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EPA Office of Compliance Sector Notebook Project

Profile of the Pulp and Paper Industry
2nd Edition

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Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
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This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), GeoLogics Corporation (Alexandria, VA), Science Applications International Corporation (McLean, VA), and Booz-Allen & Hamilton, Inc. (McLean, VA). A listing of available Sector Notebooks is included on the following page.

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The Sector Notebooks were developed by the EPA's Office of Compliance. Direct general questions about the Sector Notebook Project to:

Coordinator, Sector Notebook Project
US EPA Office of Compliance
1200 Pennsylvania Ave., NW (2224-A)
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202-564-2310

For further information, and for answers to questions pertaining to these documents, please refer to the contacts listed on the following page.

AVAILABLE SECTOR NOTEBOOKS

Questions and comments regarding the individual documents should be directed to Compliance Assistance and Sector Programs Division at 202 564-2310 unless otherwise noted below. **See the Notebook web page at: http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/ for the most recent titles and links to refreshed data.**

EPA Publication Number	Industry
EPA/310-R-95-001.	Profile of the Dry Cleaning Industry
EPA/310-R-95-002.	Profile of the Electronics and Computer Industry*
EPA/310-R-95-003.	Profile of the Wood Furniture and Fixtures Industry
EPA/310-R-95-004.	Profile of the Inorganic Chemical Industry*
EPA/310-R-95-005.	Profile of the Iron and Steel Industry
EPA/310-R-95-006.	Profile of the Lumber and Wood Products Industry
EPA/310-R-95-007.	Profile of the Fabricated Metal Products Industry*
EPA/310-R-95-008.	Profile of the Metal Mining Industry
EPA/310-R-95-009.	Profile of the Motor Vehicle Assembly Industry
EPA/310-R-95-010.	Profile of the Nonferrous Metals Industry
EPA/310-R-95-011.	Profile of the Non-Fuel, Non-Metal Mining Industry
EPA/310-R-02-001.	Profile of the Organic Chemical Industry, 2nd Edition*
EPA/310-R-95-013.	Profile of the Petroleum Refining Industry
EPA/310-R-95-014.	Profile of the Printing Industry
EPA/310-R-02-002.	Profile of the Pulp and Paper Industry, 2nd Edition
EPA/310-R-95-016.	Profile of the Rubber and Plastic Industry
EPA/310-R-95-017.	Profile of the Stone, Clay, Glass, and Concrete Ind.
EPA/310-R-95-018.	Profile of the Transportation Equipment Cleaning Ind.
EPA/310-R-97-001.	Profile of the Air Transportation Industry
EPA/310-R-97-002.	Profile of the Ground Transportation Industry
EPA/310-R-97-003.	Profile of the Water Transportation Industry
EPA/310-R-97-004.	Profile of the Metal Casting Industry
EPA/310-R-97-005.	Profile of the Pharmaceuticals Industry
EPA/310-R-97-006.	Profile of the Plastic Resin and Man-made Fiber Ind.
EPA/310-R-97-007.	Profile of the Fossil Fuel Electric Power Generation Industry
EPA/310-R-97-008.	Profile of the Shipbuilding and Repair Industry
EPA/310-R-97-009.	Profile of the Textile Industry
EPA/310-R-97-010.	Sector Notebook Data Refresh-1997 **
EPA/310-R-98-001.	Profile of the Aerospace Industry
EPA/310-R-00-001.	Profile of the Agricultural Crop Production Industry Contact: Ag Center, (888) 663-2155
EPA/310-R-00-002.	Profile of the Agricultural Livestock Production Industry Contact: Ag Center, (888) 663-2155
EPA/310-R-00-003.	Profile of the Agricultural Chemical, Pesticide and Fertilizer Industry Contact: Agriculture Division, 202 564-2320
EPA/310-R-00-004.	Profile of the Oil and Gas Extraction Industry
	Government Series
EPA/310-R-99-001.	Profile of Local Government Operations

* Spanish translations available of 1st Editions in electronic format only.

** This document revises compliance, enforcement, and toxic release inventory data for all previously published profiles. Visit the Sector Notebook web page to access the most current data.

DISCLAIMER

Pulp and Paper Industry
(SIC 2611 through 2631)

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LIST OF ACRONYMS

AFS	AIRS Facility Subsystem (CAA database)
AIRS	Aerometric Information Retrieval System (CAA database)
AOR	Area of Review (SDWA)
AOX	Adsorbable Organic Halides
BAT	Best Available Technology Economically Achievable
BCT	Best Conventional Pollutant Control Technology
BIFs	Boilers and Industrial Furnaces (RCRA)
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BPT	Best Practicable Technology Currently Available
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS	CERCLA Information System
CFCs	Chlorofluorocarbons
CFR	Code of Federal Regulations
CGP	Construction General Permit (CWA)
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
CSI	Common Sense Initiative
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
D&B	Dun and Bradstreet Marketing Index
DOC	United States Department of Commerce
EIS	Environmental Impact Statement
EPA	United States Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS	Facility Indexing System
FR	Federal Register
FRP	Facility Response Plan
HAPs	Hazardous Air Pollutants (CAA)
HSDB	Hazardous Substances Data Bank
HSWA	Hazardous and Solid Waste Amendments
IDEA	Integrated Data for Enforcement Analysis
LDR	Land Disposal Restrictions (RCRA)
LEPCs	Local Emergency Planning Committees
MACT	Maximum Achievable Control Technology (CAA)
MCLGs	Maximum Contaminant Level Goals
MCLs	Maximum Contaminant Levels
MEK	Methyl Ethyl Ketone
MSDSs	Material Safety Data Sheets

MSGP	Multi-Sector General Permit (CWA)
NAAQS	National Ambient Air Quality Standards (CAA)
NAFTA	North American Free Trade Agreement
NAICS	North Americal Industrial Classification System
NCDB	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEC	Not Elsewhere Classified
NEIC	National Enforcement Investigation Center
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NICE[3]	National Industrial Competitiveness Through Energy, Environment and Economics
NO_2	Nitrogen Dioxide
NOI	Notice of Intent
NOT	Notice of Termination
NOV	Notice of Violation
NO_x	Nitrogen Oxides
NPDES	National Pollution Discharge Elimination System (CWA)
NPL	National Priorities List
NRC	National Response Center
NSPS	New Source Performance Standards (CAA)
OAQPS	Office of Air Quality Planning and Standards
OAR	Office of Air and Radiation
OECA	Office of Enforcement and Compliance Assurance
OMB	Office of Management and Budget
OPA	Oil Pollution Act
OPPTS	Office of Prevention, Pesticides, and Toxic Substances
OSHA	Occupational Safety and Health Administration
OSW	Office of Solid Waste
OSWER	Office of Solid Waste and Emergency Response
OW	Office of Water
P2	Pollution Prevention
PCS	Permit Compliance System (CWA Database)
PM10	Particulate Matter of 10 microns or less
PMN	Premanufacture Notice
POTW	Publicly Owned Treatments Works
PSD	Prevention of Significant Deterioration (CAA)
PT	Total Particulates
RCRA	Resource Conservation and Recovery Act
RCRIS	RCRA Information System
RQ	Reportable Quantity (CERCLA)
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SEPs	Supplementary Environmental Projects
SERCs	State Emergency Response Commissions
SIC	Standard Industrial Classification
SIP	State Implementation Plan

SO_2	Sulfur Dioxide
SO_x	Sulfur Oxides
SPCC	Spill Prevention Control and Countermeasures
STEP	Strategies for Today's Environmental Partnership
SWPPP	Storm Water Pollution Prevention Plan (CWA)
TOC	Total Organic Carbon
TRI	Toxic Release Inventory
TRIS	Toxic Release Inventory System
TCRIS	Toxic Chemical Release Inventory System
TSCA	Toxic Substances Control Act
TSD	Treatment Storage and Disposal
TSP	Total Suspended Particulates
TSS	Total Suspended Solids
UIC	Underground Injection Control (SDWA)
USDW	Underground Sources of Drinking Water (SDWA)
UST	Underground Storage Tanks (RCRA)
VOCs	Volatile Organic Compounds

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water and land pollution (such as economic sector, and community-based approaches) are an important supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water and land) affect each other, and that environmental strategies must actively identify and address these interrelationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based" approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, states, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several interrelated topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the references listed at the end of this profile. As a check on the information included, each notebook went through an external document review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project (2224-A), 1200 Pennsylvania Ave., NW, Washington, DC 20460. Comments can also be sent via the Sector Notebooks web page at: http://www.epa.gov/compliance/resources/publications/assistance/sectors/notebooks/. If you are interested in assisting in the development of new Notebooks, or if you have recommendations on which sectors should have a Notebook, please contact the Office of Compliance at 202-564-2310.

Adapting Notebooks to Particular Needs

The scope of the industry sector described in this notebook approximates the national occurrence of facility types within the sector. In many instances, industries within specific geographic regions or states may have unique characteristics that are not fully captured in these profiles. The Office of Compliance encourages state and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested states may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with state and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail.

II. INTRODUCTION TO THE PULP AND PAPER INDUSTRY

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the pulp and paper industry. Facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes.

II.A. Introduction, Background, and Scope of the Notebook

The paper and allied products industry (SIC 26) comprises two types of facilities: pulp and paper mills that process raw wood fiber or recycled fiber to make pulp and/or paper, and converting facilities that use these primary materials to manufacture more specialized products such as paperboard boxes, writing paper, and sanitary paper. Portions of this notebook present information for all of SIC 26, but the notebook focuses primarily on the greatest areas of environmental concern within the industry: those from pulpmaking processes. Converting facilities are not discussed, and the papermaking stage of the pulp and paper process is de-emphasized.

The specific industry components covered in this industry are the following:

SIC 2611. Pulp mills. Pulp mills separate the fibers of wood or from other materials, such as rags, linters, wastepaper, and straw in order to create pulp. Mills may use chemical, semi-chemical, or mechanical processes, and may create co-products such as turpentine and tall oil.

This SIC code does not include pulpmaking facilities that are part of an integrated paper or paperboard facility; those would be categorized according to the appropriate final product. The following are types of pulp mills included in this SIC code:

- Deinking of newsprint
- Fiber pulp: made from wood, rags, wastepaper, linters, straw, and bagasse
- Pulp mills
- Pulp: soda, sulfate, sulfite, groundwood, rayon, and semichemical
- Rayon pulp
- Wood pulp

SIC 2621. Paper mills. Paper mills primarily are engaged in manufacturing paper from woodpulp and other fiber pulp, and may also manufacture converted paper products. Establishments primarily engaged in integrated operations of producing pulp and manufacturing paper are included in this industry if primarily shipping paper or paper products. Establishments primarily engaged in manufacturing converted paper products from purchased paper stock are classified in Industry Group 265 or Industry Group 267.

SIC 2631. Paperboard mills. Establishments in this SIC code primarily are engaged in manufacturing paperboard, including paperboard coated on the paperboard machine, from wood pulp and other fiber pulp; and may also manufacture converted paperboard products. Establishments primarily engaged in manufacturing converted paperboard products from purchased paperboard are classified in Industry Group 265 or Industry Group 267. Establishments primarily engaged in manufacturing insulation board and other reconstituted wood fiberboard are classified in Industry 2493.

The following SIC codes are within SIC 26, but are not addressed in detail in this document:

SIC 265 (2652-2657). Paperboard containers and boxes. Establishments in these SIC codes are engaged in the manufacture of corrugated and solid fiber boxes and containers from purchased paperboard. The principal commodities of this industry are boxes, pads, partitions, display items, pallets, corrugated sheets, food packaging, and non-food (e.g., soaps, cosmetics, and medicinal products) packaging.

SIC 267 (2671-2679). Miscellaneous converted paper products. These establishments produce a range of paper, paperboard, and plastic products with purchased material. Common products include paper and plastic film packaging, specialty paper, paper and plastic bags, manila folders, sanitary paper products, envelopes, stationery, and other products.

SIC codes were established by the Office of Management and Budget (OMB) to track the flow of goods and services within the economy. OMB has changed the SIC code system to a system based on similar production processes called the North American Industrial Classification System (NAICS). Because most of the data presented in this notebook apply to the pulp and paper industry as defined by its SIC codes, this notebook continues to use the SIC system to define this sector. Table 1 presents the SIC codes for the pulp and paper industry and the corresponding NAICS codes.

Table 1: SIC and NAICS Codes

1987 SIC	SIC Description	1997 NAICS	NAICS Description
2611	Pulp mills	322110	Pulp mills
2621	Paper mills	322121	Paper (except newsprint) mills (part)
		322122	Newsprint mills
2631	Paperboard mills	322130	Paperboard mills
2652	Setup paperboard boxes	322213	Setup paperboard box mfg
2653	Corrugated & solid fiber boxes	322211	Corrugated & solid fiber box mfg
2655	Fiber cans, drums & similar products	322214	Fiber cans, drums & similar products mfg
2656	Sanitary food containers	322215	Nonfolding sanitary food container mfg
2657	Folding paperboard boxes	322212	Folding paperboard box mfg
2671	Paper - coated & laminated, packaging	322221	Coated & laminated packaging paper & plastics film mfg
		326112	Unsupported plastics packaging film & sheet mfg
2672	Paper - coated & laminated, n.e.c.	322222	Coated & laminated paper mfg (part)
2673	Bags - plastics, laminated, & coated	322223	Plastics, foil, & coated paper bag mfg
		326111	Unsupported plastics bag mfg
2674	Bags - uncoated paper & multiwall	322224	Uncoated paper & multiwall bag mfg
2675	Die-cut paper & board	322226	Surface-coated paperboard mfg
		322231	Die-cut paper & paperboard office supplies mfg (part)
		322299	All other converted paper product mfg (part)
2676	Sanitary paper products	322121	Paper (except newsprint) mills (part)
		322291	Sanitary paper product mfg (part)
2677	Envelopes	322232	Envelope mfg
2678	Stationery products	322233	Stationery, tablet, & related product mfg
2679	Converted paper products, n.e.c.	322222	Coated & laminated paper mfg (part)
		322231	Die-cut paper & paperboard office supplies mfg (part)
		322299	All other converted paper product mfg (part)

Source: U.S. Census Bureau, 2000a.

II.B. Characterization of the Pulp and Paper Industry

The pulp and paper industry converts wood (harvested by logging firms in SIC 24) or recycled fiber into pulp and primary forms of paper. Other companies in the paper and allied products industry (SIC codes 265 and 267) use the products of the pulp and paper industry to manufacture specialized products including paperboard boxes, writing paper, and sanitary paper.

II.B.1. Product Characterization

The pulp and paper industry produces primary products – commodity grades of wood pulp, printing and writing papers, sanitary tissue, industrial-type papers, containerboard and boxboard – using cellulose fiber from timber or purchased or recycled fibers. The two steps are pulping and paper or paperboard manufacturing.

Pulping

Pulping is the process of dissolving wood chips into individual fibers by chemical, semi-chemical, or mechanical methods. The particular pulping process used affects the strength, appearance, and intended use characteristics of the resultant paper product. Pulping is the major source of environmental impacts in the pulp and paper industry. There are more than a dozen different pulping processes in use in the U.S.; each pulping process has its own set of process inputs, outputs, and resultant environmental concerns. Table 2 provides an overview of the major pulping processes and the main products that they produce.

Table 2: Description of Pulping Processes

<table>
<tr><th>Pulp Process</th><th>Description/Principal Products</th></tr>
<tr><td>Dissolving Kraft</td><td>Highly bleached and purified kraft process wood pulp suitable for conversion into products such as rayon, viscose, acetate, and cellophane.</td></tr>
<tr><td>Bleached Papergrade Kraft and Soda</td><td rowspan="2">Bleached or unbleached kraft process wood pulp usually converted into paperboard, coarse papers, tissue papers, and fine papers such as business, writing and printing.</td></tr>
<tr><td>Unbleached Kraft</td></tr>
<tr><td>Dissolving Sulfite</td><td>Highly bleached and purified sulfite process wood pulp suitable for conversion into products such as rayon, viscose, acetate, and cellophane.</td></tr>
</table>

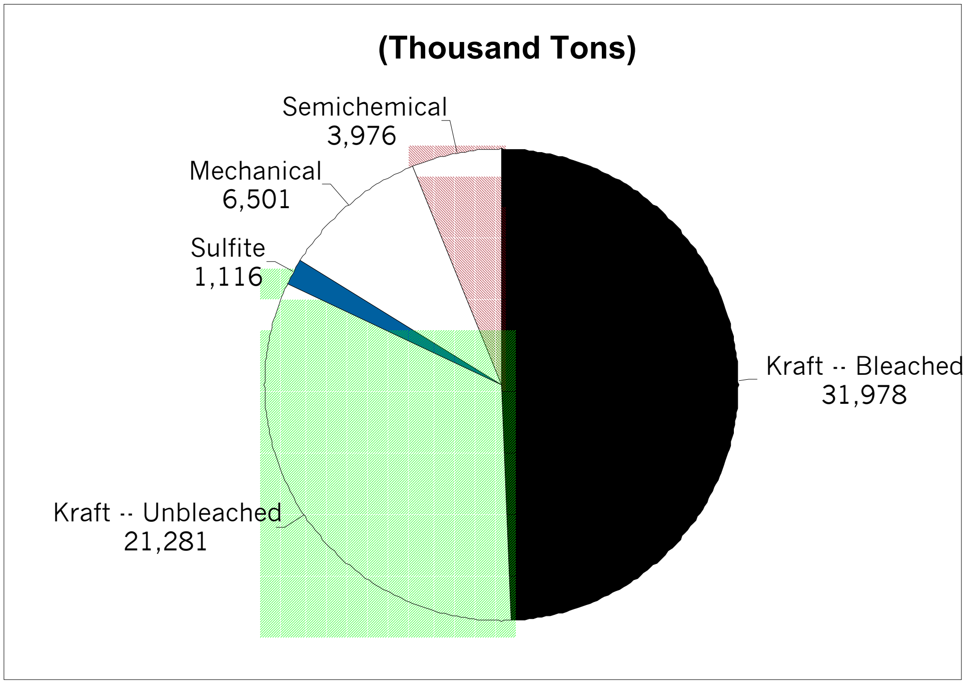
Table 2: Description of Pulping Processes (continued)

Pulp Process	Description/Principal Products
Papergrade Sulfite	Sulfite process wood pulp with or without bleaching used for products such as tissue papers, fine papers, and newsprint.
Semi-chemical	Pulp is produced by chemical, pressure, and occasionally mechanical forces with or without bleaching used for corrugating medium (cardboard), paper, and paperboard.
Mechanical pulp	Pulp manufacture by stone groundwood, mechanical refiner, thermo-mechanical, chemi-mechanical, or chemi-thermo-mechanical means for newsprint, coarse papers, tissue, molded fiber products, and fine papers.
Secondary Fiber Deink	Pulps from recovered paper or paperboard using a chemical or solvent process to remove contaminants such as inks, coatings and pigments used to produce fine, tissue, and newsprint papers.
Secondary Fiber Non-deink	Pulp production from recovered paper or paperboard without deinking processes to produce tissue, paperboard, molded products and construction papers.
Non-wood Chemical pulp	Production of pulp from textiles (e.g.,rags), cotton linters, flax, hemp, tobacco, and abaca to make cigarette wrap papers and other specialty paper products.

Source: U.S. EPA, 1993a.

The bleached and unbleached kraft processes are used to manufacture the majority of paper products. Together, these processes account for 83 percent of the pulp produced in the United States. Figure 1 presents the relative output of the major pulping processes.

Figure 1: Pulp Production, 2000



Source: AF&PA, 2001.

The pulp manufacturing process is the major source of environmental concern for this industry. For example, a bleached kraft pulp mill requires 4,000-12,000 gallons of water and 14-20 million Btu of energy per ton of pulp, of which roughly 8-10 million Btu typically are derived from biomass-derived fuel from the pulping process (*Pulp and Paper*, 2001). Across all facilities in SIC 26, the pulp, paper, and allied products industry is the largest consumer of process water and the third largest consumer of energy (behind the chemicals and metals industries) (U.S. Department of Commerce, 2000 and U.S. Department of Energy, 2000). The high use of water and energy, as well as the chemical inputs described in Section III, lead to a variety of environmental concerns.

Paper and Paperboard Manufacturing

The paper or paperboard manufacturing process is similar for all types of pulp. In this process, pulp is spread out as a wet mixture, or *slurry*, onto a screen. Water is removed by gravity and vacuums, and the resulting layer of fibers is passed through a series of rollers that compress the material into sheets. Paper and paperboard manufacturers use nearly identical processes; the difference is that paperboard is thicker (more than 0.3 mm).

II.B.2. Industry Size and Geographic Distribution

The pulp and paper industry is characterized by very large facilities; of the 514 pulp and paper mills in SIC codes 261-263 reported by the Bureau of the Census in 1998, 343 (67 percent) have 100 or more employees. Across all of these facilities, there are 172,000 employees who produced $59 billion in shipments (in 1998 dollars). In 2000, the industry employed 182,000 and produced $79 billion in shipments.

In contrast, the downstream facilities (container and specialty product manufacturers) tend to be more numerous but smaller. More than 75 percent of these facilities have fewer than 100 employees. Table 3 presents the employment distribution for both pulp and paper facilities and downstream manufacturers in 1997 (the most recent data available) as reported by the U.S. Census Bureau. Because recent years have seen some facility closures, the current number of facilities may be somewhat lower.

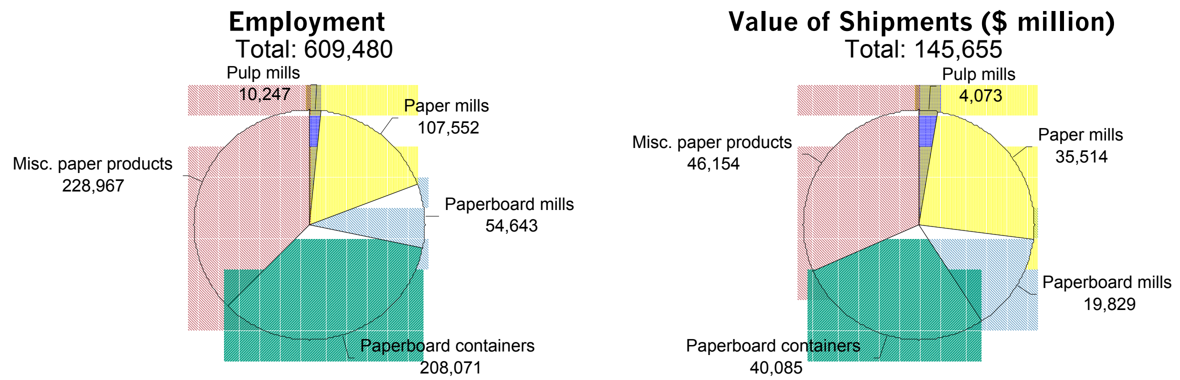
Table 3: Size of Paper and Allied Products Facilities

Industry	Employees per Facility (% of Total)			
	1-19	20-99	100-499	>499
Pulp mills (SIC 261)	3 (7%)	14 (34%)	18 (44%)	6 (15%)
Paper mills (SIC 262)	6 (2%)	63 (24%)	107 (41%)	83 (32%)
Paperboard mills (SIC 263)	8 (4%)	77 (36%)	96 (45%)	33 (15%)
Paperboard containers and boxes (SIC 265)	748 (26%)	1,311 (46%)	782 (27%)	14 (<1%)
Misc. converted paper products (SIC 267)	1,383 (44%)	1,116 (36%)	597 (19%)	70 (2%)

Source: U.S. Census Bureau, 1998.

Figure 2 presents the employment and value of shipments for both the primary and secondary portions of the paper and allied products industry. Taken together, the industry is among the top 10 U.S. manufacturing industries in value of shipments. As noted in the two graphs, the pulp and paper portion of the industry (pulp, paper, and paperboard mills) employs only 28 percent of the workers in the industry, but produces over 40 percent of the shipments.

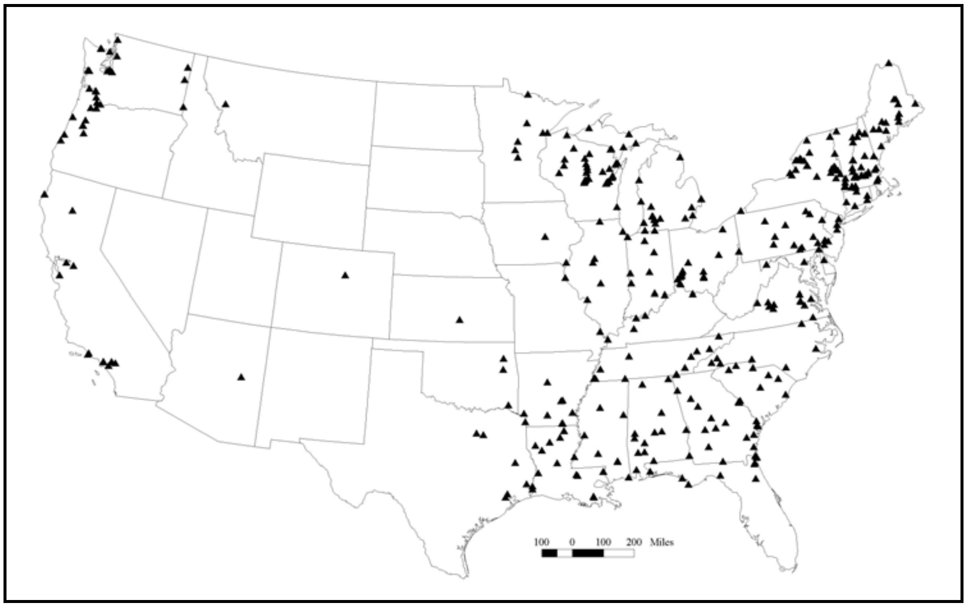
Figure 2: Employment and Value of Shipments in the Paper and Allied Products Industry[a]



[a] Integrated mills, which produce both pulp and paper (or paperboard), are included in the paper (or paperboard) categories. The pulp mill category includes only facilities producing pulp for the general market.
Source: U.S. Census Bureau, 2000b.

The geographic distribution of pulp and paper mills varies according to the type of mill. As there are tremendous variations in the scale of individual facilities, tallies of the number of facilities may not represent the level of economic activity (nor possible environmental consequences). Pulp mills are located primarily in regions of the country where trees are harvested from natural stands or tree farms: the Southeast, Northwest, Northeast, and North Central regions. Pulp mills that process recycled fiber are generally located near sources of waste paper. Paper mills, however, are more widely distributed. They are located near pulping operations and/or near converting markets. The distribution of paperboard mills reflects the location of manufacturing in general, since such operations are the primary market for paperboard products. Figure 3 presents the location of pulp and paper mills in the U.S.

Figure 3: Geographic Distribution of Pulp, Paper, and Paperboard Mills



There are no currently active mills in Alaska or Hawaii.
Source: U.S. EPA, 1999.

II.B.3. Economic Trends

World Market Competition

The U.S. produces roughly 30 percent of the world's paper and paperboard. The pulp and paper industry is one of the most important industries for the balance of trade in the U.S. This trade balance increased through most of the 1990s. In 1999, exports from SIC codes 261-263 were $8.5 billion. In recent years, however, exports have been declining and imports have been increasing. Between 1997 and 2000, exports declined 5.5% and imports increased by more than 20%. The declining exports and increasing imports are partly due to a strong dollar in this period and the recent slow down of the U.S. economy (AF&PA, 2001).

The U.S. industry has several advantages over the rest of the world market, including modern mills, a highly skilled work force, a large domestic market, and an efficient transportation infrastructure. Major export markets for pulp are Japan, Italy, Germany, Mexico, and France. The U.S. Department of Commerce anticipates exports to grow faster than production for domestic markets through 2004. World Trade Organization (WTO) efforts to reduce tariffs include those on pulp and paper products; if these are successful, the U.S. industry expects pulp and paper export rates to increase even further.

However, pulp and paper are commodities and therefore prices are vulnerable to global competition. Countries such as Brazil, Chile, and Indonesia have built modern, advanced pulp facilities. These countries have faster-growing trees and lower labor costs. Latin American and European countries also are adding papermaking capacity. Furthermore, the strong value of the dollar has made imports less expensive relative to domestically-produced goods. Because of this increased foreign competition, imports of paper to the U.S. market are expected to increase three percent annually through 2004 (U.S. Department of Commerce, 2000).

Industry Consolidation

In order to compensate for this increasingly competitive market, pulp and paper companies have undertaken a considerable number of mergers and acquisitions. Table 4 lists the major transactions that occurred between 1997 and 2002.

Table 4: Major Pulp and Paper Mergers and Acquisitions

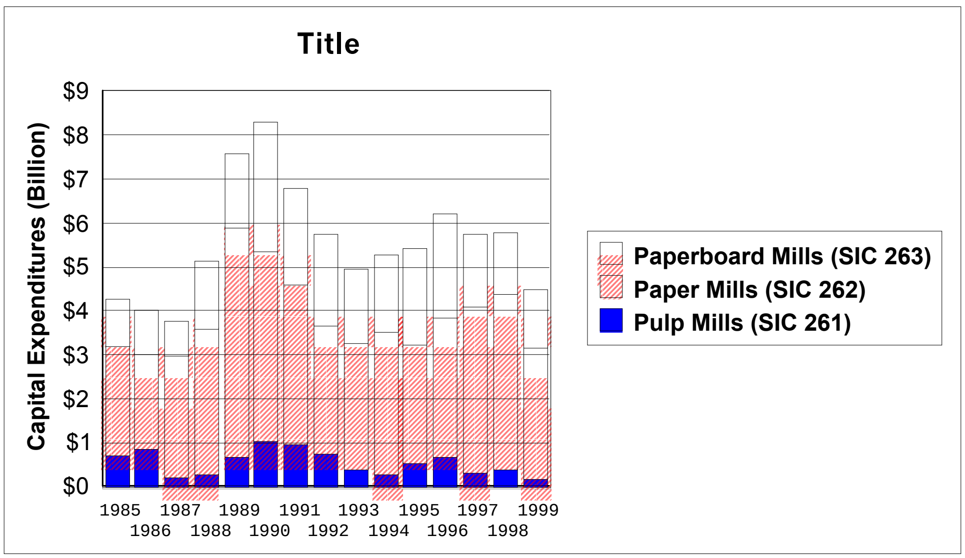
Buyer	Acquired	Value (million)	Year
International Paper Co.	Champion International Inc.	$9,600	2000
International Paper Co.	Union Camp Corp.	$7,900	1999
Jefferson Smurfit Corp.	Stone Container Corp.	$6,400	1998
Weyerhaeuser Co.	Willamette	$6,000	2002
Fort Howard Corp.	James River Corp.	$5,800	1997
Abitibi-Consolidated Inc.	Donohue Inc.	$5,300	2000
Stora Enso Oy	Consolidated Papers Inc.	$4,800	2000
Abitibi-Price Inc.	Stone-Consolidated Inc.	$3,600	1997
Westvaco	Mead	$3,000	2002
Bowater Inc.	Avenor Inc.	$2,500	1997
Weyerhaeuser Co.	MacMillan Bloedel Ltd.	$2,450	1999
Madison Dearborn Industries Inc.	Tenneco Packaging Inc.	$2,200	1999

Largest mergers and acquisitions between 1997 and mid-2000.
Source: McLaren, J et al., 2000, and Pulp & Paper International, September 2002.

Capital Improvements

Historically, U.S. pulp and paper companies have invested heavily in capital improvements to their facilities. Capital investments in recent years, however, are well below historic levels due to the difficult market conditions. For the first time, industry capacity actually declined in 2001 (Pulp & Paper International, 2002). Because few new mills are being built, most capital expenditures represent plant expansions, upgrades, and environmental protection initiatives at existing facilities. Figure 4 presents the rate of capital investments within SIC 261-263. Throughout the time period shown, capital improvements related to environmental protection claimed from 4% to 22% of the total investments with significant increases in the early and late 1990s (AF&PA, 2001).

Figure 4: Capital Improvements at Pulp and Paper Mills

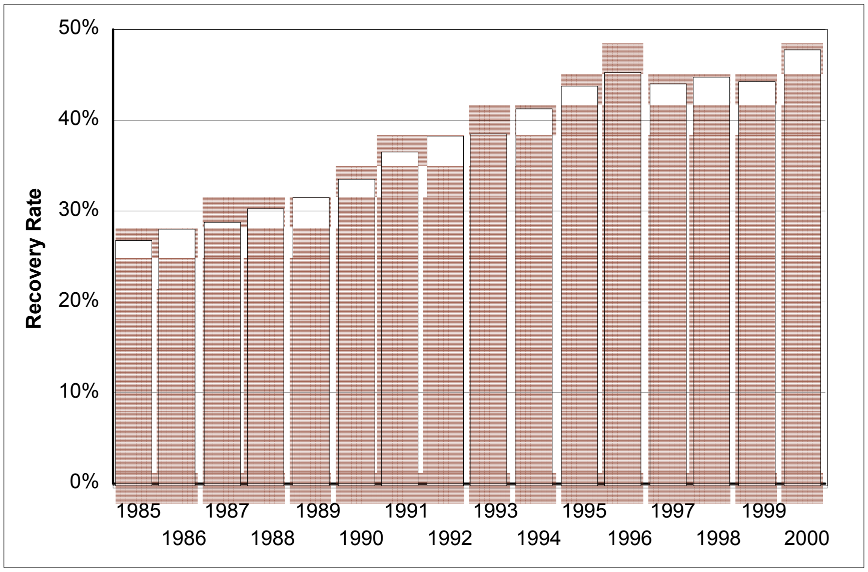


Source: AF&PA, 2001.

Recycling Efforts

A major movement within the pulp and paper industry has been an increased focus on the use of recovered paper. As shown in Figure 5, nearly 50 percent of paper now is recovered and used either as recycled paper or as products such as home insulation. Furthermore, recovered paper contributes to U.S. exports; roughly ten million tons of recovered paper were exported in 2000 (AF&PA, 2001).

Figure 5: Paper Recovery Rates



The recovery rate is the ratio of recovered paper collected to new supply of paper and paperboard.
Source: AF&PA, 2001.

III. INDUSTRIAL PROCESS DESCRIPTION

This section describes the major industrial processes within the pulp and paper industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provides a concise description of where wastes may be produced in the process. This section also describes the potential fate (via air, water, and soil pathways) of these waste products.

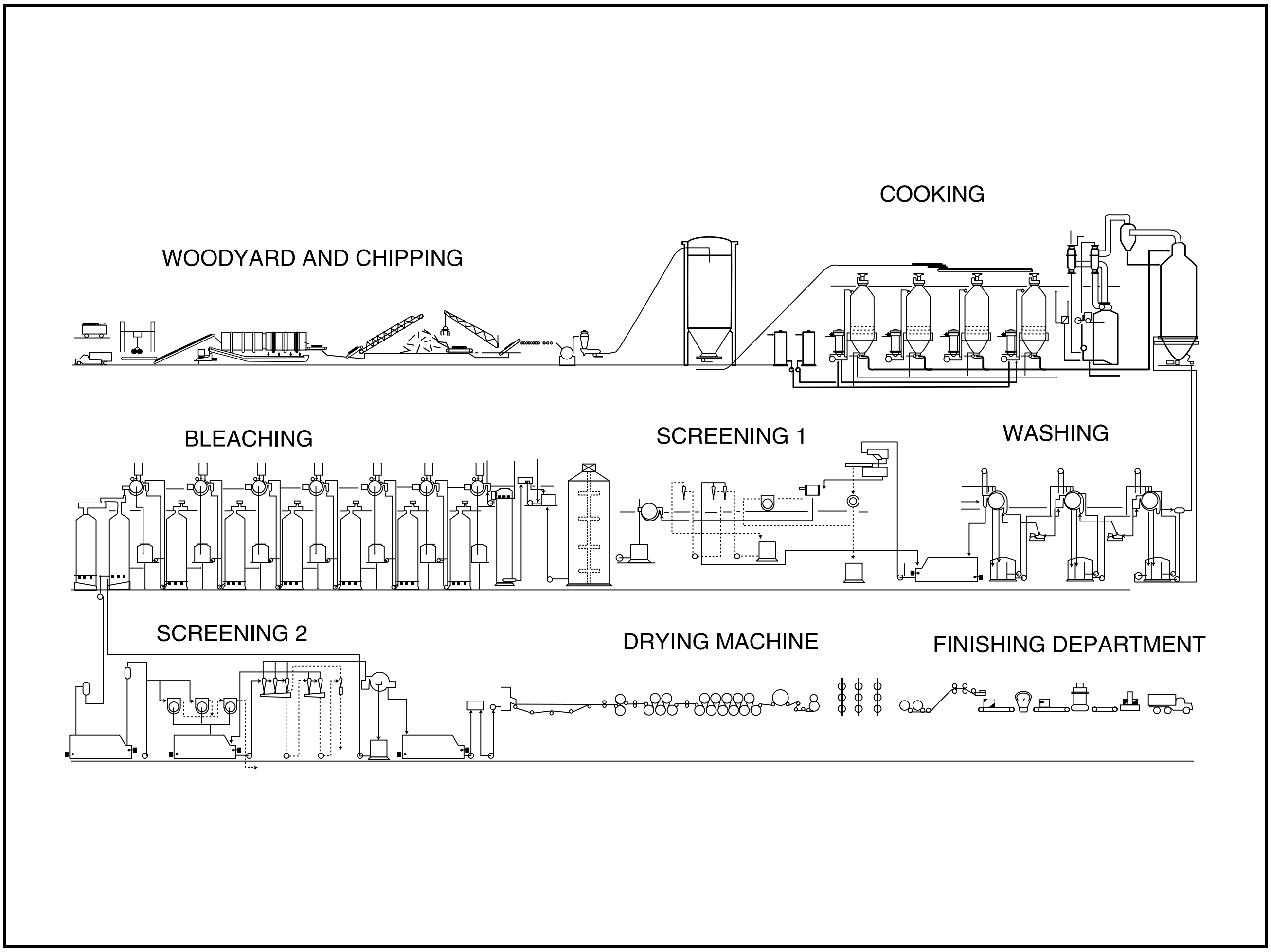
III.A. Industrial Processes in the Pulp and Paper Industry

Simply put, paper is manufactured by applying a watery suspension of cellulose fibers to a screen which allows the water to drain and leaves the fibrous particles behind in a sheet. Most modern paper products contain non-fibrous additives, but otherwise fall within this general definition. Only a few paper products for specialized uses are created without the use of water, via dry forming techniques. The individual fibers formed into paper sheets is called pulp. The production of pulp is the major source of environmental impacts in the pulp and paper industry.

Processes in the manufacture of paper and paperboard can, in general terms, be split into three steps: pulp making, pulp processing, and paper/paperboard production. Paperboard sheets are thicker than paper sheets; paperboard is thicker than 0.3 mm. In general, however, paper and paperboard production processes are identical. First, a stock pulp mixture is produced by digesting a material into its fibrous constituents via chemical, mechanical, or a combination of chemical and mechanical means. In the case of wood, the most common pulping material, chemical pulping actions release cellulose fibers by selectively destroying the chemical bonds in the glue-like substance (lignin) that binds the fibers together. After the fibers are separated and impurities have been removed, the pulp may be bleached to improve brightness and processed to a form suitable for paper-making equipment. At the paper-making stage, the pulp can be combined with dyes, strength building resins, or texture adding filler materials, depending on the intended end product. Afterwards, the mixture is dewatered, leaving the fibrous constituents and pulp additives on a wire or wire-mesh conveyor. Additional additives may be applied after the sheet-making step. The fibers bond together as they are carried through a series of presses and heated rollers. The final paper product is usually spooled on large rolls for storage (see Figure 6).

The following discussion focuses mainly on pulping processes due to their importance in understanding industry environmental impacts and current industry regulatory classification schemes. If more information on papermaking processes is desired, the *Development Document for Proposed Effluent Limitations, Guidelines and Standards for the Pulp and Paper Industry, Point Source Category* (EPA-821-R-93-019) is recommended. Additional sources are listed in Section IX of this document.

Figure 6: Simplified Flow Diagram: Integrated Mill (Chemical Pulping, Bleaching, and Paper Production)



Source: Smook, 1992.

III.A.1. Pulp Manufacture

At the pulping stage, the processed furnish (wood or other fiber source) is digested into its fibrous constituents. The bonds between fibers may be broken chemically, mechanically, or by a combination of the techniques called semi-chemical pulping. The choice of pulping technique is dependent on the type of furnish and the desired qualities of the finished product, but chemical pulping is the most prevalent. Table 5 presents an overview of the wood pu00lping types by the method of fiber separation, resultant fiber quality, and percent of 1998 U.S. pulp production. Many mills perform multiple pulping processes at the same site, most frequently non-deink secondary fiber pulping and papergrade kraft pulping (U.S. EPA, 1993a). The three basic types of wood pulping processes 1) chemical pulping, 2) semi-chemical pulping, and 3) mechanical pulping are detailed below followed by a discussion of secondary fiber pulping techniques.

Table 5: General Classification of Wood Pulping Processes

Process Category	Fiber Separation Method	Fiber Quality	Examples	% of Total 1998 US Wood Pulp Production
Mechanical	Mechanical energy	Short, weak, unstable, impure fibers	Stone groundwood, refiner mechanical pulp	10%
Semi-chemical	Combination of chemical and mechanical treatments	"Intermediate" pulp properties (some unique properties)	High-yield kraft, high-yield sulfite	6%
Chemical	Chemicals and heat	Long, strong, stable fibers	Kraft, sulfite, soda	84%

Sources: Smook, 1992; AF&PA, 1999.

A variety of technologies and chemicals are used to manufacture pulp, but most pulp manufacturing systems contain the process sequence shown in Table 6.

Table 6: Pulp Manufacturing Process Sequence

Process Sequence	Description
Fiber Furnish Preparation and Handling	Debarking, slashing, chipping of wood logs and then screening of wood chips/secondary fibers (some pulp mills purchase chips and skip this step)
Pulping	Chemical, semi-chemical, or mechanical breakdown of pulping material into fibers
Pulp Processing	Removal of pulp impurities, cleaning and thickening of pulp fiber mixture
Bleaching	Addition of chemicals in a staged process of reaction and washing increases whiteness and brightness of pulp, if necessary
Pulp drying and baling (non-integrated mills)	At non-integrated pulp mills, pulp is dried and bundled into bales for transport to a paper mill
Stock Preparation	Mixing, refining, and addition of wet additives to add strength, gloss, texture to paper product, if necessary

Overall, most of the pollutant releases associated with pulp and paper mills occur at the pulping and bleaching stages where the majority of chemical inputs occur.

Furnish Composition

Furnish is the blend of fibrous materials used to make pulp. According to the *1990 National Census of Pulp, Paper, and Paperboard Manufacturing Facilities*, the most commonly used furnish material is wood; it is used in some form by approximately 95 percent of pulp and paper manufacturers. Overall, wood furnish averages approximately 50 percent of pulp content industry-wide.

The major source of fiber for paper products comes from the vegetative tissues of vascular plants. Although almost any vascular plant could be used for paper production, the economics of scale require a high fiber yield for paper manufacture. By far, the principle source of paper-making fibers in the United States is wood from trees, the largest vascular plants available. The fibrous particles used to make paper are made of cellulose, a primary component of the cell walls of vascular plant tissues. The cellulose fibers must be removed from a chemical matrix (e.g., lignin, hemicelluloses, and resins) and result in a mixture of relatively pure fibers.

Wood used to make pulp can arrive at the mill in a variety of forms including wood logs, chips, and sawdust. Due to different physical and chemical properties of different types of wood, certain pulping processes are most efficient on specific wood types. The type of wood used can also make a difference in the final characteristics of the pulp. In general, softwood (e.g., pine and spruce) fibers are longer than those from hardwood (e.g., birch and oak) and have thinner cell walls. The longer fibers of softwood promote inter-fiber bonding and produce papers of greater strength.

Secondary fibers comprise the next most common furnish constituent. Secondary fibers consist of pre-consumer fibers (e.g., mill waste fibers) and post-consumer fiber. Post-consumer fiber sources are diverse, but the most common are newsprint and corrugated boxes (See Table 7). Although secondary fibers are not used in as great a proportion as wood furnish, approximately 80 percent of pulp and paper manufacturers use some secondary fibers in their pulp production and approximately 200 mills (approximately 40 percent of total number of mills) rely exclusively on secondary fibers for their pulp furnish (AF&PA, 1999; AF&PA, 2000c). Secondary fibers must be processed to remove contaminants such as glues or bindings, but, depending on the end product, may or may not be processed to remove ink contaminants or to brighten the pulp.

Secondary fiber use is increasing in the pulp and paper industry due to consumer demand for products made from recycled paper. Recovered fiber accounted for 75 percent of the industry's increase in fiber consumption between 1990 and 2000 (AF&PA, 2000a). The utilization of secondary fibers, expressed as the ratio of recovered paper consumption to the total production of paper and paperboard, is at approximately 39 percent and is climbing slowly (AF&PA, 2001). In a resource-deficient country such as Japan, the secondary fiber utilization rate is at about 50 percent, whereas the average utilization rate in Europe is approximately 40 percent (VDP, 1997). Due to losses of fiber substance and strength during the recycling process, a 50 percent utilization rate is considered the present maximum overall utilization rate for fiber recycling (Smook, 1992).

Secondary fiber sources are seldom used as feedstocks for high quality paper products. Contaminants (e.g., inks, paper colors) are often present, so production of low-purity products is often the most cost-effective use of secondary fibers, although decontamination technologies are available. Approximately 68 percent of all secondary fiber in the U.S. is presently used for multi-ply paperboard or the corrugating paper used to manufacture corrugated cardboard (AF&PA, 2000a). Over the next decade, an increasing proportion of the total amount will be deinked for newsprint or other higher-quality uses.

Table 7: Relative Wastepaper Usage as Secondary Fiber in 1999

Paper Type	% of Total Wastepaper Usage in 1999
Mixed Paper	18%
Old Newspaper	19%
Old Corrugated Cardboard	48%
Pulp Substitutes	6%
High-grade Deinked	9%

Source: AF&PA, 2000b.

Other types of furnish include cotton rags and linters, flax, hemp, bagasse, tobacco, and synthetic fibers such as polypropylene. These substances are not used widely, however, as they are typically for low volume, specialty grades of paper.

The types of furnish used by a pulp and paper mill depend on the type of product produced and what is readily available. Urban mills use a larger proportion of secondary fibers due to the post-consumer feedstock close at hand. More rurally located mills are usually close to timber sources and thus may use virgin fibers in greater proportion.

Furnish Preparation

Furnish is prepared for pulp production by a process designed to supply a homogenous pulping feedstock. In the case of roundwood furnish (logs), the logs are cut to manageable size and then debarked. At pulp mills integrated with lumbering facilities, acceptable lumber wood is removed at this stage. At these facilities, any residual or waste wood from lumber processing is returned to the chipping process; in-house lumbering rejects can be a significant source of wood furnish at a facility. The bark of those logs not fit for lumber is usually either stripped mechanically or hydraulically with high powered water jets in order to prevent contamination of pulping operations. Depending on the moisture content of the bark, it may then be burned for energy production. If not burned for energy production, bark can be used for mulch, ground cover, or to make charcoal.

Hydraulic debarking methods may require a drying step before burning. Usually, hydraulically removed bark is collected in a water flume, dewatered, and pressed before burning. Treatment of wastewater from this process is difficult and costly, however, whereas dry debarking methods can channel the removed bark directly into a furnace (Smook, 1992). In part because of these challenges, hydraulic debarking has decreased in significance within the industry (Potlatch, 2002).

Debarked logs are cut into chips of equal size by chipping machines. Chippers usually produce uniform wood pieces 20 mm long in the grain direction and 4 mm thick. The chips are then put on a set of vibrating screens to remove those that are too large or small. Large chips stay on the top screens and are sent to be recut, while the smaller chips are usually burned with the bark. Certain mechanical pulping processes, such as stone groundwood pulping, use roundwood; however, the majority of pulping operations require wood chips. Non-wood fibers are handled in ways specific to their composition. Steps are always taken to maintain fiber composition and thus pulp yield.

Chemical Pulping

Chemical pulps are typically manufactured into products that have high-quality standards or require special properties. Chemical pulping degrades wood by dissolving the lignin bonds holding the cellulose fibers together. Generally, this process involves the cooking/digesting of wood chips in aqueous chemical solutions at elevated temperatures and pressures. There are two major types of chemical pulping currently used in the U.S.: 1) kraft/soda pulping and 2) sulfite pulping. These processes differ primarily in the chemicals used for digesting. The specialty paper products rayon, viscose, acetate, and cellophane are made from dissolving pulp, a variant of standard kraft or sulfite chemical pulping processes.

Kraft pulping (or sulfate) processes produced approximately 83 percent of all US pulp tonnage during 2000 according to the American Forest and Paper Association (AF&PA, 2001). The success of the process and its widespread adoption are due to several factors. First, because the kraft cooking chemicals are selective in their attack on wood constituents, the pulps produced are notably stronger than those from other processes (i.e., Kraft is German for "strength"). The kraft process is also flexible, in so far as it is amenable to many different types of raw materials (i.e., hard or soft woods) and can tolerate contaminants frequently found in wood (e.g., resins). Lignin removal rates are high in the kraft process — up to 90 percent — allowing high levels of bleaching without pulp degradation. Finally, the chemicals used in kraft pulping are readily recovered within the process, making it very economical and reducing potential environmental releases (See *Chemical Recovery Systems* below).

The kraft process uses a sodium-based alkaline pulping solution (liquor) consisting of sodium sulfide (Na_2S) and sodium hydroxide (NaOH) in 10 percent solution. This liquor (white liquor) is mixed with the wood chips in a reaction vessel (digester). The output products are separated wood fibers (pulp) and a liquid that contains the dissolved lignin solids in a solution of reacted and unreacted pulping chemicals (black liquor). The black liquor undergoes a chemical recovery process (see *Chemical Recovery Systems*) to regenerate white liquor for the first pulping step. Overall, the kraft process converts approximately 50 percent of input furnish into pulp.

The kraft process evolved from the soda process. The soda process uses an alkaline liquor of only sodium hydroxide (NaOH). The kraft process has virtually replaced the soda process due to the economic benefits of chemical recovery and improved reaction rates (the soda process has a lower yield of pulp per pound of wood furnish than the kraft process).

Sulfite pulping was used for approximately two percent of U.S. pulp production in 2000 (AF&PA, 2001). Softwood is the predominant furnish used in sulfite pulping processes. However, only non-resinous species are generally pulped. The sulfite pulping process relies on acid solutions of sulfurous acid (H_2SO_3) and bisulfite ion (HSO_3^-) to degrade the lignin bonds between wood fibers.

Sulfite pulps have less color than kraft pulps and can be bleached more easily, but are not as strong. The efficiency and effectiveness of the sulfite process is also dependent on the type of wood furnish and the absence of bark. For these reasons, the use of sulfite pulping has declined in comparison to kraft pulping over time.

Semi-chemical pulping

Semi-chemical pulping comprised six percent of U.S. pulp production in 2000 (AF&PA, 2001). Semi-chemical pulp is often very stiff, making this process common in corrugated container manufacture. This process primarily uses hardwood as furnish.

The major process difference between chemical pulping and semi-chemical pulping is that semi-chemical pulping uses lower temperatures, more dilute cooking liquor or shorter cooking times, and mechanical disintegration for fiber separation. At most, the digestion step in the semi-chemical pulping process consists of heating pulp in sodium sulfite (Na_2SO_3) and sodium carbonate (Na_2CO_3) Other semi-chemical processes include the Permachem process and the two-stage vapor process. The yield of semi-chemical pulping ranges from 55 to 90 percent, depending on the process used, but pulp residual lignin content is also high so bleaching is more difficult.

Mechanical pulping

Mechanical pulping accounted for nine percent of U.S. pulp production in 2000 (AF&PA, 2001). Mechanically produced pulp is of low strength and quality. Such pulps are used principally for newsprint and other non-permanent paper goods. Mechanical pulping relies on physical pressure instead of chemicals to separate furnish fibers; however, chemicals are sometimes added at the various stages of refining. Processes include: 1) stone groundwood, 2) refiner mechanical, 3) thermo-mechanical, 4) chemi-mechanical, and 5) chemi-thermo-mechanical. The stone groundwood process simply involves mechanical grinding of wood in several high-energy refining systems. The refiner mechanical process involves refining wood chips at atmospheric pressure while the thermo-mechanical process uses steam and pressure to soften the chips before mechanical refining. In the chemi-mechanical process, chemicals can be added throughout the process to aid the mechanical refining. The chemi-thermo-mechanical process involves the treatment of chips with chemicals for softening followed by mechanical pulping under heat and pressure. Mechanical pulping typically results in high pulp yields, up to 95 percent when compared to chemical pulping yields of 45- 50 percent, but energy usage is also high. To offset its structural weakness, mechanical pulp is often blended with chemical pulp.

Secondary fiber pulping

Secondary fiber pulping accounted for 39 percent of domestic pulp production in 2000 (AF&PA, 2001). Nearly 200 mills rely exclusively on recovered paper for pulp furnish, and roughly 80 percent of U.S. paper mills use recovered paper in some way (AF&PA, 2000c). In addition, consumption of fiber from recovered paper is growing more than twice as fast as overall fiber consumption. Secondary fibers are usually presorted before they are sold to a pulp and paper mill. If not, secondary fibers are processed to remove contaminants before pulping occurs. Common contaminants consist of adhesives, coatings, polystyrene foam, dense plastic chips, polyethylene films, wet strength resins, and synthetic fibers. In some cases, contaminants of greater density than the desired secondary fiber are removed by centrifugal force while light contaminants are removed by flotation systems. Centri cleaners are also used to remove material less dense than fibers (wax and plastic particles) (AF&PA, 1995b).

Inks, another contaminant of secondary fibers, may be removed by heating a mixture of secondary fibers with surfactants. The removed inks are then dispersed in an aqueous media to prevent redeposition on the fibers. Continuous solvent extraction has also been used to recover fibers from paper and board coated with plastics and/or waxes.

Secondary fiber pulping is a relatively simple process. The most common pulper design consists of a large container filled with water, which is sometimes heated, and the recycled pulp. Pulping chemicals (e.g., sodium hydroxide, NaOH) are often added to promote dissolution of the paper or board matrix. The source fiber (corrugated containers, mill waste, etc.) is dropped into the pulper and mixed by a rotor. Debris and impurities are removed by two mechanisms: a ragger and a junker. The ragger withdraws strings, wires, and rags from the stock secondary fiber mixture. A typical ragger consists of a few "primer wires" that are rotated in the secondary fiber slurry. Debris accumulates on the primer wires, eventually forming a "debris rope" which is then removed. Heavier debris are separated from the mixture by centrifugal force and fall into a pocket on the side of the pulper. The junker consists of a grappling hook or elevator bucket. Heat, dissolution of chemical bonds, shear forces created by stirring and mixing, and grinding by mechanical equipment may serve to dissociate fibers and produce a pulp of desired consistency.

Contaminant removal processes depend on the type and source of secondary fiber to be pulped. Mill paper waste can be easily repulped with minimal contaminant removal. Recycled post-consumer newspaper, on the other hand, may require extensive contaminant removal, including deinking, prior to reuse. As noted in *Furnish Composition* above, secondary fiber typically is used in lower-quality applications such as multi-ply paperboard or corrugating paper.

III.A.2. Pulp Processing

After pulp production, pulp processing removes impurities, such as uncooked chips, and recycles any residual cooking liquor via the washing process (Figure 7). Pulps are processed in a wide variety of ways, depending on the method that generated them (e.g., chemical, semi-chemical). Some pulp processing steps that remove pulp impurities include screening, defibering, and deknotting. Pulp may also be thickened by removing a portion of the water. At additional cost, pulp may be blended to ensure product uniformity. If pulp is to be stored for long periods of time, drying steps are necessary to prevent fungal or bacterial growth.

Residual spent cooking liquor from chemical pulping is washed from the pulp using brown stock washers. Efficient washing is critical to maximize return of cooking liquor to chemical recovery (see *Chemical Recovery Systems* below) and to minimize carryover of cooking liquor (known as brown stock washing loss) into the bleach plant, because excess cooking liquor increases consumption of bleaching chemicals. Specifically, the dissolved organic compounds (lignins and hemicelluloses) contained in the liquor will bind to bleaching chemicals and thus increase bleach chemical consumption. In addition, these organic compounds function as precursors to chlorinated organic compounds (e.g., dioxins, furans), increasing the probability of their formation. The most common washing technology is rotary vacuum washing, carried out sequentially in two or four washing units. Other washing technologies include diffusion washers, rotary pressure washers, horizontal belt filters, wash presses, and dilution/extraction washers.

Pulp screening, removes remaining oversized particles such as bark fragments, oversized chips, and uncooked chips. In *open* screen rooms, wastewater from the screening process goes to wastewater treatment prior to discharge. In *closed loop* screen rooms, wastewater from the process is reused in other pulping operations and ultimately enters the mill's chemical recovery system. Centrifugal cleaning (also known as liquid cyclone, hydrocyclone, or centricleaning) is used after screening to remove relatively dense contaminants such as sand and dirt. Rejects from the screening process are either repulped or disposed of as solid waste.

Chemical Recovery Systems

The chemical recovery system is a complex part of a chemical pulp and paper mill and is subject to a variety of environmental regulations. Chemical recovery is a crucial component of the chemical pulping process: it recovers process chemicals from the spent cooking liquor for reuse. The chemical recovery process has important financial and environmental benefits for pulp and paper mills. Economic benefits include savings on chemical purchase costs due to regeneration rates of process chemicals approaching 98 percent, and energy generation from pulp residue burned in a recovery furnace (Smook, 1992). Environmental benefits include the recycle of process chemicals and lack of resultant discharges to the environment.

The kraft, sulfite, and semi-chemical pulping processes all use chemical recovery systems of some form; however, the actual chemical processes at work differ markedly. Due to its widespread usage, only the kraft chemical recovery system will be covered in depth in this document. Sulfite chemical recovery systems are discussed briefly at the end of this section.

Kraft Chemical Recovery Systems

Although newer technologies are always under development, the basic kraft chemical recovery process has not been fundamentally changed since its patent issue in 1884. The stepwise progression of chemical reactions has been refined; for example, black liquor gasification processes are now in use in an experimental phase. The precise details of the chemical processes at work in the chemical recovery process can be found in Smook, *Handbook for Pulp and Paper Technologists,* 2nd Edition, 1992 and will not be discussed here. The kraft chemical recovery process consists of the following general steps:

Black liquor concentration

Residual weak black liquor from the pulping process is concentrated by evaporation to form "strong black liquor." After brown stock washing in the pulping process, the concentration of solids in the weak black liquor is approximately 15 percent; after the evaporation process, solids concentration can range from 60 - 80 percent. In some older facilities, the liquor then undergoes oxidation for odor reduction. The oxidation step is necessary to reduce odor created when hydrogen sulfide is stripped from the liquor during the subsequent recovery boiler burning process. Almost all recovery furnaces installed since 1968 have non-contact evaporation processes that avoid these problems, so oxidation processes are not usually seen in mills with modern recovery furnaces. Common modern evaporator types include multiple effect evaporators as well as a variety of supplemental evaporators. Odor problems with the kraft process have been the subject of control measures (See Section III.B. Raw Material Inputs and Pollution Outputs in the Production Line for more information).

Recovery boiler

The strong black liquor from the evaporators is burned in a recovery boiler. In this crucial step in the overall kraft chemical recovery process, organic solids are burned for energy and the process chemicals are removed from the mixture in molten form. Molten inorganic process chemicals (smelt) flow through the perforated floor of the boiler to water-cooled spouts and dissolving tanks for recovery in the recausticizing step.

Energy generation from the recovery boiler is often insufficient for total plant needs, however, so facilities augment recovery boilers with fossil-fuel-fired and wood-waste-fired boilers (hogged fuel) to generate steam and often electricity. Industry-wide, the utilization of pulp wastes, bark, and other papermaking residues supplies 58 percent of the energy requirements of pulp and paper companies (AF&PA, 1999) (see III.A.3. Energy Generation for more information).

Recausticizating

Smelt is recausticized to remove impurities left over from the furnace and to convert sodium carbonate (Na_2CO_3) into active sodium hydroxide (NaOH) and sodium sulfide (Na_2S). The recausticization procedure begins with the mixing of smelt with "weak" liquor to form green liquor, named for its characteristic color. Contaminant solids, called dregs, are removed from the green liquor, which is mixed with lime (CaO). After the lime mixing step, the mixture, now called white liquor due to its new coloring, is processed to remove a layer of lime mud ($CaCO_3$) that has precipitated. The primary chemicals recovered are caustic (NaOH) and sodium sulfide (Na_2S). The remaining white liquor is then used in the pulp cooking process. The lime mud is treated to regenerate lime in the calcining process.

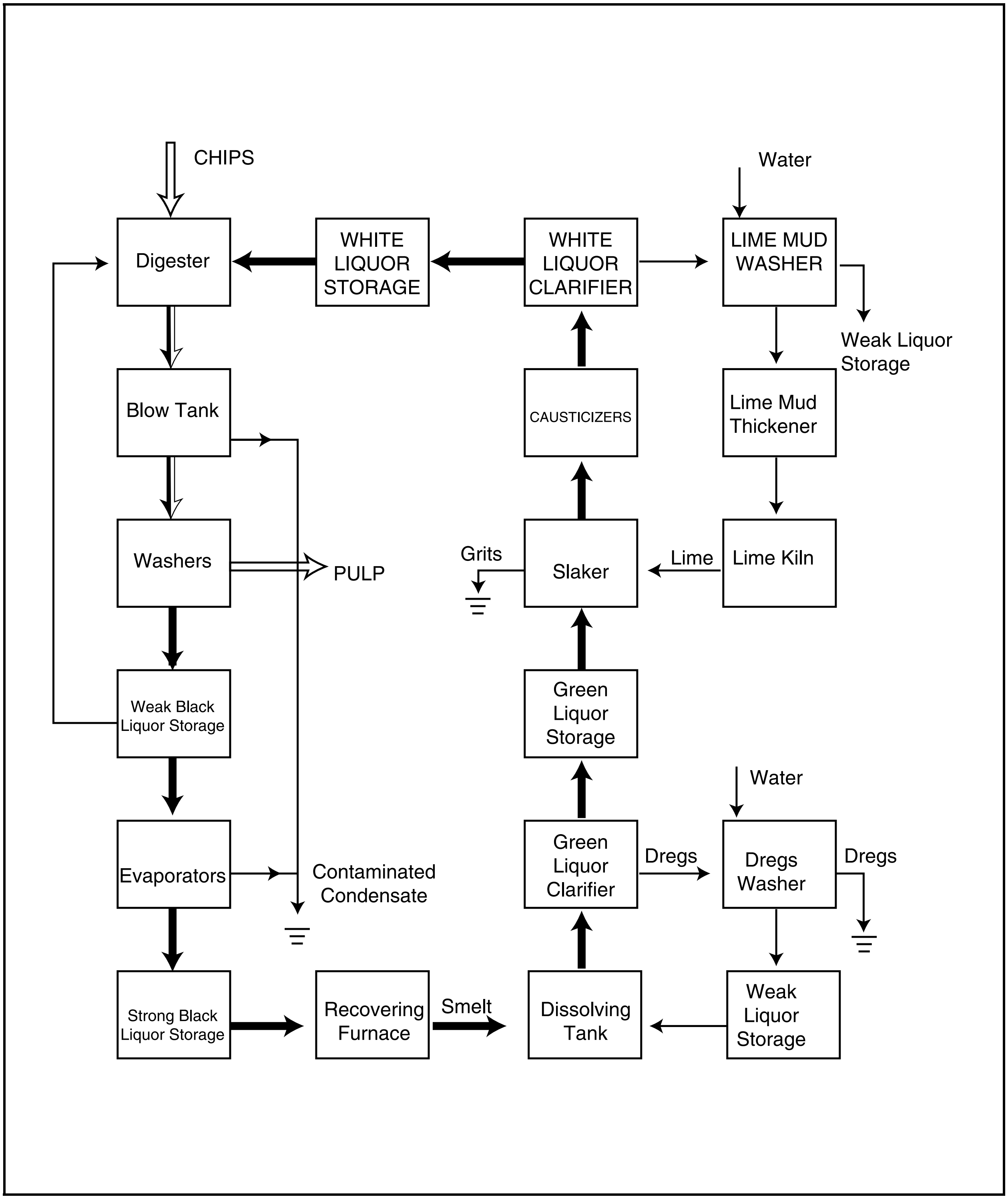
Calcining

In the calcining process, the lime mud removed from the white liquor is burned to regenerate lime for use in the lime mixing step. The vast majority of mills use lime kilns for this process, although a few mills use fluidized bed systems in which the reactants are suspended by upward-blowing air.

Sulfite Chemical Recovery Systems

There are a variety of sulfite chemical pulping recovery systems in use today. Heat and sulfur can be recovered from all liquors generated, however the base chemical can only be recovered from magnesium and sodium base processes (see Smook, 1992 for more information).

Figure 7: The Kraft Pulping Process (with Chemical Recovery)



Source: Smook, 1992.

III.A.3. Bleaching

Bleaching is defined as any process that chemically alters pulp to increase its brightness. Bleached pulps create papers that are whiter, brighter, softer, and more absorbent than unbleached pulps. Bleached pulps are used for products where high purity is required and yellowing (or color reversion) is not desired (e.g. printing and wrapping papers, food contact papers). Unbleached pulp is typically used to produce boxboard, linerboard, and grocery bags. Of the approximately 72 million tons of pulp production capacity in the United States in 2000, about 50 percent is for bleached pulp (AF&PA, 2001).

Any type of pulp may be bleached, but the type(s) of fiber furnish and pulping processes used, as well as the desired qualities and end use of the final product, greatly affect the type and degree of pulp bleaching possible. Printing and writing papers comprise approximately 60 percent of bleached paper production. The lignin content of a pulp is the major determinant of its bleaching potential. Pulps with high lignin content (e.g., mechanical or semi-chemical) are difficult to bleach fully and require heavy chemical inputs. Excessive bleaching of mechanical and semi-chemical pulps results in loss of pulp yield due to fiber destruction. Chemical pulps can be bleached to a greater extent due to their low (10 percent) lignin content.

For more information, the *Summary of Technologies for the Control and Reduction of Chlorinated Organics from the Bleached Chemical Pulping Subcategories of the Pulp and Paper Industry*, 1990 from the Office of Water Regulations and Standards is recommended. Typical bleaching processes for each pulp type are detailed below.

Chemical pulp bleaching has undergone significant process changes since approximately 1990. At that time, nearly every chemical pulp mill that used bleaching incorporated elemental chlorine (Cl_2) into some of its processes. Because of environmental and health concerns about dioxins, U.S. pulp mills now use elemental chlorine free (ECF) and total chlorine free (TCF) bleaching technologies. The most common types of ECF and TCF are shown in Table 8; the difference between ECF and TCF is that ECF may include chlorine dioxide (ClO_2) and hypochlorite (HClO, NaOCl, and $Ca(OCl)_2$) based technologies. In 2001, ECF technologies were used for about 95 percent of bleached pulp production, TCF technologies were used for about 1 percent of bleached pulp production, and elemental chlorine was used for about 4 percent of production (AET, 2002).

Table 8: Common Chemicals Used in Elemental Chlorine Free (ECF) and Total Chlorine Free (TCF) Bleaching Processes

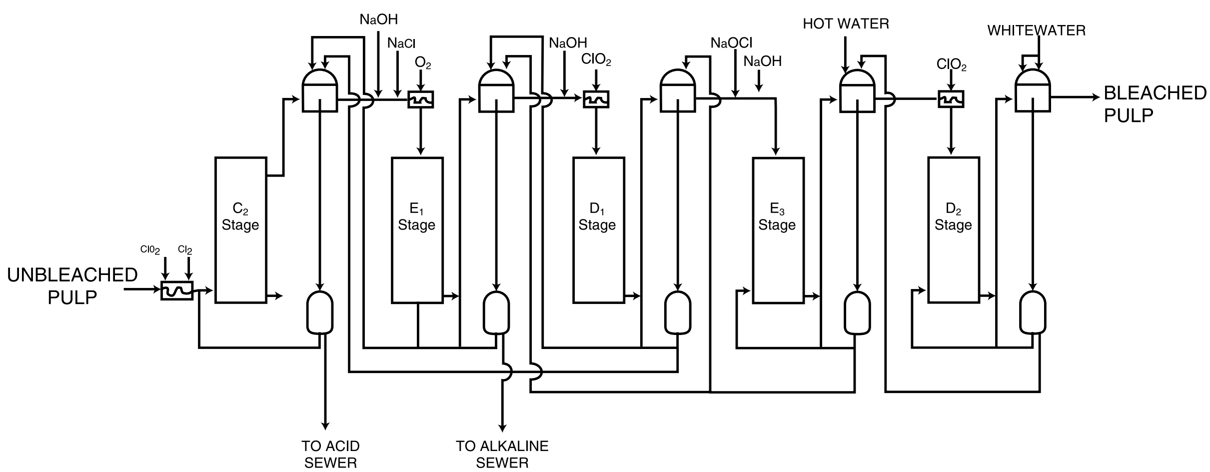
Bleaching Chemical	Chemical Formula	ECF/TCF
Sodium Hydroxide	$NaOH$	ECF and TCF
Chlorine Dioxide	ClO_2	ECF
Hypochlorite	$HClO$, $NaOCl$, $Ca(OCl)_2$	ECF
Oxygen	O_2	ECF and TCF
Ozone	O_3	ECF and TCF
Hydrogen Peroxide	H_2O_2	ECF and TCF
Sulfur Dioxide	SO_2	ECF and TCF
Sulfuric Acid	H_2SO_4	ECF and TCF

Source: U.S. EPA, 2001.

Chemical pulp is bleached in traditional bleach plants (see Figure 8) where the pulp is processed through three to five stages of chemical bleaching and water washing. The number of cycles is dependent on the whiteness desired, the brightness of initial stock pulp, and plant design.

Bleaching stages generally alternate between acid and alkaline conditions. Chemical reactions with lignin during the acid stage of the bleaching process increase the whiteness of the pulp. The alkaline extraction stages dissolve the lignin/acid reaction products. At the washing stage, both solutions and reaction products are removed. Chemicals used to perform the bleaching process must have high lignin reactivity and selectivity to be efficient. Typically, 4-8 percent of pulp is lost due to bleaching agent reactions with the wood constituents cellulose and hemicellulose, but, these losses can be as high as 18 percent.

Figure 8: Typical Bleach Plant



Source: U.S. EPA, 1993a.

Semi-chemical pulps are typically bleached with hydrogen peroxide (H_2O_2) in a bleach tower.

Mechanical pulps are bleached with hydrogen peroxide (H_2O_2) and/or sodium hydrosulfite (Na_2SO_3). Bleaching chemicals are either applied without separate equipment during the pulp processing stage (i.e., in-line bleaching), or in bleaching towers. Full bleaching of mechanical pulps is generally not practical due to bleaching chemical cost and the negative impact on pulp yield.

Deinked secondary fibers are usually bleached in a bleach tower, but may be bleached during the repulping process. Bleach chemicals may be added directly into the pulper. The following are examples of chemicals used to bleach deinked secondary fibers: hypochlorite (HClO, NaOCl, $Ca(OCl)_2$), hydrogen peroxide (H_2O_2), and hydrosulphite ($Na_2S_2O_4$).

III.A.4. Stock Preparation

At this final stage, the pulp is processed into the stock used for paper manufacture. Market pulp, which is to be shipped off-site to paper or paperboard mills, is simply dried and baled during this step. Processing of pulp in integrated mills includes pulp blending specific to the desired paper product desired, dispersion in water, beating and refining to add density and strength, and addition of any necessary wet additives. Wet additives are used to create paper products with special properties or to facilitate the papermaking process. Wet additives include resins and waxes for water repellency, fillers such as clays, silicas, talc, inorganic/organic dyes for coloring, and certain inorganic chemicals (calcium sulfate, zinc sulfide, and titanium dioxide) for improved texture, print quality, opacity, and brightness.

III.A.5. Processes in Paper Manufacture

The paper and paperboard making process consists of the following general steps:

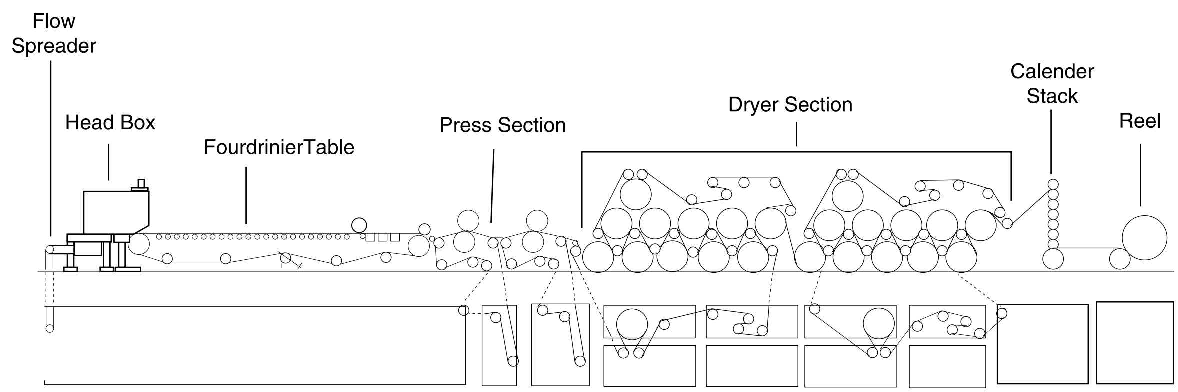
Table 9: Paper and Paperboard Making Process

Sequential Process	Description
Wet End Operations	Formation of paper sheet from wet pulp
Dry End Operations	Drying of paper product, application of surface treatments, spooling for storage

Wet End Operations

The processed pulp is converted into a paper product via a paper production machine, the most common of which is the Fourdrinier paper machine (see Figure 9). In the Fourdrinier system, the pulp slurry is deposited on a moving wire belt that carries it through the first stages of the process. Water is removed by gravity, vacuum chambers, and vacuum rolls. This waste water is recycled to the slurry deposition step of the process due to its high fiber content. The continuous sheet is then pressed between a series of rollers to remove more water and compress the fibers.

Figure 9: Fourdrinier Paper Machine



Source: U.S. EPA, 1993a.

Dry End Operations

After pressing, the sheet enters a drying section, where the paper fibers begin to bond together as steam heated rollers compress the sheets. In the calender process the sheet is pressed between heavy rolls to reduce paper thickness and produce a smooth surface. Coatings can be applied to the paper at this point to improve gloss, color, printing detail, and brilliance. Lighter coatings are applied on-machine, while heavy coatings are performed off-machine. The paper product is then spooled for storage.

III.A.6. Energy Generation

Pulp and paper mill energy generation is provided in part from the burning of liquor waste solids in the recovery boiler, but other energy sources are needed to make up the remainder of mill energy needs. Over the last 25 years, the pulp and paper industry has changed its energy generation methods from fossil fuels to a greater utilization of processes or process wastes. The increase in use of wood wastes from the wood handling and chipping processes depicted in Table 10 below is one example of this industry-wide movement. During the 1972-1999 period, the proportion of total industry power generation from the combination of woodroom wastes, spent liquor solids, and other self-generation methods increased from about 41 percent to about 58 percent, while coal, fuel oil and natural gas use decreased from about 54 percent to about 36 percent.

Power boilers at pulp and paper mills are sources of particulate emissions, sulfur dioxide ($SO_{2)}$, and nitrogen oxides (NO_x). Pollutants emitted from chemical recovery boilers include SO_2, and total reduced sulfur compounds (TRS).

Table 10: Estimated Energy Sources for the U.S. Pulp and Paper Industry

Energy Source	1972[a]	1979[a]	1990[a]	1999[b]
Purchased steam	5.4%	6.7%	7.3%	1.5%
Coal	9.8%	9.1%	13.7%	12.5%
Fuel oil	22.3%	19.1%	6.4%	6.3%
Natural gas	21.5%	17.8%	16.4%	17.6%
Other purchased energy	-	-	-	6.7%
Waste wood and wood chips (Hogged fuel) and bark	6.6%	9.2%	15.4%	13.5%
Spent liquor solids	33.7%	37.3%	39.4%	40.3%
Other self-generated power	0.6%	0.8%	1.2%	1.6%

Sources: [a]American Paper Institute Data as presented in Smook, 1992.
[b]AF&PA, 2001.

III.B. Raw Material Inputs and Pollution Outputs in the Production Line

Pulp and paper mills use and generate materials that may be harmful to the air, water, and land: pulp and paper processes generate large volumes of wastewaters which might adversely affect freshwater or marine ecosystems, residual wastes from wastewater treatment processes may contribute to existing local and regional disposal problems, and air emissions from pulping processes and power generation facilities may release odors, particulates, or other pollutants. Major sources of pollutant releases in pulp and paper manufacture are at the pulping and bleaching stages respectively. As such, non-integrated mills (i.e., those mills without pulping facilities on-site) are not significant environmental concerns when compared to integrated mills or pulp mills.

Water

The pulp and paper industry is the largest industrial process water user in the U.S. (U.S. Department of Commerce, 2000). In 2000, a typical pulp and paper mill used 4,000-12,000 gallons of water per ton of pulp produced (Pulp and Paper, 2001). General water pollution concerns for pulp and paper mills are effluent solids, biochemical oxygen demand, and color. Toxicity concerns historically occurred from the potential presence of chlorinated organic compounds such as dioxins, furans, and others (collectively referred to as adsorbable organic halides, or AOX) in wastewaters after the chlorination/extraction sequence. With the substitution of chlorine dioxide for chlorine, effluent loads of the chlorinated compounds decreased dramatically.

Due to the large volumes of water used in pulp and paper processes, virtually all U.S. mills have primary and secondary wastewater treatment systems installed to remove particulate and biochemical oxygen demand (BOD) produced in the manufacturing processes. These systems also provide significant removal (e.g., 30-70 percent) of other important parameters such as AOX and chemical oxygen demand (COD).

The major sources of effluent pollutants in a pulp and paper mill are presented in Table 11.

Table 11: Potential Water Pollutants From Pulp and Paper Processes

Source	Effluent characteristics
Water used in wood handling/debarking and chip washing	Solids, BOD, color
Chip digester and liquor evaporator condensate	Concentrated BOD, reduced sulfur compounds
"White waters" from pulp screening, thickening, and cleaning	Large volume of water with suspended solids, can have significant BOD
Bleach plant washer filtrates	BOD, color, chlorinated organic compounds
Paper machinewater flows	Solids
Fiber and liquor spills	Solids, BOD, color

Source: Smook, 1992.

Wood processing operations in pulp mills often use water for a variety of purposes. The resulting wastewaters contain BOD, suspended solids, and some color. The condensates from chip digesters and chemical recovery evaporators are sources of BOD and reduced sulfur compounds. Wastewaters containing BOD, color, and suspended solids may be generated from pulp screening operations in mills using "atmospheric" systems, though most mills have modern pressure screens that virtually eliminate such wastewaters. Kraft bleaching generates large volumes of wastewater containing BOD, suspended solids, color, and chlorinated organic compounds. From paper machines, excess white water (named for its characteristic color) contains suspended solids and BOD. Fiber and liquor spills can also be a source of mill effluent. Typically, spills are captured and pumped to holding areas to reduce chemical usage through spill reuse and to avoid loadings on facility wastewater treatment systems.

Wastewater treatment systems can be a significant source of cross-media pollutant transfer. For example, waterborne particulate and some chlorinated compounds settle or absorb onto treatment sludge and other compounds may volatilize during the wastewater treatment process.

Air

The following table is an overview of the major types and sources of air pollutant releases from various pulp and paper processes:

Table 12: Common Air Pollutants From Pulp and Paper Processes

Source	Type
Kraft recovery furnace	Fine particulates, nitrogen oxides
Fly ash from hog fuel and coal-fired burners	Coarse particulates
Sulfite mill operations	Sulfur oxides, ammonia
Kraft pulping and recovery processes	Reduced sulfur gases
Chip digesters and liquor evaporation	Volatile organic compounds
Pulp drying (non-integrated mills)	Volatile organic compounds
All combustion processes	Nitrogen oxides

Source: Smook, 1992.

Water vapors are the most visible air emission from a pulp and paper mill, but are not usually regulated unless they are a significant obscurement or climate modifier.

Pulp and paper mill power boilers are generic pulp and paper mill sources of air pollutants such as particulates and nitrogen oxides. Chip digesters and chemical recovery evaporators are the most concentrated sources of volatile organic compounds. The chemical recovery furnace is a source of fine particulate emissions and sulfur oxides. In the kraft process, sulfur oxides are a minor issue in comparison to the odor problems created by four reduced sulfur gasses, called together total reduced sulfur (TRS): hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide. The TRS emissions are primarily released from wood chip digestion, black liquor evaporation, and chemical recovery boiler processes. TRS compounds create odor nuisance problems at lower concentrations than sulfur oxides: odor thresholds for TRS compounds are approximately 1,000 times lower than that for sulfur dioxide. Humans can detect some TRS compounds in the air as a "rotten egg" odor at as little as one part per billion.

Pulp and paper mills have made significant investments in pollution control technologies and processes. According to industry sources, the pulp and paper industry spent more than $1 billion per year from 1991-1997 on environmental capital expenditures. In 1991 and 1992, this represented 20 percent of total capital expenditures (AF&PA, 1994). Chemical recovery and recycling systems in the chemical pulping process significantly reduce pollutant outputs while providing substantial economic return due to recovery of process chemicals. Chemical recovery is necessary for the basic economic viability of the kraft process. According to EPA sources, all kraft pulp mills worldwide have chemical recovery systems in place. Some sulfite mills, however, still do not have recovery systems in place. Scrubber system particulate "baghouses" or electrostatic precipitators (ESPs) are often mill air pollution control components.

Residual Wastes

The significant residual waste streams from pulp and paper mills include wastewater treatment sludges, lime mud, lime slaker grits, green liquor dregs, boiler and furnace ash, scrubber sludges, and wood processing residuals. Because of the tendency for chlorinated organic compounds to partition from effluent to solids, wastewater treatment sludge is a significant environmental concern for the pulp and paper industry.

Wastewater treatment sludge is the largest volume residual waste stream generated by the pulp and paper industry. Sludge generation rates vary widely among mills. For example, bleached kraft mills surveyed as part of EPA's 104-Mill Study reported sludge generation that ranged from 14 to 140 kg of sludge per ton of pulp (U.S. EPA, 1988). Total sludge generation for these 104 mills was 2.5 million dry metric tons per year, or an average of approximately 26,000 dry metric tons per year per plant. Pulpmaking operations are responsible for the bulk of sludge wastes, although treatment of papermaking effluents also generates significant sludge volumes. For the majority of pulp and integrated mills that operate their own wastewater treatment systems, sludges are generated onsite. A small number of pulp mills, and a much larger proportion of papermaking establishments, discharge effluents to publicly-owned wastewater treatment works (POTWs).

Potential environmental hazards from wastewater sludges are associated with trace constituents (e.g., chlorinated organic compounds) that partition from the effluent into the sludge. It should be noted, however, that recent trends away from elemental chlorine bleaching have reduced these hazards. A continuing concern is the very high pH (>12.5) of most residual wastes. When these wastes are disposed of in an aqueous form, they may meet the RCRA definition of a corrosive hazardous waste (U.S. EPA, 2002).

Landfill and surface impoundment disposal are most often used for wastewater treatment sludge, but a significant number of mills dispose of sludge through land application, conversion to sludge-derived products (e.g., compost and animal bedding), or combustion for energy recovery (AF&PA, 2002).

Process Inputs and Pollutant Outputs

Kraft chemical pulping and chlorine-based (e.g., hypochlorite or chlorine dioxide) bleaching are both commonly used and may generate significant pollutant outputs. Kraft pulping processes produced approximately 83 percent of total US pulp tonnage during 1998 according to the American Forest and Paper Association (AF&PA, 1999). Roughly 60 percent of this amount is bleached in some manner.

Pollutant outputs from mechanical, semi-chemical, and secondary fiber pulping are small when compared to kraft chemical pulping. In the pulp and paper industry, the kraft pulping process is the most significant source of air pollutants. The following table and figures (Table 13 and Figures 10 and 11) illustrate the process inputs and pollutant outputs for a pulp and paper mill using kraft chemical pulping and chlorine-based bleaching. The process outlined below produces a large portion of U.S. pulp.

Table 13 presents the process steps, material inputs, and major pollutant outputs (by media) of a kraft pulp mill practicing traditional chlorine bleaching. The following resources are recommended for pollutant production data (e.g., pounds of BOD per ton of pulp produced) for those pollutants presented in Table 13:

- *Pollution Prevention Technologies for the Bleached Kraft Segment of the U.S. Pulp and Paper Industry.* August 1993. (EPA-600-R-93-110)

- *Development Document for Proposed Effluent Limitations Guidelines and standards for the Pulp, Paper, and Paperboard Point Source Category*. October 1993. (EPA-821-R-93-019)

- *Pulp, Paper and Paperboard Industry - Background Information for Proposed Air Emission Standards: Manufacturing Processes at Kraft, Sulfite, Soda, and Semi-Chemical Mills, NESHAP.* October 1993. (EPA-453-R-93-050a)

Figure 10 is a process flow diagram of the kraft process, illustrating chemical pulping, power recovery, and chemical recovery process inputs and outputs. Figure 11 is a schematic of characteristic air emission sources from a kraft mill.

Table 13: Kraft Chemical Pulped Bleached Paper Production

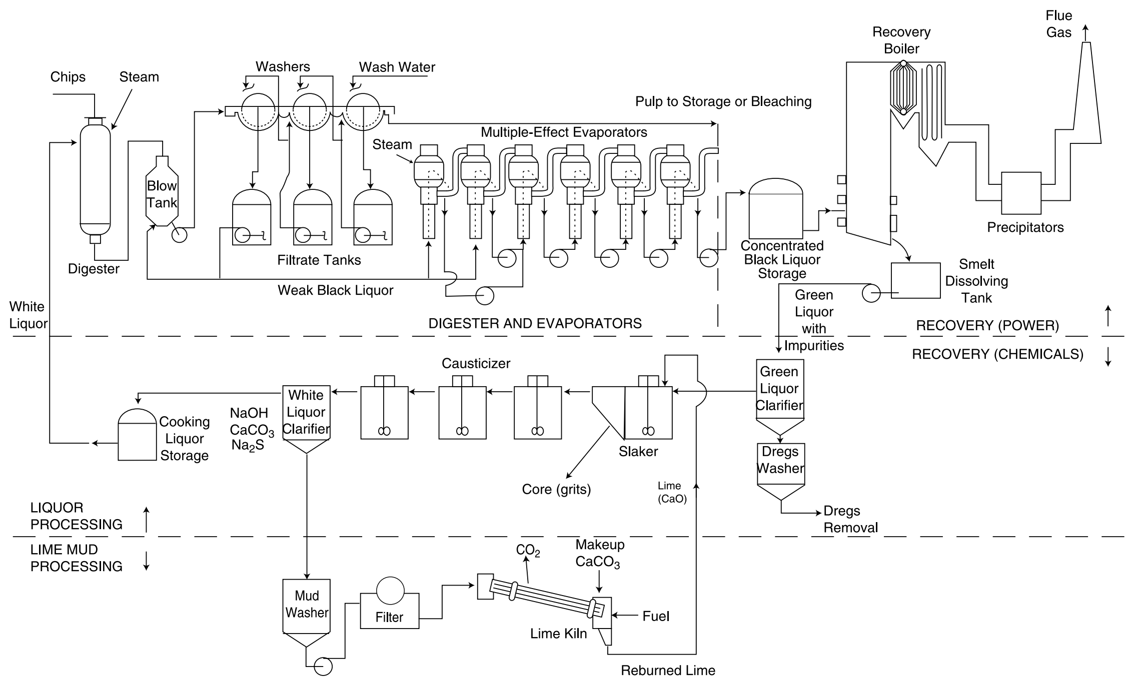
Process Step	Material Inputs	Process Outputs	Major Pollutant Outputs[a]	Pollutant Media
Fiber Furnish Preparation	Wood logs Chips Sawdust	Furnish chips	dirt, grit, fiber, bark	Solid
			BOD	Water
			TSS	
Chemical Pulping Kraft process	Furnish chips	Black liquor (to chemical recovery system), pulp (to bleaching/ processing)	resins, fatty acids	Solid
			color	Water
			BOD	
			COD	
			AOX	
			VOCs [terpenes, alcohols, phenols, methanol, acetone, chloroform, methyl ethyl ketone (MEK)]	
			VOCs (terpenes, alcohols, phenols, methanol, acetone, chloroform, MEK)	Air
	Cooking chemicals: sodium sulfide (Na_2S), NaOH, white liquor (from chemical recovery)		reduced sulfur compounds (TRS)	
			organo-chlorine compounds (e.g., 3,4,5- trichloroguaiacol)	
Bleaching[b]	Chemical pulp	Bleached pulp	dissolved lignin and carbohydrates	Water
			color	
			COD	
			AOX	
			inorganic chlorine compounds (e.g., chlorate (ClO_3^-))[c]	
	Hypochlorite (HClO, NaOCl, $Ca(OCl)_2$) Chlorine dioxide (ClO_2)		VOCs (acetone, methylene chloride, chloroform, MEK, chloromethane, trichloroethane)	Air / Water
Papermaking	Additives, Bleached/ Unbleached pulp	Paper/paperboard product	particulate wastes	Water
			organic compounds	
			inorganic dyes	
			COD	
			acetone	

Table 13: Kraft Chemical Pulped Bleached Paper Production (continued)

Process Step	Material Inputs	Process Outputs	Major Pollutant Outputs[a]	Pollutant Media
Wastewater Treatment Facilities	Process wastewaters	Treated effluent	sludge	Solid
			VOCs (terpenes, alcohols, phenols, methanol, acetone, chloroform, MEK)	Air
			BOD	Water
			TSS	
			COD	
			color	
			chlorophenolics	
			VOCs (terpenes, alcohols, phenols, methanol, acetone, chloroform, MEK)	
Power Boiler	Coal, Wood, Unused furnish	Energy	bottom ash: incombustible fibers	Solid
			SO_2, NO_x, fly ash, coarse particulates	Air
Chemical Recovery System				
Evaporators	Black liquor	Strong black liquor	evaporator noncondensibles (TRS, volatile organic compounds: alcohols, terpenes, phenols)	Air
			evaporator condensates (BOD, suspended solids)	Water
Recovery Furnace	Strong black liquor	Smelt	fine particulates, TRS, SO_2, NO_x	Air
		Energy		
Recausticizing	Smelt	Regenerated white liquor	dregs	Solids
		Lime mud	waste mud solids	Water, Solid
		Slaker grits	solids	Solid
Calcining (Lime Kiln)	Lime mud	Lime	fine and coarse particulates	Air

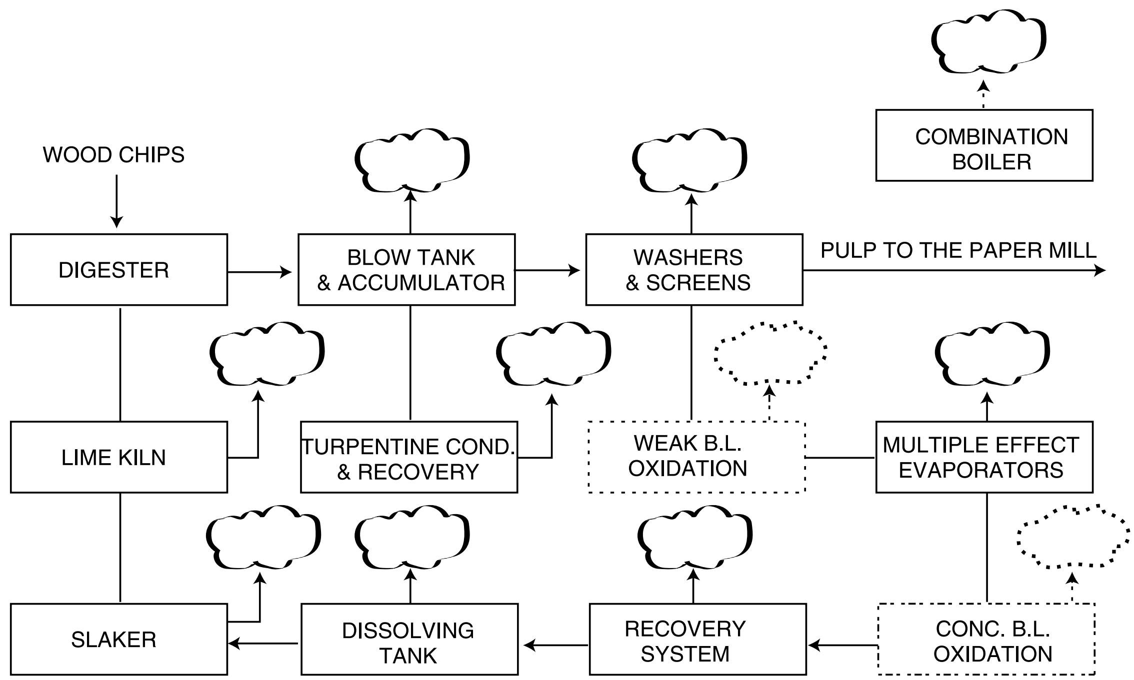
[a] Pollutant outputs may differ significantly based on mill processes and material inputs (e.g., wood chip resin content).
[b] Pollutant list based on Elemental Chlorine Free (ECF) bleaching technologies.
[c] Chlorate only significantly produced in mills with high rates of chlorine dioxide use.
Sources: EPA, 1993a; EPA, 1993b; and EPA, 1993c.

Figure 10: Kraft Process Flow Diagram



Source: Smook, 1992.

Figure 11: Air Pollutant Output from Kraft Process



Source: Smook, 1992.

IV. CHEMICAL RELEASE AND OTHER WASTE MANAGEMENT PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry in correlation with other industries. The best source of comparative pollutant release and other waste management information is the Toxic Release Inventory (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and other waste management data for over 650 toxic chemicals and chemical categories. Facilities within SIC Codes 10 (except 1011, 1081, and 1094), 12 (except 1241), 20-39, 4911 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4931 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4939 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4953 (limited to facilities regulated under the RCRA Subtitle C, 42 U.S.C. section 6921 *et seq*.), 5169, 5171, and 7389 (limited to facilities primarily engaged in solvents recovery services on a contract or fee basis) have more than 10 employees, and that manufactures, processes or otherwise uses listed chemical in quantities greater than the established threshold in the course of a calendar year are required to report to TRI annually release and other waste management quantities (on- and off-site). The information presented within the sector notebooks is derived from the most recently available (2000) TRI reporting year (which includes over 650 chemicals and chemical categories), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries. TRI data provide the type, amount and media receptor of each chemical released or otherwise managed as waste.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 2000 Toxic Release Inventory Public Data Release, reported on-site and off-site releases of toxic chemicals to the environment from original TRI reporting industries (SIC codes 20-39) decreased by more than 8 percent (644 million pounds) between 1999 and 2000 (not including chemicals added and removed from the TRI chemical list during this period). Reported on-site releases dropped by almost 57 percent between 1988 and 2000. Reported transfers of TRI chemicals to off-site locations for disposal increased by almost 7 percent (28 million pounds) between 1988 and 2000. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release Report (which is available through the EPCRA Call Center at 800-424-9346), or directly from the Internet at www.epa.gov/tri.

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount and media receptor of each chemical released or otherwise managed as waste. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

Certain limitations exist regarding TRI data. Within some sectors, (e.g., printing and transportation equipment cleaning) the majority of facilities are not subject to TRI reporting either because they do not fall under covered SIC codes, or because they are below the TRI reporting threshold amounts. However, EPA lowered threshold amounts for persistent bioaccumulative toxic (PBT) chemicals starting reporting year 2000. For these sectors, release information from other sources has been included. In addition, many facilities report to TRI under more than one SIC code, reflecting the multiple operations carried out onsite whether or not the operations are the facilities' primary area of business as reported to the U.S. Census Bureau. Reported chemicals are limited to the approximately 650 TRI chemicals and chemical categories. A portion of the emissions from pulp and paper mills, therefore, are not captured by TRI. Also, reported releases and other waste management quantities may or may not all be associated with the industrial operations described in this notebook.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings and population exposure levels to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. This project, the Risk Screening Environmental Indicators Model, can be found at http://www.epa.gov/opptintr/rsei/.

As a preliminary indication of the environmental impact of the industry's most commonly released chemicals, this notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by the organic chemical industry.

Definitions Associated with Section IV Data Tables

General Definitions

SIC Code -- is the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are facilities that are within specified SIC codes that have 10 or more full-time employees and are above established threshold amounts for manufacture or process or otherwise use activities in the course of a calendar year. These facilities are in standard industrial classification codes 10 (except 1011, 1081, and 1094), 12 (except 1241), 20-39, 4911 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4931 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4939 (limited to facilities that combust coal and/or oil for the purpose of generating electricity for distribution in commerce), 4953 (limited to facilities regulated under the RCRA Subtitle C, 42 U.S.C. section 6921 *et seq*.), 5169, 5171, and 7389 (limited to facilities primarily engaged in solvents recovery services on a contract or fee basis), and federal facilities. Facilities must submit release and other waste management estimates for all chemicals that are on the EPA's defined list and are above manufacturing or processing or otherwise use thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA's Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

ON-SITE RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) -- encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for storm water runoff and non-point losses must also be included.

Releases to Land -- includes disposal of toxic chemicals in waste to on-site landfills, land treated or incorporation into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are waste waters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or land filled within the sludge. Metals and metal compounds transferred to POTWs are considered as released to surface water.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation. In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

IV.A. EPA Toxics Release Inventory For the Pulp and Paper Industry

According to Toxic Release Inventory (TRI) data from SIC codes 261-263, the pulp and paper industry released (to the air, water, or land) and transferred (shipped off-site) a total of approximately 263 million pounds of toxic chemicals during calendar year 2000.[1] This represents approximately 2.5 percent of the total pounds of TRI chemicals released and transferred by all reporting facilities that year.

Media comparison of TRI releases

The total amount of TRI toxic chemicals generated by the pulp and paper industry is a gross profile of the types and relative amounts of chemical outputs from mill processes. Additional information which can be related back to possible compliance requirements is available from the distribution of chemical releases across specific media within the environment. The TRI data requires filers to separate the total releases for the pulp and paper industry for air, water, and land releases. This distribution across media can also be compared to the profile of other industry sectors.

The pulp and paper industry releases 66 percent of its total TRI poundage to the air, approximately 22 percent to water and POTWs, and 9 percent is disposed on land (on site and off site). This release profile differs from other TRI industries which average approximately 63 percent to land, 27 percent to air, and 4 percent to water and POTWs. A larger proportion of water releases correlates with the water intensive processes of the pulp and paper industry. An average mill requires 10 million gallons of influent water per day and will produce the corresponding amount of effluent waters. Examining the pulp and paper industry's TRI reported toxic chemicals by chemical, highlights the likely origins of industry releases (see Table 14).

Air releases can be traced to a variety of sources. Approximately 63 percent are methanol, a by-product of the pulp making process. The other major air toxic chemicals, such as chlorinated compounds and sulfuric acid, originate in the bleaching stage. Methanol is the most frequently reported chemical by pulp and paper mills, and it accounts for approximately 15 percent of the water releases and 97 percent of transfers to POTWs by the industry. Overall, methanol represents roughly 60 percent of the pulp and paper industry's TRI releases and transfers.

The diversity of processes in the pulp and paper industry can be seen in the diversity of chemicals found in the TRI report. The TRI chemical released and transferred by the second largest number of mills is ammonia, which is used as a buffer in acid sulfite pulping (Air & Waste Management Association, 1992). In addition, some TRI chemicals are only reported by a few mills, suggesting process specific needs such as paper finishing or use in wet additives.

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[1] Unless otherwise indicated, TRI data for SIC codes 261-263 were used for pulp and paper release and transfer values in this section and the tables therein.

Table 14: 2000 TRI Releases for Pulp and Paper Facilities (SICs 261, 262 and 263), by Number of Facilities Reporting (Releases Reported in pounds/year)

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
Methanol	174	5,368,130	105,189,904	3,011,860		1,014,710	114,584,624	658,532
Ammonia	166	514,616	15,782,909	1,884,126		11,939	18,193,590	109,600
Hydrochloric Acid (1995 and after "Acid Aerosols"	137	8,037	16,114,754	10			16,122,801	117,685
Acetaldehyde	125	540,704	7,749,806	177,092		3,789	8,471,391	67,771
Manganese Compounds	124	1,932	199,238	4,187,964		8,733,410	13,122,544	105,827
Polycyclic Aromatic Compounds[PBT]	122	57	114,967	1,472		2,458	118,954	975
Formaldehyde	116	57,062	1,865,446	326,507		9,651	2,258,666	19,471
Sulfuric Acid (1994 and after "Acid Aerosols" Only	113	773	9,670,724				9,671,497	85,588
Phenol	105	14,983	1,105,065	9,244		3,209	1,132,501	10,786
Chlorine	102	25,236	449,437	60,185		17	534,875	5,244
Catechol	99	11	256	17,493		605	18,365	186
Barium Compounds	96	13	252,753	540,545		2,351,605	3,144,916	32,760
Nitrate Compounds	87			9,791,260		9,234	9,800,494	112,649
Chlorine Dioxide	80	2,215	701,625				703,840	8,798
Dioxin and Dioxin-Like Compounds[PBT]	77		55	103		162	320	4
Zinc Compounds	77	19	775,453	324,492		3,255,589	4,355,553	56,566
Mercury Compounds[PBT]	75	1	2,149	56		535	2,741	37
Methyl Ethyl Ketone	64	98,368	1,024,379	14,909		5,013	1,142,669	17,854
Benzo(g,h,i)perylene[PBT]	63		1,060	115		163	1,338	21
Formic Acid	54	1,210	1,105	92,178		2,211	96,704	1,791
Chloroform	40	1,076,881	1,810,096	49,459		12,285	2,948,721	73,718
Cresol (Mixed Isomers)	32	363	827,255	1,097		708	829,423	25,919
Mercury[PBT]	23		544	8		94	646	28
Hydrogen Fluoride	17		442,166				442,166	26,010
Vanadium Compounds	16	6,102	51,541	20,204		635,418	713,265	44,579
Chloromethane	15	62	492,139	10		5	492,216	32,814
Copper Compounds	15		8,343	3,591		50,429	62,363	4,158
Nickel Compounds	13		8,021	3,337		94,451	105,809	8,139
Certain Glycol Ethers	12	17,410	54,925	7,919		2,602	82,856	6,905
Chromium Compounds	9	30	1,409	10,341		32,731	44,511	4,946
Ethylene Glycol	9	60	2,316	29,596		5,810	37,782	4,198
Toluene	9	81,244	638,734	19			719,997	80,000
Xylene (Mixed Isomers)	7	33,224	41,507	202		1,260	76,193	10,885
Polychlorinated Biphenyls[PBT]	7		31				31	4
Styrene	5	19,000	53,239	104			72,343	14,469
C.i. Direct Blue 218	5			20		1,704	1,724	345
Manganese	5		11,163	94,428		500,902	606,493	121,299
Benzene	3		276,814				276,814	92,271
Dazomet	3	2,792		600			3,392	1,131
Vinyl Acetate	3	12,303	16,900	880			30,083	10,028
Biphenyl	3		117,000				117,000	39,000
1,2,4-trimethylbenzene	3	20,920	13,396	180		10	34,506	11,502
Diethanolamine	3	549	6,505	974			8,028	2,676
N-butyl Alcohol	3	29,759	61,970	10,943			102,672	34,224
Nitric Acid	2	10	1,310				1,320	660
Decabromodiphenyl Oxide	2			5		1,100	1,105	552
Antimony	2					350	350	175
Lead Compounds[PBT]	2		1,698	796			2,494	1,247
N-hexane	2	4,100	46,100				50,200	25,100
Arsenic Compounds	2		360			6	366	183
Lead[PBT]	1							
Antimony Compounds	1							

Table 14: 2000 TRI Releases for Pulp and Paper Facilities (SICs 261, 262 and 263), by Number of Facilities Reporting (Releases Reported in pounds/year)

Chemical Name	# Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Underground Injection	Land Disposal	Total Releases	Avg. Releases Per Facility
Chlordane[PBT]	1							
Maleic Anhydride	1	200	210				410	410
Ethylbenzene	1	290	90				380	380
Potassium Dimethyldithiocarbamate	1	19		10,394			10,413	10,413
O-xylene	1	15	46,430			5	46,450	46,450
Diisocyanates	1	750					750	750
Ozone	1		102,763				102,763	102,763
Naphthalene	1	83	17,000	1		4,800	21,884	21,884
Copper	1							
Methyl Methacrylate	1	750	1,154				1,904	1,904
Acrylic Acid	1	1	280				281	281
Trichloroethylene	1							
Dichloromethane	1	6	33,316	1			33,323	33,323
Polychlorinated Alkanes	1							
Barium	1			250		250	500	500
Mixture	1	1	4				5	5
	268**	7,940,291	166,187,814	20,684,970	0	16,749,220	211,562,315	789,411

[PBT] Persistent, Bioaccumulative, and Toxic
* Refer to Section III for a discussion of the TRI data and its limitations, methodology used to obtain this data, definitions of the column headings, and the definition of persistant, bioaccumulative, and toxic chemicals.
**Total number of facilities (not chemical reports) reporting to TRI in this industry sector.

Table 15: 2000 TRI Transfers for Pulp and Paper Facilities (SICs 261, 262 and 263), by Number of Facilities Reporting (Transfers Reported in pounds/year)

Chemical Name	# Reporting Chemical	POTW Transfers	Disposal Transfers	Recycling Transfers	Treatment Transfers	Energy Recovery	Total Transfers	Avg Transfers Per Facility
Methanol	174	36,098,617	144,671	24,058	6,993,725	13,736	43,274,807	248,706
Ammonia	166	56,000	79,785		2,966		138,751	836
Hydrochloric Acid (1995 and after "Acid Aerosols"	137							
Acetaldehyde	125	111,435	757	25	10,100		122,317	979
Manganese Compounds	124	204,150	2,977,098	152,646			3,333,894	26,886
Polycyclic Aromatic Compounds[PBT]	122	1,224	1,257	52	5	129	2,667	22
Formaldehyde	116	116,817	18,814	63	53,825	279	189,798	1,636
Sulfuric Acid (1994 and after "Acid Aerosols" Only	113	5					5	0
Phenol	105	16,753	2,372	15	4,983	2,529	26,652	254
Chlorine	102	14,443			1		14,444	142
Catechol	99	66,175	602	3	630	2,250	69,660	704
Barium Compounds	96	41,058	1,316,911	86,502			1,444,471	15,047
Nitrate Compounds	87	40,310	38,220		118,370		196,900	2,263
Chlorine Dioxide	80							
Dioxin and Dioxin-Like Compounds[PBT]	77	21	101	6	10		138	2
Zinc Compounds	77	30,256	1,129,573	72,525			1,232,354	16,005
Mercury Compounds[PBT]	75	14	23,862	95			23,971	320
Methyl Ethyl Ketone	64	56,874	680	4,350	20,062	38,121	120,087	1,876
Benzo(g,h,i)perylene[PBT]	63	7	101	3	2	2	115	2
Formic Acid	54	6,334	251				6,585	122
Chloroform	40	155,257	8,630		308		164,195	4,105
Cresol (Mixed Isomers)	32	4,448	394		1,600		6,442	201
Mercury[PBT]	23		485				485	21
Hydrogen Fluoride	17							
Vanadium Compounds	16	1,400	88,540	11,463			101,403	6,338
Chloromethane	15	306					306	20
Copper Compounds	15	1,515	64,245				65,760	4,384
Nickel Compounds	13	2,120	91,928	180			94,228	7,248
Certain Glycol Ethers	12		815				815	68
Chromium Compounds	9	1,351	71,901	1,000			74,252	8,250
Ethylene Glycol	9	24,658	2,810		84,004		111,472	12,386
Toluene	9				220	383,822	384,042	42,671
Xylene (Mixed Isomers)	7				5	10,291	10,296	1,471
Polychlorinated Biphenyls[PBT]	7		207		57		264	38
Styrene	5			160	750		910	182
C.i. Direct Blue 218	5	1,984	3,848	1,065			6,897	1,379
Manganese	5		38,661				38,661	7,732
Benzene	3							
Dazomet	3	13,535					13,535	4,512
Vinyl Acetate	3					19	19	6
Biphenyl	3							
1,2,4-trimethylbenzene	3		4				4	1
Diethanolamine	3	36,070	483	715			37,268	12,423
N-butyl Alcohol	3							
Nitric Acid	2							
Decabromodiphenyl Oxide	2		26,600				26,600	13,300
Antimony	2	251	6,650				6,901	3,450
Lead Compounds[PBT]	2		127,400				127,400	63,700
N-hexane	2					11,000	11,000	5,500
Arsenic Compounds	2	120	24,200				24,320	12,160
Lead[PBT]	1		350				350	350
Antimony Compounds	1		2,200				2,200	2,200
Chlordane[PBT]	1				50		50	50
Maleic Anhydride	1							
Ethylbenzene	1					840	840	840
Potassium Dimethyldithiocarbamate	1							
O-xylene	1							
Diisocyanates	1							
Ozone	1							
Naphthalene	1							
Copper	1		675				675	675

Table 15: 2000 TRI Transfers for Pulp and Paper Facilities (SICs 261, 262 and 263), by Number of Facilities Reporting (Transfers Reported in pounds/year)

Chemical Name	# Reporting Chemical	POTW Transfers	Disposal Transfers	Recycling Transfers	Treatment Transfers	Energy Recovery	Total Transfers	Avg Transfers Per Facility
Methyl Methacrylate	1				750		750	750
Acrylic Acid	1							
Trichloroethylene	1		4,985				4,985	4,985
Dichloromethane	1							
Polychlorinated Alkanes	1				24,000		24,000	24,000
Barium	1		5,100				5,100	5,100
Mixture	1							
	268**	37,103,508	6,306,166	354,926	7,316,423	463,018	51,544,041	192,328

[PBT] Persistent, Bioaccumulative, and Toxic
* Refer to Section III for a discussion of the TRI data and its limitations, methodology used to obtain this data, definitions of the column headings, and the definition of persistant, bioaccumulative, and toxic chemicals.
**Total number of facilities (not chemical reports) reporting to TRI in this industry sector.

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below (Table 16).

Table 16: Ten Largest Volume TRI Releasing Facilities in the Pulp and Paper Industry*

Rank	Facility	Total TRI Releases in Pounds
1	Westvaco Corporation - Covington, VA	5,066,296
2	International Paper - Mansfield, LA	4,472,550
3	International Paper Company Camden Facility - Camden, AR	3,842,484
4	International Paper - Bleachboard Department - Riegelwood, NC	3,619,809
5	Georgia Pacific Corporation Port Hudson Operations - Zachary, LA	3,292,540
6	Smurfit Stone Container Corporation - Missoula, MT	3,133,396
7	Great Southern Paper Co - Cedar Springs, GA	3,125,666
8	Stora Enso North America Corporation - Wisconsin Rapids, WI	3,095,151
9	Weyerhaeuser Company - Valliant, OK	3,041,630
10	International Paper Georgetown Mill - Georgetown, SC	2,967,101

Source: 2000 Toxics Release Inventory Database

* Being included in this list does not mean that the release is associated with non-compliance with environmental laws.

IV.B. Summary of Selected Chemicals Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 2000 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the releases of these chemicals. Information regarding pollutant release reductions over time may be available from EPA's TRI program, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the Hazardous Substances Data Bank (HSDB), accessed via TOXNET. TOXNET is a computer system run by the National Library of Medicine. It includes a number of toxicological databases managed by EPA, National Cancer

Institute, and the National Institute for Occupational Safety and Health.[2] HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB. For more information on TOXNET, contact the TOXNET help line at 800-231-3766 or see the website at http://toxnet.nlm.nih.gov/.

Methanol (CAS: 67-56-1)

Toxicity. Methanol is readily absorbed from the gastrointestinal tract and the respiratory tract, and is toxic to humans in moderate to high doses. In the body, methanol is converted into formaldehyde and formic acid. Methanol is excreted as formic acid. Observed toxic effects at high dose levels generally include central nervous system damage and blindness. Long-term exposure to high levels of methanol via inhalation cause liver and blood damage in animals.

Ecologically, methanol is expected to have low toxicity to aquatic organisms. Concentrations lethal to half the organisms of a test population are expected to exceed one milligram of methanol per liter of water. Methanol is not likely to persist in water or to bioaccumulate in aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Liquid methanol is likely to evaporate when left exposed. Methanol reacts in air to produce formaldehyde which contributes to the formation of air pollutants. In the atmosphere it can react with other atmospheric chemicals or be washed out by rain. Methanol is readily degraded by microorganisms in soils and surface waters.

Physical Properties. Methanol is highly flammable.

[2] Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory).

Ammonia (CAS: 7664-41-7)

Toxicity. Anhydrous ammonia is irritating to the skin, eyes, nose, throat, and upper respiratory system.

Ecologically, ammonia is a source of nitrogen (an essential element for aquatic plant growth), and may therefore contribute to eutrophication of standing or slow-moving surface water, particularly in nitrogen-limited waters such as the Chesapeake Bay. In addition, aqueous ammonia is moderately toxic to aquatic organisms.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Ammonia combines with sulfate ions in the atmosphere and is washed out by rainfall, resulting in rapid return of ammonia to the soil and surface waters.

Ammonia is a central compound in the environmental cycling of nitrogen. Ammonia in lakes, rivers, and streams is converted to nitrate.

Physical Properties. Ammonia is a corrosive and severely irritating gas with a pungent odor.

Hydrochloric Acid (CAS: 7647-01-1)

Toxicity. Hydrochloric acid is primarily a concern in its aerosol form. Acid aerosols have been implicated in causing and exacerbating a variety of respiratory ailments. Dermal exposure and ingestion of highly concentrated hydrochloric acid can result in corrosivity.

Ecologically, accidental releases of solution forms of hydrochloric acid may adversely affect aquatic life by including a transient lowering of the pH (i.e., increasing the acidity) of surface waters.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of hydrochloric acid to surface waters and soils will be neutralized to an extent due to the buffering capacities of both systems. The extent of these reactions will depend on the characteristics of the specific environment.

Physical Properties. Concentrated hydrochloric acid is highly corrosive.

Manganese Compounds

Toxicity. Manganese is an essential nutrient for most plants and animals. However, at high concentrations can produce an irreversible syndrome resembling Parkinson's disease.

Carcinogenicity. There is currently no evidence to suggest that manganese chemicals are carcinogenic.

Environmental Fate. As ions or insoluble solids, most manganese compounds are not expected to volatilize from water and moist soil surfaces. Manganese compounds released into the ambient atmosphere are expected to exist in the particulate phase. In the particulate phase, manganese compounds may be removed from the air by wet and dry deposition. Manganese compounds do not bioconcentrate in humans and animals.

Sulfuric Acid (CAS: 7664-93-9)

Toxicity. Concentrated sulfuric acid is corrosive. In its aerosol form, sulfuric acid has been implicated in causing and exacerbating a variety of respiratory ailments.

Ecologically, accidental releases of solution forms of sulfuric acid may adversely affect aquatic life by inducing a transient lowering of the pH (i.e., increasing the acidity) of surface waters. In addition, sulfuric acid in its aerosol form is also a component of acid rain. Acid rain can cause serious damage to crops and forests.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of sulfuric acid to surface waters and soils will be neutralized to an extent due to the buffering capacities of both systems. The extent of these reactions will depend on the characteristics of the specific environment.

In the atmosphere, aerosol forms of sulfuric acid contribute to acid rain. These aerosol forms can travel large distances from the point of release before the acid is deposited on land and surface waters in the form of rain.

IV.C. Other Data Sources

The toxic chemical release data obtained from TRI captures the vast majority of facilities in the pulp and paper industry. It also allows for a comparison across years and industry sectors. Reported chemicals are limited, however, to the approximately 650 required by TRI. Some pulp and paper emissions may not be captured by TRI. The EPA Office of Air Quality, Planning, and Standards has compiled air pollutant emission factors for determining the total air emissions of priority pollutants (e.g., total hydrocarbons, SO_x, NO_x, CO, particulates, etc.) from many sources.

The EPA Office of Air's Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Table 17 summarizes releases in 2001 of volatile organic compounds (VOCs), nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2), and particulate matter of 10 microns or less (PM10).

Table 17: Air Pollutant Releases by Industry Sector (tons/year)

Industry Sector	CO	NO_2	PM10	PM25	SO_2	VOC
Metal Mining	8,039	45,341	61,358	32,534	10,926	2,109
Oil and Gas Extraction	151,763	366,793	4,607	4,379	226,208	94,549
Non-Fuel, Non-Metal Mineral Mining	27,001	15,747	48,760	20,956	16,874	3,806
Textiles	7,448	15,043	5,343	3,386	25,544	18,286
Lumber and Wood Products	142,955	37,313	57,009	38,337	9,189	100,761
Wood Furniture and Fixtures	7,046	3,008	6,905	5,260	2,779	62,457
Pulp and Paper	**567,542**	**318,263**	**85,403**	**63,577**	**488,029**	**144,373**
Printing	604	2,466	1,723	1,723	1,915	80,982
Inorganic Chemicals	176,697	94,938	19,549	12,586	201,994	43,563
Plastic Resins and Man-made Fibers	28,890	56,946	5,493	4,155	71,815	83,363
Pharmaceuticals	2,662	14,676	2,273	1,455	17,132	13,407
Organic Chemicals	128,454	166,398	34,637	16,900	102,461	159,319
Agricultural Chemicals	18,492	65,389	10,257	7,311	65,765	12,700
Petroleum Refining	438,375	298,602	33,620	26,870	478,998	161,207
Rubber and Plastic	2,515	9,565	5,209	3,217	20,368	87,258
Stone, Clay, Glass and Concrete	161,113	372,679	127,283	78,647	312,740	32,687
Iron and Steel	1,080,576	105,794	60,962	47,501	307,981	44,608
Metal Castings	104,350	6,298	22,393	15,654	4,770	17,285
Nonferrous Metals	418,647	30,882	24,019	17,433	244,413	8,663
Fabricated Metal Products	6,029	11,672	4,691	3,264	18,742	90,575
Electronics and Computers	22,105	6,428	3,184	2,349	6,882	27,453
Motor Vehicle Assembly	13,439	15,388	4,016	2,270	24,123	95,861
Aerospace	2,832	7,413	1,834	1,287	5,363	7,440
Shipbuilding and Repair	471	2,139	1,574	753	2,537	4,984
Ground Transportation	711,155	6,681,163	285,932	165,029	12,976,279	191,063
Water Transportation	83	153	2,162	733	66	6,787
Air Transportation	5,231	2,079	186	140	90	2,398
Fossil Fuel Electric Power	436,151	5,789,099	252,539	141,002	12,667,567	54,727
Dry Cleaning	217	438	190	117	220	3,163

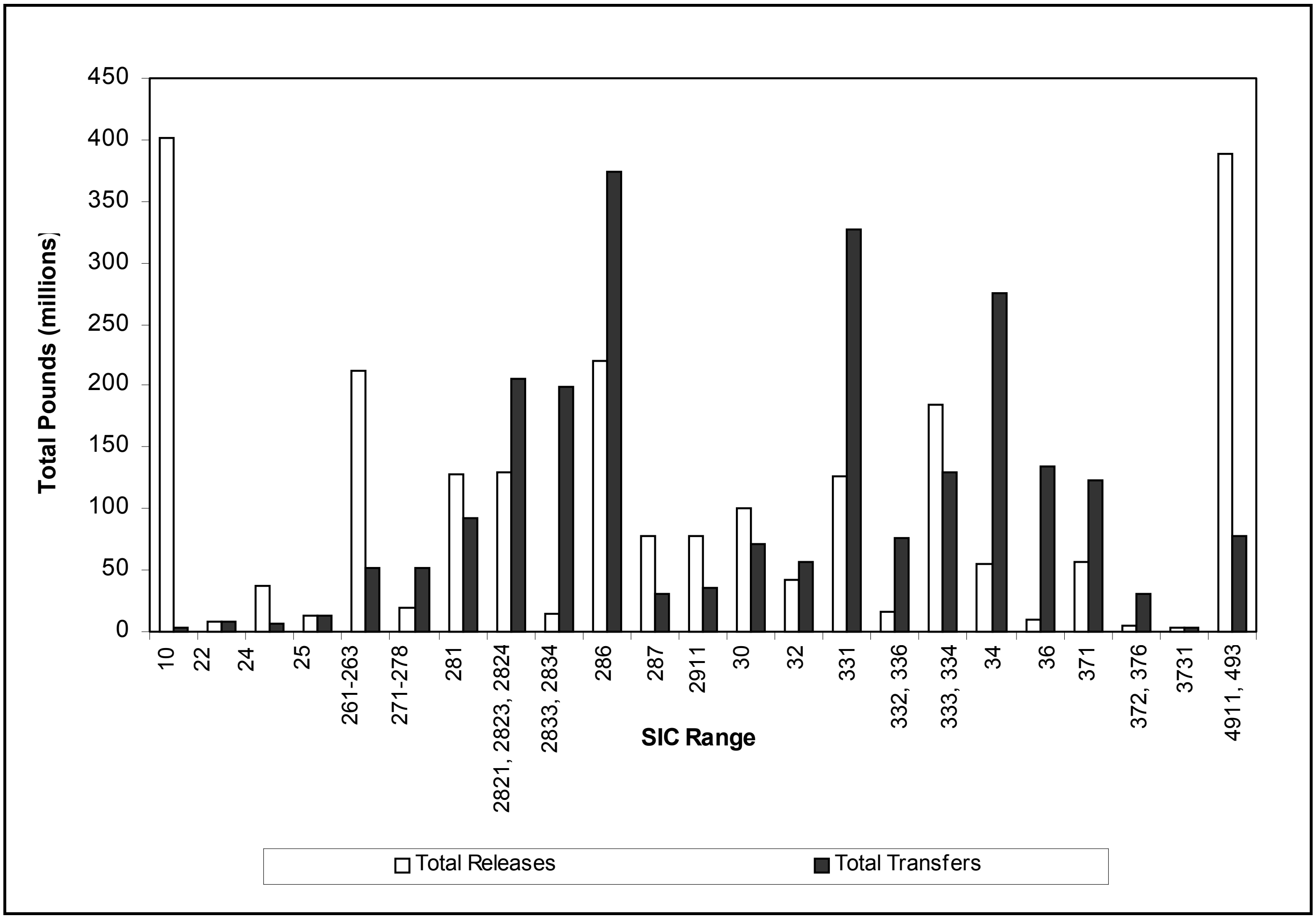
Source: U.S. EPA Office of Air and Radiation, AIRS Database, 2001.

IV.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following figure and table do not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release Report.

Figure 12 is a graphical representation of a summary of the 2000 TRI data for the Pulp and Paper industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Table 17 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of Pulp and Paper industry the 2000 TRI data presented here covers 268 facilities. These facilities listed SIC 2611-2631 (Pulp, Paper, and Paperboard Mills) as primary SIC codes.

Figure 12: 2000 Summary of TRI Releases and Transfers by Industry



Key to Standard Industrial Classification (SIC) Codes

SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
02	Agricultural Crops, Forestry	281	Inorganic Chemicals	333, 334	Nonferrous Metals
01, 08	Agricultural Livestock	2821, 2823, 2824	Plastic Resins and Man-made Fibers	34	Fabricated Metals
10	Metal Mining	2833, 2834	Pharmaceuticals	36	Electronics and Computers
13	Oil and Gas Extraction	286	Organic Chemicals	371	Motor Vehicle Assembly
14	Non-Fuel, Non-Metal Mining	287	Agricultural Chemicals	372, 376	Aerospace
22	Textiles	2911	Petroleum Refining	3731	Shipbuilding and Repair
24	Lumber and Wood Products	30	Rubber and Plastic	40, 42, 46, 4922-4925, 4932	Ground Transportation
25	Furniture and Fixtures	32	Stone, Clay, Glass and Concrete	44	Water Transportation
261-263	Pulp and Paper	331	Iron and Steel	45	Air Transportation
271-278	Printing	332, 336	Metal Casting	4911, 493	Fossil Fuel Electric Power Generation
				7216	Dry cleaning

Table 18: Toxics Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	TRI Releases		TRI Transfers		Total Releases +Transfers (million lbs.)	Average Releases + Transfers per Facility (pounds)
			Total Releases (million lbs.)	Ave. Releases per Facility (pounds)	Total Transfers (million lbs.)	Ave. Transfers per Facility (pounds)		
Agricultural Crops, Forestry	2	Industry sector currently not subject to TRI reporting.						
Agricultural Livestock	01, 08	Industry sector currently not subject to TRI reporting.						
Metal Mining	10	58	402.1	690,837	2.8	4,894	404.9	695,731
Oil and Gas Extraction	13	Industry sector currently not subject to TRI reporting.						
Non-Fuel, Non-Metal Mining	14	Industry sector currently not subject to TRI reporting.						
Textiles	22	194	8.9	17,018	8.1	15,527	17.0	32,545
Lumber and Wood Products	24	410	36.6	28,305	7.1	5,497	43.7	33,802
Furniture and Fixtures	25	280	13.0	18,912	13.5	19,605	26.6	38,517
Pulp and Paper	**261,262,263**	**268**	**211.6**	**90,180**	**51.5**	**21,971**	**263.1**	**112,151**
Printing	271-278	163	19.0	50,148	51.5	21,971	70.5	72,119
Inorganic Chemicals	281	343	128.2	64,085	91.8	45,921	220.0	110,006
Plastic Resins and Man-made Fibers	2821, 2823, 2824	369	129.5	45,534	205.1	72,139	334.5	117,673
Pharmaceuticals	2833, 2834	151	15.1	19,275	199.0	254,766	214.0	274,041
Organic Chemicals	286	467	219.4	47,377	374.3	80,833	593.6	128,210
Agricultural Chemicals	287	172	78.1	78,927	30.1	30,417	108.3	109,344
Petroleum Refining	2911	162	78.5	25,948	36.2	11,973	114.7	37,921
Rubber and Plastic	30	1,154	100.2	28,358	71.0	20,099	171.2	48,457
Stone, Clay, Glass and Concrete	32	484	42.1	21,860	56.7	29,389	98.8	51,249
Iron and Steel	331	325	125.7	63,336	327.5	164,981	453.2	228,317
Metal Casting	332, 336	447	16.8	9,081	75.5	40,849	92.3	49,930
Nonferrous Metals	333, 334	181	185.3	184,340	128.9	128,258	314.2	312,598
Fabricated Metals	34	2,047	54.8	7,759	275.5	38,991	330.3	46,750
Electronics and Computers	36	419	9.0	5,968	133.7	88,279	142.7	94,247
Motor Vehicle Assembly	371	622	56.0	19,495	123.7	43,019	179.7	62,514
Aerospace	372, 376	184	5.3	8,277	30.1	46,674	35.4	54,951
Shipbuilding and Repair	3731	39	4.0	19,884	2.5	12,316	6.4	32,200
Ground Transportation	40, 42, 46, 4922- 4925, 4932	Industry sector currently not subject to TRI reporting.						
Water Transportation	44	Industry sector currently not subject to TRI reporting.						
Air Transportation	45	Industry sector currently not subject to TRI reporting.						
Fossil Fuel Electric Power Generation	4911, 493	613	388.7	73,037	78.0	14,647	466.7	87,684
Dry cleaning	7216	Industry sector currently not subject to TRI reporting.						
Sector Notebook Total	NA	9,552	2,327.8	1,617,941	2,374.1	1,213,016	4,701.9	2,830,957
2000 TRI Total	NA	23,484	6,575.7	280,007	4,139.7	176,277	10,715.4	456,285

Source: *US EPA Toxics Release Inventory Database, 2000.*

V. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Industries have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the pulp and paper industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are being implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the technique can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects air, land and water pollutant releases.

Pollution Prevention Opportunities for the Pulp and Paper Industry

The chemical recovery systems used in chemical pulping processes are an example of pollution prevention technologies that have evolved alongside process technologies. An efficient chemical recovery system is a crucial component of chemical pulping mill operation: the chemical recovery process regenerates process chemicals, reducing natural resource usage and associated costs, as well as discharges to the environment and producing energy. Many recent pollution prevention efforts in the pulp and paper industry have focused on reducing the releases of toxics, in particular, chlorinated compounds. Pollution prevention techniques have proven to be more effective in controlling these pollutants than conventional control and treatment technologies. Most conventional, end-of-pipe treatment technologies are not effective in destroying many chlorinated compounds and often merely transfer the pollutants to another environmental medium. Efforts to prevent chlorinated releases have, therefore, focused on source reduction and material substitution techniques such as defoamers, bleaching chemical or wood chip substitution to reduce the industry's use and releases of chlorinated compounds. Such source reduction efforts and material substitutions usually require substantial changes in the production process. In addition to the major process changes aimed at reducing toxics releases, the industry is implementing a number of pollution prevention techniques to reduce water use and pollutant releases (BOD, COD, and TSS) such as: dry debarking, recycling of log flume water, improved spill control, bleach filtrate recycle, closed screen rooms, and improved storm water management. The pulp and paper industry has also worked to increase the amount of secondary and recycled fibers used for the pulping process. According to industry sources, the pulp and paper industry set and met a 1995 goal of 40 percent recycling and reuse of all paper consumed in the U.S. Currently, the industry has set a new goal of recovering 50 percent of all paper consumed in the U.S. for recycle and reuse. These figures should be compared with the utilization rate of secondary fibers (secondary fibers as a percentage of the total fibers used to make pulp) which is at approximately 37 percent and is climbing slowly (AF&PA, 1999). Current secondary fiber utilization rates in resource deficient countries such as Japan are close to 50 percent.

Because the pulp and paper industry is highly capital intensive and uses long-established technologies with long equipment lifetimes, major process-changing pollution prevention opportunities are expensive and require long time periods to implement. The pulp and paper industry is a dynamic one, however, that constantly makes process changes and material substitutions to increase productivity and cut costs. The trend towards materials substitutions is reflected in an increasing demand for alternative pulping and bleaching chemicals and in the participation of many facilities in voluntary environmental programs (see Section VIII).

One of the factors that is driving the industry towards pollution prevention much more rapidly is the integrated NESHAP and effluent limitation guidelines for the pulp and paper industry. (See Section VI.B. for a description of this "cluster rule.") These regulations were developed together in part to reduce the costs of compliance, to emphasize the multi-media nature of pollution control, and to promote pollution prevention. Many of the technology-based effluent limitation guidelines for the control of toxic releases consist of process changes that substitute chlorine dioxide for elemental chlorine and that completely eliminate elemental chlorine in bleaching processes. The NESHAP standards also allow Hazardous Air Pollutant (HAP) reductions through recycling of wastewater streams to a process unit and routing pulping emissions to a boiler, lime kiln, or recovery furnace.

Brief descriptions of some of the pollution prevention techniques found to be effective at pulp and paper facilities are provided below. For more detail on the pollution prevention options listed below and for descriptions of additional alternative pulping and bleaching processes refer to the Office of

Pollution Prevention and Toxics' 1993 report, *Pollution Prevention Technologies for the Bleached Kraft Segment of the U.S. Pulp and Paper Industry* and other pollution prevention/waste minimization documents listed in Resource Materials section. It should be noted that although many of the pollution prevention opportunities listed below are primarily aimed at reducing toxics releases, the process changes can often lead to reductions in the conventional pollutants such as BOD_5 and TSS as well as COD, AOX, and contribute to reduced water use, sludge volumes generated, and air emissions.

Extended Delignification. Extended delignification further reduces the lignin content of the pulp before it moves to the bleach plant. Because the amount of bleaching chemicals required to achieve a certain paper brightness is proportional to the amount of lignin remaining in the pulp after the pulping process, extended delignification can reduce the amounts of bleaching chemicals needed. A number of different extended delignification processes have been developed. These processes involve: increasing the cooking time; adding the cooking chemicals at several points throughout the cooking process; regulating the cooking temperatures; and carefully controlling the concentration of hydrogen sulfide ions and dissolved lignin. Importantly, the process changes do not degrade the cellulose which would normally accompany increased cooking time. Extended delignification processes have been developed for both batch and continuous pulping processes. The lignin content of the brownstock pulp has been reduced by between 20 and 50 percent with no losses in pulp yield or strength using such processes. In consequence, chlorinated compounds generated during bleaching are reduced in approximate proportion to reductions in the brownstock lignin content. In addition, the same changes have resulted in significant reductions in BOD_5, COD and color. One study demonstrated a 29 percent decrease in BOD_5 resulting from an extended delignification process. Facility energy requirements have been shown to increase slightly with extended delignification. However, off-site power requirements (associated with decreased chemical use) have been estimated to more than offset the on-site increases.

Oxygen Delignification. Oxygen delignification also reduces the lignin content in the pulp. The process involves the addition of an oxygen reactor between the kraft pulping stages and the bleach plant. The brownstock pulp from the digester is first washed and then mixed with sodium hydroxide or oxidized cooking liquor. The pulp is fluffed, deposited in the oxygen reactor, steam heated, and injected with gaseous oxygen wherein it undergoes oxidative delignification. The pulp is then washed again to remove the dissolved lignin before moving to the bleaching plant. Oxygen delignification can reduce the lignin content in the pulp by as much as 50 percent resulting in a potentially similar reduction in the use of chlorinated bleaching chemicals and chlorinated compound pollutants. The process can be used in combination with other process modifications that can completely eliminate the need for chlorine-based bleaching agents. In addition, unlike bleach plant filtrate, the effluent from the oxygen reactor can be recycled through the pulp mill recovery cycle, further reducing the non-pulp solids going to the bleaching plant and the effluent load from the bleach plant. The net effect is reduced effluent flows and less sludge generation. Facility energy requirements have been shown to increase with oxygen delignification, however, the decrease in off-site power requirements (associated with decreased chemical use) have been estimated to exceed the on-site increases resulting in a decrease in overall energy requirements. Also, the recovered energy and reduced chemical use offset the cost.

Ozone Delignification. As a result of a considerable research effort, ozone delignification (ozone bleaching) is now being used in a limited number of pulp mills. The technology has the potential to eliminate the need for chlorine in the bleaching process. Ozone delignification is performed using processes and equipment similar to that of oxygen delignification. The ozone process, however, must take place at a very low pH (1.0 to 2.0), requiring the addition of sulfuric acid to the pulp prior to the ozonation. In addition to low pH, a number of process conditions are critical for ozone delignification: organic materials must be almost completely washed out of the brownstock pulp; temperatures must stay at about 20 ˚C; and ozone reactive metals must be removed prior to the ozonation stage. Oxygen delignification and/or extended delignification processes are considered a prerequisite for successful ozone bleaching. When used in combination, the two processes can result in a high quality bright pulp that requires little or no chlorine or chlorine dioxide bleaching. Overall emissions from the combination of the oxygen and ozone processes are substantially lower than conventional processes because effluents from each stage can be recycled. Pilot systems consisting of ozone delignification in combination with oxygen delignification and oxygen extraction have shown reductions in BOD_5 of 62 percent, COD of 53 percent, color of 88 percent, and organic chlorine compounds of 98 percent. However, ozone is unstable and will decompose to molecular oxygen, thus ozone must be generated on-site and fed immediately to the pulp reactor. Ozone generation systems are complex and account for a high percentage of the total costs. Facility energy use will increase due to the on-site production of ozone, however, this energy will be offset by the energy that would normally be used to produce chlorine and chlorine dioxide.

Anthraquinone Catalysis. The addition of anthraquinone (a chemical catalyst produced from coal tar) to the pulping liquor has been shown to speed up the kraft pulping reaction and increase yield by protecting cellulose fibers from degradation. The anthraquinone accelerates the fragmentation of lignin, allowing it to be broken down more quickly by the pulping chemicals. This lowers the amount of lignin in the prechlorination pulp, thus reducing the amount of bleaching chemicals needed. Anthraquinone catalysts are increasingly used in combination with oxygen delignification and extended delignification to overcome boiler capacity bottlenecks arising from these delignification processes.

Black Liquor Spill Control and Prevention. The mixture of dissolved lignin and cooking liquor effluent from the pulping reactor and washed pulp is known as black liquor. Raw black liquor contains high levels of BOD, COD, and organic compounds. Spills of black liquor can result from overflows, leaks from process equipment, or from deliberate dumping by operators to avoid a more serious accident. Spills of black liquor can have impacts on receiving waters, are a source of air emissions, and can shock the microbial action of wastewater treatment systems. Black liquor losses also result in the loss of the chemical and heat value of the material. Systems needed to control black liquor spills are a combination of good design, engineering, and, most importantly, operator training. A few elements of an effective spill control system include: physical isolation of pieces of equipment; floor drainage systems that allow spills to be collected; backup black liquor storage capacity; sensors that provide immediate warning of potential or actual spills; and enclosed washing and screening equipment.

Enzyme Treatment of Pulp. Biotechnology research has resulted in the identification of a number of microorganisms that produce enzymes capable of breaking down lignin in pulp. Although the technology is new, it is believed that a number of mills are currently conducting enzyme treatment trials. The microorganisms capable of producing the necessary enzymes are called xylanases. Xylanases for pulp bleaching trials are available from several biotechnology and chemical companies. Since enzymes are used as a substitute for chemicals in bleaching pulp, their use will result in a decrease in chlorinated compounds released somewhat proportional to the reduction in bleaching chemicals used. Enzymes are also being used to assist in the deinking of secondary fiber. Research at the Oak Ridge National Laboratories has identified cellulase enzymes that will bind ink to the smaller fiber particles facilitating recovery of the ink sludge. Use of enzymes may also reduce the energy costs and chemical use in retrieving ink sludge from deinking effluent.

Improved Brownstock and Bleaching Stage Washing. Liquor solids remaining in the brownstock pulp are carried over to the bleach plant and then compete with the remaining lignin in the pulp for reaction with the bleaching chemicals. Improved washing, therefore, can reduce the required amount of bleaching chemicals and the subsequent reductions in chlorinated compounds as well as conventional pollutants. Modern washing systems with improved solids removal and energy efficiency are beginning to replace the conventional rotary vacuum washers. State-of-the-art washing systems include: atmospheric or pressure diffusion washers, belt washers, and pulp presses. Opportunities for reduced effluent flows and water use are also present in the bleaching plant. Acid filtrates from hypochlorite or chlorine dioxide stages can be used as dilution and wash water for the first bleaching stage. Similarly, second extraction stage filtrates can be used as dilution and wash water in the first extraction stage. Most new mills are designed with these counter-current washing systems and some mills are retrofitting their existing wash systems.

Improved Chipping and Screening. The size and thickness of wood chips is critical for proper circulation and penetration of the pulping chemicals. Chip uniformity is controlled by the chipper and screens that remove under and oversized pieces. Standard equipment normally does not sort chips by thickness although it has been demonstrated that chip thickness is extremely important in determining the lignin content of pulp. Improper chip thicknesses can therefore result in increased use of bleaching chemicals and the associated chlorinated compounds and conventional pollutants. Some mills are beginning to incorporate equipment that will separate chips according to their thickness as well as by length and width.

Oxygen-Reinforced/Peroxide Extraction. Oxygen-reinforced extraction (or oxidative extraction) and peroxide-reinforced extraction processes used separately or together have been shown to reduce the amount of elemental chlorine and chlorine dioxide needed in the bleaching process while increasing the pulp brightness. Gaseous elemental oxygen (in the case of oxygen-reinforced extraction) and aqueous hydrogen peroxide (in the case of peroxide extraction) are used as a part of the first alkaline extraction stage to facilitate the solubilization and removal of chlorinated and oxidized lignin molecules. Oxygen-reinforced extraction has seen widespread adoption by the industry in recent years. It is estimated that up to 80 percent of mills in the U.S. are using oxygen-reinforced extraction. The use of peroxide extraction is also increasing. As of 1987, it was estimated that 25 percent of domestic mills were using peroxide extraction.

Improved Chemical Controls and Mixing. The formation of chlorinated organics can be minimized by avoiding excess concentrations of chlorine-based bleaching chemicals within reactor vessels. This can be accomplished by carefully controlling the chemical application rates and by ensuring proper mixing of chemicals within the reactor. Modern chemical application control and monitoring systems and high-shear mixers have been developed which decrease formation of chlorinated organic compounds.

VI. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the federal regulations that may apply to this sector. The purpose of this section is to highlight and briefly describe the applicable federal requirements, and to provide citations for more detailed information. The three following sections are included:

- Section VI.A contains a general overview of major statutes
- Section VI.B contains a list of regulations specific to this industry
- Section VI.C contains a list of pending and proposed regulatory requirements.

The descriptions within Section VI are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

VI.A. General Description of Major Statutes

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA are classified as either “toxic” pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; or "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and “indirect” dischargers (those who discharge to publicly owned treatment works). The National Pollutant Discharge Elimination System (NPDES) permitting program (CWA section 402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized state (EPA has authorized 43 states and one territory to administer the NPDES program), contain industry-specific, technology-based and water quality-based limits and establish pollutant monitoring and reporting requirements. A facility that proposes to discharge into the nation's waters must obtain a permit prior to initiating a discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

Water quality-based discharge limits are based on federal or state water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technology-based standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from state to state, and site to site, depending on the use classification of the receiving body of water. Most states follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address storm water discharges. In response, EPA promulgated NPDES permitting regulations for storm water discharges. These regulations require that facilities with the following types of storm water discharges, among others, apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the state determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR Part 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; SIC 311-leather tanning and finishing; SIC 32 (except 323)-stone, clay, glass, and concrete; SIC 33-primary metals; SIC 3441-fabricated structural metal; and SIC 373-ship and boat building and repairing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Phase II storm water requirements were established in 1999. Permits are now required for certain small municipal separate storm sewer systems (MS4s) and for construction activity disturbing between one and five acres of land (i.e., small construction activities). The Phase II rule also revised the "no exposure" exclusion and the temporary exemption for certain industrial facilities that had been established under Phase I regulations.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly owned treatment works (POTW). The national pretreatment program (CWA section 307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under section 307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a state is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than federal standards.

Wetlands

Wetlands, commonly called swamps, marshes, fens, bogs, vernal pools, playas, and prairie potholes, are a subset of "waters of the United States," as defined in Section 404 of the CWA. The placement of dredge and fill material into wetlands and other water bodies (i.e., waters of the United States) is regulated by the U.S. Army Corps of Engineers (Corps) under 33 CFR Part 328. The Corps regulates wetlands by administering the CWA Section 404 permit program for activities that impact wetlands. EPA's authority under Section 404 includes veto power of Corps permits, authority to interpret statutory exemptions and jurisdiction, enforcement actions, and delegating the Section 404 program to the states.

EPA's Office of Water, at 202-566-1730, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water Resource Center, at 1-800-426-4791.

<u>Oil Pollution Prevention Regulation</u>

Section 311(b) of the CWA prohibits the discharge of oil, in such quantities as may be harmful, into the navigable waters of the United States and adjoining shorelines. The EPA Discharge of Oil regulation, 40 CFR Part 110, provides information regarding these discharges. The Oil Pollution Prevention regulation, 40 CFR Part 112, under the authority of Section 311(j) of the CWA, requires regulated facilities to prepare and implement Spill Prevention Control and Countermeasure (SPCC) plans. The intent of a SPCC plan is to prevent the discharge of oil from onshore and offshore non-transportation-related facilities. In 1990 Congress passed the Oil Pollution Act which amended Section 311(j) of the CWA to require facilities that because of their location could reasonably be expected to cause "substantial harm" to the environment by a discharge of oil to develop and implement Facility Response Plans (FRP). The intent of a FRP is to provide for planned responses to discharges of oil.

A facility is SPCC-regulated if the facility, due to its location, could reasonably be expected to discharge oil into or upon the navigable waters of the United States or adjoining shorelines, and the facility meets one of the following criteria regarding oil storage: (1) the capacity of any aboveground storage tank exceeds 660 gallons, or (2) the total aboveground storage capacity exceeds 1,320 gallons, or (3) the underground storage capacity exceeds 42,000 gallons. 40 CFR Part 112.7 contains the format and content requirements for a SPCC plan. In New Jersey, SPCC plans can be combined with DPCC plans, required by the state, provided there is an appropriate cross-reference index to the requirements of both regulations at the front of the plan.

According to the FRP regulation, a facility can cause "substantial harm" if it meets one of the following criteria: (1) the facility has a total oil storage capacity greater than or equal to 42,000 gallons and transfers oil over water to or from vessels; or (2) the facility has a total oil storage capacity greater than or equal to one million gallons and meets any one of the following conditions: (i) does not have adequate secondary containment, (ii) a discharge could cause "injury" to fish and wildlife and sensitive environments, (iii) shut down a public drinking water intake, or (iv) has had a reportable oil spill greater than or equal to 10,000 gallons in the past five years. Appendix F of 40 CFR Part 112 contains the format and content requirements for a FRP. FRPs that meet EPA's requirements can be combined with U.S. Coast Guard FRPs or other contingency plans, provided there is an appropriate cross-reference index to the requirements of all applicable regulations at the front of the plan.

For additional information regarding SPCC plans, contact EPA's RCRA, Superfund, and EPCRA Call Center, at 800-424-9346. Additional documents and resources can be obtained from the hotline's homepage at *www.epa.gov/epaoswer/hotline. The hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.*

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint federal-state system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of fluid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized states enforce the primary drinking water standards, which are contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set generally as close to MCLGs as possible, considering cost and feasibility of attainment.

Part C of the SDWA mandates EPA to protect underground sources of drinking water from inadequate injection practices. EPA has published regulations codified in 40 CFR Parts 144 to 148 to comply with this mandate. The Underground Injection Control (UIC) regulations break down injection wells into five different types, depending on the fluid injected and the formation that receives it. The regulations also include construction, monitoring, testing, and operating requirements for injection well operators. All injection wells have to be authorized by permit or by rule depending on their potential to threaten Underground Sources of Drinking Water (USDW). RCRA also regulates hazardous waste injection wells and a UIC permit is considered to meet the requirements of a RCRA permit. EPA has authorized delegation of the UIC for all wells in 35 states, implements the program in 10 states and all Indian lands, and shares responsibility with five states.

The SDWA also provides for a federally-implemented Sole Source Aquifer program, which prohibits federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a state-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

The SDWA Amendments of 1996 require states to develop and implement source water assessment programs (SWAPs) to analyze existing and potential threats to the quality of the public drinking water throughout the state. Every state is required to submit a program to EPA and to complete all assessments within 3 ½ years of EPA approval of the program. SWAPs include: (1)

delineating the source water protection area, (2) conducting a contaminant source inventory, (3) determining the susceptibility of the public water supply to contamination from the inventories sources, and (4) releasing the results of the assessments to the public.

EPA's Safe Drinking Water Hotline, at 800-426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding federal holidays. Visit the website at www.epa.gov/ogwdw for additional material.

Resource Conservation and Recovery Act

The Solid Waste Disposal Act (SWDA), as amended by the Resource Conservation and Recovery Act (RCRA) of 1976, addresses solid and hazardous waste management activities. The Act is commonly referred to as RCRA. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a "cradle-to-grave" system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (discarded commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitability, corrosivity, reactivity, or toxicity and designated with the code "D").

Entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. A hazardous waste facility may accumulate hazardous waste for up to 90 days (or 180 days depending on the amount generated per month) without a permit or interim status. Generators may also treat hazardous waste in accumulation tanks or containers (in accordance with the requirements of 40 CFR Part 262.34) without a permit or interim status. Facilities that treat, store, or dispose of hazardous waste are generally required to obtain a RCRA permit.

Subtitle C permits are required for treatment, storage, or disposal facilities. These permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Subparts I and S) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA treatment, storage, or disposal facilities.

Although RCRA is a federal statute, many states implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 47 of the 50 states and two U.S. territories. Delegation has not been given to Alaska, Hawaii, or Iowa.

Most RCRA requirements are not industry specific but apply to any company that generates, transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Criteria for Classification of Solid Waste Disposal Facilities and Practices** (40 CFR Part 257) establishes the criteria for determining which solid waste disposal facilities and practices pose a reasonable probability of adverse effects on health or the environment. The criteria were adopted to ensure non-municipal, non-hazardous waste disposal units that receive conditionally exempt small quantity generator waste do not present risks to human health and environment.

- **Criteria for Municipal Solid Waste Landfills** (40 CFR Part 258) establishes minimum national criteria for all municipal solid waste landfill units, including those that are used to dispose of sewage sludge.

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) establishes the standard to determine whether the material in question is considered a solid waste and, if so, whether it is a hazardous waste or is exempted from regulation.

- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an EPA identification number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste on-site for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.

- **Land Disposal Restrictions** (LDRs) (40 CFR Part 268) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs program, materials must meet treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.

- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation, burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil processor, re-refiner, burner, or marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- RCRA contains unit-specific standards for all units used to store, treat, or dispose of hazardous waste, including **Tanks and Containers**. Tanks and containers used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including large quantity generators accumulating waste prior to shipment offsite.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substances are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also includes upgrade requirements for existing tanks that were to be met by December 22, 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and, in some cases, restrict the type of waste that may be burned.

EPA's RCRA, Superfund, and EPCRA Call Center, at 800-424-9346, responds to questions and distributes guidance regarding all RCRA regulations. Additional documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The RCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response or remediation costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA hazardous substance release reporting regulations (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which equals or exceeds a reportable quantity. Reportable quantities are listed in 40 CFR Part 302.4. A release report may trigger a response by EPA or by one or more federal or state emergency response authorities.

EPA implements hazardous substance responses according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for cleanups. The National Priorities List (NPL) currently includes approximately 1,300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct cleanups and encourages community involvement throughout the Superfund response process.

EPA's RCRA, Superfund and EPCRA Call Center, at 800-424-9346, answers questions and references guidance pertaining to the Superfund program. Documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline. The Superfund Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by state and local governments. Under EPCRA, states establish State Emergency Response Commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing Local Emergency Planning Committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA section 302** requires facilities to notify the SERC and LEPC of the presence of any extremely hazardous substance at the facility in an amount in excess of the established threshold planning quantity. The list of extremely hazardous substances and their threshold planning quantities is found at 40 CFR Part 355, Appendices A and B.

- **EPCRA section 303** requires that each LEPC develop an emergency plan. The plan must contain (but is not limited to) the identification of facilities within the planning district, likely routes for transporting extremely hazardous substances, a description of the methods and procedures to be followed by facility owners and operators, and the designation of community and facility emergency response coordinators.

- **EPCRA section 304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance (defined at 40 CFR Part 302) or an EPCRA extremely hazardous substance.

- **EPCRA sections 311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA section 313** requires certain covered facilities, including SIC codes 20 through 39 and others, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media. EPA maintains the data reported in a publically accessible database known as the Toxics Release Inventory (TRI).

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's RCRA, Superfund and EPCRA Call Center, at 800-424-9346, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. Documents and resources can be obtained from the hotline's homepage at www.epa.gov/epaoswer/hotline.

The EPCRA Hotline operates weekdays from 9:00 a.m. to 6:00 p.m., EST, excluding federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments are designed to "protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population." The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the states to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAA, many facilities are required to obtain operating permits that consolidate their air emission requirements. State and local governments oversee, manage, and enforce many of the requirements of the CAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are designated as attainment areas; those that do not meet NAAQSs are designated as non-attainment areas. Under section110 and other provisions of the CAA, each state must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet federal air quality standards. Revised NAAQSs for particulates and ozone became effective in 2001.

Title I also authorizes EPA to establish New Source Performance Standards (NSPS), which are nationally uniform emission standards for new and modified stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source (see 40 CFR Part 60).

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented toward controlling specific hazardous air pollutants (HAPs). Section 112(c) of the CAA further directs EPA to develop a list of sources that emit any of 188 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 185 source categories and developed a schedule for the establishment of emission standards. The emission standards are being developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV-A establishes a sulfur dioxide and nitrogen oxides emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances that are set below previous levels of sulfur dioxide releases.

Title V of the CAA establishes an operating permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States have developed the permit programs in accordance with guidance and regulations from EPA. Once a state program is approved by EPA, permits are issued and monitored by that state.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restricting their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), were phased out (except for essential uses) in 1996.

EPA's Clean Air Technology Center, at 919-541-0800 or www.epa.gov/ttn/catc, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at 800-296-1996 or www.epa.gov/ozone, provides general information about regulations promulgated under Title VI of the CAA; EPA's EPCRA Call Center, at 800-424-9346 or www.epa.gov/epaoswer/hotline, answers questions about accidental release prevention under CAA section112(r); and information on air toxics can be accessed through the Unified Air Toxics website at http://www.epa.gov/ttn/atw/. In addition, the Clean Air Technology Center's website includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

Federal Insecticide, Fungicide, and Rodenticide Act

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was first passed in 1947, and amended numerous times, most recently by the Food Quality Protection Act (FQPA) of 1996. FIFRA provides EPA with the authority to oversee, among other things, the registration, distribution, sale and use of pesticides. The Act applies to all types of pesticides, including insecticides, herbicides, fungicides, rodenticides and antimicrobials. FIFRA covers both intrastate and interstate commerce.

Establishment Registration

Section 7 of FIFRA requires that establishments producing pesticides, or active ingredients used in producing a pesticide subject to FIFRA, register with EPA. Registered establishments must report the types and amounts of pesticides and active ingredients they produce. The Act also provides EPA inspection authority and enables the agency to take enforcement actions against facilities that are not in compliance with FIFRA.

Product Registration

Under section 3 of FIFRA, all pesticides (with few exceptions) sold or distributed in the U.S. must be registered by EPA. Pesticide registration is very specific and generally allows use of the product only as specified on the label. Each registration specifies the use site i.e., where the product may be used and the amount that may be applied. The person who seeks to register the pesticide must file an application for registration. The application process often requires either the citation or submission of extensive environmental, health and safety data.

To register a pesticide, the EPA Administrator must make a number of findings, one of which is that the pesticide, when used in accordance with widespread and commonly recognized practice, will not generally cause unreasonable adverse effects on the environment.

FIFRA defines "unreasonable adverse effects on the environment" as "(1) any unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of the pesticide, or (2) a human dietary risk from residues that result from a use of a pesticide in or on any food inconsistent with the standard under section 408 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 346a)."

Under FIFRA section 6(a)(2), after a pesticide is registered, the registrant must also notify EPA of any additional facts and information concerning unreasonable adverse environmental effects of the pesticide. Also, if EPA determines that additional data are needed to support a registered pesticide, registrants may be requested to provide additional data. If EPA determines that the registrant(s) did not comply with their request for more information, the registration can be suspended under FIFRA section 3(c)(2)(B).

Use Restrictions

As a part of the pesticide registration, EPA must classify the product for general use, restricted use, or general for some uses and restricted for others (Miller, 1993). For pesticides that may cause unreasonable adverse effects on the environment, including injury to the applicator, EPA may require that the pesticide be applied either by or under the direct supervision of a certified applicator.

Reregistration

Due to concerns that much of the safety data underlying pesticide registrations becomes outdated and inadequate, in addition to providing that registrations be reviewed every 15 years, FIFRA requires EPA to reregister all pesticides that were registered prior to 1984 (section 4). After reviewing existing data, EPA may approve the reregistration, request additional data to support the registration, cancel, or suspend the pesticide.

Tolerances and Exemptions

A tolerance is the maximum amount of pesticide residue that can be on a raw product and still be considered safe. Before EPA can register a pesticide that is used on raw agricultural products, it must grant a tolerance or exemption from a tolerance (40 CFR Parts 163.10 through 163.12). Under the Federal Food, Drug, and Cosmetic Act (FFDCA), a raw agricultural product is deemed unsafe if it contains a pesticide residue, unless the residue is within the limits of a tolerance established by EPA or is exempt from the requirement.

Cancellation and Suspension

EPA can cancel a registration if it is determined that the pesticide or its labeling does not comply with the requirements of FIFRA or causes unreasonable adverse effects on the environment (Haugrud, 1993).

In cases where EPA believes that an "imminent hazard" would exist if a pesticide were to continue to be used through the cancellation proceedings, EPA may suspend the pesticide registration through an order and thereby halt the sale, distribution, and usage of the pesticide. An "imminent hazard" is defined as an unreasonable adverse effect on the environment or an unreasonable hazard to the survival of a threatened or endangered species that would be the likely result of allowing continued use of a pesticide during a cancellation process.

When EPA believes an emergency exists that does not permit a hearing to be held prior to suspending, EPA can issue an emergency order which makes the suspension immediately effective.

Imports and Exports

Under FIFRA section 17(a), pesticides not registered in the U.S. and intended solely for export are not required to be registered provided that the exporter obtains and submits to EPA, prior to export, a statement from the foreign purchaser acknowledging that the purchaser is aware that the product is not registered in the United States and cannot be sold for use there. EPA sends these statements to the government of the importing country. FIFRA sets forth additional requirements that must be met by pesticides intended solely for export. The enforcement policy for exports is codified at 40 CFR Parts 168.65, 168.75, and 168.85.

Under FIFRA section 17(c), imported pesticides and devices must comply with U.S. pesticide law. Except where exempted by regulation or statute, imported pesticides must be registered. FIFRA section 17(c) requires that EPA be notified of the arrival of imported pesticides and devices. This is accomplished through the Notice of Arrival (NOA) (EPA Form 3540-1), which is filled out by the importer prior to importation and submitted to the EPA regional office applicable to the intended port of entry. U.S. Customs regulations prohibit the importation of pesticides without a completed NOA. The EPA-reviewed and signed form is returned to the importer for presentation to U.S. Customs when the shipment arrives in the U.S. NOA forms can be obtained from contacts in the EPA Regional Offices or www.epa.gov/oppfead1/international/noalist.htm.

Additional information on FIFRA and the regulation of pesticides can be obtained from a variety of sources, including EPA's Office of Pesticide Programs www.epa.gov/pesticides, EPA's Office of Compliance, Agriculture and Ecosystem Division http://www.epa.gov/compliance/assistance/sectors/agriculture.html, or The National Agriculture Compliance Assistance Center, 888-663-2155 or http://www.epa.gov/agriculture/. Other sources include the National Pesticide Telecommunications Network, 800-858-7378, and the National Antimicrobial Information Network, 800-447-6349.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk. It is important to note that pesticides as defined in FIFRA are not included in the definition of a "chemical substance" when manufactured, processed, or distributed in commerce for use as a pesticide.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA section 5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA section 6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under section 6 authority are asbestos, chlorofluorocarbons (CFCs), lead, and polychlorinated biphenyls (PCBs).

Under TSCA section 8(e), EPA requires the producers and importers (and others) of chemicals to report information on a chemicals' production, use, exposure, and risks. Companies producing and importing chemicals can be required to report unpublished health and safety studies on listed chemicals and to collect and record any allegations of adverse reactions or any information indicating that a substance may pose a substantial risk to humans or the environment.

EPA's TSCA Assistance Information Service, at 202-554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding federal holidays.

Coastal Zone Management Act

The Coastal Zone Management Act (CZMA) encourages states/tribes to preserve, protect, develop, and where possible, restore or enhance valuable natural coastal resources such as wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as the fish and wildlife using those habitats. It includes areas bordering the Atlantic, Pacific, and Arctic Oceans, Gulf of Mexico, Long Island Sound, and Great Lakes. A unique feature of this law is that participation by states/tribes is voluntary.

In the Coastal Zone Management Act Reauthorization Amendments (CZARA) of 1990, Congress identified nonpoint source pollution as a major factor in the continuing degradation of coastal waters. Congress also recognized that effective solutions to nonpoint source pollution could be implemented at the state/tribe and local levels. In CZARA, Congress added Section 6217 (16 U.S.C. section 1455b), which calls upon states/tribes with federally-approved coastal zone management programs to develop and implement coastal nonpoint pollution control programs. The Section 6217 program is administered at the federal level jointly by EPA and the National Oceanic and Atmospheric Agency (NOAA).

Section 6217(g) called for EPA, in consultation with other agencies, to develop guidance on "management measures" for sources of nonpoint source pollution in coastal waters. Under Section 6217, EPA is responsible for developing technical guidance to assist states/tribes in designing coastal nonpoint pollution control programs. On January 19, 1993, EPA issued its *Guidance Specifying Management Measures For Sources of Nonpoint*

Pollution in Coastal Waters, which addresses five major source categories of nonpoint pollution: (1) urban runoff, (2) agriculture runoff, (3) forestry runoff, (4) marinas and recreational boating, and (5) hydromodification.

Additional information on coastal zone management may be obtained from EPA's Office of Wetlands, Oceans, and Watersheds, www.epa.gov/owow, or from the Watershed Information Network www.epa.gov/win. The NOAA website, http://www.ocrm.nos.noaa.gov/czm/, also contains additional information on coastal zone management.

VI.B. Industry Specific Requirements

Clean Air Act (CAA)

National Ambient Air Quality Standards

At pulp and paper mills, air emissions from both process and combustion units are regulated under the National Ambient Air Quality Standards (NAAQS) and the State Implementation Plans (SIP) that enforce the standards. States may implement controls to limit emissions of particulate matter (PM), nitrogen oxides (NOx), volatile organic compounds (VOC), and sulfur dioxide (SO_2).

Although many limits are implemented at the state level, there are national guidelines that serve as a basis for more specific limits. Sources that are considered "major" under the Clean Air Act are subject to prevention of significant deterioration (PSD) or new source review (NSR). Both PSD and NSR are permit programs for facilities that were constructed or modified after a certain date.

Facilities in NAAQS attainment areas must follow PSD requirements by demonstrating that the construction/modification project will not cause a violation of air quality limits and by implementing the best available control technology (BACT).

New or modified facilities in nonattainment areas must follow NSR requirements, which require the source to meet the lowest achievable emission rate (LAER) and to obtain emission offsets to ensure that the nonattainment problem is not made worse by the new/modified source.

In addition to the PSD/NSR pre-construction obligations, there are process-specific operational standards: New Source Performance Standards (NSPS). 40 CFR 60 lists these standards, which serve as minimum requirements in states SIPs. Individual states may impose requirements that are more strict. The following NSPSs are particularly relevant to the pulp and paper industry:

Subpart BB	Kraft pulp mills (Regulates PM and TRS emissions from new kraft mills.)
Subparts D, Db, Dc	Industrial boilers (Regulates PM, nitrogen oxides (NOx) and sulfur dioxide (SO_2) from new boilers used at pulp and paper mills.)
Subpart GG	Gas-fired turbines (Regulates PM, nitrogen oxides (NOx) and sulfur dioxide (SO_2) from new gas-fired turbines used at pulp and paper mills.)
Subpart Kb	Volatile Organic Liquid Storage Vessels (Including Petroleum Liquid Storage Vessels) (Regulates VOC from applicable storage tanks containing volatile organic liquids at pulp and paper mills)

Hazardous Air Pollutants

Air toxics regulations apply to several parts of the pulp and paper milling process. National Emission Standards for Hazardous Air Pollutants (NESHAP) have been developed expressly for two processes of the pulp and paper industry. Both NESHAPs establish process-based maximum achievable control technologies (MACT) for "major sources," which are defined as facilities that emit or have the potential to emit 10 tons per year or more of any hazardous air pollutant (HAP) or 25 tons per year or more of any combination of HAPs. Standards for both MACT I & III standards are integrated into one subpart (Subpart S) of 40 CFR 63. MACT II standards are in a separate subpart (Subpart MM).:

Subpart S	Controlling HAP emissions from the pulp and paper production areas of mills using the kraft, sulfite, semi-chemical, and soda pulping processes (MACT I), and controlling HAP emissions from pulp and paper production areas of mills using mechanical, secondary fiber, and non-wood pulping, and papermaking systems at all mills (MACT II).
Subpart MM	Controlling HAP emissions from chemical recovery processes that involve the combustion of spent pulping liquor at kraft, soda, sulfite, and stand-alone semichemical pulp mills (MACT III).

Other NESHAPs that are relevant for the industry are those for asbestos (relevant during demolition and renovation activities) and mercury (important for sludge dryers and incinerators). Unlike the industry-specific NESHAP standards, chemical-specific NESHAPs may apply to all facilities regardless of their size.

Risk Management Program

Pulp and paper mills are subject to section 112(r) of CAA, which states that stationary sources using extremely hazardous substances have a "general duty" to initiate specific activities to prevent and mitigate accidental releases. The general duty requirements apply to stationary sources that produce, process, handle, or store these substances, regardless of the quantity of managed at the facility. Although there is no list of "extremely hazardous substances," EPA's Chemical Emergency Preparedness and Prevention Office provides some guidance at its website: www.epa.gov/ceppo. The general duty clause requires facilities to identify hazards that may result from accidental releases, to design and maintain a safe facility, and to minimize the consequences of releases when they occur.

Most pulp and paper mills are subject to additional, more explicit risk management requirements. Facilities that have more than a threshold quantity of any of the 140 regulated substances in a single process are required to develop a risk management program and to summarize their program in a risk management plan (RMP). Mills subject to the requirements were required to submit a registration and RMP in 1999 or whenever they first exceed the threshold for a listed regulated substance after that date.

All facilities meeting the RMP threshold requirements must follow Program 1 requirements:

- An offsite consequence analysis that evaluates specific potential release scenarios, including worst-case and alternative scenarios.
- A five-year history of certain accidental releases of regulated substances from covered processes.
- A risk management plan, revised at least once every five years, that describes and documents these activities for all covered processes.

In addition, most pulp and paper facilities may be subject to the requirements of Program 2 or 3. These additional requirements include:

- An integrated prevention program to manage risk. The prevention program will include identification of hazards, written operating procedures, training, maintenance, and accident investigation.
- An emergency response program.
- An overall management system to put these program elements into effect.

The list of chemicals that trigger RMP requirements can be found in 40 CFR 68.130; information to determine the required program level also can be found in 40 CFR 68.

Title V permits

Title V requires that all "major sources" (and certain minor sources) obtain an operating permit. Many pulp and paper mills are required to have a Title V permit, and may be required to submit information about emissions, control devices, and the general process at the facility in the permit application. Permits may limit pollutant emissions and impose monitoring, record keeping, and reporting requirements.

Title VI Stratospheric Ozone Protection

Many pulp and paper facilities operate industrial process refrigeration units, such as chillers for chlorine dioxide plants. For those units that utilize ozone-depleting chemicals, such as chlorofluorocarbons (CFCs), facilities are required under Title VI to follow leak repair requirements.

Clean Water Act (CWA)

There are two industry-specific components of the CWA requirements: NPDES permitting and pretreatment programs. Other general CWA requirements, such as those for wetlands and stormwater, may also apply to the pulp and paper mills and are described in Section VI.A.

Individual NPDES requirements have been developed for several subcategories of the industry; they are described in 40 CFR 430. For each of these subcategories, the regulations outline some or all of the following for facilities that discharge wastewater directly to the environment:

- best practicable control technology currently available (BPT) and best conventional control technology (BCT) guidelines for the control of conventional pollutants (biological oxygen demand, total suspended solids, and pH).

- best available technology economically achievable (BAT) guidelines for the control of nonconventional and toxic pollutants (trichlorophenol and pentachlorophenol, which are chemicals used as biocides).

- new source performance standards (NSPS) for the control of conventional, non-conventional, and toxic pollutants from new facilities that discharge directly to the environment.

For facilities that discharge their wastewater to a publicly-owned treatment works (POTW), pretreatment standards may apply. In addition to general standards established by EPA that address all industries, there are Pretreatment Standards for New Sources (PSNS) and Pretreatment Standards for Existing Sources (PSES) that are specific to the pulp and paper industry. These regulate the biocides trichlorophenol and pentachlorophenol, with limits that are specified for each subcategory of the industry.

In 1998, in conjunction with the development of the pulp and paper cluster rule, EPA reorganized the regulations in order to group processes that are similar. Table 19 presents the revised and original subcategory groupings, and summarizes the portions of the CWA regulations that apply. More detail can be found in 40 CFR 430.

Table 19: Applicability of Clean Water Act Requirements

Revised Subpart of 40 CFR 430	Revised Subcategory	Previous Subcategory (Previous Subpart in Parentheses)	Applicable Regulations		
			BAT, PSES, and PSNS	BPT, BCT, NSPS	BMP
A	Dissolving Kraft	Dissolving Kraft (F)	✔	✔	
B	Bleached Papergrade Kraft and Soda[a]	Market Bleached Kraft (G) BCT Bleached Kraft (H) Fine Bleached Kraft (I) Soda (P)	✔	✔	✔
C	Unbleached Kraft	Unbleached Kraft (A) • Linerboard • Bag and Other Products Unbleached Kraft and Semi-Chemical (D, V)	✔	✔	
D	Dissolving Sulfite	Dissolving Sulfite (K) • Nitration • Viscose • Cellophane • Acetate	✔	✔	
E	Papergrade Sulfite[a]	Papergrade Sulfite (J, U) • Blow Pit Wash • Drum Wash	✔	✔	✔
F	Semi-Chemical	Semi-Chemical (B) • Ammonia • Sodium	✔	✔	
G	Mechanical Pulp	Groundwood-Thermo-Mechanical (M) Groundwood-Coarse, Molded, News (N) Groundwood-Fine Papers (O) Groundwood-Chemi-Mechanical (L)		✔	

Table 19: Applicability of Clean Water Act Requirements					
Revised Subpart of 40 CFR 430	**Revised Subcategory**	**Previous Subcategory (Previous Subpart in Parentheses)**	**Applicable Regulations**		
			BAT, PSES, and PSNS	**BPT, BCT, NSPS**	**BMP**
H	Non-Wood Chemical Pulp	Miscellaneous mills not covered by a specific subpart		✔	
I	Secondary Fiber Deink	Deink Secondary Fiber (Q) • Fine Papers • Tissue Papers • Newsprint		✔	
J	Secondary Fiber Non-Deink	Tissue from Wastepaper (T) Paperboard from Wastepaper (E) • Corrugating Medium • Non-Corrugating Medium Wastepaper-Molded Products (W) Builders' Paper and Roofing Felt (40 CFR Part 431 Subpart A)			
K	Fine and Lightweight Papers from Purchased Pulp	Nonintegrated Fine Papers (R) • Wood Fiber Furnish • Cotton Fiber Furnish Nonintegrated Lightweight Papers (X) • Lightweight Papers • Lightweight Electrical Papers		✔	
L	Tissue, Filter, Non-Woven, and Paperboard from Purchased Pulp	Non-Integrated • Tissue Papers (S) • Filter and Non-Woven (Y) • Paperboard (Z)		✔	

Source: U.S. EPA, *Pulp and Paper NESHAP: A Plain English Description,* November, 1998, Pages 7 and 104.

[a]These subcategories are affected by the Cluster Rules (described below).

Cluster Rule

The cluster rule is an integrated, multi-media regulation to control the release of pollutants to two media (air and water) from one industry. The intent of the rule is to allow individual mills in particular segments of the industry to consider all regulatory requirements at one time. This combined rule allows mills to select the best combination of pollution prevention and control technologies that provide the greatest protection to human health and the environment. Because some air requirements that reduce toxic air pollutants also reduce mill wastewater toxic pollutant loadings (and water treatment requirements can reduce air impacts), the combined rules have a synergistic effect.

Some of the features of the coordinated rule include:

- Alternative emission limits
- Varying compliance periods (3-8 years)
- New and existing source controls
- Flexibility for evolving technologies
- Compliance dates coordinated with effluent limitations guidelines and standards

The rule sets new baseline limits for the releases of toxics and nonconventional pollutants to the air and water. There are three significant components:

- **Air Emissions Standards.** New and existing pulp and paper mills must meet air standards to reduce emissions of toxic air pollutants occurring at various points throughout the mills. Specifically, EPA requires mills to capture and treat toxic air pollutant emissions that occur during the cooking, washing, and bleaching stages of the pulp manufacturing process.

- **Water Effluent Limitations Guidelines and Standards.** New and existing standards in the bleached papergrade kraft and soda subcategory and the bleached papergrade sulfite subcategory must meet standards to reduce discharges of toxic and nonconventional pollutants. Specifically, EPA has set effluent limitations for toxic pollutants in the wastewater discharged directly from the bleaching process and in the final discharge from the mills.

- **Analytical Methods for 12 Chlorinated Phenolics and Adsorbable Organic Halides (AOXs)**. Samples of air emissions and water discharges from each mill must be tested using the laboratory methods included in the rule. The new methods will enable more timely and accurate measurements of releases of these pollutants to the environment and will be used to ensure compliance with air emission and water discharge permit limits.

<u>Voluntary Advanced Technology Incentives Program (VATIP)</u>
Mills in the Bleached Papergrade Kraft and Soda Subcategory have additional flexibility under the cluster rule. Mills may comply either with the baseline regulations, or with more stringent wastewater regulations under a more forgiving timetable. This latter arrangement, called the Voluntary Advanced Technology Incentives Program (VATIP), allows mills to undertake customized compliance and pollution reduction plans that further reduce environmental impacts.

Under the VATIP, each participating mill develops "Milestones Plans" for each fiber line that it enrolls in the program. Permit writers will use the Milestones Plan to incorporate enforceable interim requirements into the mill's discharge permit. Specific requirements for the Milestones Plan are found in 40 CFR 430.24(b) and (c), but the three basic components of a Milestones Plan are the following:

- A description of each technology component or process modification the mill intends to implement
- the master schedule showing the sequence of implementing new technologies and process modifications
- descriptions of the anticipated improvements in effluent quality.

Emergency Planning and Community Right-to-Know Act (EPCRA)

Three of the components of EPCRA are directly relevant to the pulp and paper industry:

- Emergency Planning (§302(a)) - Businesses that produce, use or store "hazardous substances" must: 1) submit material safety data sheets or the equivalent, and 2) Tier I/Tier II annual inventory report forms to the appropriate local emergency planning commission. Those handling "extremely hazardous substances" also are required to submit a one-time notice to the state emergency response commission.
- Emergency Notification of Extremely Hazardous Substance Release (§304) - A business that unintentionally releases a reportable quantity of an extremely hazardous substance must report that release to the state emergency planning commission and the local emergency planning commission.
- Release Reporting (§313) - Manufacturing businesses with ten or more employees that manufactured, processed, or otherwise used a listed toxic chemical in excess of the "established threshold" must file annually a Toxic Chemical Release form with EPA and the state. Documentation supporting release estimates must be kept for three years.

Resource Conservation and Recovery Act (RCRA)

The pulp and paper industry generates hazardous wastes, but most are associated with wastewater, which is rendered non-hazardous in wastewater treatment or neutralization units within manufacturing facilities, and therefore is not subject to RCRA requirements. Also, black liquor is exempt as a solid waste if it is reclaimed in a recovery furnace and reused in the pulping process. Therefore, most of the industry's RCRA requirements are those described in the general regulations outlined in Section VI.A.

VI.C. Pending and Proposed Regulatory Requirements

Clean Water Act

Effluent Guidelines and Standards for the Pulp, Paper, and Paperboard Category, Phase II
EPA will consider revising the technology-based effluent limitations guidelines and standards for 8 of the 12 subcategory for this industrial category: Unbleached Kraft; Semi-Chemical; Mechanical Pulp; Non-Wood Chemical Pulp; Secondary Fiber Deink; Secondary Fiber Non-Deink; Fine and Lightweight Papers from Purchased Pulp; and Tissue, Filter, Non-Woven, and Paperboard from Purchased Pulp. EPA proposed guidelines and standards for these subcategories as part of the Pulp and Paper Rules (also known as the Cluster Rules) in December 1993. The Agency intends to develop these revised effluent limitations in close coordination with the Office of Air Quality Planning and Standards. This is a long-term action; no definite schedule had been set at the time of the publication of this document. (Don Anderson, Office of Water, 202-566-1021)

Effluent Guidelines and Standards for the Pulp, Paper, and Paperboard Point Source Category, Dissolving Kraft and Dissolving Sulfite Subcategories (Phase III)
In 1993, EPA proposed revised effluent limitations, guidelines and standards and best management practices regulations for the Dissolving Kraft and Dissolving Sulfite Subcategories (also known as Phase III of the Cluster Rules). There are five mills in these subcategories in the U.S. EPA anticipates that the final rule will set limits for adsorbable organic halides (AOX), chemical oxygen demand (COD), chloroform, dioxin, furan, and 12 specific chlorinated phenolics. The rule is expected to be proposed in mid-2003 and finalized in 2004. (Don Anderson, Office of Water, 202-566-1021)

Minimizing Adverse Environmental Impact from Cooling Water Intake Structures at Existing Facilities Under Section 316(b) of the Clean Water Act, Phase III
This rulemaking affects existing facilities that use cooling water intake structures, and whose intake flow levels exceed a minimum threshold EPA will determine. Pulp and paper manufacturing facilities are explicitly listed as affected facilities. The rule will require that the location, design, construction, and capacity of cooling water intake structures reflect the best

technology available for minimizing adverse environmental impact. The final rule is anticipated before December, 2004. (Deborah Nagle, Office of Water, 202-566-1063 or J.T. Morgan, Office of Water, 202-564-7684)

Clean Air Act

Guidelines for Best Available Retrofit Technology (BART)
As required by the Clean Air Act, EPA issued a regional haze rule aimed at protecting visibility in 156 federal areas. The rule seeks to reduce the visibility impairment caused by many sources over a wide area. The haze rule requires states to establish goals for improving visibility in national parks and wilderness areas and to develop long-term strategies for reducing emissions of air pollutants that impair visibility. Guidelines for BART were proposed to amend the haze rule. The guidelines are for states in developing their plans for setting air pollution limits for utilities and other industrial plants built between 1962 and 1977 that have the potential to emit more than 250 tons a year of visibility impairing pollution. These facilities fall into 26 categories, including pulp mills. Many of these facilities have previously been exempt from federal pollution control requirements under the Clean Air Act. Some of the guidelines may affect emissions from boilers and recover boilers. This proposed rule only provides guidelines for states in developing their implementation plans. In most parts of the country, the plans are due in 2008. (Tim Smith, Office of Air and Radiation, 919-541-4718)

Interstate Ozone Transport, NOX State Implementation Plan Call (NOX SIP Call)

EPA has issued several actions and rulemakings related to reducing the regional transport of ozone, including the final Regional Transport of Ozone Rule ("NOx SIP call") requiring 22 eastern States and the District of Columbia to submit State Implementation Plans that address the regional transport of ground-level ozone through reductions in nitrogen oxides (a precursor to ozone). While most of the NOx SIP call was upheld, certain aspects of EPA's plan were remanded by court decisions, including a definition dealing with industrial boilers and cogeneration. In February of 2002, EPA proposed rules on a number of remanded items, including rules for certain industrial boilers that may be present at pulp and paper mills. EPA's NOx SIP call potentially affects industrial boilers that burn at least 50 percent fossil fuels. However, states are free to develop plans for reducing nitrogen oxides at sources other than industrial boilers or at industrial boilers that burn less than 50 percent fossil fuels. Pulp and paper mills in the eastern states should monitor their state implementation plans. Implementation of state plans will likely begin in 2003 in some States or 2004 for other States. (Kevin Culligan, Office of Air and Radiation, 202-564-9172)

VII. COMPLIANCE AND ENFORCEMENT HISTORY

Background

Until recently, EPA has focused much of its attention on easuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. Compliance and enforcement records from EPA's data systems are compiled to the facility level using the Facility Registry System's (FRS) Master Source ID, which links records from virtually any of EPA's data systems to a facility record. For each facility (i.e., Master Source ID), the Industry Sector Notebooks analysis uses the facility-level SIC code that is designated by IDEA, which can be described as follows:

1. If the facility reports to TRI, then the designated SIC code is the primary SIC reported in the most recent TRI reporting year.

2. If the facility does not report to TRI, the first SIC codes from all linked AFS, PCS, RCRAInfo, BRS ID/permits are assembled. If more than one permit/ID exists for a particular program then only one record from that data system is used. The SIC code that occurs most often, if there is one,

becomes the designated SIC code.

3. If the facility does not report to TRI and no SIC code occurs more often than others, the designated SIC code is chosen from the linked programs in the following order: AFS, PCS, BRS, RCR, NCD, DCK. If more than one permit/ID exists for a particular program then only one record from that data system is used.

Note that EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the information presented in this section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections or enforcement actions, and solely reflect EPA, state and local compliance assurance activity that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (September 16, 1997 to September 15, 2002) and the other for the most recent 24-month period (September 16, 2000 to September 15, 2002). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are state/local or EPA-led. However, the table breaking down the universe of violations does give the reader a general measurement of the EPA's and states' efforts within each media program. The presented data illustrate the variations across Regions for certain sectors.[3] This variation may be attributable to state/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data

[3] EPA Regions include the following states: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IA, KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); X (AK, ID, OR, WA).

do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Registry System (FRS) -- this system assigns a common Master Source ID to EPA single-media permit records. The Master Source ID allows EPA to compile and review all permit, compliance, enforcement and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FRS maintained Master Source ID identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRAInfo (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the number of the FRS maintained Master Source IDs that were designated to the listed SIC code range. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected -- indicates the level of EPA and state agency inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 24- or 60- month period.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into federal and state actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with three enforcement actions counts as one). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with three enforcement actions counts as three).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by state and local environmental agencies. Varying levels of use by states of EPA data systems may limit the volume of actions accorded state enforcement activity. Some states extensively report enforcement activities into EPA data systems, while other states may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the United States Environmental Protection Agency. This value includes referrals from state agencies. Many of these actions result from coordinated or joint state/federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Reported inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

VII.A. Pulp and Paper Industry Compliance History

Table 20 provides an overview of the reported compliance and enforcement data for the pulp and paper industry over the past five years (September 16, 1997 to September 15, 2002). These data are also broken out by EPA Region thereby permitting geographical comparisons. A few points evident from the data are listed below.

- Regions 5, 4 and 1 contain the most pulp and paper facilities, while Regions 4, 6, and 3 conducted the most inspections.

- Region 4 conducted, by far, the most inspections of pulp and paper facilities, had the lowest average time between inspections, and had the most enforcement actions.

- Regions 2 and 10 had the most enforcement actions per inspection (0.19 and 0.13, respectively).

Table 20: Five-Year Enforcement and Compliance Summary for the Pulp and Paper Industry, by Region

A	B	C	D	E	F	G	H	I	J
Region	**Facilities In Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Enforcement Actions**	**Percent of State Lead Actions**	**Percent of Federal Lead Actions**	**Enforcement to Inspection Rate**
National	585	495	6,383	5	332	503	85%	15%	0.08
1	92	73	571	10	38	37	95%	5%	0.06
2	71	57	383	11	34	73	96%	4%	0.19
3	57	47	899	4	26	77	77%	23%	0.09
4	105	96	2,024	3	90	116	91%	9%	0.06
5	144	120	721	12	48	44	70%	30%	0.06
6	45	40	944	3	32	56	70%	30%	0.06
7	7	7	33	13	2	1	100%	0%	0.03
8	2	2	3	40	0	0	0%	0%	0
9	22	18	140	9	16	12	100%	0%	0.09
10	37	32	537	4	40	72	94%	6%	0.13

VII.B. Comparison of Enforcement Activity Between Selected Industries

Tables 21 and 22 allow the compliance history of the pulp and paper sector to be compared to the other industries covered by the industry sector notebooks. Comparisons between Tables 21 and 22 permit the identification of trends in compliance and enforcement records of the industry by comparing data covering the last five years to that of the past two years. Some points evident from the data are listed below.

- Pulp and paper mills are tied with petroleum refineries as the most frequently inspected sectors of those listed.

- Pulp and paper mills have a relatively high percent of facilities with violations and enforcement actions and a relatively high rate of enforcement per inspection compared to the other sectors listed.

Tables 23 and 24 provide a more in-depth comparison between the pulp and paper industry and other sectors by breaking out the compliance and enforcement data by environmental statute. As in the previous Tables (Tables 21 and 22), the data cover the last five years (Table 23) and the last two years (Table 24) to facilitate the identification of recent trends. Two points evident from the data are listed below.

- The majority of inspections and actions are conducted under the CAA, followed by the CWA.

- In the past 2 years, the portion of actions taken under the CAA is increasing, while that taken under the CWA is decreasing.

- The pulp and paper industry has one of the lowest percentages of RCRA inspections and actions of those sectors listed.

Table 21: Five-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	**Facilities in Search**	**Facilities Inspected**	**Number of Inspections**	**Average Months Between Inspections**	**Facilities with 1 or More Enforcement Actions**	**Total Closed Enforcement Actions**	**Percent State Lead Actions**	**Percent Federal Lead Actions**	**Enforcement to Inspection Rate**
Agricultural Crop Production	146	73	164	53	10	5	60%	40%	0.03
Agricultural Livestock Production	71	30	114	37	8	6	33%	67%	0.05
Metal Mining	293	188	1,003	18	58	60	82%	18%	0.06
Oil and Gas Extraction	2,675	1,620	6,386	25	794	640	94%	6%	0.1
Non-Fuel, Non-Metal Mining	3,771	2,193	10,806	21	532	548	94%	6%	0.05
Textiles	1,284	911	4,002	19	278	271	86%	14%	0.07
Lumber and Wood	3,260	2,181	11,336	17	834	759	85%	15%	0.07
Wood Furniture and Fixtures	1,746	1,166	5,822	18	386	314	86%	14%	0.05
Pulp and Paper	**585**	**495**	**6,383**	**5**	**332**	**503**	**85%**	**15%**	**0.08**
Printing	2,445	1,589	5,100	29	434	378	87%	13%	0.07
Inorganic Chemicals	1,092	700	5,654	12	386	421	74%	26%	0.07
Plastic Resins and Fibers	779	545	4,964	9	320	429	84%	16%	0.09
Pharmaceuticals	628	463	2,605	14	204	215	78%	22%	0.08
Organic Chemicals	1,107	832	8,839	8	574	811	72%	28%	0.09
Ag. Chem., Pesticide & Fertilizer	674	375	2,290	18	218	160	52%	48%	0.07
Petroleum Refining	476	324	6,238	5	348	1,153	70%	31%	0.18
Rubber and Plastic	3,870	2,313	8,651	27	834	685	88%	12%	0.08
Stone, Clay, Glass and Concrete	3,625	2,214	13,144	17	838	933	90%	10%	0.07
Iron and Steel	704	517	7,285	6	320	493	72%	28%	0.07
Metal Castings	1,383	822	3,728	22	338	343	78%	22%	0.09
Nonferrous Metals	561	358	3,340	10	258	446	89%	11%	0.13
Metal Products	8,426	5,268	16,959	30	1,982	1,593	75%	25%	0.09
Electronics and Computers	1,663	925	2,670	37	296	220	74%	26%	0.08
Motor Vehicle Assembly	1,880	1,247	5,340	21	424	381	82%	18%	0.07
Aerospace	791	549	2,756	17	258	239	62%	38%	0.09
Shipbuilding and Repair	230	171	859	16	100	110	74%	26%	0.13
Ground Transportation	4,991	3,316	13,160	23	796	662	0%	0%	0.05
Water Transportation	263	166	406	39	42	33	82%	18%	0.08
Air Transportation	436	242	669	39	72	65	74%	26%	0.1
Fossil Fuel Electric Power Generation	3,295	2,335	18,122	11	1,062	1,346	83%	17%	0.07
Dry Cleaning	3,390	1,851	3,469	59	210	141	91%	9%	0.04

** Transportation equipment cleaning sector not included because sector is not classified by SIC code and no compliance data are available.*

Table 22: Two-Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E		F		G	H
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities with 1 or More Violations		Facilities with 1 or more Enforcement Actions		Total Closed Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Agricultural Crop Production	146	38	65	10	26%	2	5%	1	0.02
Agricultural Livestock Production	71	8	16	6	75%	6	75%	5	0.31
Metal Mining	293	124	290	74	60%	28	23%	23	0.08
Oil and Gas Extraction	2,675	931	2,135	363	39%	546	59%	352	0.16
Non-Fuel, Non-Metal Mining	3,771	1,340	3,389	328	24%	234	17%	204	0.06
Textiles	1,284	630	1,256	220	35%	174	28%	145	0.12
Lumber and Wood	3,260	1,467	3,714	580	40%	380	26%	328	0.09
Wood Furniture and Fixtures	1,746	752	1,916	316	42%	182	24%	139	0.07
Pulp and Paper	**585**	**379**	**1,837**	**238**	**63%**	**158**	**42%**	**185**	**0.1**
Printing	2,445	855	1,699	359	42%	234	27%	162	0.1
Inorganic Chemicals	1,092	473	1,793	242	51%	172	36%	141	0.08
Plastic Resins and Fibers	779	411	1,652	215	52%	164	40%	161	0.1
Pharmaceuticals	628	288	828	155	54%	76	26%	62	0.07
Organic Chemicals	1,107	599	2,782	365	61%	264	44%	261	0.09
Agricultural Chemical Pesticide & Fertilizer	674	232	734	108	47%	60	26%	37	0.05
Petroleum Refining	476	240	1,738	191	80%	224	93%	447	0.26
Rubber and Plastic	3,870	1,443	2,992	641	44%	408	28%	313	0.1
Stone, Clay, Glass and Concrete	3,625	1,488	4,254	496	33%	388	26%	351	0.08
Iron and Steel	704	373	2,201	250	67%	144	39%	149	0.07
Metal Castings	1,383	495	1,153	302	61%	180	36%	172	0.15
Nonferrous Metals	561	223	965	150	67%	118	53%	159	0.16
Metal Products	8,426	2,908	5,704	1728	59%	884	30%	588	0.1
Electronics and Computers	1,663	469	862	320	68%	140	30%	86	0.1
Motor Vehicle Assembly	1,880	816	1,897	410	50%	218	27%	167	0.09
Aerospace	791	329	854	179	54%	96	29%	69	0.08
Shipbuilding and Repair	230	100	295	63	63%	48	48%	35	0.12
Ground Transportation	4,991	2,059	4,696	490	24%	458	22%	327	0.07
Water Transportation	263	81	126	31	38%	6	7%	4	0.03
Air Transportation	436	112	216	52	46%	32	29%	18	0.08
Fossil Fuel Electric Power Generation	3,295	1,810	6,355	701	39%	520	29%	493	0.08
Dry Cleaning	3,390	785	1,212	238	30%	74	9%	50	0.04

**Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.*
Transportation equipment cleaning sector not included because sector is not classified by SIC code and no compliance data are available.

Table 23: Five-Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Facilities Inspected	Total Inspections	Total Closed Enforcement Actions	Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Agricultural Crop Production	73	164	5	61%	40%	0%	0%	36%	20%	3%	40%
Agricultural Livestock Production	30	114	6	48%	50%	0%	17%	49%	17%	3%	17%
Metal Mining	188	1,003	60	61%	52%	26%	43%	13%	3%	1%	2%
Oil and Gas Extraction	1,620	6,386	640	96%	93%	0%	1%	4%	6%	0%	0%
Non-Fuel, Non-Metal Mining	2,193	10,806	548	97%	98%	1%	1%	1%	1%	0%	0%
Textiles	911	4,002	271	74%	56%	13%	27%	13%	13%	1%	4%
Lumber and Wood	2,181	11,336	759	77%	73%	1%	2%	22%	24%	1%	2%
Wood Furniture and Fixtures	1,166	5,822	314	75%	74%	0%	1%	24%	24%	1%	1%
Pulp and Paper	**495**	**6,383**	**503**	**68%**	**73%**	**24%**	**20%**	**7%**	**5%**	**1%**	**2%**
Printing	1,589	5,100	378	65%	66%	0%	0%	35%	32%	1%	2%
Inorganic Chemicals	700	5,654	421	50%	50%	12%	13%	36%	28%	2%	10%
Plastic Resins and Fibers	545	4,964	429	51%	55%	19%	22%	29%	21%	2%	3%
Pharmaceuticals	463	2,605	215	48%	46%	6%	8%	44%	36%	2%	10%
Organic Chemicals	832	8,839	811	48%	48%	12%	15%	38%	30%	3%	7%
Agricultural Chemical Pesticide & Fertilizer	375	2,290	160	57%	31%	12%	9%	26%	21%	5%	39%
Petroleum Refining	324	6,238	1,153	63%	79%	12%	8%	24%	12%	1%	1%
Rubber and Plastic	2,313	8,651	685	69%	69%	1%	1%	29%	24%	1%	6%
Stone, Clay, Glass and Concrete	2,214	13,144	933	86%	87%	1%	1%	12%	10%	1%	2%
Iron and Steel	517	7,285	493	66%	62%	11%	14%	23%	21%	0%	3%
Metal Castings	822	3,728	343	64%	60%	2%	3%	33%	33%	1%	5%
Nonferrous Metals	358	3,340	446	65%	68%	7%	8%	27%	22%	1%	2%
Metal Products	5,268	16,959	1,593	45%	41%	2%	2%	52%	51%	1%	7%
Electronics and Computers	925	2,670	220	34%	16%	4%	4%	60%	67%	2%	13%
Motor Vehicle Assembly	1,247	5,340	381	61%	59%	1%	1%	37%	36%	0%	4%
Aerospace	549	2,756	239	48%	36%	3%	3%	48%	57%	0%	3%
Shipbuilding and Repair	171	859	110	58%	30%	5%	9%	36%	61%	1%	0%
Ground Transportation	3,316	13,160	662	78%	0%	1%	0%	21%	0%	0%	0%
Water Transportation	166	406	33	40%	33%	2%	0%	57%	67%	1%	0%
Air Transportation	242	669	65	31%	28%	2%	5%	67%	66%	0%	2%
Fossil Fuel Electric Power Generation	2,335	18,122	1,346	75%	85%	19%	9%	5%	4%	1%	2%
Dry Cleaning	1,851	3,469	141	36%	20%	0%	0%	64%	80%	0%	0%

* *Transportation equipment cleaning sector not included because sector is not classified by SIC code and no compliance data are available.*

Table 24: Two-Year Inspection and Enforcement Summary by Statute for Selected Industries

				Clean Air Act		Clean Water Act		RCRA		FIFRA/TSCA/ EPCRA/Other	
Industry Sector	Facilities Inspected	Total Inspections	Total Closed Enforcement Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Agricultural Crop Production	38	65	1	59%	100%	0%	0%	37%	0%	5%	0%
Agricultural Livestock Production	8	16	5	81%	60%	0%	20%	19%	0%	0%	20%
Metal Mining	124	290	23	46%	61%	35%	39%	19%	0%	0%	0%
Oil and Gas Extraction	931	2,135	352	97%	97%	0%	1%	3%	2%	0%	0%
Non-Fuel, Non-Metal Mining	1,340	3,389	204	97%	99%	1%	1%	2%	1%	0%	1%
Textiles	630	1,256	145	71%	61%	16%	22%	13%	13%	0%	3%
Lumber and Wood	1,467	3,714	328	75%	75%	1%	1%	24%	22%	0%	2%
Wood Furniture and Fixtures	752	1,916	139	75%	85%	0%	0%	25%	14%	0%	1%
Pulp and Paper	**379**	**1,837**	**185**	**64%**	**81%**	**28%**	**13%**	**7%**	**4%**	**0%**	**1%**
Printing	855	1,699	162	64%	0%	0%	0%	35%	0%	1%	0%
Inorganic Chemicals	473	1,793	141	44%	56%	14%	12%	42%	25%	0%	7%
Plastic Resins and Fibers	411	1,652	161	50%	65%	21%	14%	29%	19%	0%	2%
Pharmaceuticals	288	828	62	44%	45%	7%	11%	49%	37%	0%	6%
Organic Chemicals	599	2,782	261	43%	52%	14%	13%	40%	31%	2%	4%
Agricultural Chemical Pesticide & Fertilizer	232	734	37	51%	38%	13%	14%	33%	24%	3%	24%
Petroleum Refining	240	1,738	447	52%	83%	16%	6%	32%	10%	0%	1%
Rubber and Plastic	1,443	2,992	313	69%	79%	2%	0%	29%	20%	0%	2%
Stone, Clay, Glass and Concrete	1,488	4,254	351	86%	85%	2%	2%	12%	10%	0%	2%
Iron and Steel	373	2,201	149	60%	70%	13%	9%	27%	17%	0%	4%
Metal Castings	495	1,153	172	58%	60%	3%	2%	38%	33%	0%	4%
Nonferrous Metals	223	965	159	59%	80%	8%	3%	32%	16%	0%	2%
Metal Products	2,908	5,704	588	43%	46%	3%	1%	54%	43%	0%	9%
Electronics and Computers	469	862	86	30%	12%	5%	5%	65%	63%	1%	21%
Motor Vehicle Assembly	816	1,897	167	57%	63%	2%	1%	41%	32%	0%	5%
Aerospace	329	854	69	46%	44%	4%	0%	50%	51%	0%	6%
Shipbuilding and Repair	100	295	35	59%	37%	6%	11%	35%	51%	0%	0%
Ground Transportation	2,059	4,696	327	75%	0%	1%	0%	24%	0%	0%	0%
Water Transportation	81	126	4	43%	50%	2%	0%	56%	50%	0%	0%
Air Transportation	112	216	18	29%	39%	1%	0%	69%	56%	0%	6%
Fossil Fuel Electric Power Generation	1,810	6,355	493	73%	87%	21%	8%	6%	3%	0%	2%
Dry Cleaning	785	1,212	50	37%	6%	0%	0%	63%	94%	0%	0%

** Transportation equipment cleaning sector not included because sector is not classified by SIC code and no compliance data are available.*

Sector Facility Indexing Project -- Additional compliance information for the pulp and paper industry is available through EPA's Sector Facility Indexing Project (SFIP). This is a website that brings together environmental and other information from a number of data systems to produce facility-level profiles for five industry sectors (pulp manufacturing, petroleum refining, iron and steel production, primary nonferrous metal refining and smelting, and automobile assembly) and a subset of major federal facilities. SFIP information relates to compliance and inspection history, chemical releases and spills, demographics of the surrounding population and production. (Contact: SFIP hotline at 617-520-3015 or the website at http://www.epa.gov/sfipmtn1/)

VII.C. Review of Major Legal Actions

This section provides summary information about major cases that have affected this sector, and a list of Supplementary Environmental Projects (SEPs). SEPs are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

This section discusses major legal cases and pending litigation within the pulp and paper industry as well as supplemental environmental projects (SEPs) involving pulp and paper facilities. Information regarding major cases or pending litigation is available from the Office of Regulatory Enforcement.

VII.C.1. Review of Major Cases

In FY 1999 and FY 2000, three significant enforcement cases affecting the pulp and paper industry were concluded.

Potlatch Corporation. A Clean Air Act settlement was reached with the Potlatch Corporation of Lewiston, ID. From 1991 to 1996, Potlatch burned used tires in the boiler at its Lewiston, Idaho, pulp mill plant. In 1997, EPA issued Potlatch a Notice of Violation alleging that the burning of tires resulted in sulfur dioxide emissions that exceeded limits in a Clean Air Act permit issued by EPA in 1980 and also exceeded limits in a permit issued by the State in 1979. The notice also alleged that the switch to burning tires was the type of change that required Potlatch to first obtain a permit under the Clean Air Act's Prevention of Significant Deterioration preconstruction review program. Following issuance of the Notice of Violation, settlement negotiations took place and an agreement was reached to settle the violations described in the notice by payment of a $500,000 civil penalty. Potlatch has the option of burning tires if it obtains a permit and installs the required pollution control devices, but has elected not to do so.

Crane & Co., Inc. Crane & Co., Inc. ("Crane"), of Dalton, MA operates as a manufacturer and distributor of high quality specialty paper for the securities, legal, banking and business markets. This family owned and run company is nearly 200 years old, and has successfully held a currency paper contract with the U.S. Department of Treasury for 121 years. EPA's civil administrative complaint under the Emergency Planning and Community Right to Know Act (EPCRA) focused on violations found at three of Crane's facilities in Dalton and Pittsfield, MA.

Since calendar year 1994, Crane failed to file chemical inventory information (Tier II forms) for three of its manufacturing facilities with the State Emergency Response Commission (SERC), Local Emergency Planning Committee (LEPC) or local fire departments, as required by Section 312 of EPCRA. In total, Crane failed to report 28 chemicals, including sulfuric acid and formaldehyde (a component of melamine resin), which EPCRA classifies as Extremely Hazardous Substances.

By the terms of the September 2000 settlement of this action, Crane will pay a penalty of $8,164 and perform a supplemental environmental project (SEP) estimated to cost between $26,832 and $100,000. The SEP consists of replacing sodium hypochlorite as a bleaching agent in the non-wood pulp paper-making processes at the Pioneer Mill in Dalton with a 50 percent hydrogen peroxide solution. Use of peroxide bleaching will reduce human and environmental exposure to residual chlorine and chlorite ions that result from use of sodium hypochlorite. In addition, replacement of sodium hypochlorite with hydrogen peroxide will eliminate potential exposure of first responders and on-site workers to chlorine gas, which can be created if sodium hypochlorite is improperly mixed, used, or stored. Finally, discontinuing the use of sodium hypochlorite will reduce the environmental threat posed by discharging chlorinated organic compounds into the receiving waters of the Housatonic River.

Appleton Papers. Appleton Papers in Roaring Spring, Pennsylvania produces pulp using the kraft process and paper using mechanical paper machines. Initially EPA issued a compliance order to Appleton requiring the initial performance test of the brown stock washer system and installation of the continuous emission monitoring system (CEMS) required by the NSPS of the Clean Air Act. These violations were subsequently referred to the Department of Justice on 12/30/98, and a Notice of Violation was issued to Appleton on 4/19/99. Following a series of negotiations, EPA and Appleton reached a settlement which provided for a cash penalty of $490,000 and early compliance with the Pulp and Paper MACT. The penalty reflects the avoided costs of installation of Total Reduced Sulfur CEMS, as well as the company's adherence to EPA's initial compliance order. The Consent Decree was lodged August 16, 2000.

VII.C.2. Supplementary Environmental Projects

SEPs are compliance agreements that reduce a facility's non-compliance penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can reduce the future pollutant loadings of a facility. Information on SEP cases can be accessed via the Internet at http://www.epa.gov/compliance/resources/policies/civil/seps/index.html.

Table 25 presents nine examples of SEPs negotiated with pulp and paper facilities.

Six of the cases were associated with EPCRA – most relate to a failure to notify community and state emergency coordinators of a hazardous substance release (§304), a violation of emergency and hazardous chemical inventory form requirements (§312), or a violation of toxic chemical release form requirements (§313). In addition, there were multiple cases involving a violation of permit requirements for treatment, storage, or disposal of hazardous waste (RCRA §3005).

There were three general types of SEPs seen within the pulp and paper settlements:

- Three of the SEPs involve **emergency planning and response**. In each case, the defendants purchased equipment for local emergency response authorities.
- Five SEPs provide a form of **pollution reduction**. These were facility-specific, but generally involved the replacement of equipment that is more efficient or less prone to environmental releases.
- Two SEPs involve **pollution prevention**. These projects involved the installation of technologies that reuse process waste.

Table 25: FY-1996-1999 Supplemental Environmental Projects Overview: Pulp and Paper Manufacture

General Information				Violation Information			Supplemental Environmental Project Information	
FY	Docket #	Company Name	State/ Region	Type	Assessed Penalty	SEP Cost to Company	SEP Category	SEP Description
1999	04-1999-0052	Champion International Corporation	AL	EPCRA 312	$2,680	$10,720	Emergency Planning and Preparedness	Improve emergency notification to public by purchasing dictaphone and 16-channel recorder
1998	10-1997-0163	Longview Fibre Company	WA	EPCRA 304, 325	$8,539	$30,738	Emergency Planning and Preparedness	Purchase emergency response equipment for Cowlitz County Emergency Responders Project
1998	06-1998-0074	Nicolaus Paper, Inc.	LA	RCRA 3005	$2,450	$31,910	Pollution Prevention	Implement fiber and chemical recovery system that reduces fiber and chemical loss from manufacturing process.
1998	10-1997-0107	Weyerhaeuser Company	WA	EPCRA 304, 325	$400,000		Emergency Planning and Preparedness	Donate emergency equipment for five counties at a cost of $285,000 and $10,000 for weather web page.
1997	10-94-0197	Ketchikan Pulp Company	AK	CAA 165	$359,000	$2,200,000	Pollution Prevention, Pollution Reduction	Shut down and dismantle wood waste incinerator and install wood-fired boiler with electrified fluidized bed (EFB) as control device.
1997	10-96-0087	Smurfit Newsprint Corporation	OR	EPCRA 313	$5,602	$159,514	Pollution Reduction	Construct containment dams to capture and treat spills entering Willamette River.
1996	01-94-0008	Crown Paper Co./James River Paper Co.	NH	CERCLA 103 CWA 101 CWA 307 EPCRA 304 RCRA 3005	$200,000	$460,000	Pollution Reduction	Capture total reduced sulfur (TRS) gases from pump station for incineration.
1996	02-95-0165	Little Rapids Corp.	NY	TSCA 6(e)	$6,500	$44,972	Pollution Reduction	Remove, replace, and dispose of 2 PCB transformers, 1 PCB-contaminated transformer.
1996	01-95-0103	Simkins Industries	CT	EPCRA 313	$13,600	$50,000	Pollution Reduction	Removal, disposal, and replacement of 1950's PCB transformer at the New Haven Board Mill and a non-PCB transformer.

VIII. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook contains a listing and description of national and regional trade associations.

VIII.A. Sector-Related Environmental Programs and Activities

National Environmental Performance Track

EPA's National Environmental Performance Track Program is designed to motivate and reward top environmental performance. By encouraging a systematic approach to managing environmental responsibilities, taking extra steps to reduce and prevent pollution, and being good corporate neighbors, the program is rewarding companies that strive for environmental excellence. At the same time, many participating companies are finding that they are saving money and improving productivity. Five pulp and paper mills are participating in the program. (Contact: Performance Track hotline at 888-339-PTRK or the website at *www.epa.gov/performancetrack/*.)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection and the manufacturing and purchase of recycled products. As of 2001, the program had about 1,175 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. Twenty one pulp and paper companies are partners. (Contact: Jeff Tumarkin at EPA's Office of Solid Waste and Emergency Response at 703-308-8686 or Tumarkin.Jeff@epa.gov, or the WasteWi$e Hotline at 800-EPA-WISE (372-9473) or *www.epa.gov/wastewise*.)

Project XL

Project XL, which stands for "eXcellence and Leadership," is a national pilot program that allows state and local governments, businesses and federal facilities to develop with EPA innovative strategies to test better or more cost-effective ways of achieving environmental and public health protection. In exchange, EPA will issue regulatory, program, policy, or procedural flexibilities to conduct the experiment. Under Project XL private businesses, federal facilities, business sectors and state and local governments are conducting experiments that address the following eight Project XL selection criteria:

1. produce superior environmental results beyond those that would have been achieved under current and reasonably anticipated future regulations or policies

2. produce benefits such as cost savings, paperwork reduction, regulatory flexibility or other types of flexibility that serve as an incentive to both project sponsors and regulators

3. supported by stakeholders

4. achieve innovation/pollution prevention

5. produce lessons or data that are transferable to other facilities

6. demonstrate feasibility

7. establish accountability through agreed upon methods of monitoring, reporting, and evaluations

8. avoid shifting the risk burden, i.e., do not create worker safety or environmental justice problems as a result of the experiment.

By 2002, three pulp and paper companies (Georgia-Pacific, International Paper, and Weyerhaeuser) had undertaken projects under Project XL. (For more information, contact Adam Levitan in the Office of Reinvention Programs at 202-566-1466 or levitan.adam@epa.gov, or the website at www.epa.gov/projectxl/.)

Energy Star

In 1991, EPA introduced Green Lights®, a program designed for businesses and organizations to proactively combat pollution by installing energy efficient lighting technologies in their commercial and industrial buildings. In April 1995, Green Lights® expanded into Energy Star® Buildings— a strategy that optimizes whole-building energy-efficiency opportunities. The energy needed to run commercial and industrial buildings in the United States produces 19 percent of U.S. carbon dioxide emissions, 12 percent of nitrogen oxides, and 25 percent of sulfur dioxide, at a cost of $110 billion a year. If implemented in every U.S. commercial and industrial building, the Energy Star® Buildings upgrade approach could prevent up to 35 percent of the emissions associated with these buildings and cut the nation's energy bill by up to $25 billion annually.

The more than 7,000 participants include corporations, small businesses, universities, health care facilities, nonprofit organizations, school districts, and federal and local governments. Energy Star has successfully delivered energy and cost savings across the country, saving businesses, organizations, and consumers more than $5 billion a year. Over the past decade, Energy Star has been a driving force behind the more widespread use of such technological innovations as LED traffic lights, efficient fluorescent lighting, power management systems for office equipment, and low standby energy use.

Manufacturers can become partners in Energy Star by pledging to undertake the following steps:

1. Measure, track, and benchmark their organization's energy performance by using tools such as those offered by Energy Star
2. Develop and implement a plan to improve energy performance in their facilities and operations by adopting the strategy provided by Energy Star
3. Educate their staff and the public about our partnership with Energy Star, and highlight our achievements with the Energy Star label, where available.

(Contact: Energy Star Hotline, 1-888-STAR-YES (1-888-782-7937) or http://www.energystar.gov/default.shtml.)

NICE^3

The U.S. Department of Energy administers a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the chemicals, agriculture, aluminum, pulp and paper, glass, metal casting, mining, petroleum, and steel industries. (Contact: DOE's Golden Field Office 303-275-4728, or see the website at *www.oit.doe.gov/nice3*.)

EPA Audit Policy

The U.S. Environmental Protection Agency (EPA) encourages companies with multiple facilities to take advantage of the Agency's Audit Policy (Incentives for Self-Policing: Discovery, Disclosure, Correction and Prevention of Violations, 65 Fed. Reg. 19618 (April 11, 2000)) to conduct audits and develop environmental compliance systems. The Audit Policy eliminates gravity-based penalties for companies that voluntarily discover, promptly disclose and expeditiously correct violations of federal environmental law. More information on EPA's Audit Policy can be obtained from the Web site at: http://www.epa.gov/compliance/resources/policies/ incentives/ auditing/index.html.

Small Business Compliance Policy

The Small Business Compliance Policy promotes environmental compliance among small businesses (those with 100 or fewer employees) by providing incentives to discover and correct environmental problems. EPA will eliminate or significantly reduce penalties for small businesses that voluntarily discover violations of environmental law and promptly disclose and correct them. A wide range of resources are available to help small businesses learn about environmental compliance and take advantage of the Small Business Compliance Policy. These resources include: training, checklists, compliance guides, mentoring programs, and other activities. Businesses can find more information through links on the Web site: http://www.epa.gov/smallbusiness/.

Compliance Assistance Clearinghouse

The National Environmental Compliance Assistance Clearinghouse is a Web-based clearinghouse designed to provide quick access to compliance assistance tools, contacts, and planned activities across EPA and other compliance assistance providers. The Clearinghouse also serves as a forum to collaborate and exchange information. The Clearinghouse provides links to compliance assistance activities, tools, or technical assistance that: 1) assist the regulated community in understanding and complying with environmental regulations; or 2) assist compliance assistance providers in helping the regulated community to comply with environmental regulations. The Clearinghouse Web site is http://www.epa.gov/clearinghouse/.

VIII.B. Trade Association/Industry Sponsored Activities

VIII.B.1. Environmental Programs

Global Environmental Management Initiative

The Global Environmental Management Initiative (GEMI) is made up of group of leading companies dedicated to fostering environmental excellence by business. GEMI promotes a worldwide business ethic for environmental management and sustainable development, to improve the environmental performance of business through example and leadership. In 2001, GEMI's membership consisted of about 40 major corporations including the pulp and paper company Georgia-Pacific. (Contact: GEMI at 202-296-7449 or see the website at: www.gemi.org.)

ISO 14000

ISO 14000 is a series of internationally-accepted standards for environmental management. The series includes standards for environmental management systems (EMS), guidelines on conducting EMS audits, standards for auditor qualifications, and standards and guidance for conducting product lifecycle analysis. Standards for auditing and EMS were adopted in September 1996, while other elements of the ISO 14000 series are currently in draft form. While regulations and levels of environmental control vary from country to country, ISO 14000 attempts to provide a common standard for environmental management. The governing body for ISO 14000 is the International Organization for Standardization (ISO), a worldwide federation of over 110 country members based in Geneva, Switzerland. The American National Standards Institute (ANSI) is the United States representative to ISO. Information on ISO is available at the following Internet site: http://www.iso.ch/iso/en/ISOOnline.openerpage.

50 Percent Paper Recovery Goal

At the beginning of this decade, the U.S. paper industry made an unprecedented public commitment to expand paper recovery and recycling by establishing a goal to recover 40 percent of all the paper Americans used in 1995. That program involved a wide array of tools to encourage efficient paper recovery as well as a major financial commitment by U.S. papermakers to expand recycling capacity at their mills. The public-private partnership that evolved proved enormously successful: the industry's goal was achieved a year ahead of schedule.

Given the success of this initiative, the industry, through its trade association, the American Forest & Paper Association, established a new goal to recover 50 percent of all the paper Americans use and to continue its work to promote efficient paper recovery programs. By 2000, the U.S. paper recovery rate was 48 percent. (Contact: AF&PA at 202-463-2700 or see the website at www.afandpa.org.)

100% Recycled Paperboard Alliance

The 100% Recycled Paperboard Alliance (RPA-100%) is a group of leading North American recycled paperboard manufacturers representing nearly two-thirds of the recycled paperboard industry, and a sponsor of America Recycles Day.

RPA-100% encourages packaged goods and companies to use 100% recycled paperboard and educates consumers about the importance of buying recycled. Almost fifty companies have joined a new intiative from the 100% Recycled Paperboard Alliance, displaying the "100% Recycled Paperboard" symbol on their brand name and private label products. (Contact: 100% Recycled Paperboard Alliance at 877-772-6200 or see the website at www.rpa100.com.)

Agenda 2020

In 1994, the American Forest and Paper Association joined with the U.S. Department of Energy to launch Agenda 2020, an innovative, collaborative research program. Through Agenda 2020, a consortium of research institutions, industry, and national laboratories is developing new technologies, processes and measurements to manufacture products more efficiently and cost-effectively while reducing environmental impacts of operations and maximizing the efficient use and reuse of resources.

To meet these objectives, Agenda 2020 has identified six technology focus areas for collaborative research efforts. These six task groups represent a broad cross section of the forest products industry:

1. Sustainable Forest Management
2. Environmental Performance
3. Energy Performance
4. Improved Capital Effectiveness
5. Recycling
6. Sensors and Controls

Particularly noteworthy is the effort within the Agenda 2020 partnership to develop biomass gasification technologies. If fully commercialized, these technologies could make the U.S. forest products industry totally energy self-reliant and generate a surplus of 22 gigawatts of power to the grid—the equivalent of one-half of California's peak summertime electric use. The carbon displacement from biomass gasification could be even more dramatic, transforming the industry from *emitting* 24 million tons of carbon each year to *displacing* at least 18 million tons of greenhouse gas from fossil fuels – before taking into consideration the carbon sequestration benefits of forests.

Black liquor (see Section III for a description) is one biomass fuel created during the chemical pulping process. Gasification converts these pulping extractives and other forms of biomass into combustible gases that can be efficiently burned like natural gas. If fully commercialized, these technologies could produce enormous energy and environmental benefits. The first commercial-scale biomass (black liquor) plant is being built by Georgia-Pacific Corp. in Big Island, VA. It is slated to go on-line in 2003. Other commercialization tests will continue over the next 10 years, if adequately funded. Industry participants are putting up 50 percent of the investment capital for these demonstration projects. (Contact: AF&PA at 202-463-2700 or see the website at www.agenda2020.org.)

VIII.B.2. Summary of Trade Associations

The trade and professional organizations serving the pulp and paper industry are lead by the American Forest and Paper Association (AFPA), formerly the American Paper Institute (API). They have been actively involved in a number of recent rulemakings (under CAA, CWA and RCRA) that will affect their members. The National Council of the Paper Industry for Air and Stream Improvement (NCASI) does technical research for the industry. The Technical Association of the Pulp and Paper Industry (TAPPI), is a technical clearinghouse for the industry; they disseminate technical information to production facility staff throughout the U.S.

American Forest and Paper Association
1111 19th Street, NW
Suite 800
Washington, DC 20036
Phone: 202-463-2700
Fax: 202-463-2471
Internet:
www.afandpa.org

Members: 450
Staff: 140
Contact: Josephine Cooper, V.P. for Environment and Regulatory Affairs

The National Forest Products Association merged with the American Paper Institute (API) in 1993 to become the American Forest and Paper Association (AF&PA). AF&PA is the national trade association for the forest, pulp, paper, paperboard, and wood products industry. The organization focuses on information gathering/dissemination, research on industry technical issues, and represents the industry in regulatory and legislative matters. The AF&PA takes an active role by representing its members before governmental agencies, such as on the recent integrated air and water rule. Some current environmental initiatives include the 2020 Research Agenda, 50 percent recycling goal, and the Sustainable Forestry Initiative. The AF&PA publishes a variety of documents for and about its membership. Some relevant publications include the annual industry wide reviews *Capacity Report* and *Statistics of Paper, Paperboard, and Wood Pulp*, the *Paper, Paperboard, and Wood Pulp Monthly Statistical Summary*, and the *Dictionary of Paper*, published every ten years. Circulation for these publications is listed at 1,000. The AF&PA holds an annual meeting every March in New York City.

National Council of the Paper Industry for Air and Stream Improvement

P.O. Box 13318	Members: 78
Research Triangle Park, NC 27709	Staff: 90
Phone: 919-558-1999	Budget: $10,000,000
Fax: 919-558-1998	Contact: Dr. Ronald Yeske
Internet: www.ncasi.org	

Founded in 1943, the National Council of the Paper Industry for Air and Stream Improvement (NCASI) presently conducts research on environmental problems related to industrial forestry and the manufacture of pulp, paper, and wood products. NCASI produces technical documents on environmental issues facing the pulp and paper industry and conducts industry conferences. Publications include: a biweekly bulletin on general issues and a variety of technical bulletins (40/year). NCASI also holds an annual March convention in New York City.

Technical Association of the Pulp and Paper Industry (TAPPI)

Technology Park/Atlanta	Members: 33,000
P.O. Box 105113	Staff: 95
Atlanta, GA 30348	Budget: $13,000,000
Phone:770-446-1400	Contact: Charles Bohanan
Fax: 770-446-6947	Technical Divisions Operator
Internet: www.tappi.org	

The Technical Association of the Pulp and Paper Industry (TAPPI) represents executives, managers, engineers, research scientists, superintendents, and technologists in the pulp, packaging, paper, and allied industries. Founded in 1915, TAPPI is split into eleven divisions, which include: environmental, research and development, paper and board manufacture, and pulp manufacture. Though its headquarters are in Atlanta, TAPPI is also divided into 27 regional groups. Overall, TAPPI provides a variety of services to its members. TAPPI conducts conferences on topics such as forest biology, environment, packaging, pulp manufacture, and R&D

in addition to a more general annual conference. TAPPI also develops testing methodologies for process control and laboratory analysis. The main annual project of the TAPPI Environmental division consists of an environmental issues industry conference. In 1995, TAPPI launched a campaign to educate the public on industry environmental facts. TAPPI publications include an annual *Membership Directory*, a monthly *TAPPI Journal*, and the publication of research results. TAPPI's publications are available via an online catalogue and record retrieval system called TAPPI-net available at 800-332-8686.

Paper Industry Management Association

1699 Wall Street, Suite 212	Members: 5,000
Mount Prospect, IL 60056	Staff: 14
Phone: 847-956-0250	Budget: $2,000,000
Fax: 847-956-0520	Contact: Scott Baumruck, Chief
Internet: www.pima-online.org	Operating Officer

The Paper Industry Management Association, or PIMA, is a professional organization of pulp, paper mill, and paper converting production executives. The association has provided management oriented information to its membership since 1919. This association goal is embodied by their publications: an annual *Handbook* of the industry, a monthly *PIMA Magazine* dedicated to improving efficiency and productivity, and the annual *PIMA Pulp and Paper Mill Catalog* reference for industry management. This catalog contains information regarding equipment, raw materials, and chemical products, in addition to a trade name directory, a listing of manufacturers and suppliers, and a listing of reports relevant to pulp and paper manufacture.

IX. CONTACTS/ACKNOWLEDGMENTS/RESOURCE MATERIALS/BIBLIOGRAPHY

For further information on selected topics within the pulp and paper industry a list of publications and contacts are provided below:

Contacts[4]

Name	Organization	Telephone/Email	Subject
Scott Throwe	U.S. EPA, Office of Compliance	202-564-7013 throwe.scott@epa.gov	Pulp and paper industry sector lead
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Jeff Telander	U.S. EPA, Office of Air and Radiation	919-541-5427 telander.jeff@epa.gov	Non-combustion MACT NESHAP Subpart MM
Don Anderson	U.S. EPA, Office of Water	202-260-7189 anderson.donald@epa.gov	Effluent guidelines and standards
Deborah Nagle	U.S. EPA, Office of Water	202-260-2656 nagle.deborah	Cooling water intake standards
Tim Smith	Office of Air and Radiation	919-541-4718 smith.tim@epa.gov	Guidelines on Best Available Retofit Technology (BART)
Kevin Culligan	Office of Air and Radiation	202-564-9172 culligan.kevin@epa.gov	NOx SIP Call
Dickson Ozokwelu	U.S. Department of Energy, Office of Industrial Technology	202-586-8501 dickson.ozokwelu@ee.doe.gov	Technologies and processes with the potential for energy, environmental, and cost savings
James Bond	USDA Forest Service	608-231-9480 jbond@fs.fed.us	Research on environmentally benign and resource-conserving processes for the production and utilization of wood pulp fibers and chemical byproducts

[4] Many of the contacts listed above have provided valuable background information and comments during the development of this document. EPA appreciates this support and acknowledges that the individuals listed do not necessarily endorse all statements made within this notebook.

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