.56	11/78	27	28	28
3		20014	6.35	7.54	14.10	07/78	30	30	30
3		20017	4.47	4.99	5.36	07/78	29	29	29
6		20001	6.26	6.10	8.93	12/77	20	20	20
6	J	20013	20.47	11.77	16.05	01/78	21	21	21
9		20015	8.27	22.13	23.67	06/79	22	22	22
12		20007	2.69	6.28	6.11	07/77	27	23	23
35		20008	2.80	2.11	4.30	08/78	28	28	28
37		20016	9.09	5.19	9.25	06/80	7	7	7
40		20004	5.84	2.80	1.29	01/78	39	39	39
		Max.	11.9	22.1	23.7				
		Avg.	6.4	5.8	8.1				
		Min.	2.7	0.7	1.3				

TABLE A-8

DMR DATA SUMMARY UNBLEACHED KRAFT & SEMI-CHEMICAL SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
2		15007	13.48	4.14	10.18	10/78	29	29	29
3		10017	8.94	5.23	8.25	03/78	34	34	34
3		15001	10.46	3.70	6.19	01/78	39	39	39
3		15003	9.91	7.78	5.39	01/78	40	40	40
3		15004	12.68	1.70	3.20	06/79	13	13	13
3		15006	11.41	6.69	8.64	01/78	38	38	38
3		15009(1)	12.23	9.55	10.38	07/77	18	18	18
22		15002	8.70	3.32	7.50	09/77	42	41	41
27		15005	8.80	4.84	3.14	01/78	32	32	32
		Max.	13.5	9.6	10.4				
		Avg.	10.7	5.2	7.2				
		Min.	8.7	1.7	3.2				

(1) The mill has converted to bleached kraft process. The data presented are for the period before conversion.

TABLE A-9

DMR DATA SUMMARY
DISSOLVING SULFITE PULP SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TM'NT CODE TYPE	MILL NUMBER	PULP TYPE	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
1	46006	(d)	52.36	52.80	28.40	07/77	42	42	42
2 J	46004(1)	(d)	41.82	20.68	57.86	04/79	18	18	17
10	46005	(d)	84.47	82.28	103.32	11/79	14	14	14
18	46002	(b)	95.14	95.17	84.59	01/79	26	26	26
27	46001	(c)	53.65	70.86	44.74	07/77	41	43	43
45	46003	(b)	66.50	80.26	23.74	12/80	7	7	7
		Max.	95.1	95.2	103.3				
		Avg.	70.4	76.3	56.5				
		Min.	53.6	52.8	23.7				

(outlier mill 46004 excluded from max.-avg.-min.)

BPT Final Effluent Levels depend on type of pulp manufactured and are as follows:

(a) Nitration	66.0	24.2	41.8
(b) Viscose	66.0	25.9	41.8
(c) Cellophane	66.0	28.1	41.8
(d) Acetate	66.0	30.4	41.8

(1) This facility includes a paper mill.

TABLE A-10

DMR DATA SUMMARY
PAPERGRADE SULFITE SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TM'NT CODE TYPE	MILL NUMBER	PROCESS TYPE	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1	40001(1)	(b)	29.55	21.30	18.10	07/77	32	34	35
1	40002	(b)	73.16	29.86	50.78	07/79	19	21	21
1	40012	(g)	61.85	22.21	28.30	07/77	31	33	32
2 J	40009	(e)	21.41	2.95	9.66	09/79	21	21	21
2	40015	(a)	9.62	24.68	25.34	06/78	36	36	36
2	40016	(e)	27.89	13.07	29.74	06/77	35	16	44
2	40017	(c)	20.21	10.57	20.09	07/77	45	45	45
18	40008	(d)	52.51	20.52	24.89	07/80	9	9	9
18	40010	(c)	61.90	12.72	12.15	07/77	46	46	45
18	40013	(e)	24.17	8.95	14.88	11/79	17	17	17
18	40019	(g)	10.86	5.66	7.09	06/79	19	19	19
20	40018	(g)	20.53	3.61	3.48	07/77	27	27	27
23	40011	(d)	14.60	2.89	4.92	04/80	14	14	14
		Max.	73.2	29.9	50.8				
		Avg.	32.9	13.8	19.2				
		Min.	9.6	2.9	3.5				

Papergrade Sulfite BPT final effluent levels depend on the type of process employed and are as follows:

Papergrade Sulfite (Blow Pit Wash)			
(a) Bisulfite-Surface	44.5	18.6	26.0
(b) Bisulfite-Barometric	53.0	20.3	30.9
(c) Acid Sulfite-Surface	44.5	18.9	26.0
(d) Acid Sulfite-Barometric	53.0	20.8	30.9
Papergrade Sulfite (Drum Wash)			
(e) Bisulfite-Surface	44.5	15.6	26.0
(f) Bisulfite-Barometric	53.0	17.2	30.9
(g) Acid Sulfite-Surface	44.5	17.4	26.0
(h) Acid Sulfite-Barometric	53.0	19.0	30.9

(1) Pulp was not bleached at this mill. Mill is now closed.

TABLE A-11

DMR DATA SUMMARY
GROUNDWOOD-THERMO-MECHANICAL SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1		70002	8.10	7.29	12.38	06/79	22	22	22
2		70001	21.07	3.18	5.45	05/79	20	20	20
28	J	900013	36.24	15.64	19.81	01/78	36	36	36
		Max.	21.1	7.3	12.3				
		Avg.	14.6	5.2	8.9				
		Min.	8.1	3.1	5.5				

(outlier mill 900013 is excluded from max.-avg.-min.)

TABLE A-12

DMR DATA SUMMARY
GROUNDWOOD-CMN PAPERS SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
2		54015A(1)	26.89	2.48	10.44	12/78	25	25	25
2		54015B(1)	26.25	1.99	4.41	01/78	9	9	11
10		52015	16.53	7.68	5.57	01/78	24	25	25
16	J	52016(2)	17.75	14.13	11.46	01/79	28	28	28
		Max.	26.9	7.7	10.4				
		Avg.	23.2	4.1	6.8				
		Min.	16.5	2.0	4.4				

(outlier mill 52016 is excluded from max.-avg.-min.)

(1) The state increased the allowable TSS limits for this mill in 11/78. Data for 054015B are average effluent levels before 11/78 and data for 054015A are average levels after 11/78.
(2) The final effluent levels for this joint treatment system are not proratable.

TABLE A-13

DMR DATA SUMMARY
GROUNDWOOD-FINE PAPERS SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
2		52003	17.16	1.64	5.94	08/77	8	41	41
2		52004	12.89	4.47	6.11	09/77	45	45	44
2		52007	18.87	1.87	5.14	01/78	38	38	38
2		52008	9.89	0.87	2.53	01/78	36	36	33
2	J	52013	11.41	0.90	3.10	09/79	18	18	18
2		52014	8.89	0.57	0.74	02/78	39	39	40
2		54014	8.52	2.50	4.61	05/78	33	33	33
		Max.	18.9	4.5	6.1				
		Avg.	12.5	1.8	4.0				
		Min.	8.5	0.6	0.7				

TABLE A-14

DMR DATA SUMMARY
INTEGRATED MISCELLANEOUS GROUP

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

			ANNUAL AVERAGE				NO. OF MONTHS		
TREATMENT CODE TYPE	MILL NUMBER	PRODUCTS	FLOW	BOD	TSS	START DATE	FLOW	BOD	TSS
1	10056	B & UB Kraft, S. Chem.	14.51	5.49	17.97	05/78	32	32	32
1	30007	Unknown	36.42	10.57	20.01	01/79	27	27	27
1	30017	Kraft, Magnefite	58.01	16.99	23.50	12/77	32	32	32
1	30019A(1)	B Kraft	25.65	8.42	21.75	01/80	12	12	12
1	30019B(1)	B Kraft	31.70	11.02	17.41	01/78	24	24	24
1	30016	B Kraft	11.11	5.21	13.35	07/77	33	33	33
1	30053	UB Kraft, Gwd.	24.82	8.99	18.79	05/78	8	8	8
1	40003	TM Gwd., UB Sulfite, DI	23.32	12.59	18.15	01/78	36	37	37
1	40004	S Chem	18.66	21.21	28.71	09/78	30	30	30
1	52006	Unknown	28.60	7.58	15.91	07/77	39	39	39
1	52009	Gwd.	18.83	3.80	4.55	07/77	37	30	30
1	54011	Gwd., UB Sulfite, DI	16.24	10.48	14.71	07/77	40	40	40
1	54016	B Sulfite M Gwd.	18.90	12.71	11.13	01/78	34	34	34
1	900007	Unknown	84.30	8.57	13.70	01/78	39	39	39
2	10010	Unknown	28.26	2.94	14.50	10/77	17	17	17
2	10012	B & UB Kraft	36.72	6.81	17.57	07/77	30	30	30
2	10015	Unknown	12.72	4.71	7.55	03/80	9	9	9
2	10059	B Kraft, S Chem	13.01	5.69	8.51	01/80	13	13	13
2	15010	B & UB Kraft	40.20	22.81	37.13	07/77	29	29	29
2	30014	Tissue, Fine	46.21	9.16	12.15	10/78	26	26	26
2	30041	Unknown	35.21	20.30	23.15	01/78	36	36	36
2	30044	B Kraft	28.12	2.84	8.36	05/78	34	34	34
2	30050	B Kraft, S Chem	15.64	6.23	10.40	10/78	24	25	24

TABLE A-14

DMR DATA SUMMARY
INTEGRATED MISCELLANEOUS GROUP
(Continued)

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	PRODUCTS	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
2		30055	B Sulf., B Krft, M Gwd.	33.85	5.95	22.79	07/77	35	36	36
2		54003	Unknown	16.60	2.31	5.27	01/78	27	36	36
2		54008	F Wood	16.16	1.74	2.44	10/78	29	29	29
2		54009	Unknown	13.27	2.80	1.93	07/77	4	45	45
2		54012	G Wood	14.74	12.42	22.96	02/80	14	14	14
2		54017	Unknown	12.64	2.06	4.90	01/78	39	39	39
2		60002	C Mech.	12.36	3.76	3.22	01/79	29	29	29
2		60003	Unknown	18.34	14.32	16.16	07/77	39	39	39
2	J	80025	Rag	25.33	1.15	2.72	09/79	21	21	21
2		140001	Unknown	11.73	10.69	15.05	10/79	16	16	16
2		150014 (2)	Unknown	11.34	2.47	1.77	01/78	38	37	11
2	J	150015	Fine, Specialty	34.81	2.99	2.95	01/78	37	37	37
2	J	900005 (3)	Unknown	16.61	9.86	10.43	08/80	8	8	8
2	J	900006	Unknown	16.61	9.96	10.43	08/80	8	8	8
3		10011	UB Kraft, M, T Gwd.	13.24	3.86	5.47	01/78	39	39	39
3		10013	B & UB Kraft	26.05	2.94	3.57	06/78	32	32	32
3		10027	UB Kraft, S Chem	19.40	7.65	13.70	07/77	45	45	45
3		30003	B & UB Kraft, S Chem	18.51	6.18	5.83	04/78	35	35	35
3		30008	B & UB Kraft	37.19	4.82	8.09	01/78	32	32	32
3		30011	B Kraft	33.66	5.87	6.12	08/78	21	21	21
3		30021	Unknown	21.51	8.77	6.85	07/77	39	42	42
3		30035	B & UB Kraft, Gwd.	20.47	9.87	17.29	01/78	39	39	39

TABLE A-14

DMR DATA SUMMARY
INTEGRATED MISCELLANEOUS GROUP
(Continued)

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	PRODUCTS	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
3		30043	Unknown	31.07	8.56	8.55	09/78	29	29	29
3		30054	Kraft, Gwd.	36.21	11.92	15.64	01/78	36	36	36
3		52010	Unknown	24.47	9.61	11.36	09/78	13	13	13
3		54005	Unknown	22.96	5.58	6.49	06/78	29	26	26
3		54013	Unknown	24.31	6.42	2.06	08/77	38	41	41
3		60001	Molded	20.71	2.44	2.02	07/77	42	42	42
3		80054	Specialty	7.40	3.58	3.63	07/77	45	46	46
3		150020	Soda	50.65	24.93	43.23	07/77	45	45	45
5		80020	Unknown	136.69	58.52	15.10	07/78	30	30	30
5		105046	Unknown	59.04	18.84	10.04	07/77	43	43	43
6		30038	Unknown	65.26	18.62	12.04	01/78	8	8	8
7		10026	Unknown	38.17	3.59	3.96	07/77	42	42	42
9	J	80010(5)	Specialty	36.44	10.67	5.40	01/78	16	16	16
9		80035(4)	Specialty	37.00	35.70	57.95	07/78	16	16	16
13	J	80011(5)	Fine, Board	24.69	8.69	3.62	07/77	39	39	39
13	J	80012(5)	Carbonizing	24.69	8.69	3.62	07/77	39	39	39
13	J	80013(5)	Fine	24.69	8.69	3.62	07/77	39	39	39
13	J	80014(5)	Fine, Specialty	24.69	8.69	3.62	07/77	39	39	39
13	J	80015(5)	Unknown	24.69	8.69	3.62	07/77	39	39	39
13	J	80016(5)	Fine	24.65	8.69	3.62	07/77	39	39	39
17		52011	Unknown		7.17	6.69	07/77		33	33

TABLE A-14

DMR DATA SUMMARY
INTEGRATED MISCELLANEOUS GROUP
(Continued)

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	PRODUCTS	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
17		105006	Unknown	23.69	11.31	10.56	07/77	36	45	45
21		30016	Kraft	29.66	3.94	7.59	09/78	27	27	27
28	J	30029	B & UB Kraft, S Chem	34.91	10.33	19.10	11/78	26	26	26

(1) The state increased the allowable TSS limits for this mill in 12/79. Data for 030019B are average effluent levels before 12/79 and data for 030019A are average effluent levels after 12/79.
(2) This mill samples BOD once/month and TSS four times/year.
(3) Mill closed 1981.
(4) This mill was connected to a POTW.
(5) These mills discharge a portion of their effluent to a POTW.

TABLE A-15
DMR DATA SUMMARY DEINK-FINE PAPERS SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
2	140007	11.50	4.37	8.00	03/78	39	39	39
2	140019	7.48	3.98	7.50	07/77	44	43	44
3	140008	13.29	5.45	6.43	07/77	46	46	46
	Max.	13.3	5.5	8.0				
	Avg.	10.8	4.6	7.3				
	Min.	7.5	4.0	6.4				

TABLE A-16
DMR DATA SUMMARY DEINK-NEWSPRINT SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
33	900017	13.44	2.82	2.18	01/80	15	15	15
	Avg.	13.4	2.8	2.2				

TABLE A-17
DMR DATA SUMMARY DEINK-TISSUE PAPERS SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
1	140025	13.87	8.68	8.92	04/78	26	26	26
2	140015	22.67	6.84	9.43	11/77	43	43	43
2	140018(1)	4.22	6.20	2.84	12/79	10	9	10
2	140021	23.99	4.40	8.10	09/77	42	42	42
2	140030(2)	16.33	3.91	5.05	07/77	45	47	47
2	900020	32.20	18.26	30.76	01/79	24	24	24
5	140022	26.06	24.75	10.16	03/79	26	26	26
5	140024	1.90	24.14	14.40	07/77	44	44	44
5	900010	13.18	16.25	5.40	07/77	29	45	45
18	140014	20.20	8.75	14.14	07/77	44	44	44
26	900015	9.43	4.55	4.53	02/79	22	22	22
	Max.	32.2	24.8	30.8				
	Avg.	16.7	11.5	10.3				
	Min.	1.9	3.9	2.8				

(1) Treated effluent is recycled at this mill, resulting in lower flow rates than is typical for this subcategory.

(2) Deinked pulp produced at this mill is only a small percentage of final product.

TABLE A-18

DMR DATA SUMMARY
TISSUE FROM WASTEPAPER SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
2	J	85006(1)	25.33	1.15	2.72	09/79	21	21	21
3		85004	10.57	3.63	4.08	02/78	38	38	38
3		90004	12.86	7.36	3.82	07/77	37	37	37
3		100005(2)	7.05	3.69	2.56	09/77	41	42	29
3		100013	9.31	3.44	6.50	07/78	33	31	33
5		90014	22.15	11.58	7.17	03/79	25	25	25
5		100014(3)	0.94	2.53	0.63	07/77	14	14	14
5		100016	54.35	70.02	212.15	01/78	37	38	38
9		90002	9.70	6.52	2.86	07/77	33	32	33
9		100001	23.60	10.52	21.24	07/77	38	39	39
34		90010(4)	22.03	2.36	1.59	07/77	43	43	42
		Max.	54.4	70.0	212.2				
		Avg.	18.2	11.2	24.1				
		Min.	0.9	1.2	0.6				

(1) The final effluent from this joint treatment system is not proratable.
(2) Since 7/79, this mill has been required to sample BOD once/month and TSS 4 times/year.
(3) Mill closed 1980.
(4) Mill takes 1 to 4 hour composite samples/month.

TABLE A-19

DMR DATA SUMMARY
PAPERBOARD FROM WASTEPAPER SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
1		110023	2.85	2.58	2.62	07/77	45	45	45
1		110034	1.44	2.11	1.56	05/79	22	16	17
1		110070	4.49	0.57	0.52	07/77	43	43	40
1		110110	1.18	0.39	1.61	04/79	25	25	25
1		110127	5.02	1.81	1.50	07/77	34	34	34
2		110001(1)	4.96	0.27	0.67	07/77	37	36	36
2		110062	2.49	1.09	1.21	01/79	27	27	27
2		110069	7.01	0.46	1.48	01/79	24	25	25
2		110074	0.91	0.24	0.62	09/78	30	30	30
2		110077	0.54	0.33	0.41	01/78	15	15	15
2		110080(2)	7.82	5.62	5.57	01/80	14	14	14
2		110134	2.69	5.31	4.82	10/78	27	27	27
2		110144	2.04	3.23	2.54	01/80	16	16	16
2		900026	8.20	0.24	1.52	02/79	19	20	20
3		110019	7.16	1.97	2.20	08/77	25	33	38
3		110022(3)	16.31	3.46	4.45	01/78	20	20	20
3		110025	1.82	1.67	3.04	03/79	21	21	21
3		110031	1.83	0.27	0.30	07/77	42	41	42
3		110043	4.09	1.56	2.32	07/77	29	43	43
3		110052	5.71	0.77	1.02	09/77	13	13	13
3		110057	1.60	1.71	1.23	07/77	46	46	46
3		110061(4)	4.69	1.58	2.28	07/77	46	46	46
3		110067	3.69	0.86	1.63	07/78	29	30	30
3	J	110068	4.22	1.93	3.56	11/78	27	28	28
3		110094	5.23	0.95	1.35	07/77	45	45	45
3		110096(5)	0.21	0.15	0.04	10/78	4	27	27
3		110113	4.14	1.69	3.22	07/77	46	46	46
3		110119	2.91	5.34	0.93	07/78	9	21	21
3		110147	1.43	3.35	2.82	07/77	25	25	26
3		110151	3.76	2.45	1.72	07/77	9	9	9
5		110060(6)	0.63	4.45	0.36	04/78	16	16	16
5		110104	0.23	2.27	0.70	01/79	24	27	27
5		110141(4)	1.92	2.99	1.12	07/77	39	42	42
6		110054	14.05	3.35	0.88	07/78	12	12	12
8		110131(7)	3.88	9.82	2.23	01/78	24	21	21
9		110100(8)		8.83	3.04	05/78		8	8
9		900024	0.50	0.08	0.12	10/77	36	33	33
32		110032	6.18	1.76	2.21	04/78	34	35	35

TABLE A-19

DMR DATA SUMMARY
PAPERBOARD FROM WASTEPAPER SUBCATEGORY
(Continued)

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
33	110103	4.44	0.35	0.66	02/79	26	26	26
33	900023	6.80	0.62	0.74	07/77	45	44	44
42	110020	8.57	1.66	2.79	08/77	41	42	42
	Max.	16.3	9.8	5.6				
	Avg.	4.2	2.2	1.8				
	Min.	0.2	0.1	0.1				

(1) Mill closed 1980.
(2) Converted to paperboard mill in 1979. All data is for period since then.
(3) Mill closed 1980.
(4) These mills spray irrigate a portion of their final effluent which is not included in this data.
(5) Most flows are less than 0.05 kgal/ton.
(6) This mill will connect to a POTW.
(7) Mill closed 1980.
(8) Mill is now an indirect discharger.

TABLE A-20

DMR DATA SUMMARY
WASTEPAPER-MOLDED PRODUCTS SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1	150011	11.55	6.36	6.91	09/78	28	28	28
5	150025(1)	25.29	1.38	1.37	01/78	12	11	11
9	150007	13.58	24.05	26.51	10/79	12	12	12
9	150021(2)	348.96	3.87	7.91	07/77	30	30	30
	Max.	349.0	24.0	26.5				
	Avg.	99.8	8.9	10.7				
	Min.	11.6	1.4	1.4				

(1) Monitored effluent is process wastewater combined with cooling water.
(2) Mill closed 1980.

TABLE A-21

DMR DATA SUMMARY
BUILDERS' PAPER AND ROOFING FELT SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
3	120004	0.54	0.31	1.01	07/77	42	39	42
3	120008	6.56	3.11	3.30	07/77	31	32	32
5	120020	3.11	0.11	0.21	07/78	34	34	34
30	120021	0.05	0.77	0.08	10/79	4	19	19
44	120006	27.74	2.09	0.67	07/77	47	47	40
	Max.	27.7	3.1	3.3				
	Avg.	7.6	4.7	1.1				
	Min.	0.1	0.1	0.1				

TABLE A-22

DMR DATA SUMMARY
SECONDARY FIBER MISCELLANEOUS GROUP

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE TYPE	MILL NUMBER	PRODUCTS	ANNUAL AVERAGE FLOW	ANNUAL AVERAGE BOD	ANNUAL AVERAGE TSS	START DATE	NO. OF MONTHS FLOW	NO. OF MONTHS BOD	NO. OF MONTHS TSS
1	140020	Fine	19.69	6.71	11.02	07/77	38	38	38
2	110136	Board	4.12	4.03	2.98	08/77	25	31	31
2	140027	Unknown	9.72	2.25	4.51	07/77	46	46	46
5	150008	Unknown	10.94	2.38	2.83	07/77	45	45	45
5	900053	Unknown	2.54	18.36	19.28	07/77	40	40	40
9	110122	Insulation Board	2.27	0.74	0.33	07/77	45	44	44
26	140026	Fine	19.27	4.11	5.36	04/78	32	36	36

TABLE A-23

DMR DATA SUMMARY NONINTEGRATED-FINE PAPERS SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1		80007	13.31	2.88	3.28	08/77	40	40	40
1		80018	7.24	5.57	3.94	09/78	25	25	25
1		80046	12.75	2.21	3.54	03/79	25	25	25
2	J	80037	11.41	0.90	3.10	09/79	18	18	18
2		80051	12.82	5.42	5.04	10/79	16	16	16
2	J	80053	41.82	20.68	57.86	04/79	18	18	17
3		80041	27.29	3.40	2.72	11/78	28	28	28
5		80009	15.69	6.60	3.48	01/78	36	36	36
5		80030(1)	5.39		48.48	07/77	27		27
5		80033	10.87	9.40	5.25	07/77	40	41	41
5		80040(2)	24.69	26.71	29.21	07/77	9	9	9
5		80048	15.57	22.09	2.15	04/79	24	24	24
5		105047	11.84	3.51	2.18	07/77	39	45	45
5		900059	9.69	6.04	3.20	11/77	40	40	40
8		80049	11.11	8.17	10.60	08/78	31	31	31
46		80027	7.34	1.82	1.31	01/78	38	38	38
		Max.	41.8	26.7	57.9				
		Avg.	14.9	8.4	11.6				
		Min.	5.4	0.9	1.3				

(1) Mill spray irrigates its final effluent.
(2) This mill is now an indirect discharger.

TABLE A-24

DMR DATA SUMMARY NONINTEGRATED-FINE PAPERS-COTTON SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1		80003	40.59	7.33	5.44	07/77	46	46	46
5		80044	37.25	13.77	4.49	11/79	13	14	14
9		80042(3)	16.15	21.35	58.61	07/78	18	18	18
9	J	80043(1)	36.42	10.78	5.40	01/78	37	37	37
31		80032(2)	16.46	3.98	1.65	01/79	28	27	28
		Max.	40.6	21.4	58.6				
		Avg.	29.4	11.5	15.1				
		Min.	16.2	4.0	1.6				

(1) This mill discharges 10 percent of its effluent to a POTW.
(2) This mill discharges a variable amount of raw wastewater to a POTW.
(3) Now an indirect discharger.

TABLE A-25
DMR DATA SUMMARY NONINTEGRATED-TISSUE PAPERS SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1		90001	16.96	3.12	1.97	07/77	24	42	42
1		90005(1)	2.73	0.42	0.45	09/77	29	29	29
5		40006	22.03	9.70	5.28	08/79	21	22	22
5		90008	13.74	4.44	1.31	07/77	47	47	47
5		90011(2)	12.72	4.88	2.30	07/77	28	28	27
5		90013	7.06	2.28	1.24	08/77	40	40	40
5		90031	21.47	4.01	6.41	07/77	36	36	36
8		90022	14.87	6.09	5.46	07/77	20	28	26
8		90024	19.61	1.90	1.41	07/77	22	22	22
8		90028(3)	22.00	4.34	3.82	01/78	36	36	36
8		90032	32.08	4.76	6.88	08/77	26	44	44
8		555555	17.57	9.79	15.19	04/79	21	21	21
13		90019	19.26	5.82	6.54	07/77	46	46	46
16		90007	22.21	0.47	1.28	07/77	36	36	36
		Max.	32.1	9.8	15.2				
		Avg.	17.5	4.4	4.2				
		Min.	2.7	0.4	0.4				

(1) Mill closed 1980.
(2) Mill closed 1979.
(3) Mill closed 1981.

TABLE A-26
DMR DATA SUMMARY NONINTEGRATED-LIGHTWEIGHT PAPERS SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
2	J	105014(1)	34.83	2.99	2.95	01/78	37	37	37
5		80022	19.65	2.63	4.15	01/78	31	31	29
5		80024	10.82	1.27	1.48	01/78	23	23	23
5	J	105016	105.91	19.53	6.17	01/78	37	37	37
7		80021	15.81	1.74	1.08	07/77	34	34	34
8		105020	45.51	2.65	3.59	01/78	37	37	37
9		90003	15.20	6.15	3.90	08/77	41	43	43
17		90015	28.18	4.51	4.26	11/78	30	30	30
25		105013	76.65	14.49	17.72	07/77	34	36	36
43	J	80039(2)	8.55	1.61	0.69	07/77	34	24	24
		Max.	105.9	19.5	17.7				
		Avg.	36.1	5.8	4.6				
		Min.	8.6	1.3	0.7				

(1) The final effluent from this joint treatment system is not proratable.
(2) The treatment system receives an unknown portion of the wastewater from another mill. The final effluent is thus not proratable.

TABLE A-27
DMR DATA SUMMARY NONINTEGRATED-LIGHTWEIGHT PAPERS-ELECTRICAL SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1		105018	162.49	7.41	6.17	07/77	41	44	44
5	J	105015	105.91	20.11	6.17	01/78	37	37	37
5	J	105017	105.91	20.11	6.17	01/78	37	37	37
9		105009(1)	100.00	9.17	6.78	01/78	23	23	23
		Max.	162.5	20.1	6.8				
		Avg.	118.6	14.2	6.3				
		Min.	100.0	7.4	6.2				

(1) Mill closed 1980.

TABLE A-28
DMR DATA SUMMARY NONINTEGRATED-FILTER AND NONWOVEN PAPERS SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
2		105055	59.88	2.89	5.77	12/77	33	33	33
3		105033	40.86	3.56	2.18	07/77	43	44	44
5		105051	40.28	2.85	4.33	07/77	12	12	12
24		105034	48.95	7.51	5.63	07/77	39	44	44
		Max.	59.9	7.5	5.8				
		Avg.	47.5	4.2	4.5				
		Min.	40.3	2.9	2.2				

TABLE A-29
DMR DATA SUMMARY
NONINTEGRATED-PAPERBOARD SUBCATEGORY

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
3		85001	4.75	1.43	0.72	07/77	44	45	44
3		110021	13.70	3.03	5.34	07/77	41	40	40
5		85007	40.24	3.09	4.45	07/77	46	43	40
5		105002(1)	57.04	9.66	4.30	07/77	30	28	28
9		105048	6.26	0.59	0.49	01/78	33	32	33
9		105049(2)	12.30	10.99	1.04	03/78	11	11	11
		Max.	57.0	11.0	5.3				
		Avg.	22.4	4.8	2.7				
		Min.	4.8	0.6	0.5				

(1) This mill operated infrequently in 1980 and data after 2/80 were not included.
(2) The mill has connected to a POTW.

TABLE A-30

DMR DATA SUMMARY
NONINTEGRATED MISCELLANEOUS GROUP

FLOW (KGAL/TON), BOD (LBS/TON), TSS (LBS/TON)

TREATMENT CODE	TYPE	MILL NUMBER	PRODUCTS	ANNUAL AVERAGE FLOW	BOD	TSS	START DATE	NO. OF MONTHS FLOW	BOD	TSS
1		888888	Unknown	13.28	6.31	1.95	07/77	44	44	45
2		105059	Unknown	13.74	4.75	4.82	07/77	34	24	24
3		105011	Unknown	83.62	1.41	0.52	01/78	39	32	25
3		105028	Fine, Specialty	10.27	2.78	1.19	07/77	42	42	42
3		105061	Board	10.10		1.34	10/79	12		7
5		105004	Unknown	24.89	6.56	4.73	07/77	46	46	46
5		105019	Specialty	48.63	3.56	4.54	07/77	18	18	18
5		105024	Specialty	23.11	2.27	1.48	04/78	37	37	37
5		105026	Fine, Specialty	4.75	0.40	0.30	11/77	41	38	36
5		105040	Specialty	26.79	5.85	6.09	07/77	43	43	43
5		105056	Unknown	15.79	8.23	1.46	10/77	41	41	41
5		105065	Unknown	22.78	5.86	3.11	07/77	46	46	46
5		105066	Specialty	46.60	6.87	2.25	01/78	35	35	35
5		105067	Unknown	36.73	4.91	1.79	01/78	35	35	35
8		80036	Fine, Tissue	12.79	5.17	5.24	01/78	36	36	36
9		105008	Unknown	35.00	4.09	3.58	03/78	31	33	33
9		105037	Unknown	14.72	3.58	4.10	01/78	30	29	30
9		105072	Specialty	19.99	10.68	57.13	01/78	39	39	39
13		105022	Specialty, Board	27.12	7.64	6.00	07/77	45	45	45
13		105023	Saturating, Absorbant	50.34	2.29	3.85	11/77	41	41	41
13		105032	Unknown	12.38	1.36	2.44	10/78	26	26	26
13		105068	Fine	19.91	4.60	1.97	07/77	40	43	43
16	J	105038	Unknown	17.75	14.11	11.46	01/79	28	28	28

TABLE A-31

TREATMENT TYPE CODE DECODE LIST

TREATMENT CODE	TYPE	TREATMENT SYSTEM DESCRIPTION
--	J	Indicates the mill shares a joint treatment system. (Production listed for these mills is the total production for all mills sharing the joint treatment system).
01		Aerated stabilization basin (ASB).
02		Activated sludge, extended aeration.
03		ASB with polishing pond or holding lagoon with daily discharge.
04		ASB wih holding lagoon (intermittent discharge).
05		Primary treatment only.
06		Oxidation basin(s) intermittent non-continuous discharge.
07		Storage oxidation pond(s).
08		Dissolved air flotation clarification (DAF).
09		No treatment.
10		Deep tank activated sludge with DAF.
11		Pulp mill wastewater to sedimentation lagoon, paper mill wastewater to clarifier. Both streams to ASB, activated sludge, and polishing ponds.
12		ASB with less than two days detention.
13		Primary treatment with polishing pond.
14		Rotating biological surface.
15		Internal controls with recycle and preliminary treatment.
16		Settling basin and facultative lagoons.
17		Trickling filter.
18		Activated sludge with primary only for paper mill.
19		Pulp mill wastes to ASB. Paper mill wastes to primary clarifiers. Combined streams to activated sludge.
20		Settling lagoons for paper mill wastes. Pulp mill wastewater to POTW.
21		Pulp mill wastewater to primary clarifier, ASB, and oxidation pond. This effluent plus remaining mill effluent and creek flow discharged to a natural six lake system, the first and last of which are aerated.
22		ASB; during summer 20 percent of primary effluent diverted to gravel filtration basins.
23		Activated sludge with trickling filter.
24		ASB for broke washwater, primary clarifier for remainder.

TABLE A-31

TREATMENT TYPE CODE
DECODE LIST
(Continued)

TREATMENT CODE TYPE	TREATMENT SYSTEM DESCRIPTION
25	Activated sludge followed by ASB.
26	Activated sludge with polishing ponds.
27	ASB plus holding lagoon; discharge is intermittent non-continuous from holding lagoon; separate discharge from ASB.
28	Primary only for 3/4 of the flow with activated sludge used on remaining 1/4 of the flow.
29	Anaerobic-aerobic system.
30	Preliminary treatment, primary clarification. Effluent is stored and reused; when storage tanks are full, clarified effluent is discharged to river (non-continuously).
31	Primary lagoons with approximately 1/2 flow going to POTW and 1/2 to lagoons.
32	ASB followed by sand filtration.
33	Primary clarification; activated sludge; secondary clarification and sand filtration.
34	Activated sludge with patented air injection system; secondary clarification and polishing pond with one day detention.
35	ASB with polishing pond; a portion of the effluent is spray irrigated.
36	Primary, secondary clarification (oxidation pond plus ASB), plus holding pond.
37	ASB with polishing pond; primary only for paper mill.
38	Preliminary followed by spray irrigation; collected runoff is discharged to river.
39	Dissolved air flotation clarifier followed by spray irrigation.
40	Reverse osmosis, internal.
41	ASB with polishing pond plus chemically assisted clarification.
42	Six-day ASB followed by DAF.
43	Primary clarification; the treatment system receives some effluent from the primary clarifier of Mill 080038.
44	Primary clarification followed by spray irrigation.
45	Caustic extract and evaporator condensate to extended aeration. All other streams to primary.
46	Primary clarification; rotating biological surface; chemically assisted secondary clarification.

APPENDIX B

DETAILED DATA ON TREATMENT AND SLUDGE DEWATERING PRACTICES AMONG MILLS IN VARIOUS PRODUCTION CLASSES

TABLE B-1

TREATMENT SYSTEMS EMPLOYED BY MILLS IN VARIOUS PRODUCTION CLASSES

	BKM	BKF	BKC	XRC	UBK	S30 S3F	S3D	SCH	SOD	GWN GWC	GWF	TMP	DIF DIN	DIT	SPB	KPO	OTH	LWT	FLT	SPE	NIT	NIF	WPT	BLD WPB	BKG	UBG	BUB	BMD	BDO
Primary Only																													
No. of Mills	1	1	0	0	0	2	0	0	0	0	0	0	0	0	1	0	0	7	2	1	3	8	1	0	1	0	0	0	0
Total Prod.(tpd)	560	1140	0	0	0	1107	0	0	0	0	0	0	0	0	23	0	0	715	71	127	643	1902	62	0	1067	0	0	0	0
ASB																													
No. of Mills	2	1	3	1	6	2	0	2	1	0	5	3	1	1	1	2	2	1	1	1	0	5	1	7	0	0	3	1	1
Total Prod.(tpd)	1098	874	2944	2683	6683	1372	0	1297	537	0	3365	1173	274	120	94	3078	646	119	11	100	0	1490	21	727	0	0	3472	1312	1071
ASB + other treatment																													
No. of Mills	7	3	5	4	13	0	1	8	1	1	0	0	0	0	1	1	1	0	1	0	0	4	0	10	6	2	8	3	1
Total Prod.(tpd)	5177	4434	3216	6124	12124	0	431	4596	154	400	0	0	0	0	51	2060	303	0	29	0	0	1410	0	2887	6518	3534	10306	3982	1300
QSB																													
No. of Mills	0	1	0	0	4	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	2	2	0	1	0	0	0	0	0
Total Prod.(tpd)	0	417	0	0	3814	0	0	297	0	0	0	500	0	0	40	0	0	0	0	0	391	110	0	108	0	0	0	0	0
Activ. Sludge																													
No. of Mills	2	3	1	1	3	3	4	3	0	2	5	0	4	2	1	2	0	2	0	2	3	6	1	5	1	2	3	1	0
Total Prod.(tpd)	1862	1341	1846	6101	3365	1463	1823	1888	0	1081	3216	0	875	206	51	2428	0	112	0	471	1082	1456	61	1440	850	2194	2875	494	0
Activ. Sludge + Other Treatment																													
No. of Mills	0	2	0	0	1	3	1	0	0	0	0	1	1	0	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0
Total Prod.(tpd)	0	2415	0	0	1803	1897	369	0	0	0	0	165	297	0	0	1172	0	7	0	0	177	0	0	0	1091	0	0	0	0
AWT																													
No. of Mills	0	1	0	0	0	1	0	1	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	6	1	0	0	0	0
Total Prod.(tpd)	0	660	0	0	0	303	0	337	0	0	0	0	514	128	0	0	0	0	46	0	0	0	0	663	1103	0	0	0	0
Land Application																													
No. of Mills	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Total Prod.(tpd)	0	0	0	0	2050	0	0	0	0	0	0	0	0	0	100	0	0	0	0	0	328	0	0	0	0	0	0	0	0

Note: See Table 1 for Production Class Codes
See Table B2 for treatment system descriptions

TABLE B-2

TREATMENT SYSTEM DESCRIPTIONS FOR TABLE B-1

Primary only - includes gravity settling with or without chemical addition and flotation clarifiers.

ASB - aerated stabilization basins not followed by any other form of treatment.

ASB + other treatment - ASB followed by quiescent basins, polishing ponds, controlled discharge basins or used in conjunction with other forms of biological treatment or land application.

QSB - quiescent stabilization basin with no other form of biotreatment.

Activ. Sludge - activated sludge in any form.

Activ. Sludge + other treatment - activated sludge used in conjunction with other forms of biological treatment, controlled discharge or land application.

AWT - Advanced Waste Treatment - any form of biotreatment followed by chemically assisted clarification or filtration.

Land Application - spray irrigation, overland flow, or ground infiltration as the principal means of waste treatment.

TABLE B-3

SLUDGE DEWATERING PRACTICES AMONG MILLS IN VARIOUS PRODUCTION CLASSES

No. of Mills Reporting Use in 1979 Accomplishment Survey

Dewatering Technology
Primary/Mixed

PC	Precon-dition	Centri-fuge	Vacuum Filter	Belt Filter	Press Filter	Mech. Press	Basins
BKM	2/1	0/0	1/1	0/0	0/0	2/1	3/0
BKF	5/5	1/0	2/2	2/5	1/0	0/1	2/1
BKC	6/3	0/0	3/1	2/1	0/2	3/1	1/0
XRC	4/5	2/0	2/2	0/2	1/1	2/1	2/0
UBK	9/5	0/0	3/1	2/1	2/1	2/1	11/5
S3F	0/5	0/0	1/3	0/2	0/0	0/1	2/0
S3D	1/3	0/0	2/1	0/1	1/0	2/1	0/1
SCH	1/5	0/0	1/0	1/2	0/0	0/0	3/1
SOD	0/1	0/0	0/0	0/1	0/0	0/0	0/0
GWC	0/0	0/0	0/0	0/0	0/0	0/0	0/0
GWF	1/4	1/0	1/4	0/1	0/0	1/3	0/1
GWN	0/2	0/0	0/1	0/0	0/0	0/1	0/0
TMP	1/0	0/0	0/0	1/0	0/0	1/0	0/0
DIF	3/1	0/0	1/0	2/1	0/0	2/0	1/1
DIT	1/2	0/2	1/0	0/0	0/0	0/0	1/0
DIN	0/1	0/0	0/0	0/0	0/0	0/0	0/1
LWT	2/3	1/1	1/0	1/1	0/0	1/0	1/1
FLT	0/0	0/0	0/1	0/0	0/0	0/0	1/0
SPE	1/1	0/0	0/1	0/0	0/0	1/1	0/1
NIT	3/1	3/1	2/0	0/0	0/0	1/0	1/0
NIF	11/5	3/2	5/0	2/2	4/0	2/0	7/1
WPT	3/0	1/0	0/0	1/0	0/0	0/0	0/0
WPB	5/2	1/0	3/0	1/1	1/0	0/0	6/0
BKG	2/1	1/0	1/1	1/2	0/1	1/0	3/1
UBG	1/2	0/0	1/1	0/2	0/0	0/1	1/2
BUB	5/2	0/0	3/2	0/0	0/0	3/1	6/1
BMQ	1/0	1/0	2/0	1/0	1/0	3/0	2/0
BDO	0/0	0/0	1/1	0/0	0/0	0/1	0/1
S3O	2/0	0/0	2/0	0/0	0/0	2/0	0/0
KPO	3/1	2/0	2/1	0/1	1/0	2/0	0/0
OTH	2/0	1/0	1/1	1/0	0/0	1/0	1/1
SPB	0/0	0/0	2/0	1/0	0/0	0/0	1/0

Note: See Table 1 for Production Class Codes