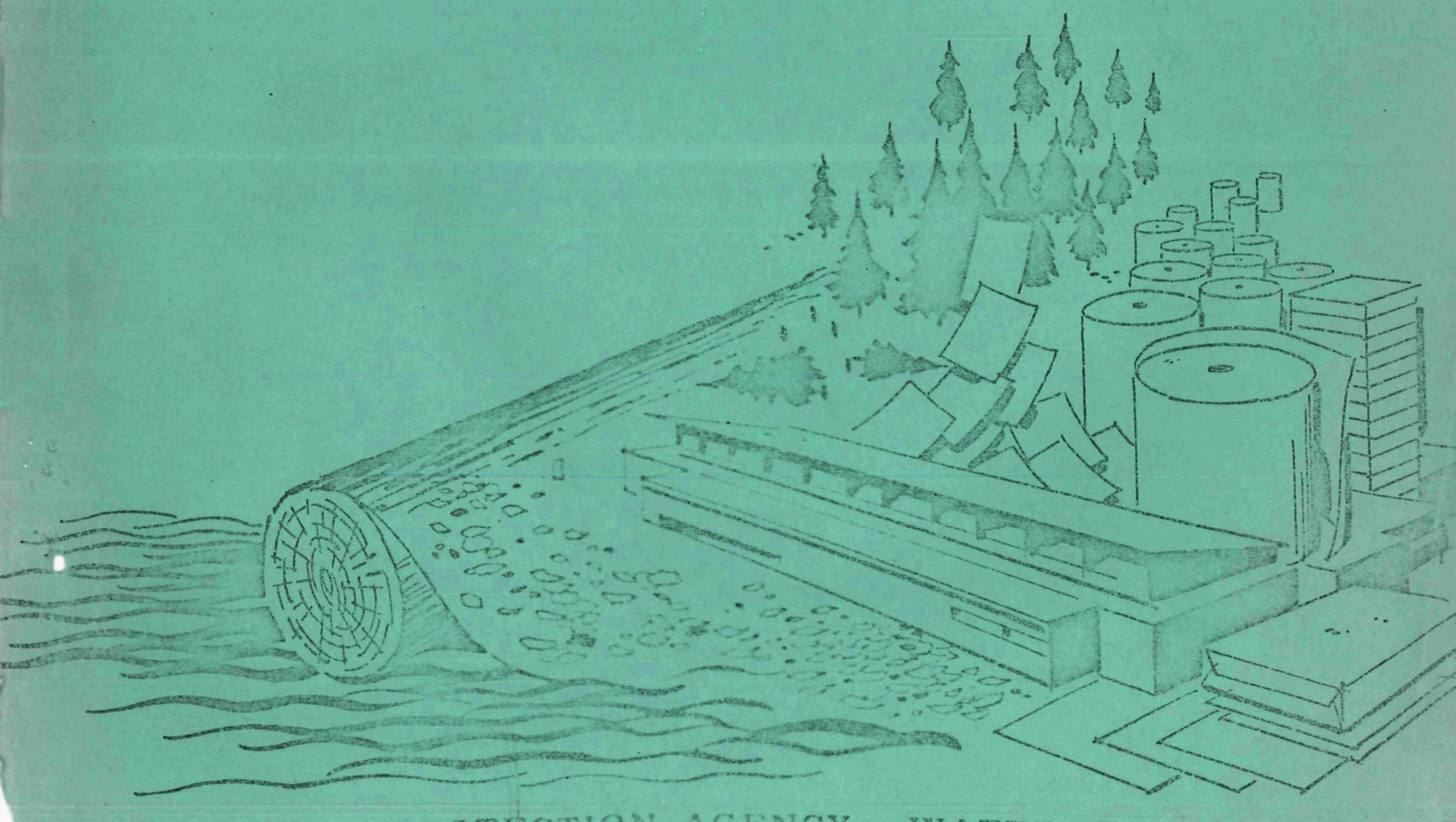
Draft 3rd Report on Waste Profiles of the Paper Industry



NVIRONMENTAL PROTECTION AGENCY • WATER QUALITY OFFICE

DRAFT THIRD REPORT
ON WASTE PROFILES
OF THE PAPER INDUSTRY

BY

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for the

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CONTENTS

SUMMARY

This report summarizes the contents of preliminary reports #1 and #II. Those reports contained, along with other items, profiles of the common pulp and paper manufacturing processes, their "Standard Raw Waste Loads," and the methods of treating them together with the results obtained in practice from which "Base Level of Treatment" ranges can be established. For convenient reference updated SRWL tables from Preliminary Report #I and treatment tables from Report #II are printed in the appendix of this report.

Work is well along on the report dealing with advanced treatment methods from which the "Best Available Treatment" can be developed. While all the data needed to complete this latter section may not be available by the time the next report is to be submitted, comments concerning the "Best Available Treatment" are included herein.

Attention is called to the fact that the figures presented are subject to modification on receipt of additional data and comments and expansion from individuals and agencies to whom the preliminary reports were distributed. These included the Office of Water Quality, the pollution control agencies of the States of Wisconsin, Washington, and Georgia, the Corps of Engineers, the NCASI, and the American Hardboard Association, as well as individual companies and consultants to the project. A group of individuals from the industry who are active in the water quality control area also received the preliminary reports and the receipt of additional information from them is also anticipated. This additional information and suggestions for improving the presentation will be incorporated in the final report by the contractor.

STANDARD RAW WASTE LOAD

The term "Standard Raw Waste Load" was carefully considered in this report and the supporting data is intended to faithfully represent discharges from manufacturing operations employing good practice in retention of raw materials in the product. For example, figures given for papermaking operations in this section of the report are from mills having save-alls as part of the paper machine system whereby fiber and filler of usable quality lost from the paper machine are to a reasonable degree reclaimed and returned to the manufacturing operation for reuse in the sheet. Where chemical recovery processes are employed, such as in chemical pulp manufacture, data from mills operating at a typical range of efficiency were selected for inclusion. Under these circumstances the effluent contains only those residual uncontrollable losses occurring during the course of normal operation.

For processes in which water-carried solid wastes are removed as part of mill operations, such as barking and lime slaking, only the character of the water leaving the process was considered in determining the SRWL. For example, the effluent from the wet barking processes was considered to be that which had been through the bark and silt removal system integral to most barking operations. Disposal of the solid wastes other than those in the effluent was assumed.

There are some circumstances where appreciable control can be exerted over raw effluent quality through the capacity and operational efficiency of internal equipment. An example of this is the pulp mill recovery system, in which adequate evaporators and pulp washing equipment can maintain a low level of sewer losses from this operation. In other instances, no internal control is possible as is the case with pulp bleaching. In this operation so much material must be removed from the pulp in order to produce a certain grade of product that recovery of it is not possible at the present stage of the art. Even a high degree of water reuse within the process only serves to concentrate the substances in the effluent. Hence, it must be sewered.

In other cases raw materials themselves exert a very significant effect on the SRWL. This is particularly true in respect to processes employing recycled papers such as pulp deinking, broke reclamation, and waste paperboard manufacture. Materials such as filler, coatings, and ink must be removed in the deinking and broke reclamation operations, and these are not suitable for reuse. Hence they must leave the plant in the waste stream and since their nature and quantity vary with the type and quality of the waste paper used, a wide variation in the SRWL occurs not only from mill to mill but at any particular mill. In the case of waste paperboard, solubles present in or on the stock purchased can cause major variation in raw effluent BOD values at any one mill. These are frequently starches and adhesives used in making the original product but they may consist of materials in which the paper came in contact through packaging. Here, too, processing itself can effect the SRWL since asphalt dispersion processes raise both the BOD and suspended solids content of the waste water.

The figures for SRWL were established on the basis of unit manufacturing operations. In some instances this represents no problem since the procedures at all mills producing a particular product are similar and individual operational losses are substantially the same. An example of this is kraft linerboard production in which unbleached kraft pulp is manufactured and made into paperboard. At some linerboard mills some NSSC pulp is also made and the spent liquor from it employed as make-up in the kraft recovery system. Given equal equipment and common good water reuse practice the effluent and SRWL from the various mills can be expected to be similar from each pulping and papermaking process.

In bleached pulp mills a more complicated situation exists. Not only are different degrees of bleaching practiced causing variable effluent loads, but substantially the same product is often manufactured by somewhat different means. One mill for example may remove less of the wood substance in the cooking process than another, in which case the additional removal must be accomplished in the bleachery. In this instance the bleachery SRWL will be higher than for the mill doing more of the work in the digesters. Also the overall load will be greater since in the latter case the recovery system receives and destroys more of the wood substance.

However, an attempt has been made to reconcile such irregularities and it is hoped that in the final presentation of the SRWL, a meaningful range of figures can be presented which, in use, can be tempered with specific knowledge of particular manufacturing operations and the raw materials employed in them. The need for employing a range is clearly brought out by examination of effluent data for a new linerboard mill published by Davis.* The normal swings in effluent strength occurring even in the best of operations are epitomized by the data presented in this paper. For older mills such swings can be considerably wider so that an average figure cannot be assumed to prevail over any long period of time. Even though treatment serves to eliminate to a large extent such changes, variations naturally occur.**

*Davis, C. L., Jr., "Lime Precipitation for Color Removal in Tertiary Treatment Kraft Mill Effluent at the Interstate Paper Corporation," AICHE Water Pollution Symposium, Chicago, Ill. (Dec. 1970).

**Burns, O. B. and Eckenfelder, W. W., Jr., "A Statistical Study of Five Years Operation of the West Virginia Paper Company's Waste Treatment Plant,"Purdue, Ind. Waste Conference #18, P. 83 (1963).

BASE LEVEL OF TREATMENT

The major surface water quality problems resulting from the discharge of pulp and papermill wastes arise from their content of suspended solids and biologically decomposable dissolved organic matter as well as biologically refractive organics which are for the most part colored. Their color is similar to that of swamp water since they are primarily wood substances such as lignins and tannins and their degredation products. All three of these fractions can cause undesirable effects of one kind or another and are the subject of water quality standards established by the states. No attempt is made here to elaborate on these effects since they will be covered in detail in the final report and are given in textbooks dealing with the subject.

There are other waste constituents, some of which are not clearly defined, that can be troublesome under particular circumstances. Some of these are complex organic compounds which can affect marine and aquatic productivity and simple inorganic salts such as chlorides and sulfates of calcium and sodium. Pigments, dyes, heavy metals, and acidity-alkalinity may be added to this list although the latter is seldom a problem. Where it is, it is very readily corrected. The presence and importance of heavy metals are not at this time well defined nor thought to be a serious problem for this industry. If present, heavy metals enter the process through impurities in purchased chemicals. Compounds containing them are no longer widely used in attendant functions such as slime control. Other possible sources are corrosion of materials, construction in the mill, or inks removed from old papers. Heavy metals from the latter, however, are most likely to be in an insoluble state and be removed by treatment.

All pulp and papermill wastes do not contain all the three major polluting constituents to significant degree. For example, a number of papermaking wastes contain only suspended material in significant amounts with practically no dissolved organics present. Hence, after clarification, which removes the suspended matter and its equivalent in BOD, the waste water is of similar quality to that of other effluents having received biological treatment and is suitable for discharge without contravention of any of the water quality criteria set forth in the standards. Examples of operations producing such wastes are tissue and wrapping paper manufacture, pulp lapping,and the production of specialty board products.

In the case of effluents of this nature the "Base Level of Treatment" is obviously clarification alone. Further treatment could obviously serve no useful purpose relative to receiving water quality since there remains little further impurities to remove. This contention is supported by information presented in Figures #1 and #2 of Preliminary Report #II and Figure #1 of Preliminary Report #I (also included in the Appendix of this report) which clearly indicate the effectiveness of sedimentation alone on the suspended solids and BOD-5 content of some of these wastes. The use of coagulants will extend to some degree the wastes falling in this category because of their ability to enhance both suspended solids removal and the BOD reduction attending it.

It is therefore recommended that if the effluent remaining after clarification contains less than eight pounds of total suspended solids and five pounds of BOD-5 per ton of product, the BLT of this waste be considered to be clarification to a degree necessary to meet existing water quality standards unless unusual and extenuating circumstances as determined by engineering judgment exist.

Most of the spent process waters from pulping and bleaching operations contain appreciable BOD as is obvious from the SRWL tables. The fact that a substantial portion of this is in a soluble state is obvious from Figures #1 and #2 in Preliminary Report #II which indicate that suspended solids removal to a high degree fails to reduce the BOD substantially. It is for this reason that many mills employ biological treatment to effectively reduce the BOD remaining after clarification as do public sewage treatment systems receiving papermill wastes.

Tables presented in Preliminary Report #II and accompanying this report indicate that by use of either storage oxidation, aerated stabilization, or the activated sludge process after clarification, effective BOD reduction is achieved for the soluble fraction of most wastes.

With the exception of the treatment of strong wastes resulting from sulfite pulping and bleaching at two mills, most wastes receiving biological treatment are relatively weak. Thus, the following Table was constructed showing the BOD_5 in terms of pounds per ton and mg/l concentration before and after the degrees of biological treatment commonly practiced. In computing the BOD_5 concentration in mg/l, 20,000 gallons per ton of product was used since most single processes can be conducted with the discharge of this quantity of waste water or less.

Where BOD_5 present in a particular clarified process waste is of sufficient magnitude to require its reduction, the Base Level of Treatment can be determined from this table on the basis of engineering computations and judgment relative to the initial strength of the waste, its volume, and the water quality standards of the receiving waters involved.

It is conceivable that some bleachery wastes may not require either clarification because of a very low initial suspended solids content or need oxidation due to a similarly low BOD value. In such instances color could be their sole pollutional contribution. In this case it appears obvious that the BLT would consist of color reduction alone.

BOD$_5$ REDUCTION BY VARIOUS

DEGREES OF BIOLOGICAL TREATMENT

Percent BOD$_5$ Reduction	Initial		60		75		85		90	
BOD$_5$ Remaining	#/ton	* mg/l	#/ton	* mg/l	#/ton	* mg/l	#/ton	* mg/l	#/ton	* mg/l
* @20,000 gal. of effluent per ton of product	20	120	8.0	48	5.0	30	3.0	18	2.0	12
	30	180	12.0	72	7.5	45	4.5	27	3.0	18
	40	240	16.0	96	10.0	60	6.0	36	4.0	24
	50	300	20.0	120	12.5	75	7.5	45	5.0	30
	60	360	24.0	144	15.0	90	9.0	54	6.0	36
	70	420	28.0	168	18.5	105	10.5	63	7.0	42
	80	480	32.0	192	20.0	120	12.0	72	8.0	48
	90	540	36.0	216	22.5	135	13.5	81	9.0	54
	100	600	40.0	240	25.0	150	15.0	90	10.0	60

BEST AVAILABLE TREATMENT

Both normal clarification processes and biological treatment are unable to remove the color bodies extracted from wood by pulping and bleaching to a major degree. Most of these will pass a sub-micron filter, are biologically refractive, and difficult to coagulate. When coagulated and precipitated they form a gelatinous mass, highly hydrous and difficult to dewater. Improvements in recovery systems and modification of the bleaching processes have to date been only partially successful in alleviating the color problem. For thirty years the pulp and paper industry has conducted extensive experimentation on both in-process and treatment techniques with only limited success. The most promising treatment methods appear to be lime precipitation and activated carbon absorption and presently demonstration units employing several such processes, jointly supported by the industry and OWQ, are in operation at pulp mills.

The single full scale plant in operation removing color from the entire waste stream is at a five hundred ton per day linerboard mill in the South. Clarification and lime precipitation are combined in a single clarifier operation. The underflow from the clarifier is discharged to sludge lagoons for land disposal and the overflow is treated for further BOD reduction by storage oxidation as is water decanted from the sludge lagoons.

The first stage of treatment removes substantially all of the total suspended solids from the waste, the effluent being reported to contain less than 10 mg/l or less than 0.8 of a pound per ton of product. The influent color of from 38 to 175 pounds per ton or 460 to 2120 mg/l is reduced to between 5 and 15 pounds or 60 to 180 mg/l. BOD_5 reduction amounts to about 30 percent in this stage, reducing the initial range of values from between 25 to 35 pounds per ton to between 15 and 25 pounds per ton of product. A substantial reduction in COD is also accomplished by this process. The storage oxidation system installed is of sufficient size to allow atmospheric carbonation and precipitation of the lime saturated effluent to occur and provide a long retention period for oxidation. The BOD_5 value of the final effluent amounts to about one pound per ton of product or between 10 and 15 mg/l concentration. At this particular installation there is a rise in color due to extraction of color bodies from the swampy soil from which the oxidation basin is constructed. This is, however, a peculiar local situation.

Experiments with recarbonation of the clarifier effluent with lime kiln off-gases indicate that the effluent could be neutralized and calcium carbonate recovered by this method. If this technique were used the effluent could be oxidized by aerated stabilization or the activated sludge process.

Two installations use lime precipitation for treating caustic extraction bleachery waste. At one of these plants this waste water passes through a wet drum barking system prior to treatment. Lime precipitation is carried on in clarifiers, the underflow from which is mixed with the lime mud from the causticizing system, dewatered by vacuum filtration, and burned in the kiln, the lime used in the precipitation being thus recovered.

It is reported that a 90 percent reduction of the color of the caustic extract results from this treatment together with a substantial reduction in BOD_5. Specific performance figures will be available for the next report. Since the caustic extract generally accounts for about 80 percent of the total color discharged by a kraft mill bleaching all the pulp produced a color reduction achieved in the total effluent in the order of 70 percent would be anticipated from this treatment.

At one of these mills this treatment is followed by storage oxidation but overall results are not as yet available to the contractor.

The major limitation of lime precipitation is the cost of the lime employed and the sludge disposal problem attendant to its application. For these reasons very extensive efforts are being made by the industry and WQO to develop adequate lime recovery systems. Once these are available the third problem of effluent neutralization should be in hand. However, the lime treatment processes have other limitations. The quantity of calcium added to the effluent, particularly in treatment of bleaching wastes, could raise the hardness of a receiving stream to a considerable degree. For example, if a bleach plant employed a total of 10 percent chlorine, as much as 312 pounds of calcium chloride could be discharged per ton of pulp produced. It is unlikely that it would be this high because of reaction of part of the chlorine with organic matter and the sodium ion introduced in the extraction stage. However, it could be appreciable even if the decolorized effluent was recarbonated for calcium carbonate recovery.

Another factor is that if lime precipitation was employed on more than one effluent stream, too much water would be introduced into the recovery system raising the fuel and equipment capacity requirements to an inordinate degree. In fact, all such processes increase the quantity of water requiring evaporation due to introduction of the hydrous lime-organic fraction resulting from precipitation of color bodies into either the kiln or to the liquor system. This procedure can raise both the capital and operating costs to an intolerable degree.

It can be concluded that the BAT at present consists of a combination of processes including clarification, lime precipitation, and biological oxidation which can serve to reduce very substantially the three major pollutional constituents of pulp and papermill effluents, namely suspended solids, color, and BOD. In the case of wastes containing only one or two of these characteristics, the BLT and the BAT become synonymous. Also as the BAT becomes more effective the area of water reclamation, either for process or other uses, comes into focus.

RECOMMENDED ADDENDUM TO REPORT

It is highly recommended that the methods of sampling and analysis of these wastes which will be used in accessing treatment performance be set forth and agreed upon by the review committee. This was thought to be an absolute necessity by the state regulatory agency members of the group who will be involved in programs embracing the effluent standards that may evolve. The peculiar characteristics of these wastes are such that special sampling techniques are needed and in fact recommended by NCASI* and some of the state agencies such as Wisconsin and Washington since many devices marketed for general sewer sampling fail to produce representative samples because of the fiberous nature of the solids contained therein. While "Standard Methods"** of analysis yield satisfactory results for some constituents or characteristics of pulp and papermill wastes, others leave much to be desired, particularly those dealing with suspended matter. It would be desirable if the "Standard Methods" could include specialized techniques for these effluents. However, there has been no disposition on the part of the committees concerned with these methods to do so for 30 years. Hence this approach appears most doubtful and a specifically directed effort on the part of WQO to set forth the best available sampling and analytical methods for use in promulgating an effluent standards program appears mandatory as has been pointed out by personnel of the state agencies in reviewing Preliminary Reports #I and #II.

Since this activity was not a part of the present contract some extended provision will be necessary should the present contractor be given this assignment.

*"Procedures for Conducting Mill Effluent Surveys," NCASI Tech. Bull. #183 (1965).

**"Standard Methods for the Examination of Water and Waste Water," 12th Edition, APHA, New York (1965).

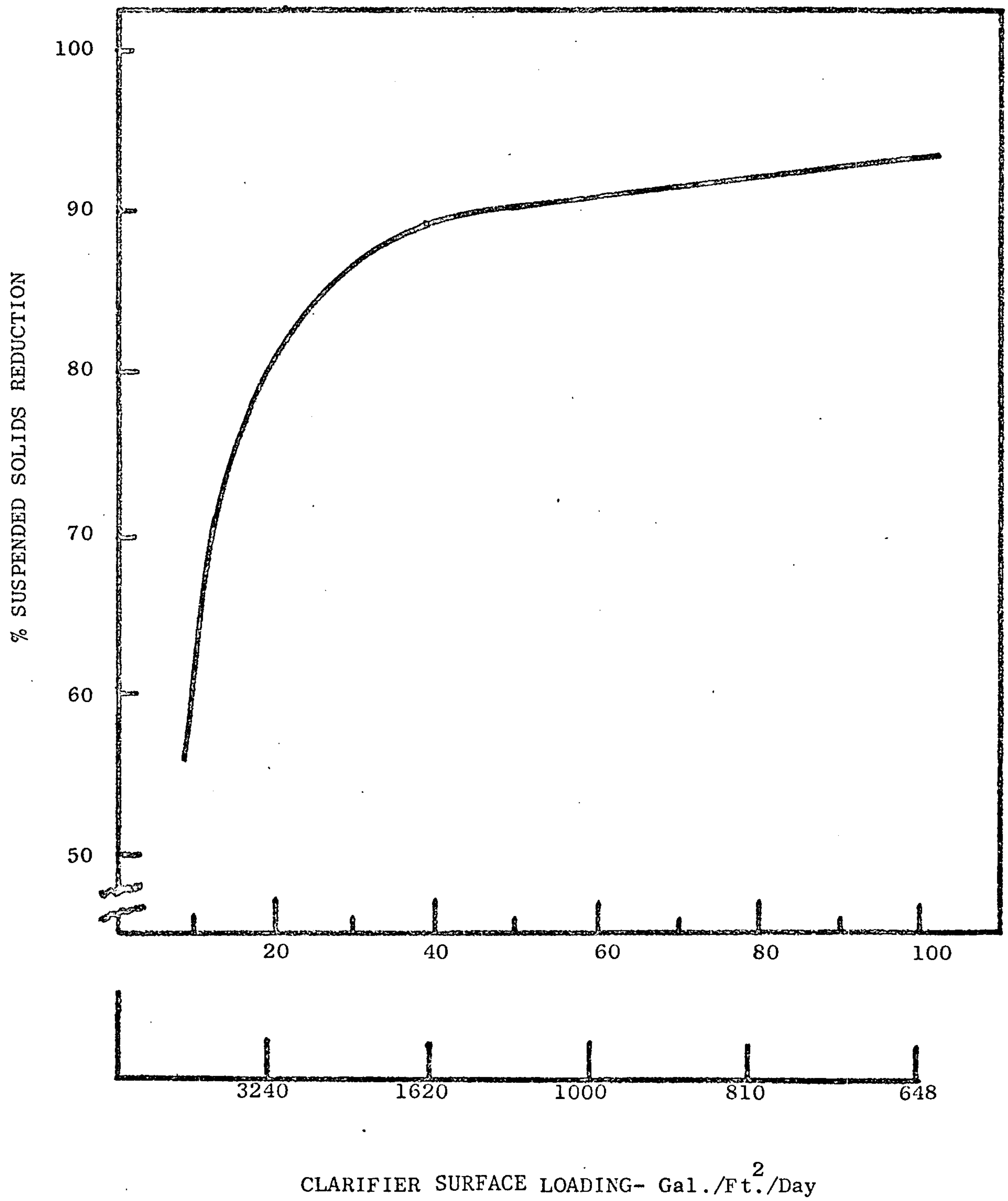
APPENDIX

FIGURE I

(Report #1)

SETTLING RATE OF

BARKER SCREENING EFFLUENT



Percent Total Suspended Solids Reduction by Settling

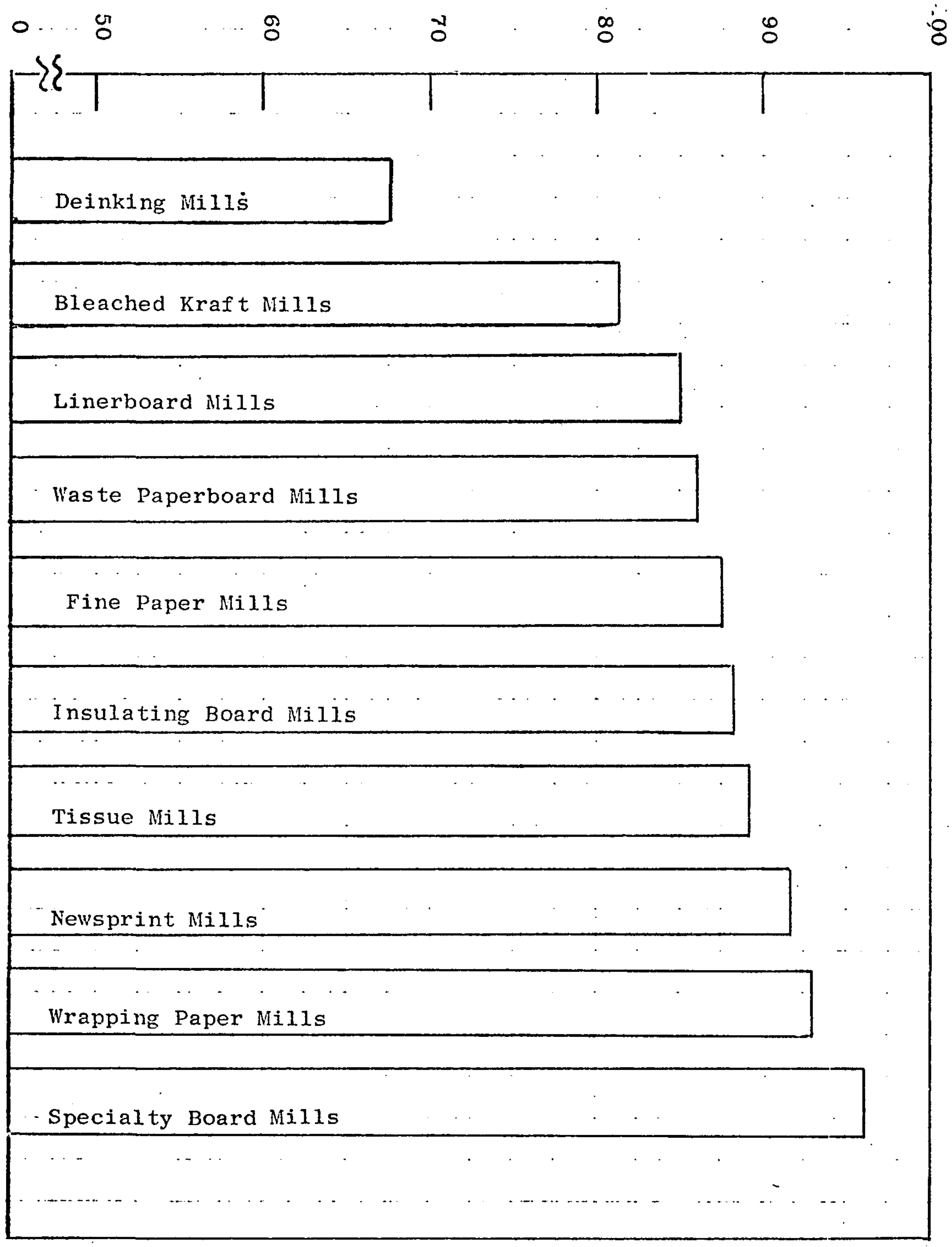


FIGURE #1

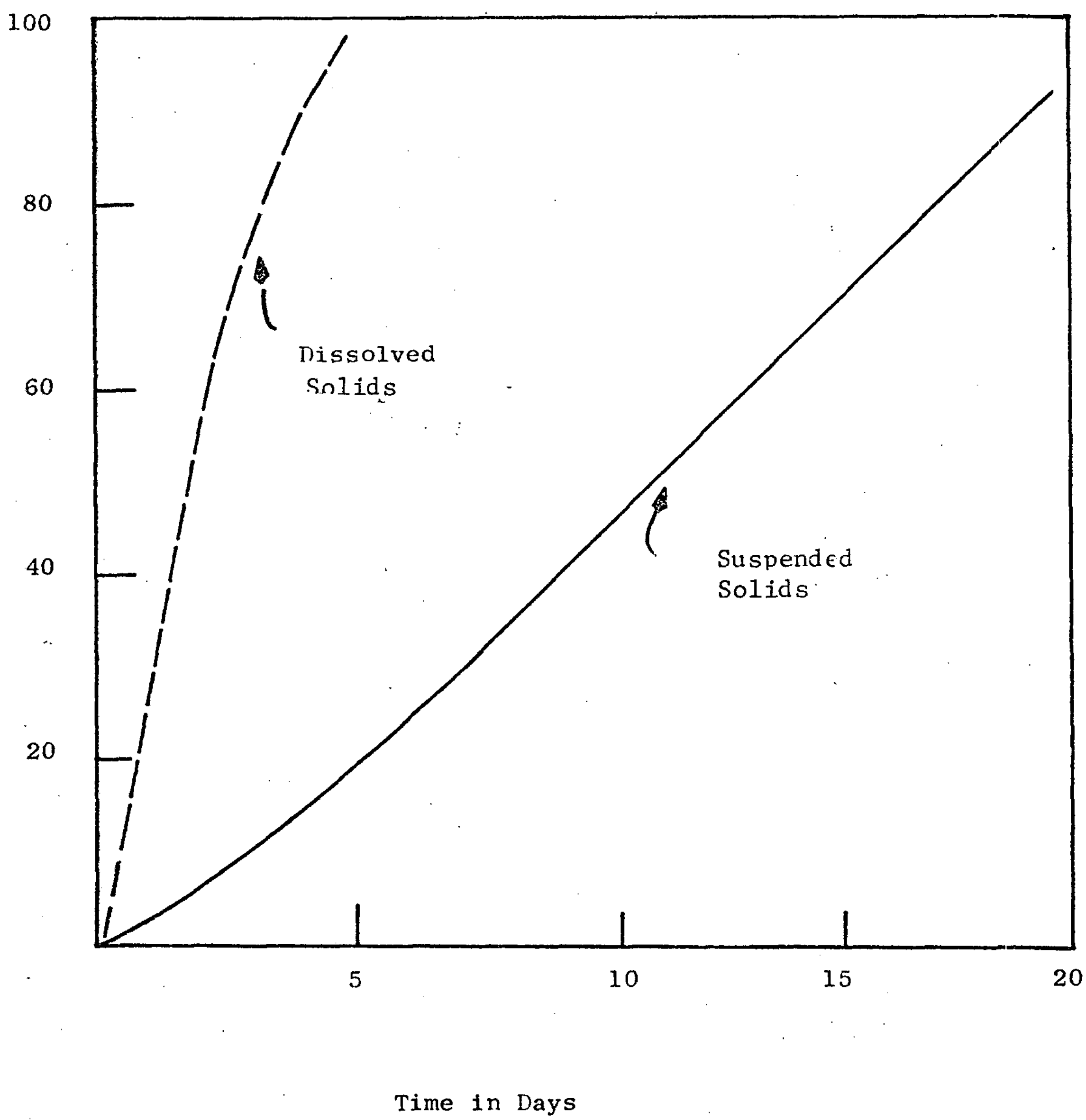
(Report #2)

Total Suspended Solids Reduction by Settling

FIGURE #2

(Report #2)

BOD Rates of Suspended
and Dissolved Organic Matter



Treatment Table Key

Internal Fiber Recovery	S-Settling DAF-Dissolved Air Floatation F-Filtration
Pretreatment	N-Neutralization K-Nutrient Addition SC-Screening E-Equalization Q-Cooling Tower
Susp. Solid Reduction	C-Mechanical Clarifier AB-Alternating Basins SB-Set in Storage Basin
Intermediate Treatment	CC.-Chem. Coagulation
BOD Reduction	T.F.-Trickling Filter H.L.-Holding Lagoon A.L.-Aerated Lagoon A.S.-Activated Sludge E.A.-Extended Aeration
Third Stage Treatment	I-Irrigation Disposal P.L.-Polishing Laggon A.-Aeration
Sludge Thickening	T.G.-Gravity Thickener T.C.-Centrifugal Thickener
Sludge Dewatering	B-Drying Beds VF.-Vacuum Filter CE-Centrifuge P-Pressing
Sludge Disposal	LF-Land Fill INC-Incineration P-Return to Process PS-To Public Sewer H-Hauled Away BP-By-Product Mfg.
Discharge Control	DIF.-Diffusser D. C. -Flow Control

TABLE VII

(Report #2)

LINERBOARD MILLS

MILL #	FIBER REC.	PRETREATMENT	SUSP. SOLIDS RED.	BOD. RED.	3RD STAGE TREATMENT	SLUDGE HANDLING			EFFLUENT FLOW MGD	BOD_5 #/ton Prod.		TSS #/ton Prod.	
						THICKENING	DEWATERING	DISPOSAL		INFLUENT	EFFLUENT	INFLUENT	EFFLUENT
1	F	K	C	AL	HL	-	-	L.F.	26	42	14	30	11
2	F	K	C	AL	-			L.F.	10	22	4	40	4
3	F	K	C	TF/ AL	-	-	CE	L.F.	19	38	10	12	6
4	F	K	C	AL	-	-	-	L.F.	3	35	11	19	20
5	F	K E	C	AL	HL	-	CE	L.F.	12	33	3	25	1
6	F	K	C	AL	-	-	P	Inc.	30	90	6	23	5
7	F	-	AB	HL	-	-	-	L.F.	15	18	5	69	7
8	F	C.C K	C	HL	A	-	-	L.F.	6	30	2	12	0.4
9	F	-	C	HL	-	-	-	L.F.	12	26	7	30	3
10	DAF	-	AB	HL	PL	-	-	L.F.	27	41	5	53	4
11	F	K	C	AL	PL	-	-	L.F.	12	27	6	55	4
12	F	K	C	AL	-	-	-	L.F.	10	101	28	139	7
13	F	K	C	AL	-	-	-	L.F.	16	33	21	-	-
14	DAF	K	C	AL	-	-	-	L.F.	9	34	2	27	3

TABLE VIII

(Report #2)

NEWSPRINT MILLS - KRAFT

MILL #	FIBER REC.	PRETREATMENT	SUSP. SOLIDS RED.	BOD. RED.	3RD STAGE TREATMENT	SLUDGE HANDLING			EFFLUENT FLOW MGD	BOD_5 #/ton Prod.		TSS #/ton Prod.	
						THICKENING	DEWATERING	DISPOSAL		INFLUENT	EFFLUENT	INFLUENT	EFFLUENT
1	DAF	K	C	AS	A	-	B	L.F.	19	24	2	60	3
2	F	K	C	AS	-	GT	V.F.	INC	13				
3	F	-	C	HL	-	-	CE	L.F.	40	39	15	122	4
4	F	-	C	HL	-	-	-	L.F.	27	44	5	71	10
5	F	-	C	AL	-	-	-	L.F.	27	56	29	80	11
6	F	-	AB	AL	PL	-	-	L.F.	25	35	15	77	6

TABLE IX

(Report #2)

INTEGRATED KRAFT MILLS

MILL #	FIBER REC.	PRETREATMENT	SUSP. SOLIDS RED.	BOD. RED.	3RD STAGE TREATMENT	SLUDGE HANDLING			EFFLUENT FLOW MGD	BOD_5 #/ton Prod.		TSS #/ton Prod.	
						THICKENING	DEWATERING	DISPOSAL		INFLUENT	EFFLUENT	INFLUENT	EFFLUENT
1	S	K	C	AS	-	-	D	LF	14.5	56	9	196	14
2	F	E/K	C	AS	AL	-	VF	LF	10.3	121	19	39	7
3	F	K/S	C	AS	-	GT	VF	LF	26.1	33	9	211	57
4	F	Q/K	C	AS	-	GT	VF	LF	25.1	73	11	158	18
5	F	K	C	AS	-	GT	VF	LF	63.0	91	10	96	17
6	F	-	AB	HL	-	-	-	LF	28.0	63	25	87	2
7	F	F/K	C	AS	-	-	-	LF	4.2	41	1	49	19
8	F	K	AB	AL	HP	-	VF	INC	40.0	39	13	49	10
9	F	K	C	AL	--	-	-	LF	3.0	35	11	189	21
10	F	K	C	AS	--	GT	VF	LF	38.0	67	9	75	27

TABLE X

(Report #2)

BLEACHED KRAFT MILLS

MILL #	FIBER REC.	PRETREATMENT	SUSP. SOLIDS RED.	BOD. RED.	3RD STAGE TREATMENT	SLUDGE HANDLING			EFFLUENT FLOW MGD	BOD_5 #/ton Prod.		TSS #/ton Prod.	
						THICKENING	DEWATERING	DISPOSAL		INFLUENT	EFFLUENT	INFLUENT	EFFLUENT
1	F	N/K	C	AL	-	-	-	LF	13.0	60	11		
2	F	K	C	AL	PL	-	-	LF	45.0	75	31	49	5
3	F	E/N K	C	AL	-	-	K	LF	13.9	38	5	71	5
4	F	K	C	AL	-	-	-	LF	34.0	78	15	-	-
5	F	K	C	AL	HP	-	-	LF	35.0	100	12	61	10
6	F	-	AB	HL	-	-	-	LF	47.0	43	0.5	111	0.6
7	F	K	C	AL	-	-	VF	LF	22.0	102	59	-	-
8	F		AB	HL	PL	-	-	LF	36.0	118	17	188	37
9	F	E/K	C	AL	PL	-	-	LF	55.0	94	24	109	17

TABLE XI

(Report #2)

ACID SULFITE PULP MILLS

MILL #	FIBER REC.	PRETREATMENT	SUSP. SOLIDS RED.	BOD. RED.	3RD STAGE TREATMENT	SLUDGE HANDLING			EFFLUENT FLOW MGD	BOD_5 #/ton Prod.		TSS #/ton Prod.	
						THICKENING	DEWATERING	DISPOSAL		INFLUENT	EFFLUENT	INFLUENT	EFFLUENT
1	DAG	KN HB	C	AS	HB	K	K	LF		235	35	-	30
2	-	K	AB	AL	-	-	-	-	4.0	160	28	Volatile 21	21

TABLE XII

(Report #2)

NSSC - Mill

MILL #	FIBER REC.	PRETREATMENT	SUSP. SOLIDS RED.	BOD. RED.	3RD STAGE TREATMENT	SLUDGE HANDLING			EFFLUENT FLOW MGD	BOD_5 #/ton Prod.		TSS #/ton Prod.	
						THICKENING	DEWATERING	DISPOSAL		INFLUENT	EFFLUENT	INFLUENT	EFFLUENT
1	F	K	Int. only	AL	-	-	-	-	0.6	125	75	45	60

TABLE XIII

(Report #2)

DEINKING - PAPERMILLS

MILL #	FIBER REC.	PRETREATMENT	SUSP. SOLIDS RED.	BOD. RED.	3RD STAGE TREATMENT	SLUDGE HANDLING			EFFLUENT FLOW MGD	BOD_5 #/ton Prod.		TSS #/ton Prod.	
						THICKENING	DEWATERING	DISPOSAL		INFLUENT	EFFLUENT	INFLUENT	EFFLUENT
1	F	K	C	AL	-	G	VF	LF	7.5	95	21	523	23
2	F	K	C	AL	-	-	-	LF	1.2	71	6	170	17
3	F	-	AB	HB	-	-	-	LF	7.0	197	36	255	26

TABLE XIV

(Report #2)

WASTE PAPERBOARD MILLS

MILL #	FIBER REC.	PRETREATMENT	SUSP. SOLIDS RED.	BOD. RED.	3RD STAGE TREATMENT	SLUDGE HANDLING: THICKENING	SLUDGE HANDLING: DEWATERING	SLUDGE HANDLING: DISPOSAL	EFFLUENT FLOW MGD	BOD_5 #/ton Prod.: INFLUENT	BOD_5 #/ton Prod.: EFFLUENT	TSS #/ton Prod.: INFLUENT	TSS #/ton Prod.: EFFLUENT
1	S	K	AB	AL	I	-	B	LF	0.7	45	4	46	2
2	F	K	C	AL	-	TC	B	LF	2.0	26	3	51	4
3	S	K	AB	AL	A	-	B	LF	2.7	23	2	81	9
4	-	K	C	AL	-	-	-	PS	2.0	30	7	87	8
5	S	K	C	AS	AS	TC	-	R H	3.3	15	0.2	7	0.5
6	-	K	C	AL	-	-	B	LF	0.3	8	1	56	3
7	-	K	AB	AL	-	-	B	LF	0.3	15	2	60	4
8	S	K	C	AS	-	-	B	LF	2.7	14	0.7	56	2
9	S	K	C	AS	-	-	B	LF	0.6	19	2	73	6

STANDARD RAW WASTE LOADS FROM PULP AND PAPER

(Figures are averages over two week period with 90% frequency)

PROCESS CATEGORY	INDIVIDUAL MANUFACTURING PROCESSES	NO. OF SAMPLES	EFFLUENT FLOW 1000 gals. per ton product RANGE		EFFLUENT FLOW TYPICAL	BOD_5 Pounds per ton product RANGE		BOD_5 TYPICAL	TOTAL SUSPENDED SOLIDS pounds per ton product RANGE		TSS TYPICAL	COLOR (Mg/1) TYPICAL	pH RANGE	POSSIBLE HEAVY METALS	AQUATIC TOXICITY	MAJOR POLLUTIONAL CHARACTERISTICS
I	WOOD PREPARATION		(Barking Wastes Pre-treated)													
I-A	Hydraulic Barking	4	0.3	0.5	0.5	0.22	1.20	0.60	1.1	2.2	2	<50	Neutral	None	No	Suspended & dissolved organic matte
I-B	Drum Barking *	3	0.2	0.4	0.3	5	15	10	2.5	3.5	3	<50	Neutral	None	No	Suspended & dissolved organic matte
I-C	Wood Washing	5	0.1	0.2	0.1	0.1	0.3	0.2	3	8	4	<50	Neutral	None	No	Suspended & dissolved organic matte
I-D	Cold Decking	-	-	-	-	7 per acre per day			-	-	-	-	Neutral	None	No	Suspended & dissolved organic matte
II	GROUNDWOOD PULP															
II-A	Stone Groundwood	8	2	8	5	4	18	15	11	42	30	<50	Neutral	Zn	No	Suspended & dissolved organic matt
II-B	Refiner Groundwood	8	2	8	5	4	18	15	11	42	30	<50	Neutral	Zn	No	Suspended & dissolved organic matt
II-C	Cold Soda & Chemi-Groundwood	3	2	6	3	78	101	100	15	52	40		8-9	None	No	Suspended & dissolved organic matt
II-D	Bleached Groundwood	2	No Additional Water Added			31	48	41	20	40	30		Neutral	Zn	Yes	Suspended & dissolved organic matt zinc when used
III	NEUTRAL SULFITE SEMI-CHEMICAL															
III-A	No Recovery	6	5	20	15	110	510	Depends on Yield	60	110	80		Neutral	None	Yes	Color & potential aquatic toxicity
III-B	With Recovery	13	2	26	10	27	150	75	8	100	60		Neutral	None	No	Suspended & dissolved organic matt
IV	KRAFT AND SODA PULPING	35	16	36	25	20	59	50	11	85	50	1200	9-10	Cr,Ni	Yes	Color & potential aquatic toxicity

*Fresh water - no recycle

PROCESS CATEGORY	INDIVIDUAL MANUFACTURING PROCESSES	NO. OF SAMPLES	EFFLUENT FLOW 1000 gals. per ton product			BOD_5 Pounds per ton product			TOTAL SUSPENDED SOLIDS Pounds per ton product			COLOR (Mg/1)	pH RANGE	POSSIBLE HEAVY METALS	AQUATIC TOXICITY	MAJOR POLLUTIONAL CHARACTERISTICS
			RANGE		TYPICAL	RANGE		TYPICAL	RANGE		TYPICAL	TYPICAL				
	PRE-HYDROLYSIS															
-A	Softwood	3	1	2	2	60	120	120	10	20	15		Neutral	None	Yes	Suspended & dissolved organic matte
-B	Hardwood	.1	0.3	-	0.3	180	200	200	Neg.	-	-	High	Neutral	None	No	Dissolved organic matter
I	KRAFT BLEACHING															
I-A	Semi-Bleach	4	18	30	25	34	48	48	10	30	20	3000	3-4	Cr, Ni, Hg	Yes	Suspended & dissolved organic matte color, & potential aquatic toxicity
I-B	High Bleach	4	18	36	25	54	148	100	10	30	20	6000	2-3	Cr, Ni, Hg	Yes	Suspended & dissolved organic matte color, & potential aquatic toxicity
I-C	Dissolving Grades(Soft Wood)	2	44	70	50	100	150	150	123	150	150		3-4	Cr, Ni, Hg	Yes	Suspended & dissolved organic matte color, & potential aquatic toxicity
I-D	Dissolving Grades(Hard Wood)	2	44	70	50	500	700	600	180	210	150		3-4	Cr, Ni Hg	Yes	Suspended & dissolved organic matte color, & potential aquatic toxicity
II	ACID SULFITE PULPING															
II-A	No Recovery	5	60	100	70	600	950	850	30	60	50		2-3	Pb	Yes	Suspended & dissolved organic matt color, aquatic toxicity, & nutrie
II-B	MgO Base Recovery	1	9	9	9	185	230	200			40		2-3	Pb, Cr, Ni	Yes	Suspended & dissolved organic matt color, aquatic toxicity, & nutrien
II-C	NH_3 Recovery	2	4	10	8	146	233	200	40	60	50		2-3	Pb, Ni, Cr	Yes	Suspended & dissolved organic matte color, aquatic toxicity, & nutrien
III	SULFITE PULP BLEACHING															
III-A	Paper Grade	3	12	23	20	15	18	17	5	12	10		2-3	Cr, Ni, Hg	No	Suspended & dissolved organic matte
III-B	Dissolving Grade	1				200	450	450					1-3	Cr, Ni, Hg	?	Color

PROCESS	PROCESSES	NO. OF	EFFLUENT FLOW 1000 gals. per ton product RANGE		EFFLUENT FLOW TYPICAL	BOD_5 Pounds per ton product RANGE		BOD_5 TYPICAL	TOTAL SUSPENDED SOLIDS Pounds per ton product RANGE		TSS TYPICAL	COLOR (Mg/1) TYPICAL	pH RANGE	POSSIBLE HEAVY METALS	AQUATIC TOXICITY	MAJOR POLLUTIONAL CHARACTERISTICS
IX	DEINKING PULP															
IX-A	Magazine & Ledger & Decoating	10	15	65	28	75	120	90	390	600	600		Neutral	*	No	Suspended & dissolved inorganic & organic matter
IX-B	News	1			28			40			110		Neutral	None	No	Suspended & dissolved inorganic & organic matter
X	PAPER MAKING															
X-A	Coarse Paper	5	2	12	10	3	10	10	3	15	10		Neutral	None	No	Suspended & dissolved inorganic & organic matter
X-B	Fine Paper	13	7	71	30	30	97	40	18	442	200		Neutral	None	No	Suspended & dissolved inorganic & organic matter
X-C	Book Paper	7	5	18	10	4	29	15	22	95	30		Neutral	None	No	Suspended & dissolved inorganic & organic matter
X-D	Tissue Paper	20	10	62	30	10	96	35	22	82	40		Neutral	None	No	Suspended & dissolved inorganic & organic matter
X-E	Specialties	(see text for comments)														
I	WASTE PAPERBOARD	34	3	22	10	10	75	35	8	123	40	< 100	Neutral	None	No	Suspended & dissolved inorganic & organic matter
XII	BUILDING PRODUCTS															
XII-A.	Building Papers	5	2	12	10	3	10	10	3	15	10		Neutral	None	No	Suspended & dissolved inorganic & organic matter
XII-B	Felts	8	1	13	3	17	89	75	26	71	50		Neutral	None	Yes	Suspended & dissolved inorganic & organic matter **
XII-C	Insulating Board	9	2	28	15	55	213	100	24	443	250	< 100	Neutral	None	Yes	Suspended & dissolved inorganic & organic matter **
XII-D	Hardboard	12	1	20	13	30	205	180	22	98	60		Neutral	None	Yes	Suspended & dissolved inorganic & organic matter **
III-E	Exploded	1						255			55		Neutral	None	No	Suspended & dissolved organic matter

*Possibly from inks

**Aquatic toxicity may result from additive