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Environmental Impact Assessment Guidelines

For New Source Pulp and Paper Mills

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ENVIRONMENTAL IMPACT

ASSESSMENT GUIDELINES

for New Source Pulp and Paper Mills

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Preface

This document is one of a series of industry specific Environmental Impact Assessment Guidelines being developed by the Office of Environmental Review for use in EPA's Environmental Impact Statement preparation program on New Source NPDES permits. It is intended to be used in conjunction with Environmental Impact Assessment Guidelines for Selected New Source Industries, on OER publication that includes a description of impacts common to most industrial new sources.

The requirement for federal agencies to assess the environmental impacts of their proposed actions is included in Section 102 of the National Environmental Policy Act of 1969 (NEPA), as amended. The stipulation that EPA's issuance of a New Source NPDES permit is an action subject to NEPA is in Section 511(c)(1) of the Clean Water Act of 1977. EPA's regulations for preparation of Environmental Impact Statements are in Part 6 of Title 40 of the Code of Federal Regulations, NEPA procedures for the New Source NPDES Program are described in Subpart F of Part 6.

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INTRODUCTION

The Clean Water Act requires that EPA establish standards of performance for categories of new source industrial wastewater dischargers. Before the discharge of any pollutant to the navigable waters of the United States from a new source in an industrial category for which performance standards have been proposed, a new source National Pollutant Discharge Elimination System (NPDES) permit must be obtained from either EPA or the State (whichever is the administering authority for the State in which the discharge is proposed). The Clean Water Act also requires that the issuance of a permit by EPA for a new source discharge be subject to the National Environmental Policy Act (NEPA), which may require preparation of an Environmental Impact Statement (EIS) on the new sources. The procedure established by EPA regulations (40 CFR 6 Subpart F) for applying NEPA to the issuance of new source NPDES permits may require preparation of an Environmental Information Document (EID) by the permit applicant. Each EID is submitted to EPA and reviewed to determine if there are potentially significant effects on the quality of the human environment resulting from construction and operation of the new source. If there are, EPA publishes an EIS on the action of issuing the permit.

The purpose of these guidelines is to provide industry specific guidance to EPA personnel responsible for determining the scope and content of EID's and for reviewing them after submission to EPA. It is to serve as supplementary information to EPA's previously published document, Environmental Impact Assessment Guidelines for Selected New Source Industries, which include the general format for an EID and those impact assessment considerations common to all or most industries. Both that document and these guidelines should be used for development of an EID for a new source pulp and paper mill.

These guidelines provide the reader with an indication of the nature of the potential impacts on the environment and the surrounding region from construction and operation of pulp and paper mills. In this capacity, the volume is intended to assist EPA personnel in the identification of those impact areas that should be addressed in an EID. In addition, the guidelines present (in Chapter I) a description of the industry, its principal processes, environmental problems, and recent trends in location, raw materials, processes, pollution control and demand for industry output. This "Overview of the Industry" is included to familiarize EPA staff with existing conditions in the pulp and paper industry.

Although this document may be transmitted to an applicant for information purposes, it should not be construed as representing the procedural requirements for obtaining an NPDES permit or as representing the applicant's total responsibilities relating to the new source EIS program. In addition, the content of an EID for a specific new source application is determined by EPA in accordance with Section 6.604 of the Code of Federal Regulations and this document does not supersede any directive received by the applicant from EPA's official responsible for implementing that regulation.

These guidelines are divided into six sections. Section I is the "Overview of the industry," described above. Section II, "Impact Identification," discusses process-related wastes and the impacts that may occur during construction and operation of the facility. Section III, "Pollution Control," describes the technology for contolling environmental impacts. Section IV discusses other impacts that can be mitigated through design considerations and proper site and facility planning. Section V, "Evaluation of Alternatives," discusses the consideration and impact assessment of possible alternatives to the proposed action. Section VI describes regulations other than pollution control that apply to the industry.

I. OVERVIEW OF THE INDUSTRY

The importance of the pulp and paper industry in the NPDES permit program is illustrated by its third-rank position among U.S. manufacturers in quantity of wastewater discharged. This industry is water-dependent, and will remain so for the foreseeable future, in that wood or any other cellulose fiber source is pulped in the presence of water and remains waterborne throughout the process until the paper sheet has been formed.

Today, wood accounts for over 98% of the virgin fiber used, and such materials as cotton linters, rags, and flax constitute the small remainder. The term "virgin" fiber is used to indicate pulp that has not been used previously. Approximately 20% of the paper and paperboard produced in this country, however, is also reused as recycled fiber.

The wood pulping process separates the fiber from other constituents of wood and fiberizes it. In some pulping methods, these steps are accomplished by cooking the wood with chemicals and water under controlled conditions of heat and pressure. In others, a purely mechanical action is used, and some technologies employ a combination of both. The repulping of waste paper is a hydraulic and mechanical process in which deinking may or may not be employed.

Many pulps, which are naturally brown in color due to the lignin content of wood, are bleached in one or more stages to provide fiber for light colored or white papers. Chlorine, chlorine dioxide, and hypochlorites are among the bleaching agents used. Bleaching is also an integral part of the process for making dissolving pulps that consist of alpha cellulose and are used in rayon, cellophane, and explosives.

There are three general categories of mills:

- Market pulp mills are mills that produce pulp only, which is shipped for use to another site, and do not engage in papermaking.

- Nonintegrated paper mills are mills that receive pulp from other sources and engage solely in papermaking. Traditionally, these mills have been subdivided according to the general nature of their major product; that is, they are called fine, coarse, tissue, and newsprint mills.

- Integrated mills are mills that manufacture both pulp and paper; these mills are usually referred to by the predominant pulping process used. Some mills are complex in that they use more than one pulping technology and manufacture a broad range of paper grades. A mill of this kind is designated by the process that accounts for its greatest pulping capacity; for example, a mill is known as a kraft mill if the kraft process accounts for the majority of its pulp production.

These categories were found to be inadequate, however, for use in establishing effluent limitations guidelines, new source performance standards

(NSPS), and pretreatment standards pursuant to the Federal Water Pollution Control Act, now commonly referred to as the Clean Water Act (Public Laws 92-500 and 95-217). Variations in production processes and raw materials used within these categories result in significant differences in wastewater characteristics, treatability, and available treatment technologies. Therefore, much narrower discrete subcategories were defined that do not conform to Standard Industrial Classifications (SIC) 2611, Pulp Mills; 2621, Paper Mills, except building paper; and 2631, Paperboard.

I.A. SUBCATEGORIZATION

The subcategories of the pulp, paper, and paperboard industry are established in 40 CFR, Part 430. The order in which they are presented there departs from the normal step-by-step progression from mechanical pulping to semichemical to chemical. To facilitate reference to the regulations, however, the same order is maintained here. The subcategories may be described as follows:

1. Unbleached kraft mills use a "full cook" process to produce kraft pulp, using a highly alkaline cooking liquor containing sodium hydroxide and sodium sulfide. This basic kraft process is common to all kraft subcategories. In this subcategory of mills, the pulp is not bleached and is used to manufacture the typical unbleached kraft products, which include linerboard (the smooth facing of corrugated boxes), wrapping paper, and paper for grocery bags and shipping sacks.

2. Neutral sulfite semichemical (NSSC) sodium base mills use a sodium base neutral sulfite semichemical process to make unbleached pulp and paper products, principally corrugated medium, the inner layer of the corrugated box "sandwich."

3. NSSC ammonia base mills are the same as those in Subcategory 2, except that ammonia is used as the cooking liquor base. Ammonia cannot be recovered for reuse and it imparts different characteristics to the wastewater.

4. NSSC/unbleached kraft mills with cross recovery are combined mills in which spent sodium base NSSC liquor is recovered in the kraft mill recovery system. This process is desirable because:

   - Recovery of sodium in NSSC liquor alone is difficult
   - Recovery of the NSSC liquor provides sodium sulfate, a make-up chemical for the kraft process
   - Both components of the corrugated product are manufactured on the same site
   - Hardwood species present to some degree in softwood timber stands can be harvested and used by the NSSC process

5. Waste paperboard mills are those in which waste paper is repulped and accounts for at least 80% of the fiber used primarily to produce unbleached folding board products such as soap cartons and bottle carriers. No deinking is practiced in connection with paperboard production, but the product is frequently upgraded with an asphalt dispersion process.

6. Bleached kraft: dissolving pulp mills produce pulp by a "full cook" process, utilizing a highly alkaline sodium hydroxide and sodium sulfide cooking liquor. Included in the manufacturing process is a "pre-cook" operation termed pre-hydrolysis. The pulp is subsequently highly bleached and purified to make dissolving pulp, used principally for the manufacture of rayon and other products requiring the virtual absence of lignin and a very high alpha cellulose content.

7. Bleached kraft: market pulp mills produce pulp by a "full-cook" process utilizing a highly alkaline sodium hydroxide and sodium sulfide cooking liquor which is subsequently bleached. The product is called papergrade market pulp.

8. Bleached kraft: paperboard, coarse, tissue (BCT) papers subcategory includes the integrated production of bleached kraft pulp and paper. Integrated production is considered to be pulp and paper manufacturing operations where all or part of the manufactured pulp is processed into paper at common or adjacent sites. The kraft pulp is produced in a "full cook" process utilizing a highly alkaline sodium hydroxide and sodium sulfide cooking liquor which is subsequently bleached. The principal products include paperboard (B), coarse papers (C), tissue papers (T), and market pulp.

9. Bleached kraft: fine papers subcategory includes the integrated production of bleached kraft pulp and paper. Integrated production is considered to be pulp and paper manufacturing operations where all or part of the manufactured pulp is processed into paper at common or adjacent sites. The kraft pulp is produced in a "full cook" process utilizing a highly alkaline sodium hydroxide and sodium sulfide cooking liquor which is subsequently bleached. The principal products are fine papers which include business, writing, printing papers, and market pulp.

10. Papergrade sulfite: blow pit washing subcategory includes integrated production of sulfite pulp and paper. The sulfite pulp is produced in a "full cook" process using an acidic cooking liquor of sulfites of calcium, magnesium, ammonia, or sodium. Following the cooking operations, the spent cooking liquor is separated from the pulp in blow pits. The

principal products made by this process are tissue papers, newsprint, fine papers, and market pulp.

11. Dissolving grade sulfite pulp subcategory includes mills which produce pulp from softwoods by a "full cook" process using strong solutions of sulfites of calcium, magnesium, ammonia, or sodium. The pulp is subsequently highly bleached and purified to produce viscose, nitration, cellophane, or acetate grades which are used principally for the manufacture of rayon and other products that require the virtual absence of lignin.

12. Groundwood: Chemi-mechanical (CMP) subcategory includes the integrated production of chemi-mechanical groundwood pulp and paper. The chemi-mechanical groundwood pulp is produced utilizing a chemical cooking liquor to partially cook the wood followed by mechanical defibration by refining with or without brightening, resulting in yields of 90% or greater. The principal products include fine papers, newsprint, and molded fiber products.

13. Groundwood: thermo-mechanical (TMP) subcategory includes the production of thermo-mechanical groundwood pulp and paper. Thermo-mechanical groundwood is produced by a brief cook utilizing steam, with or without the addition of cooking chemicals such as sodium sulfite, followed by mechanical defibration by refiners which are frequently under pressure, with or without brightening, and resulting in yields of approximately 95% or greater. The principal products of this process are market pulp, fine papers, newsprint, and tissue papers.

14. Groundwood: coarse, molded, news (CMN) papers subcategory includes the integrated production of groundwood pulp and paper. The groundwood pulp is produced, with or without brightening, utilizing mechanical defibration only, employing either stone grinders or refiners. The principal products made by this process include coarse papers (C), molded fiber products (M), and newsprint (N).

15. Groundwood: fine papers subcategory includes the integrated production of groundwood pulp and paper. The groundwood pulp is produced, with or without brightening, utilizing mechanical defibration only, employing either stone grinders or refiners. The principal products are fine papers which include business, writing, and printing papers.

16. Soda subcategory includes the integrated production of bleached soda pulp and paper. Soda pulp is produced by a "full-cook" process utilizing a highly alkaline sodium hydroxide cooking liquor and is subsequently bleached. The principal products are fine papers which include printing, writing, and business papers.

17. Deink subcategory includes the integrated production of deinked pulp and paper. The deinked pulp is produced by applying an alkaline treatment to waste paper to remove contaminants such as ink and coating pigments. The pulp is usually bleached or brightened to produce such products as printing, writing, and business papers, tissue papers, and newsprint.

18. Non-integrated (NI) fine papers subcategory includes non-integrated (NI) mills which produce fine papers from wood pulp or deinked pulp prepared at another site. The principal products of this process are printing, writing, business, and technical papers.

19. Non-integrated tissue papers subcategory includes non-integrated (NI) mills which produce tissue papers from wood pulp or deinked pulp prepared at another site. The principal products of this process include facial and toilet papers, glassine, paper diapers, and paper towels.

20. Non-integrated tissue from waste paper (FWP) subcategory includes non-integrated (NI) mills which produce tissue papers from waste papers (FWP) without deinking. The principal products made by this process include facial and toilet papers, glassine, paper diapers, and paper towels.

21. Papergrade sulfite: drum washing subcategory includes the integrated production of sulfite pulp and paper. The sulfite pulp is produced in a "full cook" process using an acidic cooking liquor of sulfites of calcium, magnesium, ammonia, or sodium. Following the cooking operations, the spent cooking liquor is washed from the pulp on vacuum or pressure drums. Also included are mills using belt extraction systems for pulp washing. The principal products made from pulp manufacturing by this process are tissue papers, fine papers, newsprint, and market pulp.

The subcategories are itemized carefully because subcategorization of the pulp and paper industry is an overriding consideration in an applicant's initial determination of whether a proposed new mill or significant modification to an existing mill can be defined as a new source. Subcategorization is emphasized because, as of this writing, NSPS have been promulgated for Subcategories 1-5, but have only been proposed for Subcategories 6-21. In addition, there are segments of the industry which have not yet been subcategorized for purposes of effluent limitations guidelines or NSPS.

By definition (Section 306(a)(2) of Public Law 92-500), a new source is one on which construction begins after applicable NSPS are proposed. In turn, Section 511(c)(1) of Public Law 92-500 authorizes application of the National Environmental Policy Act to the National Pollutant Discharge Elimination System permits for new sources so defined.

Although the New Source Performance Standards for Subcategories 6-21 of this industry were proposed on 19 February 1976, they had not been promulgated as of the writing of these guidelines. In a decision issued on 28 August 1978, EPA's Office of General Counsel ruled that an NPDES application in a subcategory for which NSPS have been proposed but not promulgated is considered a new source only if the NSPS are promulgated within 120 days of proposal. Therefore, the issuance of a permit for a discharge in Subcategories 6-21 will not be subject to NEPA until the NSPS for these subcategories are promulgated. According to a Settlement Agreement between EPA and the Natural Resources Defense Council, the NSPS for pulp and paper mills are scheduled to be promulgated by 30 September 1980.

New mills or expansions in the segments of the industry that have not been subcategorized for the application of NSPS are not covered by the above definition of a new source and cannot be so characterized. Thus, their permits do not require an environmental impact assessment or statement. These include:

- Nonintegrated mills that make a wide variety of so-called specialty products such as industrial papers and electrical insulating board

- Mills that pulp materials other than wood or waste paper (cotton linters, flax, etc.), or use market pulp made from such materials, to make very fine papers such as cigarette tissue and currency, Bible, and legal stock

Thus, the situation existing when this appendix was prepared requires that parties concerned with NPDES permits for discharges by new sources in the pulp and paper industry ascertain:

- The precise type of facility proposed

- The current status of new source performance standards applicable to such a mill

I.B. MAJOR PROCESSES

While applicants will find the subcategory definitions cited above useful in determining the applicability of the separate NSPS and pretreatment standards, a more detailed discussion of the major processes and subprocesses utilized by the industry is presented here to support the characterization of its process-oriented wastes and their impacts in Section II-A.

I.B.1 Wood Preparation

Wood is received at the mills in several forms requiring a variety of handling techniques. Saw mill scraps or barked logs can be chipped directly, a process which utilizes minimal quantities of water. Some mills still receive unbarked roundwood in short lengths, however, and the bark must be removed before pulping.

Logs are stored in piles that are water sprayed occasionally to prevent deterioration and maintain uniform water content, or are stored in water. The former practice is more prevalent because of its lower cost, and because wood solubles, silt, and bark debris collect in the storage water, increasing with reuse. Logs also are frequently shower washed before barking to remove silt.

Most of the pulpwood used in this country is small in diameter and is barked dry in drums. However, when large diameter logs are used, wet barking is practiced, using either drums, pocket barkers, or hydraulic barkers.

I.B.2. Pulping

As suggested by the subcategories, the pulping processes fall into three major categories:

- Mechanical
- Semichemical
- Chemical

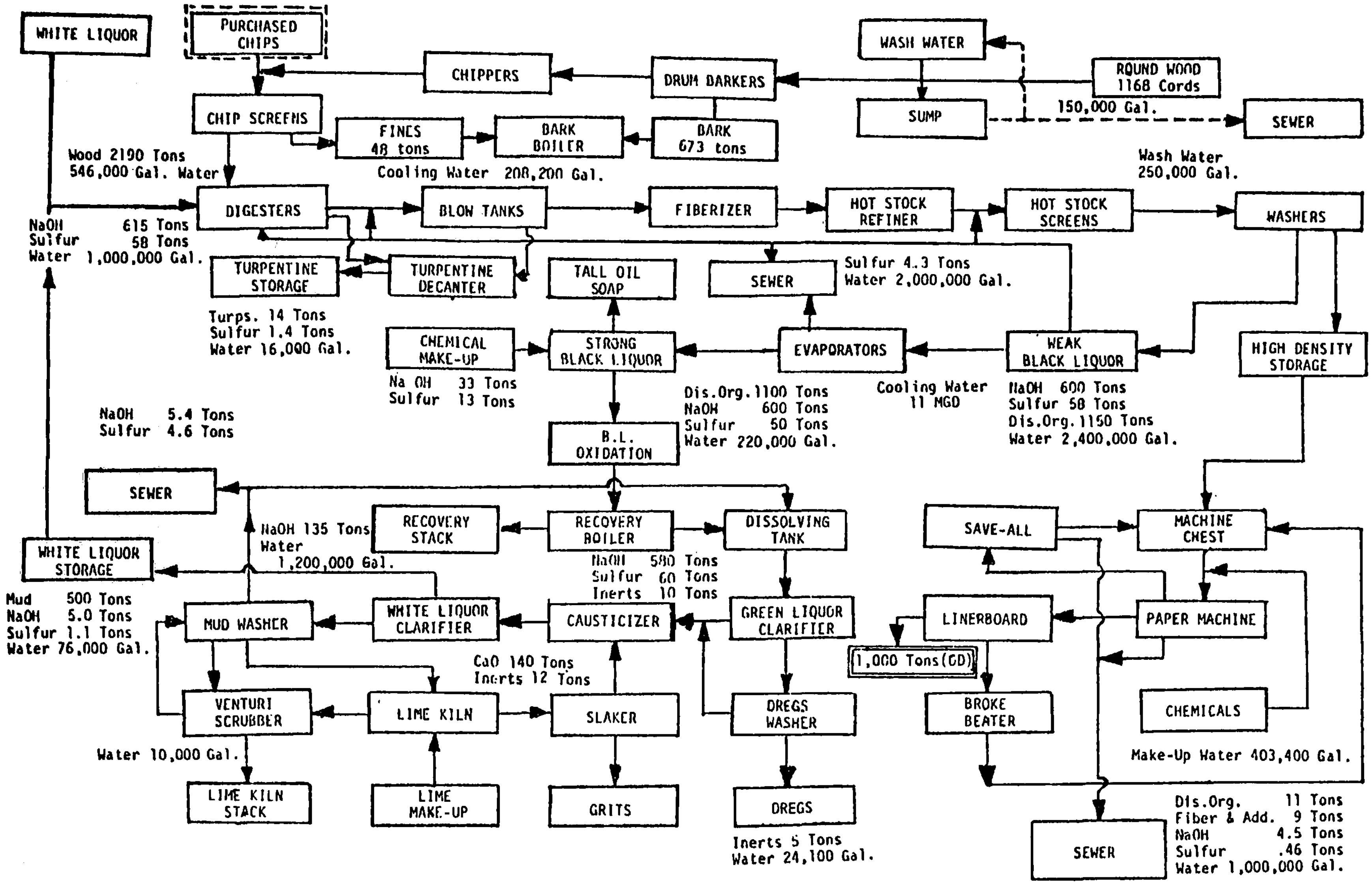
There is some overlap among the processes in that some mechanical pulping processes involve a mild chemical treatment ahead of pulping by attrition, and the chemical application in semichemical pulping is essentially a cooking process, although milder than that of full chemical pulping.

The users of this appendix are referred to two primary sources (EPA, 1974; 1976b) that describe all pulping applications and provide many references to more specialized publications.

I.B.2.a. Kraft Pulping. Because about 80% of the chemical pulp produced in the United States is manufactured by the kraft process, this process is described in detail to illustrate the major elements of chemical pulping. The interrelationship of the various steps involved is shown in Figure 1.

In kraft pulping:

- Wood chips are cooked either in batch or in continuous digesters with a mixture of caustic soda and sodium sulfide.
- When cooking is completed, the chips are "blown" into a tank; this action separates them into fibers.
- Subsequently, the spent cooking liquor is separated from the pulp by countercurrent washing. The separated spent cooking liquor, known as weak black liquor, has a consistency ranging from 12 to 20% solids and is collected in tanks for recovery.



Source: US Environmental Protection Agency. 1976a. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, deinked and non-integrated paper mills of the pulp, paper, and paperboard mills point source category. EPA 440/1-76/047-b, Dec.

Figure 1. Process flow and materials diagram for a 1,000-ton/day kraft linerboard mill

- An appropriate mixture of pulps is prepared in a beater to which needed filler, dyes, and sizing are added to impart the qualities required for various paper grades.

- After beating, the pulp is usually refined in a jordan, which cuts the fibers to the final size desired and adjusts them to the proper uniform consistency.

- Finally, the pulp is evenly distributed from a headbox over a traveling belt of fine wire screening, known as a fourdrinier paper machine, where the sheet is formed. It is then carried to rolls and a series of dryers. Most of the water in the pulp passes through the screen and is referred to as white water. This water is typically reclaimed to recover the fiber and reuse the water.

In the chemical recovery system:

- Weak black liquor is concentrated to about 40 to 45% solids in long-tube multiple-effect evaporators and is then known as strong black liquor. In the case of fatty woods, tall oil soap is skimmed from the tanks holding this strong black liquor before oxidation (if oxidation is practiced). The liquor is then concentrated further, and the skimmings sold as soap or first acidified to produce tall oil itself. Spent acid from the latter procedure consists mainly of a solution of sodium sulfate and is returned to the recovery system as chemical make-up.

- Strong black liquor is concentrated further to a consistency of 65 to 70% in a recovery furnace stack evaporator or in a concentrator, after which make-up chemicals in the form of new or recovered sodium sulfate or a residue high in content of this salt is added. The heavy liquor is then burned, and the heat is recovered in a specially designed boiler.

- During burning, the organic sodium compounds are converted to soda ash and sulfates to sulfides. The molten smelt of salts is dissolved in water to form green liquor, which is clarified by sedimentation and causticized with lime to convert the soda ash to caustic soda.

- After causticizing, the combined sodium sulfide-caustic soda solution is known as white liquor. This liquor is settled and sometimes filtered through pressure filters, adjusted to the desired strength or concentration for cooking with weak black liquor, and stored for subsequent use.

- The calcium carbonate created by the causticizing reaction is settled out, dewatered, and burned in a lime kiln to form quick lime. This is returned for hydration with the green liquor to complete the chemical recovery (NCASI, 1973).

- Washed pulp is refined to remove knots and other nondisintegrated material, bleached in some mills, and subsequently dried and delivered to the paper mill.

- Relief condensate from the digesters is condensed, and the turpentine recovered from it by decantation is sold.

I.B.2.b. Sulfite Pulping. The sulfite process is illustrated in Figure 2. Although this process is used to make two distinctly different types of pulp --papermaking and dissolving--the basic process is the same for both, although higher cooking temperatures and a stronger cooking liquor are utilized in the dissolving process. Cooking is continued until most of the lignin and part of the cellulose are dissolved; in papermaking pulps only the lignin is dissolved. The spent liquor from dissolving thus has a higher solids content.

There is another distinction in sulfite mills between blow pit washing and vacuum drum washing. With the latter it is possible to recover 95% of the liquor solids, but the limit is about 85% with displacement washing in blow pits.

I.B.2.c. Neutral Sulfite Semichemical Pulping. This process, as its name implies, incorporates some of the characteristics of both mechanical and chemical pulping. It is described as "neutral sulfite" since, by comparison with the acidic basic sulfite process, the liquor utilized is neutral or slightly alkaline--pH 7-9.

The cooking liquor is commonly prepared by burning sulfur to sulfur dioxide and absorbing the latter in soda ash or ammonia. The major reasons for selecting sodium as the base are:

- The use of this base is a well proven technology.

- It provides high quality products and high yields.

- It can utilize a wide variety of hardwoods.

- It can also utilize softwoods, including sawdust and other wastes.

- It does not involve handling gases other than SO_2, to which the industry is accustomed.

- Air and water pollution problems are minimized since the sodium base can be recovered.

- The use of sodium permits integration with a kraft mill and, thus, a cross recovery system (Worster, 1973).

The major reasons for selecting ammonia as the base are:

- Although pulp of similar quality and yield to that of sodium base NSSC can be achieved with an ammonia base,

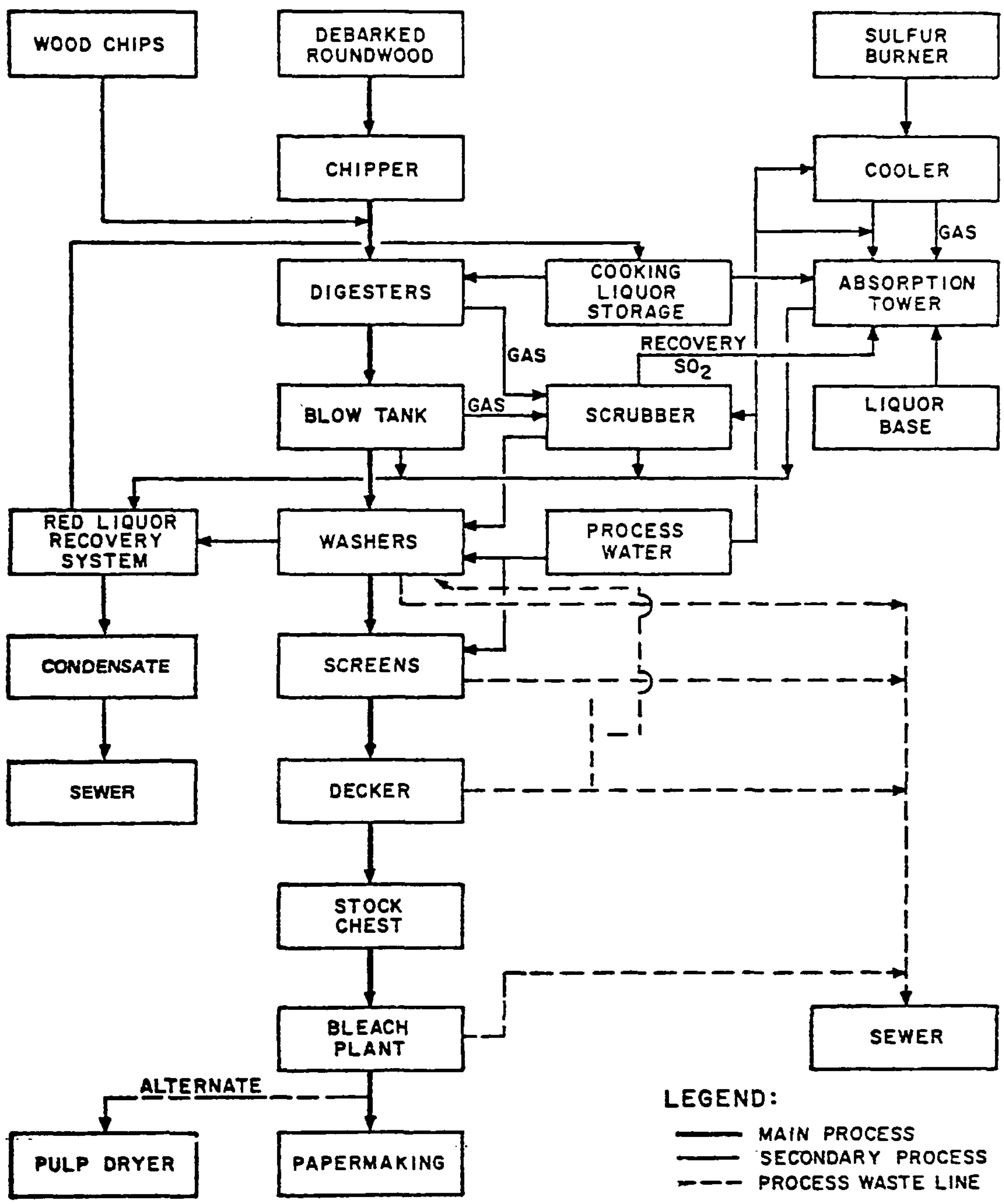


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Figure 2. Process flow diagram for a typical sulfite pulp mill

ammonia is relatively cheap and is readily available in many areas.

- The spent liquor is more readily combustible than sodium base liquor.

- It can be incinerated to a nearly ash-free product (Worster, 1972).

In this process, chips, as shown in Figure 3, are impregnated with cooking liquor, subjected to a short cook, and mechanically fiberized.

The pulp then undergoes vacuum or pressure washing, screening, and/or centrifugal cleaning. In some mills, the relief and blow gas condensate is used in pulp washing.

A small percentage of repulped waste paper is added to the NSSC furnish for corrugated products to impart desired characteristics.

I.B.2.d. Mechanical Pulping. Mechanical pulping is segmented into five distinct processes:

- Stone groundwood, the basic process, in which pulp is made by grinding short lengths of logs called billets on a grindstone

- Refiner groundwood, in which wood chips are passed through a disc refiner

- Chemi-groundwood (chemi-mechanical) in which the billets are first pressure impregnated with a dilute solution of sodium sulfite before grinding

- Cold soda pulping, in which chips are steeped in a caustic solution and refined

- Thermo-mechanical pulping, a new process, in which chips are first softened with heat and sometimes chemicals, then refined under pressure

These general descriptions are subject to modification in practice.

The official EPA subcategorization of the groundwood segment of mills, however, is an artificial division for regulatory purposes based on raw waste similarities and dissimilarities among the five processes. Although they were established on the basis of data collected in mills distinguishable according to the above segments, the subcategories established are those described in Nos. 12, 13, and 14 in Section I.A. Stone and refiner groundwood were combined to form the "groundwood (coarse, molded, newsprint)" subcategory; chemi-groundwood and cold soda were combined under "chemi-mechanical"; and "thermo-mechanical" remains a separate subcategory.

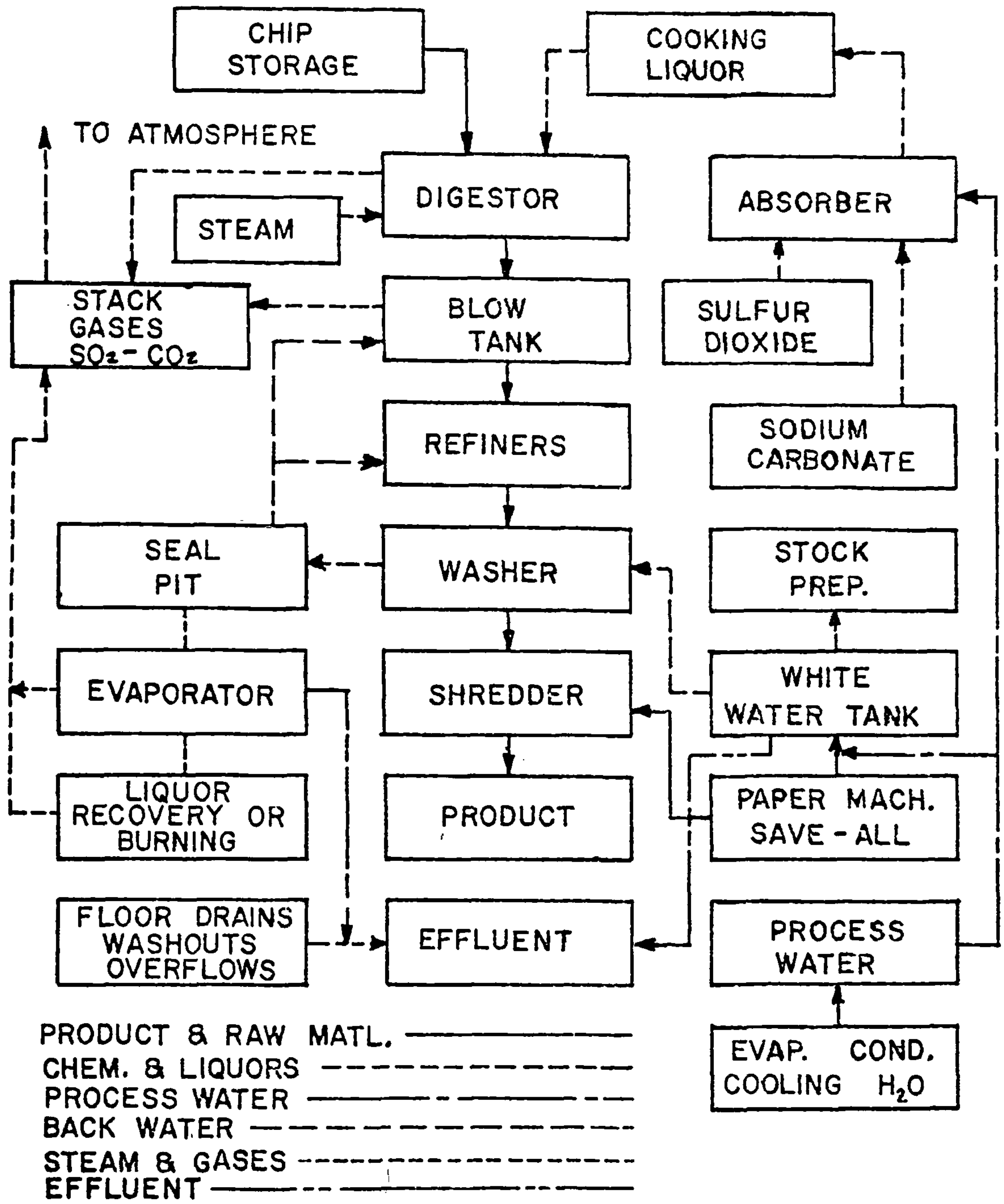

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Figure 3. Diagram for neutral sulfite semi-chemical pulping process

As a result, no data and no process descriptions can be presented that specifically fit these subcategorizations. It is necessary, therefore, to revert to traditional divisions of the mechanical pulping subcategory for this discussion.

The basic mechanical pulping process, stone groundwood, is shown in Figure 4. In this process:

- Billets are fed to the grinders by hand or automatically from a belt or chair conveyor and are forced hydraulically against the large rotating grindstone specifically designed for the purpose (Gehm, 1973). The grinding occurs in the presence of a large quantity of water that acts as both a coolant and a carrier to sluice the pulp from the body of the grinder.

- The pulp slurry is diluted to a consistency of from 0.6 to 0.8% and is passed through coarse and fine screens and a centri-cleaner to remove dirt and shives. Oversize rejects may be passed through a disc refiner and returned to the system ahead of the fine screens.

- The pulp slurry is then thickened on a decker to a consistency between 10 and 15% and discharged to a stock chest for mill use, bleached, or thickened further for transport to other mills (EPA, 1976a) either in the form of wet lap at about 25% consistency or nodules containing 50% fiber.

Groundwood pulp contains essentially all of the material contained in the basic wood. Because it is not subjected to extensive bleaching, the major variables are reduced to the pulping process and the type of paper produced.

In the chemi-mechanical and thermo-mechanical subcategories, the most significant variable is pulping, because in these processes, some pretreatment in the form of chemicals and/or heat is used and, in thermo-mechanical, pressure is added to the fiberization process as described under the subcategories in Section I.A. In the groundwood CMN subcategory, the paper produced is the more significant variable, because no major distinction is identified in the waste characteristics of stone and refiner groundwood.

I.B.2.e. Waste Paperboard Production. Waste paper is converted to secondary fiber in a pulper employing water, chemicals, and steam (EPA, 1974) as shown in Figure 5. An attached junker removes extraneous solid materials.

I.B.2.f. Deinking. Deinking is closely related to chemical pulping in that an alkaline solution is used (shown in Figure 6), consisting of soda ash, caustic soda, sodium silicate, and sometimes sodium peroxide. Some deinkers employ dispersing agents. The chemicals saponify the ink and solubilize coating adhesives, allowing the ink, coatings, and fillers to be subsequently washed from the pulp. For newsprint, containing only fiber and ink, a detergent is used to separate the ink which is washed away.

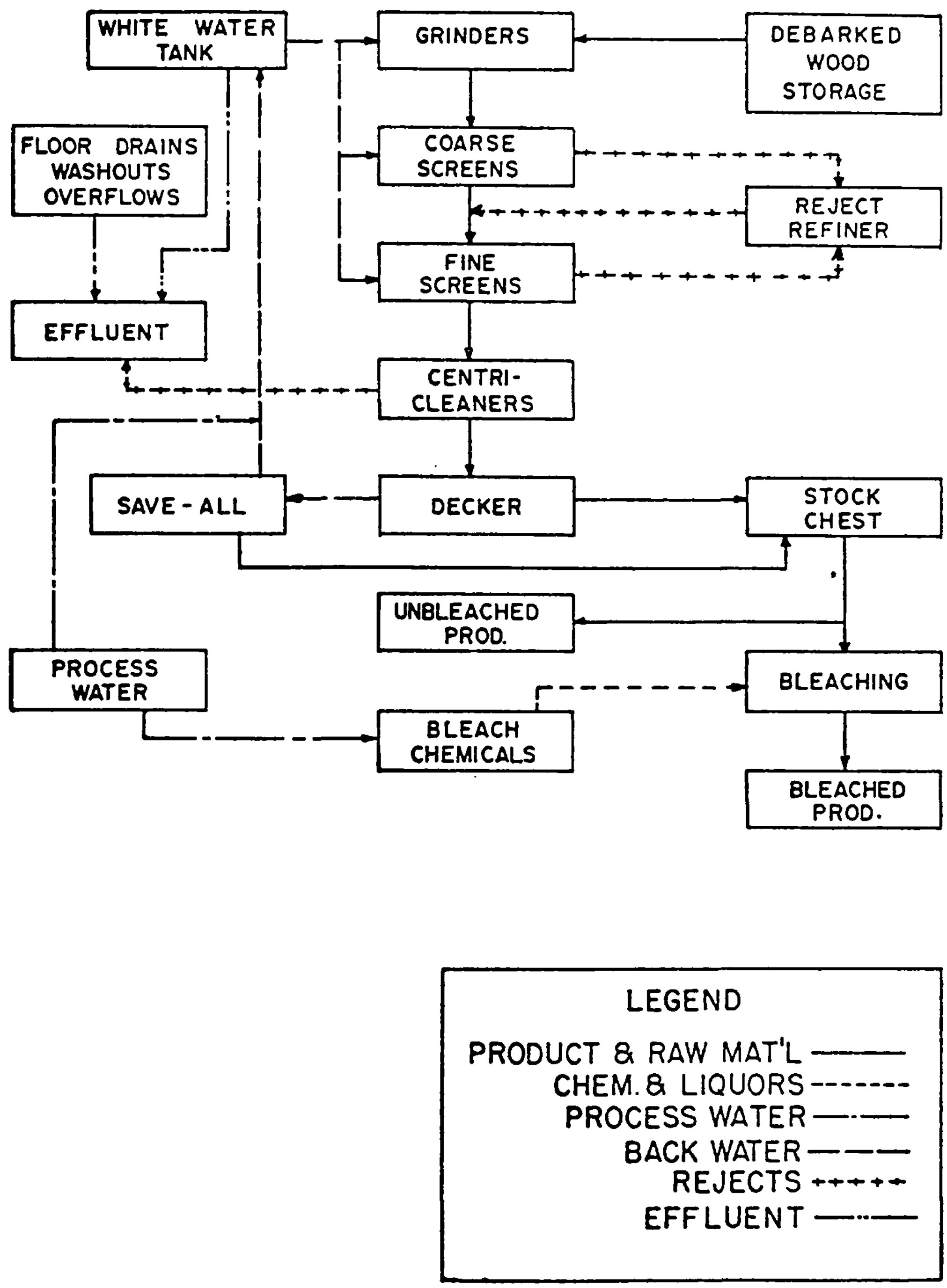

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Figure 4. Diagram for groundwood pulping process

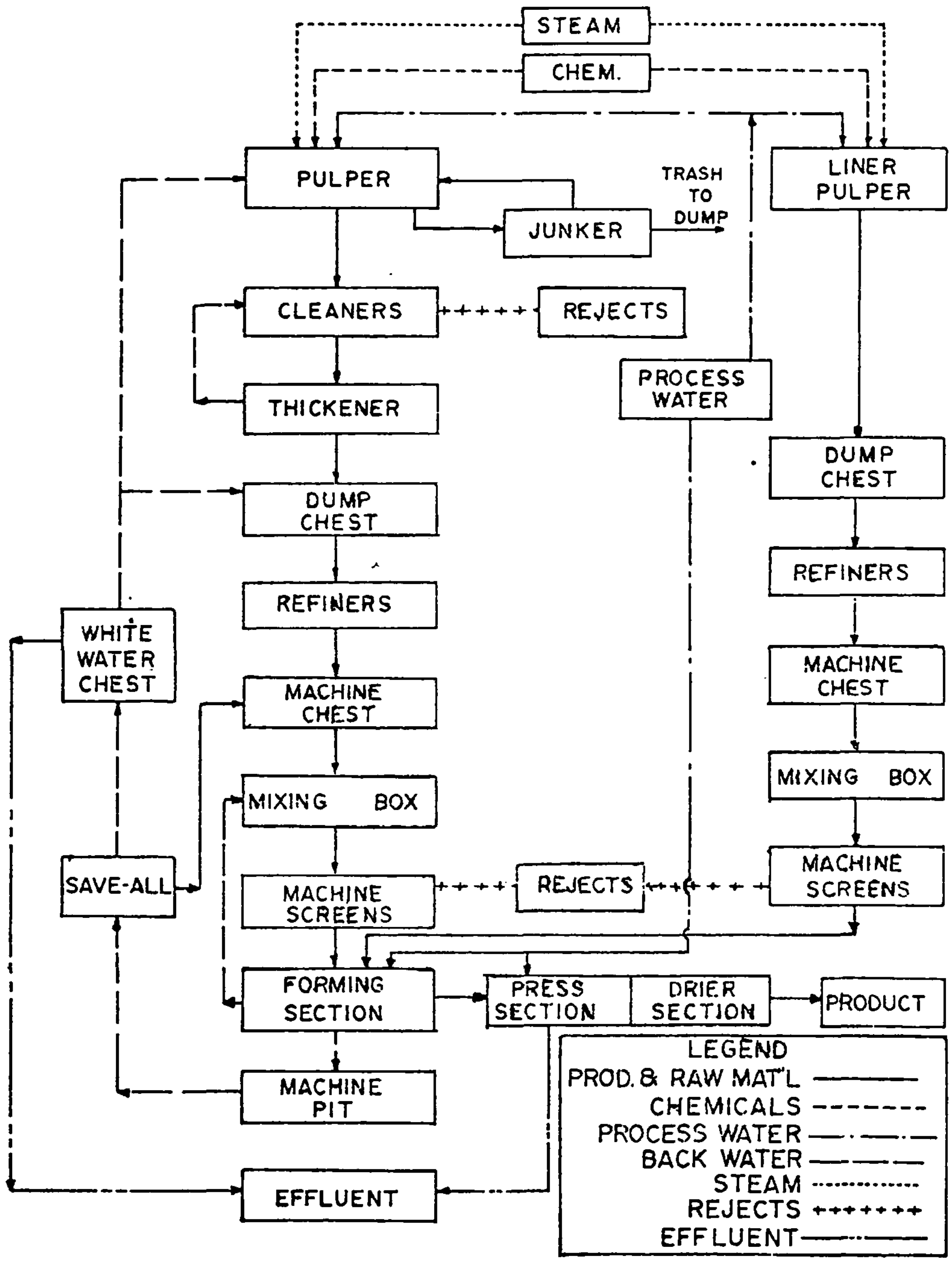

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Figure 5. Diagram for waste paper board mill pulping process

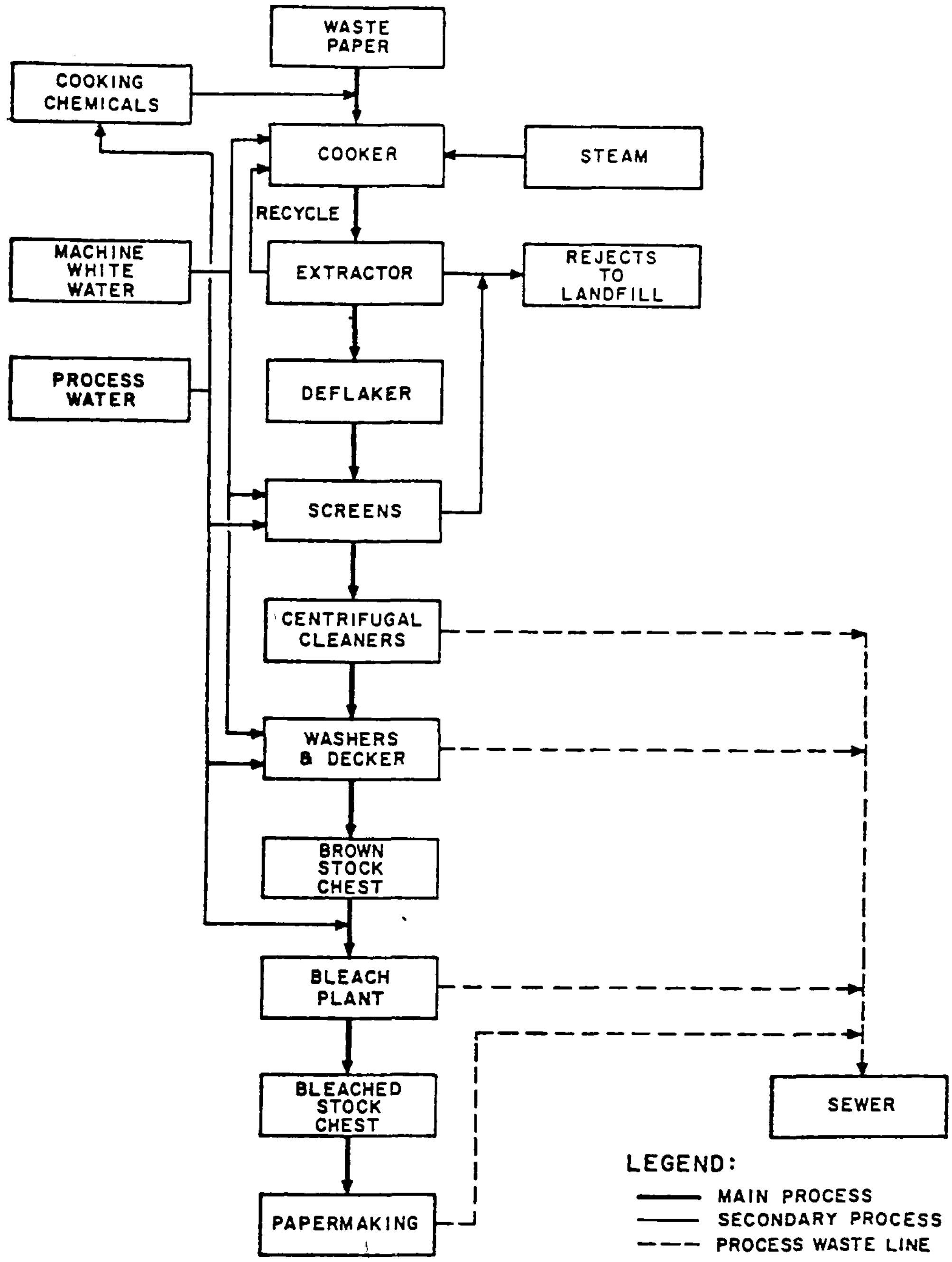

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Figure 6. Process flow diagram for deinking plant

I.B.3. Papermaking

Papermaking is described above in conjunction with the kraft process. One major type of paper machine, the fourdrinier, is illustrated in Figure 7. The other is the cylinder which revolves in the dilute pulp; it is used primarily in making multi-stock sheets of paperboard.

I.C. TRENDS

I.C.1. Location Changes

Table 1 shows the current geographic pattern of the U.S. pulp and paper industry as it has evolved after dramatic changes in structure. The most predominant changes from earlier patterns are the loss of a number of sulfite pulp mills in New England, New York, Pennsylvania, and Wisconsin, and the ascendancy of kraft pulping in the South.

Most of the sulfite mills in these areas which closed were small old mills using calcium base cooking liquor. It was not economic to recover this base and, without liquor recovery or byproduct production from the liquor, pollution control measures were not available to meet water quality standards or effluent limitations. In addition, they were confronted with the competition from kraft mills several times their size, which could produce almost any product the sulfite mills could produce and make it cheaper.

Kraft mills proliferated in the South because, in the 1930's, this process was the only one capable of using the vast stands of southern yellow pines. Similarly, the location of semichemical mills was wood-oriented to make use of otherwise unusable hardwoods.

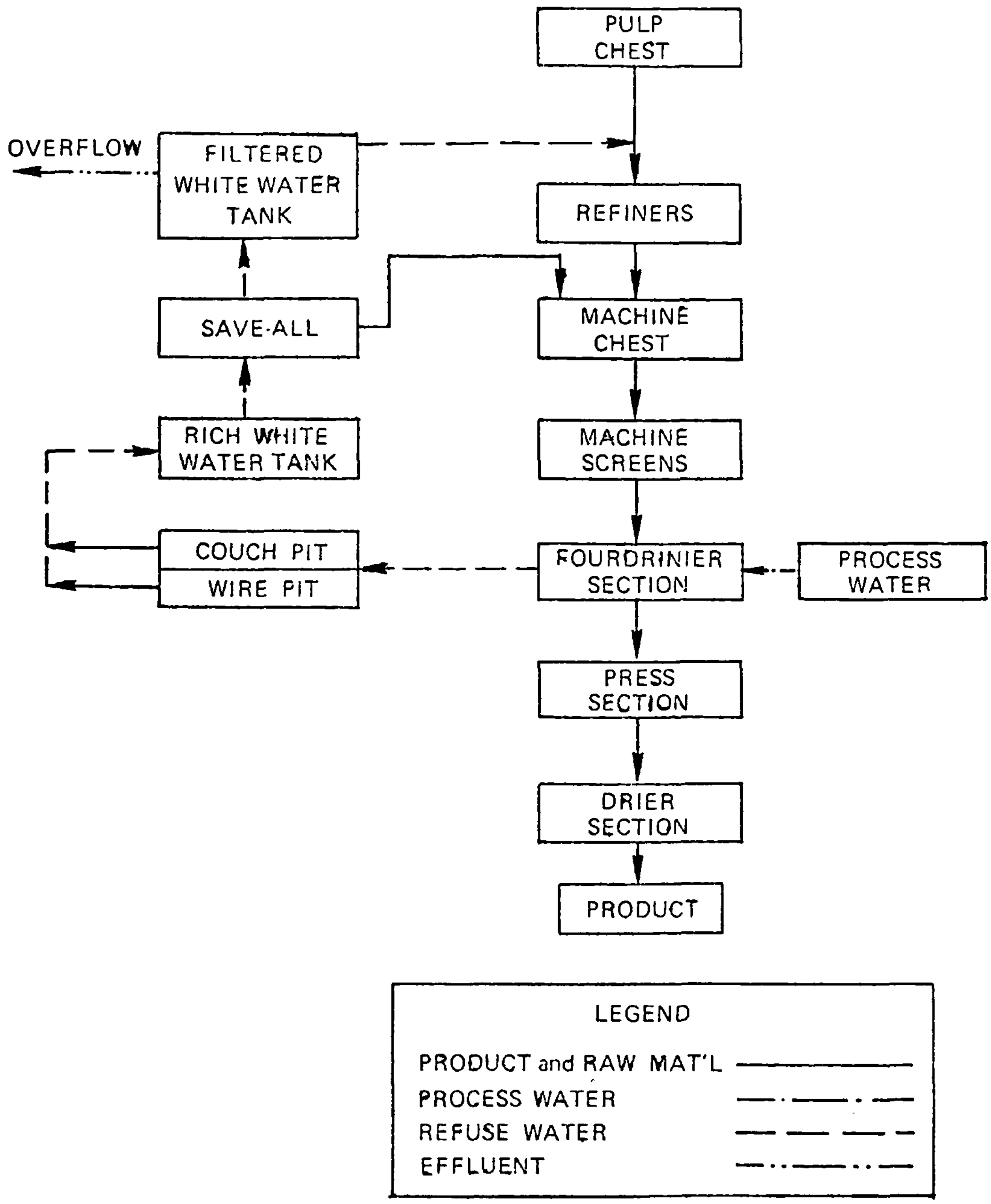
Pulping techniques have become much more versatile, however, and the location of specific wood species is not the major influence it once was. The industry also has adjusted to and compensated for other locational factors up to the present state-of-the-art of production and pollution control. Hence, no new locational shifts of the magnitude of those described here are anticipated.

The major growth at present remains in the South where one new integrated mill, one market pulp, and two paper mills were in various stages of completion in mid-1977 (Expansion Modernization, 1977). Only one other new mill was under construction in this country, in the far West.

Another type of growth which is also strongest in the South is the expansion of existing mills. In that area, this occurrence is largely a function of the increasing demand for bleached kraft products for modern packaging, especially foodboard for frozen foods.

Because the South is the center of kraft pulping, as shown in Figure 8, this trend can also be expected to continue as long as there is growth in the bleached kraft market and the unbleached kraft products as well.

Other historical factors have influenced growth in the South, although their significance is diminishing. One factor in this category was the availability of a sustained wood supply enhanced by climate and shorter growing periods than those required in other areas for other species. This point is illustrated



Source: US Environmental Protection Agency. 1976a. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, deinked and non-integrated paper mills of the pulp, paper, and paperboard mills point source category. EPA 440/1-76/047-b, Dec.

Figure 7. Process diagram for fourdrinier paper machine

Table 1. Geographic location of U.S. pulp and paper mills, by subcategory

Subcategory	Location						
	North-east	South	South Central	North Central	West	North-west	Total
Unbleached kraft	0	21	1	0	0	4	26
NSSC (sodium base and ammonia base)	1	5	0	7	0	1	14
NSSC/unbleached kraft (with cross recovery)	0	8	1	0	0	2	11
Waste paperboard	68	22	7	50	17	2	166
Bleached kraft (dissolving pulp)	0	3	0	0	0	0	3
Bleached kraft (market pulp)	0	4	0	1	2	1	8
Bleached kraft (BCT)	7	23	2	4	3	7	46
Bleached kraft (fine paper)	4	7	1	4	7	0	23
Groundwood: chemi-mechanical, thermo-mechanical, CMN papers, and fine papers	10	4	2	7	1	4	28
Soda	2	1	0	0	0	0	3
De-ink	7	1*	0	9*	2*	1	20
Nonintegrated fine papers	19	1	0	23	2	1	46
Nonintegrated tissue papers and non-integrated tissue from waste paper	46	6	0	15	5	2	74
Dissolving sulfite (high alpha and low alpha)	0	1	0	0	0	5	6
Papergrade sulfite and papergrade market sulfite	2	0	0	9	0	8	19
Totals	167	107	14	130	39	35	492

*Includes de-inked newsprint.
Note.--See Section I.A. for definitions.

Sources: US Environmental Protection Agency. 1976a. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, de-inked and non-integrated paper mills of the pulp, paper, and paperboard mills point source category. EPA 440/1-76/047-b, Dec.

US Environmental Protection Agency. 1974. Development document for effluent limitations guidelines and new source performance standards for the unbleached kraft and semichemical pulp segment. EPA 440/1-74-025-a, May.

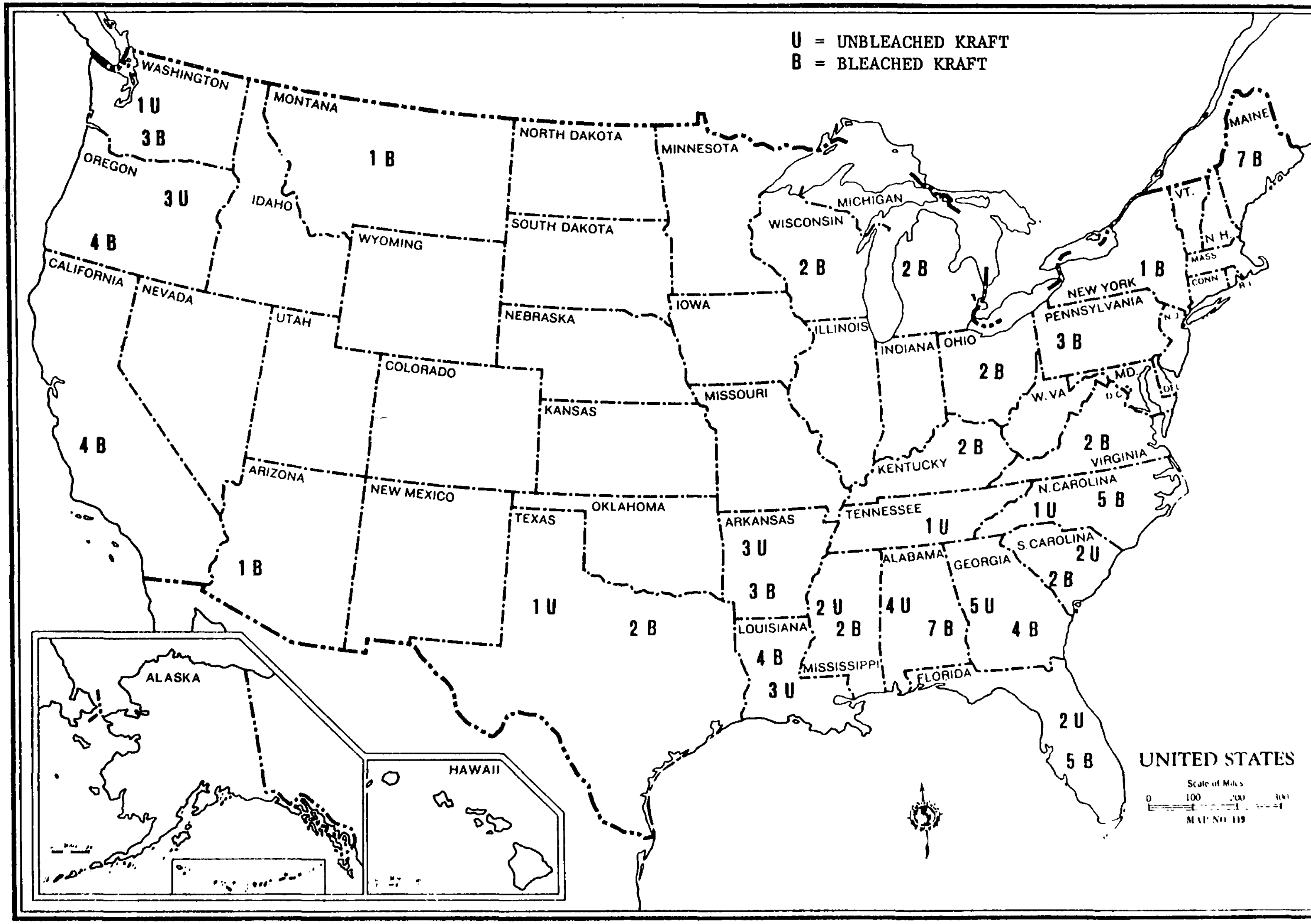


Figure 8. Distribution of kraft mills in the United States: 1973

in that the 13 southern States produced approximately 30% of the Nation's total wood supply in 1975.

According to the South's Third Forest Report, the forests of the South will have to produce approximately 55% of the total by the year 2000, or two to three times the current harvest. Annual growth to meet this demand must total 13 billion cubic feet, nearly 70% more softwood and 40% more hardwood growth than in 1965.

There is concern in the industry, however, over the long-term adequacy of quality timber at reasonable prices in the southern pine region (Zobel, 1977). There are already varying degrees of pressure on high quality pines and hardwoods, and there is a general excess of low quality hardwoods. The continued dominance of the South in paper industry growth will depend to a large degree on the success of the industry's long-range planning and improved forest practices in maintaining wood supply equal to demand in the geographical area.

Other reasons for the larger southern expansion include:

- An abundant water supply
- Tax concessions to attract industry in some States
- Good transportation, including water carriers
- Abundant and varied fuel supplies
- Somewhat lower wages and costs

The area differential in the last item is rapidly narrowing. It must be remembered, however, that expansion decisions are always based on a multitude of specific considerations within broader areawide characteristics such as those described herein.

I.C.2. Raw Materials

The primary raw materials used in pulping and papermaking can be classified as:

- Wood
- Waste paper
- Chemicals for cooking and bleaching liquors
- Papermaking additives

In addition, small quantities of cotton and linen rags, cotton linters, jute, hemp, flax, and old cordage are pulped for specialized products. The total tonnage of these materials used is miniscule compared to the quantities of wood and waste paper pulped.

There is also one full-scale bagasse mill, and straw, cotton seed hulls, esparto grass, bamboo, and corn stalks are used intermittently, either experimentally or because of periodic shortages of the usual raw material. The quantities involved are even smaller than the amounts of textile fibers used, and no increase is foreseen at present although there may be a long term potential for the use of quick growing reedy plants. Together all these fiber sources account for 1.2% of the fiber consumed by this industry.

The relative importance of the various fiber sources is illustrated in Table 2.

Pulpwood, in the form of roundwood, chips, and forest and sawmill residue, supplies 77.1% of the industry's fiber consumption. Although historically the use of delivered logs predominated, mills today are using a steadily increasing percentage of chips prepared off-site. The 1972 Census of Manufacturers shows that chip use alone increased from 37 to 47% of total softwood consumption between 1967 and 1972. Chips and sawmill wastes together accounted for 21% of hardwood consumption in 1972, but comparable data are not available for 1967. Recent statistics show that during the second quarter of 1977, roundwood consumption decreased 0.2% from the commensurate period in 1976 and chip use increased 26% (Statistical Summary, 1977). The trend toward increased use of chips is likely to continue because of the economics of transporting chips as opposed to logs and because reductions in volume of liquid effluent to be treated can be achieved in the absence of water storage of logs and wet-barking processes.

The use of whole tree chipping (WTC) in the Northeast, the Great Lakes States, and the South has increased considerably over the last decade. This practice has several advantages:

- It is particularly useful in mixed stands of timber and for thin diameter material.
- It does not require limbing and topping, which are the most expensive parts of wood handling.
- It results in higher fiber yield per acre, increased manpower productivity, reduced labor and transportation costs, and conservation of fuel (Whole Tree Chips, 1976).

These advantages currently are counterbalanced by:

- An increase in required mill maintenance
- Capital cost of equipment needed for WTC processing
- Adverse impact on product quality
- Increased wastewater loadings

As the problems are solved, the use of WTC will probably increase significantly. One company estimated that in 5 years 80% of its chips will be field-chipped wood.

Table 2. Relative fiber consumption, by fiber source, for the pulp and paper industry

Consumption	1,000 short tons (rounded) 1976 (actual)	1977 (projected)	1978 (projected)
Wood pulp	49,000	52,000	52,000
Waste paper	14,000	16,000	17,000
Other	0.746	0.792	0.804

Source: Evans, J. C. W. 1977. Wastepaper: Outlook is for steady growth in U.S. utilization, strong advances in exports. Pulp & Paper 5/(7).

With softwood timber steadily becoming scarcer, the use of hardwood has increased significantly in the last two decades. Hardwoods have represented the following approximate percentages of the total cords of pulpwood consumed:

- 11.8% in 1950
- 21.8% in 1960
- 24.1% in 1970
- 27% in 1974

The trend is expected to continue.

Recycling of paper was at its peak during World War II, when 40% of the paper produced was recycled. There was a steady decline in the succeeding two decades, and then the trend reversed. Reclamation is expected to remain at about 25% for the next few years. As shown earlier, waste paper consumption is expected to be 16 million tons in 1977 and 17 million tons in 1978. The National Academy of Science has recommended that U.S. capacity to recycle should reach 40 million tons per year by 1985.

Because of technological improvements in wood pulping, wood-content papers have eclipsed rag-content papers, and rags now are used only in small quantities to make very fine papers. No significant increase can be forecast, a conclusion supported by the short-range projections in Table 2.

The chemicals used in pulping include hydrate lime, sodium sulfide, sodium hydroxide (caustic soda), sodium sulfate, and sodium carbonate (soda ash). Unless new pulping methods are developed that do not use these substances, fluctuations in their consumption will parallel fluctuations in pulp demand. Bleaching chemicals include hydrogen peroxide, calcium and sodium hypochlorite, chlorine dioxide, and chlorine. The use of these chemicals will increase if the demand for bleached products continues to rise. Papermaking additives include fillers and coatings such as clay, talc, gypsum, sizing (such as rosin, casein, alum, and starch), pigments, and waxes. The use of many of these substances will also increase if the present upward trend in demand for magazines and increasing use of coated stock in commercial printing continues (Statistical Summary, 1977).

I.C.3. <u>Processes</u>

The current process trends in this industry include a continuing decline in sulfite pulping, further erosion in soda pulping, and the continued dominance of kraft. The versatility and favorable economics of kraft products are the major reasons. It can be expected, however, that the sulfite process will continue to be a major factor in the production of fine papers. The semichemical process will also continue to be important as long as it is the major producer of corrugated packaging products.

Other process changes in the pulp and paper industry will evolve from the search for:

- Improved products
- New products
- More economic ways to make them
- Means to reduce both the cost and problems of pollution control

In some cases, a change may respond to more than one of these considerations. For example, in searching for ways to reduce both sulfur costs and sulfur emissions, an NSSC corrugating medium producer developed a nonsulfur semi-chemical process (Shick, 1977). There are other such cases:

- Oxygen bleaching may become an acceptable substitute for more costly multiple bleaching systems used to achieve high bleach kraft pulp; it is also effective in pollution control in that the bleach plant effluents can be recycled to the pulp mill for evaporation and incineration with the black liquor. Although the use of this system in existing mills currently is limited by the capacity of installed equipment, increased requirements for color reduction from kraft bleach plant effluents could stimulate a trend toward its use.

- A full scale bleaching process has been installed in a new Canadian kraft mill which theoretically permits the bleaching system to be completely closed (Reeve, 1973). It introduces a means to burn bleach plant effluent in the recovery system, thereby reducing the cost of effluent treatment and diminishing the color associated with bleach plant wastewaters. Chlorine dioxide, an effective bleaching agent, is also produced with chlorides recovered from the system.

- Oxygen pulping is a process under intensive study, the perfection of which is forecast for this decade (Advances, 1972). Cost savings will also provide the major incentive toward this process. Again, pollution control advantages--both air and water--would accrue.

- Polysulfide pulping is another new process under investigation. Its principal benefit is increased pulp yield, although it may reduce air emissions as well.

- Nitric acid pulping and chlorine dioxide pulping are being studied. They show some advantages such as high pulp yields, but there are many serious drawbacks to be overcome before they can be applied commercially (Cox and Wanster, 1977).

- Thermo-mechanical pulping has become a proven technology, although it is relatively new in this country. Capacity for this process is expected to increase by 482% from 1975 to 1979--from 119,800 to 691,100 kkg (131,000 to 762,000 tons) (Towe, 1977).

The ultimate goal of dry pulping processes is nowhere near achievement and does not warrant discussion here. Dry paper forming processes are used abroad to a limited extent, however, and at least one U.S. company has acquired the rights to use a Danish-developed system. Capital investment, it is reported, could be lower for dry forming--using air rather than water to suspend or carry fibers during the papermaking process--for some products than it is for conventional systems (Tanazzi, 1971). Use in specialty products mills--one U.S. mill reportedly already uses the technique for this purpose--is viewed as probably the only foreseeable application (Tanazzi, 1971) in this century.

Some plastics are manufactured by paper companies for incorporation in specific packaging. These do not replace a substantial amount of paper, however, and are not likely to do so in the future.

Trends in processes to produce new and improved products are difficult to predict because competitive interest precludes advance disclosure.

I.C.4. Pollution Control

The status of innovations in pollution control should be determined very early in the planning process. Any major trends in internal measures will be tied very closely to the potential developments in process changes described earlier. Some improvements may accrue in recovery systems such as hydropyrolysis (Advances, 1972). This method could replace recovery boilers and incorporate production of activated carbon from black liquor.

New deinking mills will also have an opportunity to incorporate improvements that will substantially reduce traditional flows from this source. These improvements include continuous cooking procedures as well as the application of air flotation separation of ink and filler materials from the cooked pulp. These techniques require entirely different machinery from that employed in established deinking mills.

Wet barking operations are expected to decrease in order to eliminate this source of wastewater. Dry barking and forest chipping will be substituted. A trend to greater use of vacuum drum washing in sulfite mills may be expected to replace displacement washing in blow pits to enhance the recovery of solids.

Increased recovery of turpentine and tall oil from kraft liquors may result from newer mill practices such as shorter storage of chips, precooking extraction, or, in the case of tall oil, solvent extraction (Tapping, 1973).

There are counterbalancing inhibiting factors, however, such as the increased use of continuous digesters, mixing pine and hardwood black liquors, and use of more hardwood, sawmill wastes, and immature wood (Barton, 1973; Ellerbe, 1973). NPDES applicants should be current on the status of research efforts on kraft byproduct recovery generally since the imposition of effluent limitations may effect a stimulus in this area.

The future of this means for reducing the raw waste load of sulfite mills does not appear to be as bright. Currently, about 10% of the sulfite liquor produced in this country is used and there is little expectation that this percentage will increase (Craig, 1973).

New emphasis on heavy metals and exotic organics as water pollutants could conceivably bring about the most significant change in the current external control practices of the pulp and paper industry. It is not possible, however, to evaluate potential trends at this juncture because the most definitive appraisal yet undertaken of the industry's effluents in terms of these two classes of pollutants is not completed. If ongoing analyses indicate the existence of either or both classes in harmful concentrations, existing NSPS and pretreatment standards will be amended to require technologies for controlling their discharge. It is possible that NPDES applicants may in the future be required to apply such technologies. A precedent exists in that groundwood mills using zinc hydrosulfite as a bleaching agent are already required to use treatment to remove zinc from their effluent if they do not elect to abandon the use of this compound.

The most recent modification in conventional wastewater treatment to be adopted by this industry is the use of pure oxygen in biological processes. Applicants may wish to investigate performance at the several installations of this type in terms of improvements in sludge quantities and power requirements.

While early pilot studies on the application of the rotating biological surface (RBS) process, a dynamic trickling filter device, to pulp and paper effluents appeared promising (Gillespi, 1974; McAliley, 1974) they are mechanically troublesome to operate and offer no great advantage over the conventional trickling filter, which itself has seen little use in this industry. Each stage of the RBS becomes less effective, the sludge is particularly difficult to dewater, and their use is not currently increasing. Applicants may wish, however, to check with appropriate sources for the latest developments in this technology.

Land availability and cost will play a role in the type of biological treatment chosen by individual mills. The methods that require the most land--natural oxidation basins--are less expensive than the non-land-intensive methods --aerated stabilization basins (ASB's) and activated sludge units; however, they will probably be limited in use to some areas of the South by declining land availability and increasing land costs.

Whether color reduction technologies will be required for new or expanded mills in subcategories where color is a problem (as discussed in Section I.D.3), will depend on EPA's future course of action. Currently, the color NSPS apply only to unbleached kraft mills and NSSC mills utilizing cross recovery. The NSPS proposed in February 1976 do not contain color limitations because, as stated in an earlier version of the development document (EPA, 1975), the applicable technologies have not been demonstrated to the degree of engineering and performance required by NSPS. When color limitations are imposed, mills will be faced with the following alternatives:

- Process change such as oxygen bleaching
- End-of-process treatment such as lime treatment, as recommended by EPA, or activated carbon, reverse osmosis, or ion exchange
- Some combination of the above

Sludge dewatering and disposal is an element of waste treatment that is now in transition. The use of filter presses, belt filters, screw presses, and centrifuges is on the increase, and vacuum filters are no longer the obvious choice for dewatering (Barnhill, 1974). Automation and improved closures have helped promote filter presses, as has their ability to produce dryer cakes. Belt filters of foreign design are being applied more often to highly hydrous sludges, and screw presses are particularly successful with fibrous sludges. Centrifuges of both the disc and solid bowl type are being used successfully where sand or grit is not present, although rapid wear contributes substantially to the operating cost.

The various forms of heat treatment of sludges, with and without oxygen, are now relatively common in processing municipal sludges, and are under investigation for use in the pulp and paper industry, but to date have not shown much promise. The multiple hearth furnace, units employing air suspension drying and burning, and the fluid bed are used. Some sludge is also incinerated with bark in bark boilers. However, until the cost of incineration is reduced the application of sludge incineration will be limited unless the sludges can be dewatered to a point where they can more than support their own combustion.

Landfilling of pulp and paper mill sludges should continue to be a viable means of disposal if the sites used meet the constraints of the Resource Conservation and Recovery Act, discussed in Section I.E.3, including leachate control. However, EPA's pulp and paper research and development waste treatment program envisions study of the industry's sludges, with emphasis on heavy metals. The continuation of landfilling of sludge and the extent of engineering precautions required could depend on the outcome of such a study.

New kraft mills can be expected to incorporate the most recent advances in recovery furnace and liquor system design for odor control. This feature will be necessary to reduce total reduced sulfur (TRS) emissions to an acceptable level. The new air NSPS (discussed in Section I.E.2) applicable to the TRS emissions from the lime kiln will also require improvements in the mud washing system or air or molecular oxygen oxidation of the sulfides in the mud. In new mills, oxidation can be accomplished by installing vacuum filters that have sufficient capacity to allow air or oxygen to be drawn through the mud cake.

The collection and oxidation of miscellaneous sources of TRS in the digester and evaporator systems will be designed into new mills. These sources include all the points of emissions regulated by the NSPS discussed in Section I.E.2.

Improvements in sulfur dioxide scrubbing in acid sulfite and NSSC mills can be anticipated as a result of a recent survey (Rosenburg et al., 1975b) of all mills in these segments of the industry. The data collected can be employed by NPDES applicants to allow selection of the best available system to serve various specific needs. The scale control system developed by Rosenburg et al. also can be introduced.

Conversely, the lack of demonstrated control techniques prevented EPA from applying SO_2 NSPS to kraft mill recovery furnaces and lime kilns (EPA, 1976b). Thus, at the present state of the art, no projections can be made at this time on the trend of efforts to control this pollutant from these sources.

The same is true of the carbon monoxide (CO) and nitrogen oxide (NO_x) emissions from these same sources. Currently no control technology has been demonstrated for these facilities (EPA, 1976b). Similarly, there are no discernible trends in the control of NO_x from ammonia base sulfite or NSSC mills.

I.C.5. Environmental Impact

Greater environmental impact due to growth in pulp and paper production capacity can be expected from incremental expansion of existing facilities--expanded pulping capacity and additional paper machines--rather than from completely new mills since the current prevailing trend to modernization is expected to continue (Michaud, 1977; New Plants, 1978). However, the trend toward increased size--whether in existing or new mills--can exert a strong local aesthetic impact.

The trend toward countywide land use planning, which exists today in many areas, should reduce the mistakes of the past when industrial zoning, if it existed, was confined mostly to municipal communities. In-town mills are usually not of the very large dimensions envisioned here (although there are some exceptions) and generally it is the countryside that will be most affected by their appearance.

Environmental pollution from new or expanded mills may impact local and regional environs to different degrees depending on site specific conditions, type of facility proposed, and extent of pollution control and other mitigative measures.

In terms of air pollution, the impact of new mills constructed in pristine areas will be minimized by the significant deterioration regulations discussed in Section I.E.2. The net impact of the emissions of new or expanded facilities planned for industrialized areas also should be less than in the past because of EPA's offset regulations, also discussed in Section I.E.2.

In terms of liquid effluents, while new mills have the advantage of incorporating new or improved processes, EPA's background study to establish effluent guidelines and standards (EPA, 1976a) found no significant correlation between age of the mill and raw waste load. Many old mills have been upgraded and modernized to remain competitive with new mills, and as a result have remained competitive in waste treatment required. Thus, if there are differences in degree of water quality impact between new mills and old ones, they will result primarily from variations in stringency of effluent limitations imposed. Age of mills was not a determination in subcategorization of this industry.

The size of mills was similarly discounted in subcategorizing the industry because the data available demonstrated no apparent correlation between size of mill and raw waste flow and BOD load in terms of gallons and pounds per ton of product, respectively (EPA, 1976a), and the effluent limitations were designed to equalize the requirements for all mills, regardless of size. However, the potential effect of the effluents of larger mills on individual stream assimilative capacity may indicate the need for water quality related effluent limitations authorized by Section 302 of P.L. 92-500. Applicants should consider this potential early in the site selection process where discharge into small streams is involved.

The process trends discussed in Section I.C.3 will tend to lessen adverse air and/or water impacts if and when any of them are perfected for widespread use.

I.C.6. Markets and Demands

In 1971, based on the anticipated performance of the gross national product (GNP), the traditional bellwether of paper industry growth, the American Paper Institute (API) made the projections shown in Table 3. Due to the economic recession during 1974, and concomitant slump in the GNP, actual production is running far behind these projections. Bureau of the Census production data for 1976 (in 1,000 short tons) are:

- Paper, 26,573
- Paperboard, 28,439
- Total, 55,012 (excluding building paper and hardboard)

Because demand has not correlated well with the GNP since the recession, API is not updating such long-range forecasts and does not plan to do so until the industry stabilizes. Thus, any estimates on the number of new mills or the type or size required beyond the immediate future would be unreliable.

The short-range view is that if the predicted GNP growth for 1978 is accurate, paper and board production is likely to rise by about 5% in 1978 (Towe, 1977). This means that the industry could be operating at close to capacity in nearly all grades. This will not necessarily mean an intense effort to expand existing capacity, however, because as indicated by Pulp & Paper (Towe, 1977), when high operating rates are approached during an expanding economy, more capacity is normally found than is reported. Such increases are achieved by maximizing grade mix and by lowering product standards.

The United States continues to lead the world in per capita consumption of paper and paperboard. In 1968, consumption was 551 pounds per year; in 1969, it was 576 pounds, and in 1970, 556 pounds. Sweden was second with figures of 270, 410, and 420 pounds per year in 1968, 1969, and 1970, respectively. Canada was in third place, just slightly behind Sweden. Current per capita consumption is nearly 600 pounds per year in the United States and could reach 750 pounds per year by the year 2000 if present use trends continue.

I.D. SIGNIFICANT ENVIRONMENTAL PROBLEMS

When all recent Federal environmental control statutes are fully implemented at the state and local level, environmental problems that could be classed as "significant" should be greatly reduced in new or expanded pulp and paper mills, under normal conditions, with one major exception. This exception is odor from kraft mills, which can remain detectable in the ambient air in the part-per-billion range, even after regulatory requirements are met (NCASI/EPA, 1973).

Table 3. Paper industry production: 1970-1990

Year	1,000 short tons			
	Paper	Paperboard	Other grades	Total
1970	23,220	24,940	4,297	52,457
1975	29,704	31,873	5,634	67,211
1980	36,035	35,590	6,745	81,370
1985	43,260	46,300	8,115	97,675
1990	52,700	55,700	9,850	118,250

Source: Statistical summary. 1977. American Paper Institute Monthly, July.

I.D.1. Location

Most of the largest mills will be constructed in relatively undeveloped, rural areas or in areas of much smaller structures. Such mills will be very large in overall dimension to accommodate the great capacity for which they are designed--paper machines may be a city block long. Mills which engage in pulping are also likely to be very tall to accommodate the height of large digesters. Thus, significant alteration to an existing landscape can occur.

The most effective mitigating measure appears to be siting the facility where the least number of persons will be impacted by it. Site locations of this sort occur naturally in some areas where mills are located in a vast expanse of wooded terrain that provides the raw material for the mill.

Any new mill designed to pulp wood grown on the premises will, of course, be more amenable to this type of site selection. Mills that are to use woods chipped in off-site forests and brought in by truck or rail will have a wider range of site choice and will probably constitute the more troublesome location problem.

All pulp mills and most paper mills are located on bodies of water because of the large quantities of water required for process and cooling use and ultimately for wastewater discharge. Compliance with applicable NSPS to be imposed by EPA, or with the even stricter Section 302 site-specific effluent limitations of P.L. 92-500, should minimize potential impacts on receiving water bodies.

Similarly, mill location could be a factor in air pollution problems when new or expanded mills are proposed for pristine areas. All proposed facilities are subject to prevention of significant deterioration (PSD) review by EPA, and those proposed for such areas will be subject to standards which should serve to minimize degradation of existing air quality. The locational significance of mills proposed for nonattainment air quality areas where additional emissions would violate ambient air standards likewise is reduced by the offset regulations. Both situations are discussed in Section I.E.2.

The impact of locating mills in wooded areas can be positive or negative depending on the specific site. If the forests are in nonrecreation areas and the principal use would be to serve the mill, they can act as an effective buffer in terms of public perception of odor and noise and can screen the mill from public view. Conversely, a mill location adjacent to a national forest, for example, could interfere with public use and enjoyment of the forest.

Because the siting of pulp or paper mills can involve a significant change in land use, particularly in rural areas, direct and indirect social and ecological impacts can occur. The direct impacts primarily will be a function of the type of facility proposed and the site specific conditions; the magnitude and significance of secondary or indirect impacts, such as induced growth, infrastructure changes, and demographic changes will depend largely on the local economy, existing infrastructure, numbers and characteristics of construction workers (e.g., local or nonlocal, size of workers family), and other related factors. Long-term secondary impacts usually are most significant when the mill, because of its size, processing methods, and location, employs a sufficiently large number of workers to lead to the creation of a mill town.

Paperboard mills are most likely to be constructed in metropolitan areas which supply their raw material. Their impact will be felt in increased flow and pollutant loads in the municipal wastewater treatment system into which they discharge. Due to the mandatory cost-sharing provisions of the Federal Water Pollution Control Act imposed on users of publicly-owned treatment plants, applicants should determine the relative costs of pretreating their wastes to reduce loadings. Although the wastes from paperboard mills are generally compatible with municipal waste treatment, pretreatment measures should be considered.

Prudent site selection also can be a means to alleviate the kraft mill odor problem. The extent of community exposure can be minimized by careful study of local meteorological conditions that affect the dispersion or dilution of the odorous emissions to indicate the most favorable location from this standpoint.

I.D.2. Raw Materials

The raw materials enumerated earlier contribute substantially to the potential environmental problems. Fiber generates a large BOD raw waste load and pulping chemicals, predominantly sulfur compounds, cause unpleasant odors. Where ammonia is used as the pulping base in sulfite or NSSC mills, nitrogen oxide (NO_x) emissions may also result. Chemical pulping and bleaching operations also produce great quantities of color. Fillers commonly used, such as clay, talc, and gypsum, contribute to the suspended solids and turbidity in the waste streams. Wood, where wet barking is practiced on the premises, also contributes fine particles of bark and wood, as well as dissolved solids, sand, and grit.

The unloading, storing, and handling of raw materials always have the potential for causing environmental problems. Spills and leaks of liquid chemicals, such as caustic soda, ammonia, and sulfuric acid, from tank cars or tank trucks do occur, and provisions should be made to contain, store, and treat such chemicals. Fuel oil leaks or spills should also be considered, and procedures should be established to minimize impacts that could result from such discharges.

The impacts associated with the harvesting of trees to supply the raw material for pulping may also present environmental problems separate from those on the mill site. While these impacts are of concern, they are beyond the scope of this guidance document.

For additional comments on raw material trends and associated impacts, see Sections I.C.2. and II.B.1., respectively.

I.D.3. Processes

Many pollution problems in this industry are process-oriented. First, the processes employed will dictate, to a major extent, the use of certain types of raw materials which generate the problems discussed above in I.D.2. Second, the processes themselves will bring about various chemical reactions that directly affect the type and quantity of pollution generated. The inter-relationships of kraft pulp bleaching and color and kraft chemical recovery and odor are major examples. The process/pollution interface is further delineated by the large number of separate subcategories necessary to account for all of the process-oriented waste variations.

The major characteristics of the raw waste loads contributed by the primary processes used by the industry are summarized in Table 4.

Foam on receiving waters is another problem which in some instances is traceable to the process because it can result from black liquor losses. Alkaline liquors have a strong propensity toward foaming. Good loss control should be practiced to avoid this problem.

The major air pollution problems related primarily to processes, in addition to kraft odor, are:

- Sulfur dioxide (SO_2) emissions from kraft, sulfite, and NSSC mills
- SO_2 and particulate emissions from power boiler operations

Nitrogen oxides from kraft recovery operations and lime kilns, and, potentially ammonia base sulfite and NSSC mills, along with carbon monoxide emissions from the same kraft sources are much lesser problems (EPA, 1976b).

The major process-oriented solid wastes include:

- Bark and grit from wood preparation
- Bottom ash, clinkers, or fly ash from power boilers utilizing coal and/or bark
- Sludge from wastewater treatment
- Wire, strapping, tramp metal, glass, plastics, dirt, coatings, ink, and fillers from wastepaper reclamation
- Inert grits and dregs from kraft pulping
- Inert materials and some oxide of the base cooking chemical from sulfite pulping
- Shives from groundwood pulping
- Unusable waste product in specialty mills such as glassine, zinc oxide, solvent, or plastic coated papers, and high wet-strength grades (Gorham, 1974a)

I.D.4. Pollution Control

With proper control of losses from the mill, well-designed, maintained, and

Table 4. Major characteristics of process raw waste loads of the pulp and paper mill industry

Activity	Characteristics
Wood preparation	Suspended organic and inorganic matter
Groundwood pulping (all types)	Suspended and dissolved organic matter Alkaline pH (chemigroundwood)
Kraft pulping	Suspended and dissolved organic matter Color Aquatic toxicity Slightly alkaline pH
Prehydrolysis	Dissolved organic matter Color Aquatic toxicity
Soda pulping	Same as kraft pulping
Sulfite pulping	Suspended and dissolved organic matter Color Heavy metals Aquatic toxicity Acidic pH
NSSC Pulping	Suspended and dissolved organic matter Color Aquatic toxicity
Deinking:	
Fine papers	Dissolved organic matter Slightly alkaline pH
Newsprint	Suspended organic and inorganic matter
Groundwood bleaching	Suspended and dissolved organic matter (carried over from pulping) Zinc (if zinc hydrosulfite is used)
Kraft bleaching (papergrade and dissolving)	Suspended and dissolved organic matter Color Heavy metals Aquatic toxicity Acidic pH
Sulfite bleaching (papergrade and dissolving)	Dissolved organic matter Color Heavy metals Aquatic toxicity Acidic pH

Table 4. Major characteristics of process raw waste loads of the pulp and paper mill industry--Continued

Activity	Characteristics
Papermaking:	
Coarse*	Suspended organic matter
Fine	Suspended organic and inorganic matter
Tissue	Suspended organic matter
Specialty*	Varies according to product

*Not yet a subcategory.

Source: Gehm, H.W. 1971. Industrial waste study of the paper and allied products industries. EPA Contract No. 68-01-0012. (unpublished) operated aerobic primary and biological waste treatment systems should not produce odor of public significance. However, odors associated with anaerobic decomposition are detectable in very low concentrations when this condition is permitted to occur. Some of these odors are sulfurous in nature while others are characteristic of wood extractives (EPA, 1976a). In the case of kraft mills, good recovery of spent pulping liquors is particularly necessary to reduce the TRS compounds reaching the treatment system to avoid odor from this source.

Odor problems should also be minimal in land application of well-digested or otherwise stabilized wastewater treatment plant sludges. Undigested sludges used in this manner would certainly produce odor and create insect problems as well. The odor of wet sludges can be particularly troublesome during basin cleaning.

Because of the nature of pulp and paper mill sludges, high temperature incineration using high-efficiency scrubbers should provide an adequate safeguard against the release of air pollutants. None of the substances that EPA has designated as hazardous air pollutants is expected to be present in the sludge. The only possible exception is asbestos, which is used only intermittently at a very few specialty mills, if use of this material has not been abandoned altogether.

The air pollution control equipment which will be required to meet the kraft mill NSPS will not contribute significantly to land disposal problems. The dry-bottom electrostatic precipitator for control of recovery furnace and lime kiln emissions is the only device which would collect particulates as a dry mass. The sodium sulfate collected from the recovery furnace will be reused, and the sodium salts, calcium carbonate, and calcium oxide collected from the lime kiln emissions can be similarly returned to the system (EPA, 1976b).

If the caustic scrubber is used to control lime kiln emissions, it may be necessary to dispose of some sodium waste depending on the mill's ability to accept the added sodium in the form of caustic. Slurries from wet bottom electrostatic precipitators on recovery furnaces and smelt tank scrubber water are recycled to the recovery system (EPA, 1976b). Power boiler scrubber effluents are the only wastes of this type which are commonly lagooned although some mills send them to the effluent line.

There has been virtually no measurement of leachate contamination from the land disposal of pulp and paper mill solid wastes. If studies of this kind have been conducted at specific sites, the results are the property of the mill. Because of the nature of most of the industry's solid wastes, disposal control agencies have in the past tended to be lenient in granting permits without specific information on leaching potential (Gorham, 1974).

Bark, however, has sufficient leaching potential to require careful disposal in order to avoid ground and surface water contamination. Leaching of its water soluble components can generate color, COD, BOD, and bacterial oxygen changes if anaerobic conditions exist (Hanson, 1972). A number of organic compounds could also be leached from bark on contact with waste solvents in a disposal environment. These include terpenes, fats, waxes, resins, tannins, and many others (Gorham, 1974). The impact of these types of leachates as well as those from essentially inorganic wastes can be considerably reduced by collecting and returning them to the waste treatment system.

A mixture of alkaline and acid wastewaters in mill sewering arrangements, air entrainment in sewers, and aeration in biological treatment may also lead to an unaesthetic foam problem. Correct sewering arrangements, good outfall design, diffusers, or, where necessary, foam control agents should be employed.

I.E. REGULATIONS

I.E.1. Water Pollution

The Federal Water Pollution Control Act (FWPCA) Amendments of 1972 established two major, interrelated procedures for controlling industrial effluents from new sources, and specifically included pulp and paper mills in the list of affected categories of sources. The principal mechanism for discharge regulation is the NPDES permit. The other provision is the new source performance standard. The Clean Water Act of 1977 (P.L. 95-217), which amends P.L. 92-500, made no change in these basic procedures.

The NPDES permit, authorized by Section 402 of FWPCA, prescribes the conditions under which effluents may be discharged to surface waters. The conditions applicable to new or expanded pulp and paper mills will be in accordance with NSPS, adopted by EPA pursuant to Section 306, and pretreatment standards promulgated to implement Section 307(b). Different standards will be applicable nationwide depending on the subcategory of mill under consideration. Stricter effluent limitations may be applied on a site specific basis if required to achieve water quality standards.

The effluent NSPS promulgated for new sources in the unbleached kraft, NSSC sodium base, NSSC ammonia base, NSSC/unbleached kraft with cross recovery, and waste paperboard subcategories are shown in Table 5. Effluent NSPS are proposed for the other 17 subcategories and also are included in Table 5. If the proposed standards are adopted, most mills will be represented in this table. The absence of effluent NSPS applicable to specialty mills and textile fiber mills means that new or expanded mills in these categories cannot be defined as new sources and the issuance of NPDES permits by EPA is not subject to NEPA.

New sources that discharge wastewater to publicly owned treatment works (POTW's) are required to comply with EPA's pretreatment regulations, issued in the June 26, 1978 Federal Register (as 40 CFR 403). These regulations stipulate that certain POTW's, categorized by size and influent characteristics, develop POTW Pretreatment Programs. These programs are intended to prevent the introduction of pollutants by industrial users that would interfere with the operations of treatment works, would pass through treatment works, or would adversely affect opportunities to recycle and reclaim wastewaters and sludges.

Regardless of specific limitations required by the Pretreatment Programs, the regulations (Section 403.5) state that the following may not be introduced into a POTW:

- Pollutants which create a fire or explosion hazard in the POTW.
- Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, unless the works is specifically designed to accomodate such discharges.

Table 5. Promulgated and proposed Federal new source performance standards applicable to subcategories of the pulp, paper, and paperboard point source categories

Subcategory	BOD_5				Total suspended solids				pH
	1-day maximum		Maximum average of daily values for 30 consecutive days		1-day maximum		Maximum average of daily values for 30 consecutive days		
	kg/kkg of product	lb/ton of product	kg/kkg of product	lb/ton of product	kg/kkg of product	lb/ton of product	kg/kkg of product	lb/ton of product	
Unbleached kraft*†	3.1	6.2	1.55	3.1	6.5	15.0	3.75	7.5	6.0-9.0
NSSC sodium base*†	5.2	10.4	2.6	5.2	7.7	15.4	3.85	7.7	6.0-9.0
NSSC ammonia base*	7.5	15.0	3.75	7.5	7.5	15.0	3.75	7.5	6.0-9.0
NSSC unbleached kraft (cross recovery)*†	3.8	7.6	1.9	3.8	8.0	16.0	4.0	8.0	6.0-9.0
Waste paperboard*	1.5	3.0	0.75	1.5	4.0	8.0	2.0	4.0	6.0-9.0
Dissolving kraft	11.75	23.5	6.1	12.2	15.5	3.10	8.35	16.7	5.0-9.0
Market bleached kraft	3.8	7.6	2.0	4.0	5.35	10.7	2.9	5.8	5.0-9.0

Table 5. Promulgated and proposed Federal new source performance standards applicable to subcategories of the pulp, paper, and paperboard point source categories--Continued

Subcategory	BOD_5				Total suspended solids				pH
	1-day maximum		Maximum average of daily values for 30 consecutive days		1-day maximum		Maximum average of daily values for 30 consecutive days		
	kg/kkg of product	lb/ton of product	kg/kkg of product	lb/ton of product	kg/kkg of product	lb/ton of product	kg/kkg of product	lb/ton of product	
BCT bleached kraft	7.05	14.1	3.7	7.4	9.3	18.6	5.0	10.0	5.0-9.0
Fine bleached kraft	4.95	9.9	2.55	5.1	6.5	13.0	3.5	7.0	5.0-9.0
Papergrade sulfite	18.15	36.3	9.45	18.9	12.0	24.0	6.45	12.9	5.0-9.0
Low alpha dissolved sulfite	23.75	47.5	12.35	24.7	16.75	33.5	9.0	18.0	5.0-9.0
Groundwood chemi-mechanical**	3.15	6.3	1.65	3.3	6.15	12.3	3.3	6.6	5.0-9.0
Groundwood thermo-mechanical**	4.45	8.9	2.3	4.6	5.85	11.7	3.15	6.3	5.0-9.0
Groundwood CMN papers**	3.85	7.7	2.0	4.0	5.85	11.7	3.15	6.3	5.0-9.0

Table 5. Promulgated and proposed Federal new source performance standards applicable to subcategories of the pulp, paper, and paperboard point source categories--Continued

Subcategory	BOD_5				Total suspended solids				pH
	1-day maximum		Maximum average of daily values for 30 consecutive days		1-day maximum		Maximum average of daily values for 30 consecutive days		
	kg/kkg of product	lb/ton of product	kg/kkg of product	lb/ton of product	kg/kkg of product	lb/ton of product	kg/kkg of product	lb/ton of product	
Groundwood fine papers**	3.7	7.4	1.9	3.8	5.6	11.2	3.0	6.0	5.0-9.0
Soda	6.0	12.0	3.15	6.3	7.95	15.9	4.3	8.6	5.0-9.0
Deink	7.5	15.0	3.9	7.8	7.45	14.9	4.0	8.0	5.0-9.0
Nonintegrated fine paper	2.6	5.2	1.35	2.7	2.6	5.2	1.4	2.8	5.0-9.0
Nonintegrated tissue paper	4.15	8.3	2.15	4.3	4.1	8.2	2.2	4.4	5.0-9.0
Nonintegrated tissue from waste paper	3.7	7.4	1.9	3.8	3.65	7.3	1.9	3.9	5.0-9.0
High alpha dissolved sulfite	26.5	53.0	13.8	27.6	17.6	35.2	9.45	18.9	5.0-9.0
Papergrade sulfite market pulp	19.3	38.6	1.05	20.1	12.7	25.4	6.85	13.7	5.0-9.0

Table 5. Promulgated and proposed Federal new source performance standards applicable to subcategories of the pulp, paper, and paperboard point source categories--Continued

* Promulgated; all others proposed.

† The color limitations are as follows:

	1-day maximum		Maximum average of daily values for 30 consecutive days	
	kg/kkg of product	lb/ton of product	kg/kkg of product	lb/ton of product
Unbleached kraft	15.0	30.0	10.0	20.0
NSSC/unbleached kraft	25.0	37.5	12.5	25.0

**Mills using zinc hydrosulfite as a bleaching agent are subject to zinc pretreatment standards.

Source: US Environmental Protection Agency. 1976a. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, deinked and non-integrated paper mills of the pulp, paper, and paperboard mills point source category. EPA 440/1-76/047-b, Dec.

- Solid or viscous pollutants in amounts which cause obstruction to the flow in sewers, or other interference with the operation of the POTW.

- Any pollutant, including oxygen demanding pollutants, released in a discharge of such volume or strength as to cause interference in the POTW.

In addition, there is a restriction on thermal discharges that becomes effective in June 1981.

Since new sources discharging to POTW's do not require NPDES permits, they are not subject to NEPA under Section 511(c)(1) of the Federal Water Pollution Control Act, as amended by the Clean Water Act of 1977.

NPDES permits also impose special conditions beyond the effluent limitations stipulated, such as schedules of compliance and treatment standards. Once mills are constructed in conformance with all applicable standards of performance, however, they are relieved by Section 306(d) from meeting any more stringent standards of performance for 10 years or during the period of depreciation or amortization, whichever ends first. This guarantee does not extend, however, to toxic effluent standards adopted under Section 307(a), which can be added to the mill's NPDES permit when they are promulgated.

The toxic standards will be industry-specific--or possibly subcategory-specific --and a study to determine the need for such standards in the pulp and paper industry is currently in progress. The outcome of this will not be known for some time, although the EPA Administrator is under court order to promulgate toxic effluent standards for a number of specified industries, including the pulp and paper industry, no later than 30 September 1980, if the finding is that an industry's effluents contain more than trace amounts of the toxic compounds itemized in the recent consent agreement.* P.L. 95-217 also expands Section 307(a) of P.L. 92-500 dealing with toxic standards or prohibitions on existing sources. Thus, any evaluation of the impact of new or expanded mills should include a verification of the status of applicable toxic effluent standards.

Many States have qualified, as permitted by Public Law 92-500, to administer their own NPDES permit programs. The major difference in obtaining an NPDES permit through approved State programs vis-a-vis the Federal NPDES permit program is that the Act does not extend the NEPA environmental impact assessment requirements to State programs. As of April 1976, however, 26 States had enacted NEPA-type legislation and others plan to do so. Thus, it is likely that new mills or major expansions of existing mills will come under increased environmental review in the future. Because the scope of the implementing regulations varies considerably, current information on prevailing requirements

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*Natural Resources Defense Council, Inc., et al., v. Russel Train, Civil Action No. 2153, Final Order and Decree, U.S. District Court for the District of Columbia (1976).

should be obtained early in the planning process from permitting authorities in the appropriate jurisdiction.

I.E.2. Air Pollution

The Federal regulations applicable to the air emissions from pulp and paper mills are the particulate and sulfur dioxide ambient air quality standards and NSPS on particulate and total reduced sulfur emissions of kraft mills. The NSPS, which are emission standards, were finalized in the Federal Register of 23 February 1978, Part V.

The particulate standards (40 CFR Part 60, Subpart BB) are shown in Table 6.

Because quantification of odor is a subjective area in air pollution control, the TRS standards use limitations on TRS emissions themselves rather than on the intensity of odors. This approach is expected to ensure more objective and efficient enforcement. The TRS standards for recovery furnaces, cross recovery furnaces, lime kilns, brown stock washer systems, black liquor oxidation systems, condensate stripper systems, digester systems, multiple-effect evaporator systems, and smelt dissolving tanks are shown in Table 7. The standards for the last six of these sources may be waived if the off gases are combusted in a lime kiln or recovery furnace which meets the requirements of the standards applicable to those sources, or in an incinerator or other device, or in a lime kiln or recovery furnace not subject to the standards, provided they are subjected to a minimum temperature of 649°C (1200°F) for at least 5 seconds.

These limitations are expected to prevent odor problems from most new kraft mills except in the immediate vicinity when downwash conditions occur, and the proposed particulate standards will substantially reduce ground-level ambient air concentrations of that pollutant. These standards will apply to all kraft pulp mills because they are not further subcategorized for purposes of air pollution control. However, the EPA Administrator may exempt any new, modified, or reconstructed black liquor oxidation system or brown stock washer system at an existing kraft pulp mill from the TRS standard, provided the owner or operator demonstrates that incineration of the exhaust gases from such systems in an existing recovery furnace is not technologically and economically feasible. Any exempt system will become subject to the provisions of this subpart if the recovery furnace is changed so that the gases can be incinerated.

As of October 1974, 12 States and several California counties had adopted emission standards applicable to all sources of TRS discharges or to kraft mills in particular. They range from 1.0 to 70.0 ppm and from 0.05 to 1.0 kg/kkg (0.1 to 2.0 lb/ton) of ADP. Promulgation of the Federal NSPS for TRS emissions from kraft mills does not prevent state or local agencies from adopting more stringent emission limitations for these sources.

Power boilers of 250 million Btu input or larger operated on fossil fuels are subject to the standard shown in Table 8. EPA is considering the applicability of the particulate standard to bark boilers, but the question is not yet resolved. There are currently no standards for smaller boilers.

Table 6. New source performance standards for particulates from kraft pulp mills

Recovery furnace	Maximum particulate matter 0.10 g/d/stdm^3 (0.044 gr/d/stdft^3) at 8% oxygen Maximum 35% opacity
Smelt dissolving tank	Maximum particulate matter 0.1 g/kg black liquor solids (BLS) (0.2 lb/ton BLS) (dry weight)
Lime kiln:	
When gaseous fossil fuel is burned	Maximum particulate matter 0.15 g/d/stdm^3 (0.067 gr/d/stdft^3) at 10% oxygen
When liquid fossil fuel is burned	Maximum particulate matter 0.30 g/d/stdm^3 (0.13 gr/d/stdft^3) at 10% oxygen

Source: 40 CFR Part 60, Subpart B.B.

Table 7. New source performance standards for total reduced sulfur (TRS) for kraft pulp mills

System	ppm[a]	g/kg(lb/ton) BLS (dry weight)
Recovery Furnace	5[b]	
Cross Recovery Furnace	25[b]	
Lime Kiln	8[c]	
Brown Stock Washer System	5[c]	
Black Liquor Oxidation System	5[c]	
Condensate Stripping System	5[c]	
Digester System	5[c]	
Multiple-Effect Evaporator System	5[c]	
Smelt Dissolving Tank		0.0084(0.0168)

[a] By volume dry basis.

[b] Corrected to 8% oxygen.

[c] Corrected to 10% oxygen.

Table 8. Standards for power boilers: Pulp and paper industry

Component	Standard
Particulate	No particulate in excess of 43 ng/J (0.10 lb/millions Btu)
Opacity	Exhibit>20% opacity except 40% opacity for 2 minutes in any hour
SO_2	Maximum of 520 ng/J heat input (1.2 lb/million Btu)

Source: 40 CFR Part 60.

The Federal NSPS do not impose SO_2 emission standards on processes of pulp and paper mills. As noted in Section I.C.4., the emissions of this pollutant from kraft mill recovery furnaces and lime kilns were specifically excluded from the NSPS because best demonstrated control techniques, considering costs, have not been identified (EPA, 1976b). Some States have, however, adopted such standards, although some of them apply only to specific industries or only to combustion sources. The applicability of these standards should be clarified when considering the impact of any new source.

It is possible that the Federal SO_2 ambient air quality standards (40 CFR Part 50), which are nonenforceable goals for acceptable levels of this pollutant, may be exceeded in the vicinity of kraft, sulfite, or NSSC pulp mills. Depending on site-specific operations, ambient air standards for particulates could be violated by many types of operations in this industry, although no particulate-related problems are likely to be associated with enclosed mechanical pulping operations. Particulate standards are shown in Table 9; SO_2 standards appear in Table 10.

Kraft mills with the potential to emit 91 kkg (100 tons) or more per year of any air pollutant, or any other mills with the potential to emit 227 kkg (250 tons) or more per year of any pollutant, may be excluded from certain areas under the Federal PSD regulations or be required to meet more stringent air quality goals than the ambient air standards in others. The Clean Air Act Amendments of 1977 (Public Law 95-95) establish three types of areas:

- Class I areas, in which almost any deterioration of air quality is deemed significant
- Class II areas, in which a moderate increase in pollution concentration is acceptable, to allow for moderate growth
- Class III areas, in which a greater pollutant increase is acceptable

Increases in pollutant concentrations over baseline values are limited in these areas to those shown in Table 11. The allowable increments are limited to those which will not cause violations of the ambient air quality standards.

All international parks, national wilderness areas, and national memorial parks that exceed 5,000 acres, and all national parks that exceed 5,000 acres are classified as Class I areas. However, an exception may be granted to a source exceeding the Class I allowable increase on these mandatory Class I areas if a Federal land manager certifies that the facility will have no adverse impact on the air-quality-related values, including visibility. In such cases, the allowable increases listed in the last column of Table 11 apply.

All other areas are designated as Class II, but States may redesignate these areas as Class I or III, provided certain requirements of Public Law 95-95 are fulfilled.

Similar air quality regulations may be applied to new mills or significantly modified existing mills in industrial areas where ambient air standards are being exceeded. Permits will be required for construction and operation of major new or modified sources and applicants will be required to achieve the

Table 9. Federal ambient air standards for particulates

	($\mu g/m^3$)
Primary standard:	
Annual geometric mean	75
Maximum 24-hour concentration, not to be exceeded more than once a year	260
Secondary standard:	
Annual geometric mean	60

Source: 40 CFR Part 50.

Table 10. Federal ambient air standards for sulfur dioxide

	$\mu g/m^3$
Primary standard:	
Annual arithmetic mean	80
Maximum 24-hour concentration not to be exceeded more than once a year	365
Secondary standard:	
Maximum 3-hour concentration not to be exceeded more than once a year	1300

Source: 40 CFR Part 50

Table 11. Nondeterioration increments for SO_2 and particulate matter in areas with different air quality classifications

Pollutant	Class I ($\mu g/m^3$)	Class II ($\mu g/m^3$)	Class III ($\mu g/m^3$)	Class I exception ($\mu g/m^3$)
Particulate matter:				
Annual geometric mean	5	20	37	19
24-hour maximum	10	37	75	37
Sulfur dioxide:				
Annual arithmetic mean	2	20	40	20
24-hour maximum	5*	91	182	91
3-hour maximum	25*	512	700	325

*A variance may be allowed to exceed each of these increments on 18 days per year, subject to limiting 24-hour increments of 36 $\mu g/m^3$ for low terrain and 62 $\mu g/m^3$ for high terrain and 3-hour increments of 130 $\mu g/m^3$ for low terrain and 221 $\mu g/m^3$ for high terrain. To obtain such a variance requires both State and Federal approval.

Source: Clean Air Act Amendments of 1977.

"lowest achievable emission rate" of any pollutant which exceeds the standards. This rate is defined as a rate of emissions which reflects:

- The most stringent emission limitation in the applicable State implementation plan unless the applicant can demonstrate that such limitations are not achievable; or

- The most stringent limitation which is actually achieved in practice by similar mills.

Public Law 95-95 further requires that the permit to construct and operate may only be issued if:

- By the time the mill is to commence operation, total allowable emissions from all existing and new sources in the Air Quality Control Region, including the new or modified mill, will permit reasonable further progress toward attainment of the applicable national ambient air standard for the identified pollutant, or

- The emissions of such pollutant from the new or modified mill will not cause the total emissions of the pollutant to exceed the allowance permitted by the implementation plan for the pollutant from all new or modified sources in the area.

I.E.3. Land Disposal of Wastes

The applicability of various provisions of the Resource Conservation and Recovery Act (RCRA) to wastes of pulp and paper mills is not well defined at present. The most stringent provisions of this legislation deal with hazardous wastes, and all parties who generate, transport, treat, store, or dispose of hazardous wastes are subject to regulation, through EPA or a State with an approved State program.

At the time of publication of these guidelines, EPA's Hazardous Waste Management Division had not listed the wastes of the pulp and paper industry that are sent to land disposal, including waste treatment sludge, as hazardous within the meaning of the Act. Unless this situation changes, the pulp and paper industry, as a whole, will not be considered as an affected party under Subtitle C of RCRA, which provides for regulation of hazardous wastes. The determination of whether to list pulp and paper mill industry waste as hazardous will be made in part on the outcome of studies on the concentrations of toxic substances in pulp and paper mill sludges conducted by EPA's Industrial Waste Laboratories. Until such a determination is made, each new proposed mill will be evaluated on a case-by-case basis. The applicant should present in the EID an analysis of the projected characteristics of sludges from the facility. The analysis should be based on the nature of the raw materials to be used, on the types of production and waste treatment processes proposed, and on data on sludges from comparable facilities.

The industry's other solid wastes for land disposal -- inert grits and dregs, bark, ash, trash, etc. -- will be subject to the sections of RCRA dealing with nonhazardous solid wastes. In general, recovery or disposal in a sanitary landfill will be required under a State regulatory program. New open dumps will be prohibited.

Existing State regulatory requirements for solid and hazardous waste disposal that do not meet or exceed the new Federal requirements will be superseded, and for purposes of this discussion, they may be considered obsolete. The acceptable types of land disposal are discussed in Section III.

II. IMPACT IDENTIFICATION

II.A. PROCESS WASTES

This subsection covers the generation of liquid effluents, stack emissions, and wastes for land disposal.

II.A.1. Wood Preparation

Where wet barking is practiced, total woodyard effluents that may be expected are on the order of those shown in Table 12.

There are no data available on particulate emissions from pulp mill woodyards, and airborne material will not be a problem in wet operations. In the dry barking systems, there is a potential for minor problems of this type.

Solid
wood slivers.

II.A.2. Kraft Pulping

The major sources of wastewater from the kraft pulping process are pulp washing, digester and evaporator condensates, and chemical recovery. Figure 9 shows the added contribution of bleaching in bleached kraft mills and the papermaking operation. These values represent an average mill, and reflect minor variations from other data because of rounding.

Pollution components of kraft pulping include suspended solids, dissolved organics, electrolytes, and inorganic compounds attached to the organic compounds. The biological degradable organics include fatty acids, methanol, ethanol, turpenes, acetone, and other cellulose decomposition products (Hruitford and McCarthy, 1967; NCASI, 1972; Wenzl, 1967; Wilson et al., 1972). This component accounts for a major percentage of the BOD_5 in kraft mill effluent. The nondegradable organic component--lignins and tannins--is responsible for a large part of the color. Color is especially troublesome in bleached kraft operations because bleaching extracts these color bodies. Chlorides are also a major pollutant contributed by bleaching.

The range in parameters among the unbleached kraft mills surveyed for the effluent guidelines study is shown in Table 13. American Public Health Association (APHA) color units are typically in the 500-1,000 range.

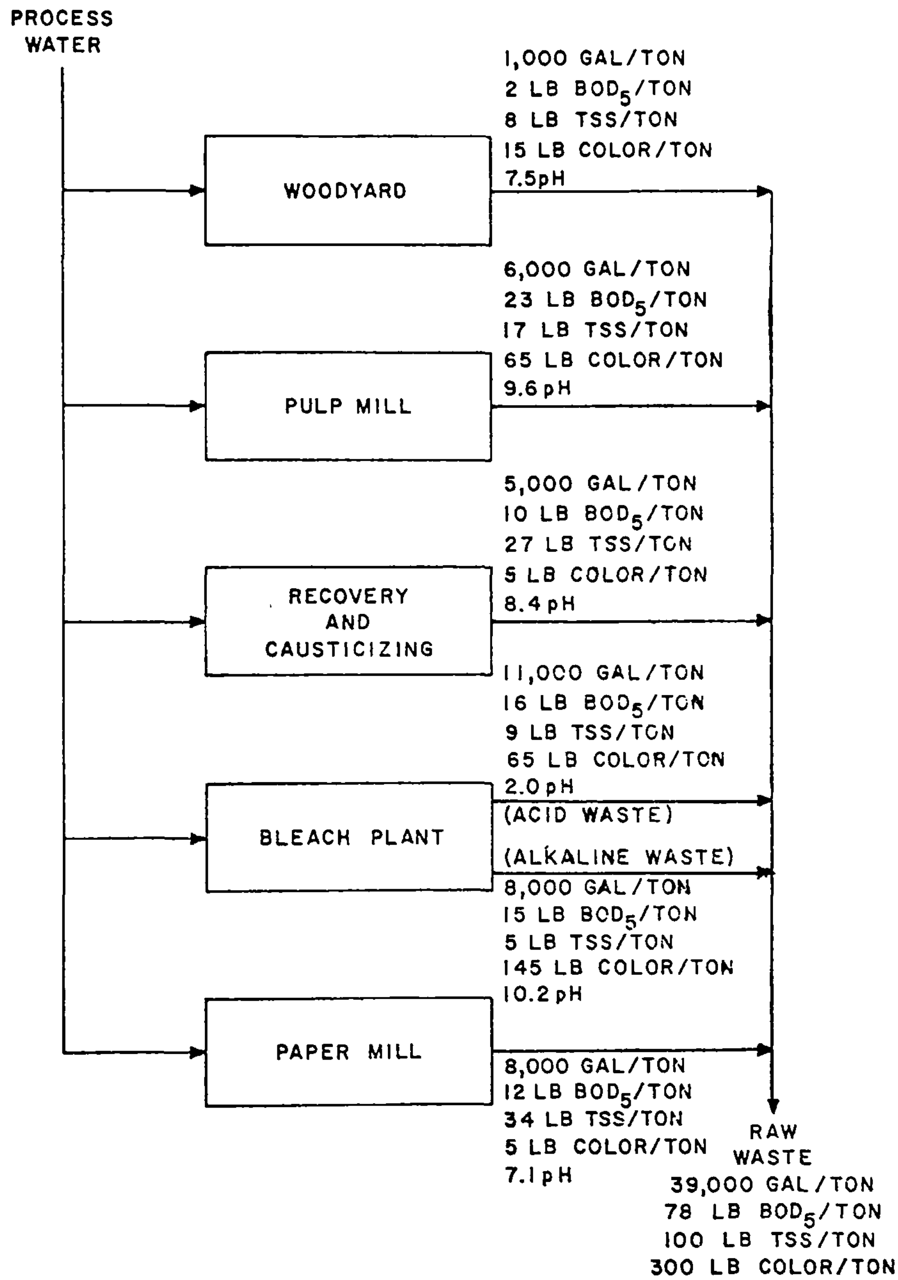
In bleached kraft mills:

- Total suspended solids (TSS) concentrations in effluents range widely, but average between about 20 and 30 kg/kkg (40 and 60 lb/ton) in well-operated mills.
- The average BOD_5 load amounts to 12.5-25 kg/kkg (25-50 lb/ton).
- APHA color units during periods of normal operation range from 500 to 2,000 values.

Table 12. Woodyard effluents during wet barking operations

Woodyard operation	Type of pulping: Groundwood	Papergrade kraft, soda, sulfite	Dissolving pulp
Debarking:			
Flow, in kl/kkg (kgal/ton)	15.4 (3.7)	30.8 (7.4)	42.5 (10.2)
BOD_5, in kg/kkg (lb/ton)	2.55 (5.1)	5.1 (10.2)	7.0 (14.0)
Log chip wash:			
Flow, in kl/kkg (kgal/ton)	1.7 (0.4)	3.4 (0.8)	4.6 (1.1)
BOD_5, in kg/kkg (kgal/ton)	0.3 (0.6)	0.6 (1.2)	0.9 (1.7)
Flume/pond:			
Flow, in kl/kkg (kgal/ton)	3.3 (0.8)	6.6 (1.6)	9.2 (2.2)
BOD_5, in kg/kkg (lb/ton)	0.4 (0.8)	0.8 (1.6)	1.1 (2.2)

Source: US Environmental Protection Agency. 1976a. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, deinked and non-integrated paper mills of the pulp, paper, and paperboard mills point source category. EPA 440/1-76/047-b, Dec.



Source: US Environmental Protection Agency. 1976a. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, deinked and non-integrated paper mills of the pulp, paper, and paperboard mills point source category. EPA 440/1-76/047-b, Dec.

Figure 9. Effluent characteristics for bleached kraft mill process waters

Table 13. Water quality values among unbleached kraft mills

Item	Range	Number of mills	Mean
Flow		11	
kl/kg	39.2-112.6		75
gal/ton	9.4- 27.0		18
BOD_5		9	
kg/kkg	12.2- 21.2		17
lb/ton	24.5- 42.5		34
TSS		7	
kg/kkg	10.5- 28.0		19
lb/ton	21.0- 56.0		38

The kraft mill odor problem arises from the use of sodium sulfide as a component of the cooking liquor. In the digesters, the sulfide ion combines with various organic side-chain radicals from the cellulose and the lignin of wood chips to form such organic sulfides as methyl mercaptan, dimethyl sulfide, dimethyl disulfide, and small amounts of similar ethyl sulfide compounds. In addition, hydrogen sulfide is formed in considerable amounts. These gases are released with the digester relief and blow gases, as well as from the recovery furnace, lime kiln, smelt dissolving tank, multiple-effect evaporators, black liquor oxidation, brown stock washer, and condensate stripping (Eddinger et al., 1974; NCASI, 1973).

Typical TRS emissions from an uncontrolled 907 kkg/d (1,000-ton/d) kraft mill are shown in Table 14.

Particulate emissions occur primarily from the recovery furnace, the lime kiln, and the smelt dissolving tank as follows:

- Recovery furnace emissions consist primarily of sodium sulfate and sodium carbonate.
- Lime kiln emissions are primarily sodium salts, calcium carbonate, and calcium oxide.
- Smelt dissolving emissions are caused primarily by the entrainment of particles and odorous materials in the vent gases.

Particulate emissions are also generated by power and bark boilers (NCASI, 1973).

Typical particulate emissions for an uncontrolled 907-kkg/d (1,000-ton/d) kraft mill are shown in Table 15.

In addition to the bark generated in wood preparation, ash from the recovery furnace and power boilers, and rejects and screenings, kraft mill recovery systems generate solid wastes that are largely peculiar to kraft pulping:

- Rejects from slakers and unburned lime rejects from the lime kilns
- Dewatered dregs from the green liquor clarifier, discharged as inert solid wastes, such as iron compounds, carbon, grit, and refractory materials, amounting to about 22.5 kg/kkg (45 lb/ton) of pulp produced (EPA, 1974)
- Sodium salts removed with the dregs depending in amount on the completeness of the dregs-washing operation (Expansion, 1977)

II.A.3. Sulfite Pulping

The most significant effects on sulfite effluent quantity and quality are exerted by:

Table 14. Typical TRS emissions: Uncontrolled 907-kkg kraft mill

Source	Exhaust gas flow rate (acfm)	TRS emission rate ppm	kg/h	lb/h	kg/kkg	lb/ton ADP
Digester system	6,200	9,500	28.6	63	0.75	1.5
Multiple-effect evaporator system	2,200	6,800	19.0	42	0.5	1.0
Brown stock washer system	150,000	30	5.9	13	0.15	0.3
Black liquor oxidation system	30,000	35	1.8	4	0.05	0.1
Recovery furnace system	450,000	550	283	625	7.5	15.0
Smelt dissolving tank	58,100	60	3.6	8	0.1	0.2
Lime kiln	79,200	170	15.0	33	0.4	0.8
Condensate stripping	4,000	5,000	37.6	83	1.0	2.0

Source: National Council for Air and Stream Improvement/US Environmental Protection Agency. 1973. Atmospheric emissions from the pulp and paper manufacturing industry. Report 450/1-73-002, Sept.

Table 15. Typical particulate emissions: Uncontrolled 907-kkg kraft mill

Source	Exhaust gas flow rate (acfm)	Particulate emission rate					
		gr/dscf	g/dscm	kg/h	lb/h	k/kkg	lb/T ADP
Recovery furnace system	450,000	3.81	8.72	3,400	7,500	90	180
Smelt dissolving tank	58,000	1.39	3.18	151	333	4	8
Lime kiln	79,200	9.73	22.26	1,510	3,333	40	80

Source: National Council for Air and Stream Improvement/US Environmental Protection Agency. 1973. Atmospheric emissions from the pulp and paper manufacturing industry. Report 450/1-73-002, Sept.

- The woodyard
- Pulp washing and recovery of the spent liquor
- Type of condenser
- Type of cooking liquor
- Bleaching

The effects exerted by barometric and surface condensers and the very acidic cooking liquors (pH less than 3.0) as opposed to bisulfite liquors (pH between 3.0 and 6.0) are illustrated in Table 16.

Raw waste TSS levels in sulfite wastewaters--ranging between 50 and 100 kg/kkg (100 and 200 lb/ton)--are of secondary importance to BOD concentrations in terms of the characteristics of treated effluents. The solubles present in the pulping effluent consist of lignosulfonates, lower fatty acids, alcohols, ketones, wood sugars, and a number of other complex compounds (EPA, 1976a).

The relative contributions of the sulfite pulping and papermaking operations are shown in Figure 10.

The dissolving sulfite subcategory uses essentially the same basic process used in the papergrade subcategories; it generates a much stronger effluent, however, because both the cooking and bleaching stages are more stringent--to the point where over 60% of the wood becomes waste.

Sulfur dioxide is the principal air contaminant generated by sulfite pulping; it derives mainly from the absorption towers used in producing the acidic cooking liquor by reacting SO_2 with the desired base chemical, blow pit or dump tank, multiple-effect evaporators, and chemical recovery systems.

The amount of SO_2 emitted from the absorption tower will depend on the design and operating conditions of the individual tower. SO_2 emissions from the blow pit stack may range as follows (NCASI, 1973):

- Blow pit, hot blow: 100-125 lb/ton ADP
- Dump tank: 10-25 lb/ton ADP

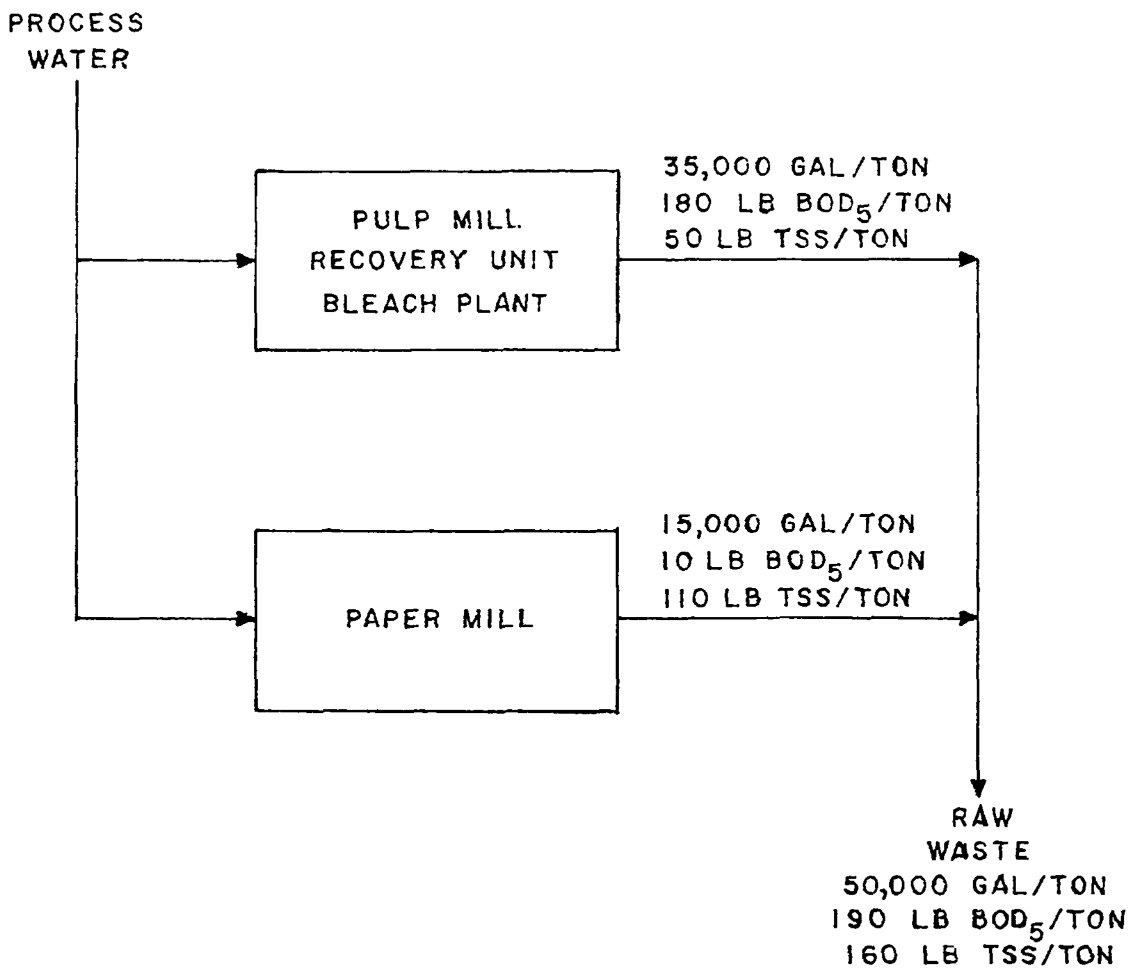
The recovery practice and the SO_2 emissions will vary from one base to another --i.e., sodium, magnesium, and ammonia. Sulfur dioxide emissions from the evaporators range from 5 to 10 kg/kkg (10 to 20 lb/ton) (NCASI, 1973).

Solid wastes from sulfite pulping may include bark, rejects and screenings, ash, and waste paper, as well as some inert materials and some oxide of the base cooking chemical generated in the chemical recovery system.

In sulfite mills with recovery, solid waste generation averages about 5 kg/kkg (10 lb/ton) of pulp production. In some cases, portions of these solid wastes are deposited in the wastewater system for removal rather than segregated for separate collection.

Table 16. Summary of raw waste characteristics of papergrade sulfide mill effluents

Subcategory	Flow		BOD_5	
	kl/kkg	kgal/ton	kg/kkg	lb/ton
Blow pit wash:				
Bisulfite/barometric	221	53.0	116	232
Acid sulfite/barometric	221	53.0	121	242
Bisulfite/surface	186	44.5	116	232
Acid sulfite/surface	186	44.5	121	242
Drum wash:				
Bisulfite/barometric	221	53.0	84	168
Acid sulfite/barometric	221	53.0	104	207
Bisulfite/surface	186	44.5	84	168
Acid sulfite surface	186	44.5	104	207



Source: US Environmental Protection Agency. 1976a. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, deinked and non-integrated paper mills of the pulp, paper, and paperboard mills point source category. EPA 440/1-76/047-b, Dec.

Figure 10. Effluent characteristics for sulfite mill pulping: Drum wash

II.A.4. Neutral Sulfite Semichemical Pulping

The raw waste load from NSSC mills depends largely on the base used (sodium or ammonia), on whether chemical recovery is employed, and on the amount of waste paper added to the furnish. The effects of furnish and waste liquor handling on sodium base NSSC effluents are illustrated in Table 17.

The wastewater characteristics of sodium base and ammonia base mills are similar except for the nitrogen content of ammonia base effluents. Typical nitrogen values for an ammonia base effluent are 210 mg/l Kjeldahl nitrogen and 150 mg/l ammonia nitrogen. Only minor amounts of nitrogen are contained in sodium base effluents.

Although extensive internal recycling has succeeded in reducing flow and BOD loadings to very low levels in some NSSC mills, this performance cannot be maintained because of an intolerable build-up of spent cooking liquor in the final product. Thus, the high degree of recycle commonly practiced is frequently accompanied by high BOD losses.

Sulfur dioxide is the primary air contaminant generated by NSSC mills and occurs principally when the pulp is blown from the digester. Sulfur dioxide emissions will also result from the burning of ammonia base spent liquors, a water pollution control measure. The NSSC process is virtually free of reduced sulfur compound emissions with minor exceptions. No data were found on particulates from the NSSC process.

The solid wastes generated by NSSC mills include bark, rejects and screenings, chemical ash from bark incinerators and chemical combustion, and waste paper. No data were found on typical quantities.

II.A.5. Unbleached Kraft/NSSC (with cross recovery)

In combined NSSC/unbleached kraft operations, if the ratio of NSSC production to kraft production does not exceed 1:3, the increase in BOD and TSS of the kraft effluent is not expected to exceed 10%. For surveyed NSSC/unbleached kraft mills with cross recovery:

- Average flow is approximately 58.4 kl/kkg (14 kgal/ton)
- Average BOD load is about 19.4 kg/kkg (38.8 lb/ton)
- Average TSS level is about 20.5 kg/kkg (41 lb/ton)

The NSSC contribution to the combined effluent does not settle as well as kraft effluent alone because of the higher load of fines. The hardwoods used in the NSSC mill also contribute somewhat more color than the softwoods used in the kraft mill.

II.A.6. Mechanical Pulping

As discussed in Section I.B.2.d., data on mechanical pulping effluents are only available according to the traditional division of mills in this segment of the industry--stone, refiner, chemi-groundwood, cold soda, and thermomechanical. It was the unexpected similarity in wastewater data among

Table 17. The effects of furnish and waste liquor handling on sodium base NSSC effluents

Liquor handling	Flow kl/kkg	k gal/ton	Waste paper furnish (%)	BOD_5 kg/kkg	lb/ton	TSS kg/kkg	lb/ton
Spray irrigation	44.6	10.7	33	8.5	17	8.5	17
Evaporation and incineration	48.8	11.7	6	31.0	62	17.5	35
			33	35.0	70		
			27-37	24.0	48		
			17-21	31.0	62		

some of these processes that led to the regulatory division described in Section I.A. and I.B.2.d. Nevertheless, to illustrate the quantity and quality of groundwood effluents, the background data must be employed.

Effluents from all of these processes contain suspended solids and dissolved organic matter, both of which contribute to the BOD load (EPA, 1976a). Chemi-groundwood and cold soda process waters also contriubte electrolytes containing some ions of the residual and spent chemicals.

There is no discernible relationship between TSS effluent concentration and the several groundwood processes. One study (EPA, 1976a) found a TSS range from 21 to 80 kg/kkg (42 to 161 lb/ton).

The dissolved organic materials in groundwood effluents consist of wood sugars and cellulose degradation products as well as resinous substances. The BOD_5 loads in the effluents of the various groundwood processes range as shown in Table 18. It is noted that the processes involving the use of chemical conditioning agents show the higher BOD values.

The effluent flow from groundwood pulping is relatively low and can be expected to range from 8.3 to 16.7 kl/kkg (2.0 to 4.0 kgal/ton). However, the flow from the groundwood papermaking operations is substantially higher. This relationship is illustrated in Figure 11. The color is usually below 100 units. New groundwood mills can be expected to replace traditional zinc hypochlorite bleaching with another process to avoid high effluent concentrations of zinc.

Limited data from two thermo-mechanical mills indicate, respectively:

- Flows of 86.7 (20.8) and 88.0 kg/kkg (21.1 kgal/ton)
- BOD_5 at 19.8 (39.6) and 39.2 kg/kkg (78.4 lb/ton)
- TSS at 49.2 (08.3) and 39.9 kg/kkg (79.8 lb/ton)

No data were found on air pollution emissions from groundwood operations, and there is less potential for this type of problem than in full chemical pulping. Even in those processes where chemicals are used, they are not subjected to the harsh heat and pressure conditions of chemical pulping. Some volatile organics may be expected, however.

Solid wastes from groundwood mills consist typically of bark (if barking is performed on the premises), shives (small pieces of wood that will not grind properly), screenings, ash, and waste paper.

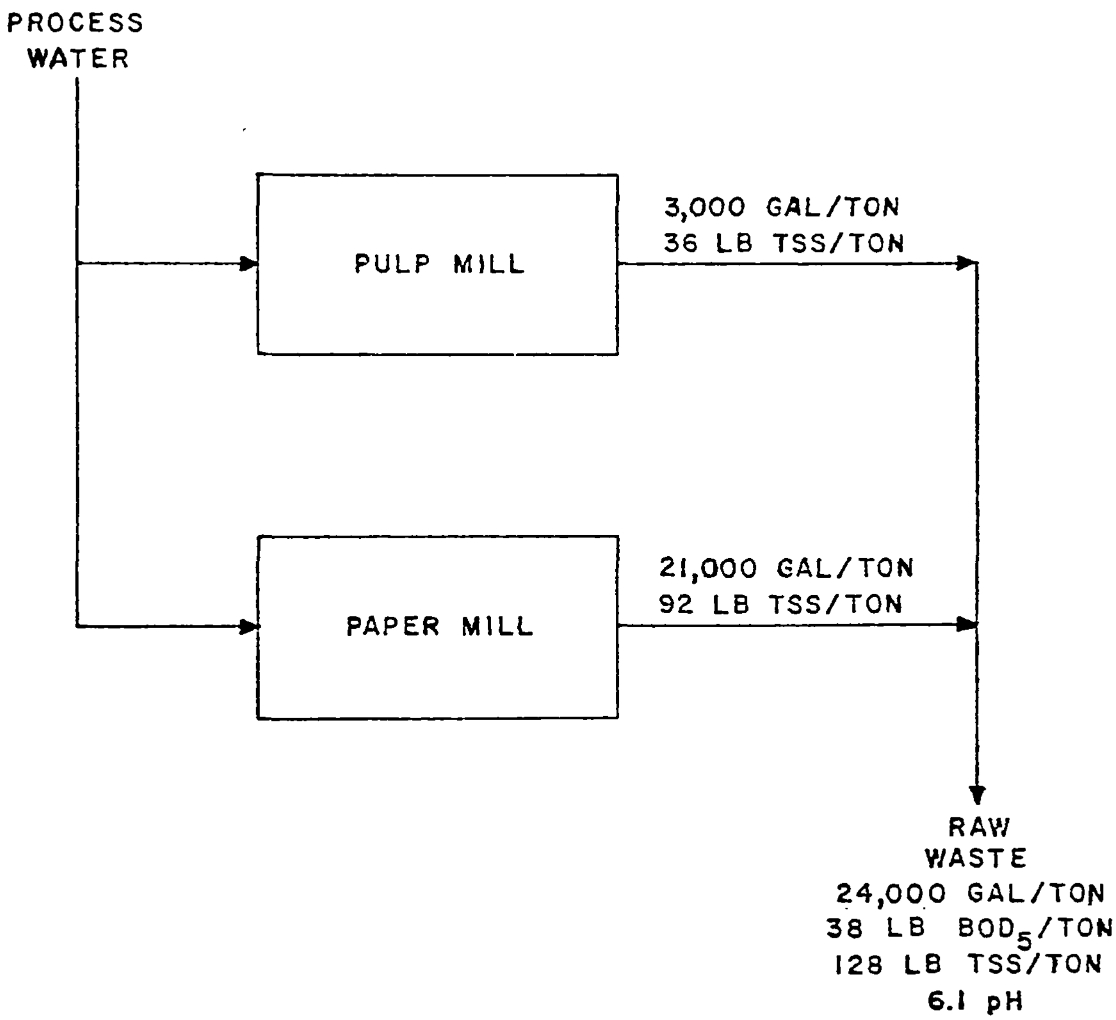
II.A.7. Waste Paperboard Production

The raw waste load of waste paperboard mills is generated in the stock preparation area and is mainly a function of the type of raw materials and additives used. In general, the higher the percentage of kraft or NSSC waste-paper used in the furnish, the higher the BOD_5 value per ton of product. Mills whose wastes have the higher BOD_5 values also generally include those that employ an asphalt dispersion system in the stock preparation process in order to melt and disperse the asphalt found in corrugated waste paper.

Table 18. Range of BOD_5 loads in effluents of groundwood processes

Type of pulp	BOD_5 kg/kkg	BOD_5 lb/ton
Stone	4.0- 9.5	8- 19
Refiner	9.0-16.0	18- 32
Chemigroundwood	34.5-40.5	69- 81
Cold soda	36.5-50.5	73-101

Source: US Environmental Protection Agency. 1976a. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, deinked and non-integrated paper mills of the pulp, paper, and paperboard mills point source category. EPA 440/1-76/047-b, Dec.



Source: US Environmental Protection Agency. 1976a. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, deinked and non-integrated paper mills of the pulp, paper, and paperboard mills point source category. EPA 440/1-76/047-b, Dec.

Figure 11. Effluent characteristics for groundwood (coarse, molded, newsprint) mill

Compiled data on waste paperboard effluents indicate a flow range from 14 to 100 kl/kkg (3 to 24 kgal/ton) for an average of 46 kl/kkg (11 kgal/ton) (Bishop et al., 1968; Wisconsin State Department of Health, 1965; Michigan Water Resources Commission, undated), values that usually reflect a high degree of water recycling. If food board, which will be adversely affected by accumulated taste and odor producing substances, is not produced, the potential for reuse is greater and volumes should be smaller. Effluent has been virtually eliminated at three waste paperboard mills because the coarse grade of the products permits.

The data on waste paperboard mills also show a range of TSS losses from 4.0 to 61.5 kg/kkg (8 to 123 lb/ton) for an average of 19.2 kg/kkg (38.4 lb/ton). BOD_5 values ranged from 5.0 to 37.5 kg/kkg (10 to 75 lb/ton). Residual pulping liquor, starch, and other adhesives account for most of the BOD. In a later survey (EPA, 1974), the average BOD raw waste load was 11.2 kg/kkg (22.5 lb/ton), with a range of 4-20 kg/kkg (8-40 lb/ton).

The wastepaper reclamation process has a unique solid waste generation problem in that contaminants present in the wastepaper must be removed before new paper and paperboard products can be manufactured from the available fiber. The highly diversified contaminants were enumerated in Section I.D.3. Some of the heterogeneous materials removed will form a long continuous rope; others, such as glass or plastics, will break into small pieces.

The extent of contamination and the amount of cleaning required will vary with each batch of wastepaper and with the specific end use. For example, mills using mixed wastepaper to produce lower grade products will generate more solid waste than mills using high grade segregated wastepaper.

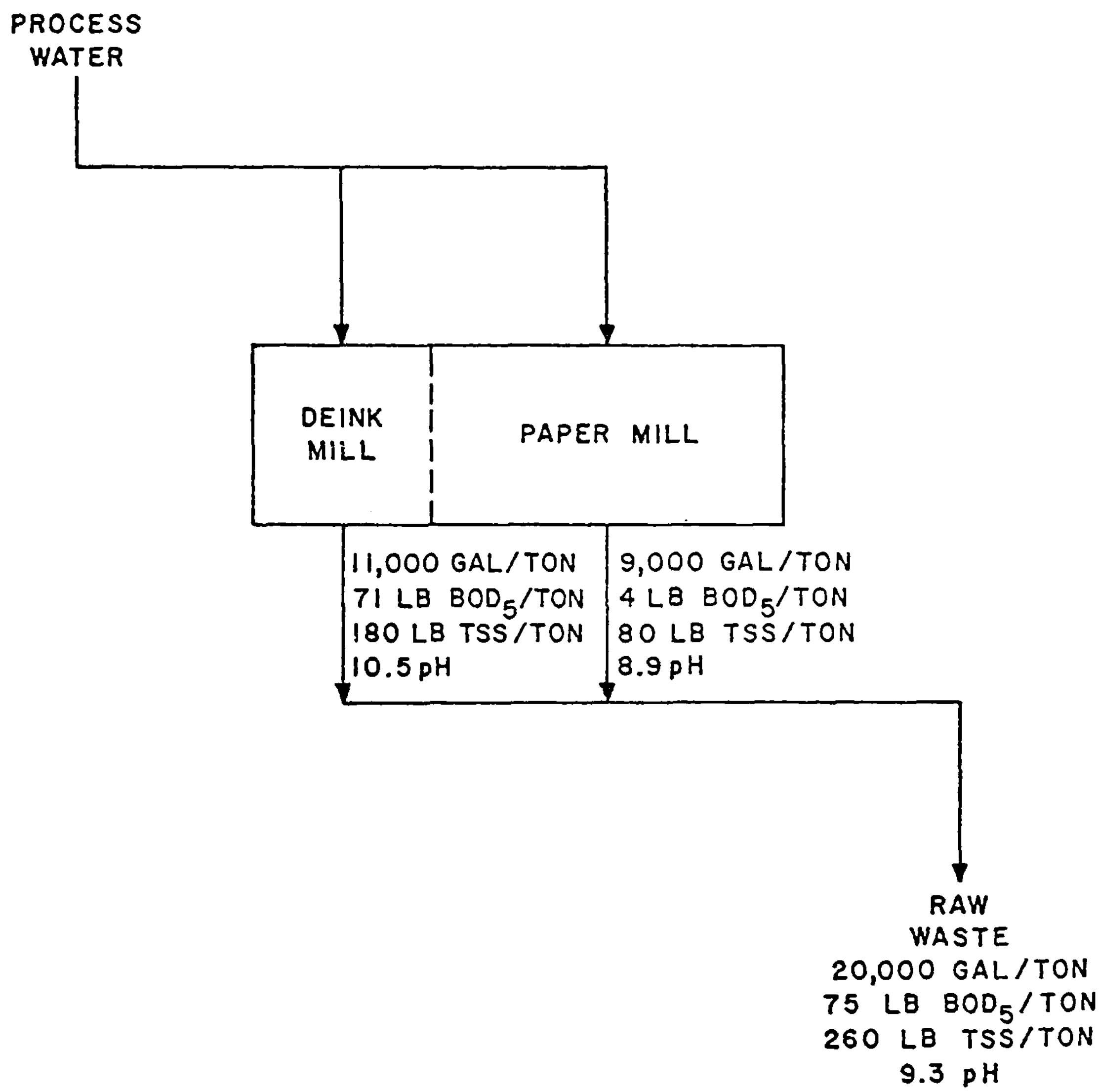
II.A.8. Deinking

The major sources of effluent from the deinking process are the washers and centricleaners; the remaining streams consist mainly of miscellaneous white water overflows, floor drainage, washup, and cooling waters. Clarified white water from papermaking operations may supply a considerable part of the water used for washing and cleaning. The entire wastewater flow from a single stage bleaching operation can also be used in deinking for dilution and preliminary wash water.

The major polluting characteristics of deinking effluents are BOD_5 and suspended solids, both settleable and dispersed (Hodge and Morgan, 1947; NCASI, 1946). Organics present include adhesives, products of hydrolysis, and fiber lost in the process. Inorganics derive from mineral fillers, ink pigments,, and other materials separated from the fiber in wastepaper as well as chemicals used in the process. Included in the latter are dissolved electrolytes--mostly sodium salts--and detergents, which add to the total solids and foaming propensities of receiving waters.

BOD and TSS loads from deinking operations are in the neighborhood of 50 kg/kkg (100 lb/ton) and 150 kg/kkg (300 lb/ton), respectively, on the basis of wastepaper handled.

The relative contributions of the deinking process and the papermaking operation are shown in Figure 12. The values in this diagram are not directly



Source: US Environmental Protection Agency. 1976a. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, deinked and non-integrated paper mills of the pulp, paper, and paperboard mills point source category.

Figure 12. Effluent characteristics for deink mill process

comparable with those values given in the preceding paragraph because they are based upon thousands of kilograms (tons) of paper produced.

Because deinking also involves the use of wastepaper, trash such as that described for waste paperboard will be generated to some extent. The papers are of much higher quality, however, and quantities should be smaller. Some solid wastes also accrue from the fillers and other solids separated from the recycled paper. The permit applicant should identify such wastes and suggest appropriate measures to treat and/or dispose of them.

II.A.9. Papermaking

The principal wastewater discharges from papermaking are as follows:

- Excess white water from seal pits or other tank overflows
- Rejects from stock cleaning devices (centrifugal cleaners, screens, and junk traps)
- Felt and wire cleaning waters
- Spills, washups, discharge of tank dregs, and other non-equilibrium losses
- Cooling water discharges
- Boiler blowdown and other miscellaneous discharges

Data breakdowns on these individual discharges are not available because of sewer interconnections and reuse complications.

Sources of BOD_5 in papermaking wastewaters are the organic raw materials used as the constituents of paper. Cellulose is foremost, constituting 80% or more of the weight of most papers. Rosin sizings and starch or protein adhesives also contribute to BOD_5 loadings, as do many special organic chemicals such as wet strength resins. Some or all of these constituents, including cellulose fibers, are in the solid or precipitated state, and therefore also contribute to TSS loadings. Fillers and coating pigments such as clay and titanium dioxide are responsible for virtually no BOD_5, but add to TSS loadings.

The combined papermaking effluents vary with the grade of paper produced. Averages for nonintegrated paper mills, indicated by data developed during the effluent guidelines study, are shown in Table 19. There were insufficient data on which to characterize the effluents of coarse paper mills, and there is only one nonintegrated newsprint mill.

II.B. TOXICITY OF WASTES AND POTENTIAL ENVIRONMENTAL DAMAGE

II.B.1. Toxicity

Pulping effluents have historically been associated with fish kills downstream of mills. The substances in the raw pulping wastes to which these occurrences were attributed include resin acids, fatty acids, other acidics, chlorinated phenolics, and chloroform (Easty et al., 1978).

Table 19. Water quality values for combined papermaking effluents by grade

Grade	Flow		BOD_5		TSS	
	kl/kkg	kgal/ton	kg/kkg	lb/ton	kg/kkg	lb/ton
Fine papers	63.4	15.2	10.75	21.5	30.8	61.6
Tissue	95.9	22.9	11.5	22.9	34.7	69.4

However, a Federal census of pollution-caused fish kills indicates that such pulp mill related occurrences have become rare (Pollution, 1960-68). While this can be attributed to several factors--such as more widespread use of and improvements in spent liquor recovery systems and increased caution in avoiding spills and leaks of potentially toxic materials--the greatest contributor is biological treatment of effluents. Efficiencies of up to 100% removal of toxic compounds have been reported with good operating conditions and process modifications (Mueller et al., 1977).

More recent EPA-sponsored research in this field indicates that advanced waste treatment technologies can also accomplish good results in detoxification of effluents (Easty et al., 1978). Specific results of this study to be considered by new source NPDES permit applicants include:

- Greater than 90% removal of fatty and resin acids was achieved by the treatment plants at 8 out of 13 mills.
- The levels of chlorinated fatty acids and resin acids reached detectable amounts (740 ppb) in the final effluents of only 3 mills.
- Chloroform concentrations in treated effluents (8-75 ppb) compared favorably with levels reported in municipal drinking waters (3-152 ppb).
- Removal of fatty and resin acids greatly exceeded BOD removal in the lime precipitation system studied.
- Tertiary treatment by alum precipitation reduced fatty and resin acids and chlorinated fatty acids to below detection limits.
- Reverse osmosis essentially completely rejected fatty and resin acids.
- The rejection by a pilot ultrafiltration system with a dynamic polymer was good, although such a unit with a synthetic polymer membrane was much less effective.

Other studies have demonstrated that the 96-hour LC_{50} values of neutralized bleached kraft effluents without further treatment commonly range from 15 to 50% v/v, and after biological treatment they are "essentially nontoxic" (Warren, 1972). Indications are that sulfite wastewater toxicity is similar to that of kraft (Williams et al., undated; Wilson and Chappell, 1973), and with a high degree of recycle, 96-hour LC_{50} values in groundwood operations can be reduced to as low as 1-2% v/v (Borton and Blosser, 1977).

After detoxification by effective biological treatment, pulp and paper effluents will allow 50% or more survival of fish in a 96-hour exposure at 100% concentration, which is about 10-20 times what the no-stress level has been determined to be (Mueller et al., 1977). Because the removal of toxic substances of the types identified above is proportional to BOD reduction, this level of detoxification will be accomplished by the effluent NSPS BOD removal requirements. Still greater reduction can be achieved by final effluent storage.

The high level of treatment embodied in the effluent NSPS is facilitated by practices that hold the load of toxic substances reaching the treatment works to reasonably low and constant levels. These include diversion of washer and evaporator sewers to storage during high liquor loss periods and careful control of turpentine decantation. Because this type of control is not available in the case of wet barking operations, bleach plants, and mechanical pulping, treatment performance alone must meet the effluent NSPS.

A 20:1 receiving water dilution ratio, which with few exceptions is met or exceeded by the streams receiving kraft mill effluents, will result in maintenance of dissolved oxygen levels near saturation.

Any remaining potential for pulp and paper mill effluent toxicity, either through system upset or the volume of discharge, is most important in the waters inhabited by salmon and trout, because these species are the least tolerant to the toxic constituents of pulp and paper mill wastes. There is abundant literature on the lethal and sublethal effects to these and other members of the aquatic community (Mueller et al., 1977; Warren, 1971; Warren, 1972; William et al., undated; Wilson and Chappel, 1973). Available data show that concentrations of kraft effluent of 0.03-0.05 of the 96-hour LC_{50} are below the threshold considered deleterious, and that threshold concentrations of various sublethal parameters are between 0.05 and 0.1 of the 96-hour LC_{50} (Warren, 1972). Sublethal effects include poor growth, reduced swimming speed, and a "general stress response" rather than a specific toxicological effect within the fish (Borton and Blosser, 1977).

The results of the study of toxics in this industry sponsored by EPA's Effluent Guidelines Division will determine what course of action applicants must take to avoid toxicity occurrences. As noted in Section I.C.4, technology-oriented standards will be imposed by 30 September 1980 if warranted by the study findings.

II.B.2. Other Potential Adverse Impacts

II.B.2.a. Air Pollution. Generally, the most likely adverse impacts of air pollution from pulp and paper mills can be characterized as follows (Stockman, 1966):

- Odor
- Visibility reduction
- Corrosion of metals
- Damage to painted surfaces
- Physiologic
- General dirtiness and soiling of surfaces

These factors vary from mill to mill and the degree to which they occur, if at all, is dependent primarily on the process utilized and the degree of air pollution abatement practiced. Location and plant size may also be involved as secondary functions.

The sulfur compounds associated with chemical pulp mills--SO_2 in all chemical subcategories and TRS in kraft mills--and particulate matter represent the greatest potential problems. The group of TRS compounds, because of its strong odor, is often identified as the most apparent pulp mill air pollutant and the one of greatest concern to individuals. The consensus of a national advisory group to EPA was that TRS should be controlled, whether or not it is linked to long term health effects, simply because it is a nuisance (Litton, 1969). The effects of the presence of odor which have resulted in legal redress for damages include loss of sleep, loss of appetite, nausea, and reduced enjoyment of property (Copley, 1973). It can be seen that these nuisance factors may at some point also become inimical to amenity values and economic interests.

Hydrogen sulfide (H_2S), a compound of the TRS group, tarnishes silver and copper, and darkens house paint containing lead, a situation which should not occur in the future because of restrictions on lead based paint. Ambient levels of H_2S high enough to cause vegetative damage, eye or respiratory irritation, systemic effects, or death are not anticipated (American Assn., 1965; Goldsmith, 1962).

In contrast, sulfur dioxide has no discernible odor at the ambient concentrations found in industrial communities. However, since SO_2 damage to human health, plants, livestock, materials (metals, building materials, fabric, paper, and leather), can occur at relatively low levels, the national ambient air quality standards have been set at levels which provide a margin of safety.

There is a synergistic effect between particulate matter and SO_2 and in combination they may produce health effects greater than the sum of the effects caused by these pollutants individually. In addition, airborne SO_2 may oxidize to sulfur trioxide which on contact with moisture in the atmosphere converts to sulfuric acid. This pollutant is potentially more damaging to humans than SO_2 and may accelerate corrosion and deterioration of various materials. Sulfuric acid mists also scatter light to reduce visibility. This phenomenon has been observed to increase with higher relative humidity.

The health effects of mixed particulate matter alone on the populations of small communities are not well established. However, low ambient concentrations are desirable from the standpoint of economic and aesthetic benefits as related to visibility, soiling, corrosion, and other adverse effects. Again, the particulate national ambient air quality standards are designed to provide for these amenities.

Thus, the applicant should describe in his environmental information document the measures to be taken to insure that neither the SO_2 or particulate standards are exceeded in the environs of the mill.

The applicant is referred to two definitive documents on the effects of sulfur dioxide and particulates. These are:

- Air Quality Criteria for Particulate Matter

- Air Quality Criteria for Sulfur Oxides

Both were published by the U.S. Public Health Service in 1969.

II.B.2.b. Leachates. There are no published studies on the specific effects of leaching on groundwater from the land disposal of pulp and paper wastes. However, there is a great body of literature on the use of treated and untreated effluents for irrigation which indicates that the soil exerts a purifying effect on the wastes. During the years in which storage ponds have been utilized for liquid wastes in areas of highly pervious soils, no adverse incidents attributable to seepage have been reported, and one nonintegrated paper mill in Pomona, California has utilized its effluents for direct groundwater recharge.

However, it will be incumbent upon the applicant to demonstrate in the EID that leaching will be controlled and that no toxicity, tastes, odors, or other undesirable characteristics will be introduced to groundwater from the mill's land disposal facilities.

II.C. IMPACT OF NONEQUILIBRIUM CONDITIONS

Although mill production operations may be regarded as a continuous sequential balanced series of unit operations, in practice there is a discontinuity that can create problems both in internal control and influences on external waste treatment facilities. The losses that occur when the production process is not in equilibrium may account for one-third to one-half of the suspended solids and BOD_5 raw waste load in pulping operations, and from one-quarter to one-half of paper mill losses. These factors include:

- Spills
- Overflow
- Washup
- Breakdown of equipment
- Routine maintenance
- Planned shutdowns and start-ups
- Power failures
- Paper grade changes

Continuous monitoring, especially on conductivity, should be employed by the applicant within mill sewers to give immediate warning of spills to facilitate immediate remedial action. Automatic diversion devices operated by the conductivity measuring instruments may also be employed. Mill personnel should be trained to respond promptly with effective corrective measures in all cases.

Best practice also includes the use of storage facilities adequately sized to avoid overflows in at least 90% of process upsets and during maintenance procedures such as evaporator "boil out." Provision should be made to return these stored materials to the originating subprocess at a later time.

If overflows would cause treatment plant upset or increased discharge of pollutants, production should be curtailed as necessary if the overflows cannot be prevented by some other means. Sewer segregation can be used, especially in new mills, to minimize these impacts, in conjunction with adequate storage.

Storage lagoons located before treatment may be provided to accept longer term shock loads, the contents of which can then be gradually returned to the process or diverted to treatment without detriment to treatment operations. Provision of storage lagoons also provides some period of time to correct malfunction of external operations or offers temporary facilities for solids sedimentation if properly designed to satisfy such uses. Fresh water used to cool bearings, variable speed couplings, brake linings in paper rewind applications, and similar areas throughout a mill can be collected and reused. It is not contaminated and can be recycled either directly after heat removal or indirectly by discharge into the fresh water system if heat buildup is not a problem.

The impact of paper grade changes on wastewater quality may be minimized by scheduling production so that one product is not immediately followed by a completely different one. This practice also reduces the interim period in which production meets the specification for neither product with a further reduction in wastewater.

Some mills have extended the period between washups in recent years; these periods, with foresight, may be planned to coincide with felt or wire life cycle and to permit changes of this equipment during scheduled shutdowns.

Nonequilibrium occurrences do not appear to have as significant an impact on air pollution emissions, with modern practice. However, there may be some incidental occurrences; the applicant, therefore, should estimate those occurrences and discuss the specific abatement measures that are proposed to mitigate potential adverse impacts.

II.D. OTHER IMPACTS

II.D.1. Raw Materials and Byproducts Handling

Many raw materials are prepared on the site by chemical reaction, and special care should be taken to contain the byproducts of these materials. Examples of this type of operation are:

- The preparation of hydrogen or sodium peroxide for bleaching at groundwood mills
- Hypochlorites at kraft mills
- Sulfurous acid at sulfite mills
- Perhaps, in some new mills, oxygen for the new bleaching process using this element

Chlorine dioxide is always manufactured at the site because of the instability of this compound.

Normally, the delivery of products from pulp and paper mills does not represent a signficant environmental impact vis-a-vis spills, ruptures, and so forth, because most of the product is dry paper in one form or another. There could be exceptions; for example, the shipment of byproducts such as tall oil and turpentine from kraft mills and concentrated liquor, lignosulfonates, ethanol, furfural, and sulfuric acid from sulfite mills could pose a spill hazard. Usually these materials have only a low or moderate toxicity rating, but spills are not desirable aesthetically and the potential does exist for degradation of water quality as a result of direct spillage or indirect contamination through leaching. Therefore the applicant should project the probability of such accidents occurring and disclose any plans that are proposed to handle these potential hazards.

One other mode of product delivery that must be handled with care to avoid adverse effects is the shipment of groundwood pulp in a solution of sodium silicate and hydrogen peroxide. In this case, the tank car or truck acts as the reaction vessel for bleaching.

II.D.2. Site Preparation

The environmental effects of site preparation and construction of new pulp and paper mills are common to land disturbing activities on construction sites in general. Erosion, dust, noise, vehicular traffic and emissions, and some loss of wildlife habitats are to be expected and minimized through good construction practices wherever possible. At present, however, neither the quantities of the various pollutants resulting from site preparation and construction nor their effects on the integrity of aquatic and terrestrial ecosystems have been studied sufficiently to permit broad generalizations. Therefore, in addition to the impact assessment framework provided in the EPA document, Environmental Impact Assessment Guidelines for Selected New Sources Industries, the permit applicant should tailor the conservation practices to the site under consideration in order to account for and to protect certain site specific features that warrant special consideration (e.g., critical habitats, archaeological/historical sites, high quality streams, or other sensitive areas on the site). All mitigation/conservation measures that are proposed should be discussed in the EID.

Additional guidance on pollution from construction sites is provided in Section III.E.

II.E. MODELING OF IMPACTS

The ability to forecast environmental impacts accurately often is improved by the use of mathematical modeling of the dispersion and dissipation of air and water pollutants as well as the effects of storm runoff.

Two of the most widely used and accepted models are:

- DOSAG (and its mofifications)
- The QUAL series of models developed by the Texas Water Development Board and modified by Water Resources Engineers, Inc.

Some of the parameters that these models simulate are:

- Dissolved oxygen
- BOD
- Temperature
- pH
- Solids

In addition, there are many available water quality models that were developed in association with NPDES activity and the need for optimization of waste load schemes for an entire river basin.

There are also available mathematical models that have been used for air pollution sutdies and solid waste management optimization:

- For short-term dispersion modeling of point sources, EPA's PTMAX, PTDIS, and PTMTP models may be employed.
- For modeling of long-term concentrations over larger areas, the EPA Climatological Dispersion Model may be used for point and area sources

In general, the use of mathematical models is indicated when arithmetic calculations are too repetitious or too complex. Their use also simplifies analysis of systems with intricate interaction of variables. Models thus offer a convenient way of describing the behavior of environmental systems.

III. POLLUTION CONTROL

III.A. STANDARDS OF PERFORMANCE TECHNOLOGY: IN PROCESS CONTROLS AND EFFECTS ON WASTE STREAMS

Internal control measures are procedures to reduce pollutant discharges at their origin, some of which result in the recovery of chemicals, fiber, and byproducts and in conservation of heat and water. Similar methods are available to all subcategories and should be considered by the applicant as applicable:

- Effective pulp washing
- Chemical and fiber recovery
- Treatment and reuse of selected waste streams
- Collection of spills
- Prevention of accidental discharges

New processes to reduce pollutant loads are continually being developed. Those currently available for incorporation in new mills are shown in Table 20. There is, however, very little documentation on the magnitude of raw waste reductions achieved through the use of a particular technology. In general, reductions in raw waste loads permit reductions in effluent flow through recycle.

Although water recycle has been a major goal of the industry in recent years, and great progress has been made, reuse is limited by several factors. Impurities in water supply and raw materials can concentrate to the extent that they cause corrosion or scaling. Fines and dirt can also build up to the point where product quality is affected. As a result, a completely closed system has been accomplished at only a few small mills--either because coarse product quality permits or because of the relationship between product, size, and water availability.

New mills are most capable of maximizing water reuse as the various integral processes of the mills are designed. The applicant should describe the engineering concepts which will be utilized to decrease consumptive use of water.

III.B. STANDARDS OF PERFORMANCE TECHNOLOGY: END-OF-PROCESS CONTROLS (EFFLUENTS) AND EFFECTS ON WASTE STREAMS

The Federal Water Pollution Control Act, as amended by the 1977 Clean Water Act, does not require the use of specific treatment technologies. Instead, it leaves to the discretion of individual mills the option as to how to meet the effluent limitations and NSPS imposed. The mills may elect to achieve the required pollutant reduction with well-designed and -operated external treatment systems or by a combination of both internal and external controls that may prove to be more cost effective.

Table 20. Internal control technologies used as applicable in pulp and/or paper mills and their effects on wastewater streams

Technology	Effect
Hot stock screening	Avoid decker sewer losses
Fourth stage brown stock washer	Improve liquor separation; reduce waste load
Decker filtrate for stock washer showers	Reduce flow through reuse
Pulp mill spill collections	Avoid shock load
Jump stage countercurrent washing in bleaching	Reduce flow through reuse; improve liquor recovery
Evaporation boil-out tank	Avoid shock load
Liquor storage tank spill collection	Avoid shock load
Reuse of blow steam & evaporator condensate	Reduce flow
Green liquor dregs filtering	Improve separation; obtain cleaner liquor
High level alarms for chemical tanks	Avoid spills and shock load
Hot water collection and reuse	Reduce flow
Paper machine saveall	Reduce waste load through fiber recovery
Segregation of white water systems	Maximize reuse and reduce fiber in waste
Paper machine white water showers	Reduce flow through reuse
Vacuum pump seal water reuse	Reduce flow
Cooling water segregation and reuse	Reduce flow
Felt hair removal	Permit reuse of press water
Flow control of seal water lines	Reduce gland water use

Table 20. Internal control technologies used as applicable in pulp and/or paper mills and their effects on wastewater streams (Continued)

Source: US Environmental Protection Agency. 1976. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, deinked, and non-integrated paper mills of the pulp, paper, and paperboard mills point source subcategory. EPA 440/1-76/047-b, Dec.

The internal controls vary to some degree among subcategories, but the external treatment technologies employed by the pulp and paper industry are essentially the same across the range of subcategories. For this reason the discussion that follows assumes the controls are applicable to all subcategories.

III.B.1. Suspended Solids Reduction

The identified new source technology for suspended solids reduction for the unbleached kraft, the sodium and ammonia base NSSC, the kraft NSSC with cross recovery, and waste paperboard subcategories includes (EPA, 1974):

- An earthen sedimentation basin
- Mechanical clarification and sludge removal and/or dissolved air flotation

It is not anticipated that sedimentation basins will be used widely in new mills because of large land requirements, inefficient performance, and high cleaning costs. The most common suspended solids removal technology and the one likely to be employed by the greatest number of new mills is the mechanical clarifier. This device is usually a large circular tank of concrete with a rotating sludge scraper mechanism mounted in the center. It is capable of 95% reduction of the settleable suspended solids in the effluent, which account, for example, for 85% of the total suspended solids in unbleached kraft mills. Since some of the settleable solids are biodegradable, clarification results in some BOD reduction (EPA, 1974; 1976a).

Although dissolved air flotation has achieved up to 98% suspended solids removal efficiency, this equipment is relatively costly and mechanically complex and has a high power requirement. Dissolved air flotation is used extensively in save-alls, but it is not expected to be employed for full effluent treatment except where space is at a premium (EPA, 1974; 1976a).

All clarification systems must be preceded by screening to remove bark or trash materials that could seriously damage the equipment.

III.B.2. BOD Reduction

The new source technology for BOD removal consists of a biological oxidation system with nutrient addition. (Except for ammonia base NSSC and sulfite mill wastes, pulp and paper mill wastes are almost devoid of phosphorus and nitrogen, and the presence of one or the other, in appropriate quantity, is necessary for biological treatment to function properly.) The treatment system may consist of the activated sludge process, aerated stabilization basins, and/or storage oxidation ponds.

The principal benefit gained from biological treatment is that the treated effluents do not deplete the dissolved oxygen levels of receiving streams to levels that would be inimical to aquatic life. Other benefits include reduction of toxicity, as noted earlier, reduction in foaming tendencies, reduction of turbidity, and elimination of sliming tendencies. Normally there is also a slight reduction in color.

All types of biological treatment have advantages and disadvantages related to waste characteristics, waste volume, land availability, costs, and localized factors. The applicant should consider in further detail such characteristics as the following:

Storage oxidation--large natural or man-made basins of various depths that rely on natural reaeration from the atmosphere--can be expected to be used only where large land areas of suitable topography and remoteness from dwellings are available. Its two principal advantages are that it is capable of handling accidental discharges of strong wastes without upset and has no mechanical devices to generate maintenance problems. Thus, efficient continuous operation can be expected and, in addition to a reduction in BOD of 85-90%, a significant reduction of suspended solids will be accomplished.

Aerated stabilization basins also achieve a high degree of BOD reduction, with a significantly smaller land requirement than that of natural basins--typically 0.21 ha/million liters (2 acres/264,200 gal.) as compared with 4.8 ha/million liters (40 acres/264,000 gal.). Detention times in aerated stabilization basins normally range from 5 to 15 days, averaging about 10 days. Aeration is normally accomplished with gear-drive turbine type aerators, direct-drive axial flow-pump aerators, or, in a few cases, diffused aerators.

The activated sludge process is similar to the aerated stabilization system except that it is much faster, with total retention times ranging from 4 to 8 hours. The biological mass grown in the aeration tank is settled in a secondary clarifier and returned to the aeration tank, building up a large concentration of active biological material. This process is susceptible to upset caused by shock loads, and it takes several days to return to normal BOD removal rates. It suffers several other disadvantages compared to the aerated stabilization basin, but it requires even less land, and may be used where the high cost or unavailability of land dictates.

III.B.3. Color Removal

At present, color removal to enhance stream aesthetics is included in the effluent NSPS treatment technologies only for unbleached kraft and NSSC/kraft mills with cross recovery. The NSPS for sodium base and ammonia base NSSC mills do not include color limitations because the applicable treatment process, reverse osmosis, has not been proven in NSSC mills (EPA, 1974). It can be expected that when NSPS are finally established for the remaining subcategories, color removal also will be required for bleached kraft mills and perhaps sulfite operations.

The minimum lime treatment is recommended for color removal in unbleached kraft mills and has achieved efficiencies of over 80% (David, 1971).

III.B.4. Pretreatment

Only minimal pretreatment is required before the effluents of paper mills can be discharged to municipal wastewater treatment plants. The external pretreatment currently practiced is generally limited to suspended solids removal and equalization. In addition, in waste paperboard, tissue, reclaimed newsprint, and fine paper mills, a high degree of internal fiber recovery is required as a form of pretreatment before discharge to a municipal system, along with means for controlling spills and handling wash-ups. The applicant can achieve, as applicable, this level of pretreatment through the use of filtration, flotation, and sedimentation devices incorporated in the manufacturing process.

Only 5 pulp mills in the country discharge to municipal sewers, and in these instances the treatment plants were designed to treat the combined waste flow. Increased use of public facilities for treating chemical pulp mill wastes is doubtful, both because of the costs involved under the terms of Public Law 92-500 and because most or all of them will have biological treatment.

III.C. STANDARDS OF PERFORMANCE TECHNOLOGY: END-OF-PROCESS CONTROLS (EMISSIONS) AND EFFECTS ON WASTE STREAMS

III.C.1. Kraft Mill Odors

The technologies available to the applicant for reducing TRS emissions from the following sources are:

- Digester and Evaporators: Collection and thermal oxidation of the noncondensable gases, either in the lime kiln, special incinerators, or recovery boilers.

- Recovery Furnace: Black liquor oxidation and substitution of contact evaporators with concentrators and recycle of stack gas into the secondary air supply of the furnace. Improvements in furnace design and operation have also been incorporated at some mills.

- Lime Kiln: Maintenance of proper process conditions including temperature at the point of discharge, oxygen content of off-gases, sulfide content of lime mud feed, and pH and sulfide content of the scrubbing water (Eddinger et al., 1974). Scrubbing the off-gases with a caustic solution increases the effectiveness of hydrogen sulfide and methyl mercaptan removal. Efforts are underway to minimize sulfide in the incoming mud by oxidizing it on the vacuum filter (Caron, 1977a). In practice, this procedure reduced the TRS in the kiln discharge to less than 10% (Wilhelmsen, 1977).

- Smelt Dissolving Tank: Modification of process conditions such as use of water low in sulfides. This tank is a minor source of TRS emissions.

- Black Liquor Oxidation: Collection and thermal oxidation of off-gases.

- Brown Stock Washer: Collection and thermal oxidation in recovery furnace or special incinerator, or, in some cases, the lime kiln.

- Condensate Stripping: Collection and thermal oxidation in the lime kiln, recovery boilers, or special incinerators.

Recent studies on the ability of chlorine to oxidize TRS compounds and thus reduce the most objectionable fraction of the kraft odor have been encouraging. For this approach to be feasible for new mills, complete oxidation at practical concentrations will be required.

Applicants seeking NPDES permits for new mills will also have an opportunity to incorporate improved methods for handling the numerous small sources of odor that are not available to existing mills (Fisher, 1977). Applicants also should take advantage of improved monitoring methods (NCASI, 1975) and studies on odor perception (NCASI, 1970; 1971).

III.C.2. Sulfur Dioxide

Although SO_2 emissions may occur at all types of chemical pulp mills that use sulfur compounds in their cooking liquors, an EPA study of kraft mill SO_2 emissions found that recovery furnaces and lime kilns in these mills are not significant sources of SO_2. EPA tests on 2 recovery furnaces and 3 lime kilns indicated SO_2 emission levels of about 3.9 lb/ton ADP (70 ppm) and 0.3 lb/ton ADP (30 ppm) respectively (EPA, 1976b). Sulfidity of the cooking liquor has been identified as the major factor in determining stack losses of SO_2 from the recovery boilers, and the stack concentration can be kept below 100 ppm if this value does not exceed 31% (Gansler, 1977). It has also been shown that SO_2 stack concentration is affected by, in descending order, excess oxygen, total air flow, boiler load, and air distribution to the furnace.

Similarly, SO_2 losses can be minimized at NSSC mills by maintaining a proper ratio of sodium to sulfur in the liquor. Ammonia base systems recover SO_2 in a manner similar to that used by acid sulfite mills, described below, and the levels discharged by fluidized bed furnaces is low because of its reaction with soda in the smelt (Collins, 1969; Galeano et al., 1971).

Methods are also available and in effect at most sulfite mills, which are greater sources of this pollutant, for recovering SO_2 from the digester blow and relief gases. The gases are generally absorbed in a packed tower, and the recovered SO_2 is reused in the process. This system is about 75% effective in absorbing SO_2 from the blow pit stacks.

Abatement devices are also applied to the collected SO_2 emissions from more minor sources such as the evaporators and washer heads (Caron, 1976b). In addition to packed towers, these include venturi scrubbers, turbulent contact absorbers, and spray contact devices (Johnson and Gamsler, 1971; NCASI, 1973; Rosenburg et al., 1975). Recoveries as high as 97% have been reported, and SO_2 emissions are reduced to acceptable levels.

SO_2 emissions from power boilers are a function of the sulfur content of the fuel burned, and the use of low-sulfur fuels is the only means currently available for minimizing these emissions from boilers of the size range used by pulp and paper mills. Mills required to use coal under the Energy Supply and Environmental Coordination Act of 1974 (P.L. 93-319) instead of oil or natural gas may be granted compliance date extensions if certain conditions are met (40 CFR, Part 55). The applicant should determine the sulfur content of coals available to him and calculate the SO_2 emissions which would result from their combustion.

III.C.3. Miscellaneous Odor Problems

While odor control in external effluent treatment systems is not subject to Federal new source performance standards, ambient odor from any source is subject to state and local regulation. Thus, new source NPDES applicants should demonstrate in their EIA's the measures to be utilized which will effectively control odor from this source.

Abatement procedures begin with loss control in the mill. This is especially necessary in kraft mills to minimize the quantity of TRS compounds reaching the treatment plant.

Good loss control is a function of a number of factors which should be considered by the applicant. They include (EPA, 1976a):

- Process operational control practices such as the brown stock washing process
- Spill and leak control
- Process design efficiency--for example, no direct sewering of evaporator condensate and blow tank gases
- Production vs. design rate
- Practical efficiency limitations of the kraft process itself

Treatment plant odor generated because the mill does not recover turpentine or because some crude turpentine escapes from the byproducts recovery process to an aerated stabilization basin may be controlled by initiating turpentine recovery in the first instance or improving turpentine capture in the second.

Odor control in the treatment system itself relies largely on good system design, operation, and maintenance. However, if localized treatment system odor which impacts the public cannot be alleviated by improved operation and maintenance practices, specific control measures may be needed.

This situation is not, however, a broad general problem in this industry and there is no general solution. Measures which the applicant can consider include:

- Roofed concrete tanks, vented in one place, and oxidized with ozone
- Ozonation of wastewater

Both technologies have been researched by EPA, and the current status of the Agency's findings should be ascertained. Ozone application as it applies to municipal sewage treatment is covered in the publication Design Manual for Small Wastewater Treatment Plants (1976). Other technologies which might be investigated are discussed in EPA's publication Direct Environmental Factors at Municipal Wastewater Treatment Works (1976).

If odor results from chlorine losses from bleach plant reaction towers, the problems can be reduced to a large extent by the use of a scrubber in the exhaust stack of the tower designed to remove over 95% of the gas (Morrison, 1968). The scrubber water or alkali, as the case may be, can be employed in the manufacture of hypochlorite for use in the bleachery. In addition, some reduction may be achieved by process control.

On occasion, odors caused by cellulose decomposition products, decaying size materials, and sulfides from sulfate reduction are a source of air pollution proximate to pulp and paper mills. In general, these problems, which derive from storage oxidation basins and sludge impoundments, are readily controllable. In the case of oxidation basins, limited aeration can be added to prevent localized anaerobic conditions. In the case of sludge storage basins, several control methods can be employed including dewatering of the sludge before storage, pH control, and the addition of masking agents. The dewatering process has proven to be by far the most effective odor control measure.

III.C.4. Particulate Control

The three process areas where particulate control will be required in kraft mills are the recovery furnace, the smelt dissolving tanks, and the lime kiln. The technologies available to the applicant for meeting the NSPS are:

- Recovery Furnace: Electrostatic precipitators and direct contact evaporators. Although the purpose of the evaporator is to concentrate black liquor, it may also scrub particulate matter from the gas stream (EPA, 1976b). Where cyclones or venturis are used as direct contact evaporators, the black liquor serves as the particulate scrubbing liquor. If two highly efficient venturis are used in this manner, a precipitator may not be necessary.

- Smelt Dissolving Tanks: Scrubbers of several types, ranging from the low energy demister pads (fine wire mesh screens) to low pressure drop venturis, packed towers, and cyclones with water sprays. The tank gases can also be combined with the recovery furnace gases and sent to the electrostatic precipitator.

- Lime Kiln: Usually venturi scrubbers with pressure drops ranging from 25 to 62.5 cm (10 to 25 in.) of water. Impingement scrubbers are used less frequently.

Particulate emissions from power boilers may be controlled by the use of:

- Cyclone collectors

- Scrubbers

- Electrostatic precipitators

III.D. STATE OF THE ART TECHNOLOGY: END-OF-PROCESS CONTROL (SOLID WASTES) AND EFFECTS ON WASTE STREAMS

The primary problem of solid waste disposal in many mills is the large quantity of waste generated. It represents a materials handling problem for which there is no universal solution, and each mill requires a system engineered to meets it particular needs and local conditions. This system should be described in detail in the EID.

The major solid waste problems are substantially organic materials including wood wastes and treatment plant sludges. Because of the high water content and the low specific gravity of these solids, their bulk is greater than that of the inorganics and thus they require larger disposal areas.

III.D.1. Sludge Handling and Disposal

Major efforts have been made to reduce sludge volume by reducing its water content. This process not only reduces land requirements for disposal, but it also reduces odor since sludge cakes do not produce odor. Dewatering also enhances the option for incineration and facilitates composting and application on agricultural land (Aspitarte et al., 1973; Wyson, 1976; Marshall and Miner, 1976). Neither of these applications for disposal is yet in widespread use, however, and land disposal remains the dominant method.

Despite the years of study and pilot plant work, the dewatering and disposal of sludges resulting from the treatment of pulp and papermaking wastewaters remains a major industry problem. Today's requirement for secondary treatment has resulted in the production of great quantities of gelatinous activated sludge that is very difficult to dewater and dispose of. The emphasis on reuse has also compounded the problem in that far more fibers are captured than in the past and now end up in the sludge. However, primary sludges rich in fiber are relatively easy to dewater.

A variety of thickening or dewatering processes are available and their relative suitability for use at the posposed mill should be investigated. They include (Gehm, 1973; 1976):

- Gravity thickening
- Mechanical thickening
- Flotation
- Vacuum filters
- Centrifuges
- Belt filters
- Presses

Although pulp and paper mill sludge can be thickened in the primary clarifier, it is often withdrawn and thickened in a gravity thickener. Either the conical tank or "picket fence" type of thickener is employed, with the latter in more common use today. The rotation of a rake mechanism with a series of vertical vanes accelerates the separation of the solids from the water.

Dissolved air flotation units have been used to separate pulp fines and fillers from paper mill white waters. Recently flotation has also been used to thicken the thin, slimy sludges, such as activated and hydrous tissue mill sludges.

Continuous rotary vacuum filters are widely used in the industry to dewater sludges. The filter media is either cloth, wire mesh, or coil spring. Preconditioning the sludge is common practice using a variety of polymers, lime, ferric chloride, alum, and additives such as fiber, fly ash, or coal. There has also been some use of heat conditioning and partial wet air oxidation of sludges to improve dewatering.

Both disc and solid bowl centrifuges have been successfully applied to pulp and paper industry sludges. In most cases, sludge conditioning is necessary to get appreciable increases in solids and satisfactory capture of solids. Sand and grit not properly removed in earlier processing can be very troublesome, particularly in the solid bowl scrolls.

Several manufacturers have available belt-type filters that use a combination of gravity and compression to remove water from sludges. There has been a revival in the use of filter pressing based on improved design of cloth and closure plus the application of automation to reduce operating cost.

Sludge from smaller mills can be chemically stabilized to reduce odor. Larger new mills should provide for dewatering the sludge and returning the drainage from the disposal areas to the treatment system for BOD removal. Alternatively, good landfill practices will be required to control odor.

III.D.2. Disposal of Wood and Other Organic Wastes

Wood wastes and other organic waste materials are also disposed of on land. Disposal of such wastes should be in accord with modern management techniques as described in the EPA publication Sanitary Landfill Design and Operation (Brunner, 1971) and methodologies for reclaiming disposal sites (Gorham, 1974; NCASI, 1977). Wood waste deposits, particularly those containing a large quantity of bark, produce a leachate containing considerable color. It is anticipated that either effluent limitations on color or State regulations under RCRA will require that the leachate be impounded and treated to remove the color or that impervious containment areas be constructed.

In some cases bark can be sold as a mulching agent, and in large mills it can be burned as a fuel in the power boilers. Wood wastes do not contain sufficient nitrogen to be used successfully in composting. Standard landfills appear to be an acceptable method for the dipsosal of waste paper and organic trash material removed from it.

III.D.3. Disposal of Inorganic Wastes

Leachate from land disposal of the inorganic portion of pulp and paper mill solid wastes--deinking and decoating wastes, chemical recovery wastes (inert grits and dregs), and coal and bark ash--usually does not present a problem and can be combined with the mill's liquid waste stream before final treatment or discharge (Andersland and Laza, 1972). New land disposal regulations may require containment as an alternative and, therefore, the status and applicability of such regulations should be determined by the permit applicant.

With the current emphasis on coal as a mandated fuel, the quantity of fly ash requiring disposal will increase. This may result in increased use of spent cooking liquor as a fuel to avoid a vast ash disposal problem.

Methods are being developed for the recovery of deinking and decoating wastes such as filler materials (S.D. Warren Company, 1972; Springer, 1976). The trash separated from waste paper in deinking, decoating, and waste paperboard mills may include some inorganic material such as metal wire which requires standard landfill methods only.

III.E. TECHNOLOGIES FOR CONTROL OF POLLUTION FROM CONSTRUCTION SITES

The major pollutant at a construction site is loosened soil that finds its way into the adjacent water bodies and becomes "sediment." This potential problem of erosion and sedimentation is not unique to pulp or paper mill construction, but applies widely to all major land disturbing activities. Common remedial measures include, but are not limited to, proper planning at all stages of development and application of modern control technology to minimize the production of huge loads of sediment. Specific control measures include:

- The use of paved channels or pipelines to prevent surface erosion
- Staging or phasing of clearing, grubbing, and excavation activities to avoid high rainfall periods
- The use of storage ponds to serve as sediment traps, where the overflow may be carefully controlled
- The use of mulch or seeding immediately following disturbance

If the applicant chooses to establish temporary or permanent ground cover, grasses normally are more valuable than shrubs or trees because of their extensive root systems that entrap soil. Grasses may be seeded by sodding, plugging, or sprigging. During early growth, grasses should be supplemented with mulches of wood chips, straw, and jute mats. Wood fiber mulch has also been used as an antierosion technique. The mulch, prepared commercially from waste wood products, is applied with water in a hydroseeder.

The extent of control technologies used will be determined, in part, by the quantity of soil removed because there is a range in unit cost per acre. The acreage involved from mill to mill will vary to some degree with capacity, although limited data indicate an economy of scale in that acreage required to accommodate larger mills does not increase commensurately with increased capacity (Table 21). Products are not a significant factor in acreage requirements.

Table 21. Typical acreage used for three subcategories of pulp and paper mills

Product	Plant capacity		Main mill area		Waste treatment basins		Total	
	kkg/d	Tons/d	Hectares	Acres	Hectares	Acres	Hectares	Acres
Thermo-mechanical	272	300	16.2	40	*	*	16.2	40
Bleached kraft	1,088	1,200	32.4	80	64.8	160	97.2	240
Unbleached kraft	1,814	2,000	36.4	90	36.4	90	72.8	180

*Activated sludge included.

III.F. REGULATIONS

In addition to applying the best available technology to abate and control adverse environmental impacts from air emissions, wastewater streams, and land disposal of wastes, an NPDES permit applicant will be required to demonstrate compliance with applicable pollution control regulations. The NPDES permit itself may require monitoring, recording, and recordkeeping on flow and all pollutants that are subject to reduction or elimination under the terms and conditions of the permit, as well as any other pollutant as required by the State or EPA. Monitoring intervals must be sufficiently frequent to yield data that reasonably characterize the nature of the discharge. These requirements are set forth in 40 CFR, Part 125.27.

The NSPS for the TRS and particulate emissions of kraft mills (Federal Register, 23 February 1978) also require testing, monitoring, and recordkeeping and set forth required methods for measuring these two pollutants. Similarly, monitoring of leachate, runoff, and air emissions will be required under the Federal RCRA on sites where wastes determined to be hazardous are landfilled. In addition, it is not inconceivable that some type of monitoring may be required for some, if not all, disposal sites for nonhazardous wastes to ensure that "there is no reasonable probability of adverse effects on health or the environment" (Section 4004(a), RCRA).

IV. OTHER CONTROLLABLE IMPACTS

IV.A. AESTHETICS

The physical features of mills themselves that will impact the surroundings are discussed in Section I. Exterior design will be determined largely by the processes--and thus the specific equipment--employed. Digesters and recovery furnaces require height and paper machines require breadth. Capacity is another design feature that will influence overall size.

New roads to the mill and/or railroad sidings and loading/unloading facilities are also factors in new mill planning. The magnitude and significance of truck and equipment noise and emissions as well as other mobile emission sources (vehicles of employees) must be assessed in the EID.

Locating mills and attendant facilities out of the view of major roads is a primary consideration in any area, but the selection of other mitigating locations is necessarily area specific. It will be necessary for mill planners to consider minimizing landscape disruption along with such factors as convenience to raw material supply, markets, and water.

The intrusive nature of pulp mills is heightened to some degree by moisture plumes emanating from their recovery systems and bark burning operations, as well as cooling towers where such equipment is used (Hewson et al, 1973). These opaque plumes are not harmful but can be seen for some distance.

In addition, ground visibility can be affected by the plumes, although such occurrences are infrequent. A local predisposition to fog formation makes this effect more likely and increases importance of plumes.

Stack height, location, and configuration can influence the dispersion of such plumes (ASME, 1968; Stockman, 1971). The most serious uncertainty in predicting plume behavior, however, appears to be the influence of the aerodynamic downwash in the lee of a plant building. Computer models to predict downwash are not available. Interference with visibility at the proposed mill can be alleviated, however, by giving careful attention to the relationship of prevailing winds, the mill site, and major roads, as well as by constructing and locating cooling towers in accord with established principles (Stockman, 1971).

IV.B. NOISE

Although considerably more attention has been given to internal noise at pulp and paper mills, external noise also may be determined to be significant (Gellman, 1974). The following are the more common external sources of noise (Phelps and Schuler, 1970):

- Log-barking drums
- Chippers
- Conveyors and log-handling equipment
- Fans and blowers
- Converting machinery
- Transportation equipment

In the case of most pulp mills, the major source of noise is wood preparation, and this activity is frequently remote from habitation because of the size of the site. Sound measurements of similar activities at other sites can be used in conjunction with standard noise diminution tables to determine local effect. In addition, a survey of the effect of vegetation buffer strips in mitigating noise levels will be helpful in planning a new mill.

Noise criteria for various areas have been suggested (Burgess-Manning, 1967), and indicate that in heavy industrial areas pulp and paper mills will not usually generate many serious ambient noise problems off the mill site, especially when the community noise levels are in the common 50 dB range. Perhaps the greatest noise contributions made by pulp and paper operations are indirect, emanating from truck and rail transportation in the vicinity of municipalities.

Although means exist to reduce the noise of particular sources, they are, in most cases quite costly. However, noise levels of equipment maintained in good operating condition are usually considerably lower than if the equipment is neglected.

IV.C. ENERGY SUPPLY

Wood wastes in the form of bark and hog fuel with spent cooking liquors provide over 61% of the fuel requirement of the pulp and paper industry; the liquors account for 49.2% of the Btu employed. The relative amounts of coal, oil, and natural gas are in the process of change as mills switch from the use of oil to coal as mandated by the Federal government. A small amount of propane is also used, together with some water power and a substantial quantity of purchased power (Duke, 1974).

In addition, because of the impending energy shortage, as well as rising costs, the industry has been increasing the use of bark as fuel and the individual mills have carried on a vigorous campaign for conserving energy (Urbas et al., 1977). The use of community solid wastes to supplement bark as fuel is also being explored at two mills. In one instance, a mill and a power station are being linked in the use of municipal wastes, bark, and other mill wastes as supplemental fuel. In fact, all available organic residues are being examined by the industry as possible fuel sources to supplement the present ones.

The energy requirements for common pulp and papermaking processes are shown in Table 22. The table illustrates that the steam requirements of chemical pulping and papermaking are similar and that those of ancillary processes are considerably less. The mechanical pulping processes are all high consumers of energy.

A daily Btu requirement of 240×10^9 was necessary to reach the 1977 level of control of air and water pollution and 390×10^9 will be needed to reach the 1983 level (Blosser, 1977; Roy F. Weston, Inc., 1977). The energy requirements to meet the 1977 control level are about equally divided between water and air and over 60% of the total 1983 requirement is needed for water pollution, or about double that of the 1977 demand. This substantial increase can be accounted for largely by the addition of color reduction and effluent filtration. The figures presented include both separate and process-related control techniques.

Table 22. Energy requirements for pulp and papermaking operations

Use	Process steam
Steam (million Btu/adt):	
Paper drying (to 7% moisture)	3.4
Sizing	0.8
Stack heating per 10° above 135°	0.8
Batch pulping	3.5
Continuous pulping	2.5
Evaporators	2.2
Bleaching	1.3
Electrical power (kW/ton/ad):	
Woodroom and chipping	110
Digester	140
Bleach plant	175
Groundwood ADT	1,400
Pulp drying	450

Source: Blosser, R.O. 1977. Environmental protection engery use in the pulp and paper industry. TAPPI, 60, 8.

In planning a new mill, all sources of energy available at a given site must be considered, and their potential impact on the environment must be carefully determined. The need for meteorological studies to aid in this assessment and the need to investigate such factors as stack height and vapor control are apparent.

IV.D. SOCIOECONOMIC

The introduction of a large new pulp and/or paper mill into a community will cause economic and social changes. Therefore, it is necessary for an applicant to understand the types of impacts or changes that may occur so that they can be evaluated adequately. The importance of these changes usually, but not always, depends on the nature of the area where the mill is located (e.g., size of existing community). Normally, however, the significance of the changes caused by a mill of a given size will be greater in a small, rural community than in a large, urban area. This is primarily because a small, rural community is likely to have a nonmanufacturing economic base and a lower per capita income, fewer social groups, a more limited socioeconomic infrastructure, and fewer leisure pursuits than a large urban area. There are situations, however, in which the changes in a small community may not be significant and, conversely, in which they may be considerable in an urban area. For example, a small community may have had a manufacturing (or natural resource) economic base that has declined. As a result, such a community may have a high incidence of unemployment in a skilled labor force and a surplus of housing. Conversely, a rapidly growing urban area may be severely strained if a new pulp mill is located therein.

The rate at which the changes occur (regardless of the circumstances) also is often an important determinant of the significance of the changes. The applicant should distinguish clearly between those changes occasioned by the construction of the mill, and those resulting from its operation. The former changes could be substantial but usually are temporary; the latter may or may not be substantial, but normally are more permanent in nature. The changes which should be evaluated include:

- Increased sedimentation during construction
- Higher runoff rate from developed land
- Increased emissions from space heating and vehicular traffic
- Loss of agricultural land and terrestrial habitat
- Higher noise levels
- Increased demand for water supply
- Increased sewage and solid waste production

During the construction phase, the impact will be greater if the project requires large numbers of construction workers to be brought in from outside the community than if local, unemployed workers are available. The impacts are well known and include:

- Creation of social tension

- Demand for increased housing, police and fire protection, public utilities, medical facilities, recreation facilities, and other public services

- Strained economic budget in the community where existing infrastructure becomes inadequate

Various methods of reducing the strain on the budget of the local community during the construction phase should be explored. For example, the company itself may build the housing and recreation facilities and provide the utility services and medical facilities for its imported construction force. Or the company may prepay taxes, and the community may agree to a corresponding reduction in the property taxes paid later. Alternatively, the community may float a bond issue, taking advantage of its tax-exempt status, and the company may agree to reimburse the community as payments of principal and interest become due.

During mill operation, the more extreme adverse changes of the construction phase are likely to disappear. Longer run changes may be profound, but less extreme, because they evolve over a longer period of time and may be both beneficial and adverse.

The permit applicant should document fully in the EID the range of potential impacts that are expected and demonstrate how possible adverse changes will be handled. For example, an increased tax base generally is regarded as a positive impact. The revenue from it usually is adequate to support the additional infrastructure required as the operating employees and their families move into the community.

The spending and respending of the earnings of these employees has a multiplier effect on the local economy, as do the interindustry linkages created by the mill. The linkages may be backward and forward. Backward linkages are those in the mill's suppliers. Logging, hauling, and outfitting logging and hauling operations are the more important linkages here. Forward linkages are those to the mill's markets. The distant markets include those demanding paper and those demanding pulp for a variety of uses, including clothing. The local markets include those that may use lumber cut but not wanted by the mill, such as small sawmills, and those that may use the chips. In extreme cases, the size of the mill may be so great as to induce logging operations on a scale sufficient to justify the search for a market for timber. Finally, an assured local market for timber may lead to an improvement in forest practices.

Socially, the community may benefit as the increased tax base permits the provision of more diverse and higher quality services, and the variety of its interests increases with growth in population. Contrastingly, the transformation of a small, quiet, community into a larger, busier, community may be regarded as an adverse change by some of the residents, who chose to live in the community, as well as by those who grew up there and stayed, because of its amenities.

The applicant also should consider the economic repercussions if, for example, the quality of the air and water declines as a result of various waste streams from the mill. In some cases, other, more traditional sections of economic activity may decline as a consequence, or because labor is drawn away from them into higher paying mill-related or tertiary sector activities. As an illustration, the fishing sector may decline if water pollution increases, or if fishermen abandon the occupation in favor of mill-related activities. Again, the tourist sector may decline if air and water pollution is noticeable or if logging is practiced on such a scale that the landscape is degraded.

In brief, the applicant's framework for analyzing the socioeconomic impacts of the location of a pulp and/or paper mill must be comprehensive. Most of the changes described can be measured, and should be measured to assess fully the potential costs and benefits. The applicant should distinguish clearly between the short-term (construction) and long-term (operation) changes, although some changes may be common to both (e.g., the provision of infrastructure) because the significance of the changes depends not only on their absolute magnitude, but on the rate at which they occur.

The applicant should develop and maintain close coordination with State, regional, and local planning and zoning authorities to ensure full understanding of all existing and/or proposed land use plans and other related regulations.

V. EVALUATION OF AVAILABLE ALTERNATIVES

V.A. SITE ALTERNATIVES

As with all industries, the pulp and paper industry locates mills on the basis of market demand for specific paper products, convenience to raw materials, an adequate labor force and water supply, proximity to energy supplies and transportation, minimization of environmental problems, and other factors. A variety of sites should be considered initially and, following a detailed analysis of each one, a preferred alternative should be selected that appears to satisfy the objectives and that is expected to result in the least adverse environmental impact.

The factors considered in selecting each site, and especially those that influenced a positive or negative decision on its suitability, should be carefully documented in the permit applicant's EID. Adequate information on the feasibile alternatives to the proposed site is a necessary consideration in issuing, conditioning, or denial of an NPDES permit (see 40 CFR, Part 6.924).

Specifically, the advantages and disadvantages of each alternative site must be catalogued with due regard to preserving natural features such as wetlands and other sensitive ecosystems and to minimizing significant adverse environmental impacts. The applicant should ascertain that all impacts are evaluated as to their significance, magnitude, frequency of occurrence, cumulative effects, reversibility, secondary or induced effects, and duration. Accidents or spills of hazardous or toxic substances vis-a-vis site location should be addressed.

When a proposed site is controversial, it may have to be abandoned for a number of reasons. Such opposition may derive from the fact that the proposed mill would significantly impact a unique, recreational, archaeological, or other important natural or man-made resource area. It may destroy the rural or pristine character of an area. It may conflict with the planned development for the area. The site may be opposed by citizen groups. It may have to be discarded for meteorological and climatological reasons. It may be subject to periodic flooding, hurricanes, earthquake, or other natural disasters.

If the proposed site location proves undesirable, then alternative sites from among those originally considered should be reevaluated, or new sites should be identified and evaluated. Expansion at an existing mill site also could be a possible alternative solution. Therefore, it is critical that a permit applicant systematically identify and assess all feasible alternative site locations as early in the planning process as possible.

V.B. PROCESS ALTERNATIVES

Typically, when the decision is made to expand manufacturing capacity--either through a new mill or an addition to an existing one--the type of facility to be constructed is already fixed; that is, the demand for any given product which initiated the decision would have dictated the type of process to be used. While the limitation on process alternatives is not as severe as it once was because of improved process versatility, it is still improbable, for example, that a sulfite mill would be substituted for a kraft mill or a kraft mill for a groundwood mill. The kraft process can be used to make almost any product, but groundwood is still preeminent in newsprint, as is sulfite for some very fine paper grades. In addition to demand, the process alternative should be selected on the basis of availability of required raw material as well as environmental considerations. The applicant should present clearly and systematically in the EID the methodology used to identify, evaluate, and select the preferred process alternative.

V.C. NO-BUILD ALTERNATIVE

In all proposals for facilities developed, the applicant must consider and evaluate the alternative of not constructing the proposed new source facility. Because this analysis is not unique to the development of pulp and/or paper mills, no specific guidance is provided as part of this appendix. The permit applicant is, therefore, referred to Chapter IV (Alternatives to the Proposed New Source) in the EPA document, Environmental Impact Assessment Guidelines for Selected New Sources Industries, which was published in October 1975.

VI. REGULATIONS (OTHER THAN POLLUTION CONTROL)

The applicant should be aware that there may be a number of regulations other than pollution control regulations that have some application to the siting and operation of new pulp and paper mills. The applicant should coordinate with the appropriate EPA Regional Administrator regarding applicability of such regulations to the proposed new source. Federal statutes which generated regulations that may be pertinent to a proposed facility are:

Coastal Zone Management Act of 1972

The Fish and Wildlife Coordination Act

The National Environmental Policy Act of 1969

USDA Agriculture Conservation Service Watershed Memorandum 198 (1971)

Wild and Scenic Rivers Act of 1969

The Flood Control Act of 1944

Federal-Aid Highway Act, as amended (1970)

The Wilderness Act (1964)

Endangered Species Preservation Act, as amended (1973)

The National Historical Preservation Act of 1974

Executive Order 11593

Archaeological and Historic Preservation Act of 1974

Procedures of the Council on Historic Preservation (1973)

Occupational Safety and Health Act of 1970

In connection with these regulations, the applicant should place particular emphasis on obtaining the services of a recognized archaeologist to determine the possibilities of disturbing an archaeological site, such as an early Indian settlement or a prehistoric site. The National Register of Historic Places also should be consulted for historic sites such as battlefields. The applicant should consult the appropriate wildlife agency (State and Federal) to ascertain that the natural habitat of a threatened or endangered species will not be adversely affected.

From a health and safety standpoint all complex industrial operations involve a variety of potential hazards, and to the extent that these hazards could affect the health of plant employees, they may be characterized as potential environmental impacts. These hazards exist in pulp and paper mills because of the very nature of the operation--for example, the use of chemicals under conditions of high temperatures and pressures--and all mill owners should emphasize that no phase of operation or administration is of greater importance than safety and accident prevention. Company policy should provide and maintain safe and healthful conditions for its employees and establish operating practices that will result in safe working conditions and efficient operation.

The mill must be designed and operated in compliance with the standards of the U.S. Department of Labor, the Occupational Safety and Health Administration, and the appropriate State statutes relative to industrial safety. The applicant also should coordinate closely with local or regional planning and zoning commissions to determine possible building or land use limitations.

REFERENCES

Advances in alakline pulping. 1972. Pulp & Paper, Nov.

American Association for the Advancement of Science. 1965. Air Conservation. Publication No. 80.

American Society of Mechanical Engineers. 1968. Recommended Guide for the Prediction of the Dispersion of Airborne Effluents. ASME, New York.

Andersland, O.B., and R. W. Laza. 1972. Consolidation behavior of high ash paper mill sludges. NCASI Technical Bulletin No. 257.

Aspitarte, T.R., et al. 1973. Pulp and paper mill sludge utilization and disposal. EPA Technology Series R-2-73-232.

Barnhill, K. G. 1974. Sludge dewatering. Industrial Water Engineering, Sept.-Oct.

Barton, J. S. 1973. Future technical needs and trends of the paper industry byproduct usage. TAPPI, 56, 6.

Bishop, F. W., et al. 1968. Biological waste treatment case histories in the pulp and paper industry. NCASI Technical Bulletin No. 220.

Blosser, R. O. 1977. Environmental protection energy use in the pulp and paper industry. TAPPI, 60, 8.

Borton, D. L., and R. O. Blosser. 1977. Effect of bleached kraft mill effluents on growth and production of fish in experimental channels. NCASI Technical Bulletin No. 292.

Brunner, D. R., and D. I. Keller. 1971. Sanitary landfill design and operation. EPA. PB 227 565 NTIS.

Burgess-Manning. 1967. Silencing Handbook.

Can South provide more timber? 1977. Paper Trade Journal. Mar.

Caron, A. L. 1977a. Mud oxidation at the vacuum filter. NCASI Special Report No. 77-01.

Caron, A. L. 1978b. Practices used by the sulfite pulping industry in the handling and treatment of sulfur dioxide from miscellaneous sources. NCASI Special Report No. 77-02.

Collins, T. C. 1969. Development of sodium base sulfite chemical recovery. Pt. 1. Paper Trade Journal, June 30.

Copley International Corp. 1973. A study of the social and economic impact of odors. EPA Contract No. 68-02-0095. Feb.

Cox, L. A., and H. E. Wanster. 1977. An assessment of some sulfur-free chemical pulping processes. TAPPI, 54, 11.

Craig, D. 1973. Justification for pulp and paper byproducts development. AIChE Synposium Series, 133, 69.

David, C. L. 1971. Color removal from kraft pulping effluent by lime addition. Interstate Paper Corp., EPA Project 12040 ENC.

Duke, J. M. 1974. Patterns of fuel and energy consumption in the U.S. pulp and paper industry. American Paper Institute. Mar.

Easty, D. B., et al. 1978. Removal of wood derived toxics from pulping and bleaching wastes. EPA Grant No. R-803525-04. Feb.

Edde, H. 1966. A manual of practice for biological waste treatment in the pulp and paper industry. NCASI Technical Bulletin No. 190.

Ellerbe, R. W. 1973. Why, where and how U.S. mills recover tall oil soap. Paper Trade Journal, June 25.

Environmental Protection Agency. 1974. Development document for effluent limitations guidelines and new source performance standards for the unbleached kraft and semichemical pulp segment. EPA 440/1-74-025-a, May.

Environmental Protection Agency. 1975. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, deinked and non-integrated paper mills of the pulp, paper, and paperboard mills point source category. EPA 440-1-75/04.

Environmental Protection Agency. 1976a. Development document for effluent limitations guidelines and new source performance standards for the bleached kraft, groundwood, sulfite, soda, deinked and non-integrated paper mills of the pulp, paper, and paperboard mills point source category. EPA 440/1-76/047-b, Dec.

Environmental Protection Agency. 1976b. Standards support and environmental impact statement. Vol. 1. Proposed standards of performance for kraft paper mills. EPA 450/2-76-014-2, Sept.

Environmental Protection Agency. 1976c. Design manual for small wastewater treatment plants. Office of Technology Transfer.

Environmental Protection Agency. 1976d. Direct environmental factors at municipal wastewater teatment works. EPA-430/9-76-003. Jan.

Evans, J. C. W. 1977. Wastepaper: Outlook is for steady growth in U.S. utilization, strong advances in exports. Pulp & Paper, 51(7).

Expansion modernization projects at North American pulp and paper mills. 1977. Pulp & Paper, June 30.

Federal Water Pollution Control Administration. 1960-68. Pollution caused fish kills.

Fisher, R. P. 1977. Advances in source emission control. NCASI Special Report No. 77-01.

Galeano, S. F., et al. 1971. Air pollution controlled operation of a NSSC recovery furnace. TAPPI, 54, 5

Gansler, N. 1977. Nature and control of sulfur dioxide emissions from a kraft recovery operation. NCASI Special Report No. 77-02.

Gehm, H. W. 1956. Millsite evaluation. NCASI Technical Bulletin No. 81, Pt. 1.

Gehm, H. W. 1971 Industrial waste study of the paper and allied products industries. EPA Contract No. 68-01-0012. (unpublished)

Gehm, H. W. 1973. State-of-the-art review of pulp and paper waste treatment. EPA-R-2-73-184, Apr.

Gehm, H. W. 1976. Sludge handling and disposal. In: Handbook of Water Resources and Pollution Control. Van Nostrand Reinhold Company, New York.

Gellman, I. 1974. Some current paper industry environmental problems. Paper Trade Journal. Apr. 1.

Gillespi, W. J., et al. 1974. A pilot scale evaluation of the efficacy of rotating biological surface treatment of pulp and paper mill wastes. TAPPI Environmental Conf.

Goldsmith, J. R. 1962. Effects of air pollution on humans. In: Air Pollution, A. C. Stern, Ed. Vol I, Academic Press, New York.

Gorham International, Inc. 1974a. Study of solid waste management in the pulp and paper industry. EPA PB-234-944.

Gorham International, Inc. 1974b. Study of solid waste priorities in the pulp and paper industry. US Environmental Protection Agency, Office of Solid Waste Management Programs. Feb.

Hanson, A. 1972. Bark as an environmental problem. Svensk Paperstidning, 75(22). Dec. 15.

Hewson, E. W., et al. 1973. Factors controlling formation and persistence of ground level visibility--reducing moisture plumes. NCASI Atmospheric Quality Improvement Bulletin No. 66.

Hodge, W. W., and P. F. Morgan. 1947. Characteristics and methods of treatment of deinking wastes. Sewage Works Journal, 19, 5.

Howard, T. E., and C. C. Walden. 1975. Effluent characteristics and treatment of mechanical pulping effluents. Paper presented at TAPPI Mechanical Pulping Conference, San Francisco.

Hrutfiord, B. F., and J. L. McCarthy. 1967. SEKOR-I volatile organic compounds in kraft mill effluent streams. TAPPI, 50, 2.

Johnson, W. D., and H. Gansler. 1971. How Rayonier cuts blowpit sulfur dioxide with chemical scrubbing system. Pulp & Paper, 45, 13.

Kinstrey, R. 1977. Odors from an aerated stabilization basin. NCASI Special Report No. 77-02.

Litton Systems, Inc. 1969. Preliminary air pollution survey of hydrogen sulfide. APTD 69-37. Oct.

McAliley, J. E. 1974. A pilot study of a rotating biological surface for secondary treatment of unbleached kraft mill wastes. TAPPI, Environmental Conference.

Marshall, D. W., and R. A. Miner. 1976. Sludge disposal practices of the pulp and paper industry. NCASI Technical Bulletin No. 286.

McLeay, D. J. 1975. Journal of the Fisheries Board of Canada, 32, 753.

Michaud, R. W. 1977. Only 36 companies can afford future growth and expansion. Paper Trade Journal, Oct. 15.

Michigan Water Resources Commission. Undated. Reports on the Kalamazoo River.

Morrison, J. J. 1968. Recovery scrubber for waste chlorine gas. TAPPI, 51, 12.

Mueller, J. C., et al. 1977. Detoxification of bleached kraft mill effluents --a manageable problem. TAPPI, 60, 9.

National Council for Air and Stream Improvement. 1946. Deinking report. NCASI Technical Bulletin No. 5.

National Council for Air and Stream Improvement. 1962. Identification of non-sulfur compounds in stack gases from pulp mills. Atmospheric Quality Improvement Technical Bulletin No. 17.

National Council for Air and Stream Improvement. 1970. On sensory evaluation of odorous air pollution intensities. Atmospheric Quality Improvement Technical Bulletin No. 50.

National Council for Air and Stream Improvement. 1971. Fundamentals of odor perception--their applicability to air pollution control programs. Atmospheric Quality Improvement Technical Bulletin No. 54.

National Council for Air and Stream Improvement. 1972. Evaluation of analytical procedures for the analysis of selected organic compounds in kraft mill effluents. NCASI Technical Bulletin No. 258.

National Council for Air and Stream Improvement. 1975. A laboratory and field study of reduced sulfur sampling and monitoring systems. Atmospheric Quality Improvement Bulletin No. 81.

National Council for Air and Stream Improvement. 1977. Landfill disposal of pulp and paper industry sludges. NCASI Special Report No. 77-02.

National Council for Air and Stream Improvement/US Environmental Protection Agency. 1973. Atmospheric emissions from the pulp and paper manufacturing industry. EPA 450/1-73-002, Sept.

New plants and facilities - CE construction alert. 1978. Chemical Engineering. March 27.

Phelps, A. H., and B. F. Schuler. 1970. An introduction to ambient noise. NCASI Atmospheric Quality Improvement Technical Bulletin No. 52.

Reeve, D. W., et al. 1973. Effluent free bleached pulp mill - IV. Salt recovery process. Paper Trade Journal, July 30.

Rosenburg, H. H., et al. 1975a. The status of sulfur dioxide control systems. Chemical Engineering Progress, 71, 5.

Rosenburg, H. H., et al. 1975b. The status of SO_2 control systems. Chemical Engineering Progress, 71, 66.

Roy F. Weston, Inc. 1977. Energy requirements for environmental control in the pulp and paper industry. US Department of Commerce, Office of Environmental Affairs, Mar.

S. D. Warren Company. 1972. Sludge disposal and materials recovery system for the manufacture of filled and coated paper. EPA Project No. 12040 FES.

Shick, P. E. 1977. Non-sulphur pulping--a new process. Southern Pulp and Paper Manufacturer, Feb.

Slinn, R. J. 1977. Energy conservation and constraints in the pulp and paper industry. TAPPI, 60, 3.

Springer, A. M. 1976. An investigation of the separability and reuse of the ash component of high ash content paper mill sludges. NCASI Technical Bulletin No. 285.

Statistical summary. 1977. American Paper Institute Monthly, July.

Stockman, J. 1971. Cooling tower study. Illinois Institute of Technology, Research Institute Report No. C6187-3.

Stockman, R. L. 1966. Physiologic, economic, and nuisance effects from sulfate pulping. Proceedings of the International Conference on Atmospheric Emissions from Sulfate Pulping. USPHS, NCASI, and University of Florida. Sanibel Island. April 28.

Tanazzi, F. D. 1971. Dry forming processes for the manufacture of paper and paperboard. CPPA.

Tapping the chemical motherlode of the southern pines. 1973. Chem 26/Paper Processing, 9, 11.

Towe, K. E. 1977. Paper industry posts good running from 1975 times, despite some poor pricing. Pulp & Paper, June.

Urbas, J. C., et al. 1977. Implementing a conservation program: An energy audit. TAPPI, 60, 8.

Vogt, C. 1977. Revision of the 1983 effluent guidelines--the role of toxic compounds. TAPPI, 60, 7.

Walden, C. C., and T. E. Howard. 1977. Toxicity of pulp and paper mill effluents. TAPPI, 60, 1.

Warren, C. E. 1971. Biology of water pollution control. W. B. Saunders. Philadelphia.

Warren, C. E. 1972. Laboratory and controlled experimental stream studies of the effect of kraft mill effluents on the growth and production of fish. NCASI Technical Bulletin No. 259.

Water technology in the pulp and paper industry. 1957. TAPPI Monograph No. 18.

Wenzl, H. F. J. 1967. Kraft Pulping Theory and Practice. Lockwood Publishing Company, Inc., New York.

Whole tree chips: A look at the state of the art after six years. 1976. Paper Trade Journal, Apr. 15.

Wilhelmsen, L. 1977. Mud oxidation for kiln TRS control. NCASI Special Report No. 77-04.

Williams, D. F., et al. 1972. Methanol, ethanol, and acetone in kraft mill streams. TAPPI, 55, 8.

Wilson, M. A., and C. I. Chappell. 1973. Reduction of toxicity of sulphite effluents. CPAR Report 49-2. Canadian Forestry Service, Ontario.

Wisconsin State Department of Health. 1965. Pulp and Paper Advisory Committee report.

Worster, H. E. 1973. Present state of semichemical pulping--a literature review. Paper Trade Journal. Aug. 20.

Wysong, M. L. 1976. C. Z.'s solid waste problems at Wanna reduced by composting. Pulp & Paper, 50, 10.

Zobel, B. J. 1977. Will timber resources of the southern United States meet the demands? Paper presented at TAPPI Annual Meeting, Atlanta. Feb. 14-16.

GLOSSARY

BAGASSE. The fibrous material remaining after grinding sugarcane for its sugar juices. It is normally recovered for use as a fuel for sugar mill boilers, but is also attractive as a raw material for papermaking.

BLACK LIQUOR. Spent liquor recovered from a kraft digester up to the point of its introduction into the recovery plant.

BLEACHING. The brightening and delignification of pulp by addition of chemicals such as chlorine or hypochlorite.

BLOW TANK. A cylindrical tank with conical bottom into which the digester contents are blown tangentially at the top of the tank so that the stock drops to the bottom of the tank and the steam and gases escape from the top vent to a steam condenser.

BROKE. Partly or completely manufactured paper that does not leave the machine room as saleable paper or board; also paper damaged in finishing operations such as rewinding rools, cutting, and trimming.

BROWN STOCK CHEST. The tank into which the stock is dumped after leaving the brown stock washers and deckers.

CORD. The quantity of wood contained in a pile of 4-foot wood 8 feet long and 4 feet high when the wood is stacked in an orderly manner with all logs parallel.

DECKER. A mechanical device used to remove water or spent cooking liquor from pulp, and to thicken pulp consistency.

FIBER. The cellulosic portion of the tree used to make pulp, paper, and paperboard.

FOURDRINIER MACHINE. The more popular papermaking machine using an endless moving belt made of metal or plastic, resembling a window screen, upon which a sheet of paper is formed.

FURNISH. The mixture of fibers and chemicals used to manufacture paper.

JORDAN. A type of refiner (see refiner). Old-type Jordans used large hand-wheels for plug setting, with an improvised weight hung to it to prevent it brom backing off. Modern units can be set either manually or automatically with precision and accuracy.

LIGNIN. A nondegradable organic compound of wood.

MACHINE CHEST. The tank into which the pulp from the refiners and recovered pulp from the save-alls is dumped before being delivered to the machine screens.

REFINER. A device used to reduce the size of the fiber in the stock. It consists of a plug rotating in a shell, and both shell and plug are fitted with bars or knives in the axial direction. The plug and shell may be tapered. Then the stock is fed into the small end, sometimes under pressure, at a consistency usually in the range of 2 to 5% and discharged out of the top of the large end.

REJECTS. Material unsuitable for pulp or papermaking that has been separated in the manufacturing process.

SCREENINGS. Rejects from a pulp mill separating device such as a screen.

SHIVES. Small pieces of wood that will not grind properly.

SULFIDITY. Sulfidity is a measure of the amount of sulfur in kraft cooking liquor. It is the percentage ratio of NaS, expressed as NaO, to active alkali.

TRIMMINGS. The material cut off at the end of the papermaking machine, when the sheet is trimmed to meet a particular specification.

WASH-UP. Periodic cleaning of equipment.

WHITE WATER. Water that drains through the wire of a paper machine that contains fiber, filler, and chemicals.

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

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15. SUPPLEMENTARY NOTES

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16. ABSTRACT

The report provides guidance for evaluating the environmental impacts of a proposed pulp and paper mill requiring a new source National Pollutant Discharge Elimination System (NPDES) permit from the Environmental Protection Agency (EPA) to discharge wastewater to the navigable waters of the U.S. The guidelines are intended to assist in the identification of potential impacts, and the information requirements for evaluating such impacts, in an Environmental Information Document (EID). An EID is a document prepared for EPA by a new source permit applicant; it is used by the Agency to determine if the preparation of an Environmental Impact Statement (EIS) is warranted for the proposed facility.

The report includes guidance on (1) identification of potential wastewater effluents, air emissions, and solid wastes from pulp and paper mills, (2) assessment of the impacts of new facilities on the quality of the environment, (3) state-of-the-art technology for in-process and end-of-process control of waste streams, (4) evaluation of alternatives, and (5) environmental regulations that apply to the industry. In addition, the guidelines include an "overview" chapter that gives a general description of the pulp and paper industry, significant problems associated with it, and recent trends in location, raw materials, processes, pollution control, & the demand for industry output.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
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