



Development Document for Effluent Limitations Guidelines and Standards for the

Proposed

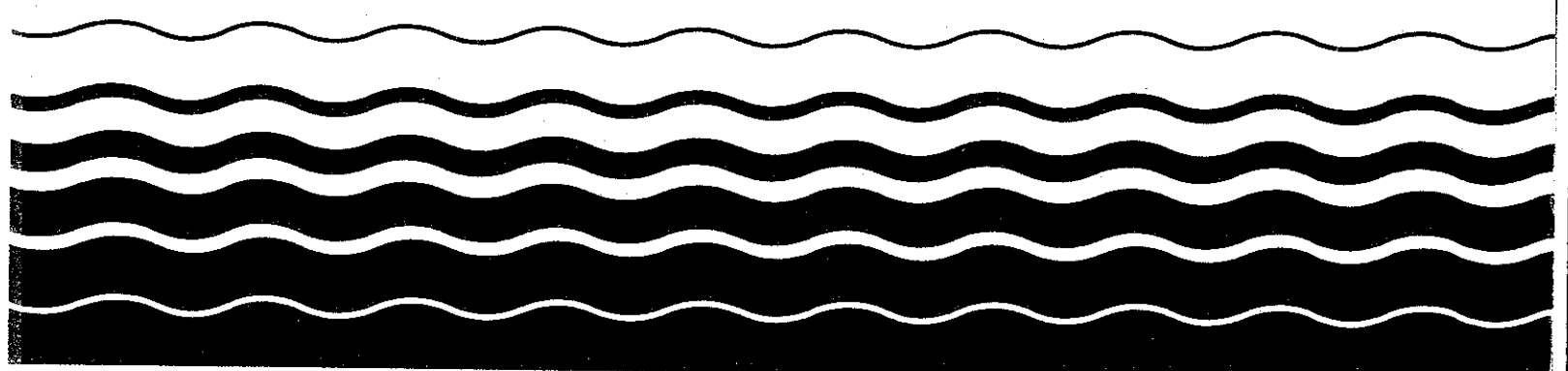
Gum and Wood Chemicals Manufacturing

Point Source Category



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DEVELOPMENT DOCUMENT
for
PROPOSED EFFLUENT LIMITATIONS GUIDELINES,
NEW SOURCE PERFORMANCE STANDARDS, AND
PRETREATMENT STANDARDS

for the
GUM AND WOOD CHEMICALS
POINT SOURCE CATEGORY

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ABSTRACT

This document presents the findings of an extensive study of the gum and wood chemicals industry for the purpose of developing effluent limitations for existing sources, standards of performance for new sources, and pretreatment standards for existing and new sources to implement Sections 301, 304, 306, and 307 of the Clean Water Act. The study covers approximately 119 gum and wood chemicals facilities in SIC Group 2861 of which seven are specifically affected by the findings.

Effluent limitations guidelines are set forth for the degree of effluent reduction attainable through the application of the best practicable control technology currently available (BPT) for a new subcategory, Sulfate Turpentine processing. Effluent limitation guidelines are set forth for the degree of effluent reduction attainable through the application of the best available technology economically achievable (BAT) and the best conventional pollutant control technology (BCT), which must be achieved by existing point sources by July 1, 1984. The standards of performance for new sources (NSPS) set forth the degree of effluent reduction that is achievable through the application of the best available demonstrated control technology, processes, operating methods, or other alternatives. Pretreatment standards for existing and new sources (PSES and PSNS) set forth the degree of effluent reduction that must be achieved in order to prevent the discharge of pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTW.

The proposed regulation for BPT for Sulfate Turpentine processing is based on the same methodology used to derive the existing BPT regulations. The proposed regulations for BCT are based on best practicable control technology. The proposed regulations for BAT and NSPS are based on best practicable control technology (BPT) plus metals removal at-the-source where the metals are used as catalysts. The proposed regulations for PSES and PSNS are based on metals removal at-the-source where the metals are used as catalysts.

Supportive data, rationale, and methods for development of the proposed effluent limitation guidelines and standards of performance are contained in this document.

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SECTION I

CONCLUSIONS

The Gum and Wood Chemicals manufacturing point source category encompasses seven industrial segments. This document provides background information and the technical data base used in the review of effluent limitations guidelines for the Gum and Wood Chemicals point source category. Technologies are defined as best practicable control technology currently available (BPT), best conventional pollutant technology (BCT), best available technology economically achievable (BAT), and pretreatment standards (PSES and PSNS).

The rationale for the exclusion of three subcategories from regulation is given in accordance with the provisions of Paragraph 8 of the Settlement Agreement in Natural Resources Defense Council, et. al. v. Train (June 8, 1976).

The Agency has extensively sampled the remaining four subcategories (50 percent of the plants were sampled in the verification phase) for the presence or absence of the 129 toxic pollutants listed in Appendix A. Many of the toxic pollutants found in the raw wastes and treated effluents originate in specific process-related raw materials and chemicals used in the manufacturing process. In the case of certain pollutants found in widely varying amounts or with erratic frequencies of occurrence, the precise sources generally remain unknown, but are not suspected to be process-related.

The rationale by which the Agency then developed effluent limitations guidelines based on each technology level is presented. A review of the previously promulgated BPT limitations demonstrated that the industry can meet the limitations with the BPT or equivalent biological technologies in use. The BPT rationale was then used to derive the BPT effluent limitations guidelines for the Sulfate Turpentine subcategory.

Based on data from the sampling program, it appears that BPT or equivalent biological treatment (including oil/water separation, activated sludge or aerated lagoons treatment, and polishing ponds) provides effective control for the organic toxic pollutants. The data available indicate that after the application of BPT technology, the organic toxic pollutants decrease to levels equal to or less than 0.2 mg/l.

Two of the subcategories, Rosin-Based Derivatives and Sulfate Turpentine, employ modification of intermediates by metallic catalysts. These catalysts - copper and nickel in sulfate turpentine and zinc in rosin-based derivatives - were detected in the effluent at a number of the plants. Therefore, for these two subcategories, EPA

proposes BAT numerical effluent limitations guidelines to limit these metallic toxic pollutants. The remaining two subcategories--Wood Rosin, Turpentine, and Pine Oil and Tall Oil Rosin, Fatty Acids, and Pitch do not use metals in their processes.

Pretreatment standards for existing sources (PSES) recognize that organic toxic pollutants in this industry are reduced by good biological treatment. Numerical effluent limitations guidelines are proposed for control of metallic toxic pollutants in the same subcategories covered by metallic toxic pollutant limitations under BAT.

New source performance standards for direct dischargers are equivalent to BPT and BAT. New source performance standards for indirect dischargers are equivalent to PSES.

The Agency estimates that the total investment cost to be incurred by existing sources, both direct and indirect dischargers, to achieve these effluent limitations guidelines (BPT for Sulfate Turpentine and BAT) and pretreatment standards (PSES) is \$484 thousand, with total operating cost of \$937 thousand. A total of approximately 150 additional pounds per day of conventional pollutants will be removed as a result of the proposed BPT regulations for Sulfate Turpentine. In addition, a total of 2 pounds per day of nickel, 11 pounds per day of copper, and 120 pounds per day of zinc, will be removed by compliance with BAT and PSES regulations.

Subcategories	Treatment Technology	Values for BPTCA (1977)					pH
		BOD5		TSS			
		Maximum Day kg/kg Product	30-Day Average kg/kg Product	Maximum Day kg/kg Product	30-Day Average kg/kg Product		
Subcategory A Char and Charcoal Briquets							
Subcategory B Gum Rosin and Turpentine	Biological treatment and sludge disposal	1.42	0.755	0.077	0.026	>6 to <9	
Subcategory C Wood Rosin, Turpen- tine and Pine Oil	Biological treatment and sludge disposal	2.08	1.10	1.38	0.475	>6 to <9	
Subcategory D Tall Oil Rosin, Pitch and Fatty Acid	Biological treatment and sludge disposal	0.995	0.529	0.705	0.243	>6 to <9	
Subcategory E Essential Oils	Biological treatment and sludge disposal	22.7	12.0	9.01	3.11	>6 to <9	
Subcategory F Rosin-Based Derivatives	Biological treatment and sludge disposal	1.41	0.748	0.045	0.015	>6 to <9	
Subcategory G Sulfate Turpentine	Biological treatment and sludge disposal	5.504	2.924	0.686	0.236	>6 to <9	

Subcategories	Treatment Technology	Values for BCT				pH
		BOD ₅		TSS		
		Maximum Day kg/kg Product	30-Day Average kg/kg Product	Maximum Day kg/kg Product	30-Day Average kg/kg Product	
Subcategory A Char and Charcoal Briquets						
Subcategory B Gum Rosin and Turpentine	BPTCA	1.42	0.755	0.077	0.026	>6 to <9
Subcategory C Wood Rosin, Turpentine and Pine Oil	BPTCA	2.08	1.10	1.38	0.475	>6 to <9
Subcategory D Tall Oil Rosin, Pitch and Fatty Acid	BPTCA	0.995	0.529	0.705	0.243	>6 to <9
Subcategory E Essential Oils	BPTCA	22.7	12.0	9.01	3.11	>6 to <9
Subcategory F Rosin-Based Derivatives	BPTCA	1.41	0.748	0.045	0.015	>6 to <9
Subcategory G Sulfate Turpentine	BPTCA	5.504	2.924	0.686	0.236	>6 to <9

Subcategories	Contaminants of Interest	Treatment Technology	Values for BATEA (1983)		
			30-Day Average Copper mg/l	30-Day Average Nickel mg/l	30-Day Average Zinc mg/l
<hr/>					
Subcategory A					
Char and Charcoal					
Briquets					
No discharge of the process wastewater pollutants					
Subcategory B					
Gum Rosin and					
Turpentine					
Subcategory C					
Wood Rosin, Turpentine					
and Pine Oil					
Subcategory D					
Tall Oil Rosin,					
Pitch and Fatty Acids					
Subcategory E					
Essential Oils					
Subcategory F					
Rosin-Based					
Derivatives					
Zinc					
Metals Removal					
and Sludge					
Disposal					
1.8					
Subcategory G					
Sulfate Turpentine					
Copper					
Nickel					
Metals Removal					
and Sludge					
Disposal					
1.8					
1.8					

Values for New Source Performance Standards (NSPS)																	
Subcategories	Contaminants of Interest	Treatment Technology	BOD ₅			TSS			Copper			Nickel			Zinc		
			Maximum Day	kg/kg Product	kg/kg Product	Maximum Day	kg/kg Product	kg/kg Product	Maximum Day	mg/l	30-Day Average	mg/l	Maximum Day	mg/l	30-Day Average	mg/l	
Subcategory A Char and Charcoal Briquets																	
Subcategory B Gum and Rosin and Turpentine	BOD ₅ , TSS, pH	BPTCA															
Subcategory C Wood Rosin, Turpentine and Pine Oil	BOD ₅ , TSS, pH	BPTCA	2.08		1.10	1.38		0.475									>6 - <9
Subcategory D Tall Oil Rosin, Pitch and Fatty Acids	BOD ₅ , TSS, pH	BPTCA	0.995		0.529	0.705		0.243									>6 - <9
Subcategory E Essential Oils	BOD ₅ , TSS, pH	BPTCA															
Subcategory F Rosin-based Derivatives	BOD ₅ , TSS, pH, Zinc	BPTCA and Metals Removal	1.41		0.748	0.045		0.015								4.2	1.8
Subcategory G Sulfite Turpentine	BOD ₅ , TSS, pH, Copper, Nickel	BPTCA and Metals Removal	5.504		2.924	0.686		0.236								4.5	1.8
																4.1	1.8
																	>6 - <9

Subcategories	Contaminants of Interest	Treatment Technology	Values for Pretreatment Standards for Existing Source (PSES)					
			Copper		Nickel		Zinc	
			Maximum	30-Day Average	Maximum	30-Day Average	Maximum	30-Day Average
			Day	mg/l	Day	mg/l	Day	mg/l
			mg/l		mg/l		mg/l	
Subcategory A Char and Charcoal Briquets								
Subcategory B Gum Rosin and Turpentine								
Subcategory C Wood Rosin, Turpentine and Pine Oil								
Subcategory D Tall Oil Rosin, Pitch and Fatty Acids								
Subcategory E Essential Oils								
Subcategory F Rosin-Based Derivatives	Zinc	Metals Treatment and Sludge Disposal					4.2	1.8
Subcategory G Sulfate Turpentine	Copper Nickel	Metals Treat- ment and Sludge Disposal	4.5	1.8	4.1	1.8		

Values for Pretreatment Standards for New Sources (PSNS)

Subcategories	Contaminants of Interest	Treatment Technology	Copper		Nickel		Zinc	
			Maximum Day	30-Day Average	Maximum Day	30-Day Average	Maximum Day	30-Day Average
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
Subcategory A Char and Charcoal Briquets								
Subcategory B Gum Rosin and Turpentine								
Subcategory C Wood Rosin, Turpentine and Pine Oil								
Subcategory D Tall Oil Rosin, Pitch and Fatty Acids								
Subcategory E Essential Oils								
Subcategory F Rosin-Based De ivatives	Zinc	Metals Treatment and Sludge Disposal					4.2	1.8
Subcategory G Sulfate Turpentine	Copper Nickel	Metals Treat-ment and Sludge Disposal	4.5	1.8	4.1	1.8		

SECTION II

RECOMMENDATIONS

GENERAL

This document recommends effluent limitations guidelines commensurate with BPT, BCT, BAT, PSES, NSPS, and PSNS for the Gum and Wood Chemicals manufacturing point source category. A discussion of in-plant and end-of-pipe control technology required to achieve the recommended effluent limitations guidelines and new source performance standards is included.

EFFLUENT LIMITATIONS GUIDELINES

After review of industry processes and wastewater treatment, the Agency recommended exclusion of three subcategories from further study. The basis for the exclusion of Char and Charcoal Briquets, Gum Rosin and Turpentine, and Essential Oils appears in Appendix C.

Table II-1 presents effluent limitation guidelines commensurate with BPT for the Sulfate Turpentine subcategory of the Gum and Wood Chemicals industry. The effluent limitation guidelines represent the maximum average of daily values for 30 consecutive days and the maximum for any one day and were developed on the basis of performance factors discussed in Sections IX and XIV of this Development Document.

Process wastewaters subject to these limitations do not include non-contact sources such as boiler and cooling water blowdown, sanitary, and other similar flows. BPT also includes the maximum utilization of applicable in-plant pollution abatement technology to minimize capital expenditures for end-of-pipe wastewater treatment facilities. Flow for BPT is identical with flow for BCT and BAT in this document. End-of-pipe technology for BPT involves the application of biological treatment, as typified by activated sludge or equivalent biological treatment systems.

Effluent limitations guidelines to be attained by application of BAT are presented in Table II-3. Treatment for BAT includes at-the-source metals precipitation by pH adjustment and filtration or clarification for sulfate turpentine and rosin-based derivatives. This treatment is to be followed by BPT treatment of all process waste streams. It is emphasized that the model treatment system does not preclude the use of other metals removal technologies. BAT is further discussed in Section X.

Effluent limitations guidelines to be attained by application of NSPS are presented in Table II-4. Treatment for NSPS includes metals precipitation at-the-source by pH adjustment and filtration or clarification for sulfate turpentine and rosin-based derivatives followed by biological treatment. NSPS is further discussed in Section XII. Effluent limitations guidelines to be attained by application of PSNS and PSES are presented in Tables II-5 and II-6, respectively. PSNS and PSES includes metals precipitation at-the-source by pH adjustment and filtration or clarification for sulfate turpentine and rosin-based derivatives.

Table II-1. BPT Effluent Limitations Guidelines

Subcategory	Effluent Characteristic	Effluent Limitations	
		Maximum for Any One Day (kg/kkg)*	Average of Daily Values for 30 Consecutive Days Shall Not Exceed (kg/kkg)*
A	No discharge of process wastewater pollutants		
B	BOD ₅	1.420	0.755
	TSS	0.077	0.026
C	BOD ₅	2.08	1.10
	TSS	1.38	0.475
D	BOD ₅	0.995	0.529
	TSS	0.705	0.243
E	BOD ₅	22.7	12.0
	TSS	9.01	3.11
F	BOD ₅	1.41	0.748
	TSS	0.045	0.015
G	BOD ₅	5.504	2.924
	TSS	0.686	0.236

* kg/kkg production is equivalent to lbs/1,000 lbs production.

Table II-2. BCT Effluent Limitations Guidelines

Subcategory	Effluent Characteristic	Effluent Limitations	
		Maximum for Any One Day (kg/kkg) *	Average of Daily Values for 30 Consecutive Days Shall Not Exceed (kg/kkg) *
C	BOD ₅	2.08	1.10
	TSS	1.38	0.475
D	BOD ₅	0.995	0.529
	TSS	0.705	0.243
F	BOD ₅	1.41	0.748
	TSS	0.045	0.015
G	BOD ₅	5.504	2.924
	TSS	0.686	0.236

Table II-3. BAT Effluent Limitations Guidelines

Subcategory	Effluent Characteristic	Effluent Limitations	
		Maximum for Any One Day mg/l	Average of Daily Values for 30 Consecutive Days Shall Not Exceed (mg/l)
F	Zinc**	4.2	1.8
G	Copper**	4.5	1.8
	Nickel**	4.1	1.8

* kg/kg production is equivalent to lbs/1,000 lbs production.

** At the source (mg/l).

Table II-4. New Source Performance Standards

Subcategory	Effluent Characteristic	Effluent Limitations	
		Maximum for Any One Day (kg/kkg)	Average of Daily Values for 30 Consecutive Days Shall Not Exceed (kg/kkg) *
C	BOD ₅	2.08	1.10
	TSS	1.38	0.475
D	BOD ₅	0.995	0.529
	TSS	0.705	0.243
F	BOD ₅	1.41	0.748
	TSS	0.045	0.015
	Zinc**	4.2	1.8
G	BOD ₅	5.504	2.924
	TSS	0.686	0.236
	Copper**	4.5	1.8
	Nickel**	4.1	1.8

* kg/kkg production is equivalent to lbs/1,000 lbs production.

** At the source (mg/l).

Table II-5. Pretreatment Standards for New Sources

Subcategory	Effluent Characteristic	Effluent Limitations	
		Maximum for Any One Day (mg/l)	Average of Daily Values for 30 Consecutive Days Shall Not Exceed (mg/l)
F	Zinc*	4.2	1.8
G	Copper*	4.5	1.8
	Nickel*	4.1	1.8

* At the source (mg/l).

Table II-6. Pretreatment Standards for Existing Sources

Subcategory	Effluent Characteristic	Effluent Limitations	
		Maximum for Any One Day (mg/l)	Average of Daily Values for 30 Consecutive Days Shall Not Exceed (mg/l)
F	Zinc*	4.2	1.8
G	Copper*	4.5	1.8
	Nickel*	4.1	1.8

*At the source (mg/l).

SECTION III

INTRODUCTION

AUTHORITY

Section 304(b) of the Federal Water Pollution Control Act of 1972 required the Administrator to publish regulations providing guidelines for effluent limitations, including BAT. Section 306 required the Administrator to publish regulations establishing Federal standards of performance for categories of new industrial sources (NSPS). Section 304(b) required the Administrator to publish regulations establishing pretreatment standards for the introduction of incompatible pollutants into publicly owned treatment works. Further, section 307(a) required the Administrator to publish regulations establishing effluent standards for certain toxic pollutants. Finally, section 501 authorized the Administrator to prescribe such regulations in order to carry out these functions under the Act.

EPA was unable to promulgate many of the regulations required by the 1972 Act's prescribed dates. In 1976, several environmental groups sued EPA with respect to this issue. EPA and the plaintiffs executed a "Settlement Agreement", with Court approval. The Agreement required EPA to develop a program and adhere to a schedule for promulgating BAT effluent limitations guidelines, pretreatment standards, and new source performance standards for 65 "priority" (toxic) pollutants and classes of pollutants. See Natural Resources Defense Council, Inc. v. Train 8 ERC 2120 (D.D.C. 1976).

On December 27, 1977, the President signed into law the Clean Water Act of 1977, amending the prior Act. The amendment incorporates into the Act many elements of the Settlement Agreement program for toxic pollutants control. Section 301(b)(2) requires achievement, by July 1, 1984, of BAT for toxic pollutants. "Conventional pollutant" parameters, including biochemical oxygen demand, suspended solids, fecal coliform bacteria and pH, are to be controlled, by the same date, pursuant to BCT. For non-toxic, non-conventional pollutants, sections 301(b)(2)(A) and (b)(2)(F) require achievement of BAT effluent limitations within three years after their establishment or by July 1, 1984, whichever is later, but not later than July 1, 1987.

Guidelines and standards developed with reference to this document will be directed toward implementation of those requirements.

PURPOSE AND SCOPE

This document presents the technical data base used to establish effluent limitations guidelines for the Gum and Wood Chemicals Industry. The information presented is intended to support EPA's

establishment of guidelines defining best practicable control technology currently available ("BPT"; see sections 301(b)(1)(A), (B), and (C) and 304(b)(1) of the Clean Water Act, 33 U.S.C. §1251 et seq.) for the Sulfate Turpentine subcategory and best available technology economically achievable ("BAT"; see sections 301(b)(2)(A), (C), (D), and (E) and 304(b)(2)), pretreatment standards for existing sources ("PSES"; See Section 307(b)), and pretreatment standards for new sources ("PSNS"; See Section 304(b)) for the Rosin-based Derivatives and Sulfate Turpentine subcategories. The information is also intended to support EPA's establishment of new source performance standards ("NSPS"; See Section 306) for the Wood Rosin, Turpentine, and Pine Oil; Tall Oil Rosin, Fatty Acids, and Pitch; Rosin-based Derivatives; and Sulfate Turpentine subcategories.

The document presents an industry profile and describes alternative treatment and control technologies, both in-plant and end-of-pipe, for the industry. It includes information on the processes, procedures, and effectiveness of technologies which eliminate or reduce pollutant discharges from sources in the industry. It also includes data concerning the costs of implementing the technologies.

EPA developed the information through review of all available historical data, industry questionnaires, plant visits and sampling, and analysis of samples for traditional and toxic pollutants. In addition, monitoring data generated by individual plants under existing National Pollutant Discharge Elimination System ("NPDES") permits were collected and analyzed.

EPA promulgated Interim Final guidelines specifying best practicable control technology currently available ("BPT") for six subcategories of sources in the Gum and Wood Chemicals manufacturing point source category on May 18, 1976. EPA has not established BAT guidelines, new source performance standards, or pretreatment standards for the industry.

GENERAL DESCRIPTION OF INDUSTRY

This industry is identified as Standard Industrial Classification (SIC) Code 2861--Gum and Wood Chemicals. Within this classification are establishments primarily engaged in manufacturing hardwood and softwood distillation products, wood and gum naval stores, charcoal, natural dyestuffs, and natural tanning materials.

Some materials produced under SIC 2861, such as rosin, may be further processed into materials classified under different SIC codes. Cases in which materials change classifications within the same plant are included in this study; not included, however, are those plants which receive SIC 2861 products for further processing under different codes.

The Standard Industrial Classifications list was developed by the United States Department of Commerce and is oriented toward the collection of economic data related to gross production, sales, and unit costs. The list is useful in that it divides American industry into discrete product-related segments. The SIC list is not necessarily related to the nature of the industry in terms of actual plant operations, production processes, or considerations associated with water pollution control.

More specifically, then, the scope of coverage of this study is as follows:

1. Plants engaged in the manufacture of char and charcoal briquets, as well as pyroligneous acids and other by-products;
2. Plants engaged in the manufacture of gum rosin and turpentine by the distillation of crude pine gum;
3. Plants engaged in the manufacture of wood rosin, turpentine, and pine oil from pine stump wood;
4. Plants engaged in the manufacture of tall oil rosin, fatty acids, and pitch by fractionation of Kraft process crude tall oil;
5. Plants engaged in the manufacture of essential oils-turpenes, hydrocarbons, alcohols, or ketones;
6. Plants engaged in the manufacture of rosin derivatives: esters, adduct modified esters, and alkyds; and
7. Plants engaged in the processing of sulfate turpentine.

SUMMARY OF METHODOLOGY

The effluent limitations and pretreatment standards were developed in the following manner. EPA reviewed the original development document (1976) for possible industry subcategorization. This evaluation studied whether differences in raw material used, product produced, manufacturing process employed, equipment, age, size, wastewater constituents, and other factors required development of different industry subcategories. The raw waste characteristics for each subcategory were identified and used in this analysis. The analysis included consideration of: (1) the sources and volume of water used in the processes and the sources of pollutants and wastewaters in the plant and (2) the constituents (including thermal) of all wastewaters, including toxics and other constituents which produce taste, odor, or color in water or aquatic organisms. The wastewater constituents to be considered for pretreatment standards were identified (see Section VI).

The Agency identified the full range of control and treatment technology existing within the point source category. This included identification of each distinct control and treatment technology, including the amounts of constituents (including thermal) and the chemical, physical, and biological characteristics of pollutants, and the effluent levels resulting from the application of each of the treatment and control technologies. The problems, limitations, and reliability of each treatment and control technology were also identified. Also discussed were the non-water quality environmental impacts of such technologies upon other pollution problems, including air, solid waste, and noise.

EPA considered various factors in assessing treatment and control technologies. These included the total cost of technology application, the equipment and facilities involved, the processes employed, the engineering aspects of the application of various types of control techniques, process changes, non-water quality environmental impacts (including energy requirements), and other factors.

DATA AND INFORMATION GATHERING PROGRAM

The first step in the review process was to assemble and evaluate all existing sources of information on the wastewater management practices and production processes of the Gum and Wood Chemicals Industry. Sources of information included:

1. Current literature, EPA demonstration project reports, EPA Technology Transfer reports;
2. Development Document for Interim Final Effluent Limitation Guidelines and Proposed New Source Performance Standards for the Gum and Wood Chemicals Manufacturing Point Source Category, U.S. EPA, April 1976;
3. Data submitted by individual plants and trade associations in response to publication of proposed regulations, and information provided directly for this study;
4. Information obtained from direct interviews, plant visits, and sampling visits to production facilities.

Section XVI of this document presents a complete bibliography of all literature reviewed during the course of this project. Analysis of the above sources indicated the need for additional information, particularly concerning the use and discharge of toxic pollutants. The Agency also needed updated information on production-related process raw waste loads (RWL), potential in-process waste control

techniques, and the identity and effectiveness of end-of-pipe treatment systems.

308 Data Collection Portfolio

Recognizing that the best sources of existing information were the individual plants, EPA prepared a data collection portfolio and sent it directly to manufacturing plants. The portfolio was designed to update the existing data base concerning water consumption, production processes, wastewater characterization, raw waste loads based on historical production and wastewater data, method of ultimate wastewater disposal, in-process waste control techniques, and the effectiveness of in-place external treatment technology. The portfolio also requested information concerning the use of materials which could contribute toxic pollutants to wastewater and asked for any data on toxic pollutants in wastewater discharges. Responses served as the source of updated, long-term, historical information for the traditional parameters such as BOD, COD, solids, pH, phenols, and metals. A copy of the blank survey form appears in Appendix B.

The mailing list for the data collection portfolio was derived from the following sources:

1. Previous plant listings in the EPT administrative record;
2. 1977 Dun and Bradstreet listing for SIC 2861;
3. State Chambers of Commerce directories of manufacturing;
4. Standard and Poor listing;
5. 1977 Stanford Research Institute Directory of Chemical Producers.

The final revised mailing list consisted of 343 plants.

There were a total of 195 responses to the 308 survey. Since plant visits and other contacts with the industry indicated that in a number of cases the survey had been received either late or not at all, the Agency took a follow-up telephone survey to determine receipt of the questionnaire. Eighty-seven plants were contacted by telephone.

Table III-1. List of Plants Identified in the Gum and Wood Chemicals Study

Plant	Location
Reichhold Chemicals Inc.	Bay Minette, AL
Arizona Chemical Co., Inc.	Panama City, FL
Reichhold Chemicals, Inc.	Telogia, FL
Reichhold Chemicals, Inc.	Pensacola, FL
S.C.M. Corp.	Jacksonville, FL
Sylvachem Corp.	Port St. Joe, FL
Union Camp Corp.	Jacksonville, FL
Hercules, Inc.	Savannah, GA
Hercules, Inc.	Brunswick, GA
Union Camp Corp.	Valdosta, GA
Union Camp Corp.	Savannah, GA
Arizona Chemical Co., Inc.	Springhill, LA
Westvaco	DeRidder, LA
Crosby Chemicals, Inc.	Picayune, MS
Hercules, Inc.	Hattiesburg, MS
Monsanto Company	Nitro, WV
Hercules, Inc.	Portland, OR
Hercules, Inc.	Franklin, VA
Westvaco	Charleston Heights, SC
Reichhold Chemicals, Inc.	Oakdale, LA

Summary of Response to Industry Survey

		Total
Survey returned--Gum & Wood	35	
Telephone responses--Gum & Wood	2	37
Survey returned--Charcoal	37	
Telephone responses--Charcoal	8	
Status unconfirmed--Charcoal	32	77
Survey returned--not applicable	117	
Telephone responses--not applicable	63	180
Survey returned--out of business	6	
Telephone responses--out of business	6	12
Unreachable--no listing	28	
Unreachable--disconnected	<u>4</u>	<u>32</u>
TOTAL	338	338

Plant Visits

Survey teams of project engineers and scientists visited 12 plants from December 1977 to June 1978. The selected plants were most representative of the industrial processes and treatment systems available in the industry.

Information on process plant operations and the associated RWL was obtained through interviews with plant operating personnel, examination of plant design and operating data (original design specifications, flow sheets, and day-to-day material balances around individual process modules or unit operations where possible), and sampling of individual process wastewater. Information on the identity and performance of wastewater treatment systems was obtained through interviews with plant water pollution control or engineering personnel, examination of treatment plant design and historical operating data, and sampling of treatment plant influents and effluents.

Raw Materials Review

Only in rare instances did plants acknowledge the presence of toxic pollutants in waste discharges in the responses to the survey questionnaires. Establishing toxic pollutant data in waste discharges of the industry, therefore, required engineering review of raw materials and production processes and a screening sampling and analysis program. EPA made every effort to choose facilities where

meaningful information for both treatment facilities and manufacturing operations could be obtained.

Screening Sampling

The screening sampling program took place during April and May of 1978. Five plants were sampled, representing six of the seven major Gum and Wood Chemicals processes. (The seventh process, char and charcoal briquets, is dry). A single 24-hour composite sample was obtained from the raw and treated wastewater streams at each plant and analyzed for the 129 toxic pollutants listed in Appendix A of this document. Sampling and analyses were conducted according to Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants, U.S. EPA, Cincinnati, March 1977 (revised April 1977), and Analytical Methods for the Verification Phase of the EAT Review, U.S. EPA Effluent Guidelines Division, Washington, D.C., June 1977.

The purpose of the screening sampling and analysis program was to determine which toxic pollutants were present in wastewaters from each sampled industrial segment and to determine the extent of the contamination.

EPA then evaluated the results of the screening analyses along with the process engineering review for each subcategory. The toxic pollutants found in levels above the detection limits for the analyses or those suspected of being present due to their use as raw materials, by-products, final products, etc., were selected for verification. Asbestos, cyanide, PCB's, and the pesticides were not analyzed in the verification phase because they did not appear in levels above the detection limit in the screening phase. The screening sampling visits to the five selected plants also produced two 24-hour verification samples at four of the plants.

Verification Program

The verification sampling and analysis program, conducted over a three-month period, was intended to obtain for each subcategory as much quantitative data as possible on the toxic pollutants selected for verification during the screening program. The sampled plants represented the full range of in-place process and wastewater treatment technology for each subcategory. Nine plants were sampled during verification sampling. The verification program analyzed for all 129 toxic pollutants except asbestos, cyanide, PCB's, and pesticides.

Three consecutive 24-hour composite samples of the raw wastewater, final treated effluent, and, in appropriate cases, effluent from intermediate treatment steps were obtained at each plant. A single

grab sample of incoming fresh process water also was taken at each plant.

Processing of Information

The technical data base which established subcategorization within the industry (Section IV), and identified the full range of in-process and treatment technology options available within each subcategory (Section VII) consisted of the following:

1. Review of available literature and previous studies;
2. Analysis of the data collection portfolios;
3. Information from industry and trade associations;
4. Information from plant visits; and
5. Results of analyses from the screening and verification sampling programs.

The raw waste characteristics for each subcategory were then identified (Section V). This included an analysis of:

1. The source and volume of water used in the specific processes and the sources of wastes and wastewaters in the plant; and
2. The constituents of all wastewaters, including traditional and toxic pollutants.

The full range of control and treatment technologies existing within each candidate subcategory was identified. This included an identification of each existing control and treatment technology, including both in-plant and end-of-pipe systems. It also included an identification of the wastewater characteristics resulting from the application of each existing treatment and control technology.

The costs and energy requirements of each of the candidate technologies identified were then estimated (Section VIII) both for a flow-weighted average plant within the subcategory and on a plant-by-plant basis. BPT technology costs were not considered except for sulfate turpentine processing.

Additional evaluation was made of non-water quality environmental impacts, such as the effects of the application of such technologies on other pollution problems.

PROFILE OF INDUSTRY

The Gum and Wood Chemicals Industry began in the United States when early colonists harvested pine cleorosin for use in construction of naval vessels. Since that time the industry has grown and expanded as new uses have been found for pine products. One of the more significant innovations has been the development of by-products from the Kraft paper process--tall oil and sulfate turpentine--as raw materials for the Gum and Wood Chemicals Industry.

The modern Gum and Wood Chemicals Industry can be grouped into the following major areas:

1. Char and charcoal briquets;
2. Gum rosin and turpentine;
3. Wood rosin, turpentine, and pine oil;
4. Tall oil rosin, fatty acids, and pitch;
5. Essential oils;
6. Rosin derivatives; and
7. Sulfate turpentine.

Char and Charcoal Briquets

Char results from the destructive distillations of softwood and hardwood (primarily the latter). Char, in turn, may be processed into charcoal briquets or activated carbon. Pyroligneous acid was once a by-product of the process, but has been discontinued in favor of petroleum substitutes. With the rising cost of petrochemicals, some plants are considering reinstituting the recovery process.

Charcoal is one of the more economically important products of the Gum and Wood Chemicals Industry. It is widely used as a recreational fuel, in the chemical and metallurgical industries, and in other areas, including use as a filter for gaseous and liquid streams.

The char and charcoal industry in the United States consists of 77 plants primarily concentrated in the eastern section of the country, with the heaviest concentration in the Ozark and Appalachian hardwood areas. Plant ownership varies from companies with numerous plants to singly-owned plants with local product distribution.

Gum Rosin and Turpentine

In terms of product value, gum rosin and turpentine products are a minor portion of the Gum and Wood Chemicals Industry. High labor costs for gum collection coupled with competition from foreign products has reduced the number of plants and the value of product shipments and the decline will probably continue.

Currently there are only seven plants in this segment of the industry, all located in Georgia. The greatest production is concentrated in southern and southeastern Georgia. The two largest plants have diversified and now are producing rosin-based derivatives in conjunction with gum rosin and turpentine.

The raw material comes from a few remaining pine gum farmers and from gum wholesalers. Although gum rosin and turpentine are the highest quality of such products in the naval stores industry, decreasing availability of domestic gum rosins is forcing manufacturers to rely on foreign sources or to use wood or tall oil rosin in derivative operations.

Wood Rosin, Turpentine, and Pine Oil

Wood rosin, turpentine, and pine oil produced by the solvent extraction and steam distillation of resinous wood stumps, account for 19 percent of the total product value of the Gum and Wood Chemicals Industry, according to the 1972 Census of Manufacturers. The economic life of this segment of the industry is limited by diminishing raw materials and the development of competitive processes.

Historically, the industry used the pine stumps remaining from the harvesting of first-generation southern pine forests in the early part of the twentieth century. Few such stumps remain at the present time and second-generation stumps contain considerably lower rosin content.

This segment of the industry consists of five plants--one in Mississippi, three in Florida, and one in Georgia. Each plant occupies a land area of 40 to 60 hectares (100 to 150 acres), the majority of which is used for raw material storage. Three of the plants are located in urban areas; the remaining two are in rural settings.

Tall Oil Rosin, Fatty Acids, and Pitch

The growth of tall oil refining has continued since 1949; however, the production of fatty acids and rosins with low cross-product contamination is a fairly recent development.

Crude tall oil is particularly attractive as a raw material because of its availability as a "waste" product of the Kraft pulp and paper industry; this segment of the industry, therefore, provides increasing supplies of raw materials for tall oil fractionators. While there is a steady decline in naval stores production from gum and wood extraction, there is a corresponding production increase from tall oil.

Recent trends in the amount of tall oil produced by the kraft process have indicated a reduced rate of increase in the amount available. This has resulted from changes both in the Kraft process and in the Kraft process raw materials. More hardwood and younger growth pines are in use so that less oleoresin is available. If this trend continues, the availability of tall oil may decline.

Twelve tall oil distillation plants are currently in operation, primarily in the Southeast. Two additional plants are not in operation, but could be made operational if economic conditions so dictated.

Essential Oils

The essential oils produced in the Gum and Wood Chemicals Industry are cedarwood oil and pine scent. Cedarwood oil is produced by the steaming of cedarwood sawdust in pressure retorts to remove the oil from wood particles. One plant produces pine leaf oil for use as a scent in Christmas products. Pine needles are steamed to extract the oil.

In the eastern United States, cedarwood oil is a by-product of the production of cedarwood lumber and furniture from Juniperus virginiana. This wood contains 2 to 4 percent oil. Currently three plants produce cedarwood oil from this type of cedarwood.

In the western portion of the country, cedarwood oil is produced directly from a tree of the Cedrus family which is unsuitable for lumber production. Five plants use this raw material. The process involves grinding the whole tree into wood dust and extracting the oil by steaming.

The growing concerns in the industry are competition with synthetic oils and the dwindling supply of trees as raw material.

Rosin-Based Derivatives

Rosin-based derivatives are not included in SIC 2861, Gum and Wood Chemicals, but in SIC 2821, Plastics and Synthetic Materials. However, derivatives production is a natural extension of processing in Gum and Wood Chemicals plants since the rosin is available in the

plants. This study applies only to those derivatives operations which are located within and in conjunction with Gum and Wood Chemicals facilities.

Currently 13 Gum and Wood Chemicals plants are producing rosin derivatives. These plants are located within all four types of rosin producing plants.

Of all the Gum and Wood Chemicals processing operations, derivatives processing is the most profitable, at least partly due to a large product and market development effort in the industry. Derivatives products include ink resins, paint additives, paper size, oil additives, adhesives, wetting agents, chewing gum base, and chemical-resistant resins.

Sulfate Turpentine

Sulfate turpentine originally was considered a waste product in the digester relief gas of the Kraft pulp and paper process; with modern technology, however, it can be profitably recovered to such an extent that sulfate turpentine is the major source of turpentine in the Gum and Wood Chemicals Industry.

The distillation of sulfate turpentine yields four major compounds--a-pinene, b-pinene, dipentene, and pine oil. The primary uses of these compounds are for flavor, fragrances, resins, and insecticides. While b-pinene and dipentene are the components of greatest use, new methods and markets currently are being developed for a-pinene.

Turpene derivatives--generally produced in conjunction with sulfate turpentine distillation with b-pinene and dipentene as raw materials--provide tack (stickiness) in polymeric mixtures and pressure sensitive tapes.

DESCRIPTIONS OF PROCESSES

Char and Charcoal Briquets

Char and charcoal result from the combustion (thermal decomposition) of raw wood which drives off gases and vapors and leaves about one-third of the wood, by weight, as charcoal. Commercial charcoal is produced at a temperature of about 400° to 500°C.

During carbonization, distillates--collectively referred to as pyroligneous acid--are formed. Pyroligneous acid contains such compounds as methanol, acetic acid, acetone, tars, and oils. Because synthetic substitutes are cheaper, current industry practice does not recover the by-products, but feeds the distillate and other flue gases to an afterburner for thermal destruction before exhausting them to

the atmosphere. This study found no facilities in the United States which recover distillation by-products. The condensable distillates or vapor also may be recycled as a fuel supply supplement, but this is not common in the industry.

Gum Rosin and Turpentine

Crude gum is obtained from healthy pines by exposing the sapwood. This operation usually takes place during December or January, since early removal of the bark stimulates early gum flow in the spring. The main flow of gum occurs from March through September, with the wound typically being treated with sulfuric acid to prolong the period of flow.

The processing plants receive the raw gum, composed of about 68 percent rosin and 20 percent turpentine, in 197.3 kg (435 lb) barrels. A typical process flow schematic is shown in Figure III-1. The gum is emptied into a vat by inverting the crude gum containers over a high-pressure steam jet. This mixture is then filtered and washed, and the prepared crude gum material is distilled to separate the turpentine from the gum rosin. Non-contact shell-and-tube steam heating and sparging steam are used in the stills. Turpentine and water are distilled overhead and condensed with shell-and-tube condensers. The water is separated from the turpentine in the downstream receivers.

The gum rosin is removed from the bottom of the still and transferred to shipping containers while the rosin is in a molten state. Wastewater usually originates in three areas:

1. The liquid waste from the raw gum wash tank;
2. The water fraction from the turpentine-water separator; and
3. In some plants, a brine waste from a sodium chloride dehydration used to dewater the turpentine.

Wood Rosin, Turpentine and Pine Oil

Figure III-2 shows a typical process diagram. Pine stumps are washed in the plant and the water and sediment flow to a settling pond from which water recycles back to the washing operation. Wood hogs, chippers, and shredders mechanically reduce the wood stumps to chips approximately 5 centimeters (2 inches) in length and 3 millimeters (1/16 inch) thick. The chips are fed to a battery of retort extractors, which employ the following steps:

1. Water is removed from the chips by azeotropic distillation with a water-immiscible solvent;

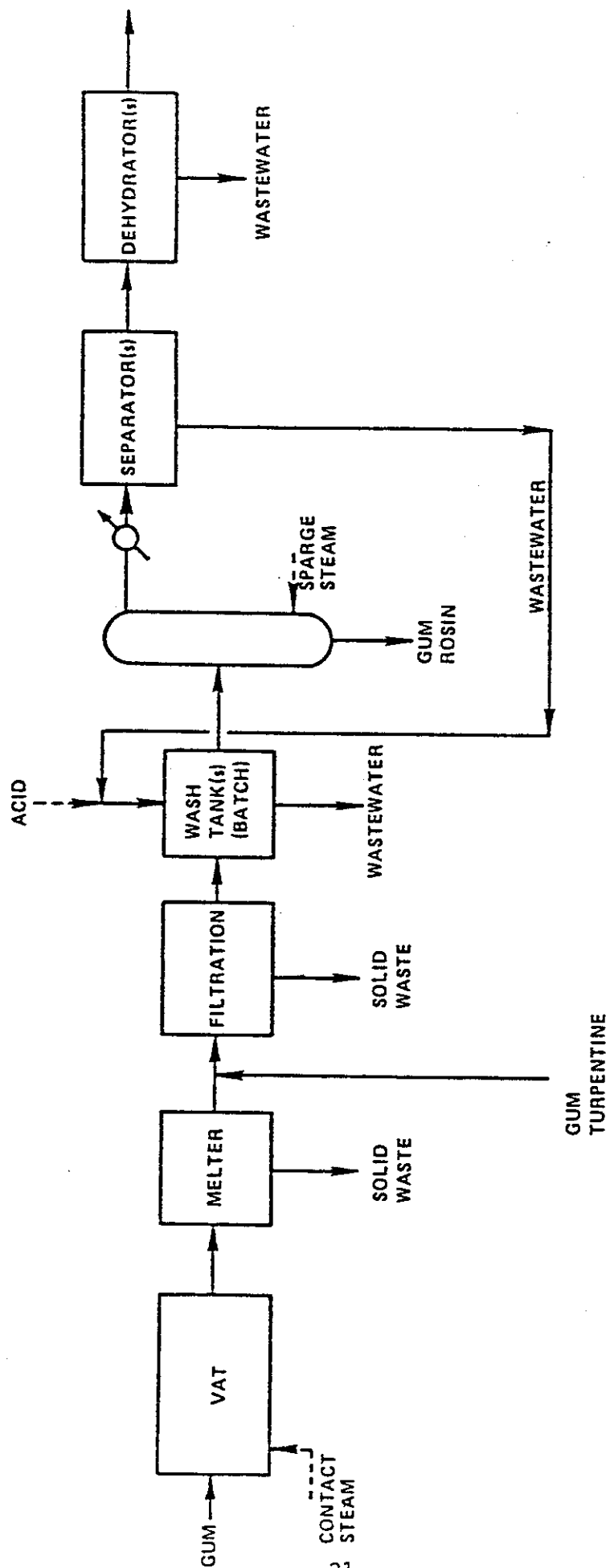


Figure III- 1.

GUM ROSIN AND TURPENTINE PRODUCTION

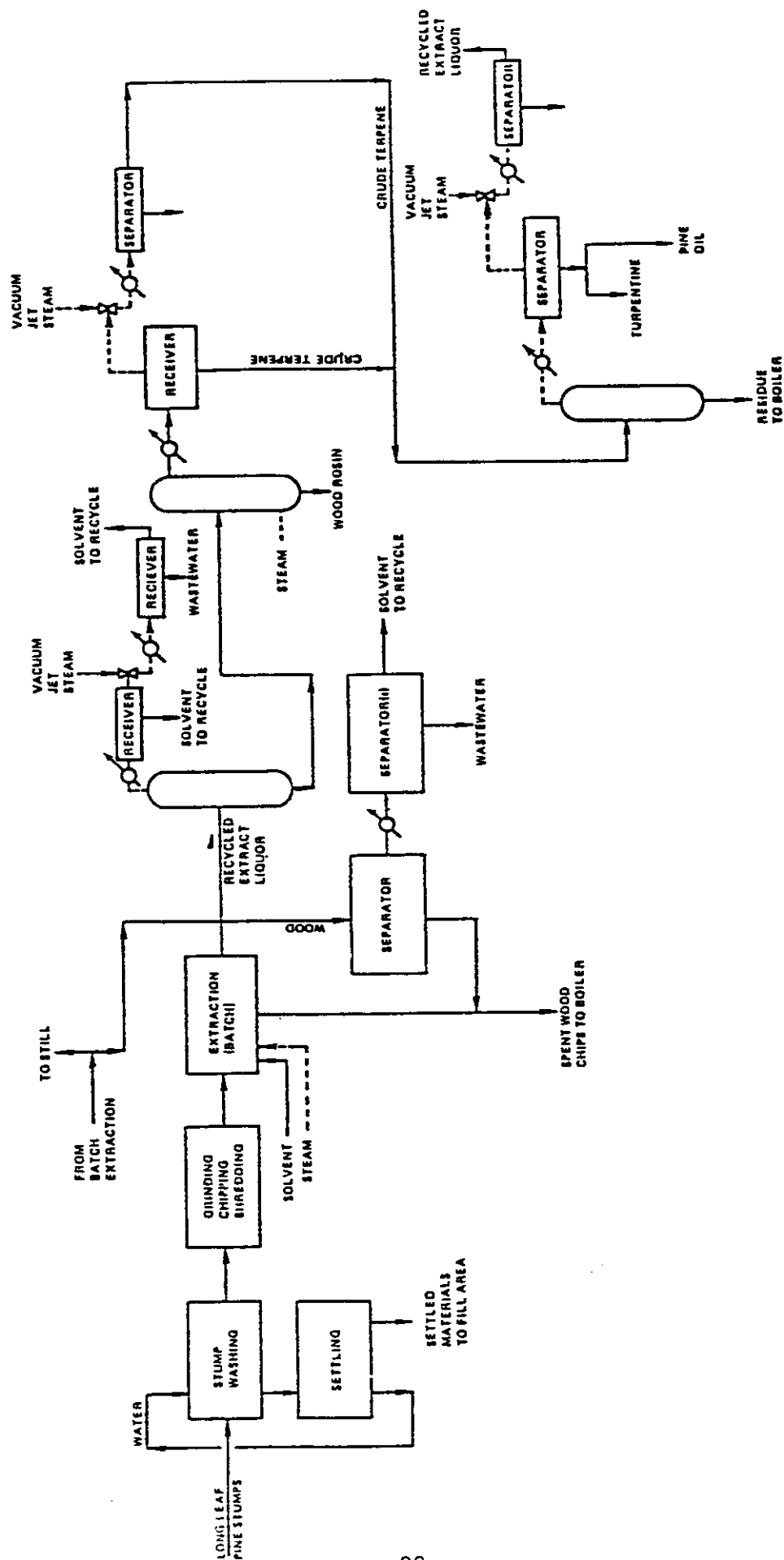


Figure III-2.

WOOD ROSIN, PINE OIL, AND TURPENTINE VIA SOLVENT EXTRACTION

2. The resinous material is extracted from the wood chips with a water-immiscible solvent; and

3. Residual solvent is removed from the spent wood chips by steaming.

After the steaming step, spent chips are removed from the retort and sent to the boilers as fuel. Any entrained wood fines coming from the retorts are removed in the entrainment separator and used also as fuel. The vapors from the entrainment separator are condensed and proceed to one or more separators where the solvent-water mixture separates. The solvent is recycled for use in the retorts.

The extract liquor is sent to a distillation column to separate the solvent from the products. The overhead from the column is condensed and enters a separator where condensed solvent is removed and recycled to the retorts. The vapor phase from the separator condenses in a shell-and-tube exchanger and enters a separator in which the remaining solvent is separated. The solvent is sent to recycle and wastewater to treatment.

The bottom stream from the first distillation column enters a second distillation column, as shown in Figure III-2. Steam introduced into the bottom of the tower strips off the volatile compounds. This overhead steam enters a condenser and separator. A portion of the condensed liquor phase is refluxed back to the distillation column, but a larger portion is stored as crude turpene for further processing. The non-aqueous phase from the separator is stored as crude turpene while the aqueous phase is removed as wastewater. The bottom stream from the second distillation column is the finished wood rosin product.

The crude turpene removed in the second distillation column is stored until a sufficient quantity accumulates for processing in a batch distillation column. The distillation column is charged with the crude turpene material, and the condensed material enters a separator. The turpene and pine oil products are removed from the separator, while the vapors and steam from the steam ejector enter a second shell-and-tube exchanger and proceed to a separator. The bottom from this batch distillation column is a residue containing high-boiling point materials, best described as pitch, which are used as fuel.

Tall Oil Rosin, Fatty Acids, and Pitch

A schematic process flow diagram of a typical crude tall oil fractionation process is presented in Figure III-3.

The crude tall oil is treated with dilute sulfuric acid to remove some residual lignins as well as mercaptans, disulfides, and color

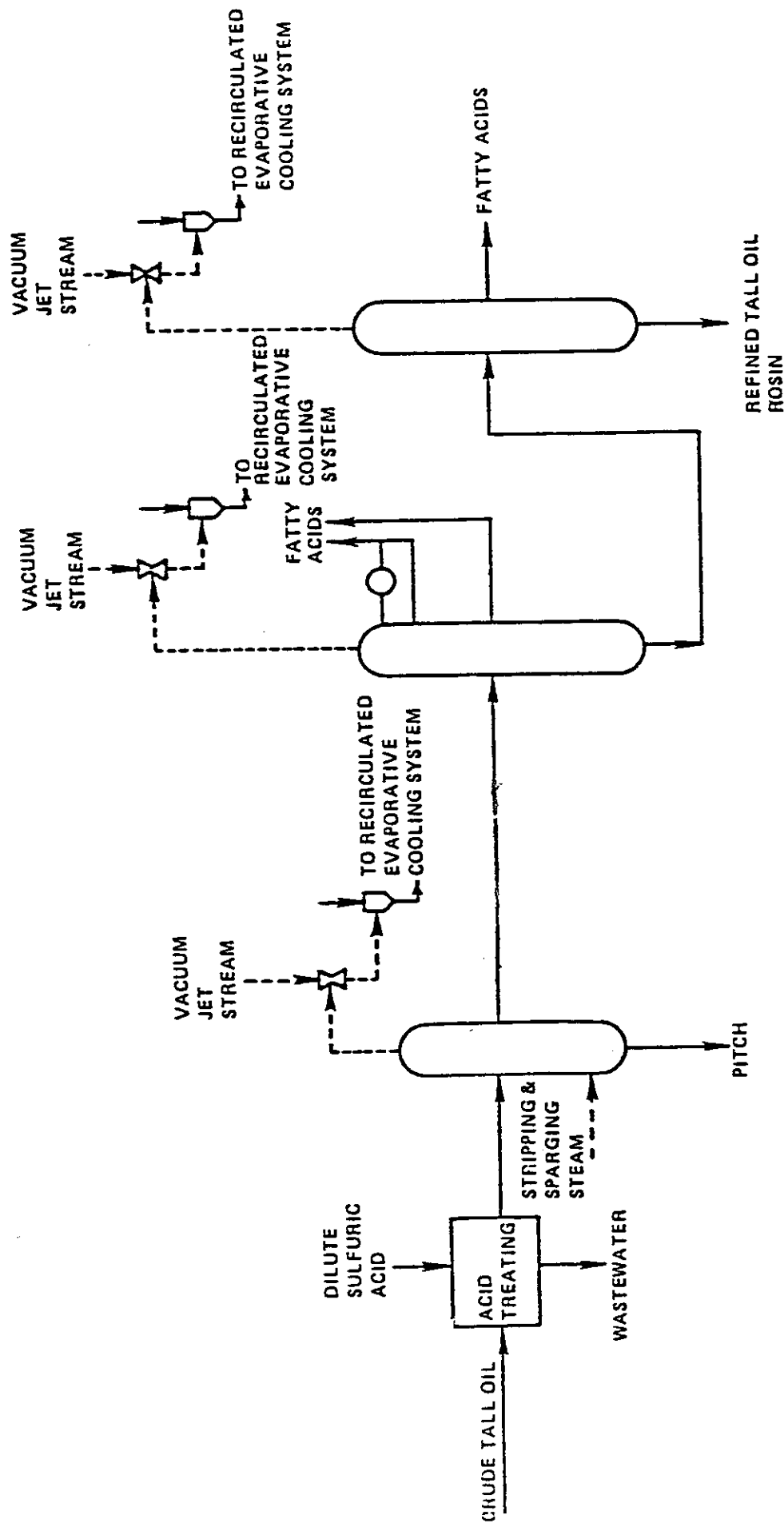


Figure III- 3.
CRUDE TALL OIL FRACTIONATION AND REFINING

materials. Acid wash water is discharged to the process sewer. The stock then proceeds to the fractionation process. In the first fractionation column, the pitch is removed from the bottoms and is either sold, saponified for production of paper size, or burned in boilers as fuel. The remaining fraction of the tall oil (rosin and fatty acid) proceeds to the pale plant, which improves the quality of the raw materials by removing unwanted materials such as color bodies. The second column separates low-boiling point fatty acid material, while the third column completes the separation of fatty and rosin acids.

The wastewater generated in this subcategory results from pulling a vacuum on the distillation towers. This water generally is recycled, but excess water is discharged to the plant sewer.

Essential Oils

Figure III-4 is a typical process flow schematic diagram for steam distillation of cedarwood oil from scrap wood fines of red cedar.

Raw dry dust from the planing mill and raw grain dust from the sawmill are mixed to obtain a desired blend and then fed pneumatically to mechanical cyclone separators located on top of the retorts. The cedarwood oil is extracted by injecting steam directly into the retort. The steam diffuses through the cedarwood dust, extracts the oil of cedarwood, exits through the top of the retort, and condenses to an oil/water mixture. Following the steam extraction, the spent sawdust cools. It is then stored and eventually sent to the boiler as a fuel.

The primary product is a crude light oil which is separated by two oil/water separators immediately downstream of the condensers. The light oil is removed and mixed with clay which lightens the product by removing color bodies and stabilizes the color of the product by inhibiting further oxidation. The clay/oil slurry is filtered through plate and frame filter presses, and the spent clay-filter material is hauled to landfill for final disposal. The lightened oil product proceeds to bulk storage and blending, and is finally drummed for shipment.

The water phase, which is separated in the stillwells, contains a heavy red crude oil. This material is separated from the water phase in three consecutive settling tanks. The heavy red oil is periodically removed and drummed for sale as a by-product, while the underflow, or remaining water phase, is discharged as wastewater.

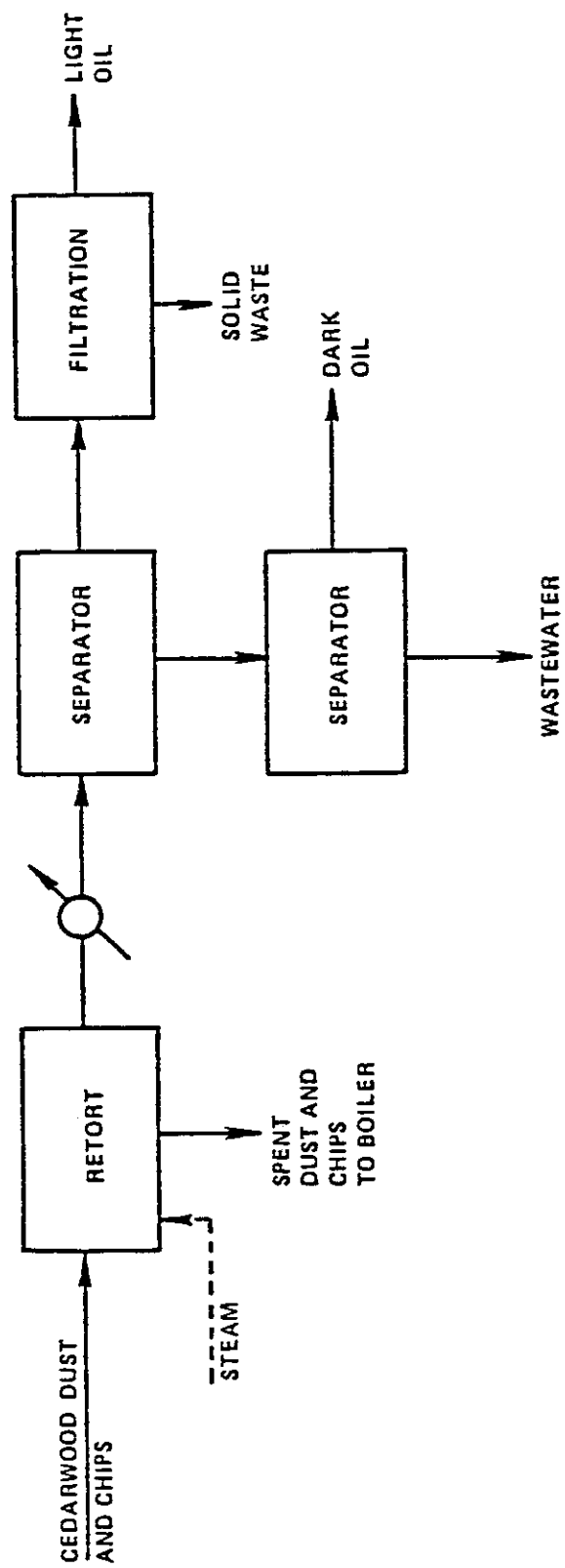


Figure III- 4.

DISTILLATION AND REFINING OF ESSENTIAL OILS

Rosin Derivatives

Figure III-5 illustrates a typical rosin derivative process. Process operating conditions in the reaction kettle depend on product specifications, raw materials, and other variables. A simple ester is produced from stump wood rosin (WW grade) and U.S.P. glycerin under high-temperature vacuum conditions. A steam sparge (lasting approximately 2-3 hours) removes excess water of esterification; this allows completion of the reaction and removes fatty acid impurities for compliance with product specifications. The condensable impurities are condensed in a non-contact condenser on the vacuum leg and stored in a receiver. Non-condensables escape to the atmosphere through the reflux vent and steam vacuum jets. The production of phenol and maleic anhydride modified tall oil resin ester is similar to simple rosin ester production except that steam sparging is seldom, if ever, used; and other polyhydric alcohols may be used in the product formulation.

Wastewater comes from the chemical reaction, separation of product, and wash down of reaction vessels.

Sulfate Turpentine

Figure III-6 is a simple process flow schematic diagram for distillation of sulfate turpentine, which is condensed from the relief gas from the digester of the Kraft pulping process. During distillation, the first tower usually strips odor-causing mercaptans from the turpentine. Subsequent fractionation breaks the turpentine into its major components: alpha-pinene, beta-pinene, dipentene, and sulfated pine oil. Minor components include limonene, camphene, and anethol.

The distillation of sulfate turpentine is an intermediate production step. Some of these turpentine components are marketed after distillation, but the majority of them remain in the plant for further processing.

The operations are usually batch reactions that take place in reaction kettles in the presence of some organic solvent and metal catalyst. The selection of catalysts and solvents depends on the desired products, of which there are approximately 200.

Wastewater usually is generated from the condensation in the distillation tower and from wash down of reactors.

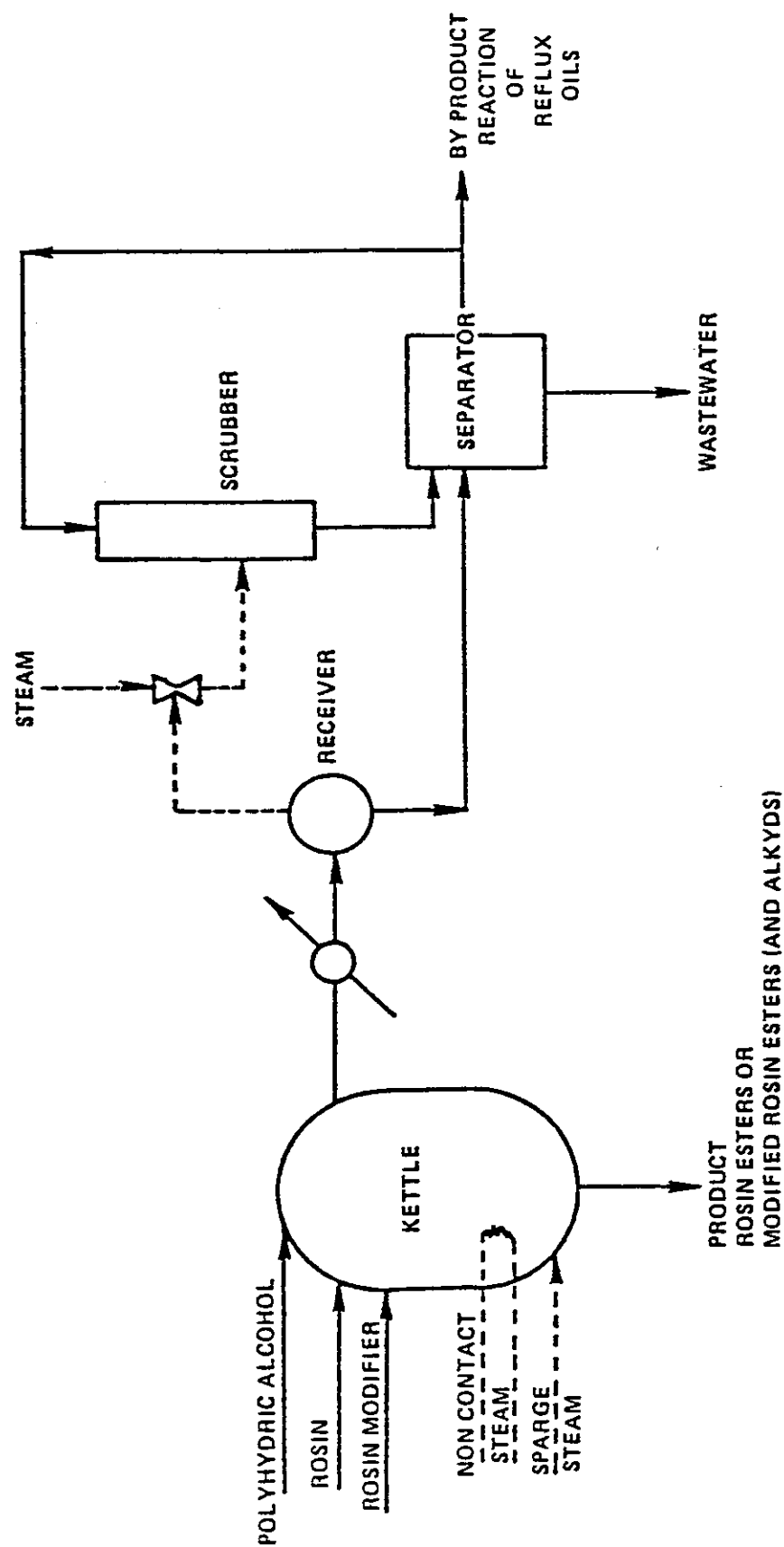


Figure III-5.

ROSIN DERIVATIVES MANUFACTURE

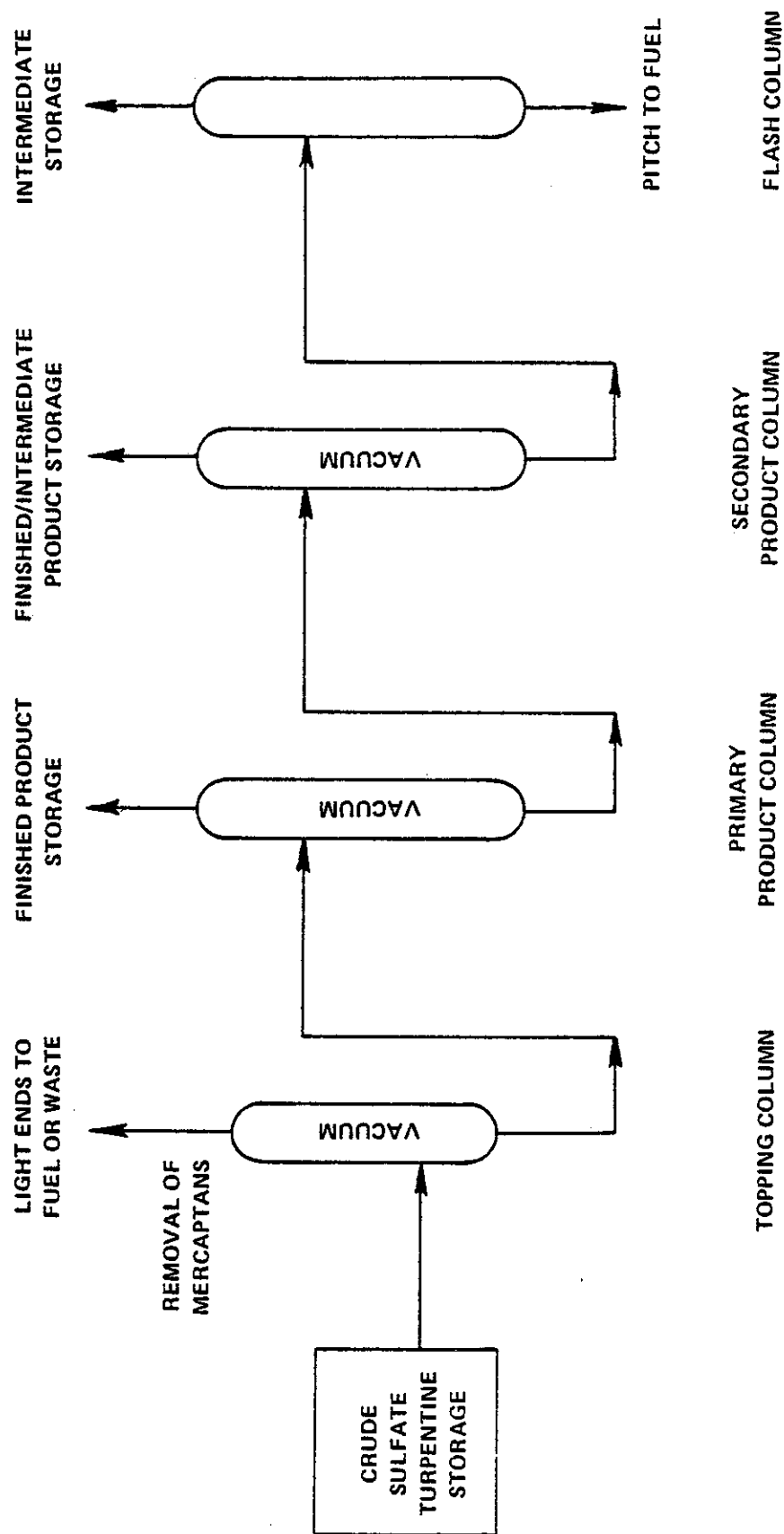


Figure III- 6.

BASIC PROCESS FLOW TURPENTINE DISTILLATION

SECTION IV

INDUSTRIAL SUBCATEGORIZATION

Review of existing industrial subcategorization for the Gum and Wood Chemicals Industry required a determination of whether sufficient differences exist within the industry to support the current subcategorization scheme, or whether modifications are required. The rationale for subcategorization is based upon such factors as: (1) plant characteristics and raw materials; (2) wastewater characteristics, including toxic pollutant characteristics; (3) manufacturing processes; and (4) applicable methods of wastewater treatment and disposal.

In developing the previously published effluent limitation guidelines and pretreatment standards for the industry, EPA determined that plants exhibited sufficient differences to justify multiple subcategorization. That subcategorization was as follows:

1. Char and charcoal briquets;
2. Gum rosin and gum turpentine;
3. Wood rosin, turpentine, and pine oil;
4. Tall oil rosin, pitch, and fatty acids;
5. Essential oils; and
6. Rosin derivatives.

The subcategorization review confirmed the above subcategories were appropriate, except that a seventh subcategory, Sulfate Turpentine, should be included.

SUBCATEGORIZATION REVIEW

The Agency considered the following factors in the subcategorization review:

1. Manufacturing process;
2. Plant location and climate;
3. Raw materials;
4. Plant age, size, and flow;

5. Products; and

6. Wastewater characteristics and treatability.

Manufacturing Process

The process step common to gum, wood, tall oil chemical, essential oils, and sulfate turpentine production is the use of steam distillation to separate the major constituents. However, there is a large difference in the degree of technology used in the five processes. Wood, rosin, tall oil chemicals, and sulfate turpentine use fractionation towers for multi-product separation. The gum and essential oil subcategories use simple reactors to separate the volatile from the non-volatile components.

The production of charcoal and rosin-based derivatives differs from the other processes because steam distillation is not employed. Charcoal is a destructive distillation product of wood. The production of rosin-based derivatives is not a distillation but a chemical modification. For some reactions, a catalyst is employed. The Agency has determined that these distinct manufacturing processes are a basis for subcategorization.

Plant Location and Climate

The 1972 Census of Manufacturers places the majority of the gum and wood chemicals production facilities in the southern states (see Figures IV-1 and IV-2). These plants produced over 84 percent of the industry output in terms of dollar value added to the raw material.

Plant location and local climate can affect the performance of certain end-of-pipe wastewater treatment systems, e.g., aerated lagoons and activated sludge. However, treatment systems including biological treatment, can be adapted to the small variation in climate found in the Gum and Wood Chemicals Industry. Plant location and climate are not criteria for subcategorization because of the general southeastern location of the plants and the adaptability of the treatment systems to climatic conditions.

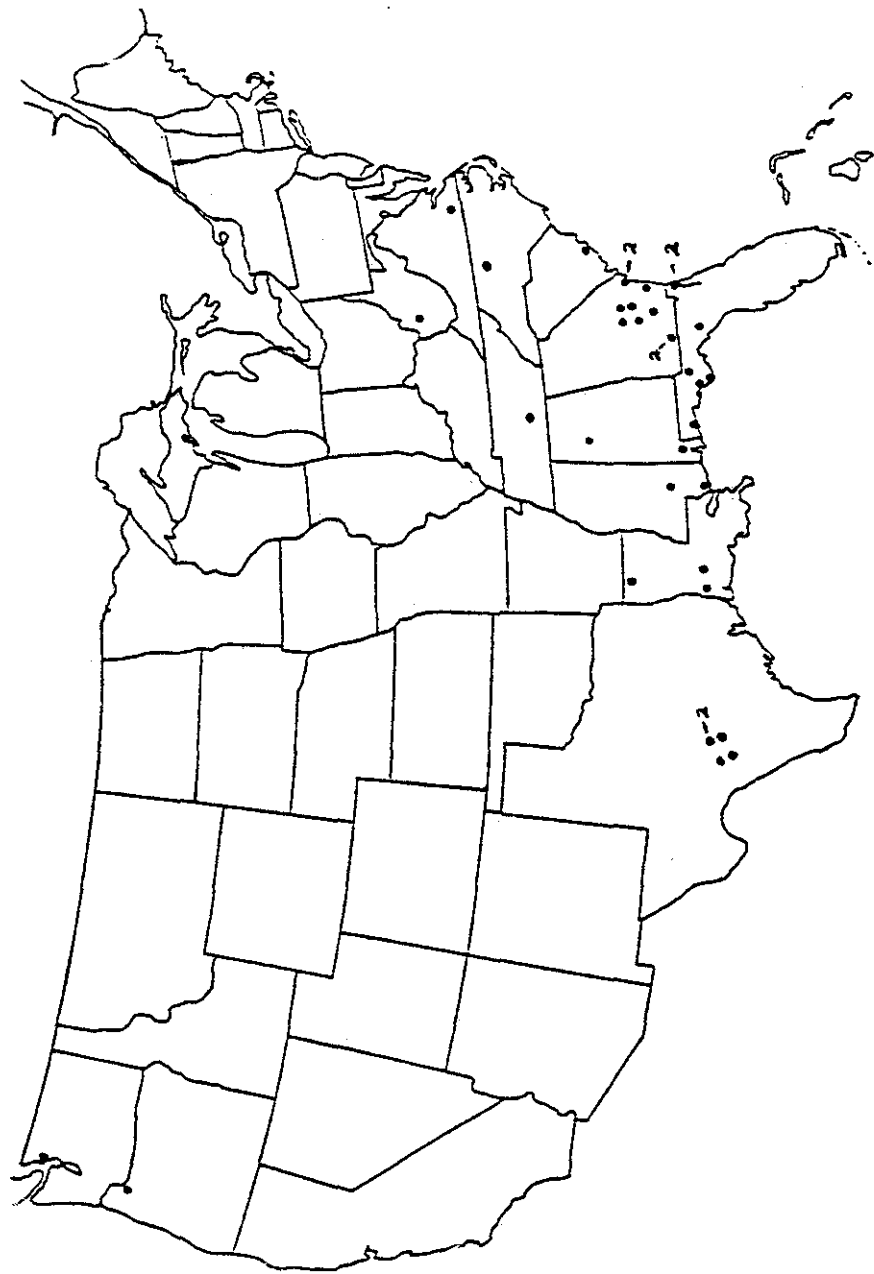


Figure IV-1. Location of Naval Stores Plants

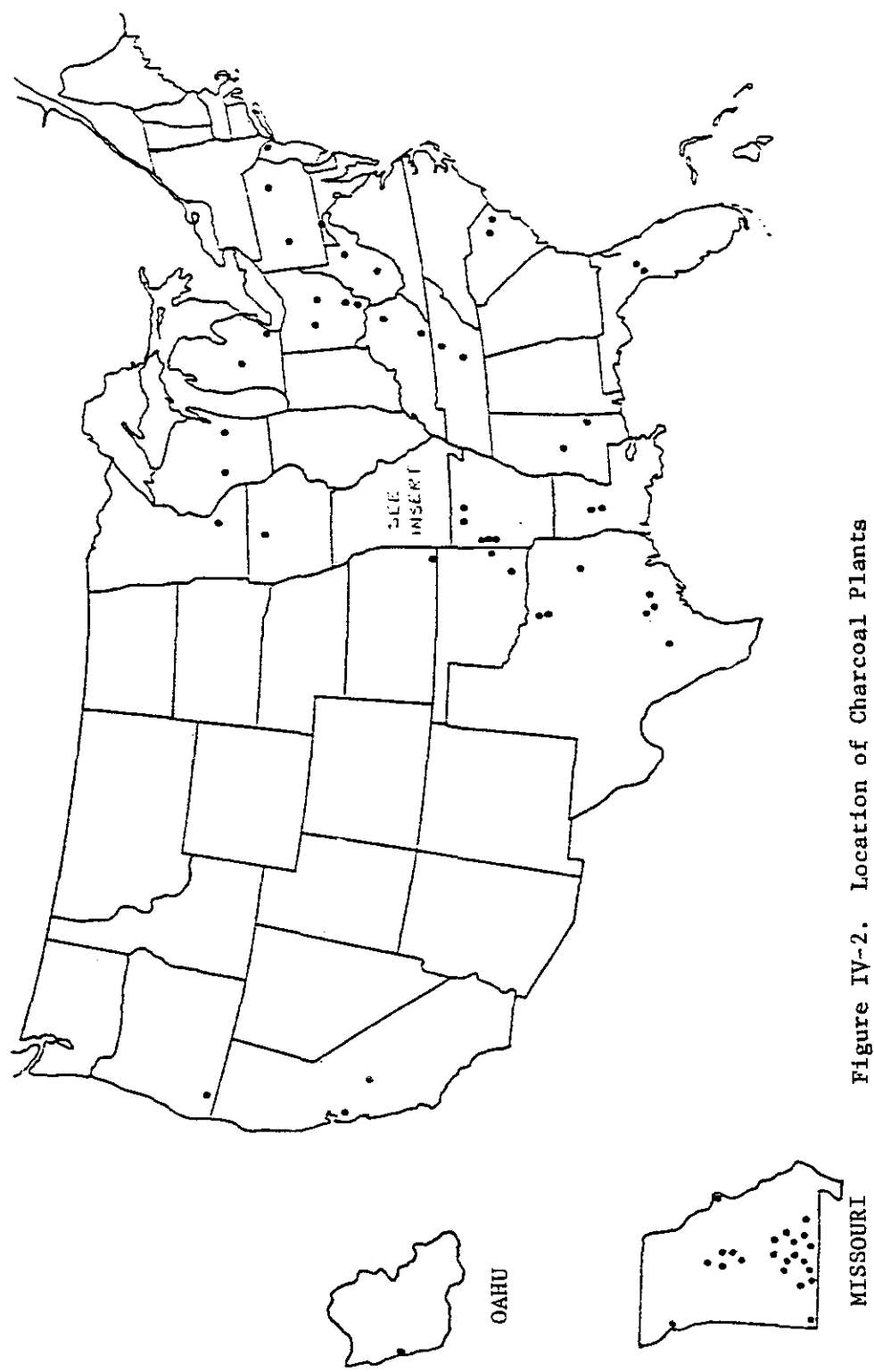


Figure IV-2. Location of Charcoal Plants

Raw Materials

The basic raw materials for each of the product subcategories are as follows:

<u>Product</u>	<u>Raw Material Source</u>
Char and Charcoal Briquets	Hardwood and softwood scraps
Gum Rosin and Turpentine	Crude "gum" oleoresin from the sapwood of living trees
Wood Rosin, Turpentine, and Pine Oil	Wood stumps and other resinous woods from cut over forest
Tall Oil Rosin, Pitch, and Fatty Acids	By-product crude tall oil from the Kraft process
Essential Oils	Scrap wood fines, twigs, barks, or roots of select woods or plants
Rosin Derivatives	Rosin products from gum, wood, and tall oil chemicals
Sulfate Turpentine	Low boiling vapors condensed from the Kraft pulping of pine wood

Variations in raw materials within each subcategory do occur. For example, seasonal changes can change crude gum composition. Late in the growing season, crude gum is termed scrape, which generally contains less turpentine and more rosin. Where variations in raw materials require additional processing to achieve product quality, additional wastes are generated.

Because of these factors, the Agency concluded that raw materials are a basis for subcategorization. Variations in raw wastewater generation due to seasonal changes are reflected in the analysis of long term wastewater characteristics and were determined not to be a factor requiring further subcategorization.

Plant Age

Manufacturers continuously upgrade and modernize their operations and equipment as it becomes necessary, thus the actual age of production facilities cannot be determined accurately. Furthermore, the age of the equipment does not necessarily affect wastewater generation. Operation and maintenance of the equipment are more important factors. Therefore, plant age in itself is not a basis for subcategorization.

Plant Size and Flows

Operations in gum and wood chemicals manufacturing range from intermittent batch operations operated by a handful of personnel, to large complexes which employ hundreds. Water use management techniques are affected by economy of scale, as well as such factors as geographical location. On the other hand, smaller operations may have waste treatment and disposal options, such as retention, land spreading, and trucking to landfill, that are impractical for large-scale operations.

The volume of wastewater produced by the plants in the Gum and Wood Chemicals Industry ranges from 9 to 7,570 cubic meters per day (2,300 to 2,000,000 gallons per day). Discharge flow rates for each subcategory are difficult to quantify because most plants have combined processes that fall under several different subcategories, and all process wastewater typically is discharged to a common sewer. Although total plant flow can be determined from this discharge pipe, a breakdown into components from each process is not possible. Table IV-1 tabulates wastewater flows for each plant, and groups them according to the processes within the plant.

Plant size does not appear to affect wastewater quantity and characteristics; therefore, plant size is not a basis for subcategorization.

Product

The major products of the Gum and Wood Chemicals Industry differ significantly as discussed in Section III. Therefore, product type is a basis for subcategorization.

Wastewater Characteristics and Treatability

The physical characteristics of the wastewater from the Gum and Wood Chemicals plants are similar. The raw wastewaters have floating oils and emulsified oils; the organic components of the wastewater include turpenes, natural components of the wood, and various solvents. Metals are used as catalysts in two subcategories in the Gum and Wood Chemicals Industry. The type of manufacturing process determines the type of metals found in the waste stream.

The Gum and Wood Chemicals wastewater streams are amenable to biological treatment, which is the major treatment method now used by the direct discharging plants. Moreover, where metals are used as catalysts, they are subcategory specific. The wastewater characteristics and treatability themselves do not support the use of this as a criterion for further subcategorization.

POTENTIAL SUBCATEGORIES

Consideration of the plant characteristics, raw materials, wastewater volume, wastewater characteristics, manufacturing processes, and wastewater treatment and disposal methods current in the industry confirms the existing subcategorization of the Gum and Wood Chemicals Industry and adds the sulfate turpentine subcategory.

Table IV-1. Tabulated Wastewater Flows by Plant

Subcategories	Plant No.	Type Discharge	Production lbs/day	Wastewater Flow (GPD)
G	009	Indirect	126,900	72,000
	885	Indirect	190,000	325,000
G, F	159	Direct	99,715	1,180,000
G, C, F	571	Indirect	480,000	580,000
	222	Indirect	1,023,000	463,000
G, D, F	743	Direct	460,000	180,000
	993	*	1,028,000	1,011,000
E, F	485	Indirect	100,000	5,000
C	934	Direct	106,000	155,000
C, F	242	Direct	740,000	1,930,000
D, F	334	Direct	438,000	800,000
	244	Direct	306,000	168,000
	714	*	422,900	533,000
	660	Indirect	152,300	49,100
	454	*	675,000	118,000
	040	*	499,000	900,000
	049	*	595,000	352,000
D	759	Direct	360,000	41,760
	436	Direct	335,000	600,000
	590	*	425,000	260,000

E = Gum rosin and turpentine

C = Wood rosin, turpentine, and pine oil.

D = Tall oil rosin, pitch, and fatty acid.

F = Rosin- and terpene-based derivatives.

G = Sulfate turpentine.

* Plant discharges into the waste stream of another plant.

SECTION V

WASTEWATER CHARACTERISTICS

GENERAL

This section defines the plants wastewater quality in those subcategories identified in Section IV. Raw waste load (RWL) data are also presented for some plants which produce in more than one subcategory or process flows that produce data extending across more than one subcategory. Raw waste load data are for both traditional parameters and for toxic pollutants for each subcategory.

The term "raw waste load," as used in this document, refers to the quantity of a pollutant in wastewater prior to a treatment process. Where treatment processes are designed primarily to recover raw materials from the wastewater stream, raw waste loads are obtained following these processes. An example is the use of gravity oil-water separators which remove the surface oils for reprocessing or recover them for fuel value.

For purposes of cost analysis only, EPA has defined representative raw waste characteristics for each subcategory in order to establish design parameters for model plants.

The data in this document represent a summary of the most current information available from each contacted plant. Sampling data in most cases are the sole source of qualitative information for toxic pollutant raw waste loads.

Exclusion Under Paragraph 8

EPA has submitted three of the seven Gum and Wood Chemical subcategories for exclusion under paragraph 8 of the NRDC Settlement Agreement. These subcategories are char and charcoal briquet, gum rosin and turpentine, and essential oil. Appendix C is the recommendation package containing the rationale for the exclusion of these subcategories.

Wood Rosin, Turpentine, and Pine Oil

Five plants process wood stumps for their extractable components. Only one plant has segregated wood rosin waste streams; the other four plants have multi-process waste streams. The multi-process streams could not be used to characterize the wastewater from the subcategory.

Table V-1 shows the analytical results of sampling conducted at this plant. Levels for methylene chloride and benzene in the ground water are unusually high and may indicate contamination of the sample for

Table V-1. Sample Analysis, Plant 464

Parameters ug/l	1757	1758	1759	8676 Blank	1760	8678	1761	8190	8187	8677 Blank
Methylene Chloride	910	190	560	NA	260	NA	260	430	340	280
Chloroform	20		10	NA	30	NA				
Ethylbenzene		50	10	NA		NA				
Toluene		Ind.	>400	NA	>400	NA		10		
Arsenic				15	14	17	22	12		
Copper		33						16		21
Chromium		1500	980		620		92	130	110	
Lead		15	17		13					
Zinc		160	89	29	150	46	49	29	32	56
Total Phenols	120	460	980		10			30	140	
Suspended Solids (mg/l)		240	220		160		48	70	48	
COD (mg/l)	11	1200	1100		730		110	230	340	
BOD (mg/l)		1500	650		270		27	25	13	
Oil & Grease (mg/l)					18				12	

Values of <10 ug/l have not been included.

Blank values have not been subtracted.

Ind.—Indeterminate because of high organic compound loading.

NA—Not analyzed.

Table V-1A. Sample Numbers, Plant 464

1757	Process make-up water--well water
1758	Wastewater influent to equalization basin
1759	Wastewater effluent from equalization basin of approximately 15-day retention
1760	Wastewater effluent from ash settling basin
1761	Final wastewater effluent after aerated lagoon and settling
8190	Final wastewater effluent after aerated lagoon and settling
8187	Final wastewater effluent after aerated lagoon and settling
8676, 8678, 8677	Blanks

these two compounds. As shown in the analysis, toluene is the major organic toxic pollutant contained in the wastestream.

Toluene is the extractive solvent in the production process and this explains its presence in the wastestream. For removal of toluene concentrations below 10 mg/l, biological treatment is the least expensive method. Table V-1 clearly shows a reduction from a concentration greater than 400 ug/l to a concentration of 10 ug/l or less. Benzene and ethylbenzene are trace contaminants found in industrial grade toluene. These compounds appeared in concentrations of 200 and 50 ug/l in the raw process wastestream but were not detected in the discharge effluent. These compounds are also amenable to biological treatment, which this plant provides by use of an aerated lagoon and a settling basin. This plant also employs a unique pretreatment procedure of mixing wood ash from the boiler with the equalized wastewater. The wastewater with ash is allowed to settle and is then sent to the biological treatment. The adsorption characteristics of the wood ash have not been determined.

The major inorganic toxic pollutants for this plant were chromium and zinc. Chromium in the raw wastewater, as shown in Table V-1, was 1500 ug/l, and decreased to approximately 100 ug/l in the treated effluent. Zinc was reduced through the treatment system, from 160 ug/l in the raw wastewater to approximately 30 ug/l in the treated effluent. The other metals occurred at concentrations of less than 20 ug/l.

Tall Oil, Rosin, Pitch, and Fatty Acids

Of the twelve tall oil distillation plants currently in the industry, three perform only tall oil distillation and some rosin size operations. One of these plants (Plant 949) was sampled during the sampling program, and the results of that sampling are presented in Table V-2. The nine other tall oil distillation plants have combined processes which make them unsuitable for characterizing the waste streams.

The plant's makeup water comes from wells located on plant property. The analysis of the well water showed high concentration levels of methylene chloride (710 ug/l) and also concentrations of benzene (120 ug/l) and toluene (20 ug/l). These are unusually high levels of these compounds for well water and may be due to sample contamination. This plant is the only plant in the industry that recycles all of its barometric condenser water from the tall oil fractionation towers. Sample Number 8186 presents an analysis of this recycled barometric condenser water. Phenol was the major toxic pollutant found in this waste stream. The concentration level was 7.5 mg/l. This concentration may be due to a high equilibrium concentration of the recycled wastewater.

Table V-2. Sample Analysis, Plant 949

Parameters ug/l	8182	1718	8675 Blank	8184	8186	1735	8684 Blank
Methylene Chloride	740	710	30	780	210	850	
Chloroform	10	10		10		10	
Benzene	120	120		110	30	120	
Ethylbenzene		20		10			
Toluene	20	20		50	70	20	
Phenol					7500		
Copper		150	16	230	300	220	280
Chromium	110	83	85	97	280	88	100
Lead		14			26		
Nickel	13	19	20	24	66	43	14
Selenium		11					
Zinc		50	70	27	80	44	
Total Phenols		550		100	1700	29	
Suspended Solids (mg/l)		44		15	170	19	
COD (mg/l)		1100		160	8400	130	
BOD (mg/l)		42		12	176		
Oil & Grease (mg/l)		48			167	13	

Values of <10 ug/l have not been included.
Blank values have not been subtracted.

Table V-2A.

Sample Numbers, Plant 949

Sample Numbers

8182	Process make-up water--well water
1718	Raw effluent
8184	Effluent after initial settling
8186	Barometric condenser closed system
1735	Treated effluent

Aerated lagoons are used in this plant to provide biological treatment of the wastewater, supplemented by the use of alum coagulation to enhance settling of emulsified oils.

Sulfate Turpentine

There are seven U.S. plants which fractionate sulfate turpentine. The Agency sampled four of these plants. Tables V-3 through V-5A show the results. Two of the sampled plants have waste streams that are combined with effluents from other processing areas. Under normal circumstances, the products of sulfate turpentine fraction are chemical intermediates used in other processing steps. The major products of fraction are α -pinene, β -pinene, dipentene, camphene, and pine oil. The final products of these intermediaries are "synthetic" pine oil, poly-turpene resins, insecticides, fragrances, and sizes.

Plants 337 and 610 produce fragrances and Plant 065 produces polyturpene resins and turpene specialty products. The sampling results for Plants 337 and 610 appear in Tables V-3 and V-4.

The volatile organic toxic pollutants are toluene in concentrations of approximately 2 mg/l and benzene in the concentration range of 50 ug/l to 220 ug/l. Chloroform was found in concentrations of 1 mg/l to 1.4 mg/l in Plant 337, but was not found in Plant 610. Methylene chloride appeared in well water supplies of both plants, which may indicate a contamination problem.

The significant non-volatile organics were phenol at a concentration of 700 to 850 ug/l at Plant 337 and bis(2-ethylhexyl) phthalate at Plant 610 at a concentration of 1,900 ug/l after biological treatment. Phenol is a natural component of wood. The bis(2-ethylhexyl) phthalate is not used in the processes of Plant 610 and was not found in the raw effluent. It was detected in only one sample out of three and may be either a contaminant or a result of the treatment process.

The major inorganic toxic pollutants are copper, nickel, and zinc. These three metals are common catalysts in the gum and wood chemicals industry. Copper was found in concentrations as high as 4.5 mg/l, nickel as high as 1.1 mg/l, and zinc at 2.4 mg/l.

The waste stream from Plant 065 differs greatly from that of Plants 337 and 610. Much higher concentrations of volatile organic solvents occur in this process waste stream than in those of the other two plants. Toluene was found to be as high as 40 mg/l and ethylbenzene concentrations as high as 67 mg/l. Phenol was found in concentrations of 1.1 mg/l, and bis(2-ethylhexyl) phthalate at a concentration of 3 mg/l. Table V-5 shows the results of the sample analysis.

Table V-3. Sample Analysis, Plant 337

Parameters ug/l	801	802	804	1745	743 Blank	803	805	1753	742 Blank
Methylene Chloride	400	450	740			490	2100	980	360
Chloroform		1000	1400	980		900	1400	1000	
Benzene	74					120	240	210	70
Toluene			2200	1000		1900	2000	1100	
Phenol		760	130			850			
Arsenic		35	43	59	12	35	120	73	
Copper		1800	6000	2700	32	2700	3100	1800	
Chromium		1300	760	580		880	850	480	
Lead			21	12			13		
Nickel		520	4100	3000		180	700	1100	
Zinc		170	530	300	29	99	430	260	32
Total Phenols	28	1600	1000	960		2600	1300	1000	
Suspended Solids (mg/l)		60		18		36	32	30	
COD (mg/l)	18	6400	7300	5400		6400	7400	5800	
BOD (mg/l)		3400	3200	2200		3900	4800	2500	
Oil & Grease (mg/l)		354	407	284		485	506	450	

Values of <10 ug/l have not been included.
Blank values have not been subtracted.

Table V-3A. Sample Numbers, Plant 337

801	Process make-up water
802, 804, 1745	Process effluent after skimming and initial settling
803, 805, 1753	Final effluent

Table V-4. Sample Analysis, Plant 610

Parameters ug/l	705	708	710	726	8667 Blank	723	703	711	8666 Blank
Methylene Chloride	560	16000	3200	650	NA	1700	1900	2400	300
Benzene			140		NA		210		
Toluene			2100	920	NA		170		
Bis(2-ethylhexyl) phthalate						1900			
Arsenic			110						
Copper	250	2700	1700	1600	190	4700	1900	2300	220
Chromium	120	510	49	51	36	250	94	100	16
Lead		13	11			14	19	14	
Nickel	36	220	160	140	13	46	310	340	16
Selenium						19			
Zinc		200	290	240	30	320	450	320	30
Total Phenols	18	1300	4500	530		14000	2000	1600	
Suspended Solids (mg/l)		300	240	180		520	470	280	
COD (mg/l)	16	15000	7900	7500		5600	3800	4600	
BOD (mg/l)		1200	1200	2000		590	400	330	
Oil & Grease (mg/l)		450	260	160		49	74	300	

Values of <10 ug/l have not been included.
Blank values have not been subtracted.

Table V-4A. Sample Numbers, Plant 610

705	Process make-up water--well water
708, 710, 726	Raw process effluent
723, 703, 711	Final treated effluent
8667, 8666	Blanks

Table V-5. Sample Analysis, Plant 065--Turpene Sump

Parameter (ug/l	1747	1751	1755	8668 Blank
Methylene Chloride	2000	2400	510	52
Chloroform	320	1000	80	
1,1,1-Trichloroethane		640		
Benzene	180	Ind.	90	60
Ethylbenzene	67000	Ind.	6600	
Toluene	4300	>40000	730	
Phenol	150		1100	
Bis(2-ethylhexyl) Phthalate			3000	
Arsenic	20		17	11
Copper	100	180	33	
Chromium	130	190	130	
Lead	57		27	
Nickel	66	130	120	
Zinc	680	810	320	39
Total Phenols	2000	970	6000	
Suspended Solids (mg/l)	200	190	170	
COD (mg/l)	15000	19000	7000	
BOD (mg/l)	4500	4800	960	
Oil & Grease (mg/l)	14	1800	670	

Values of <10 ug/l have not been included.

Blank values have not been subtracted.

Ind.--Indeterminate because of high organic compound loading.

Table V-5A. Sample Numbers, Plant 065

1747	Turpene sump, first day
1751	Turpene sump, second day
1755	Turpene sump, third day
8668	Blank

Rosin Derivatives

Rosin derivatives are a major product within the Gum and Wood Chemicals Industry. These products are not classified under SIC Code 2861, but rather under SIC CODE 2821 (rosin-modified resins). The Agency determined that these products should be covered under Gum and Wood Chemicals as long as they were directly related to the Gum and Wood Chemicals plants in SIC code 2861.

EPA selected Plant 097 for sampling because it separated the rosin derivatives process wastewater from other waste streams. The rosin derivatives subcategory has a diverse product line, however, and these results may not characterize all rosin derivatives operations. The results of the verification analyses appear in Table V-6.

The major toxic pollutants in this subcategory are the organic solvents. Toluene is a standard solvent used in the industry. Ethylbenzene is not used in the plant specifically, but is a contaminant of the industrial grade xylene which the plant uses in its process.

The only non-volatile organic found in sampling was phenol. High concentrations of phenol (23 mg/l) were present because this plant produces a phenolic resin.

Zinc is a common catalyst used in the industry and the high levels were not unexpected.

The consistently high levels of methylene chloride suggest a contamination problem because it is not used in the plant processes. Its presence could not be explained by the plant's raw materials, production process, or through interviews with plant personnel.

Table V-6. Sample Analysis, Plant 097--Rosin Derivatives Process

Parameter (ug/l)	730	706	737	2694 Blank
Chloroethane			520	
Methylene Chloride	2700	7300	6700	630
1,1,1-Trichloroethane		830		
Benzene		170	710	
Ethylbenzene	12000	2200	28000	
Toluene	17000	5300	>4000	
Phenol	>10620	14000	23000	
Arsenic	41	53		
Cadmium	95	120	100	
Copper	300	180	190	
Chromium	48	62	34	
Lead	54	72	49	
Nickel	100	34	35	
Zinc	38000	38000	38000	
Total Phenols	41000	46000	53000	
Suspended Solids (mg/l)	71	87	70	
COD (mg/l)	31000	40000	38000	
BOD (mg/l)	1260	450		
Oil & Grease (mg/l)	92	146	62	

Values of <10 ug/l have not been included.
Blank values have not been subtracted.

Table V-6A. Sample Numbers, Plant 097

730	Resin plant effluent, first day
706	Resin plant effluent, second day
737	Resin plant effluent, third day
2694	Blank

SECTION VI

SELECTION OF POLLUTANT PARAMETERS

WASTEWATER PARAMETERS OF SIGNIFICANCE

A thorough analysis of the literature, industry data and sampling data obtained from this study and EPA permit data demonstrates that the following wastewater parameters are of significance in the gum and wood chemicals industry:

Conventional and Nonconventional Pollutant Parameters

- Biochemical Oxygen Demand (5-day, 20 degrees C., BOD₅)
- Total Suspended Solids (TSS)
- pH

Toxic Pollutants

- Organics
 - Volatile
 - Semi-Volatile
 - Basic/Neutral Fraction
 - Acidic Fraction

- Inorganics
- Metals

CONVENTIONALE AND NONCONVENTIONAL POLLUTANT PARAMETERS

Biochemical Oxygen Demand (BOD)

Biochemical oxygen demand is the quantity of oxygen required for the biological and chemical oxidation of waterborn substances under ambient or test conditions. Material which may contribute to the BOD include: carbonaceous organic materials usable as a food source by aerobic organisms; oxidizable nitrogen derived from nitrites, ammonia, and organic nitrogen compounds which serve as food for specific bacteria; and certain chemically oxidizable materials such as ferrous iron, sulfides, sulfite, etc., which will react with dissolved oxygen or which are metabolized by bacteria.

In the gum and wood chemicals wastewaters, the BOD derives principally from organic materials, such as fatty acids and resins.

The BOD of a waste adversely affects the dissolved oxygen resources of a body of water by reducing the oxygen available to fish, plant life, and other aquatic species. It is possible to reach conditions which totally exhaust the dissolved oxygen in the water, resulting in

anaerobic conditions and the production of undesirable gases such as hydrogen sulfide and methane. The reduction of dissolved oxygen can be detrimental to fish populations, fish growth rate, and organisms used as fish food. A total lack of oxygen due to excessive BOD can result in the death of all aerobic aquatic inhabitants in the affected area.

Water with a high BOD indicates the presence of decomposing organic matter and associated increased bacterial concentrations that degrade its quality and potential uses. High BOD increases algal concentrations and blooms; these result from decaying organic matter and form the basis of algal populations.

The BOD₅ (5-day BOD) test is used widely to estimate the oxygen requirements of discharged domestic and industrial wastes. Complete biochemical oxidation of a given waste may require a period of incubation too long for practical analytical test purposes. For this reason, the 5-day period has been accepted as standard, and the test results have been designated as BOD₅. Specific chemical test methods are not readily available for measuring the quantity of many degradable substances and their reaction products. In such cases, testing relies on the collective parameter, BOD₅. This procedure measures the weight of dissolved oxygen utilized by microorganisms as they oxidize or transform the gross mixture of chemical compounds in the wastewater. The biochemical reactions involved in the oxidation of carbon compounds are related to the period of incubation. The 5-day BOD normally measures only 60 to 80 percent of the carbonaceous biochemical oxygen demand of the sample, and for many purposes this is a reasonable parameter. Additionally, it can be used to estimate the gross quantity of oxidizable organic matter.

Total Suspended Solids (TSS)

Suspended solids include both organic and inorganic materials. The inorganic compounds include sand, silt, clay, and toxic metals. The organic fraction includes such materials as grease, oil, animal and vegetable waste products, and adsorbed toxic organic pollutants. These solids may settle out rapidly and bottom deposits are often a mixture of both organic and inorganic solids. Solids may be suspended in water for a time and then settle to the bed of the stream or lake. They may be inert, slowly biodegradable materials, or rapidly decomposable substances. While in suspension they increase the turbidity of the water, reduce light penetration, and impair the photosynthetic activity of aquatic plants.

Aside from any toxic effect attributable to substances leached out by water, suspended solids may kill fish and shellfish by causing abrasive injuries, by clogging gills and respiratory passages screening out light, and by promoting and maintaining the development

of noxious conditions through oxygen depletion. Suspended solids also reduce the recreational value of the water.

pH

pH. Although not a specific pollutant, pH is related to the acidity or alkalinity of a wastewater stream. It is not a linear or direct measure of either; however, it may properly be used to control both excess acidity and excess alkalinity in water. The term pH describes the hydrogen ion--hydroxyl ion balance in water. Technically, pH is the hydrogen ion concentration or activity present in a given solution. pH numbers are the negative logarithm of the hydrogen ion concentration. A pH of 7 generally indicates neutrality or a balance between free hydrogen and free hydroxyl ions. Solutions with a pH above 7 indicate that the solution is alkaline, while a pH below 7 indicates that the solution is acidic.

Knowledge of the pH of water or wastewater aids in determining measures necessary for corrosion control, pollution control, and disinfection. To protect POTW from corrosion, pH levels of wastewaters entering the sewerage system must remain above 5. Waters with a pH below 6.0 corrode waterworks structures, distribution lines, and household plumbing fixtures. This corrosion can add such constituents to drinking water as iron, copper, zinc, cadmium, and lead. Low pH waters not only tend to dissolve metals from structures and fixtures, but also tend to redissolve or leach metals from sludges and bottom sediments. The hydrogen ion concentration also can affect the taste of water; at a low pH, water tastes "sour."

Extremes of pH or rapid pH changes can stress or kill aquatic life. Even moderate changes from "acceptable" pH limits can harm some species. Changes in water pH increase the relative toxicity* to aquatic life of many materials. Metalocyanide complexes can increase a thousand-fold in toxicity with a drop of 1.5 pH units. The toxicity of ammonia similarly is a function of pH. The bactericidal effect of chlorine in most cases lessens as the pH increases, and it is economically advantageous to keep the pH close to 7.

The lacrimal fluid of the human eye has a pH of approximately 7.0 and a deviation of 0.1 pH unit from the norm may irritate the eyes; appreciable irritation will cause severe pain.

Wastewater pH values below 6.0 can magnify problems of hydrogen sulfide gas evolution and poor metals removal. On the other hand, unusually high pH (for instance 11.0) can cause significant loss of active biomass in biological treatment systems, especially activated sludge.

TOXIC POLLUTANTS

The 129 toxic pollutants are divided into three major groups: organics, pesticides and PCB's, and inorganics. Toxic pollutants detected in gum and wood chemicals wastes are discussed on the basis of these three groups.

Tables VI-3 and VI-4 present information on the molecular structure, number of plants where identified, concentration range in the wastewater, and, wherever possible, a brief description of the gum and wood chemical industry uses of these compounds.

Organic Toxic Pollutants

Several of the organic toxic pollutants appeared in the gum and wood chemical wastewaters at concentrations of 10 ppb or higher. Organics are classified by the physical-chemical properties which permit GC/MS analysis of these materials. The organic toxic pollutants include compounds in a volatile fraction, a basic or neutral fraction, and an acidic fraction.

Volatile Fraction. Table VI-3 summarizes the volatile organic toxic pollutants identified in the gum and wood chemical wastewaters. Frequency of identification and concentration ranges for these compounds also are summarized along with information on common uses. Nine organic pollutants were found at least once in the sampled effluents.

*The term toxic or toxicity is used herein in the normal scientific sense of the word, not the legal.

Benzene appeared in raw effluents in levels ranging up to 3800 ppb, and in concentrations up to 270 ppb in treated effluents. Benzene is not a major process raw material in the gum and wood chemicals industry. It is, however, a contaminant of toluene, which is a major solvent used in the industry.

The EPA proposed water quality criterion to protect freshwater aquatic life from the toxic effects of benzene is 3,100 ug/l as a 24 hour average; the concentration should never exceed 7,000 ug/l. For saltwater aquatic life, the 24 hour average and maximum permissible concentrations are 920 ug/l and 2,100 ug/l, respectively.

Benzene is a suspected human carcinogen. Studies of the effect of benzene vapors on humans indicate a relationship between chronic benzene poisoning and a high incidence of leukemia. There is no recognized safe concentration for a human carcinogen; for the maximum protection of human health from the potential carcinogenic effect of benzene exposure through ingestion of water and contaminated aquatic

Table VI-1. Screening Sample Results for Halomethanes

Plant	Sample #	Concentration ug/l	
		Methylene Chloride	Chloroform
868	0722	-108	0
	0728	>341	0
	2290-B	>568	10
055	8182	710	10
	1718	680	10
	8184	750	10
	8186	180	
	1735	820	10
	8675-B	30	
723	0705	260	
	0708	15,700	
	0723	1,400	
	8666-B	300	
013	714	-20	10
	724	40	
	730	2070	
	707	1270	
	2694-B	630	
	1710	-1100	
001	3150	-200	
	1720	-480	10
	1714	-720	
	8670-B	1300	

Table VI-2. Screening Sample Results for Aromatic Solvents

Plant	Sample #	Benzene	Concentration ug/l	
			Toluene	Ethylbenzene
868	0720	90	0	
	0728	>64	20	
	2290-B	140	20	
055	8182	120	20	
	1718	120	20	
	8184	110	50	
	8186	30	70	
	1735	120	20	
	8675-B			
723	0705			
	0708			
	0723			
	8666-B			
086	714	110	20	
	724	140	100	
	730		17,000	12,000
	707			2,700
	2694-B			
	1710	20	10	
001	3150	>1110	>1220	
	1720	>131	180	
	1714	590	2500	
	8670-B			

Table VI-3. Toxic Pollutants Detected (Organics)

	Raw Wastewater Sample		Treated Wastewater Sample		
	Number of Plant	Concentration Ranges ug/l	Number of Plant	Concentration Ranges ug/l	
<u>Volatiles</u>					
Benzene	9	10-3,800	8	10-270	Not used in the industry found as a contaminant of Toluene.
Carbon Tetrachloride	1	2,900-11,000	-	-	Not used in the Gum and Wood Chemical Industry but used as a solvent in other industrial operations.
1,1,1-Trichloroethane	4	36-830	2	87-140	Used as a degreaser in one of the plants sampled.
Chloroethane	2	82-520	1	87-140	Not used in industry.
Chloroform	3	10-1,100	3	10-28	Not used in industry.
Ethylbenzene	8	10-67,000	4	13-21,000	Found as a contaminant of industrial grade Xylene.
Methylene Chloride	10	20-2,100	9	110-3,800	One plant uses it as a solvent but that plant was not sampled. Probably a sampling contaminant.

Table VI-3. Toxic Pollutants Detected (Organic) (Continued, Page 2 of 2)

	<u>Raw Wastewater Sample</u>		<u>Treated Wastewater Sample</u>		
	Number of Plant	Concentration Ranges ug/l	Number of Plant	Concentration Ranges ug/l	
<u>Volatiles (Continued)</u>					
Trichlorofluoromethane	4	10-1,400	3	220-1,400	Not used in the industry.
Toluene	10	20-30,000	7	10-2,000	Major solvent in the industry.
<u>Acid Extractables</u>					
Phenol	7	64-23,000	7	49-19,000	Component of Phenolic Resin in industry product.
Pentachlorophenol	1	47	-	-	Not used in the industry.
<u>Base-Neutral Extractables</u>					
Naphthalene	1	84-150	1	27	Not used in the industry but found as a contaminant of industrial grade alcohol.
Bis (2-Ethylhexyl) Phthalate	11	31-3,000	1111	12-1,900	Not used in Gum and Wood Chemicals industrial process.

Table VI-4. Toxic Pollutants Detected (Metals)

	<u>Raw Wastewater Sample</u>		<u>Treated Wastewater Sample</u>		
	Number of Plants	Concentration Ranges ug/l	Number of Plant	Concentration Ranges ug/l	
Arsenic	8	10-59	8	10-170	Not used in Gum and Wood Chemicals Process
Cadmium	1	36-120	1	33-48	Not used in Gum and Wood Chemicals Process
Copper	10	23-6,000	10	13-47	Used as Catalyst in Sulfate Turpentine Subcategory
Chromium	9	13-1,500	8	11-880	Not used in Gum and Wood Chemicals Process
Lead	10	10-2,100	8	11-670	Not used in Gum and Wood Chemicals Process
Mercury	9	0.3-9.4	8	0.3-8.4	Not used in Gum and Wood Chemicals Process
Nickel	10	17-4,100	8	10-1,100	Used as Catalyst in Sulfate Turpentine Subcategory
Silver	1	22	-	-	Not used in Gum and Wood Chemicals Process
Zinc	10	27-91,000	10	29,24,000	Used as Catalyst in Rosin Derivatives Subcategory
Selenium	1	11	1	19	Not used in Gum and Wood Chemicals Process

organisms, the Agency recommends an ambient water concentration of zero.

Dichloromethane, also known as methylene chloride, was found in the raw, primary, and secondary effluents of a number of plants. It is a common solvent; found in insecticides; and is used also as a degreasing and cleaning liquid.

The proposed criterion to protect freshwater aquatic life is 4,000 ug/l as a 24 hour average; the concentration should never exceed 9,000 ug/l. The proposed 24 hour average concentration to protect saltwater aquatic life is 1,900 ug/l, and the maximum concentration is 4,400 ug/l. For the protection of human health from the toxic properties of methylene chloride ingested through water, the Agency recommends an ambient water quality criterion of 2 ug/l.

Ethylbenzene appeared in gum and wood chemical effluents at a higher concentration than any other volatile organic pollutant. Concentrations were as high as 67 ppm in raw wastewater and as high as 21 ppm in the treated wastewater.

Exposure to ethylbenzene has been shown to adversely affect both aquatic and human life. The compound can affect fish by direct toxic action and by imparting a taste to fish flesh. For the protection of human health from the toxic properties of ethylbenzene ingested through water, the proposed ambient water quality criterion is 1,100 ug/l.

Tetrachloromethane, commonly known as carbon tetrachloride, is a solvent for fats, oils, and waxes; an insecticide; and a chemical intermediate. Toxicological data show that rats and mice exposed to carbon tetrachloride incur liver and kidney damage, biochemical changes in liver function, neurological damage, and liver cancer. It is well documented that carbon tetrachloride is toxic to humans. Poisoning symptoms include nausea, abdominal pain, liver enlargement, and renal failure.

Carbon tetrachloride has been shown to be a carcinogen in laboratory animals and is a suspected human carcinogen. As there is no recognized safe concentration for a human carcinogen, EPA has recommended that for the maximum protection of human health, the ambient water concentration of carbon tetrachloride equal zero. To protect freshwater and saltwater aquatic life, the proposed 24 hour average concentration is 620 ug/l and 2,000 ug/l, respectively; the recommended maximum concentrations of 1,400 ug/l and 4,600 ug/l, respectively.

Toluene, a common general organic solvent, appeared in concentrations varying from trace to more than 30 ppm in raw wastewater. In treated wastewater the highest concentration was 2000 ppb.

A study using mice showed that toluene is a central nervous system depressant that can cause behavioral changes as well as loss of consciousness and death at high concentrations. Human exposure to toluene for a 2-year period has led to cerebellar disease and impaired liver function. The proposed water quality criterion to protect freshwater aquatic life is 2300 ug/l as a 24 hour average; the concentration should never exceed 5,200 ug/l. The 24 hour average and maximum concentrations to protect saltwater aquatic life are 100 ug/l and 230 ug/l, respectively.

1,1,1-Trichloroethane was found in raw and treated effluents. Its primary use is as a solvent and degreasing agent. It exhibits strong solvent action on organics, especially oils, greases, waxes, and tars; and it blends with other solvents to reduce their flammability or provide added solvent properties.

Trichlorofluoromethane was detected in the raw and treated effluents of four plants. It is used in aerosols, as a refrigerant, and in air conditioning. It is not used in the gum and wood chemicals processing industry.

Trichloromethane, commonly known as chloroform, appeared in the raw and treated effluents of several plants. It is a general solvent, refrigerant, and cleaning agent, and is registered for pesticide use on cattle. Lab tests show chloroform to be toxic to organisms at various levels of the food chain; in higher organisms it exhibits both temporary and lasting effects. Several studies indicate that chloroform is carcinogenic to rats and mice. Human exposure to chloroform can lead to liver damage, hepatic and renal damage, and depression of the central nervous system.

The proposed 24 hour average and maximum concentrations to protect freshwater aquatic life from the toxic effect of chloroform are 500 ug/l and 1,200 ug/l, respectively. The proposed water quality criterion to protect saltwater aquatic life is 620 ug/l as a 24 hour average, with a maximum concentration of 1,400 ug/l. For the maximum protection of human health from the potential carcinogenic effects of exposure to chloroform, the recommended ambient water concentration is zero.

Semi-Volatile Fraction

Basic/Neutral Fraction. The Agency identified only two basic/neutral organic compounds. These were naphthalene and bis(2-ethylhexyl) phthalate. Bis (2-ethylhexyl) phthalate was the only phthalate ester

identified in gum and wood chemical wastewater. It is not used in the direct processing of gum and wood chemical, but was found in the raw and treated effluents.

Phthalate esters can harm aquatic and terrestrial organisms at low concentrations. The compounds exhibit teratogenic and mutagenic effects under certain laboratory conditions. Of the fish species tested, the rainbow trout was the least sensitive and the bluegill the most sensitive to di-n-butyl phthalate. A cray fish species tested was the least sensitive and a freshwater zooplankton the most sensitive of all species tested.

High levels of phthalate concentration in water where reproductive impairment in certain species are suggestive of potential environmental damage. The presence of these compounds in water affects the growth and reproduction essential for maintenance of animal populations.

As a class, the phthalate esters' response to biochemical oxidation is inversely related to their molecular weight. Adsorption on activated carbon is directly related to increasing molecular weight.

Naphthalene appeared in the raw and treated effluent from one plant. It was found to be a contaminate in a industrial grade alcohol. The effects of naphthalene poisoning on humans have been studied. Naphthalene poisoning can cause convulsions and hematologic changes. Reports also indicate that workers exposed to naphthalene for extensive periods of time are likely to develop malignant tumors.

Naphthalene bioconcentrates in aquatic organisms and reduces or interferes with microbial growth. It also reduces photosynthetic rates in algae. Naphthalene accumulates in sediments up to concentrations twice that in overlying water and can be degraded by microorganisms to 1,2-dehydro-1,2-dihydroxynaphthalene and ultimately to carbon dioxide and water.

Acidic Fraction. EPA identified two acidic fraction organic compounds from gum and wood chemicals plants; phenol and pentachlorophenol.

Phenol was found in seven plants. Phenolic compounds can affect freshwater fishes adversely by direct toxicity to fish and fish-food organisms, by lowering the amount of available oxygen because of the high oxygen demand of compounds, and by tainting fish flesh. The toxicity of phenol to fish increases as the dissolved oxygen level diminishes; the temperature rises; and hardness is lessens. Phenol appears to act as a nerve poison, causing too much blood to get to the gills and to the heart cavity.

Mixed phenolic substances are especially troublesome in imparting taste to fish flesh. Monochlorophenols produce a bad taste in fish far below lethal or toxic doses. Threshold concentrations for taste or odor in chlorinated water supplies have been reported as low as 0.0003 mg/l.

The human ingestion of a concentrated phenol solution results in severe pain, renal irritation, shock, and possibly death.

Various environmental conditions can increase the toxicity of phenol. Lower dissolved oxygen concentrations; increased salinity; and increased temperature all enhance the toxicity of phenol. The recommended water quality criterion to protect freshwater aquatic life is 600 ug/l as a 24 hour average and the concentration should never exceed 3,400 ug/l.

Pentachlorophenol was found in one raw wastewater sample at one plant at a concentration of 47 ppb. Several bioassays have shown that pentachlorophenol is lethal to various species of aquatic life at a concentration of approximately 200 ug/l. The lethal concentration for species tested ranged from 195 ug/l for the brown shrimp to 220 ug/l for the gold fish. The recommended 24 hour average and maximum concentrations to protect freshwater aquatic life are 6.2 ug/l and 14 ug/l, respectively. To protect saltwater aquatic life, the recommended 24 hour average concentration is not to exceed 3.7 ug/l; at no time should the pentachlorophenol concentration exceed 8.5 ug/l.

A study of genetic activity demonstrated that pentachlorophenol exhibited weak but definite mutagenic activity. In nonhuman mammals the sublethal effects of pentachlorophenol poisoning include pathological and histopathological changes in the kidneys, liver, spleen, lungs, and brain. In humans, the results of pentachlorophenol poisoning can range from elevated blood pressure and rapid respiration to coma and death. For the protection of human health the ambient water concentration should be no greater than 680 ug/l.

Pentachlorophenol is highly persistent in soils. Reports have indicated that the compound can persist in moist soil for at least a 12-month period.

Inorganic Toxic Pollutants

Several of the inorganic toxic pollutants were found in gum and wood chemical wastewaters at levels of 10 ppb or more. The three metals used in the industry copper, nickel, and zinc.

Chromium also appeared in the wastewater streams. It is not used in the processing of gum and wood chemicals except as a biocide in some

cooling towers. The raw wastewater's highest concentration was 1.5 ppm and the treated wastewater concentration was 0.88 ppm.

Chromium in its various valence states is hazardous to man. It can produce lung tumors when inhaled and induces skin sensitizations. Large doses of chromates have corrosive effects on the intestinal tract and can cause inflammation of the kidneys. Levels of chromate ions that have no effect on man appear to be so low as to prohibit determination to date. The toxicity of chromium salts to fish and other aquatic life varies widely with the species, temperature, pH, valence of the chromium, and synergistic or antagonistic effects, especially those of hard water. Studies show that trivalent chromium is more toxic to fish of some types than is hexavalent chromium. Other studies show opposite effects. Fish food organisms and other lower forms of aquatic life are extremely sensitive to chromium; it also inhibits the growth of algae. Therefore, both hexavalent and trivalent chromium must be considered potentially harmful to particular fish or organisms.

Fish appear to be relatively tolerant of chromium, but some aquatic invertebrates are quite sensitive. Toxicity varies with species, chromium oxidation state, and pH.

Chromium concentration factors in marine organisms have been reported to be 1,600 in benthic algae, 2,300 in phytoplankton, 1,900 in zooplankton, and 440 in molluscan soft parts.

Copper. Copper oxides and sulfates are used for pesticides, fungicides, and certain metallized dyes. The toxicity of copper to aquatic life is dependent on the alkalinity of the water, as the copper ion is complexed by anions present, which in turn affect toxicity. At lower alkalinity copper is generally more toxic to aquatic life. Other factors affecting toxicity include pH, organic compounds, and the species tested. Relatively high concentrations of copper may be tolerated by adult fish for short periods of time; the critical effect of copper appears to be its higher toxicity to young or juvenile fish.

In most natural fresh waters in the United States, copper concentrations below 0.025 mg/l as copper evidently are not rapidly fatal for most common fish species. In acute tests copper sulfate in soft water was toxic to rainbow trout at 0.06 mg/l copper. In very hard water the toxic concentration was 0.6 mg/l copper. In general the salmonids are very sensitive and the sunfishes are less sensitive to copper.

Copper appears in all soils, and its concentration ranges from 10 to 80 ppm. In soils, copper occurs in association with hydrous oxides of manganese and iron and also as soluble and insoluble complexes with

organic matter. Keeney and Walsh (1975) found that the extractable copper content of sludge-treated soil decreased with time, which suggests that a reversion of copper to less soluble forms.

Copper is essential to the growth of plants, and the normal range of concentrations in plant tissue is from 5 to 20 ppm. Copper concentrations in plants normally do not build up to high levels when toxicity occurs. For example, the concentrations of copper in snapbean leaves and pods was less than 50 and 20 ppm, respectively, under conditions of severe copper toxicity. Even under conditions of copper toxicity, most of the excess copper accumulates in plant tissues. Copper toxicity may develop in plants from application of sewage sludge if the concentration of copper in the sludge is relatively high.

For copper, the proposed water quality criterion depends on water hardness. At a hardness of 75 mg/l, the criterion to protect freshwater aquatic life is 2.4 ug/l as a 24 hour average, the concentration should never exceed 16 ug/l at this water hardness. The recommended criterion to protect saltwater aquatic life is 0.79 ug/l and 18 ug/l as 24 hour average and maximum concentrations, respectively.

Nickel. Studies of the toxicity of nickel to aquatic life indicate that tolerances vary widely and are influenced by species, pH synergistic effects, and other factors.

Available data indicate that: (1) nickel in water is toxic to plant life at concentrations as low as 100 ug/l; (2) nickel adversely affects reproduction of a freshwater crustacean at concentrations as low as 0.095 mg/l; (3) nickel concentrations as low as 0.31 mg/l can kill marine clam larvae; and (4) nickel seriously affects reproduction of freshwater minnow at concentrations as low as 0.73 mg/l and the reproduction of Daphnia at 53 ug/l.

In nonhuman mammals nickel acts to inhibit insulin release, depress growth, and reduce cholesterol. A high incidence of cancer of the lung and nose has been reported in humans engaged in the refining of nickel.

Zinc. Toxic concentrations of zinc compounds cause adverse changes in the morphology and physiology of fish. Acutely toxic concentrations induce cellular breakdown of the gills, and possibly the clogging of the gills with mucous. Chronically toxic concentrations of zinc compounds, in contrast, cause general enfeeblement and widespread histological changes to many organs, but not to gills. Growth and maturation are retarded. In general, salmonids are most sensitive to elemental zinc in soft water; the rainbow trout is the most sensitive in hard waters. In tests with several heavy metals, the immature

aquatic insects seem to be less sensitive than many tested fish. Although available data is sparse on the effects of zinc in the marine environment, zinc accumulates in some species, and marine animals contain zinc in the range of 6 to 1,500 mg/kg. For zinc, the proposed water quality criterion depends on water hardness. At a hardness of 75 mg/l, the proposed criterion to protect freshwater aquatic life is 35 ug/l as a 24 hour average and the concentration should never exceed 185 ug/l at this hardness.

SECTION VII

CONTROL AND TREATMENT TECHNOLOGY

GENERAL

This section discusses the range of wastewater control and treatment technologies available to the Gum and Wood Chemicals Industry. In-plant pollution abatement as well as end-of-pipe treatment technologies are presented. For the purpose of cost analysis, one or more candidate technologies were selected for each subcategory.

There are many possible combinations of in-plant and end-of-pipe systems capable of attaining the pollutant reductions reported for the candidate technologies. Performance levels reported for the candidate treatment technologies are based upon the demonstrated performance of similar systems within the industry or upon well documented results of readily transferable technology. The industry can achieve these performance levels by using the model treatment systems proposed. The purpose of the model treatment systems is to establish the cost of achieving the effluent levels reported for the candidate treatment technologies. Each individual plant must make the final decision concerning the specific combination of pollution control measures best suited to its particular situation.

IN-PLANT CONTROL MEASURES

Wood Rosin, Turpentine, and Pine Oil

The major in-plant water control measure in this subcategory is the recycling of stump wash water. Stumps are washed mainly to minimize the abrasive effect of sand on subsequent processing equipment. The quantity of sand has become a major factor only in the last few years. The current practice of plowing stumps out of the ground with large tractors does not loosen sand as the older blasting method did.

Spent wash water is collected and pumped to settling basins, the size of which depends on the land available to the plant.

Plants 976 and 068 have basins large enough to allow for settling without the addition of a settling aid. They use a two-basin system in which one basin operates while the other is dredged. Dredging varies with the plant work schedule.

Because of limited space, Plant 102 has a settling basin 9.7 meters (32 feet) by 11.5 meters (38 feet) by 3.7 meters (12 feet). Because of its size, polymer is added to the basin to enhance settling. Daily dredging removes approximately 90 to 181 metric tons (100 to 200 tons)

per day of wet sand and sediment, approximately 50 percent of which is water.

Plant 687 does not recycle its stump wash water but routes it to a basin for settling and solids removal followed by clarification and discharge (see Figure VII-1). The long term average daily concentration of solids discharged is 50 mg/l. The long term average daily flow from the stump washing operation is 22,330 cubic meters per day (5.9 mgd). The long term average daily solids loading from the plant is approximately 1,080 kg/day (2,400 lbs/day), which is discharged to the surface water.

Tall Oil Rosin, Pitch, and Fatty Acids

Tall oil plants use barometric condensers to induce reduced pressure in the distillation tower. The barometric condenser water is contact water and becomes contaminated with the low boiling point constituents of the tall oil.

The tall oil distillation industry recirculates its barometric condenser water through separate "oily water" cooling towers, which skim off the condensed oil prior to cycling through the main cooling tower. The skimmed oil is returned to the process or is sold as a by-product. The volume of water going into the "oily water" cooling system depends on the amount of steam used for distillation. The steam is then condensed by the barometric condenser along with any water retained in the tall oil. The condensate is the source of make-up water for the "oily water" cooling system.

Water volume in the "oily water" system is controlled by evaporation, drift, and blowdown from the cooling tower. Plant 877 has zero discharge from this type of system; the holding basin is large enough to handle any excess "oily water" generated during times of low evaporation or rainy weather. The largest flow noted from an "oily water" system was a long term average of 272 cubic meters per day (50 gpm) from Plant 476

Recycling this "oily water" concentrates it. The "oily water" in Plant 476 was sampled in conjunction with that of the waste streams. The pollutants were more concentrated than those in the raw wastewater discharged by the plant. Table VII-1 compares the raw wastewater and the "oily water" cooling system.

The use of barometric condensers is standard throughout plants located in the South; however, the size of the holding basins varies significantly between the plants. The holding pond at Plant 474 has a capacity just equal to the volume of the cooling tower and the oil skimmer. This plant uses a continuous cooling tower blowdown of approximately 54.5 cubic meters per day (10 gpm) to maintain the

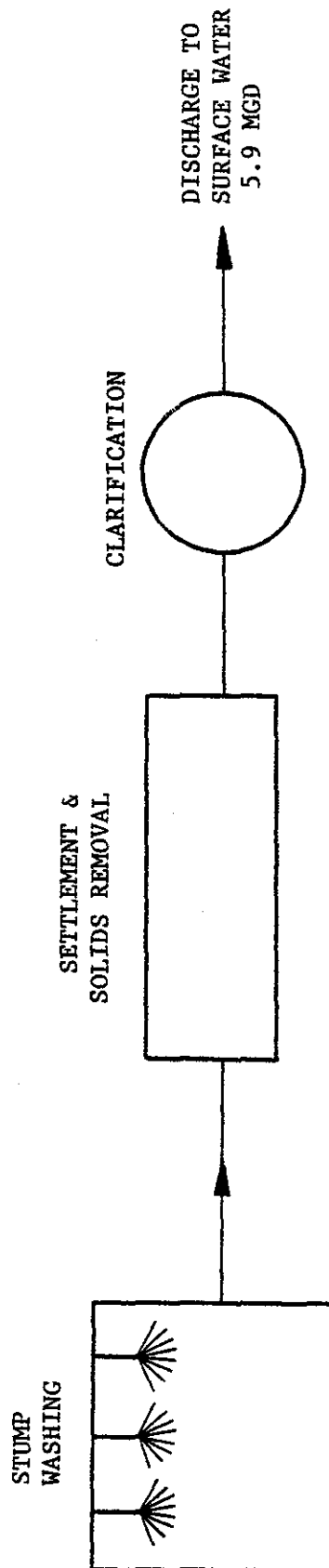


Figure VII-1. STUMP WASH WATER TREATMENT SYSTEM - PLANT 687

Table VII-1. Plant 476--Comparison of Raw Wastewater and "Oily Water"
Cooling System

	Raw Wastewater	"Oily Water" Cooling System
Total Phenol mg/l	550	1700
Total Suspended Solids mg/l	44	170
COD mg/l	1100	8400
Phenol mg/l	*	7500†

* Value was less than the detection limit.

† Value may vary from that for the total phenol because of analytical technique.

proper level in the system. Other plants have intermittent blowdowns depending on the solids build-up in the tower and the need to control the water level in the system.

Plants 140 and 864, located in a relatively cold climate, use steam jets to reduce the water in the distillation towers, and non-contact condensers to cool the condensate. The condensate is discharged to the waste treatment process. Plant 140 estimates the flow due to the steam jet vacuum system and the condensate to be approximately 272 cubic meters per day (50 gpm).

End-of-Pipe Treatment

EPA identified the following end-of-pipe treatment unit operations for potential inclusion in BPT Sulfate Turpentine, BCT, EAT, and New Source Performance Standards.

Free Oil Removal--Oily products such as turpentine and fatty acids are a major factor in this industry. Gravity oil-water separation is used throughout the industry to recover oil for use as a fuel supplement or, in some cases, for recycle to the plant process.

A baffle separator at the effluent end of an equalization basin is the most common system used in the industry. The oil can be skimmed from the basin either manually or continuously, depending on the wastewater flow and the quantity of oil products produced at the plant. This study did not consider free oil removal as a part of the treatment system, and wastewater characteristics across oil-water separators were not considered.

Chemical Flocculation--Wastewater from the industry typically has high concentrations of emulsified oil, the quantity of which varies from plant to plant depending on the efficiency of the oil-water separator and the pH of the waste stream. A pH less than 3 greatly reduces the emulsion problem; however, the pH of industry waste streams industry typically ranges from 3 to 9.

Chemical coagulation of the emulsified oil is a recognized method of removal. The coagulants normally used in industrial wastewater processes are lime, alum, and ferric chloride, with polymer often added as a flocculant. The selection of a coagulant depends on the characteristics of each particular waste stream.

Plants 877 and 68 currently using chemical coagulation. One plant fractionates tall oil, and the other is a major producer in the wood rosin and turpene area. These plants reduce oil and grease by 65 to 85 percent using coagulation and settling equipment with polymer as a flocculation aid. The flocculated effluent generally contains from 7 to 16 mg/l of oil and grease.

Equalization--Equalization is a treatment step used to smooth out surges in both flow and pollutant concentration. Because treatment unit operations must be able to handle peak flow rates and concentrations, plants can realize significant capital cost savings by minimizing the peaks with equalization. Operating costs for chemical addition processes also can be reduced by optimizing chemical dosage. Plant wastewater flow rates and pollutant concentrations vary, depending on the process and the process stage. The retention time in the equalization basin can be reduced by using some type of mixing method such as aeration.

Neutralization--Gum and Wood Chemicals industrial waste streams vary in pH from 3 to 9, which may require neutralization before the various treatment steps. Oil emulsion breaking is best accomplished with a pH of less than 3; metals precipitation is best accomplished with a pH of approximately 9; and biological treatment is best accomplished with a pH of approximately 7.

pH adjustment uses either alkalies or acids, depending on the pH requirement. Commonly used alkalies are lime, caustic, or soda ash. Sulfuric acid is the usual acid.

Flotation--Flotation is a process which separates solids or oils from the carrier wastewater by attaching them to floating gas bubbles. Flotation occurs in three ways: (1) air flotation--aeration at atmospheric pressure; (2) dissolved air flotation--aeration of a liquid under pressure with subsequent release of the pressure; and (3) vacuum flotation--aeration of a liquid at atmospheric pressure followed by application of a vacuum to the liquid. The basic principle is that air bubbles attach themselves to oil globules or suspended particles and float them to the surface for skimming. Chemicals such as coagulants, polymers, acids, and/or alkalies are often used prior to flotation to promote the formation of larger more easily removed particles.

Plants 778 and 767 use air flotation devices. A study conducted by Plant 778 reported that air flotation removed 204 kg/day (450 lbs/day) of BOD, 181 kg/day (400 lbs/day) of oil and grease, and 236 kg/day (521 lbs/day) of COD. Plant 767 is currently installing the flotation equipment, and pollutant removal rates are not available.

Plant 102 also uses a dissolved air flotation process. A plant study showed a reduction of TOC across the flotation unit of 2,860 kg/day (6,300 lb/day). Oils recovered from the flotation unit are used as a fuel supplement.

Metals Removal--Varying levels of copper, chrome, nickel, and zinc appeared in the waste streams across the industry. Some of these metals are used as catalysts in industry processes.

The most accepted method of metals removal is the formation of metal hydroxides. Heavy metal ions can be precipitated from wastewater streams as metal hydroxides. The first step in the process is to adjust the wastewater pH to a level at which the solubility of heavy metals is sufficiently low. The solubility curves for four common metals in distilled water are shown in Figure VII-2.

Figure VII-2 suggests that a pH of 9 can remove metals most efficiently; however, the actual operating pH level must be determined for each plant. Metal salt formation varies with the waste stream matrix and the metal ions present. The Agency suggests the formation of metal hydroxides instead of metal sulfides.

Although the particles formed by metal salts are colloidal in nature and are kept in suspension by electrical surface charges, they can be neutralized by the use of coagulants or polymers which bond the smaller colloidal particles into larger floc particles and allow them to settle with conventional settling techniques.

Biological Treatment--Biological treatment is the controlled oxidation of organic matter to inorganic end products like CO_2 , H_2O , NO_3 , and SO_4 by aquatic microorganisms (primarily bacteria). The microorganisms utilize organic matter as a food source; in so doing, they simultaneously propagate themselves. Two types of biological treatment processes treat Gum and Wood Chemicals wastewater: activated sludge and aerated lagoons.

In the activated sludge system, wastewater, microorganism sludge, and nutrients are fed into a tank with sufficient detention time for the required BOD reduction. The tank is aerated to supply oxygen and mix the sludge enough to keep it in suspension. The aeration tank effluent then goes to a clarification tank where the sludge settles out of the treated wastewater stream and is partially recycled to the aeration tank. Because net solids are produced by the propagating microorganisms, a portion of the sludge must be wasted to avoid build-up of excess solids in the system.

Aerated lagoons use the same basic process. Wastewater and nutrients are fed into the lagoon and aerated. However, the aerated lagoons do not recycle sludge, excess sludge produced by the biological action settles either in the poorly mixed zones of the lagoon or in a separate clarification basin.

Carbon Adsorption--The efficacy of activated carbon in wastewater treatment has been "rediscovered" in recent years, although very little of the work has been relevant to the Gum and Wood Chemicals Industry.

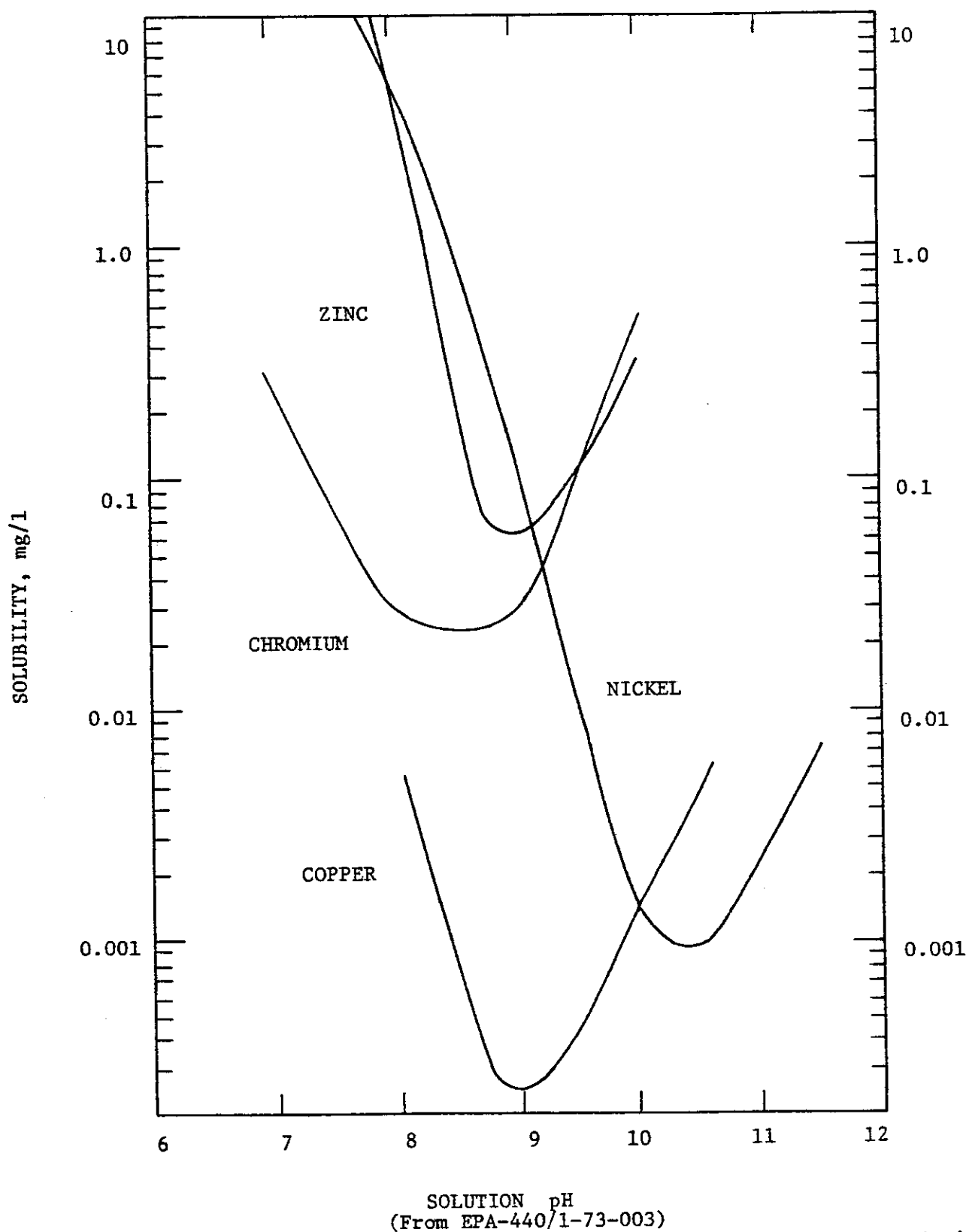


Figure VII-2. Solubility Curves for Chromium, Copper, Nickel, and Zinc

One facility presently uses activated carbon adsorption. Plant 102 has oil-water separation, neutralization, dissolved air flotation, filtration, and finally, granular activated carbon (GAC). This granular activated carbon system is used in lieu of biological treatment.

Adsorption isotherms were developed by three separate laboratories using the parameter COD. The results were carbon loadings of between 0.85 and 1.2 kg COD/kg carbon (0.85 lb COD/1.2 lb carbon). The pilot plant studies revealed that the optimal conditions were flow rates of 176 to 293 m³/m²/day (3 to 5 gpm/ft²) and a contact time of 45 to 50 minutes. Under these conditions, COD removals were 75 to 85 percent. The pilot plant results confirmed the isotherm results by yielding a carbon loading of approximately 1.0 kg COD/kg carbon (1 lb COD/lb carbon).

The GAC system was designed and is operating at a carbon loading of approximately 1.2 kg COD/kg carbon (1.2 lb COD/lb carbon) and 0.44 kg TOC/kg carbon (0.44 lb TOC/lb carbon). Pollutant reductions were approximately 84 percent COD and 79 percent TOC. Representative performance data for the GAC system appear in Table VII-2. The entire treatment system removed better than 95 percent of COD and TOC. Typical performance data for the total treatment system are shown in Table VII-3.

Very little data are available on adsorption of toxic pollutants in Gum and Wood Chemicals wastewater. Carbon adsorption is not effective for removing most metals. The organics commonly identified during screening and verification were benzene, toluene, ethylbenzene, and phenol. Guisti, et al. (1975) performed tests which indicated that carbon adsorption probably could remove 75 percent of these compounds. Actual screening and sampling data from Plant 102 showed removals for benzene and toluene of approximately 64.4 percent and 74.9 percent, respectively.

Evaporation--Due to the significant volumes of plant wastewater generated, evaporation is not a widely-used technology in the Gum and Wood Chemicals Industry. However, it may apply to disposal of specific high-strength, low volume, process waste streams.

Spray evaporation involves containing the wastewater in lined lagoons sufficiently large to accommodate several months of process wastewater, as well as directly rainwater on the lagoon. The wastewater is sprayed under pressure through nozzles, producing fine aerosols which evaporate in the atmosphere. The driving force for this evaporation is the difference in relative humidity between the atmosphere and the humidity within the spray evaporation area. Temperature, relative humidity, pond dimensions, wind speed, spray

Table VII-2. Secondary Treatment Feed and Effluent Analysis and Performance Data

Item	Influent	Effluent	% Reduction	Removal lb/day
Design:				
12,260 m ³ /day (3.24 mgd)				
COD, mg/l	600	125	79	12,800
TOC, mg/l	160	30	81	3,500
BOD, mg/l	250	50	80	5,400
Start-up period:				
9,810 m ³ /day (2.592 mgd)				
COD, mg/l	975	152	84	17,800
TOC, mg/l	222	46	79	3,500
Typical operation:				
9,810 m ³ /day (2.592 mgd)				
COD, mg/l	752	160	79	12,800
TOC, mg/l	203	42	79	3,500
Selected samples:				
(2.592 mg/l)				
BOD, mg/l	300	82	73	4,700
Phenols, mg/l	4.66	0.58	88	88
Ni, mg/l	1.02	0.33	68	15
Zn, mg/l	1.11	0.29	74	18
Cd, mg/l	0.91	0.22	76	15
Cu, mg/l	1.29	0.36	72	20
Cr, mg/l	1.12	0.26	77	19
TS, mg/l	1,211	965	20	5,300
SS, mg/l	81	13	84	1,500
DS, mg/l	1,130	952	16	3,800
Chlorides, mg/l	1.82	0.84	48	19
NO ₂ , mg/l	5.16	4.28	17	19
Oil and grease, mg/l	28.1	2.2	92	560

Table VII-3. Typical Total Treatment System Performance Data*

Parameter	Raw Waste Water (mg/l)	Primary Treated Effluent (mg/l)	Secondary Treated Effluent (mg/l)	Overall Reduction (%)
COD	3,200	670	143	95.5
TOC	1,200	198	37	96.9
BOD	1,600	267	73	95.4
TSS	320	72	12	96.3
Oil and Grease	500	25	2	99.6

* @ 9,810 m³/day (2.592 MGD).

nozzle height, and pressure are all variables which affect the amount of wastewater which can be evaporated.

To be effective, spray evaporation should follow effective oil removal. Excess oil content in the wastewater may retard evaporation and increase the potential for air pollution. Careful segregation of uncontaminated water from the wastewater stream is particularly important in minimizing the amount of wastewater to be evaporated.

Land Disposal Systems--Controlled application on land can dispose of wastewater or sludge. Methods of application include spray irrigation, subsurface injection, overland flow, and rapid infiltration.

The pollutant removal mechanisms include biological oxidation by soil microorganisms, ion exchange, physical straining, precipitation, nutrient uptake by vegetation, and volatilization. Pretreatment of wastewater is required to prevent odors; to maximize the application rate; and to protect crops, public health, groundwater, soil, and the application equipment. Pretreatment processes typically include pH adjustment, suspended solids removal, oil removal, and chlorination.

One plant practices land disposal of aerated lagoon sludge. Current EPA encouragement of land disposal and increasingly strict effluent limitations may result in more plants using this system in the future. A major drawback for many existing plants is the absence of suitable land.

In-Place Treatment Technology

This report assumes that "Best Practicable Control Technology Currently Available" (BPT) requirements are being met. The direct discharge plants in the industry have not all used the same treatment scheme. The Gum and Wood Chemicals plants that discharge to municipal treatment plants presently are not required by Federal law to treat wastewater. Some municipalities do require pretreatment of wastewater, but this is on a city-by-city basis only. The final group of plants discharges wastewater to the waste streams of pulp and paper mills. These waste stream flows are generally large--in the 20 MGD range, while flows from the Gum and Wood Chemicals plants are 1 MGD or less.

Metals removal is not practiced generally in the industry at this time. Plant 17 treats for metals on a particular waste stream containing heavy metals. The lack of industry-wide information required a review of the technology available from other industrial categories. While the levels of metals found in the plating industry are higher than those in the Gum and Wood Chemicals Industry, the general technique of precipitating metal salts is a well accepted treatment method. Additionally, the wastewaters from the metal

plating operations more closely resemble the types of problems encountered in the Gum and Wood Chemicals industry oil and grease and chelating agents.

Plant 102 uses granular activated carbon in lieu of biological treatment. Operational problems have resulted in the formation of biomass in the columns, restricting the flow. Down time of the carbon regeneration system due to equipment failure also has been a problem. A new type of regeneration furnace is being installed and a biological treatment study is underway.

Plant 976 slurries carbonaceous ash from the spent wood chip-fired boiler with the wastewater to utilize the adsorption capacity of the ash. Table VII-4 shows the effectiveness of this method.

Table VII-5 shows a matrix of the current in-place treatment technology in the Gum and Wood Chemicals Industry. As mentioned previously, the direct dischargers have at least some treatment in-place at this time; pretreatment processes for indirect dischargers depend on the requirements of the receiving treatment works. Eight plants discharge their wastewater to POTW's and four plants discharge their wastewater to the waste streams of other industries such as pulp and paper mills. The plants that discharge to POTW's have treatment equipment to meet POTW's requirements.

Table VII-4. Plant 976--Pollutant Reduction Across Fly Ash Slurry

Parameter	Concentration	
	Influent	Effluent
Trichloroethylene	3 ug/l	NF
Benzene	100 ug/l	10 ug/l
Toulene	ND	ND
Ethylbenzene	10 ug/l	NF
COD	1,100 mg/l	730 mg/l

NF = Not found.

ND = Not determined.

Table VII-5. Treatment Scheme

	Type of Discharger	Oil Sep.	Equalization	Air Flot.	Neutralization	Nutrient Add.	Aerated Lagoon	Chrome Red.	Metals Removal	Clarification	Filtration	Granular Carbon Adsorption	Chemical Coagulation	Settling	Mixing Carbonaceous Fly	Non Aerated Pond	Activated Sludge
778	D	X	X	X	X	X	X							X			
476	*	X												X			
976	D	X	X			X	X							X	X		
068	I		X		X								X	X			
291	I	X												X			
649	*	X												X			
017	I	X			X	X	X							X			
110		X				X	X			X							
687	AI BD	X	X							X				X X			
974	I	X	X		X						X						
474	*	X								X							
573	*	X												X			
877	D	X					X						X	X			
286	D	X	X				X						X	X		X	
102	D	X	X	X	X					X	X	X		X			
140	*	X												X			
479	I	X	X	X	X					X				X			
864	D	X	X		X	X								X		X	X
943	*	X												X			
767	D	X	X	X	X	X	X							X			

SECTION VIII

COST, ENERGY, AND NON-WATER QUALITY ASPECTS

COST INFORMATION

This section presents cost information for the candidate treatment technologies developed in Section VII in order to assess the economic impact on the industry.

EPA has arrived at two types of cost estimates. First, the total battery limit costs of the technologies are estimated for the model plants according to raw wastewater characteristics described in Section V for each subcategory. These estimates include the cost of each unit process associated with the suggested technology at each level of treatment.

The second type of cost estimate presented is a plant-by-plant estimate of the costs of achieving the applicable candidate technologies within each subcategory. This estimate was prepared for every plant in the technical data base.

A number of factors affect the cost of a particular facility, and these highly variable factors may differ from those assumed in this study. One of the most variable factors is the cost of land. Other site-specific factors include local soil conditions, construction materials (e.g., steel versus concrete tanks), building codes, labor costs, and energy costs.

Some installations may use cost accounting systems which cause reported costs to differ from those in this section. For example, it is not uncommon for a portion of a manufacturing plant's administrative costs to be allocated to the waste treatment system. Such factors are not included in this document.

Table VIII-1 lists the assumptions used in developing the costs presented in this section. Tables VIII-2 and VIII-3 describe each technology for which costs are estimated for the Gum and Wood Chemicals Industry. In considering costs for these technologies, the four existing plants who commingle their wastes with other industrial wastewaters prior to treatment and discharge to waters of the United States are considered as indirect dischargers.

EPA developed model plants for four different types of Gum and Wood manufacturing plants: (1) those which produce tall oil rosin, fatty acids, and pitch; (2) those which produce tall oil rosin, fatty acids, pitch, and rosin-based derivatives; (3) those which produce sulfate turpentine; and (4) those which produce sulfate turpentine, and rosin-based derivatives. The development of model plants was restricted to

these four types of manufacturing facilities because the existing market and raw material supply almost precludes construction of the other types of Gum and Wood plants.

Raw wastewater characteristics for the model plants were based on data provided by plants in the industry. The production and wastewater flow data were based on historical data provided by the data collection portfolio respondents. Tables VIII-4 through VIII-6 contain the design flow and raw wastewater characteristics for the model plants.

Energy Requirements of Candidate Technologies

Energy costs are itemized in each of the cost estimates presented in this section.

Total Cost of Candidate Technologies

Tables VIII-7 through VIII-27 present the total battery limit costs of candidate treatment technologies for combinations of subcategories for which new plants might reasonably be expected.

Cost of Compliance for Individual Plants

EPA performed a plant-by-plant analysis on each Gum and Wood plant in the technical data base to determine the compliance cost for each applicable candidate treatment technology. The individual plants' wastewater flow, raw wastewater characteristics, and in-place technology were all considered. Costs of compliance for individual Gum and Wood plants appear in Tables VIII-28 through VIII-44.

NON-WATER QUALITY IMPACTS OF CANDIDATE TECHNOLOGIES

The most significant non-water quality impact of the candidate technologies involves the disposal of wastewater sludges. Such disposal must be managed properly to mitigate ground or surface water contamination.

Data in this document have indicated that organic toxic pollutants may be removed by biological treatment. Organic materials may be biodegraded, stripped from the wastewater by aeration, or removed with the waste sludge. Metals precipitated from the wastewater may appear in the sludge.

It was not within the scope of this document to define whether wastes from the Gum and Wood Chemicals Industry are hazardous materials. No effort was made to characterize accurately the sludge produced as a result of wastewater treatment. No sludge samples were collected during the screening or verification sampling program. However, some

wastes generated as a result of these regulations may be classified as hazardous under new RCRA regulations.

Some impacts on air quality may occur as a result of spray evaporation or cooling tower evaporation, since the wastewater being evaporated contains volatile organic compounds which may evaporate with the waste and increase the equivalent hydrocarbon content of the air. Drift losses caused by wind may also cause an air quality impact as a result of spray evaporation or cooling tower evaporation. In addition, volatile organic compounds may be stripped from wastewater by aeration, such as in activated sludge units or aerated lagoons.

Precipitation of metals as hydroxide flocs will result in sludges containing some water. The disposal of these sludges will result in a small increase in consumptive water losses. However, the industry is located in areas with sufficient water supplies and no significant impacts are anticipated.

Increased energy consumption resulting from implementation of these effluent guidelines will be small. One of the two direct discharging sulfate turpentine plants may have to upgrade the biological treatment system by addition of aeration horsepower. For the BAT and PSES treatment systems, six of the twenty plants may require some pumps and other ancillary equipment for operation of the system. The Agency projects that increased energy consumption resulting from BPT, BAT and PSES will be kilowatts per year.

Table VIII-1. Cost Assumptions

1. All costs are reported in June 1977 dollars.
(Engineering News Record, "Construction Cost Index," Conversion to March 1979 Dollars = 1.136)
2. Excavation costs \$5.00 per cubic yard.
3. Reinforced concrete costs \$210 per cubic yard.
4. Site preparation costs \$2,000 per acre.
5. Contract hauling of sludge to landfill costs \$25 per cubic yard.
6. On-site sludge disposal costs \$5 per cubic yard.
7. Land costs \$10,000 per acre
8. Surface dressing for lagoons costs \$0.03 per square foot.
9. Fencing costs \$2.00 per linear foot, installed.
10. Clay lining for lagoons costs \$0.23 per square foot.
11. New carbon costs \$0.40 per pound.
12. Epoxy coating costs \$2.00 per square foot.
13. Electricity costs \$0.05 per kilowatt-hour.
14. Phosphoric acid costs \$0.25 per pound.
15. Anhydrous ammonia costs \$0.18 per pound.
16. Polymer costs \$0.60 per pound.
17. Sulfuric acid costs \$0.06 per pound.
18. Sodium hydroxide costs \$0.10 per pound.
19. Sulfur dioxide costs \$0.25 per pound.
20. Engineering costs 15 percent of construction cost.
21. Contingency is 15 percent of the sum of the capital cost, land cost, and engineering cost.
22. Annual insurance and taxes cost 3 percent of the sum of the capital cost plus land cost.
23. Average labor costs \$20,000 per man per year, including fringe benefits and overhead.
24. Equipment Life Expectancy--20 years.

Table VIII-2. Gum and Wood Candidate Treatment
Technologies - Indirect Discharge

- Technology 1: Metals Removal (At Source)
Monitoring Station
Sludge Disposal (Truck Haul and/or
On-Site Landfill)
- Technology 2: Metals Removal (End-of-Pipe)
Sludge Disposal (Truck Haul and/or
On-Site Landfill)
-

Table VIII-3 Gum and Wood Candidate Treatment
Technologies - Direct Discharge

- Technology 1: Equalization
Pump Stations (2)
pH Adjustment
Polymer Addition
Air Flootation (Tall Cil Only)
Neutralization
Nutrient Addition
Activated Sludge
Monitoring Station
Control House
Sludge Disposal
- Technology 2: Metals Removal (At the Source)
Monitoring Station
Sludge Disposal (Truck Haul and/or
On-Site Landfill)
- Technology 3: Metals Removal (End-of-Pipe)
Sludge Disposal (Truck Haul and/or
On-Site Landfill)
- Technology 4: Filtration and Activated Carbon
Adsorption
Sludge Disposal (Spent Carbon)
-

Table VIII-4. Tall Oil Rosin, Fatty Acid, and Pitch Producing Plants - Model Plant Design Criteria

	Design Criteria	
	1	2
Production, Kkg/day (TPD)	290 (320)	290 (320)
Unit Wastewater Flow, bl/Kkg (kgal/ton)	1.7 (0.4)	8.3 (2.0)
Wastewater Flow, Kkl/day (MGD)	0.38 (0.1)	2.3 (0.6)
Influent BOD Concentration, mg/l	612	612
Influent O&G Concentration, mg/l	111	111
Influent pH	6.5	6.5

Table VIII-5. Tall Oil, Rosin, Fatty Acid, Pitch, and Rosin Based Derivatives Producing Plant - Model Plant Design Criteria

	Design Criteria	
	1	2
Production, Kkg/day (TPD)	100 (110)	249 (275)
Unit Wastewater Flow, kl/Kkg (kgal/ton)	3.6 (0.87)	7.9 (1.9)
Wastewater Flow, Kkl/day (MGD)	0.38 (0.1)	1.9 (0.5)
Influent BOD Concentration, mg/l	850	850
Influent O&G Concentration, mg/l	467	467
Influent pH	5.0	5.0

Table VIII-6. Sulfate Turpentine Producing Plants - Model Plant
Design Criteria

	Design Criteria
Production, Kkg/day (TPD)	72 (79)
Unit Wastewater Flow, kl/Kkg (kgal/ton)	9.6 (2.3)
Wastewater Flow, Kkl/day (MGD)	0.76 (0.2)
Influent BOD Concentration, mg/l	1,916
Influent O&G Concentration, mg/l	448
Influent pH	9.0

Table VIII-7. Sulfate Turpentine and Rosin Based Derivatives
Producing Plants - Model Plant Design Criteria

	Design Criteria
Production, Kkg/day (TPD)	45(50)
Unit Wastewater Flow, kl/Kkg (kgal/ton)	30 (7.2)
Wastewater Flow, kkl/day (MGD)	1.5 (0.4)
Influent BOD Concentration, mg/l	5,107
Influent O&G Concentration, mg/l	810
Influent pH	3.9

Table VIII-8. Tall Oil Rosin, Fatty Acids, and Pitch Producing Plants

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 1

Unit	Flow = 0.6 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Equalization	275,000	24,000	16,000
Pump Stations (2)	76,000	8,600	2,680
pH Adjustment (pH->2.5)	39,300	54,040	810
Polymer Addition	6,500	22,500	750
Air Flotation	142,000	5,300	580
Neutralization	46,800	111,050	810
Activated Sludge	629,000	72,170	37,500
Nutrient Addition	23,800	15,000	1,250
Monitoring Station	16,390	2,170	530
Control House	31,000	1,600	350
Land	10,000		
Engineering	192,870		
Contingency	223,800		
Sludge Disposal		8,000	
Labor		20,000	
Insurance and Taxes		38,580	
TOTAL	1,711,960	383,010	61,260

Table VIII-9. Tall Oil Rosin, Fatty Acids, and Pitch Producing Plants

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 4

Unit	Flow = 0.6 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Activated Carbon	2,200,000	400,000	44,000
Land	10,000		
Engineering	330,000		
Contingency	381,000		
Sludge Disposal (Spent Carbon)		9,600	
Labor		20,000	
Insurance and Taxes		66,300	
TOTAL	2,921,000		44,000

Table VIII-10. Tall Oil Rosin, Fatty Acids, and Pitch and Rosin Based Derivatives

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 1

Unit	Flow = 0.5 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Equalization	246,000	20,800	13,500
Pump Stations (2)	70,000	7,800	2,300
pH Adjustment (pH->2.5)	26,200	28,660	800
Polymer Addition	6,300	19,800	750
Air Flotation	205,000	8,700	1,400
Neutralization	40,200	92,730	800
Activated Sludge	449,000	39,250	19,000
Nutrient Addition	24,800	17,500	1,250
Monitoring Station	16,390	2,170	530
Control House	31,000	1,600	350
Land	10,000		
Engineering	167,240		
Contingency	193,820		
Sludge Disposal		4,000	
Labor		20,000	
Insurance and Taxes		33,750	
TOTAL	1,485,950	296,760	40,680

Table VIII-11. Tall Oil Rosin, Fatty Acids, and Pitch and Rosin Based Derivatives

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 2

Unit	Flow = 0.1 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	40,100	59,840	2,870
Monitoring Station	16,390	2,170	530
Land	10,000		
Engineering	8,474		
Contingency	9,973		
Sludge Disposal (Metals)		31,000	
Labor		20,000	
Insurance and Taxes		1,995	
TOTAL	84,937	115,005	3,400

Table VIII-12. Tall Oil Rosin, Fatty Acids, and Pitch and Rosin Based Derivatives

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 3

Unit	Flow = 0.5 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	98,000	258,060	2,990
Land	10,000		
Engineering	14,700		
Contingency	18,405		
Sludge Disposal (Metals)		62,000	
Labor		20,000	
Insurance and Taxes		3,240	
TOTAL	141,105	343,300	2,990

Table VIII-13. Tall Oil Rosin, Fatty Acids, and Pitch and Rosin Based Derivatives

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 4

Unit	Flow = 0.5 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Activated Carbon	2,070,000	320,000	39,400
Land	10,000		
Engineering	310,500		
Contingency	358,575		
Sludge Disposal (Spent Carbon)		8,000	
Labor		20,000	
Insurance and Taxes		62,400	
TOTAL	2,749,075	410,400	39,400

Table VIII-14. Tall Oil Rosin, Fatty Acids, and Pitch and Rosin Based Derivatives

COST SUMMARY FOR NEW SOURCES

INDIRECT DISCHARGERS TREATMENT TECHNOLOGY 1

Unit	Flow = 0.1 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	40,100	59,840	2,870
Monitoring Station	16,390	2,170	530
Land	10,000		
Engineering	8,473		
Contingency	11,245		
Sludge Disposal (Metals)		31,000	
Labor		20,000	
Insurance and Taxes		1,995	
TOTAL	86,208	115,005	3,400

Table VIII-15. Tall Oil Rosin, Fatty Acids, and Pitch and Rosin Based Derivatives

COST SUMMARY FOR NEW SOURCES

INDIRECT DISCHARGERS TREATMENT TECHNOLOGY 2

Unit	Flow = 0.5 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	98,000	258,060	2,990
Monitoring Station	16,390	2,170	530
Land	10,000		
Engineering	17,158		
Contingency	21,232		
Sludge Disposal (Metals)		62,000	
Labor		20,000	
Insurance and Taxes		3,732	
TOTAL	145,622	345,962	3,520

Table VIII-16. Sulfate Turpentine

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 1

Unit	Flow = 0.4 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Equalization	220,000	17,500	11,000
Pump Stations (3)	96,000	10,200	3,000
Neutralization	34,000	1,350	790
Nutrient Addition	27,500	39,000	1,250
Activated Sludge	1,005,000	192,600	132,400
Monitoring Station	16,390	2,170	530
Control House	62,000	3,200	700
Land	10,000		
Engineering	219,134		
Contingency	255,004		
Sludge Disposal		105,825	
Labor		20,000	
Insurance and Taxes		7,950	
TOTAL	1,945,028	399,795	149,670

Table VIII-17. Sulfate Turpentine

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 2

Unit	Flow = 0.1 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	40,100	59,840	2,870
Monitoring Station	16,390	2,170	530
Land	10,000		
Engineering	8,480		
Contingency	11,250		
Sludge Disposal (Metals)		31,000	
Labor		20,000	
Insurance and Taxes		2,000	
TOTAL	86,220	115,010	3,400

Table VIII-18. Sulfate Turpentine

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 3

Unit	Flow = 0.4 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	86,000	217,150	2,960
Land	10,000		
Engineering	12,900		
Contingency	16,335		
Sludge Disposal (Metals)		48,000	
Labor		20,000	
Insurance and Taxes		2,880	
TOTAL	125,235	288,030	2,960

Table VIII-19. Sulfate Turpentine

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 4

Unit	Flow = 0.4 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Activated Carbon	1,950,000	250,000	35,000
Land	10,000		
Engineering	292,500		
Contingency	337,875		
Sludge Disposal (Spent Carbon)		6,400	
Labor		20,000	
Insurance and Taxes		58,800	
TOTAL	2,590,375	335,200	35,000

Table VIII-20. Sulfate Turpentine

COST SUMMARY FOR NEW SOURCES

INDIRECT DISCHARGERS TREATMENT TECHNOLOGY 1

Unit	Flow = 0.1 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	40,100	59,840	2,870
Monitoring Station	16,390	2,170	530
Land	10,000		
Engineering	8,480		
Contingency	11,250		
Sludge Disposal (Metals)		31,000	
Labor		20,000	
Insurance and Taxes		2,000	
TOTAL	86,220	115,010	3,400

Table VIII-21. Sulfate Turpentine

COST SUMMARY FOR NEW SOURCES

INDIRECT DISCHARGERS TREATMENT TECHNOLOGY 2

Unit	Flow = 0.4 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	86,000	217,150	2,960
Monitoring Station	16,390	2,170	530
Land	10,000		
Engineering	15,360		
Contingency	19,170		
Sludge Disposal (Metals)		59,000	
Labor		20,000	
Insurance and Taxes		3,370	
TOTAL	146,920	301,690	3,490

Table VIII-22. Tall Oil Rosin, Fatty Acids, and Pitch: Rosin Based Derivatives and Sulfate Turpentine

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 1

Unit	Flow = 0.5 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Equalization	246,000	20,800	13,500
Pump Stations (2)	70,000	7,800	2,300
pH Adjustment (pH->2.5)	26,200	28,660	800
Polymer Addition	6,300	19,800	750
Air Flotation	205,000	8,700	1,400
Activated Sludge	550,000	114,750	87,660
Nutrient Addition	33,000	52,000	1,250
Neutralization	40,200	92,730	800
Monitoring Station	16,390	2,170	530
Control House	31,000	1,600	350
SUBTOTAL (1)	1,224,090	349,010	109,340
Engineering	183,620		
Land	10,000		
SUBTOTAL (2)	1,417,710		
Contingency	212,660		
Insurance and Taxes		37,020	
Sludge Disposal		4,000	
Labor		20,000	
TOTAL	1,630,370	410,030	109,340

Table VIII-23. Tall Oil Rosin, Fatty Acids, and Pitch; Rosin Based Derivatives and Sulfate Turpentine

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 2

Sulfate Turpentine Processing			
Unit	Flow = 0.075 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	24,400	29,945	1,990
Monitoring Station	16,390	2,170	530
Land	10,000		
Engineering	6,120		
Contingency	8,540		
Sludge Disposal (Metals)		26,000	
Labor		20,000	
Insurance and Taxes		1,530	
TOTAL	65,450	79,645	2,520

Rosin Based Derivatives Processing			
Unit	Flow = 0.1 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	27,700	37,075	1,990
Monitoring Station	16,390	2,170	530
Land	10,000		
Engineering	6,620		
Contingency	9,110		
Sludge Disposal (Metals)		31,000	
Labor		20,000	
Insurance and Taxes		1,630	
TOTAL	69,820	91,875	2,520

Table VIII-24. Tall Oil Rosin, Fatty Acids, and Pitch; Rosin Based Derivatives and Sulfate Turpentine

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 3

Unit	Flow = 0.5 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	70,500	149,500	2,050
Land	10,000		
Engineering	10,575		
Contingency	13,661		
Sludge Disposal (Metals)		62,000	
Labor		20,000	
Insurance and Taxes		2,415	
TOTAL	104,736	233,915	2,050

Table VIII-25. Tall Oil Rosin, Fatty Acids, and Pitch; Rosin Based Derivatives and Sulfate Turpentine

COST SUMMARY FOR NEW SOURCES

DIRECT DISCHARGERS TREATMENT TECHNOLOGY 4

Unit	Flow = 0.5 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Activated Carbon	2,172,000	323,200	40,700
Land	10,000		
Engineering	325,800		
Contingency	376,170		
Sludge Disposal (Spent Carbon)		8,000	
Labor		20,000	
Insurance and Taxes		65,460	
TOTAL	2,883,970	416,660	40,700

Table VIII-26. Tall Oil Rosin, Fatty Acids, and Pitch; Rosin Based Derivatives and Sulfate Turpentine

COST SUMMARY FOR NEW SOURCES

INDIRECT DISCHARGERS TREATMENT TECHNOLOGY 1

Sulfate Turpentine Processing			
Unit	Flow = 0.075 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	24,400	29,945	1,990
Monitoring Station	16,390	2,170	530
Land	10,000		
Engineering	6,120		
Contingency	8,540		
Sludge Disposal (Metals)		26,000	
Labor		20,000	
Insurance and Taxes		1,530	
TOTAL	65,450	79,675	2,520

Rosin Based Derivatives Processing			
Unit	Flow = 0.1 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	27,700	37,075	1,990
Monitoring Station	16,390	2,170	530
Land	10,000		
Engineering	6,620		
Contingency	9,110		
Sludge Disposal (Metals)		31,000	
Labor		20,000	
Insurance and Taxes		1,630	
TOTAL	69,820	91,875	2,520

Table VIII-27. Tall Oil Rosin, Fatty Acids, and Pitch; Rosin Based
Derivatives and Sulfate Turpentine

COST SUMMARY FOR NEW SOURCES

INDIRECT DISCHARGERS TREATMENT TECHNOLOGY 2

Unit	Flow = 0.5 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	70,500	149,500	2,050
Land	10,000		
Engineering	10,575		
Contingency	13,661		
Sludge Disposal (Metals)		62,000	
Labor		20,000	
Insurance and Taxes		2,415	
TOTAL	104,736	233,915	2,050

Table VIII-28.

TREATMENT OPTION FOR PLANT 151

TECHNOLOGY 2

Rosin Based Derivatives Process			
Unit	Flow = 0.133 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	29,650	46,109	2,025
Monitoring Station	16,390	2,170	530
Engineering	6,910		
Contingency	7,942		
Sludge Disposal (Metals)		32,000	
Labor		20,000	
Insurance and Taxes		1,381	
TOTAL	60,892	101,660	2,555

Sulfate Turpentine Process			
Unit	Flow = 0.012 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	15,300	12,447	1,960
Monitoring Station	16,390	2,170	530
Engineering	4,760		
Contingency	5,467		
Sludge Disposal (Metals)		6,000	
Labor		20,000	
Insurance and Taxes		950	
TOTAL	42,217	41,567	2,490

Table VIII.29.

TREATMENT OPTION FOR PLANT 151

TECHNOLOGY 3

Unit	Flow--0.58 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	87,500	276,550	2,190
Neutralization	22,700	1,250	800
Engineering	16,530		
Contingency	19,010		
Sludge Disposal (Metals)		65,000	
Labor		20,000	
Insurance and Taxes		3,310	
TOTAL	145,740	366,110	2,990

Table VIII-30.

TREATMENT OPTION FOR PLANT 090

TECHNOLOGY 2

Unit	Flow--0.005 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	14,560	11,313	2,058
Neutralization			
Engineering	2,180		
Contingency	2,510		
Sludge Disposal (Metals)		2,500	
Labor		20,000	
Insurance and Taxes		440	
TOTAL	19,250	34,250	2,058

Table VIII-31.

TREATMENT OPTION FOR PLANT 090

TECHNOLOGY 3

Unit	Flow--0.005 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	14,560	11,313	2,058
Neutralization			
Engineering	2,180		
Contingency	2,510		
Sludge Disposal (Metals)		2,500	
Labor		20,000	
Insurance and Taxes		440	
TOTAL	19,250	34,250	2,058

Table VIII-32.

TREATMENT OPTION FOR PLANT 686

TECHNOLOGY 2

Unit	Flow = .001 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	12,100	9,107	1,910
Monitoring Station	16,390	2,170	530
Engineering	4,280		
Contingency	4,915		
Sludge Disposal (Metals)		500	
Labor		20,000	
Insurance and Taxes		854	
TOTAL	37,685	32,631	2,440

Table VIII-33.

TREATMENT OPTION FOR PLANT 686

TECHNOLOGY 3

Unit	Flow--0.12 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	33,600	64,930	2,130
Neutralization	10,400	4,930	780
Engineering	6,600		
Contingency	7,590		
Sludge Disposal (Metals)		34,000	
Labor		20,000	
Insurance and Taxes		1,320	
TOTAL	58,190	125,180	2,910

Table VIII-34.

TREATMENT OPTION FOR PLANT 698
TECHNOLOGY 2

Unit	Flow = 0.52 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	48,400	154,345	2,010
Monitoring Station	16,390	2,170	530
Engineering	9,719		
Contingency	11,180		
Sludge Disposal (Metals)		41,000	
Labor		20,000	
Insurance and Taxes		1,940	
TOTAL	85,689	219,460	2,540

TECHNOLOGY 3

Unit	Flow = 1.93 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	216,500	937,245	3,490
Engineering	32,470		
Contingency	37,350		
Sludge Disposal (Metals)		92,150	
Insurance and Taxes		6,480	
TOTAL	286,320	1,035,875	3,490

Table VIII-35.

TREATMENT OPTION FOR PLANT 948

TECHNOLOGY 2

Unit	Flow = 0.08 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	25,300	31,240	1,990
Monitoring Station	16,390	2,170	530
Engineering	6,260		
Contingency	7,190		
Sludge Disposal (Metals)		27,000	
Labor		20,000	
Insurance and Taxes		1,250	
TOTAL	55,140	81,660	2,520

TECHNOLOGY 3

Unit	Flow = 0.168 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	39,200	89,980	2,120
Engineering	5,880		
Contingency	6,762		
Sludge Disposal (Metals)		41,000	
Labor		20,000	
Insurance and Taxes		1,176	
TOTAL	51,842	152,156	2,120

TECHNOLOGY 4

Unit	Flow = 0.168 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Filtration and Activated Carbon Adsorption	1,470,000	107,000	23,800
Land	5,000		
Engineering	220,500		
Contingency	254,325		
Sludge Disposal (Spent Carbon)		8,000	
Labor		320,500	
Insurance and Taxes		44,250	
TOTAL	1,949,825	479,750	23,800

Table VIII-36.

TREATMENT OPTION FOR PLANT 416

TECHNOLOGY 4

Unit	Flow--0.042 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Filtration & Activated Carbon Adsorption	950,000	38,000	15,500
Land	5,000		
Engineering	143,250		
Contingency	164,740		
Sludge Disposal (Spent Carbon)		670	
Labor		150,000	
Insurance and Taxes		28,650	
TOTAL	1,262,990	217,320	15,500

Table VIII-37.

TREATMENT OPTION FOR PLANT 333

TECHNOLOGY 4

Unit	Flow--0.6 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Filtration & Activated Carbon Adsorption	2,200,000	380,000	45,000
Land	5,000		
Engineering	330,750		
Contingency	380,360		
Sludge Disposal (Spent Carbon)		9,600	
Labor		340,000	
Insurance and Taxes		79,910	
TOTAL	2,916,110	66,150	45,000

Table VIII-38.

TREATMENT OPTIONS FOR PLANT 121

TECHNOLOGY 2

Unit	Flow = 0.288 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	47,700	89,168	2,030
Monitoring Station	16,390	2,170	530
Engineering	9,620		
Contingency	11,060		
Sludge Disposal (Metals)		45,000	
Labor		20,000	
Insurance and Taxes		1,920	
TOTAL	84,770	158,260	2,560

TECHNOLOGY 3

Unit	Flow = 1.18 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	133,500	493,320	2,340
Neutralization	36,000	40,423	860
Engineering	24,425		
Contingency	29,090		
Sludge Disposal (Metals)		80,000	
Insurance and Taxes		5,090	
TOTAL	223,020	618,830	3,200

TECHNOLOGY 4

Unit	Flow = 1.18 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Filtration and Activated Carbon Adsorption	3,000,000	800,000	73,000
Land	5,000		
Engineering	450,750		
Contingency	518,360		
Sludge Disposal (Spent Carbon)		18,880	
Labor		420,000	
Insurance and Taxes		90,150	
TOTAL	3,974,110	1,329,080	73,000

Table VIII-39.

TREATMENT OPTION FOR PLANT 087

TECHNOLOGY 2

Unit	Flow--0.325 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal at Source	57,500	159,210	2,140
Neutralization	16,800	11,810	785
Engineering	11,150		
Contingency	12,820		
Sludge Disposal (metals)		53,500	
Labor		20,000	
Insurance and Taxes		2,230	
TOTAL	98,270	246,750	2,925

Table VIII-40.

TREATMENT OPTION FOR PLANT 087

TECHNOLOGY 3

Unit	Flow--0.325 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	57,500	159,210	2,140
Neutralization	16,800	11,810	785
Engineering	11,150		
Contingency	12,820		
Sludge Disposal (metals)		53,500	
Labor		20,000	
Insurance and Taxes		2,230	
TOTAL	98,270	246,750	2,925

Table VIII-41.

TREATMENT OPTION FOR PLANT 266

TECHNOLOGY 3

Unit	Flow--0.072 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Metals Removal End of Pipe	26,800	49,680	2,100
Neutralization	8,500	3,325	770
Engineering	5,295		
Contingency	6,090		
Sludge Disposal (Metals)		25,000	
Labor		20,000	
Insurance and Taxes		1,060	
TOTAL	46,685	99,065	2,870

Table VIII-42.

TREATMENT OPTION FOR PLANT 800

TECHNOLOGY 4

Unit	Flow--0.18 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Filtration & Activated Carbon Adsorption	1,500,000	115,000	24,000
Land	5,000		
Engineering	225,750		
Contingency	259,610		
Sludge Disposal (Spent Carbon)		2,800	
Labor		235,000	
Insurance and Taxes		45,150	
TOTAL	1,990,360	397,950	24,000

Table VIII-43.

TREATMENT OPTION FOR PLANT 606

TECHNOLOGY 4

Unit	Flow--0.155 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Filtration & Activated Carbon Adsorption	1,450,000	100,000	23,000
Land	5,000		
Engineering	218,250		
Contingency	250,990		
Sludge Disposal (Spent Carbon)		2,480	
Labor		225,000	
Insurance and Taxes		43,650	
TOTAL	1,924,240	371,130	23,000

Table VIII-44.

TREATMENT OPTION FOR PLANT 693

TECHNOLOGY 4

Unit	Flow--0.097 MGD		
	Capital (\$)	Operating (\$/YR)	Energy (\$/YR)
Filtration & Activated			
Carbon Adsorption	1,240,000	680,000	19,700
Land	5,000		
Engineering	186,750		
Contingency	214,760		
Sludge Disposal (Spent Carbon)		1,550	
Labor		200,000	
Insurance and Taxes		37,350	
TOTAL	1,651,510	918,900	19,700

SECTION IX

EFFLUENT REDUCTION ATTAINABLE THROUGH THE APPLICATION OF THE BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE--EFFLUENT LIMITATIONS GUIDELINES

GENERAL

The effluent limitations which were to be achieved by July 1, 1977, specified the degree of effluent reduction attainable through the application of the Best Practicable Control Technology Currently Available (BPT). The best practicable control technology currently available generally was based upon the average of the best existing performance by plants of various sizes, ages, and unit processes within the industry. This average was not based upon a broad range of plants within the Gum and Wood Chemicals Industry, but upon performance levels achieved by exemplary plants. In industrial categories where present control and treatment practices were uniformly inadequate, a higher level of control than any currently in place may have been required if the technology to achieve such higher level could be practically applied.

In establishing the Best Practicable Control Technology Currently Available Effluent Limitations Guidelines, the Agency was to consider:

1. The total cost of applying the technology in relation to the effluent reduction benefits achieved from such application;
2. The age and size of equipment and facilities involved;
3. The processes employed;
4. The engineering aspects of applying various types of control techniques;
5. Process changes; and
6. Non-water quality environmental impact (including energy requirements).

BPT emphasized treatment facilities at the end of manufacturing processes, but also included control technologies within the process itself when the latter were normal practice within an industry.

A further consideration was the degree of economic and engineering reliability which the technology must have demonstrated in order to have been "currently available." As a result of demonstration projects, pilot plants, and general use, there must have existed a

high degree of confidence in the engineering and economic practicability of the technology at the beginning of construction for the control facilities.

Age and Size of Equipment and Facilities

As indicated previously in this report, there appeared to have been no significant data to substantiate that either the age or the size of the Gum and Wood Chemicals plant justified special consideration of different effluent limitations.

IDENTIFICATION OF BEST PRACTICABLE TECHNOLOGY CURRENTLY AVAILABLE

EPT regulations were published Interim Final on May 18, 1976, for the Char and Charcoal Briquets; Gum Rosin and Turpentine; Wood Rosin, Turpentine, and Pine Oil; Tall Oil Rosin, Fatty Acids, and Pitch; Essential Oils; and Rosin-Based Derivatives subcategories. The following unit operations and unit processes served as the technology base for these regulations:

- Oil/water separation,
- Equalization;
- Dissolved air flotation (Wood Rosin and Tall Oil);
- Secondary biological treatment (Activated Sludge); and
- Polishing Pond.

The current review of effluent guidelines limitations for the Gum and Wood Chemicals Industry has added the new subcategory of Sulfate Turpentine to the regulations. Two options were evaluated for developing the effluent limitations for this subcategory.

The first option would have required the industry to submit three or four years of effluent data (flow, BOD5, TSS, and pH) and production data (types and amounts of end-products). The Agency use this information to correlate production and effluent quality and develop long-term treatability; additionally, the Agency would develop variability factors for use in deriving statistically accurate maximum 30-day averages and maximum daily effluent limitations guidelines. Several problems were apparent with this approach. Direct discharge sulfate turpentine facilities are all associated with other unit operations in the Gum and Wood Chemicals Industry and their wastewater streams are comingled. Industry compilation of the data and the statistical review by the Agency would have been very time- and manpower-intensive.

The second option involved reviewing the rationale for the previously promulgated regulations. See Table IX-1. The basis of this rationale had been long-term BOD5 data and short-term TSS data from one activated sludge treatment system in the industry, with performance

factors transferred from the Petroleum Refining Point Source Category. In evaluating the rationale, the Agency would use the production data from the plants and the promulgated effluent guidelines limitations to develop mass limitations. The Agency then would compare these limitations to the actual data supplied by plants in response to the 308 survey questionnaire. If plants with BPT or equivalent biological treatment in-place achieved the limitations, they would form a reasonable basis for applying the same rationale to the Sulfate Turpentine subcategory.

The Agency chose Option Two because it significantly reduced the effort required by individual plants and would allow review of the currently existing effluent limitations guidelines. Table IX-2 presents the results of the analysis. The review demonstrated that the limitations were consistently achievable by the BPT or equivalent biological treatment systems. The Agency is therefore basing BPT for the Sulfate Turpentine subcategory on the BPT treatment system used in the 1976 regulations.

This review has demonstrated that the methodology for developing the original BPT effluent limitations guidelines is reasonable and demonstrably achievable. To develop effluent limitations guidelines for the sulfate turpentine subcategory, the Agency obtained raw waste load data from an indirect discharge sulfate turpentine plant exhibiting good water use. These data were compiled to establish a long-term raw waste load and the resulting loads then were reduced by 90 percent, reflecting BPT long-term average daily effluent values. EPA applied performance factors from the Petroleum Point Source Category to the BPT long-term average daily effluent values to derive the maximum 30-day average and maximum day effluent limitations guidelines. These values are presented in Table IX-3.

These values plus the previously promulgated guidelines were then used to calculate mass loading limitations for direct discharge plants with sulfate turpentine unit operations. These were then compared with data from the direct discharging plants with sulfate turpentine production. Based on this analysis, the effluent limitations guidelines can be achieved by existing plants by implementation of the BPT technology.

Table IX-1. Review of Individual Plants

* Eight direct discharging plants

Three plants have products that are not in the Gum and Wood Chemicals Industry

Two plants have insufficient data due to plant transitions

Three plants were checked for compliance:

Plant A

In compliance

BOD₅--10 of 12 months

TSS--0 of 12 months

Plant B

In compliance

BOD₅--12 of 12 months

TSS--0 of 12 months

Plant C

In compliance

BOD₅--6 of 12 months

TSS--0 of 12 months

Table IX-2. BPT Effluent Limitations Guidelines

Subcategories	Flow L/kg Product (gal/1,000 lbs.)	Raw Waste Load (RWL)		BPTCA (1977) Long-Term		Effluent Limitations (1-4-81)		
		Parameter	kg/kg	mg/L	Average Parameter	kg/kg	Average of Daily Values for 30 Consecutive Days Shall Not Exceed	Maximum for Any One Day
		Parameter	mg/L	mg/L	Parameter	kg/kg	Parameter	mg/L
No Discharge of Process Wastewater Pollutants								
Subcategory A								
Char and Charcoal Briquets								
Subcategory B	528 (63.4)	BOD ₅	4.44	8,410	BOD ₅	.444	840	2667
		COD	8.40	15,900	COD	2.27	4,300	1.42
		TSS	--	--	TSS	0.026	50	0.077
Subcategory C	9,470 (1,140)	BOD ₅	6.49	685	BOD ₅	0.649	68	219
		COD	12.6	1,330	COD	3.40	360	1.38
		TSS	--	--	TSS	0.475	50	145
Subcategory D	4,860 (583)	BOD ₅	3.11	640	BOD ₅	0.31	64	204
		COD	7.08	1,460	COD	1.91	394	145
		TSS	--	--	TSS	0.243	50	0.705
Subcategory E	62,100 (7,450)	BOD ₅	70.8	1,140	BOD ₅	7.08	114	365
		COD	86.9	1,400	COD	23.5	378	145
		TSS	--	--	TSS	3.11	50	145
Subcategory F	309 (37)	BOD ₅	4.40	14,200	BOD ₅	0.44	1420	4569
		COD	8.58	27,800	COD	2.32	7,510	1.41
		TSS	--	--	TSS	0.015	50	0.045

1 kg/kg product is equivalent to lbs./1,000 lbs. production

Table IX-3. BPT Effluent Limitations Guidelines

Subcategories	Flow (/kg Product (gal/1,000 lbs.))	Raw Waste Load (RWL)		BPTCA (1977) Long-Term		Average of Daily Values for 30		Effluent Limitations	
		Parameter	kg/kg	mg/L	Parameter	kg/kg	mg/L	Parameter	kg/kg
Subcategory G Sulfate Turpentine	4,730 (567)	BOD ₅	17.2	3,770	BOD ₅	2.92	641	BOD ₅	5.50
		TSS	--	--	TSS	0.402	85	TSS	0.686
									1,210
									145

SECTION X

EFFLUENT REDUCTION ATTAINABLE THROUGH THE APPLICATION OF THE BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE-- EFFLUENT LIMITATIONS GUIDELINES

INTRODUCTION

The effluent limitations which must be achieved by July 1, 1984, are not based on an average of the best performance within an industrial category, but on the very best control and treatment technology employed by a specific point source within the industrial category or subcategory or by another industry from which it is readily transferable. The Agency must determine the availability of control measures and practices to eliminate the discharge of pollutants, taking into account the cost of such elimination.

EPA also considers:

1. The age of the equipment and facilities involved;
2. The process employed;
3. The engineering aspects of applying various types of control techniques;
4. Process changes;
5. The cost of achieving the effluent reduction resulting from applying the technology; and
6. Non-water quality environmental impact (including energy requirements).

BAT emphasizes in-process controls as well as control or additional treatment techniques employed at the end of the production process; including those which are not common industry practice.

This level of technology considers those plant processes and control technologies which at the pilot plant, semi-works, and other levels, have demonstrated sufficient technological performance and economic viability to justify investing in such facilities. BAT represents the highest degree of demonstrated control technology for plant-scale operation, up to and including "no discharge" of pollutants. Although economic factors are considered, this level of control is intended to incorporate the top-of-the-line current technology, subject to limitations imposed by economic and engineering feasibility. There may be some technical risk, however, with respect to performance and certainty of costs; some technologies may require process development and adaptation before application at a specific plant site.

IDENTIFICATION OF THE BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE

EAT uses BPT as a basis for further improvements. The Agency has selected the treatment of toxic metals by pH adjustment to form hydroxide flocs and the treatment of toxic organics by granular activated carbon columns as candidate technologies. EPA has determined, however, that the use of GAC is economically damaging to the industry, and has not proposed it as a treatment process. Conventional pollutants and the toxic organics are treated adequately by the biological treatment required by BPT.

Metals Removal

Three metals were identified as a significant problem--copper, zinc, and nickel. These metals enter the waste stream through their use as catalysts in sulfate turpentine and rosin-based derivatives processing. Treatment of metals in the particular process streams where they are used is the most economical method, because of lower flows.

DEVELOPMENT OF EAT EFFLUENT LIMITATIONS

The effluent limitations were developed for the control technology options in a building block fashion, using BPT technology (oil and grease removal, biological treatment) as a base.

After establishing the BPT base, the Agency selected a plant in each subcategory that fulfilled the BPT requirements. The manufacturing processes and sampling results for the plant were studied to determine the incidence of toxic pollutants. This analysis showed that BAT regulations for toxic organic pollutants would not be necessary; wood rosin and tall oil distillation wastewaters showed reduced levels of toxic pollutants when treated with the required BPT treatment scheme. The Agency concluded that no further treatment for toxic pollutants was required.

The remaining two subcategories, sulfate turpentine and rosin-based derivatives, use metal catalysts - copper, nickel, and zinc - in the processing. These metals appeared in the wastewater effluents of the plants. The use of these catalysts is process-specific. One plant in the sulfate turpentine industry has a metals removal unit for the process in which a metal catalyst is used. Prior to treatment, the initial concentration was 155 mg/l; metals removal reduced the concentration to 1 mg/l. To supplement this information, the Agency reviewed the wastewater characteristics and the treatability data from several other industrial categories which already treated for these metals. This review indicated that the wastewater from the electroplating industry appears to resemble more closely the

wastewater from gum and wood chemicals. Several of the same characteristics which may present treatability problems (i.e; oil and grease and chelating agents) also appear in electroplating wastewaters. Therefore, EPA has transferred the numerical limitations for copper, nickel, and zinc from the Electroplating Point Source Category to the Gum and Wood Chemicals Point Source Category.

REGULATED POLLUTANTS

- 1) Non-toxic, non-conventional pollutants--There are no non-toxic, non-conventional pollutants limited by these proposed regulations.
- 2) Toxic pollutants--The toxic pollutants expressly controlled for direct dischargers in two subcategories are copper, zinc, nickel, which are subject to numerical limitations expressed in milligrams per liter of pollutant.

SIZE, AGE, PROCESSES EMPLOYED, LOCATION OF FACILITIES

In the Gum and Wood Chemicals Industry, size, age, and location of the plants do not affect the application of BAT technology. The industrial process employed does affect BAT technology in that two subcategories, wood rosin and tall oil, do not use metal catalysts and do not require metals removal. The remaining subcategories, sulfate turpentine and rosin-based derivatives, do use metals in processing and require metals removal treatment.

TOTAL COST OF APPLICATION

The statutory assessment of BAT "considers" costs, but does not require a balancing of costs against effluent reduction benefits (see Weyerhaeuser v. Costle, supra). In developing the proposed BAT, however, EPA has given substantial weight to the reasonableness of costs. The Agency has considered the volume and nature of discharges, the volume and nature of discharges expected after application of BAT, the general environmental effects of the pollutants, and the costs and economic impacts of the required pollution control levels.

Twelve plants in the Gum and Wood Chemicals Industry are direct dischargers subject to BAT standards for existing sources. Eight of these plants are multiple-subcategory plants (i.e., plants producing in more than one subcategory). The estimated costs assume that all plants have BPT technology in-place. A survey of sulfate turpentine and rosin-based derivatives plants indicates that metals removal will be required at two of the 12 plants. Total investment costs to meet proposed BAT will be approximately \$226 thousand with total annual operating costs of about \$460 thousand.

EPA expects the achievement of BAT regulations to remove approximately 60 pounds per day of zinc from two rosin-based derivatives plants.

ENGINEERING ASPECTS OF BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE

Metals removal is the major treatment process for BAT and will impact only the two subcategories - rosin-based derivatives and sulfate turpentine - where metal catalysts are used. The use of metals is process specific and not distributed throughout the whole category.

The most accepted method of metals removal is the precipitation of metal salts. These include hydroxides, sulfides, and carbonates. The one plant in the industry that currently removes metals uses hydroxide salts for the precipitation process. The sulfide salts produce better removal rates, but the system is more complex and the stability of the sludges has not been determined. Carbonate salts have the least effective removal rate.

Process Changes

The most cost- and performance-effective waste treatment approach is to prevent the entry of pollutants into the waste stream, or to remove the pollutants from the source stream before dilution, contamination, or other interaction occurs in the mixing of several waste streams. Aside from in-plant waste stream isolation and collection for treatment, no in-plant process changes are required for achievement of the recommended effluent limitations.

NON-WATER QUALITY ENVIRONMENTAL IMPACT

The primary non-water quality environmental impact of the proposed BAT effluent limitations is the potential concentration of toxic metallic pollutants removed from wastewater.

No increase in air pollution should result from the BAT technology since metals removal is accomplished in the aqueous phase and no release of hydrocarbons or metals to the air should result. Consumptive water loss by entrainment of water in the hydroxide flocs should be minor. Small increases in energy requirements are expected for operation of pumps and other ancillary equipment.

TABLE X-1. BAT EFFLUENT LIMITATIONS

SUECATEGORY F--ROSIN-BASED DERIVATIVES

Pollutant or Pollutant Property	<u>EAT Effluent Limitations</u>	
	Maximum for Any One Day	Average of Daily Values for 30 Consecutive Days
<u>milligrams per liter (mg/l)</u>		
Zinc*	4.2	1.8

* At the source

SUECATEGORY G--SULFATE TURPENTINE

Pollutant or Pollutant Property	<u>EAT Effluent Limitations</u>	
	Maximum for Any One Day	Average of Daily Values for 30 Consecutive Days
<u>milligrams per liter (mg/l)</u>		
Copper*	4.5	1.8
Nickel*	4.1	1.8

* At the source

SECTION XI

EFFLUENT REDUCTION ATTAINABLE BY BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY

The 1977 amendments to the Act added section 301(b)(4)(E) establishing "best conventional pollutant control technology" (BCT) for discharges of conventional pollutants from existing industrial point sources. Conventional pollutants are those defined in section 304(b)(4)--BCD, TSS, fecal coliform, and pH--and any additional pollutants defined by the Administrator as "conventional." On July 29, 1979, EPA added oil and grease to the conventional pollutant list (44 Fed. Reg. 44501).

BCT is not an additional limitation, but replaces BAT for the control of conventional pollutants. BCT requires that limitations for conventional pollutants be assessed in light of a new "cost-reasonableness" test, which compare the cost and level of reduction of conventional pollutants from the discharge of publicly-owned treatment works to the cost and level of reduction of such pollutants from a class or category of industrial sources. As part of its review of BAT for certain "secondary" industries, the Agency proposed methodology for this cost test. See 44 Fed. Reg. 50732 (August 26, 1979).

The Agency conducted a search to upgrade the existing BPT technology for evaluation as BCT. Various oxidation techniques have been studied but none of them is in current use in the industry. Therefore, EPA is proposing BCT effluent limitations at the same level as BPT effluent limitations.

TABLE XI-1. ECT EFFLUENT LIMITATIONS

Subcategory C--Wood Rosin, Turpentine, and Pine Oil Subcategory

Pollutant or Pollutant Property	Maximum for Any One Day	Average of Daily Values for 30 Consecutive Days
kg/kkg (or lb/1,000 lb) cf product		
BCD5	2.08	1.10
TSS	1.38	0.475
pH	Within the range of 6.0 to 9.0 at all times	

Subcategory D--Tall Oil Rosin, Pitch, and Fatty Acids Subcategory

Pollutant or Pollutant Property	Maximum for Any One Day	Average of Daily Values for 30 Consecutive Days
kg/kkg (or lb/1,000 lb) cf product		
BCD5	0.995	0.529
TSS	0.705	0.243
pH	Within the range of 6.0 to 9.0 at all times	

Subcategory F--Rosin-Based Derivatives

Pollutant or Pollutant Property	Maximum for Any One Day	Average of Daily Values for 30 Consecutive Days
kg/kg (or lb/1,000 lb) cf product		
BCD5	1.41	0.748
TSS	0.045	0.015
pH	Within the range of 6.0 to 9.0 at all times	

Subcategory G--Sulfate Turpentine

Pollutant or Pollutant Property	Maximum for Any One Day	Average of Daily Values for 30 Consecutive Days
kg/kg (or lb/1,000 lb) cf product		
BCD5	5.504	2.924
TSS	0.686	0.236
pH	Within the range of 6.0 to 9.0 at all times	

SECTION XII

NEW SOURCE PERFORMANCE STANDARDS

The basis for new source performance standards (NSPS) under section 306 of the Act is the best available demonstrated technology (BAT). New plants have the opportunity to design the best and most efficient Gum and Wood Chemicals processes and wastewater treatment technologies, and Congress therefore directed EPA to consider the best demonstrated process changes, in-plant controls, and end-of-pipe treatment technologies which reduce pollution to the maximum extent feasible. A major difference between NSPS and BAT is that the Act does not require evaluation of NSPS in light of the BAT cost test.

EPA has selected BPT plus metals removal for the sulfate turpentine and rosin-based derivatives subcategory. Metals removal need not be required if a plant can show that the metals are not used as catalysts, active ingredients, or by-products. The new source requirements for the wood rosin and the tall oil subcategory are the BPT requirements currently in effect.

The biological treatment required by BPT has shown adequate removal of the toxic organic compounds. EPA believes that GAC (granular activated carbon) columns would be too expensive for the removal of toxic chemicals.

Since the control and treatment technology basis for NSPS is the same as for BPT, the methodology used to develop the effluent limitations, the engineering aspects of this technology, and the numerical effluent limitations are also the same.

TABLE XII-1. NSPS EFFLUENT LIMITATIONS

Subcategory C--Wood Rosin, Turpentine, and Pine Oil Subcategory

Pollutant or Pollutant Property	Maximum for Any One Day	Average of Daily Values for 30 Consecutive Days
kg/kg (or lb/1,000 lb) cf product		
BCD5	2.08	1.10
TSS	1.38	0.475
pH	Within the range of 6.0 to 9.0 at all times	

Subcategory D--Tall Oil Rosin, Pitch, and Fatty Acids Subcategory

Pollutant or Pollutant Property	Maximum for Any One Day	Average of Daily Values for 30 Consecutive Days
kg/kg (or lb/1,000 lb) cf product		
BCD5	0.995	0.529
TSS	0.705	0.243
pH	Within the range of 6.0 to 9.0 at all times	

Subcategory F--Rosin-Based Derivatives

Pollutant or Pollutant Property	Maximum for Any One Day	Average of Daily Values for 30 Consecutive Days
kg/kg (or lb/1,000 lb) cf product		
BCD5	1.41	0.748
TSS	0.045	0.015
milligrams/liter (mg/l)		
Zinc*	4.2	1.8
pH	Within the range of 6.0 to 9.0 at all times	
*At-the-source		

Subcategory G--Sulfate Turpentine

Pollutant or Pollutant Property	Maximum for Any One Day	Average of Daily Values for 30 Consecutive Days
kg/kg (or lb/1,000 lb) of product		
BCD5	5.504	2.924
TSS	0.686	0.236
milligrams per liter (mg/l)		
Zinc*	4.2	1.8
Nickel*	4.1	1.8
pH	Within the range of 6.0 to 9.0 at all times	
*At-the-source		

SECTION XIII

PRETREATMENT STANDARDS

INTRODUCTION

The effluent limitations that must be achieved by new and existing sources in the Gum and Wood Chemicals Industry discharging into a publicly-owned treatment works (POTW) are termed pretreatment standards. Section 307(b) of the Act requires EPA to promulgate pretreatment standards for existing sources (PSES) to prevent the discharge of pollutants which pass through, interfere with, or are otherwise incompatible with the operation of POTWs. The Clean Water Act of 1977 adds a new dimension by requiring pretreatment for pollutants, such as heavy metals, that limit POTW sludge management alternatives, including the beneficial use of sludges on agricultural lands. The legislative history of the 1977 Act indicates that pretreatment standards are to be technology-based, analagous to the best available technology for removal of toxic pollutants. The general pretreatment regulations (40 CFR Part 403) can be found in 43 Fed. Reg. 27736-27773 (June 26, 1978).

In establishing a pretreatment standard, the Agency also considered the following:

1. The total cost of applying technology in relation to the effluent reduction benefits achieved from such application;
2. The size and age of equipment and facilities involved;
3. The processes employed;
4. The engineering aspects of applying pretreatment technology and its relationship to POTW;
5. Process changes; and
6. Nonwater quality environment impact (including energy requirements).

Pretreatment standards must reflect effluent reduction achievable by the application of the best available pretreatment technology. This may include preliminary treatment technology as used in the industry and in-plant controls considered to be normal industry practice.

A final consideration is the determination of economic and engineering reliability in the application of the pretreatment technology. This is developed through demonstration projects, pilot plant experiments, and, most preferably, general use within the industry.

PRETREATMENT STANDARDS FOR EXISTING SOURCES

Pretreatment Technology

Candidate control technologies for pretreatment include the same in-plant control and pretreatment technologies considered as candidate EAT technologies for direct dischargers.

These technologies include:

- Water conservation and reuse for reduced flow
- Stream segregation for separate pretreatment
- Metals removal by pH adjustment and filtration or

RATIONALE FOR THE PRETREATMENT STANDARD

The rationale for the pretreatment standard rests primarily on the concept of interference with or pass-through POTW as used in section 307(b) of the Act and delineated in the recently promulgated pretreatment regulations (40 CFR Part 403, 43 Fed. Reg. 27773, June 26, 1978). Among the pollutants in the raw waste from Gum and Wood Chemicals plants, copper, nickel, and zinc appear in sufficient concentrations to present potential problems of pollutant pass-through or sludge disposal for POTW.

Within this technology-based analysis, EPA has assumed the following:

- * Any joint municipal-industrial POTW which receives Gum and Wood Chemicals wastewater includes primary sedimentation and secondary biological treatment with final clarification and sludge management. These facilities are properly designed and diligently operated.
- * Analysis of pass-through and upset of POTW has been determined from the point of wastewater release from the Gum and Wood Chemicals plant; therefore, specific collection system circumstances must be considered at the local level.
- * Locally specific water quality constraints and unique operational or sludge disposal problems, beyond the requirement for compliance with section 405(d) of the Clean Water Act, have not been considered within this technology-based analysis.
- * Strict adherence to and local enforcement of the general prohibited discharge provisions of the pretreatment regulation, and similar provisions in local ordinances, are essential to ensure that potential problems of upset and/or pass-through noted below are not permitted to occur.

Wastewaters from sulfate turpentine and rosin-based derivatives plants potentially can create or contribute to the following problems for a POTW:

- * A potential future problem with disposal of sludges.
- * Potential sludge digestion problems.

These problems can be eliminated largely through strict adherence to prohibited discharge provisions of local ordinances and the national pretreatment regulation.

The data and information gathered during this study indicate that the BOD5 and TSS found in Gum and Wood Chemicals wastewaters respond well to properly designed and operated secondary biological treatment.

Similarly, oil and grease found in Gum and Wood Chemicals plants decreased to low levels through a combination of oil/water separation and biochemical oxidation in biological treatment systems. Properly designed and operated oil/water separators prior to discharge to a POTW should result in treatable levels of oil and grease. This fact, and the nature of the oil and grease being discharged (i.e., primarily animal and/or vegetable origin) make pretreatment limitations unnecessary.

The same data indicate that, in general, copper, nickel, and zinc are removed from wastewater. Since these elements are not biodegradable, the Agency suspects that they form hydroxide flocs at the elevated pH necessary for biological treatment (i.e., pH 7) or that they complex with other components of the waste stream. In either case, the metals probably occur in the sludges formed by biological treatment. Studies conducted at the Robert A. Taft Sanitary Engineering Center indicate that copper, zinc, and nickel may interfere with biological treatment. In addition, copper and zinc may interfere with the digestion of sludge in the activated sludge process.

Effluent data from Gum and Wood Chemicals plants with biological treatment indicate that organic toxic pollutants of concern (i.e., phenol, toluene, benzene, and ethylbenzene) are discharged at concentrations less than or equal to 0.2 mg/l. In consideration of this performance and the enhanced treatment provided by activated sludge treatment systems, pretreatment limitations are unnecessary for the toxic organic pollutants.

REGULATED POLLUTANTS

1) Conventional Pollutants - As noted above, the conventional pollutants from Gum and Wood Chemicals plants respond well to properly

designed and operated secondary biological treatment. therefore, no limitations are proposed for the conventional pollutants.

2) Non-toxic, non-conventional pollutants - there are no non-toxic, non-conventional pollutants limited by these proposed regulations.

3) Toxic pollutants - The toxic pollutants expressly controlled for direct dischargers in two subcategories are copper, nickel, and zinc, which are subject to numerical limitations expressed in milligrams per liter of pollutant.

SIZE, AGE, PROCESSES EMPLOYED, LOCATION OF FACILITIES

The size and age of Gum and Wood Chemical plants do not affect the proposed pretreatment control technology. Neither is the location of the facilities a factor. The processes employed were a factor in prescribing pretreatment. Subcategories C and D use no metals and those present are probably the result of corrosion or other forms of non-process related contamination. For Subcategories F and G, which use metals in the chemical modification of rosins and turpenes, at-the-source effluent treatment is proposed as the pretreatment standard.

TOTAL COST OF APPLICATION

At this time eight plants in the Gum and Wood Chemicals Industry discharge to POTWs and are thus subject to pretreatment standards for existing sources. The estimated costs are based on a survey of sulfate turpentine and rosin-based derivatives plants indicating that metals removal units will be required at four plants (this technology is in-place at one of the four plants). Total investment costs to meet proposed PSES will be approximately \$259 thousand with total annual operating costs of about \$470 thousand.

Achievement of PSES regulations by metals removal control and treatment technology is expected to remove approximately 13 pounds per day of copper and nickel and 119 pounds per day of zinc.

ENGINEERING ASPECTS OF PRETREATMENT TECHNOLOGY AND RELATIONSHIP TO PUBLICLY-OWNED TREATMENT WORKS

As noted earlier in this section, each of the problems associated with Gum and Wood Chemicals wastewater can be controlled largely by strict adherence to general prohibited discharge regulations and to these pretreatment standards which limit copper, nickel, and zinc. The metals are being regulated directly as the most significant toxic pollutants because of their pass-through of POTWs and their potential to reduce biodegradation at the POTW and affect sludge digestion. Careful design and diligent operation of a POTW are also extremely

important for progress toward achievement of secondary treatment standards by POTWs.

IN-PLANT CHANGES

While metals precipitation at-the-source is considered an end-of-pipe treatment technology, the technology needs to be located near a process unit dedicated to chemical modification of rosins and turpenes. Since these units are generally aboveground, a repiping of the wastewater piping and dedication of certain plant areas will be required. These costs plus the cost of the unit will be generally smaller than installation of metals removal technology applied to the total waste stream from a sulfate turpentine or rosin-based derivatives plants.

Table XIII-1 Subcategory F--Rosin-Based Derivatives

<u>Pollutant or</u> <u>Pollutant Property</u>	<u>PSES Effluent Limitations</u>	
	<u>Maximum for</u> <u>Any One Day</u>	<u>Average of Daily Values</u> <u>for 30 Consecutive Days</u>
	milligrams per liter (mg/l)	
Zinc*	4.2	1.8
<u>*At-the-Source</u>		

Subcategory G--Sulfate Turpentine

<u>Pollutant or</u> <u>Pollutant Property</u>	<u>PSES Effluent Limitations</u>	
	<u>Maximum for</u> <u>Any One Day</u>	<u>Average of Daily Values</u> <u>for 30 Consecutive Days</u>
Copper*	4.5	1.8
Nickel*	4.1	1.8
<u>*At-the-Source</u>		

PRETREATMENT STANDARDS FOR NEW SOURCES

Section 307(c) of the Act requires EPA to promulgate pretreatment standards for new sources (PSNS) at the same time that it promulgates NSPS. New indirect dischargers, like new direct dischargers, have the opportunity to incorporate the best available demonstrated technologies including process changes, in-plant controls, and end-of-pipe treatment technologies, and to use plant site selection to ensure adequate treatment system installation.

Candidate control technologies for pretreatment for new sources include the same in-plant control and pretreatment technologies considered as candidate pretreatment technologies discussed previously for existing sources.

RATIONALE FOR THE PRETREATMENT STANDARD

The rationale for the pretreatment standard rests primarily on the concept of interference with or pass-through POTW as used in section 307(b) of the Act and delineated in the recently promulgated pretreatment regulations (40 CFR Part 403, FR27736-27773, June 26, 1978). Among the pollutants in the raw waste from Gum and Wood Chemicals plants copper, nickel, and zinc appear in sufficient concentrations to present potential problems of pollutant pass-through or sludge disposal for POTW.

As noted in the rationale for PSES, metals removal pretreatment technology should permit achievement by POTWs of EAT effluent limitations resulting in levels of toxics less than or equal to that achieved by BAT. While pass-through of toxic pollutants and the presence of toxic pollutants in sludges will still occur, they should be at levels low enough not to interfere with biological treatment and, in the case of organic toxic pollutants, at levels lower than achieved by BPT. The Agency has therefore chosen to propose PSNS at the same effluent quality required by PSES. The numerical concentration limitations for Subcategories F and G are listed as follows:

NON-WATER QUALITY ENVIRONMENTAL IMPACT

As with BAT, the Agency expects the primary non-water quality impact to be the concentration of toxic metal pollutants removed from the wastewater. The Agency also expects no increase in air pollution and small increases in consumptive water loss and energy requirements.

Table XIII-2 Subcategory F--Rosin-Eased Derivatives

<u>Pollutant or</u>	<u>Maximum for</u>	<u>Average of Daily Values</u>
<u>Pollutant Property</u>	<u>Any One Day</u>	<u>for 30 Consecutive Days</u>

milligrams per liter (mg/l)

Zinc*

4.2

1.8

*At-the-Source

Subcategory G--Sulfate Turpentine

<u>Pollutant or</u>	<u>Maximum for</u>	<u>Average of Daily Values</u>
<u>Pollutant Property</u>	<u>Any One Day</u>	<u>for 30 Consecutive Days</u>

milligrams per liter (mg/l)

Copper*

4.5

1.8

Nickel*

4.1

1.8

*At-the-Source

SECTION XIV

PERFORMANCE FACTORS FOR TREATMENT PLANT OPERATIONS

PURPOSE

This section discusses the causes of variations in the performance of wastewater treatment facilities and techniques for minimizing these variations.

FACTORS WHICH INFLUENCE VARIATIONS IN PERFORMANCE OF WASTEWATER TREATMENT FACILITIES

The factors influencing the variation in performance of wastewater treatment facilities are common to all subcategories. The most important factors are summarized in this section.

Temperature

Temperature affects the rate of biological reaction; lower temperatures decrease biological activity and cause higher effluent BOD levels. Effluent solids levels also increase as a result of incomplete bio-oxidation and decreased settling rates under reduced temperatures. Settling basins and aerated lagoons are susceptible to thermal inversions. Significant variations in the levels of effluent solids may result as settled solids rise to the surface and are discharged.

Proper design and operation considerations can reduce the adverse effects of temperature on treatment efficiencies. Such considerations include the installation of insulation and the addition of heat. Techniques for temperature control are both well known and commonly used in the sanitary engineering field. Cost-effectiveness is usually the critical criterion for the extent and effectiveness of temperature control.

Shock Loading

Once a system is acclimated to a given set of steady state conditions, rapid quantitative or qualitative changes in loading rates can cause a decrease in treatment efficiencies. Several days or weeks are often required for a system to adjust to a new set of operating conditions. Systems with short retention times, such as activated sludge, are particularly sensitive to shock loading.

While it is unlikely that total and permanent prevention of shock loadings for a particular system can be achieved, proper design and operation can greatly reduce adverse effects. Sufficient flow equalization prior to biological treatment can mitigate shock loads.

Complete mix activated sludge is less likely to upset conditions than other activated sludge modifications.

System Stabilization

A new biological system, or one that has been out of operation, requires a stabilizing period of up to several weeks before optimum, consistent efficiency can be expected. During this start-up period, large variations in pollutant parameters can be expected in the discharge.

System Operation

Good operation and maintenance is essential to the successful performance of any activated sludge system. Operators must be well-trained specialists thoroughly familiar with the system they are operating.

Nutrient Requirements

Adequate amounts of nutrients, particularly nitrogen and phosphorus, are necessary to maintain a viable microbial population in a biological system. Proper design and operation of a system will provide sufficient nutrients for optimum performance.

System Controllability

In addition to the design considerations mentioned above, an activated sludge system should include appropriate meters and accurate, controllable gates, valves, and pumps for optimum performance. A qualified instrument technician should be available.

An adequate laboratory should be provided, along with monitoring facilities. Essential control tests should be conducted at least once every 8-hour shift, and more frequently when necessary.

SECTION XV

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SECTION XVI

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Nickel. Draft Criteria Document, U.S. Environmental Protection Agency. PB 296800, Natl. Tech. Info. Serv., Springfield, VA.

SECTION XVII

GLOSSARY OF TERMS AND ABBREVIATIONS

Absorption--A process in which one material (the absorbent) takes up and retains another (the absorbate) with the formation of a homogeneous mixture having the attributes of a solution. Chemical reaction may accompany or follow absorption.

Act--The Federal Water Pollution Control Act Amendments of 1972, Public Law 92-500.

Activated Carbon--Carbon which is treated by high-temperature heating with steam or carbon dioxide producing an internal porous particle structure.

Activated Sludge--Sludge floc produced in raw or settled wastewater by the growth of zoogeal bacteria and other organisms in the presence of dissolved oxygen and accumulated in sufficient concentration by returning floc previously formed.

Activated Sludge Process--A biological wastewater treatment process in which a mixture of wastewater and activated sludge is agitated and aerated. The activated sludge is subsequently separated from the treated wastewater (mixed liquor) by sedimentation and wasted or returned to the process as needed.

Adsorption--An advanced method of treating wastes in which a material removes organic matter not necessarily responsive to clarification or biological treatment by adherence on the surface of solid bodies.

Aerated Lagoon--A natural or artificial wastewater treatment pond in which mechanical or diffused-air aeration is used to supplement the oxygen supply.

Aqueous Solution--One containing water or watery in nature.

Azeotrope--A liquid mixture that is characterized by a constant minimum or maximum boiling point which is lower or higher than that of any of the components and that distills without change in composition.

EAT (BATEA) Effluent Limitations--Limitations for point sources, other than publicly-owned treatment works, which are based on the application of the Best Available Technology Economically Achievable. These limitations must be achieved by July 1, 1984.

Biological Wastewater Treatment--Forms of wastewater treatment in which bacterial or biochemical action is intensified to stabilize, oxidize, and nitrify the unstable organic matter present. Intermittent sand filters, contact beds, trickling filters, and activated sludge processes are examples.

Blank--deionized water used to rinse automatic sampler prior to collection of sample.

Blowdown--The removal of a portion of any process flow to maintain the constituents of the flow at desired levels.

BOD--Biochemical Oxygen Demand is a measure of biological decomposition of organic matter in a water sample. It is determined by measuring the oxygen required by microorganisms to oxidize the organic contaminants of a water sample under standard laboratory conditions. The standard conditions include incubation for five days at 20 C.

BOD7--A modification of the BOD test in which incubation is maintained for seven days. The standard test in Sweden.

EPT(BPCTCA) Effluent Limitations--Limitations for point sources, other than publicly-owned treatment works, which are based on the application of the Best Practicable Control Technology Currently Available. These limitations must be achieved by July 1, 1977.

Carbonization--A process whereby a carbon residue is produced via the destructive distillation of wood.

Chipper--A machine which reduces logs or wood scraps to chips.

Chlorination--The application of chlorine to water, sewage or industrial wastes, generally for the purpose of disinfection but frequently for accomplishing other biological or chemical results.

Clarification--Process of removing turbidity and suspended solids by settling. Chemicals can be added to improve and speed up the settling process through coagulation.

Clarifier--A unit of which the primary purpose is to reduce the amount of suspended matter in a liquid.

cm--Centimeters.

COD--Chemical Oxygen Demand. Its determination provides a measure of the oxygen demand equivalent to that portion of matter in a sample which is susceptible to oxidation by a strong chemical oxidant.

Composite Sample--A combination of individual samples of wastes taken at selected intervals, generally hourly for 24 hours, to minimize the effect of the variations in individual samples. Individual samples making up the composite may be of equal volume or be roughly apportioned to the volume of flow of liquid at the time of sampling.

cu m--Cubic meters.

cu ft--Cubic feet.

Cyclone--A conical-shaped vessel for separating either entrained solids or liquid materials from the carrying air or vapor. The vessel has a tangential entry nozzle at or near the largest diameter, with an overhead exit for air or vapor and a lower exit for the more dense materials.

Data Collection Portfolio--Information solicited from industry under Section 308 of the Act.

Derivative--A substance extracted from another body or substance.

Destructive Distillation--Decomposition of wood (or a hydrocarbon) by heat in a closed container and the collection of the volatile substances produced.

Digester--(1) Device for conditioning chips using high pressure steam, (2) A tank in which biological decomposition (digestion) of the organic matter in sludge takes place.

Distillation--The separation, by vaporization, of a liquid mixture of miscible and volatile substance into individual components, or, in some cases, into a group of components. The process of raising the temperature of a liquid to the boiling point and condensing the resultant vapor to liquid form by cooling. It is used to remove substances from a liquid or to obtain a pure liquid from one which contains impurities or which is a mixture of several liquids having different boiling temperatures. Used in the treatment of fermentation products, yeast, etc., and other wastes to remove recoverable products.

DO--Dissolved Oxygen is a measure of the amount of free oxygen in a water sample. It is dependent on the physical, chemical, and biochemical activities of the water sample.

Effluent--A liquid which leaves a unit operation or process. Sewage, water or other liquids, partially or completely treated or in their natural states, flowing out of a reservoir basin, treatment plant or any other unit operation. An influent is the incoming stream.

Entrainment Separator--A device to remove liquid and/or solids from a gas stream. Energy source is usually derived from pressure drop to create centrifugal force.

Equalization Basin--A holding basin in which variations in flow and composition of a liquid are averaged. Such basins are used to provide a flow of reasonably uniform volume and composition to a treatment unit.

Essential Oils--Oils composed mainly of terpene hydrocarbons (turpentine), which are obtained by steam distillation of wood chips, bark, or leaves of select trees.

Ester Gum--A resin made from rosin or rosin acids and a polyhydric alcohol, such as glycerin or pentaerythritol.

Esterification--This generally involves the combination of an alcohol and an organic acid to produce an ester and water. The reaction is carried out in the liquid phase, with aqueous sulfuric acid as the catalyst. The use of sulfuric acid has in the past caused this type of reaction to be called sulfation.

Exudate--Exuded matter.

Exude--To ooze or trickle forth through pores or gushes, as sweat or gum, etc.

Fatty Acids--An organic acid obtained by the hydrolysis (saponification) of natural fats and oils, e.g., stearic and palmitic acids. These acids are monobasic and may or may not contain some double bonds. They usually contain sixteen or more carbon atoms.

Fines--Crushed solids sufficiently fine to pass through a screen, etc.

Flocculation--The agglomeration of colloidal and finely divided suspended matter.

Flotation--The raising of suspended matter to the surface of the liquid in a tank as scum--by aeration, the evolution of gas, chemicals, electrolysis, heat, or bacterial decomposition--and the subsequent removal of the scum by skimming.

F:M Ratio--The ratio of organic material (food) to mixed liquor (microorganisms) in an aerated sludge aeration basin.

Fractionation (or Fractional Distillation)--The separation of constituents, or group of constituents, of a liquid mixture of miscible and volatile substances by vaporization and recondensing at specific boiling point ranges.

Gal--Gallons.

Gland Water--Water used to lubricate a gland. Sometimes called "packing water."

GPD--Gallons per day.

GPM--Gallons per minute.

Grab Sample--(1) Instantaneous sampling; (2) A sample taken at a random place in space and time.

Gum--The crystallized pine oleoresin or "scrape" collected from scarified "faces" of trees being worked for turpentine, exudates from living long leaf and slash pine trees.

Hardwood (or Deciduous Woods)--Trees that lose their leaves annually. Morphologically and chemically distinct from the conifers and commonly referred to as hardwoods, despite the fact that certain species such as basswood and poplar have woods that are relatively soft. Fibers are substantially shorter than those of coniferous wood. Normally, deciduous woods are not a source of turpentine.

Holding Ponds--See Impoundment.

Impoundment--A pond, lake, tank, basin, or other space, either natural or created in whole or in part by the building of engineering structures, which is used for storage, regulation, and control of water, including wastewater.

Influent--Any sewage, water, or other liquid, either raw or partly treated, flowing into a reservoir, basin, treatment plant, or any part thereof. The influent is the stream entering a unit operation; the effluent is the stream leaving it.

Kl/day--Thousands of liters per day.

Kraft (or Sulfate) Process--The digestion of wood chips with a solution of sodium hydroxide, sodium sulfide, and sodium carbonate to produce paper pulp. This process delignifies the wood chip and allows separation of the cellulose fibers from a caustic solution of lignin degradation products (sugars, hemicellulose, resin, and fatty acids) and unsaponifiables.

Lagoon--A pond containing raw or partially treated wastewater in which aerobic or anaerobic stabilization occurs.

Leaching--Mass transfer of chemicals to water from wood which is in contact with it.

l/day--Liters per day.

Metric ton--One thousand kilograms.

MGD--Million gallons per day.

mg/l--Milligrams per liter (equal parts per million, ppm, when the specific gravity is one).

Mixed Liquor--A mixture of activated sludge and organic matter undergoing activated sludge treatment in an aeration tank.

ml/l--Milliliters per liter.

mm--Millimeters.

Naval Stores--Chemically reactive oils, resins, tars, and pitches derived from the oleoresin contained in, exuded by, or extracted from trees chiefly of the pine species (Genus Pinus), or from the wood of such trees.

Neutralization--The restoration of the hydrogen or hydroxyl ion balance in a solution so that the ionic concentrations of each are equal. Conventionally, the notation "pH" (puissance d'hydrogen) is used to describe the hydrogen ion concentration or activity present in a given solution. For dilute solutions of strong acids, i.e., acids which are considered to be completely dissociate (ionized in solution), activity equals concentration.

Non-Condensables--Vapors or gases that remain in the gaseous state at the temperature and pressure specified. These normally would be considered the final vented gases under operating conditions.

No Discharge--The complete prevention of polluted process wastewater from entering navigable waters.

NPDES--National Pollutant Discharge Elimination System.

NSPS--New Source Performance Standards.

Nutrients--The nutrients in contaminated water are routinely analyzed to characterize the food available for microorganisms to promote organic decomposition. They are:

Ammonia Nitrogen (NH₃), mg/l as N
Kjeldahl Nitrogen (ON), mg/l as N
Nitrate Nitrogen (NO₃), mg/l as N
Total Phosphate (TP), mg/l as P
Ortho Phosphate (OP), mg/l as P

Oil-Recovery System--Equipment used to reclaim oil from wastewater.

Oleoresin--Pine gum, the non-aqueous secretion of rosin acids dissolved in a terpene hydrocarbon oil which is produced or exuded from the intercellular resin ducts of a living tree or accumulated, together with oxidation products, in the dead wood of weathered limbs and stumps.

PCE--Polychlorinated Biphenyls.

PCP--Pentachlorophenol.

Pentachlorophenol--A chlorinated phenol with the formula $C_{15}Cl_5O$ and formula weight of 266.35 that is used as a wood preservative. Commercial grades of this chemical are usually adulterated with tetrachlorophenol to improve its solubility.

pH--pH is a measure of the acidity or alkalinity of a water sample. It is equal to the negative log of the hydrogen ion concentration.

Phenol--The simplest aromatic alcohol.

Phenols, Phenolic Compounds--A wide range of organic compounds with one or more hydroxyl groups attached to the aromatic ring.

Pine Tar Oil--The oil obtained by condensing the vapors from the retorts in which resinous pine wood is destructively distilled (carbonized).

Pitch--A dark viscous substance obtained as residue in the distillation of the volatile oils from retort pine oil or crude tall oil.

Pitch, Brewer's--A term used to designate a type of pitch made by blending certain oils, waxes, or other ingredients with rosin for the coating of beer barrels.

Point Source--A discrete source of pollution. Channeled wastewater.

POTW--Publicly-owned treatment works.

Pretreatment--Any wastewater treatment processes used to partially reduce pollution load before the wastewater is delivered into a treatment facility. Usually consists of removal of coarse solids by screening or other means.

Primary Treatment--The first major treatment in a wastewater treatment works. In the classical sense, it normally consists of clarification.

As used in this document, it generally refers to treatment steps preceding biological treatment.

Priority Pollutants--Those compounds listed in the 1976 Consent Decree.

Process Wastewater--Water, which during manufacturing or processing, comes into contact with or results in the production or use of any raw material, intermediate product, finished product, by-product, or waste product.

psi--Pounds per square inch.

Pyroligneous Acid--A product of the destructive distillation of hardwoods composed primarily of acetic acid, crude methanol, acetone, tars and oils, and water.

Resin--A large class of synthetic products that have properties similar to natural resin, or rosin, but are chemically different.

Retort--A vessel in which substances are distilled or decomposed by heat.

Rosin--A specific kind of natural resin obtained as a nitreous water-insoluble material from pine oleoresin by removal of the volatile oils, or from tall oil by the removal of the fatty acid components thereof. It consists primarily of tricyclic monocarboxylic acids having the general empirical formula $C_{20}H_{30}O_2$, with small quantities of compounds saponifiable with boiling alcoholic potassium or sodium hydroxide, and some unsaponifiable. The three general classifications of kinds of rosins in commerce are: gum rosin, obtained from the oleoresin collected from living trees; wood rosin, from the oleoresin contained in dead wood, such as stumps and knots; and tall oil rosin, from tall oil.

Rosin, Modified--Rosin that has been treated with heat or catalysts, or both; with or without added chemical substances, so as to cause substantial change in the structure of the rosin acids, as isomerization, hydrogenation, dehydrogenation, or polymerization; without substantial effect on the carboxyl group.

RWL--Raw Waste Load. Pollutants contained in untreated wastewater.

Saponification--The reaction in which caustic combines with fat or oil to produce soap.

Screening--The removal of relatively coarse, floating, and suspended solids by straining through racks or screens.

Seal Leg--The line through which an underflow liquid flows, constructed to maintain a liquid trap that will not empty upon nominal pressure changes in the vessel.

Secondary Treatment--The second major step in a waste treatment system. As used in this document, the term refers to biological treatment.

Sedimentation Tank--A basin or tank in which water or wastewater containing settleable solids is retained to remove by gravity a part of the suspended matter.

Separator--The vessel connected to the vent-relief to separate wood fines carried over in the vent-relief gases, and which permits the steam and turpentine vapors (including non-condensables) to proceed in vapor form to the condenser.

Settling Ponds--An impoundment for the settling out of settleable solids.

Sludge--The accumulated solids separated from liquids, such as water or wastewater, during processing.

Softwood--Wood from evergreen or needle-bearing trees.

Soil Irrigation--A method of land disposal in which wastewater is applied to a prepared field. Also referred to as soil percolation.

Solids--Various types of solids are commonly determined on water samples. These types of solids are:

Total Solids (TS)--The material left after evaporation and drying a sample at 103 -105 C.

Suspended Solids (SS)--The material removed from a sample filtered through a standard glass fiber filter. Then it is dried at 103 -105 C.

Total Suspended Solids (TSS)--Same as Suspended Solids.

Dissolved Solids (DS)--The difference between the total and suspended solids.

Volatile Solids (VS)--The material which is lost when the sample is heated to 550 C.

Settleable Solids (STS)--The material which settles in an Imhoff cone in one hour.

Solvent Extraction--A mixture of two components is treated by a solvent that preferentially dissolves one or more of the components in the mixture. The solvent in the extract leaving the extractor is usually recovered and reused.

Sparge--To heat a liquid by means of live steam entering through a perforated or nozzled pipe.

Spray Evaporation--A method of wastewater disposal in which the water in a holding lagoon equipped with spray nozzles is sprayed into the air to expedite evaporation.

Spray Irrigation--A method of disposing of some organic wastewaters by spraying them on land, usually from pipes equipped with spray nozzles. See Soil Irrigation.

sq m--Square meter.

Steam Distillation--Fractionation in which steam introduced as one of the vapors or in which steam is injected to provide the heat of the system.

Steaming--Treating wood material with steam to soften it.

Sump--(1) A tank or pit that receives drainage and stores it temporarily, and from which the drainage is pumped or ejected; (2) A tank or pit that receives liquids.

Tall Oil--A generic name for a number of products obtained from the manufacture of wood pulp by the alkali (sulfate) process, more popularly known as the Kraft process. To provide some distinction between the various products, designations are often applied in accordance with the process or composition, some of which are crude tall oil, acid-refined tall oil, distilled tall oil, tall oil fatty acids, and tall oil rosin.

Tall Oil, Crude--A dark brown mixture of fatty acids, rosin, and neutral materials liberated by the acidification of soap skimmings. The fatty acids are a mixture of oleic acid and linoleic acid with lesser amounts of saturated and other unsaturated fatty acids. The rosin is composed of resin acids similar to those found in gum and wood rosin. The neutral materials are composed mostly of polycyclic hydrocarbons, sterols, and other high-molecular-weight alcohols.

Terpenes--The major chemical components of turpentine. A class of unsaturated organic compounds having the empirical formula $C_{10}H_{16}$, occurring in most essential oils and oleoresinous plants. Structurally, the important terpenes and their derivatives are

classified as monocyclic (dipentene), bicyclic (pinene), and acyclic (myrcene).

Tertiary Treatment--The third major step in a waste treatment facility. As used in this document, the term refers to treatment processes following biological treatment.

TOC--Total Organic Carbon is a measure of the organic contamination of a water sample. It has an empirical relationship with the biochemical and chemical oxygen demands.

T-PO4-P--Total phosphate as phosphorus. See Nutrients.

Total Phenols--See Phenols.

Traditional Parameters--Those parameters historically of interest, e.g., BOD, COD, SS, as compared to Priority Pollutants.

Turpentine--A light-colored, volatile essential oil from resinous exudates or resinous wood associated with living or dead coniferous kinds of turpentine as follows: (1) gum turpentine, obtained by distilling the gum collected from living pine trees; (2) steam-distilled wood turpentine, from the oleoresin within the wood of pine stumps or cuttings, either by direct steaming or mechanically disintegrated wood or after solvent extraction of the oleoresin from the wood; (3) sulfate wood turpentine, recovered during the conversion of wood pulp by the Kraft (sulfate) process. (Sulfate wood turpentine is somewhat similar to gum turpentine in composition); and (4) destructively distilled wood turpentine, obtained by fractionation of certain oils recovered from the destructive distillation of pine wood.

Vacuum Water--Water extracted from wood during the vacuum period following steam conditioning.

Vat--Large metal containers in which logs are "conditioned" or heated prior to cutting. The two basic methods for heating are by direct steam contact in "steam vats" or by steam-heated water in "hot water vats."

Water Balance--The water gain (incoming water) of a system versus water loss (water discharged or lost).

Water-Borne Preservative--Any one of several formulations of inorganic salts, the most common of which are based on copper, chromium, and arsenic.

Wet Scrubber--An air pollution control device which involves the wetting of particles in an air stream and the impingement of wet or dry particles on collected surfaces, followed by flushing.

Zero Discharge--See No Discharge.

EPA Effluent Guidelines Division List of Priority Pollutants for B.A.T. Revision Studies

COMPOUND NAME

- | | | |
|---|---|---|
| 1. *acenaphthene | *haloethers (other than those listed elsewhere) | 85. *tetrachloroethylene |
| 2. *acrolein | 40. 4-chlorophenyl phenyl ether | 86. *toluene |
| 3. *acrylonitrile | 41. 4-bromophenyl phenyl ether | 87. *trichloroethylene |
| 4. *benzene | 42. bis(2-chloroisopropyl) ether | 88. *vinyl chloride (chloroethylene) |
| 5. *benzidine | 43. bis(2-chloroethoxy) methane | pesticides and metabolites |
| 6. *carbon tetrachloride (tetrachloromethane) | *halomethanes (other than those listed elsewhere) | 89. *aldrin |
| *chlorinated benzenes (other than dichlorobenzenes) | 44. methylene chloride (dichloromethane) | 90. *dieldrin |
| 7. chlorobenzene | 45. methyl chloride (chloromethane) | 91. *chlordan (technical mixture & metabolites) |
| 8. 1,2,4-trichlorobenzene | 46. methyl bromide (bromomethane) | *DDT and metabolites |
| 9. hexachlorobenzene | 47. bromoform (tribromomethane) | 92. 4,4'-DDT |
| *chlorinated ethanes (including 1,2-dichloroethane, 1,1,1-trichloroethane and hexachloroethane) | 48. dichlorobromomethane | 93. 4,4'-DDE (p,p'-DDX) |
| 10. 1,2-dichloroethane | 49. trichlorofluoromethane | 94. 4,4'-DDD (p,p'-TDE) |
| 11. 1,1,1-trichloroethane | 50. dichlorodifluoromethane | *endosulfan and metabolites |
| 12. hexachloroethane | 51. chlorodibromomethane | 95. a-endosulfan-Alpha |
| 13. 1,1-dichloroethane | 52. *hexachlorobutadiene | 96. b-endosulfan-Beta |
| 14. 1,1,2-trichloroethane | 53. *hexachlorocyclopentadiene | 97. endosulfan sulfate |
| 15. 1,1,2,2-tetrachloroethane | 54. *isophorone | *endrin and metabolites |
| 16. chloroethane | 55. *naphthalene | 98. endrin |
| *chloroalkyl ethers (chloromethyl, chloroethyl and mixed ethers) | 56. *nitrobenzene | 99. endrin aldehyde |
| 17. bis(chloromethyl) ether | *nitrophenols (including 2,4-dinitrophenol and dinitrocresol) | *heptachlor and metabolites |
| 18. bis(2-chloroethyl) ether | 57. 2-nitrophenol | 100. heptachlor |
| 19. 2-chloroethyl vinyl ether (mixed) | 58. 4-nitrophenol | 101. heptachlor epoxide |
| *chlorinated naphthalene | 59. *2,4-dinitrophenol | *hexachlorocyclohexane (all isomers) |
| 20. 2-chloronaphthalene | 60. 4,6-dinitro-o-cresol | 102. a-BHC-Alpha |
| *chlorinated phenols (other than those listed elsewhere; includes trichlorophenols and chlorinated cresols) | *nitrosamines | 103. b-BHC-Beta |
| 21. 2,4,6-trichlorophenol | 61. N-nitrosodimethylamine | 104. r-BHC (lindane)-Gamma |
| 22. parachlorometa cresol | 62. N-nitrosodiphenylamine | 105. g-BHC-Delta |
| 23. *chloroform (trichloromethane) | 63. N-nitrosodi-n-propylamine | *polychlorinated biphenyls (PCB's) |
| 24. *2-chlorophenol | 64. *pentachlorophenol | 106. PCB-1242 (Arochlor 1242) |
| *dichlorobenzenes | 65. *phenol | 107. PCB-1254 (Arochlor 1254) |
| 25. 1,2-dichlorobenzene | *phthalate esters | 108. PCB-1221 (Arochlor 1221) |
| 26. 1,3-dichlorobenzene | 66. bis(2-ethylhexyl) phthalate | 109. PCB-1232 (Arochlor 1232) |
| 27. 1,4-dichlorobenzene | 67. butyl benzyl phthalate | 110. PCB-1248 (Arochlor 1248) |
| *dichlorobenzidine | 68. di-n-butyl phthalate | 111. PCB-1260 (Arochlor 1260) |
| 28. 3,3'-dichlorobenzidine | 69. di-n-octyl phthalate | 112. PCB-1016 (Arochlor 1016) |
| *dichloroethylenes (1,1-dichloroethylene and 1,2-dichloroethylene) | 70. diethyl phthalate | 113. *toxaphene |
| 29. 1,1-dichloroethylene | 71. dimethyl phthalate | 114. *antimony (total) |
| 30. 1,2-trans-dichloroethylene | *polynuclear aromatic hydrocarbons | 115. *arsenic (total) |
| 31. *2,4-dichlorophenol | 72. benzo(a)anthracene (1,2-benzanthracene) | 116. *asbestos (fibrous) |
| *dichloropropane and dichloropropene | 73. benzo(a)pyrene (3,4-benzopyrene) | 117. *beryllium (total) |
| 32. 1,2-dichloropropane | 74. 3,4-benzofluoranthene | 118. *cadmium (total) |
| 33. 1,2-dichloropropylene (1,3-dichloropropene) | 75. benzo(k)fluoranthene (1,1,2-benzofluoranthene) | 119. *chromium (total) |
| 34. *2,4-dimethylphenol | 76. chrysene | 120. *copper (total) |
| *dinitrotoluene | 77. acenaphthylene | 121. *cyanide (total) |
| 35. 2,4-dinitrotoluene | 78. anthracene | 122. *lead (total) |
| 36. 2,6-dinitrotoluene | 79. benzo(ghi)perylene (1,12-benzoperylene) | 123. *mercury (total) |
| 37. *1,2-diphenylhydrazine | 80. fluorene | 124. *nickel (total) |
| 38. *ethylbenzene | 81. phenanthrene | 125. *selenium (total) |
| 39. *fluoranthene | 82. dibenzo(a,h)anthracene (1,2,5,6-dibenzanthracene) | 126. *silver (total) |
| | 83. indeno (1,2,3-cd)pyrene (2,3-o-phenylenepylene) | 127. *thallium (total) |
| | 84. pyrene | 128. *zinc (total) |
| | | 129. **2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) |

*Specific compounds and chemical classes as listed in the consent decree.

**This compound was specifically listed in the consent decree. Because of the extreme toxicity (TCDD), EPA recommends that laboratories *not* acquire analytical standard for this compound.

APPENDIX A-1

TOXIC OR POTENTIALLY TOXIC SUBSTANCES NAMED IN CONSENT DECREE

Acenaphthene
Acrolein
Acrylonitrile
Aldrin/Dieldrin
Antimony
Arsenic
Asbestos
Benzidine
Benzene
Beryllium
Cadmium
Carbon Tetrachloride
Chlordane
Chlorinated Benzene
Chlorinated Ethanes
Chlorinated Ethers
Chlorinated Phenol
Chloroform
2-Chlorophenol
Chromium
Copper
Cyanide
DDT
Dichlorobenzene
Dichlorobenzidine
Dichloroethylene
2,4-Dichlorophenol
Dichloropropane
2,4-Dimethylphenol
Dinitrotoluene
1,2-Diphenylhydrazine
Endosulfan
Endrin
Ethylbenzene
Fluoranthene
Haloethers
Halomethanes
Heptachlor
Hexachlorobutadiene
Hexachlorocyclohexane
Hexachlorocyclopentadiene
Isophorone
Lead
Mercury
Nickel
Nitrobenzene
Nitrophenol
Nitrosamines

APPENDIX A-2

LIST OF SPECIFIC UNAMBIGUOUS RECOMMENDED PRIORITY POLLUTANTS

1. benzidine
2. 1,2,4-trichlorobenzene
3. hexachlorobenzene
4. chlorobenzene
5. bis(chloromethyl) ether
6. bis(2-chloroethyl) ether
7. 2-chloroethyl vinyl ether (mixed)
8. 1,2-dichlorobenzene
9. 1,3-dichlorobenzene
10. 1,4-dichlorobenzene
11. 3,3'-dichlorobenzidine
12. 2,4-dinitrotoluene
13. 2,6-dinitrotoluene
14. 1,2-diphenylhydrazine
15. ethylbenzene
16. 4-chlorophenyl phenyl ether
17. 4-bromophenyl phenyl ether
18. bis(2-chloroisopropyl) ether
19. bis(2-chloroethoxy) methane
20. isophorone
21. nitrobenzene
22. N-nitrosodimethylamine
23. N-nitrosodiphenylamine
24. N-nitrosodi-n-propylamine
25. bis(2-ethylhexyl) phthalate
26. butyl benzyl phthalate
27. di-n-butyl phthalate
28. diethyl phthalate
29. dimethyl phthalate
30. toluene
31. vinyl chloride (chloroethylene)
32. acrolein
33. acrylonitrile
34. acenaphthene
35. 2-chloronaphthalene
36. fluoranthene
37. naphthalene
38. 1,2-benzanthracene
39. benzo(a)pyrene(3,4-benzopyrene)
40. 3,4-benzofluoranthene
41. 11,12-benzofluoranthene
42. chrysene
43. acenaphthylene
44. anthracene
45. 1,12-benzoperylene
46. fluorene
47. phenanthrene
48. 1,2,5,6-dibenzanthracene

2. List of Specific Unambiguous Recommended Priority Pollutants

1. benzidine
2. 1,2,4-trichlorobenzene
3. hexachlorobenzene
4. chlorobenzene
5. bis(chloromethyl) ether
6. bis(2-chloroethyl) ether
7. 2-chloroethyl vinyl ether (mixed)
8. 1,2-dichlorobenzene
9. 1,3-dichlorobenzene
10. 1,4-dichlorobenzene
11. 3,3'-dichlorobenzidine
12. 2,4-dinitrotoluene
13. 2,6-dinitrotoluene
14. 1,2-diphenylhydrazine
15. ethylbenzene
16. 4-chlorophenyl phenyl ether
17. 4-bromophenyl phenyl ether
18. bis(2-chloroisopropyl) ether
19. bis(2-chloroethoxy) methane
20. isophorone
21. nitrobenzene
22. N-nitrosodimethylamine
23. N-nitrosodiphenylamine
24. N-nitrosodi-n-propylamine
25. bis(2-ethylhexyl) phthalate
26. butyl benzyl phthalate
27. di-n-butyl phthalate
28. diethyl phthalate
29. dimethyl phthalate
30. toluene
31. vinyl chloride (chloroethylene)
32. acrolein
33. acrylonitrile
34. acenaphthene
35. 2-chloronaphthalene
36. fluoranthene
37. naphthalene
38. 1,2-benzanthracene
39. benzo(a)pyrene(3,4-benzopyrene)
40. 3,4-benzofluoranthene
41. 11,12-benzofluoranthene
42. chrysene
43. acenaphthylene
44. anthracene
45. 1,12-benzoperylene
46. fluorene
47. phenanthrene
48. 1,2,5,6-dibenzanthracene

49. indeno (1,2,3-,cd)pyrene
50. pyrene
51. benzene
52. carbon tetrachloride (tetrachloromethane)
53. 1,2-dichloroethane
54. 1,1,1-trichloroethane
55. hexachloroethane
56. 1,1-dichloroethane
57. 1,1,2-trichloroethane
58. 1,1,2,2-tetrachloroethane
59. chloroethane
60. 1,1-dichloroethylene
61. 1,2-trans-dichloroethylene
62. 1,2-dichloropropane
63. 1,2-dichloropropylene (1,2-dichloropropene)
64. methylene chloride (dichloromethane)
65. methyl chloride (chloromethane)
66. methyl bromide (bromomethane)
67. bromoform (tribromomethane)
68. dichlorobromomethane
69. trichlorofluoromethane
70. dichlorodifluoromethane
71. chlorodibromomethane
72. hexachlorobutadiene
73. hexachlorocyclopentadiene
74. tetrachloroethylene
75. chloroform (trichloromethane)
76. trichloroethylene
77. aldrine
78. dieldrin
79. chlordane (technical mixture and metabolites)
80. 4,4'-DDT
81. 4,4'-DDE (p,p'-DDX)
82. 4,4'-DDD (p,p'-TDE)
83. a-endosulfan-Alpha
84. b-endosulfan-Beta
85. endosulfan sulfate
86. endrin
87. endrin aldehyde
88. endrin ketone
89. heptachlor
90. heptachlor epoxide
91. a-BHC-Alpha
92. b-BHC-Beta
93. r-BHC (lindane)-Gamma
94. g-BHC-Delta
95. PCB-1242 (Arochlor 1242)
96. PCB-1254 (Arochlor 1254)
97. toxaphene
98. 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD)
99. 2,4,6-trichlorophenol

- 100. parachlorometa cresol
- 101. 2-chlorophenol
- 102. 2,4-dichlorophenol
- 103. 2,4-dimethylphenol
- 104. 2-nitrophenol
- 105. 4-nitrophenol
- 106. 2,4-dinitrophenol
- 107. 4,6-dinitro-o-cresol
- 108. pentachlorophenol
- 109. phenol
- 110. cyanide (Total)
- 111. asbestos (Fibrous)
- 112. arsenic (Total)
- 113. antimony (Total)
- 114. beryllium (Total)
- 115. cadmium (Total)
- 116. chromium (Total)
- 117. copper (Total)
- 118. lead (Total)
- 119. mercury (Total)
- 120. nickel (Total)
- 121. selenium (Total)
- 122. silver (Total)
- 123. thallium (Total)
- 124. zinc (Total)

Table A-1. Itemization of Volatile Priority Pollutants

chloromethane	dichlorodifluoromethane
bromomethane	vinyl chloride
chloroethane	methylene chloride
trichlorofluoromethane	1,1-dichloroethylene
bromochloromethane (IS)	1,1-dichloroethane
trans-1,2-dichloroethylene	chloroform
1,2-dichloroethane	1,1,1-trichloroethane
carbon tetrachloride	bromodichloromethane
bis-chloromethyl ether (d)	1,2-dichloropropane
trans-1,3-dichloropropene	trichloroethylene
dibromochloromethane	cis-1,3-dichloropropene
1,1,2-trichloroethane	benzene
2-chloroethylvinyl ether	2-bromo-1-chloropropane (IS)
bromoform	1,1,2,2-tetrachloroethene
1,1,2,2-tetrachloroethane	1,4-dichlorobutane (IS)
toluene	chlorobenzene
ethylbenzene	acrolein
acrylonitrile	

Plant Code/Subcat. _____
Date Response Rec'd. _____

GUM AND WOOD CHEMICALS MANUFACTURING POINT SOURCE CATEGORY
(SIC 2861)

Note: Carefully read Instructions and Definition
of Terms before responding to these questions.

A. GENERAL INFORMATION

- (1) Plant/firm name _____
(2) Plant Location _____
(3) Plant mailing address _____
(4) Name of Respondent _____ Title _____
(5) Address of Respondent _____
(6) Telephone number of Respondent _____

B. PLANT OPERATIONS

(7) ☐ If this plant does no manufacturing on site (i.e., a sales office, warehouse, etc.), do not complete the remainder of this survey. Check this block and return the entire form in the enclosed envelope.

(8) ☐ If this plant manufactures only char and charcoal briquets, check this block and answer questions 64 or 65, then return the entire form in the enclosed envelope.

Has this plant filled out another industry survey for the EPA Effluent Guidelines Division?

(9) ☐ Yes

(10) ☐ No

If yes, in what category was the questionnaire submitted? (11) _____

Indicate the type of operations at this site:

(12) ☐ Only Gum and Wood Chemicals (SIC 2861) are produced at this site.

(13) ☐ This plant produces gum and wood chemicals (SIC 2861), but also, produces other classes of products. (Specify) _____

Indicate the date this plant was placed in operation (14)_____

Indicate the date of the most recent physical plant renovation
(15)_____.

C. PRODUCTS AND PROCESSES

Please provide a simple schematic diagram of the manufacturing processes involving gum and wood chemicals.

Total 1977 production of Gum and Wood Chemicals was (16)_____pounds.

Average 1977 production of Gum and Wood Chemicals was (17)_____pounds per day.

Number of days in 1977 with production of Gum and Wood Chemicals
(18)_____days.

Total 1977 production of all other products manufactured at plant location was (19)_____pounds.

Average 1977 production of all other products manufactured at plant location was (20)_____pounds per day.

Is the production of Gum and Wood Chemicals seasonal at your plant?

(21) ☐ yes

(22) ☐ no

Provide approximate percentages of total production of Gum and Wood Chemicals for each of the following products, if produced in 1977:

Subcategory A -Sulfated turpentine, a by-product of the Kraft (sulfate) pulping process:

a - Pinene	(23)	_____
b - Pinene	(24)	_____
Dipentine	(25)	_____
Limonene	(26)	_____
Other	(27)	_____

Subcategory B - Gum resin and turpentine manufacture by steam distillation of crude gum (exudate) from living longleaf pine and slash pine trees:

Gum Resin	(28)	_____
Gum Terpentine	(29)	_____
a - Pinene	(30)	_____
b - Pinene	(31)	_____
Paper Size	(32)	_____
Other	(33)	_____

Subcategory C - Wood Resin, turpentine, and pine oil manufacture by solvent extraction and steam distillation of old resinous wood stumps from cut-over pine forests:

Wood Resin	(34)	_____
Wood Turpentine	(35)	_____
Dipentene (intermediate terpenes)	(36)	_____
Wood Pine Oil	(37)	_____
a - Pinene	(38)	_____
b - Pinene	(39)	_____
Paper Size	(40)	_____
Other	(41)	_____

Subcategory D - Tall oil resin, pitch, and fatty acids manufacture by fractionation of crude tall oil, a by-product of the Kraft (sulfate) pulping process:

Tall Oil Resin	(42)	_____
Tall Oil Fatty Acids	(43)	_____
Tall Oil Pitch	(44)	_____
Sulfate Turpentine	(45)	_____
Sulfate Pine Oil	(46)	_____
Methyl Mercaptan	(47)	_____
a - Pinene	(48)	_____
b - Pinene	(49)	_____
Paper Size	(50)	_____
Other	(51)	_____

Subcategory E - Essential oils manufacture by steam distillation of scrap wood fines from select lumbering operations:

Cedarwood Oil	(52)	_____
Wintergreen Oil	(53)	_____
Spearmint Oil	(54)	_____
Eucalyptus Oil	(55)	_____
Other	(56)	_____

Subcategory F - Resin based derivatives (specifically, resin esters and modified resin esters) manufactured by the chemical reaction of gum, wood, and tall oil resins:

Resin Oils	(57)	_____
Ester Gum (Glycerol esters)	(58)	_____
Synthetic Resins:		
Phenolic resins	(59)	_____
Alkyd resins	(60)	_____
Maleic resins	(61)	_____
Fumaric resins	(62)	_____
Other	(63)	_____

D. WASTEWATER GENERATION

Note: Process wastewaters include those resulting from contact cooling, wet scrubbers, and cleanup, or other process related use, i.e. water contacting product or raw materials.
Segregated non-contact cooling waters, boiler blowdown, and sanitary wastewaters are not included.

Does any process wastewater result from your operations?

(64) ☐ Yes

(65) ☐ No

Estimated volume of process wastewater in gallons per day that corresponds to the production data given in Section C for each of the following products during normal manufacturing of Gum and Wood Chemicals only:

Subcategory A - Sulfated turpentine, a by-product of the Kraft (sulfate) pulping process:

a - Pinene	(66)	_____
b - Pinene	(67)	_____
Dipentene	(68)	_____
Limonene	(69)	_____
Other	(70)	_____

Subcategory B - Gum resin and turpentine manufacture by steam distillation of crude gum (exudate) from living longleaf pine and slash pine trees:

Gum Resin	(71)	_____
Gum Turpentine	(72)	_____
a - Pinene	(73)	_____
b - Pinene	(74)	_____
Paper Size	(75)	_____
Other	(76)	_____

Subcategory C - Wood Resin, turpentine, and pine oil manufacture by solvent extration and steam distillation of old resinous wood stumps from cut over pine forests:

Wood Resin	(77)	_____
Wood Turpentine	(78)	_____
Dipentene (intermediate		
terpenes)	(79)	_____
Wood Pine Oil	(80)	_____
a - Pinene	(81)	_____
b - Pinene	(82)	_____
Paper Size	(83)	_____
Other	(84)	_____

Subcategory D - Tall oil resin, pitch, and fatty acids manufacture by fractionation of crude tall oil, by-products of the Kraft (sulfate) pulping process:

Tall Oil Resin	(85)	_____
Tall Oil Fatty Acids	(86)	_____
Tall Oil Pitch	(87)	_____
Sulfate Turpentine	(88)	_____
Sulfate Pine Oil	(89)	_____
Methyl Mercaptan	(90)	_____
a - Pinene	(91)	_____
b - Pinene	(92)	_____
Paper Size	(93)	_____
Other	(94)	_____

Subcategory E - Essential oils manufacture by steam distillation of scrap wood fines from select lumbering operations:

Cedarwood Oil	(95)	_____
Wintergreen Oil	(96)	_____
Spearmint Oil	(97)	_____
Eucalyptus Oil	(98)	_____
Other	(99)	_____

Subcategory F - Resin based derivatives (specifically, resin esters and modified resin esters) manufactured by the chemical reaction of gum, wood, and tall oil resins:

Resin Oils	(100)	_____
Ester Gum (Glycerol esters)	(101)	_____
Synthetic Resins:		
Phenolic resins	(102)	_____
Alkyd resins	(103)	_____
Maleic resins	(104)	_____
Fumaric resins	(105)	_____
Other	(106)	_____

If you have reason to believe that your Gum and Wood Chemicals manufacturing operations do not fit into any of the above subcategories, please attach an explanation of your rationale and an estimate of the gallons of wastewater generated each day for each product.

The average volume of process wastewater produced from Gum and Wood Chemicals manufacturing operations (107) _____gallons/day.

The average volume of process wastewater produced from all other manufacturing operations at plant location (108) _____gallons/day.

Do you use wet scrubbers in the Gum and Wood Chemicals manufacturing for air pollution control?

(109) ☐ Yes

(110) ☐ No

E. WASTEWATER DISPOSAL

Please indicate method used to dispose of process wastewaters.

(111) ☐ Do you discharge treated or untreated process-related wastewaters directly to a receiving body of water? If so, check this block.

(112) ☐ Do you discharge partially treated or untreated process-related wastewaters directly to a Publicly Owned Treatment Works (POTW) via municipal sewer system? If so, check this block.

(113) ☐ If you have a discharge other than that described by (111) or (112), such as to the waste stream of another plant, a septic tank, an evaporation lagoon, an irrigation system, etc., please explain briefly below:

(114) ☐ If you answered Question 111 or 113 yes, do you have firm plans to discharge process-related wastewater to a POTW in the future? _____.

Do you have an NPDES permit?

(115) ☐ Yes

(116) ☐ No

If not, have you made application for an NPDES permit?

(117) ☐ Yes

(118) ☐ No

If you discharge directly to a receiving body of water, attach a copy of your most recent permit and application if you answered yes to (115), (117), above and provide agency name, complete address, telephone number, and contact to which application, monitoring data, or other permit information is sent:

(119) _____

If process-related wastewater is discharged to a publicly owned treatment works, provide complete name, address, and telephone number of municipality or sewer authority:

(120) _____

If process-related wastewater is discharged to a city sewer, indicate if the municipality or sewer authority utilizes any of the following:

- (121) ☐ Industrial Waste Ordinance (If yes, attach copy)
- (122) ☐ Wastewater sampling at your plant
- (123) ☐ Local permit system to discharge to the sewer
- (124) ☐ A requirement that you sample and analyze your own waste.

If you discharge to an industrial treatment plant or to the wastewater stream of another plant, provide the complete name, address, and telephone number of the plant that is providing this service to you.

(125) _____

This plant makes use of the following method(s) of treatment or conditioning for Gum and Wood Chemicals process wastewater prior to discharge:

Note: Please provide a simple schematic diagram of the treatment methods involving gum and wood chemicals process wastewater.

- (126) ☐ None
- (127) ☐ Contract hauling
- (128) ☐ Equalization
- (129) ☐ Clarification
- (130) ☐ Aerated Lagoon
- (131) ☐ Activated Sludge
- (132) ☐ Neutralization
- (133) ☐ Nutrient Addition
- (134) ☐ Non-aerated Pond
- (135) ☐ Air Flotation Control
- (136) ☐ Granular Activated Carbon
- (137) ☐ Powdered Carbon Addition
- (138) ☐ Filtration
- (139) ☐ Evaporation
- (140) ☐ Oil Skimming
- (141) ☐ Settling
- (142) ☐ Other (specify) _____.

Do you discharge substandard or other spoiled batches with wastewater?

- (143) ☐ Yes
- (144) ☐ No

F. WASTEWATER MONITORING DATA

This section refers to routine monitoring data for untreated or treated process-related wastewaters or sludges resulting from the manufacture of Gum and Wood Chemicals ONLY. Please note whenever data are for process wastewater combined with non-process wastewater or wastewater from other than Gum and Wood Chemical manufacturers.

Report average 1977 concentrations (mg/l) of treated and untreated wastewater. Please attach copies of your 1977 monitoring data.

<u>Parameter</u>	<u>Wastewater Untreated</u>	<u>Sample Frequency</u>	<u>Wastewater Treated</u>	<u>Sample Frequency</u>
(145) BOD5	_____	_____	_____	_____
(146) COD	_____	_____	_____	_____
(147) Flow (MGD)	_____	_____	_____	_____
(148) pH	_____	_____	_____	_____
(149) Oil and Grease	_____	_____	_____	_____
(150) Phenols	_____	_____	_____	_____
(151) Phosphorus	_____	_____	_____	_____
(152) Dissolved Solids	_____	_____	_____	_____
(153) Nitrogen Compounds	_____	_____	_____	_____
(154) Sulfates	_____	_____	_____	_____
(155) Temperature	_____	_____	_____	_____
(156) TOC	_____	_____	_____	_____
(157) TSS	_____	_____	_____	_____
(158) Heavy Metals	_____	_____	_____	_____
(159) Trace Organics	_____	_____	_____	_____
(160) Other (specify)	_____	_____	_____	_____

This facility is conducting or has conducted any of the following measures in the past three years to abate water pollution:

- (161) ☐ private consultant studies
- (162) ☐ in-house engineering studies
- (163) ☐ bench scale treatability studies
- (164) ☐ pilot plant studies
- (165) ☐ in-process hydraulic surveys
- (166) ☐ treatment system improvements
- (167) ☐ process changes or modifications
- (168) ☐ other _____

G. WATER POLLUTION COSTS: ALLOCATED ANNUAL COSTS TO GUM AND WOOD ONLY.

DIRECT DISCHARGERS

	Before 1975	1975	1976	1977	Average/year Projected 1978-83
(169) Annual Operating Costs	\$ _____	_____	_____	_____	_____
(170) Capital Expenditures	\$ _____	_____	_____	_____	_____

INDIRECT DISCHARGERS: ALLOCATED ANNUAL COSTS TO GUM AND WOOD CHEMICALS ONLY.

	1974	1975	1976	1977	Average/year Projected 1978-83
(171) Annual User Charges	\$ _____	_____	_____	_____	_____
(172) Annual Capital Cost Recovery Charge	\$ _____	_____	_____	_____	_____
(173) Pretreatment System Capital Cost	\$ _____	_____	_____	_____	_____
(174) Annual Operating Cost	\$ _____	_____	_____	_____	_____

ENERGY USAGE FOR WASTEWATER TREATMENT.

(175) Electric power cost for 1977 \$ _____/kwh Total kilowatt/hours (176) _____
 (177) Other Energy Required 1977 _____ BTU.

Approximate percentage of total energy usage in Gum and Wood Chemical Manufacturing attributable to water pollution controls (178) _____%.

H. PRIORITY POLLUTANTS FOR GUM AND WOOD CHEMICAL MANUFACTURING ONLY.

Please complete the following Priority Pollutant listing. For each pollutant please check whether it is Known To Be Present, Suspected To Be Present, Suspected To Be Absent, Known To Be Absent, or Unknown. Suitable responses should be based on the following descriptions:

Known To Be Present: The compound has been detected in the discharge or is known to be present in the raw waste load.

Suspected To Be Present: The compound is a raw material in the processes employed, a product, a by-product, catalyst, etc. Its presence in the raw waste load and discharge is a reasonable technical judgment.

Suspected To Be Absent: No known reason to predict that the compound is present in the discharge.

Known To Be Absent: The compound has not been detected in the raw waste load.

Unknown: The compound has not been tested for in the raw waste load and is not a raw material employed in the process, a product, a by-product, catalyst, etc.

<u>Priority Pollutant</u>	<u>Known Present</u>	<u>Suspected Present</u>	<u>Suspected Absent</u>	<u>Known Absent</u>	<u>Unknown</u>
(179) acenaphthene	_____	_____	_____	_____	_____
(180) acrolein	_____	_____	_____	_____	_____
(181) acrylonitrile	_____	_____	_____	_____	_____
(182) benzene	_____	_____	_____	_____	_____
(183) benzidine	_____	_____	_____	_____	_____
(184) carbon tetrachloride (tetra chloromethane)	_____	_____	_____	_____	_____
(185) chlorobenzene	_____	_____	_____	_____	_____
(186) 1,2,4-trichlorobenzene	_____	_____	_____	_____	_____
(187) hexachlorobenzene	_____	_____	_____	_____	_____
(188) 1,2-dichloroethane	_____	_____	_____	_____	_____
(189) 1,1,1, trichloroethane	_____	_____	_____	_____	_____
(190) hexachloroethane	_____	_____	_____	_____	_____
(191) 1,1-dichloroethane	_____	_____	_____	_____	_____
(192) 1,1,2-trichloroethane	_____	_____	_____	_____	_____
(193) 1,1,2,3-tetrachloroethane	_____	_____	_____	_____	_____
(194) chloroethane	_____	_____	_____	_____	_____
(195) bis(chloromethyl) ether	_____	_____	_____	_____	_____
(196) bis(2-chloroethyl) ether	_____	_____	_____	_____	_____
(197) 2-chloroethyl vinyl ether (mixed)	_____	_____	_____	_____	_____
(198) 2-chloronaphthalene	_____	_____	_____	_____	_____
(199) 2,4,6-trichlorophenol	_____	_____	_____	_____	_____
(200) parachlorometa cresol	_____	_____	_____	_____	_____
(201) chloroform (trichloromethane)	_____	_____	_____	_____	_____
(202) 2-chlorophenol	_____	_____	_____	_____	_____
(203) 1,2-dichlorobenzene	_____	_____	_____	_____	_____
(204) 1,3-dichlorobenzene	_____	_____	_____	_____	_____
(205) 1,4-dichlorobenzene	_____	_____	_____	_____	_____
(206) 3,3-dichlorobenzidine	_____	_____	_____	_____	_____
(207) 1,1-dichloroethylene	_____	_____	_____	_____	_____
(208) 1,2-trans-dichloroethylene	_____	_____	_____	_____	_____
(209) 2,4-dichlorophenol	_____	_____	_____	_____	_____

Part VI (Cont.)

<u>Priority Pollutant</u>	<u>Known Present</u>	<u>Suspected Present</u>	<u>Suspected Absent</u>	<u>Known Absent</u>	<u>Unknown</u>
(210) 1,2-dichloropropane	_____	_____	_____	_____	_____
(211) 1,3-dichloropropylene (1,3-dichloropropene)	_____	_____	_____	_____	_____
(212) 2,4-dimethylphenol	_____	_____	_____	_____	_____
(213) 2,4-dinitrotoluene	_____	_____	_____	_____	_____
(214) 2,6-dinitrotoluene	_____	_____	_____	_____	_____
(215) 1,2-diphenylhydrazine	_____	_____	_____	_____	_____
(216) ethylbenzene	_____	_____	_____	_____	_____
(217) fluoranthene	_____	_____	_____	_____	_____
(218) 4-chlorophenyl phenyl ether	_____	_____	_____	_____	_____
(219) 4-bromophenyl phenyl ether	_____	_____	_____	_____	_____
(220) bis(2-chloroisopropyl) ether	_____	_____	_____	_____	_____
(221) bis(2-chloroethoxy) methane	_____	_____	_____	_____	_____
(222) methylene chloride (dichloromethane)	_____	_____	_____	_____	_____
(223) methyl chloride (chloromethane)	_____	_____	_____	_____	_____
(224) methyl bromide (bromomethane)	_____	_____	_____	_____	_____
(225) bromoform (tribromome- thane	_____	_____	_____	_____	_____
(226) dichlorobromomethane	_____	_____	_____	_____	_____
(227) trichlorofluoromethane	_____	_____	_____	_____	_____
(228) dichlorodifluoromethane	_____	_____	_____	_____	_____
(229) chlorodibromomethane	_____	_____	_____	_____	_____
(230) hexachlorobutadiene	_____	_____	_____	_____	_____
(231) hexachlorocyclopentadiene	_____	_____	_____	_____	_____
(232) isophorone	_____	_____	_____	_____	_____
(233) naphthalene	_____	_____	_____	_____	_____
(234) nitrobenzene	_____	_____	_____	_____	_____

Part VI (Cont.)

<u>Priority Pollutant</u>	<u>Known Present</u>	<u>Suspected Present</u>	<u>Suspected Absent</u>	<u>Known Absent</u>	<u>Unknown</u>
(235) 2-nitrophenol					
(236) 4-nitrophenol					
(237) 2,4-dinitrophenol					
(238) 4,6-dinitro-o-cresol					
(239) N-nitrosodimethylamine					
(240) N-nitrosodiphenylamine					
(241) N-nitrosodi-n-propylamine					
(242) pentachlorophenol					
(243) phenol					
(244) bis(2-ethylhexyl) phthalate					
(245) butyl benzyl phthalate					
(246) di-n-butyl phthalate					
(247) diethyl phthalate					
(248) dimethyl phthalate					
(249) di-n-octyl phthalate					
(250) 1,2-benzathracene					
(251) benzo (a)pyrene (3,4-benzo pyrene)					
(252) 3,4-benzofluoranthene					
(253) 11,12-benzofluoranthene					
(254) chrysene					
(255) acenaphthylene					
(256) anthracene					
(257) 1,12-benzoperylene					
(258) fluorene					
(259) phenanthrene					
(260) 1,2:5,6-dibenzanthracene					
(261) indeno(1,2,3-C,D) pyrene					
(262) pyrene					
(263) 2,3,7,8-tetrachlorodi- benzo-p-dioxin (TCDD)					
(264) tetrachloroethylene					
(265) toluene					
(266) trichloroethylene					
(267) vinyl chloride (chloroethylene)					
(268) xylene					

Part VI (Cont.)

<u>Priority Pollutant</u>	<u>Known Present</u>	<u>Suspected Present</u>	<u>Suspected Absent</u>	<u>Known Absent</u>	<u>Unknown</u>
<u>Pesticides and Metabolites</u>					
(269) aldrin	_____	_____	_____	_____	_____
(270) dieldrin	_____	_____	_____	_____	_____
(271) chlordane (technical mixture and metabolites)	_____	_____	_____	_____	_____
(272) 4,4'-DDT	_____	_____	_____	_____	_____
(273) 4,4'-DDE (p,p'-DDX)	_____	_____	_____	_____	_____
(274) 4,4'-DDD (p,p'-TDE)	_____	_____	_____	_____	_____
(275) a-endosulfan	_____	_____	_____	_____	_____
(276) B-endosulfan	_____	_____	_____	_____	_____
(277) endosulfan sulfate	_____	_____	_____	_____	_____
(278) endrin	_____	_____	_____	_____	_____
(279) endrin aldehyde	_____	_____	_____	_____	_____
(280) heptachlor	_____	_____	_____	_____	_____
(281) heptachlor epoxide	_____	_____	_____	_____	_____
(282) a-BHC	_____	_____	_____	_____	_____
(283) B-BHC	_____	_____	_____	_____	_____
(284) -BHC (lindane)	_____	_____	_____	_____	_____
(285) -BHC	_____	_____	_____	_____	_____
(286) PCB-1242 (Archlor 1242)	_____	_____	_____	_____	_____
(287) PCB-1254 (Archlor 1254)	_____	_____	_____	_____	_____
(288) PCB-1221, 1248, 1232, 1260, or 1016	_____	_____	_____	_____	_____
(289) Toxaphene	_____	_____	_____	_____	_____
<u>Metals</u>					
(290) Antimony (Total)	_____	_____	_____	_____	_____
(291) Arsenic (Total)	_____	_____	_____	_____	_____
(292) Asbestos (Fibrow)	_____	_____	_____	_____	_____
(293) Beryllium (Total)	_____	_____	_____	_____	_____
(294) Cadmium (Total)	_____	_____	_____	_____	_____
(295) Chromium (Total)	_____	_____	_____	_____	_____
(296) Copper (Total)	_____	_____	_____	_____	_____
(297) Cyanide (Total)	_____	_____	_____	_____	_____
(298) Lead (Total)	_____	_____	_____	_____	_____
(299) Mercury (Total)	_____	_____	_____	_____	_____
(300) Nickel (Total)	_____	_____	_____	_____	_____
(301) Selenium (Total)	_____	_____	_____	_____	_____
(302) Silver (Total)	_____	_____	_____	_____	_____
(303) Thallium (Total)	_____	_____	_____	_____	_____
(304) Zinc (Total)	_____	_____	_____	_____	_____

For those Priority Pollutants which are known or suspected to be present, please indicate to the best of your knowledge the prime source of the material.

Specific Pollutant

Source (Raw Material/Process Line)

_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

QUESTIONNAIRE COMPILATION

Please provide the following information regarding completion of questionnaire.

Compiler _____ Title _____

Office Location _____ Telephone _____

Date Completed _____

If you have any questions, please contact

THANK YOU FOR YOUR COOPERATION. UPON COMPLETION OF THE SURVEY, PLACE THE FORMS AND ALL REQUESTED ATTACHMENTS IN THE ENVELOPE PROVIDED AND RETURN TO:

U. S. EPA GUM AND WOOD CHEMICALS INDUSTRY SURVEY

P. O. BOX 13454

GAINESVILLE, FL. 32604

BE SURE TO RETAIN A COMPLETE COPY FOR YOUR RECORDS. RESPONDENTS WILL BE CONTACTED WHEN NECESSARY TO COMPLETE OR CLARIFY ANSWERS.

APPENDIX C

RECOMMENDED PARAGRAPH 8 EXCLUSION UNDER THE NRC SETTLEMENT AGREEMENT

GUM AND WOOD CHEMICALS INDUSTRY CHAR AND CHARCCAL BRIQUETS SUBCATEGORY

Summary of Recommendations

EPA is recommending the exclusion of revise BAT and NSPS limitations for all specific pollutants based on paragraph 8(a)(i) of the Settlement Agreement since the existing BPT already requires no discharge of process wastewater.

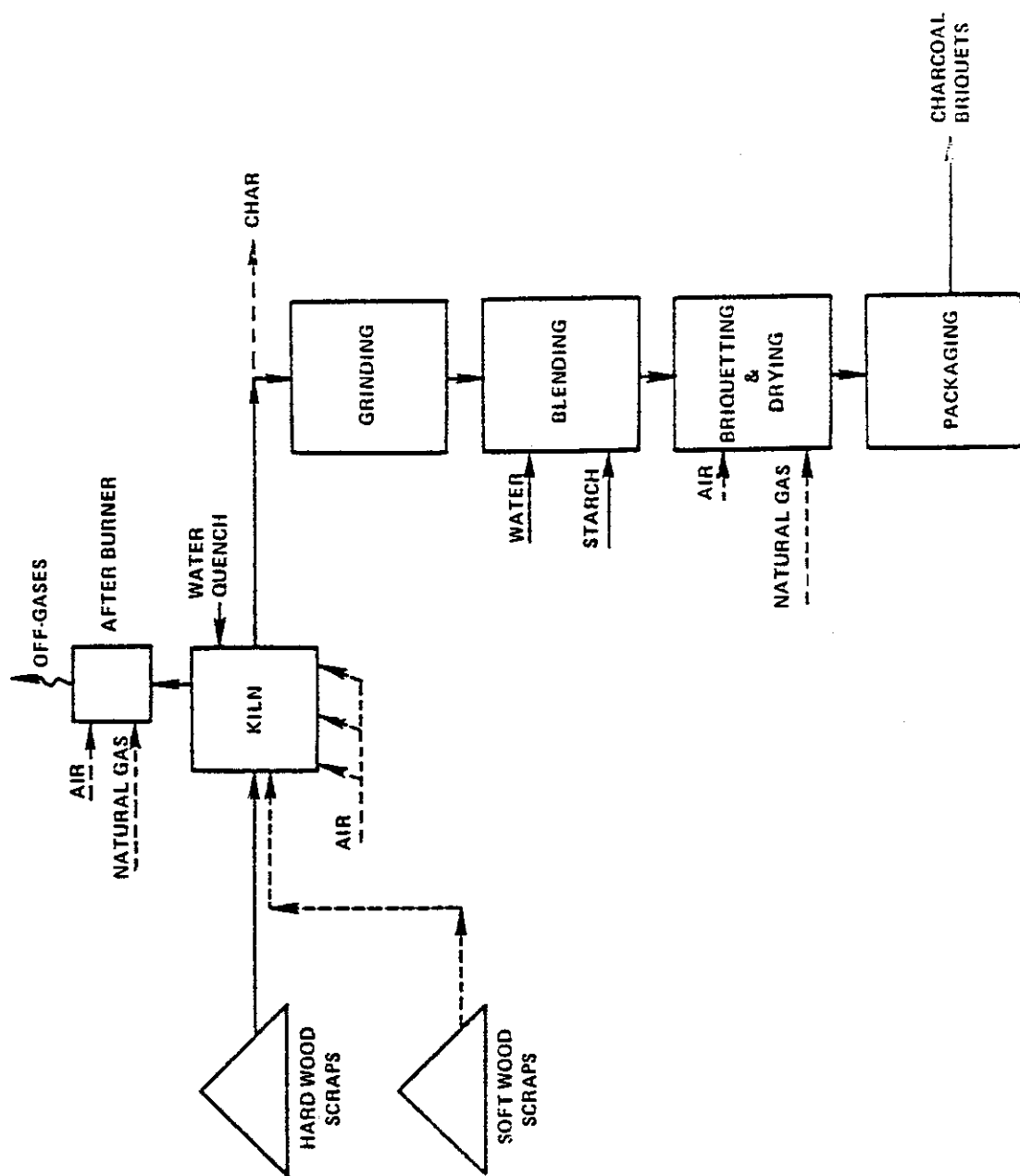
Production Processes and Effluents

Char and charcoal are produced by the thermal decomposition of raw wood. Decomposition forms wood distillates which leave the kiln with the flue gases. The condensable distillates are collectively referred to as pyroligneous acid, which contains methanol, acetic acid, acetone, tars, oils, and water. These materials have steadily declined in economic importance because of cheaper synthetic substitutes; therefore, most plants have discontinued recovery of the by-products from the pyroligneous acid. Instead, the distillate and other flue gases are exhausted to the atmosphere. The condensable distillates may also be recycled as fuel for the kiln or recycled in the vapor phase as a fuel supply supplement.

A typical flow diagram for char and charcoal briquets manufacturing is illustrated in Figure 1. This study found no facilities which recovered distillation by-products in the United States.

The off gases from the furnaces contain compounds such as acetic acid, methanol, acetone, tars, and oils. These materials are presently oxidized in the afterburners. The natural gas fuel required for the afterburners is a significant operating cost. An alternative emission control now under consideration scrubs the off gases from the furnace to remove the condensables from the flue gases. The resulting scrubber liquor would be sent to a separator where the pyroligneous acid could be recovered. The water and soluble compounds would be reused in the scrubber system. The separated products can then be recovered for sale or used as an auxiliary fuel.

FIGURE 1.
CHAR AND CHARCOAL BRIQUET MANUFACTURING



Plants

Seventy-seven plants were identified in the industry profile and fifty-five percent responded.

Toxic Pollutants

Toxic pollutant sampling was not conducted on this subcategory because current BPT, BAT, and NSPS limitations call for zero discharge of process wastewater. All of the plants responding had no discharge of process wastewater.

EAT and NSPS Limitations

EPA is recommending the exclusion of revised EAT and NSPS under paragraph 8(a)(i) for all toxic pollutants based on the response of 55 percent of the plants, all of which had no process wastewater, and on the basis of existing BPT limitations which require zero discharge of process wastewater.

Pretreatment Limitations

EPA is recommending the exclusion of pretreatment limitations under paragraph 8(a)(i) based on a survey of 55 percent of all plants, none of which had process wastewater.

RECOMMENDED PARAGRAPH 8 EXCLUSION UNDER THE NRIC SETTLEMENT AGREEMENT

GUM AND WOOD CHEMICALS INDUSTRY ESSENTIAL OIL SUBCATEGORY

Summary of Recommendations

EPA is recommending the exclusion of BAT, NSPS, and pretreatment standards for all specific toxic pollutants based on paragraph 8(a) (iii). This subcategory includes seven plants--none of which are direct dischargers. One plant is an indirect discharger; the remaining six do not discharge. Flows of process wastewater in this subcategory are low (a maximum flow of 0.015 MGD from the indirect discharger under full-scale production). The only toxic pollutants detected from the screening of the indirect discharger were benzene and metals, and all were at low levels.

EPA is recommending the exclusion of the NSPS limitation since no new sources are expected due to competition from synthetic oils and the lack of raw materials. Exclusion of pretreatment also is recommended since only one indirect discharger exists, discharging a small number of toxic pollutants at low concentrations from a small flow.

Production Processes and Effluents

The only essential oil produced in this subcategory is cedarwood oil. Cedarwood oil is produced by steaming cedarwood saw dust in pressure retorts to remove the oil from the wood particles. The overhead vapors are condensed and separated into cedar oil and wastewater. Production of cedarwood oil is under stiff competition from the synthetic oils manufactured by petroleum companies. The cedarwood oil industry is divided into two branches--the western cedar group and the eastern cedar group. The western group is a more economical production because its sole function is the production of cedarwood oil. Entire cedar trees are ground up for the oil production. The eastern branch, however, produces cedarwood oil as a by-product of the production of cedar wood. The effluent from six of these plants is self-contained by a lagoon or spray irrigation. The single indirect discharger releases the effluent with no pretreatment to a POTW. Wastewater from this plant is about 15,000 gallons per day when all three pressure retorts are in operation.

Plants

Nine plants exist in this subcategory, one indirect discharger and seven self-contained dischargers. The indirect discharger discharges a maximum of approximately 0.015 MGD when all three retorts are in operation. In 1977, the plant used only one retort (approximately 0.005 MGD) because of a shortage of raw materials and low market

demand. Future retort use by this plant will depend primarily on the market demand for cedarwood oil.

Toxic Pollutants Screen sampling was conducted at the indirect discharger. The analytical results detected benzene and metals in low concentrations.

EAT and NSPS Limitations

EPA is recommending the exclusion of BAT and NSPS limitations under paragraph 8(a)(iii) for all toxic pollutants on the basis that no direct exist and no new plants dischargers are expected.

Pretreatment Limitations

EPA is recommending the exclusion of pretreatment limitations under paragraph 8(a)(iii) for all toxic pollutants on the basis that only one indirect discharger exists, the volume of discharge is low (approximately 0.015 MGD maximum), the concentration of toxic pollutants is low, and the industry is not expected to grow because of competition from synthetic oils and raw material limitations.

RECOMMENDED PARAGRAPH 8 EXCLUSION UNDER THE NRDC SETTLEMENT AGREEMENT

GUM AND WOOD CHEMICALS INDUSTRY GUM ROSIN AND TURPENTINE SUBCATEGORY

Summary of Recommendations

EPA is recommending the exclusion of BAT, NSPS, and pretreatment standards for all specific toxic pollutants on the basis of paragraph 8(a) (iii). Of seven plants in the industry, one is an indirect discharger and the remaining six are self-contained. These six plants operate on a seasonal basis between May and September (approximately 180 days per year). Flows of process wastewaters in this subcategory are quite low (averaging about 1,400 gals/day per plant).

The only toxic pollutants found during screening analysis of the indirect discharger were benzene, toluene, d-BHC, and metals. Exclusion of the NSPS limitations is recommended because no new sources are expected and most existing plants are expected to close within the next 10 years for economic reasons. Exclusion of pretreatment also is recommended because only one indirect discharger exists.

Production Processes and Effluent

Gum turpentine and rosin are produced by the distillation of pine oleoresin. The crude oleoresin is collected from the exposed sapwood of pine trees. This process is limited to the growing cycle of the tree which occurs during May through September.

The crude oleoresin is delivered to the processing plants in 435-lb barrels, steam-washed to remove trash, and stored or processed. The process is a simple distillation. The crude gum is heated and the lower boiling turpentine and water are collected as condensate. The higher boiling rosin is taken from the bottom of the still as a hot liquid.

The wastewater generated by this process is from the washing of the crude gum and the water freed in the distillation process. The condensed water is chemically treated, then recycled and used for gum wash water.

In all but one of the gum processes the wastewater is collected on-site and held in evaporation/percolation ponds. The one plant which does not use this method discharges to a POTW.

Plants

There are seven plants in Subcategory B (Gum Turpentine and Rosin). Six have self-contained discharges of low-volume process wastewaters, and one plant, which is an indirect discharger, has a flow of approximately 2,300 GPD from its Subcategory B operations and about 2,700 GPD from its Subcategory F (Rosin-based derivatives) operation.

Toxic Pollutants

Sampling was conducted at the indirect discharging plant. The process wastewater flow from the Gum Rosin and Turpentine production was sampled separately from rosin-based derivatives wastewater flow. The analytical results detected benzene, toluene, d-BHC, and metals.

EPA and NSPS Limitations

EPA is recommending exclusion under paragraph 8(a) (iii) for all toxic pollutants on the basis that no direct dischargers exist, no new plants are expected, and most plants in this subcategory are expected to close within the next 10 years.

EPA is recommending the exclusion of pretreatment limitations under paragraph 8(a) (iii) for all toxic pollutants on the basis that only one indirect discharger exists, and it discharges very low volumes (2,300 gal/day).

APPENDIX D

ANALYTICAL METHODS AND EXPERIMENTAL PROCEDURE

INTRODUCTION

Protocol

Sampling and analysis of samples for the Gum and Wood Chemicals Point Source Category were conducted from March 1978 to October 1978 according to "Sampling and Analysis Procedures for Screening of Industrial Effluents," U.S. Environmental Protection Agency, March 1977 (revised April 1977).

Overview of Methods

The toxic pollutants may be conventionally considered according to the broad classification of organics and metals. The organic toxic pollutants constitute the larger group and were analyzed according to the categories of purgeable volatiles, extractable semi-volatiles, and pesticides and PCB's. The principal analytical method for identification and quantitation of organic toxic pollutants was repetitive scanning Gas Chromatography/Mass Spectrometry (GC/MS). Pesticides and PCB's were analyzed by Gas Chromatography/Electron Capture Detector (GC/ECD).

The mass spectrometers were tuned daily in a manner to provide consistent compound fragmentation thereby permitting quantitation directly from the mass spectral reconstructed chromatograms.

Compound identification entailed both gas chromatographic and mass spectroscopic criteria. These criteria are enumerated as follows: (1) Appropriate retention time within a window defined as ± 1 minute that of the compound in the standard; (2) coincidence of the extracted ion current profile maxima of two (volatiles) or three (extractables) characteristic ions enumerated in the protocol; and (3) proper relative ratios of these extracted ion current profile peaks.

Relative response factors for the individual compounds were determined as:

$$R = \frac{A_c/C_c}{A_s/C_s}$$

where A is the integrated area taken from the extracted ion current profile, and C is the concentration of the component expressed in ppb, and the subscripts c and s denote compound and standard, respectively.

Concentrations were calculated using these response factors according to the expression:

$$C = \frac{A_c}{A_s} \frac{C_s}{R}$$

with the terms as defined previously.

Due to the variable nature of the samples as indicated by the presence of very large peaks or large unresolved humps in the chromatograms, all base neutral and phenolic extracts were subjected to GC/FID screening under conditions quite similar to that employed in the GC/MS analysis. Those extracts with very large peaks and/or large unresolved humps were diluted appropriately prior to GC/MS analysis. Due to the number of extracts requiring dilution, the internal standard was added after dilution.

The concentrations of compounds in these extracts were calculated according to the above expression with the incorporation of a multiplicative dilution factor. This factor is defined as the quotient of the final diluted sample extract volume and the original sample extract volume.

Pesticides and PCB's were analyzed by GC/ECD. Identification was based on retention time relative to a standard analyzed under the identical conditions. Quantitation was based on peak height for the same standard injection. Confirmation analysis was routinely carried out on a dissimilar chromatographic column with GC/MS confirmation restricted to high level samples.

The metals were done by atomic absorption spectroscopy. All classical parameters were done by standard methods.

DETAILED DESCRIPTION OF ANALYTICAL METHODS

Volatile Toxic Pollutants

The purgeable volatile toxic pollutants are those compounds which possess a relatively high vapor pressure and low water solubility. These compounds are readily stripped with high efficiency from the water by bubbling an inert gas through the sample at ambient temperature.

The analytical methodology employed for the volatiles was based on the dynamic headspace technique of Bellar and Lichtenberg. This procedure consists of two steps. Volatile organics are purged from the raw-water sample onto a Tenax GC-silica gel trap with a stream of inert gas. The volatile organics are then thermally desorbed into the GC inlet for subsequent GC/MS identification and quantitation.

The purgeable volatile toxic pollutants are listed in Table D-1.

Table D-1. Purgeable Volatile Toxic Pollutants

chloromethane	ethylbenzene
bromomethane	dichlorodifluoromethane
chloroethane	vinyl chloride
trichlorofluoromethane	methylene chloride
trans-1,2-dichloroethylene	1,1-dichloroethylene
1,2-dichloroethane	1,1-dichloroethane
carbon tetrachloride	chloroform
bis-chloromethyl ether (d)	1,1,1-trichloroethane
trans-1,3-dichloropropene	bromodichloromethane
dibromochloromethane	1,2-dichloropropane
1,1,2-trichloroethane	trichloroethylene
2-chloroethylvinyl ether	cis-1,3-dichloropropene
bromoform	benzene
1,1,2,2-tetrachloroethane	1,1,2,2-tetrachloroethene
toluene	chlorobenzene
acrylonitrile	

A 5-ml aliquot of the raw water sample spiked with the internal standards bromochloromethane and 1,4-dichlorobutane was purged at ambient temperature with He for 12 minutes onto a 25-cm x 1/8-in. o.d. stainless steel trap containing an 18-cm bed of Tenax GC 60/80 mesh and a 5-cm bed of Davison Grade 15 silica gel 35/60 mesh. This 5-ml aliquot represented a single grab sample or a composite of the various grab samples collected at the individual station.

The organics were thermally desorbed from the trap for 4 minutes at 180 with a He flow of 30 ml/min into the GC inlet. The collection of repetitively scanned mass spectra was initiated with the application of heat to the trap. The enumeration of all instrument parameters is presented in Table D-2.

The bromochloromethane internal standard was employed to quantitate individual volatile compounds in a manner analogous to that discussed previously in the Overview of Methods.

The high levels of organics contained in many of the process waste streams necessitated preliminary screening of samples. To accomplish such screening, a 10-ml portion of the sample was extracted with a single 1-ml portion of isooctane, and the extract was subjected to GC/FID analysis to permit the judicious selection of appropriate sample volume, i.e., less than 5 ml, for purge and trap analysis. Organic-free water was employed for the dilution so that a uniform 5-ml sample was purged in all cases.

Many samples contained milligram-per-liter levels of phenol, alkyl sulfides and disulfides, and a variety of isoprenoid compounds. The presence of phenol and the late eluting isoprenoid compounds caused some difficulty in the volatile analyses as these compounds are very slowly eluted from the gas chromatographic column.

Although the nonvolatile compounds purge poorly, significant quantities can accumulate on the analytical column from samples containing high levels of organics present in the wastewater. A column of 0.1 percent SP-1000 (Carbowax 20 M esterified with nitroterephthalic acid) on 80/100-mesh Carbowax C was employed. The greater temperature stability of the SP-1000 stationary phase, as compared with the lower molecular weight Carbowax 1500, permitted column bake out at elevated temperatures for extended periods of time without adverse effects.

For the same reasons, the purge and trap apparatus employed emphasized: (1) short-heated transfer lines, (2) low dead-volume construction, (3) manually-operated multiport valve, and (4) ready replacement of all component parts. This design permitted the ready substitution of component parts with thoroughly preconditioned

replacement parts when serious contamination was indicated by system blanks.

Foaming tended to be excessive with a number of the samples, particularly those analyzed without dilution. The brief application of localized heat to the foam trap, as foam began to accumulate, was often effective in breaking the foam. A stock standard was prepared on a weight basis by dissolving the volatile solutes in methanol. Intermediate concentrations prepared by dilution were employed to prepare aqueous standards at the 20- and 100-ppb levels. A 5-ml aliquot of these standards was spiked with the internal standards and analyzed in a manner identical to that employed with the samples. The attendant reconstructed total ion current chromatogram for a purgeable volatile organic standard is presented in Figure D-1.

Semivolatile Toxic Pollutants

The extractable semivolatile toxic pollutants are compounds which are readily extracted with methylene chloride. They are subjected to a solubility class separation by serial extraction of the sample with methylene chloride at pH of 11 or greater and at pH 2 or less. This provides the groups referred to as base neutrals and acidics (phenolics), respectively.

Base neutrals and phenolics were fractionated on the basis of a solubility class separation. Due to the widely varying chemical and physical properties possessed by the individual semivolatile toxic pollutants, the whole sample, i.e., suspended solids, oil and grease, etc., was subjected to extraction. A listing of the base neutrals and acidic semivolatiles is provided in Tables D-3 and D-4. A 0.7- to 1-liter sample was subjected to two successive extractions with three portions of methylene chloride (150-, 75-, and 75-ml) at pH 11 or greater and pH 2 or less to provide the base neutral and acidic fractions, respectively.

Emulsions were broken by the judicious addition of Na_2SO_4 or methanol and/or simply by standing.

The extract from each fraction was dried by passage through Na_2SO_4 , and the volume was reduced with a Kuderna-Danish evaporator to 5 to 10 ml. The extract was further concentrated to 1 ml in the Kuderna-Danish tube, using a modified micro Snyder column and gentle heating on a water bath.

The solvent extract was subjected to GC/FID screening and spiked with 10 μl of the d10-anthracene internal standard solution of 2 $\mu\text{g}/\mu\text{l}$ for GC/MS analysis.

RECONSTRUCTED TOTAL ION CURRENT CHROMATOGRAM FOR PURGABLE VOLATILE ORGANICS STANDARD

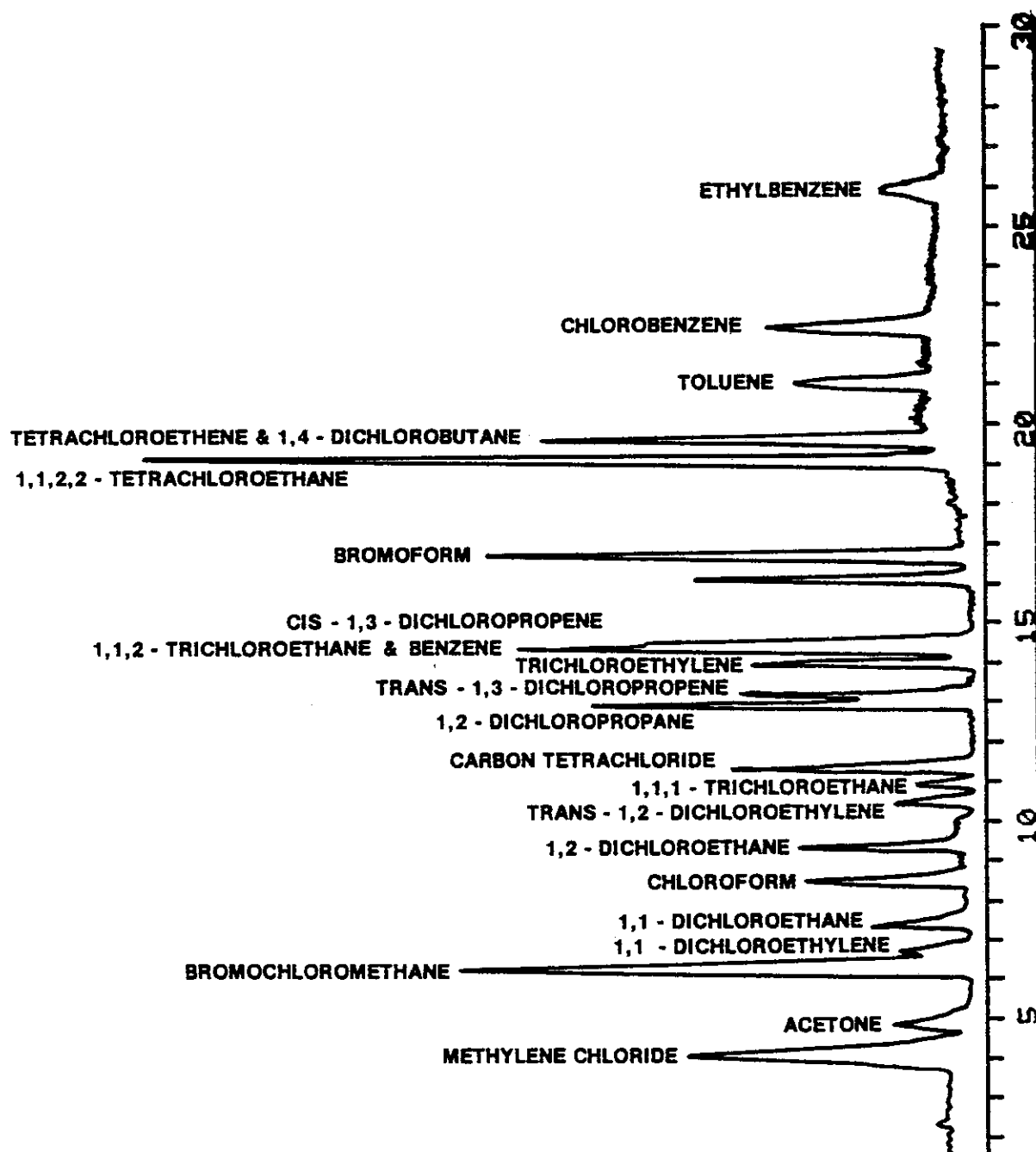


Figure D-1.

The presence of large quantities of a variety of organics in the extracts of many of the process waste streams necessitated screening of all extracts by GC/FID prior to GC/MS analysis. Sample extracts were diluted as indicated by the GC/FID scan and subjected to GC/MS analysis. Reconstructed total ion current chromatograms for base neutrals and for phenolic standard are shown in Figures D-2 and D-3, respectively.

GC/MS instrument parameters employed for the analysis of base neutrals and phenolics are presented in Tables D-5 and D-6.

RECONSTRUCTED TOTAL ION CURRENT CHROMATOGRAM FOR BASE NEUTRALS

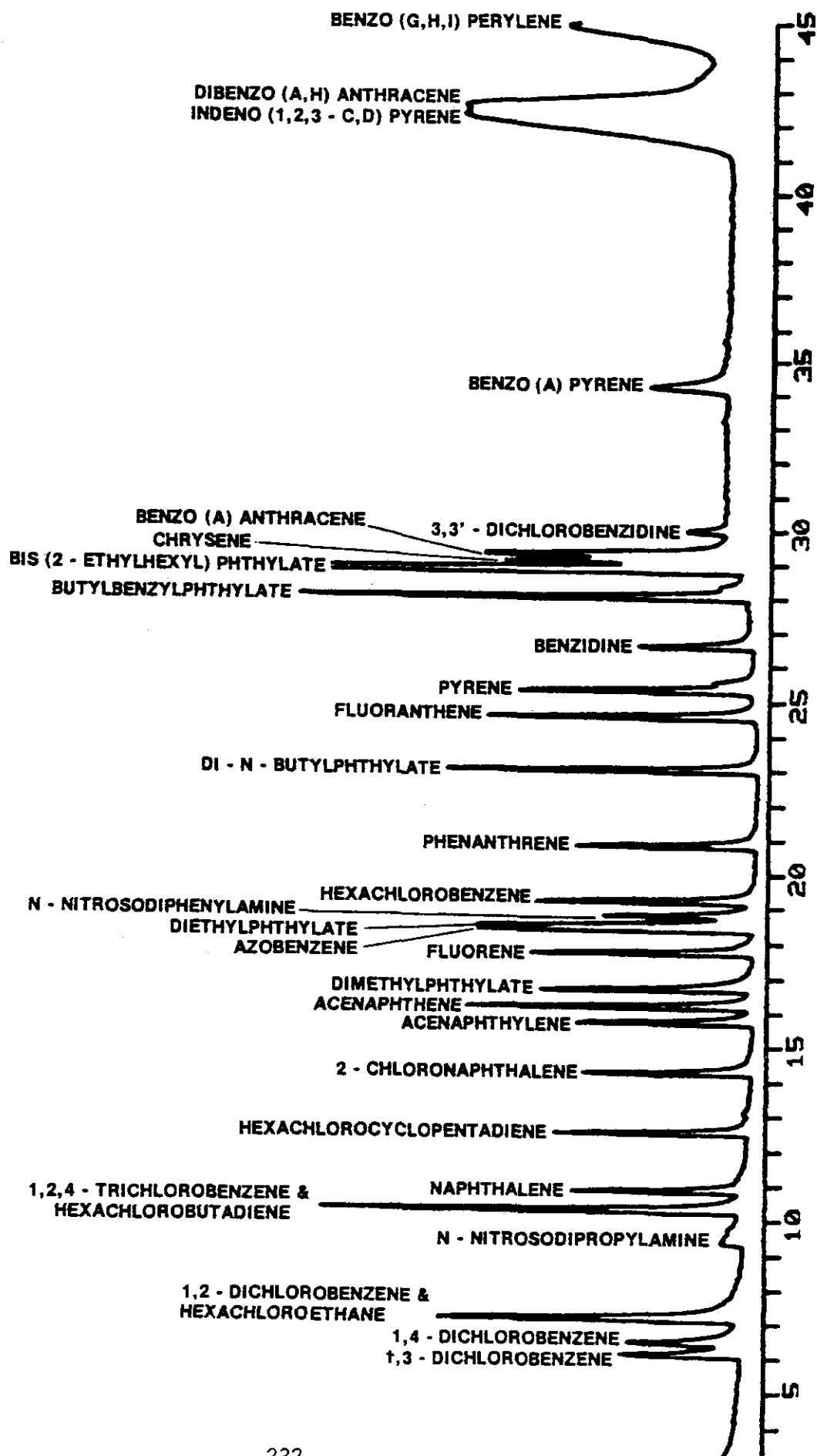


Figure D-2.

RECONSTRUCTED TOTAL ION CURRENT CHROMATOGRAM FOR PHENOLIC STANDARD

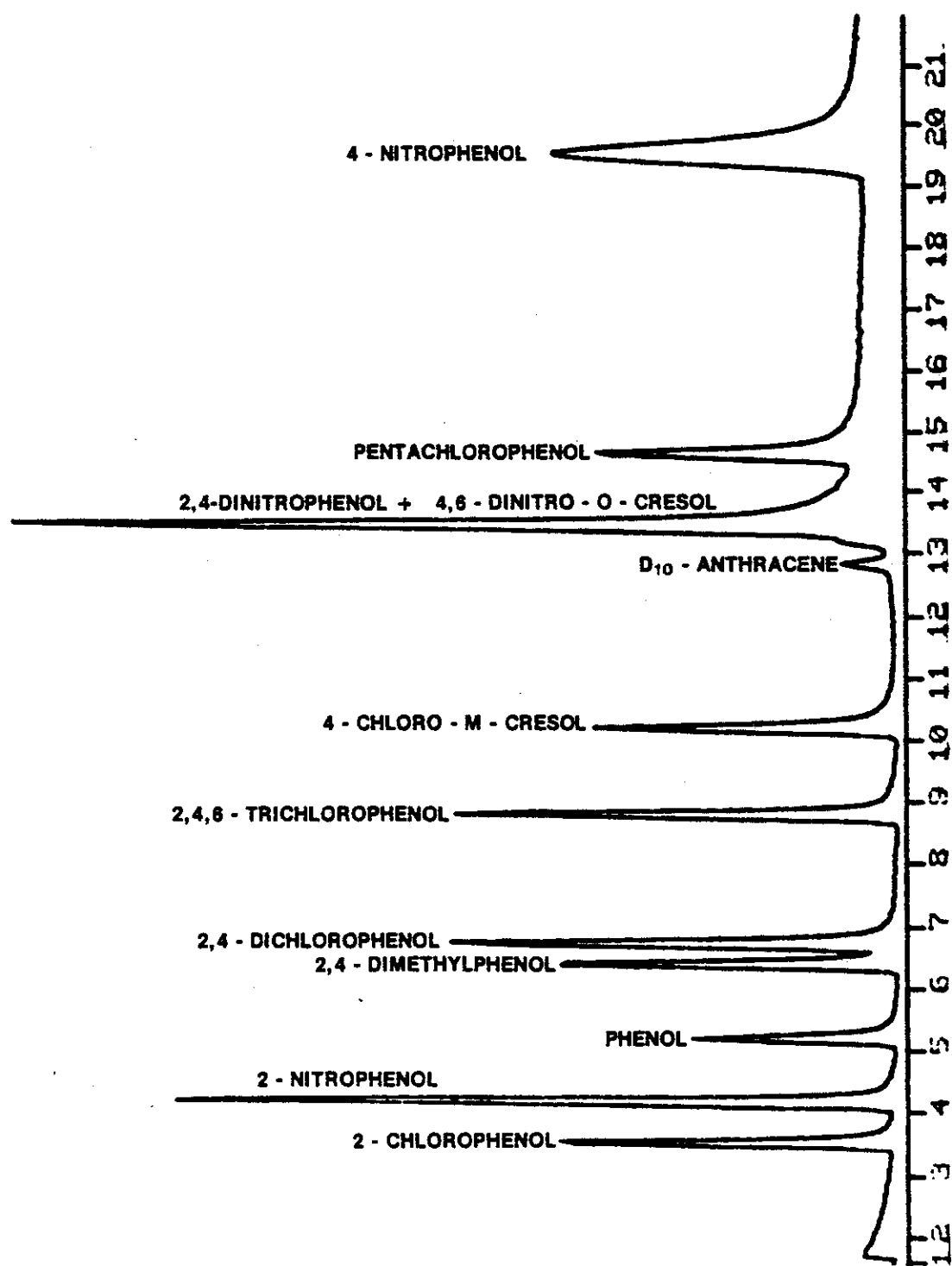


Figure D-3.

Table D-2. Parameters for Volatile Organic Analysis

Purge Parameters

Gas	He 40 ml/min
Purge duration	12 min
Purge temperature	5 ml
Sample purge volume	Ambient
Trap	10 in x 1/8 in o.d. 316 ss and 0.010 in wall thickness containing 7 in Tenax GC 60/80 mesh plus 2 in Davison Grade 15 silica gel 35/60 mesh
Desorption temperature	180
Desorption time	4 min

GC Parameters

Column	8 ft x 1/8 in nickel, 0.1% SP-1000 on Carbopack C 80/100
Carrier	He 30 ml/min
Program	50 isothermal 4 min then 8 /min to 175 isothermal 10 min
Separator	Single-stage glass jet at 185

MS Parameters

Instrument	Hewlett Packard 5985A
Mass Range	35-335 amu
Ionization Mode	Electron impact
Ionization Potential	70 eV
Emission Current	210 uA
Scan time	2 sec

Table D-3. Base Neutral Extractables

1,3-dichlorobenzene	1,4-dichlorobenzene
hexachloroethane	1,2-dichlorobenzene
bis(2-chloroisopropyl) ether	hexachlorobutadiene
1,2,4-trichlorobenzene	naphthalene
bis(2-chloroethyl) ether	hexachlorocyclopentadiene
nitrobenzene	bis(2-chloroethoxy) methane
2-chloronaphthalene	acenaphthylene
acenaphthene	isophorone
fluorene	2,6-dinitrotoluene
1,2-diphenylhydrazine	2,4-dinitrotoluene
N-nitrosodiphenylamine	hexachlorobenzene
4-bromophenyl phenyl ether	phenanthrene
anthracene	dimethylphthalate
diethylphthalate	fluoranthene
pyrene	di-n-butylphthalate
benzidine	butyl benzylphthalate
chrysene	bis(2-ethylhexyl) phthalate
benzo(a) anthracene	benzo(b) fluoranthene
benzo(k) fluoranthene	benzo(a) pyrene
indeno(1,2,3-cd) pyrene	dibenzo(a,h) anthracene
benzo(g,h,i) perylene	N-nitrosodimethylamine
N-nitrosodi-n-propylamine	4-chloro-phenyl phenyl ether
endrin aldehyde	3,3'-dichlorobenzidine
2,3,7,8-tetrachlorodibenzo-p-dioxin	bis(chloromethyl) ether
di-n-octyl phthalate	

Table D-4. Acidic Extractables

2-chlorophenol
2-nitrophenol
phenol
2,4-dimethylphenol
2,4-dichlorophenol
2,4,6-trichlorophenol
4-chloro-m-cresol
2,4-dinitrophenol
4,6-dinitro-o-cresol
pentachlorophenol
4-nitrophenol

Table D-5. Parameters for Base Neutral Analysis

GC Parameters

Column	6 ft x 2 mm i.d., glass, 1% SP-2250 on 100/120 mesh Supelcoport
Carrier	He 30 ml/min
Program	50 isothermal 4 min then 8 /min to 275 for 8 min
Injector	285
Separator	Single-stage glass jet at 275
Injection Volume	2 ul

MS Parameters

Instrument	Hewlett Packard 5985 A
Mass Range	35-400 amu
Ionization Mode	Electron impact
Ionization Potential	70 eV
Emission Current	2.10 uA
Scan time	2.4 sec

Table D-6. Parameters for Phenolic Analysis

GC Parameters

Column	6 ft x 2 mm i.d., glass, 1% SP-1240 DA on 100/120 mesh Supelcoport
Carrier Program	He 30 ml/min 90 to 200 at 8 /min with 16 min hold
Injector	250
Separator	Single-stage glass jet at 250
Injection Volume	2 ul

MS Parameters

Instrument	Hewlett Packard 5985 A
Mass Range	35-400 amu
Ionization Mode	Electron impact
Ionization Potential	70 eV
Emission Current	210 uA
Scan time	2.4 sec

The SP-1240 DA chromatographic phase employed for the analysis of the phenolic extracts provided superior performance as compared with that achieved on Tenax GC. The SP-1240 DA phase provided improved separation, decreased tailing, decreased adsorption of nitrophenols and pentachlorophenol, and increased column life. The improved chromatographic performance of this phase is clearly demonstrated in Figure D-3.

PESTICIDES AND PCB's

Pesticides and PCB's were extracted and analyzed as a separate sample. These compounds were analyzed by gas chromatograph with electron capture detection (GC/ECD). Only when the compounds were present at high levels were the samples subjected to GC/MS confirmation.

GC/ECD detection limits vary with the degree of chlorination, but range from one-half part per billion for PCB's to 50 parts per trillion for the chlorinated pesticides, while the GC/MS detection limits are in the mid- to low-ppb range. The pesticides and PCB's reported below 2 ppb have been confirmed on two columns using GC/ECD but not by GC/MS. Table D-7 presents the GC/ECD parameters employed for the analysis of pesticides and PCB's.

The procedure used for the analysis of pesticides and PCB's was a modification of the procedure from the Federal Register. Figure D-4 provides a flow chart indicating the step-by-step procedure employed. The major difference between the procedure used and the Federal Register procedure is the substitution of silica gel clean-up for the Florisil clean-up procedure. Sufficient quality control was run on standard solutions in order to determine the proper elution volume for the individual pesticides.

The compounds of this category are listed in Table D-8. A chromatogram of selected representative compounds is provided in Figure D-5.

METALS

The metals analysis was performed by atomic absorption spectroscopy. The metals analyzed consisted of the following:

Beryllium	Silver
Cadmium	Arsenic
Chromium	Antimony
Copper	Selenium
Nickel	Thallium
Lead	Mercury
Zinc	

FLOW CHART FOR PESTICIDES AND PCB'S

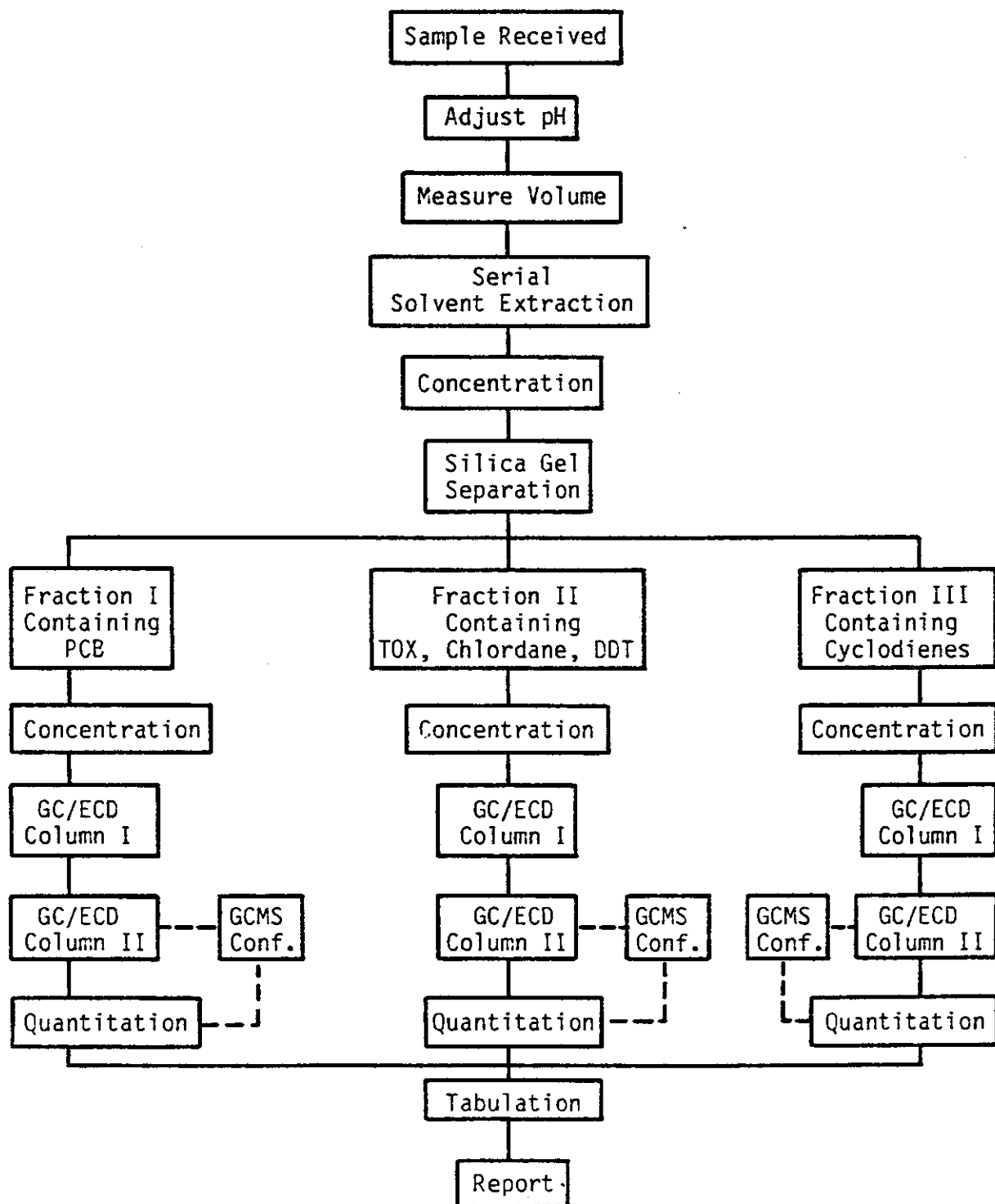


Figure D-4.

PESTICIDE MIXED STANDARD

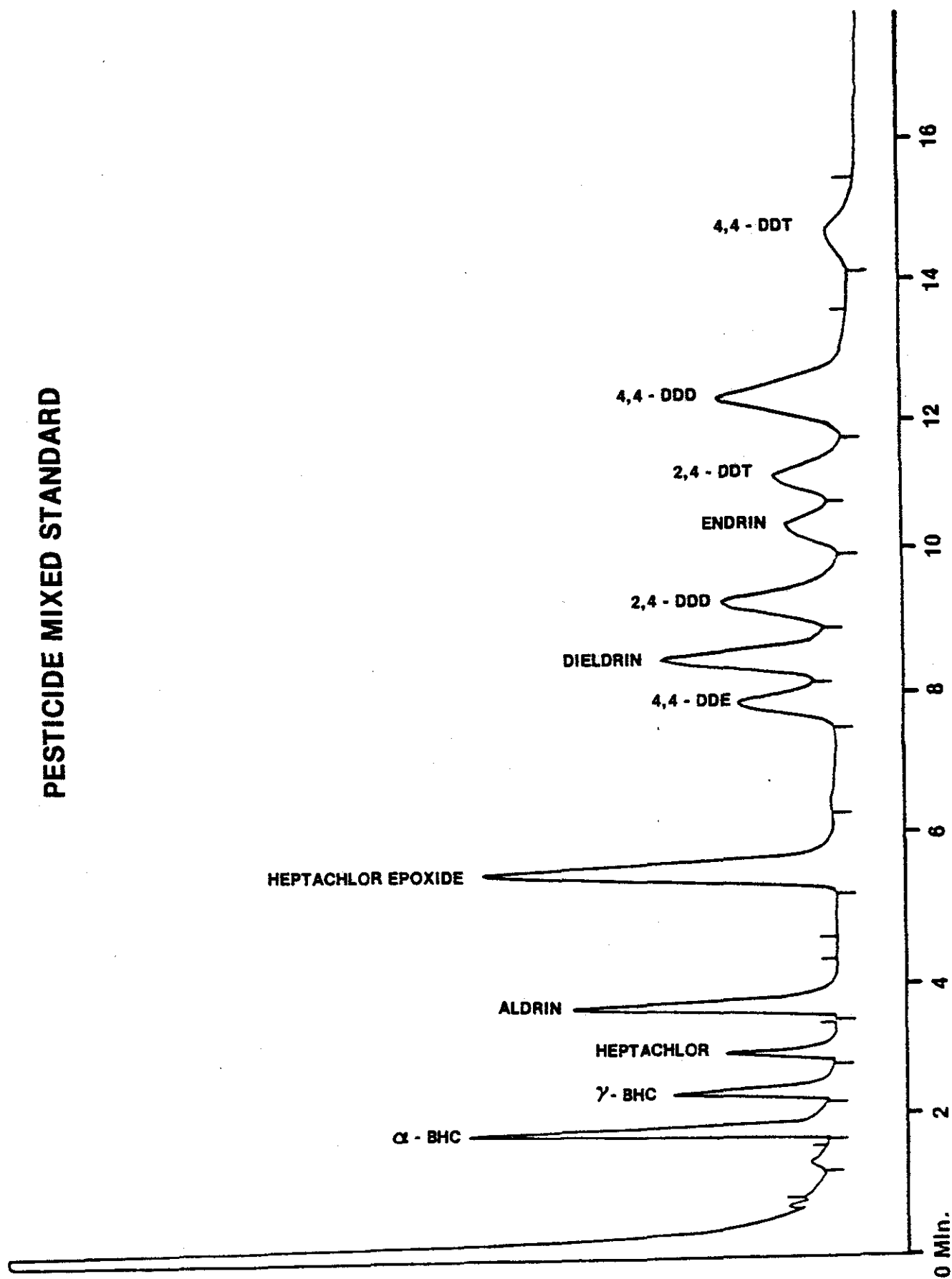


Figure D-5.

Table D-7, GC/ECD Parameters for Pesticide and PCE Analysis

Instrument	Hewlett Packard 4739A Radiofrequency Pulsed 63Ni ECD
Column	6 ft x 2 mm i.d. glass 1.5% OV-17/1.95% QF-1 Confirmation 6% SF-30/4% OV210 On Supelcoport 80/100
Carrier	5% methane/Argon 50 ml/min
Program	200 C isothermal

Table D-8. Pesticides and PCB's

-endosulfan
-BHC
-BHC
-BHC
-BHC
aldrin
heptachlor
heptachlor epoxide
-endosulfan
dielddrin
4,4'-DDE
4,4'-DDD
4,4'-DDT
endrin
endrin aldehyde
endosulfan sulfate
-BHC
chlordan
toxaphene
PCB-1016
PCB-1221
PCB-1232
PCB-1242
PCB-1248
PCB-1254
PCB-1260

Excluding the Hg analysis, all samples were worked up with three successive digestions with concentrated nitric acid. Samples were screened by flame for all metals except Hg. Samples with levels below the flame detection limit were re-analyzed by graphite furnace. A separate portion of the sample was worked up for the Hg analysis by the cold vapor technique. The analyses for Be, Tl, Se, Sb, and Ag were not Table D-7. GC/ECD Parameters for Pesticide and PCB Analysis performed on the verification samples since the screening data showed no significant levels of these metals.

The metals analysis was characterized at times by severe matrix problems. The method of standard additions was normally adequate to compensate for these interferences; however, some analyses such as for Se, As, and Hg required extensive dilution.

TRADITIONAL OR CLASSICAL PARAMETERS

The traditional parameters investigated included:

- BOD
- COD
- TSS
- Oil and Grease
- Total Phenol
- Total Cyanide

All of these parameters were analyzed by standard methods.

The colormetric method for cyanide entailed the steam distillation of cyanide from strongly acidic solution. The hydrogen cyanide gas was absorbed in a solution of sodium hydroxide, and the color was developed with addition of pyridine-barbituric acid reagent.

APPENDIX E

CONVERSION TABLE

Multiply (English Units)		By	To Obtain (Metric Units)	
<u>English Unit</u>	<u>Abbreviation</u>	<u>Conversion</u>	<u>Abbreviation</u>	<u>Metric Unit</u>
acre	ac	0.405	ha	hectares
acre-feet	ac ft	1233.5	cu m	cubic meters
British Thermal Unit	BTU	0.252	kg cal	kilogram-calories
British Thermal Unit/pound	BTU/lb	0.555	kg cal/kg	kilogram calories per kilo-gram.
cubic feet per minute	cfm	0.028	cu m/min	cubic meters per minute
cubic feet per second	cfs	1.7	cu m/min	cubic meters per minute
cubic feet	cu ft	0.028	cu m	cubic meters
cubic feet	cu ft	28.32	l	liters
cubic inches	cu in	16.39	cu cm	cubic centi-meters
degree Farenheit	F	0.555 (F-32) *	C	degree Centigrade
feet	ft	0.3048	m	meters
gallon	gal	3.785	l	liter
gallon per minute	gpm	0.0631	l/sec	liters per second
pounds per square inch	psi	0.06803	atm	atmospheres (absolute)

* Actual conversion, not a multiplier

CONVERSION TABLE

Multiply (English Units)		By	To Obtain (Metric Units)	
English Unit	Abbreviation	Conversion	Abbreviation	Metric Unit
gallon per ton	gal/ton	4.173	l/kg	liters per metric ton
horsepower	hp	0.7457	kw	kilowatts
inches	in	2.54	cm	centimeters
million gallons per day	MGD	3.7×10^{-3}	cu m/day	cubic meters per day
pounds per square inch (gauge)	psi	$(0.06805 \text{ psi} + 1) *$	atm	atmospheres
pounds	lb	0.454	kg	kilograms
board feet	b.f.	0.0023	cu m, m ³	cubic meters
ton	ton	0.907	kg	metric ton
mile	mi	1.609	km	kilometer
square feet	ft ²	0.0929	m ²	square meters

* Actual conversion, not a multiplier.

