EPA-440/1-82/024a

DEVELOPMENT DOCUMENT

for

EFFLUENT LIMITATIONS GUIDELINES

NEW SOURCE PERFORMANCE STANDARDS

and

PRETREATMENT STANDARDS

for the

IRON AND STEEL MANUFACTURING
POINT SOURCE CATEGORY

Anne M. Gorsuch
Administrator

Steven Schatzow
Director
Office of Water Regulations and Standards

Jeffery Denit, Acting Director
Effluent Guidelines Division

Ernst P. Hall, P.E.
Chief, Metals & Machinery Branch

Edward L. Dulaney, P.E.
Senior Project Officer

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Effluent Guidelines Division
Office of Water Regulations and Standards
U.S. Environmental Protection Agency
Washington, D.C. 20460

VOLUME I

TABLE OF CONTENTS

VOLUME I

TABLE OF CONTENTS (Continued)

VOLUME I

TABLE OF CONTENTS (Continued)

VOLUME I

TABLES

TABLES (Continued)

VOLUME I

TABLES (Continued)

VOLUME I

FIGURES

VOLUME I

PREFACE

The United States Environmental Protection Agency has promulgated effluent limitations and standards for the steel industry pursuant to Sections 301, 304, 306, 307 and 501 of the Clean Water Act. The regulation contains effluent limitations for best practicable control technology currently available (BPT), best conventional pollutant control technology (BCT), and best available technology economically achievable (BAT), as well as pretreatment standards for new and existing sources (PSNS and PSES), and new source performance standards (NSPS).

This Development Document highlights the technical aspects of EPA's study of the steel industry. This volume addresses general issues pertaining to the industry, while the remaining volumes contain specific subcategory reports.

The Agency's economic analysis of the regulation is set forth in a separate document entitled Economic Analysis of Effluent Guidelines - Integrated Iron and Steel Industry. That document is available from the Office of Planning and Evaluation, PM-220, USEPA, Washington, D.C., 20460.

VOLUME I

SECTION I

CONCLUSIONS

1. Total process water usage in the steel industry is about 5,740,000,000 (5740 MGD) gallons per day. The untreated process wastewaters contain about 43,600 tons/year of toxic organic pollutants, 121,900 tons/year of toxic inorganic pollutants, and 14,500,000 tons/year of conventional and nonconventional pollutants. Steel industry process wastewaters are treatable by currently available, practicable and economically achievable control and treatment technologies.

2. The Regulation contains limitations and standards for process wastewaters generated in the different subcategories, subdivisions and segments of the industry. The subcategorization is based primarily upon differences in wastewater quantity and quality related to differences in industry manufacturing processes. The Agency has adopted a revised subcategorization of the industry from that used in prior regulations to more accurately effect production operations in the industry, and, to simplify the use of the regulation. The subcategorization of the industry in this fashion does not affect the substantive requirements of the regulation. The Regulation applies to the 12 subcategories of the steel industry, their subdivisions, and segments as shown below:

Subpart/Subcategory	Subdivision	Segment
A. Cokemaking	By-Product	Iron and Steel Merchant
	Beehive	-
B. Sintering	-	-
C. Ironmaking	Iron Blast Furnace Ferromanganese Blast Furnace	-
D. Steelmaking	Basic Oxygen Furnace	Semi-Wet Wet-Suppressed Combustion Wet-Open Combustion
	Open Hearth Furnace	Wet
	Electric Arc Furnace	Semi-Wet

		Wet
E. Vacuum Degassing	-	-
F. Continuous Casting	-	-
G. Hot Forming	Primary	Carbon and Specialty Mills without Scarfers Carbon and Specialty Mills with Scarfers
	Section	Carbon Mills Specialty Mills
	Flat	Hot Strip and Sheet Mills Carbon Plate Mills Specialty Plate Mills
	Pipe & Tube Mills	-
H. Salt Bath Descaling	Oxidizing	Batch: Sheet, Plate Batch: Rod, Wire, Bar Batch: Pipe, Tube Continuous
	Reducing	Batch Continuous
I. Acid Pickling	Sulfuric Acid	Rod, Wire, Coil Bar, Billet, Bloom Strip, Sheet, Plate Pipe, Tube, Other Fume Scrubber
	Hydrochloric Acid	Rod, Wire, Coil Strip, Sheet, Plate Pipe, Tube, Other Fume Scrubber Acid Regeneration
	Combination Acid	Rod, Wire, Coil Bar, Billet, Bloom Strip, Sheet, Plate-Continuous Strip, Sheet, Plate-Batch Pipe, Tube, Other Fume Scrubber

J.	Cold Forming	Cold Rolling	Recirculation: Single Stand Multi-Stand Combination Direct Application: Single-Stand Multi-Stand
		Cold Worked Pipe & Tube	Water Solutions Oil Solutions
K.	Alkaline Cleaning	Batch Continuous	- -
L.	Hot Coating	Galvanizing, Terne and Other Metal Coatings	Strip, Sheet, and Miscellaneous Products Wire Products and Fasteners
		Fume Scrubbers	-

3. <u>Best Practicable Control Technology Currently Available (BPT)</u>

For the most part, the BPT limitations for the basic steelmaking operations (cokemaking, sintering, ironmaking, steelmaking, vacuum degassing, and continuous casting) are the same as those contained in the prior regulations and those proposed in January 1981, (46 FR 1858). Where the BPT limitations for the basic steelmaking operations are different than those proposed, the changes are the result of the Agency's evaluation and response to comments received during the public comment period for the proposed regulation. The major changes are summarized below:

A. Cokemaking

The total suspended solids limitations were relaxed to reflect actual operations of biological treatment systems used to treat cokemaking wastewaters. Separate limitations are promulgated for merchant cokemaking operations.

B. Sintering

The limitations were relaxed to reflect a higher model treatment system effluent flow rate.

C. Ironmaking

None

D. Steelmaking

The limitations for the BOF wet-open combustion and EAF-Wet segments were relaxed to reflect higher model treatment system effluent flow rates. The Open Hearth semi-wet segment was deleted.

E. Vacuum Degassing

None

F. Continuous Casting

None

Many of the BPT effluent limitations for the forming and finishing operations (hot forming, descaling, cold rolling, acid pickling, alkaline cleaning, and hot coating) were changed. Some of the final limitations are more stringent than those proposed and some are less stringent. These changes result partly from revised segmentation and subdivision of certain subcategories and partly from the Agency's re-assessment of its existing data base and additional data received during the public comment period for the proposed regulation. In all cases, however, the basic technologies underlying the BPT limitations have remained the same. The model treatment system flow rates and effluent quality were changed to reflect actual flows in the industry and the performance of properly designed and operated treatment systems. In all cases, the Agency believes the changes made have resulted in more appropriate, technically sound limitations. These changes are summarized below:

G. Hot Forming

The model treatment system flow rates and effluent quality were revised to reflect actual performance of the model treatment systems.

H. Salt Bath Descaling

The subcategory was resegmented to provide more appropriate rinsewater flows by product and by type of operation. Limitations were promulgated for suspended solids, chromium, nickel, and pH.

I. Acid Pickling

The subcategory was resegmented to provide more appropriate rinsewater flows by product. Separate daily mass limitations were promulgated for fume scrubbers and for regeneration system absorber vent scrubbers. Lead and zinc are limited for sulfuric and hydrochloric acid pickling operations and chromium and nickel are limited for combination acid pickling operations.

J. Cold Forming

Separate limitations were promulgated for single stand recirculation and direct application cold rolling mills. Lead and zinc are limited for cold rolling operations processing carbon steels and chromium and nickel are limited for cold rolling operations processing specialty steels. Limitations for naphthalene and tetrachloroethylene are provided for all cold rolling operations. There are no changes to the BPT limitations for cold worked pipe and tube operations.

K. Alkaline Cleaning

The limitations were relaxed to reflect higher model treatment system effluent flow rates.

L. Hot Coating

Separate daily mass limitations were promulgated for fume scrubbers. Limitations were promulgated for lead and zinc for all hot coating operations. Chromium limitations are promulgated for those hot coating operations with chromate rinse operations.

The model treatment system flow rates and effluent quality used to develop the BPT limitations are presented in Table I-1. Comparisons of the BPT limitations contained in prior regulations with the promulgated BPT limitations are presented in Table I-2.

4. <u>Best Available Technology Economically Achievable (BAT)</u>

The BAT limitations for the basic steelmaking operations are generally based upon the same treatment technologies as the proposed limitations. However, in several cases, the limitations were changed based upon comments and data received as a result of the public comment period. In some cases, different model treatment technologies were used to develop the limitations. The more significant changes are summarized below:

A. Cokemaking

The limitations for ammonia-N, cyanide, and phenols (4AAP) were relaxed to a minor extent based upon a review of extensive data for the model treatment system. Only daily maximum limitations for benzene, benzo(a)pyrene, and naphthalene are promulgated. Separate limitations are promulgated for merchant cokemaking operations.

B. Sintering

The model treatment system effluent flow rate was relaxed to reflect achievable wastewater recycle rates for sintering operations with wet air pollution control systems on all parts of the process. The selected model treatment technology is filtration as opposed to alkaline chlorination. However, limitations for ammonia-N, total cyanide, and phenols (4AAP) were promulgated for those sintering operations with wastewaters co-treated with ironmaking wastewaters.

C. Ironmaking

The ammonia-N limitation was significantly relaxed to take into account full scale operation of the selected model treatment technology.

D. Steelmaking

The model treatment system was changed by deleting the final effluent filter and the limitations were adjusted accordingly. Only limitations for lead and zinc were promulgated. Limitations for chromium were proposed.

E.,F. Vacuum Degassing, Continuous Casting

The model treatment systems were changed from filtration to lime precipitation and sedimentation to address treatment of dissolved toxic metals. The promulgated limitations for lead and zinc are consistent with those for steelmaking operations.

G. Hot Forming

BAT limitations are not promulgated for hot forming operations. The Agency has determined that the BPT model treatment system provides sufficient control of toxic metals.

H.,I.,J. Salt Bath Descaling, Acid Pickling, Cold Forming

BAT limitations more stringent than the promulgated BPT limitations were not promulgated for descaling, acid pickling, and cold forming operations.

K. Alkaline Cleaning

None

L. Hot Coating

For those operations with fume scrubbers, BAT limitations based upon recycle of fume scrubber wastewaters and the BPT model treatment system were promulgated. For those operations without fume scrubbers, BAT limitations more stringent than the respective BPT limitations were not promulgated.

The model treatment system effluent flow rates and effluent quality used to develop the BAT limitations are presented in Table I-3. The BAT limitations are presented in Table I-4.

5. New Source Performance Standards (NSPS)

In all cases, the promulgated NSPS are based upon the same basic technologies used to develop the BPT and BAT limitations. In several instances, NSPS more stringent than the respective BPT and BAT limitations were promulgated based upon more stringent model treatment system discharge flow rates demonstrated in the industry. The development of NSPS is set out in each subcategory report. The model treatment system effluent flow rates and effluent quality used to develop NSPS are presented in Table I-5. The NSPS are presented in Table I-6.

6. Pretreatment Standards (PSES and PSNS)

The promulgated pretreatment standards are designed to minimize pass through of toxic pollutants discharged to POTWs from steel industry operations. Except for cokemaking operations, the promulgated PSES and PSNS are the same as the respective BAT limitations and NSPS. For cokemaking operations, PSES and PSNS are based upon the same pretreatment the industry provides for on-site biological treatment of cokemaking wastewaters. The model treatment system effluent flow rates and the effluent quality used to develop the PSES are presented in Table I-7. The PSES are presented in Table I-8. The same information for PSNS and the PSNS are presented in Tables I-5 and I-6, respectively.

7. Best Conventional Technology (BCT)

As a result of the remand of the Agency's BCT costing methodology in API vs EPA [660 F.2d 954 (4th Cir. 1981)] the Agency has reserved BCT limitations in those subcategories where the model BAT treatment technologies provide for conventional pollutant removal beyond that provided by the model BPT technologies (sintering, ironmaking, steelmaking, vacuum degassing, continuous casting). For the remaining subcategories, the Agency has promulgated BCT limitations that are the same as the respective BPT limitations.

The model treatment system flow rates and effluent quality used to develop the BCT limitations are presented in Table I-9. The BCT limitations are presented in Table I-10.

8. The Agency concludes that the effluent reduction benefits associated with compliance with the regulation will result in significant removals of toxic, conventional and other pollutants.

Table I-11 presents a summary of the effluent reduction benefits associated with this regulation on an industry-wide basis. Table I-12 and I-13 present summaries for direct and indirect dischargers, respectively.

The Agency concludes that the effluent reduction benefits associated with compliance with both existing and new source limitations and standards outweigh the minor adverse energy and non-water quality environmental impacts.

9. The Agency estimates that based upon production and treatment facilities in place as of July 1, 1981, the industry will incur the following costs to comply with the regulation. The Agency has determined that the effluent reduction benefits associated with compliance with the limitations and standards outweigh the costs of compliance.

Costs (Millions of July 1, 1978 Dollars)

	Capital Costs			Total
	Total	In-place	Required	Annual
BPT	1697	1491	206	204
BAT	101	24	77	24
PSES	173	132	41	31
TOTAL	1971	1647	324	259

Table I-14 presents these costs by subcategory. The Agency has also determined that the effluent reduction benefits associated with compliance with new source standards (NSPS, PSNS) justify the associated costs.

The industry production capacity profile used in this study differs slightly from that used in the preparation of Economic Analysis of Proposed Effluent Guidelines - Integrated Iron and Steel Industry which reviews in detail the potential economic impact of this regulation. The capacity profile used in that analysis is based upon information obtained from AISI and includes predictions of future retirements, modernization, and reworks over the next ten years, whereas this development document has focused on the industry as it now exists and the extent to which pollution control technologies are demonstrated.

10. With respect to the general issues remanded by the United States Court of Appeals for the Third Circuit, the Agency concluded:

a. The "age" of facilities has no significant impact on the "cost or feasibility of retrofitting" pollution controls. First, "age" is a relatively meaningless term in the steel industry. It is extremely difficult to define because many plants are continually rebuilt and modernized.

Whether "first year of production" or "years since last rebuild" is taken as an indicia of plant "age", the data show that "age" has no significant impact on the "feasibility" of retrofitting. Many "old" facilities are served by modern and efficient retrofitted treatment systems. With regard to the impact of plant "age" on the cost of retrofitting, most respondents to EPA questionnaires were unable to estimate "retrofit" costs, reported no retrofit costs, or reported retrofit costs of less than 5% of pollution control costs. The Agency compared its model based cost estimates with actual industry costs for over 90 installed treatment facilities, many of which were retrofitted to older production facilities. The Agency found that the model based cost estimates are sufficiently generous to account for retrofit costs at both older and newer plants. Also, detailed engineering studies and industry cost estimates for three of the "oldest" plants in the country produced cost estimates similar to EPA's model plant estimates.

The Agency found that both old and newer facilities generate similar raw wastewater pollutant loadings; that pollution control facilities can be and have been retrofitted to both old and newer production facilities without substantial retrofit costs; that these pollution control facilities can and are achieving the same effluent quality; and, that further subcategorization or further segmentation within each subcategory on the basis of age is not appropriate.

However, even assuming that plant "age" does affect the "cost or feasibility of retrofitting," EPA believes that separate subcategorization or relaxed limitations for "older" plants are not justifiable. "Older" plants cause similar pollution problems as "newer" plants, and the need to control these problems would justify the expenditure of reasonable, if any, additional "retrofit" costs. Therefore the regulation does not differentiate between "old" and "new" facilities.

b. The Agency's cost estimates are sufficiently generous to reflect all costs to be incurred when installing wastewater treatment systems, including "site-specific costs". The Agency's cost models now include several "site-specific cost" items not included in prior cost models (See Sections III and VII) and incorporate several conservative assumptions. As noted above, the Agency also compared its model plant cost estimates with actual costs reported by the industry including "site-specific costs." Finally, detailed plant-by-plant engineering estimates (cost estimates provided by the industry) for eight plants reveal estimated costs (including "site-specific costs") similar to EPA's model plant cost estimates.

c. The BPT and BAT limitations and the PSES, PSNS, and NSPS in seven subcategories are based upon model treatment systems including recycle systems and mechanical draft cooling towers. The installation of these systems may result in evaporative water losses of about 4.2 MGD above current losses (16.0 MGD). However, the environmental benefits of these treatment systems justify the additional evaporative water losses. Recycle and cooling systems are extensively used at steel plants in water-scarce areas and the Agency concludes that the incremental impacts of the regulation on these plants is either minimal or nonexistent.

11. Table I-15 presents a summary, by subcategory, of the water pollution control and treatment technologies considered by the Agency in developing the limitations and standards.

TABLE I-1

BPT CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY

Subcategory		Discharge Flow (GPT)	BPT Effluent Concentrations (mg/l) TSS	O&G	Ammonia	Phenol (4AAP)	CN-T	Cr^{+6}	Cr	Ni	Pb	Zn	Toxic Organics 55	85
Cokemaking														
Iron & Steel	Avg	225	140	11.6	97.2	1.6	23.3							
	Max		270	34.8	292	4.8	70.0							
Merchant	Avg	240	140	11.6	97.2	1.6	23.3							
	Max		270	34.8	292	4.8	70.0							
Beehive	Avg	0												
	Max													
Sintering	Avg	120	50	10										
	Max		150	30										
Ironmaking														
Iron	Avg	125	50		103	4.0	15.0							
	Max		150		309	12.0	45.0							
Ferromanganese	Avg	250	100		410	20.0	150							
	Max		300		1240	60.0	450							
Steelmaking														
BOF:Semi-Wet	Avg	0												
	Max													
BOF:Wet-Open Combustion	Avg	110	50											
	Max		150											
BOF: Wet-Suppressed Combustion	Avg	50	50											
	Max		150											
Open Hearth-Wet	Avg	110	50											
	Max		150											
Electric Arc Furnace:Semi-Wet	Avg	0												
	Max													
Electric Arc Furnace:Wet	Avg	110	50											
	Max		150											
Vacuum Degassing	Avg	25	50											
	Max		150											

TABLE I-1
BPT CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 2

Subcategory		Discharge Flow (GPT)	BPT Effluent Concentrations (mg/l) TSS	O&G	Ammonia	Phenol (4AAP)	CN-T	Cr^{+6}	Cr	Ni	Pb	Zn	Toxic Organics 55	Toxic Organics 85
Continuous Casting	Avg	125	50	15										
	Max		150	45										
Hot Forming														
Primary: Carbon & Spec w/o scarf.	Avg	897	15	-										
	Max		40	10										
Primary:Carbon & Spec w/scarf.	Avg	1326	15	-										
	Max		40	10										
Section:Carbon	Avg	2142	15	-										
	Max		40	10										
Section:Specialty	Avg	1344	15	-										
	Max		40	10										
Flat:Hot Strip & Sheet (Carbon & Specialty)	Avg	2560	15	-										
	Max		40	10										
Flat:Plate-Carbon	Avg	1360	15	-										
	Max		40	10										
Flat:Plate-Spec.	Avg	600	15	-										
	Max		40	10										
Pipe & Tube	Avg	1270	15	-										
	Max		40	10										
Salt Bath Descaling														
Oxidizing-Batch, Sheet & Plate	Avg	700	30						0.4	0.3				
	Max		70						1.0	0.9				
Oxidizing-Batch Rod & Wire	Avg	420	30						0.4	0.3				
	Max		70						1.0	0.9				
Oxidizing-Batch Pipe & Tube	Avg	1700	30						0.4	0.3				
	Max		70						1.0	0.9				
Oxidizing-Cont.	Avg	330	30						0.4	0.3				
	Max		70						1.0	0.9				

TABLE I-1
BPT CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 3

			BPT Effluent Concentrations (mg/l)										Toxic Organics	
Subcategory		Discharge Flow (GPT)	TSS	O&G	Ammonia	Phenol (4AAP)	CN-T	Cr^{+6}	Cr	Ni	Pb	Zn	55	85
Salt Bath Descal. (Cont.)														
Reducing-Batch	Avg	325	30				0.25		0.4	0.3				
	Max		70				0.75		1.0	0.9				
Reducing-Cont.	Avg	1820	30				0.25		0.4	0.3				
	Max		70				0.75		1.0	0.9				
Sulfuric Acid Pickling														
Strip, Sheet & Plate	Avg	180	30	10[1]							0.15	0.1		
	Max		70	30[1]							0.45	0.3		
Rod, Wire & Coil	Avg	280	30	10[1]							0.15	0.1		
	Max		70	30[1]							0.45	0.3		
Bar, Billet & Bloom	Avg	90	30	10[1]							0.15	0.1		
	Max		70	30[1]							0.45	0.3		
Pipe, Tube & Other	Avg	500	30	10[1]							0.15	0.1		
	Max		70	30[1]							0.45	0.3		
Fume Scrubber[2]	Avg	15 GPM	30	10[1]							0.15	0.1		
	Max		70	30[1]							0.45	0.3		
HCl Acid Pickling														
Rod, Wire & Coil	Avg	490	30	10[1]							0.15	0.1		
	Max		70	30[1]							0.45	0.3		
Strip, Sheet & Plate	Avg	280	30	10[1]							0.15	0.1		
	Max		70	30[1]							0.45	0.3		
Pipe, Tube & Other	Avg	1020	30	10[1]							0.15	0.1		
	Max		70	30[1]							0.45	0.3		
Fume Scrubber[2]	Avg	15 GPM	30	10[1]							0.15	0.1		
	Max		70	30[1]							0.45	0.3		
Acid Regeneration	Avg	100 GPM	30	10[1]							0.15	0.1		
	Max		70	30[1]							0.45	0.3		
Comb. Acid Pickling														
Rod, Wire & Coil	Avg	510	30	10[1]					0.4	0.3				
	Max		70	30[1]					1.0	0.9				
Bar, Billet & Bloom	Avg	230	30	10[1]					0.4	0.3				
	Max		70	30[1]					1.0	0.9				

TABLE I-1
BPT CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 4

Subcategory		Discharge Flow (GPT)	BPT Effluent Concentrations (mg/l) TSS	O&G	Ammonia	Phenol (4AAP)	CN-T	Cr^{+6}	Cr	Ni	Pb	Zn	Toxic Organics 55	85
Comb. Acid Pickling (Cont.)														
Cont.-Strip, Sheet	Avg	1500	30	10[1]					0.4	0.3				
& Plate	Max		70	30[1]					1.0	0.9				
Batch-Strip, Sheet	Avg	460	30	10[1]					0.4	0.3				
& Plate	Max		70	30[1]					1.0	0.9				
Pipe, Tube & Other	Avg	770	30	10[1]					0.4	0.3				
	Max		70	30[1]					1.0	0.9				
Fume Scrubber[2]	Avg	15 GPM	30	10[1]					0.4	0.3				
	Max		70	30[1]					1.0	0.9				
Cold Forming														
Cold Rolling: Recir	Avg	5	30	10					0.4[3]	0.3[3]	0.15	0.1	-	-
Single Stand	Max		60	25					1.0[3]	0.9[3]	0.45	0.3	0.1	0.15
Cold Rolling: Recir	Avg	25	30	10					0.4[3]	0.3[3]	0.15	0.1	-	-
Multi Stand	Max		60	25					1.0[3]	0.9[3]	0.45	0.3	0.1	0.15
Cold Rolling:	Avg	300	30	10					0.4[3]	0.3[3]	0.15	0.1	-	-
Combination	Max		60	25					1.0[3]	0.9[3]	0.45	0.3	0.1	0.15
Cold Rolling: Direct	Avg	90	30	10					0.4[3]	0.3[3]	0.15	0.1	-	-
Appl. Single Stand	Max		60	25					1.0[3]	0.9[3]	0.45	0.3	0.1	0.15
Cold Rolling: Direct	Avg	400	30	10					0.4[3]	0.3[3]	0.15	0.1	-	-
Appl. Multi Stand	Max		60	25					1.0[3]	0.9[3]	0.45	0.3	0.1	0.15
Pipe & Tube	Avg	0												
	Max													
Alkaline Cleaning														
Batch	Avg	250	30	10										
	Max		70	30										
Continuous	Avg	350	30	10										
	Max		70	30										

TABLE I-1
BPT CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 5

Subcategory		Discharge Flow (GPT)	TSS	O&G	Ammonia	Phenol (4AAP)	CN-T	Cr^{+6}	Cr	Ni	Pb	Zn	Toxic Organics 55	Toxic Organics 85
			BPT Effluent Concentrations (mg/l)											
Hot Coating - (Includes all coating operations)														
Strip/Sheet/Misc. wo/ Scrubbers	Avg	600	30	10				0.02(4)			0.15	0.1		
	Max		70	30				0.06(4)			0.45	0.3		
Wire Fasteners wo/ Scrubbers	Avg	2400	30	10				0.02(4)			0.15	0.1		
	Max		70	30				0.06(4)			0.45	0.3		
Fume Scrubbers(2)	Avg	100 GPM	30	10				0.02(4)			0.15	0.1		
	Max		70	30				0.06(4)			0.45	0.3		

NOTE: pH is also regulated in all subcategories and is limited to 6.0 to 9.0 standard units.

(1): This pollutant is regulated only when these wastes are treated in combination with cold rolling mill wastes.
(2): The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation.
(3): This pollutant shall apply in lieu of lead and zinc when cold rolling wastewaters are treated with descaling or combination acid pickling wastewaters.
(4): This pollutant shall apply only to those galvanizing operations which discharge wastewaters from a chromate rinse step.

TABLE I-2

BPT EFFLUENT LIMITATIONS COMPARISON
IRON & STEEL INDUSTRY

Subcategory		Discharge Flow (GPT)	BPT Effluent Limitations ($kg/kkg \times 10^{-5}$) TSS	O&G	Ammonia	Phenol (4AAP)	Fe-D	CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	F	Toxic Organics 55	Toxic Organics 85
Cokemaking																
Iron & Steel	1976 Avg	175	3650	1090	912	146		2190								
	Max		11000	3290	2740	438		6570								
	Rev. Avg	225	13100	1090	9120	150		2190								
	Max		25300	3270	27400	451		6570								
Merchant	1976 Avg	No Separate Limitations Proposed for this Segment														
	Max															
	Rev. Avg	240	14000	1160	9730	160		2330								
	Max		27000	3480	29200	481		7010								
Beehive	1976 Avg	0														
	Max															
	Rev. Avg	No Change														
	Max															
Sintering	1976 Avg	50	1040	209												
	Max		3130	626												
	Rev. Avg	120	2500	501												
	Max		7510	1500												
Ironmaking																
Iron	1976 Avg	125	2600		5370	209		782								
	Max		7820		16100	626		2340								
	Rev. Avg	No Change														
	Max															
Ferromanganese	1976 Avg	250	10400		42900	2080		15600								
	Max		31300		128000	6240		46900								
	Rev. Avg	No Change														
	Max															
Steelmaking																
BOF: Semi-Wet	1976 Avg	0														
	Max															
	Rev. Avg	No Change														
	Max															
BOF: Wet-Supp.	1976 Avg	50	1040													
	Max		3130													
	Rev. Avg	No Change														
	Max															
BOF: Wet-Open	1976 Avg	50	1040													
	Max		3130													
	Rev. Avg	110	2290													
	Max		6880													
Open Hearth: Semi-Wet	1976 Avg	50	1040													
	Max		3130													
	Rev. Avg	Segment Eliminated														
	Max															

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
PAGE 2

BPT Effluent Limitations (kg/kkg x 10^{-5})

Subcategory			Discharge Flow (GPT)	TSS	O&G	Ammonia	Phenol (4AAP)	Fe-D	CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	F	Toxic Organics 55	Toxic Organics 85
Open Hearth: Wet	1976	Avg	50	1040													
		Max		3130													
	Rev.	Avg	110	2290													
		Max		6880													
EAF: Semi-Wet	1976	Avg	0														
		Max															
	Rev.	Avg	No Change														
		Max															
EAF: Wet	1976	Avg	50	1040													
		Max		3130													
	Rev.	Avg	110	2290													
		Max		6880													
Vacuum Degassing	1976	Avg	25	522													
		Max		1560													
	Rev.	Avg	No Change														
		Max															
Continuous Casting	1976	Avg	125	2600	780												
		Max		7800	2340												
	Rev.	Avg	No Change														
		Max															
Hot Forming																	
Prim.-Carbon w/s	1976	Avg	845	4530	3520												
		Max		13600	10600												
	Rev.	Avg	1326	8300	-												
		Max		22100	5530												
Prim.-Carbon wo/s	1976	Avg	692	3710	2880												
		Max		11100	8640												
	Rev.	Avg	897	5610	-												
		Max		15000	3740												
Prim.-Spec. w/s	1976	Avg	1220	6540	5080												
		Max		19600	15200												
	Rev.	Avg	1326	8300	-												
		Max		22100	5530												
Prim.-Spec. wo/s	1976	Avg	1220	6540	5080												
		Max		19600	15200												
	Rev.	Avg	897	5610	-												
		Max		15000	3740												
Section-Carbon	1976	Avg	2626	24200	11000												
		Max		72600	33000												
	Rev.	Avg	2142	13400	-												
		Max		35700	8940												

TABLE 1-2
BPT EFFLUENT LIMITATIONS COMPARISON
PAGE 3

Subcategory			Dis-charge Flow (GPT)	BPT Effluent Limitations (kg/kkg x 10^{-5}) TSS	O&G	Ammonia	Phenol (4AAP)	Fe-D	CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	F	Toxic Organics 55	Toxic Organics 85
Section-Spec.	1976	Avg	2626	24200	11000												
		Max		72600	33000												
	Rev.	Avg	1344	8410	-												
		Max		22400	5610												
Flat-Carbon HS&S	1976	Avg	4180	33100	17400												
		Max		99800	52200												
	Rev.	Avg	2560	16000	-												
		Max		42700	10700												
Flat-Spec. HS&S	1976	Avg	4180	33100	17400												
		Max		99300	52200												
	Rev.	Avg	2560	16000	-												
		Max		42700	10700												
Flat-Carbon Plate	1976	Avg	4000	16700	16700												
		Max		50100	50100												
	Rev.	Avg	1360	8510	-												
		Max		22700	5670												
Flat-Spec. Plate	1976	Avg	9366	37600	37600												
		Max		113000	113000												
	Rev.	Avg	600	3750	-												
		Max		10000	2500												
Pipe & Tube-Carbon	1976	Avg	1002	14200	4180												
		Max		42600	12500												
	Rev.	Avg	1270	7950	-												
		Max		21200	5300												
Pipe & Tube-Spec.	1976	Avg	1002	14200	4180												
		Max		42600	12500												
	Rev.	Avg	1270	7950	-												
		Max		21200	5300												
Salt Bath Descaling																	
Ox.-Batch S&P(1)	1976	Avg	500	5210				209	52.1	10.4	104*						
		Max		15600				627	156	31.3	313*						
	Rev.	Avg	700	8760							117	87.6					
		Max		20400							292	263					
Ox.-Batch R/W/B(1)	1976	Avg	500	5210				209	52.1	10.4	104*						
		Max		15600				627	156	31.3	313*						
	Rev.	Avg	420	5260							70.1	52.6					
		Max		12300							175	158					
Ox.-Batch P&T(1)	1976	Avg	500	5210				209	52.1	10.4	104*						
		Max		15600				627	156	31.3	313*						
	Rev.	Avg	1700	21300							284	213					
		Max		49600							709	638					

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
PAGE 4

Subcategory		Discharge Flow (GPT)	BPT Effluent Limitations (kg/kkg x 10^{-5}) TSS	O&G	Ammonia	Phenol (4AAP)	Fe-D	CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	F	Toxic Organics 55	Toxic Organics 85
Ox.-Cont.[1]	1976 Avg	500	5210				209	52.1	10.4	104*						
	Max		15600				627	156	31.3	313*						
	Rev. Avg	330	4130							55.1	41.3					
	Max		9640							138	124					
Red.-Batch[2]	1976 Avg	1200	12500				501	125	25.0	250*						
	Max		37500				1500	375	75.1	751*						
	Rev. Avg	325	4070					33.9		54.2	40.7					
	Max		9490					102		136	122					
Red.-Cont.[2]	1976 Avg	1200	12500				501	125	25.0	250*						
	Max		37500				1500	375	75.1	751*						
	Rev. Avg	1820	22800					190		304	228					
	Max		53200					759		569	683					
Sulf. Acid Pickl.																
Batch & Continuous Acid Recovery	1976 Avg	0														
	Max															
	Rev. Avg	Subdivision Eliminated														
	Max															
Batch Neut.	1976 Avg	360	7510	1500[3]			150									
	Max		22500	4500[3]			450									
	Rev. Avg	Subdivision Eliminated														
	Max															
Cont. Neut. wo/SPL	1976 Avg	225	4690	939[3]			93.9									
	Max		14100	2820[3]			282									
	Rev. Avg	Subdivision Eliminated														
	Max															
Cont. Neut. w/SPL	1976 Avg	250	5210	1040[3]			104									
	Max		15600	3120[3]			313									
	Rev. Avg	Subdivision Eliminated														
	Max															
Strip/Sheet/Plate	1976 Avg	New Subdivision														
	Max															
	Rev. Avg	180	2250	751[3]								7.51	11.3			
	Max		5260	2250[3]								22.5	33.8			
Rod/Wire/Coil	1976 Avg	New Subdivision														
	Max															
	Rev. Avg	280	3500	1170[3]								11.7	17.5			
	Max		8180	3500[3]								35.0	52.6			

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
PAGE 5

Subcategory			Discharge Flow (GPT)	BPT Effluent Limitations (kg/kkg x 10^{-5}) TSS	O&G	Ammonia	Phenol (4AAP)	Fe-D	CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	F	Toxic Organics 55	85
Bar/Billet/Bloom	1976	Avg	New Subdivision														
		Max															
	Rev.	Avg	90	1130	375(3)								3.75	5.63			
		Max		2630	1130(3)								11.3	16.9			
Pipe/Tube/Other	1976	Avg	New Subdivision														
		Max															
	Rev.	Avg	500	6260	2090(3)								20.9	31.3			
		Max		14600	6260(3)								62.6	93.9			
Fume Scrub.(5)	1976	Avg	No Separate Limitations Proposed														
		Max															
	Rev.	Avg	15 GPM	245000	81900(3)								819	1230			
		Max		572000	245000(3)								2450	3680			
HCl Acid Pickl.																	
Cont. Neut. w/s	1976	Avg	280	5840	1170(3)			117									
		Max		17500	3510(3)			351									
	Rev.	Avg	Subdivision Eliminated														
		Max															
Cont. Neut. wo/s	1976	Avg	230	4800	960(3)			96.0									
		Max		14400	2880(3)			288									
	Rev.	Avg	Subdivision Eliminated														
		Max															
Cont. Regen. w/s	1976	Avg	450	9380	1870(3)			187									
		Max		28100	5610(3)			561									
	Rev.	Avg	Subdivision Eliminated														
		Max															
Cont. Regen. wo/s	1976	Avg	400	8340	1660(3)			166									
		Max		2500	4980(3)			498									
	Rev.	Avg	Subdivision Eliminated														
		Max															
Bat. Neut. w/s	1976	Avg	280	5840	1170(3)			117									
		Max		17500	3510(3)			351									
	Rev.	Avg	Subdivision Eliminated														
		Max															
Bat. Neut. wo/s	1976	Avg	230	4800	960(3)			96.0									
		Max		14400	2880(3)			288									
	Rev.	Avg	Subdivision Eliminated														
		Max															

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
PAGE 6

Subcategory			Discharge Flow (GPT)	BPT Effluent Limitations (kg/kkg x 10^{-5}) TSS	O&G	Ammonia	Phenol (4AAP)	Fe-D	CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	F	Toxic Organics 55	Toxic Organics 85
Strip/Sheet/Plate	1976	Avg	New Subdivision														
		Max															
	Rev.	Avg	280	3500	1170(3)								11.7	17.5			
		Max		8180	3500(3)								35.0	52.6			
Rod/Wire/Coil	1976	Avg	New Subdivision														
		Max															
	Rev.	Avg	490	6130	2040(3)								20.4	30.7			
		Max		14300	6130(3)								61.3	92.0			
Pipe, Tube & Other	1976	Avg	New Subdivision														
		Max															
	Rev.	Avg	1020	12800	4260(3)								42.6	63.8			
		Max		29800	12800(3)								128	191			
Regeneration(5)	1976	Avg	New Subdivision														
		Max															
	Rev.	Avg	100 GPM	1630000	545000(3)								5450	8190			
		Max		3810000	1630000(3)								16300	24500			
Fume Scrub.(5)	1976	Avg	No Separate Limitations Proposed														
		Max															
	Rev.	Avg	15 GPM	245000	81900(3)								819	1230			
		Max		572000	245000(3)								2450	3680			
Comb. Acid Pickl. Cont.	1976	Avg	1000	10400	4170(3)			417			209*	104*			6260		
		Max		31200	12500(3)			1250			627*	312*			18800		
	Rev.	Avg	1500	18800	6260(3)						250	188					
		Max		43800	18800(3)						626	563					
Bat., P & T	1976	Avg	700	7300	2920(3)			292			146*	73.0*			4380		
		Max		21900	8760(3)			876			438*	219*			13100		
	Rev.	Avg	770	9640	3210(3)						128	96.4					
		Max		22500	9640(3)						321	289					
Bat. Other	1976	Avg	200	2090	834(3)			83.4			41.7*	20.9*			1250		
		Max		6270	2500(3)			250			125*	62.7*			3750		
	Rev.	Avg	Subdivision eliminated														
		Max															
Bat. Strip/Sheet/ Plate	1976	Avg	New Subdivision														
		Max															
	Rev.	Avg	460	5760	1920(3)						76.8	57.6					
		Max		13400	5760(3)						192	173					

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
PAGE 7

Subcategory		Discharge Flow (GPT)	TSS	O&G	Ammonia	Phenol (4AAP)	Fe-D	CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	F	Toxic Organics 55	Toxic Organics 85
			BPT Effluent Limitations (kg/kkg x 10^{-5})													
Rod/Wire/Coil	1976 Avg		New Subdivision													
	Max															
	Rev. Avg	510	6380	2130[3]						85.1	63.8					
	Max		14900	6380[3]						213	191					
Bar/Billet/Bloom	1976 Avg		New Subdivision													
	Max															
	Rev. Avg	230	2880	960[3]						38.4	28.8					
	Max		6720	2880[3]						96.0	86.4					
Fume Scrubber[5]	1976 Avg		No separate limitations proposed													
	Max															
	Rev. Avg	15 GPM	245000	81900[3]						3270	2450					
	Max		572000	245000[3]						8190	7350					
Cold Forming CR-Single Recir.	1976 Avg	25	261	104			10.4[4]									
	Max		783	312			31.2[4]									
	Rev. Avg	5	62.6	20.9						0.83[7]	0.63[7]	0.21	0.31		-	-
	Max		125	52.2						2.09[7]	1.88[7]	0.63	0.94		0.21	0.31
CR-Multi Recirc.	1976 Avg	25	261	104			10.4[4]									
	Max		783	312			31.2[4]									
	Rev. Avg	25	313	104						4.17[7]	3.13[7]	1.04	1.56		-	-
	Max		626	261						10.4[7]	9.39[7]	3.13	4.69		1.04	1.56
CR-Comb.	1976 Avg	400	4170	1670			167[4]									
	Max		12500	5010			501[4]									
	Rev. Avg	300	3750	1250						50.1[7]	37.5[7]	12.5	18.8		-	-
	Max		7510	3130						125[7]	113[7]	37.5	56.3		12.5	18.8
CR-Single DA	1976 Avg	1000	10400	4170			417[4]									
	Max		31200	12500			1250[4]									
	Rev. Avg	90	1130	375						15.0[7]	11.3[7]	3.75	5.63		-	-
	Max		2250	939						37.5[7]	33.8[7]	11.3	16.9		3.75	5.63
CR-Multi DA	1976 Avg	1000	10400	4170			417									
	Max		31200	12500			1250									
	Rev. Avg	400	5010	1670						66.8[7]	50.1[7]		16.7	25.0	-	-
	Max		10000	4170						167[7]	150[7]		50.1	75.1	16.7	25.0
P&T	1976 Avg	1002	14200	4180												
	Max		42600	12500												
	Rev. Avg	0														
	Max															

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
PAGE 8

Subcategory		Discharge Flow (GPT)	BPT Effluent Limitations (kg/kkg x 10^{-5}) TSS	O&G	Ammonia	Phenol (4AAP)	Fe-D	CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	F	Toxic Organics 55	Toxic Organics 85
Alkaline Cleaning	1976 Avg	50	522				20.9			10.4*	5.22*					
Batch	Max		1570				62.6			31.3*	15.6*					
	Rev. Avg	250	3130	1040												
	Max		7300	3130												
Continuous	1976 Avg	50	522				20.9			10.4*	5.22*					
	Max		1570				62.6			31.3*	15.6*					
	Rev. Avg	350	4380	1460												
	Max		10200	4380												
Hot Coating	1976 Avg	1200	25000	7500					10.0[7]	1500		2500				
Galv-Strip/Sheet/	Max		75000	2250					30.0[7]	4500		7500				
Misc w/s	Rev. Avg		Separate Allowance Given for Fume Scrubber													
	Max															
Galv-Strip/Sheet/	1976 Avg	600	12500	3750					5.00[7]	750		1250				
Misc wo/s	Max		37500	11300					15.0[7]	2250		3750				
	Rev. Avg	600	7510	2500					5.01[7]			25.0	37.5			
	Max		17500	7510					15.0[7]			75.1	113			
Galv-Wire/Fast.	1976 Avg		No Separate Limitations Proposed for this Segment													
w/s	Max															
	Rev. Avg		Separate Allowance Given For Fume Scrubber													
	Max															
Galv-Wire/Fast.	1976 Avg		No Separate Limitations Proposed for this Segment													
wo/s	Max															
	Rev. Avg	2400	30000	10000					20.0[7]			100	150			
	Max		70100	30000					60.1[7]			300	451			
Terne-w/s	1976 Avg	1200	25000	7500									250			
	Max		75000	22500									750			
	Rev. Avg		Separate Allowance Given for Fume Scrubber													
	Max															
Terne-wo/s	1976 Avg	600	12500	3750									250			
	Max		37500	11300									750			
	Rev. Avg	600	7510	2500					5.01[7]			25.0	37.5			
	Max		17500	7510					15.0[7]			75.1	113			
Other Strip/Sheet	1976 Avg		No Separate Limitations Proposed for this Segment													
Misc w/s	Max															
	Rev. Avg		Separate Allowance Given For Fume Scrubber													
	Max															
Other-Wire/Fast.	1976 Avg		No Separate Limitations Proposed for this Segment													
Misc wo/s	Max															
	Rev. Avg	600	7510	2500					5.01[7]			25.0	37.5			
	Max		17500	7510					15.0[7]			75.1	113			

TABLE I-2
BPT EFFLUENT LIMITATIONS COMPARISON
PAGE 9

Subcategory			Dis-charge Flow (GPT)	TSS	O&G	Ammonia	Phenol (4AAP)	Fe-D	CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	F	Toxic Organics 55	Toxic Organics 85
				BPT Effluent Limitations (kg/kkg x 10^{-5})													
Other-Wire/Fast w/s	1976	Avg		No Separate Limitation Proposed for this Segment													
		Max															
	Rev.	Avg		Separate Allowance Given For Fume Scrubber													
		Max															
Other-Wire Fast wo/s	1976	Avg		No Separate Limitations Porposed for this Segment													
		Max															
	Rev.	Avg	2400	30000	10000					20.0[7]			100	150			
		Max		70100	30000					60.1[7]			300	451			
Fume Scrub.[5]	1976	Avg	No Separate Limitations Proposed for this Segment														
		Max															
	Rev.	Avg	100 GPM	1630000	545000					1090[7]			5450	8190			
		Max		3810000	1630000					3270[7]			16300	24500			

(1) Original limits were for the kolene scale removal subcategory.
(2) Original limits were for the hydride scale removal subcategory.
(3) This load is allowed only when these wastes are treated in combination with cold rolling mill wastes.
(4) This load is allowed only when these wastes are treated in combination with pickling wastes.
(5) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation. The loads are expressed in kg/day x 10^{-5}.
(6) This load shall be applied in lieu of those for lead and zinc when cold rolling wastewaters are treted with descaling or combination acid pickling wastewaters.
(7) This load shall apply only to those galvanizing operations which discharge wastewater from a chromate rinse.
* : Dissolved Metal

NOTE: pH is also regulated in all subcategories and is limited to 6.0 - 9.0 standard units.

TABLE I-3

BAT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY

Subcategory		Selected Option	Dis. Flow (GPT)	BAT Effluent Concentrations (mg/l) Ammonia	Chlor.	Phenol (4AAP)	Toxic Organics (4)	(55)	(73)	(85)	Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Cokemaking																
I&S-Bio.	Avg	1	153	25		0.05	-	-	-			5.5				
	Max			85		0.1	0.05	0.05	0.05			10				
I&S-Phy. Chem.	Avg	1	103	75		0.1	-	-	-							
	Max			150		0.2	0.05	0.05	0.05							
Merch.-Bio.	Avg	1	170	25		0.05	-	-	-			5.5				
	Max			85		0.1	0.05	0.05	0.05			10				
Merch.-Phy. Chem.	Avg	1	120	75		0.1	-	-	-			-				
	Max			150		0.2	0.05	0.05	0.05			-				
Beehive	Avg	BPT	0													
	Max															
Sintering	Avg	1	120	10	-	0.1						1	0.25		0.3	
	Max			30	0.5	0.2						2	0.75		0.9	
Ironmaking																
Iron	Avg	4	70	10	-	0.1						1	0.25		0.3	
	Max			30	0.5	0.2						2	0.75		0.9	
Ferromanganese	Avg	Reserved														
	Max															
Steelmaking																
BOF: Semi-wet	Avg	BPT	0													
	Max															
BOF: Wet-Open	Avg	2	110										0.3		0.45	
	Max												0.9		1.35	
BOF: Wet-Supp.	Avg	2	50										0.3		0.45	
	Max												0.9		1.35	
Open Hearth	Avg	2	110										0.3		0.45	
	Max												0.9		1.35	
EAF: Semi-wet	Avg	BPT	0													
	Max															
EAF: Wet	Avg	2	110										0.3		0.45	
	Max												0.9		1.35	
Vacuum Degassing	Avg	2	25										0.3		0.45	
	Max												0.9		1.35	
Continuous Casting	Avg	2	25										0.3		0.45	
	Max												0.9		1.35	
Hot Forming																
Prim.: C&S w/os	Avg	No BAT Selected														
	Max															
Prim.: C&S w/s	Avg	No BAT Selected														
	Max															
Sect.: Carb.	Avg	No BAT Selected														
	Max															
Sect.: Spec.	Avg	No BAT Selected														
	Max															

TABLE I-3
BAT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

Subcategory		Selected Option	Dis. Flow (GPT)	Ammonia	Chlor.	Phenol (4AAP)	Toxic Organics (4)	Toxic Organics (55)	Toxic Organics (73)	Toxic Organics (85)	Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Flat: HS&S (C&S)	Avg	No BAT Selected														
	Max															
Flat: Plate-Carb.	Avg	No BAT Selected														
	Max															
Flat: Plate-Spec.	Avg	No BAT Selected														
	Max															
P&T	Avg	No BAT Selected														
	Max															
Salt Bath-Descaling																
Ox.-Bat. S&P	Avg	BPT	700								0.4			0.3		
	Max										1.0			0.9		
Ox.-Bat. R&W	Avg	BPT	420								0.4			0.3		
	Max										1.0			0.9		
Ox.-Bat. P&T	Avg	BPT	1700								0.4			0.3		
	Max										1.0			0.9		
Ox.-Cont.	Avg	BPT	330								0.4			0.3		
	Max										1.0			0.9		
Red.-Bat.	Avg	BPT	325								0.4	0.25		0.3		
	Max										1.0	0.75		0.9		
Red.-Cont.	Avg	BPT	1820								0.4	0.25		0.3		
	Max										1.0	0.75		0.9		
Sulf. Acid Pickling																
Rod, Wire, Coil	Avg	BPT	280										0.15		0.1	
	Max												0.45		0.3	
Bar, Billet, Bloom	Avg	BPT	90										0.15		0.1	
	Max												0.45		0.3	
Strip, Sheet, Plate	Avg	BPT	180										0.15		0.1	
	Max												0.45		0.3	
Pipe, Tube & Other	Avg	BPT	500										0.15		0.1	
	Max												0.45		0.3	
Fume Scrub.(1)	Avg	BPT	15 GPM										0.15		0.1	
	Max												0.45		0.3	
HCl Acid Pickling																
Rod, Wire, Coil	Avg	BPT	490										0.15		0.1	
	Max												0.45		0.3	
Strip, Sheet, Plate	Avg	BPT	280										0.15		0.1	
	Max												0.45		0.3	
Pipe, Tube & Other	Avg	BPT	1020										0.15		0.1	
	Max												0.45		0.3	
Fume Scrub.(1)	Avg	BPT	15 GPM										0.15		0.1	
	Max												0.45		0.3	
Acid Regeneration	Avg	BPT	100 GPM										0.15		0.1	
	Max												0.45		0.3	

TABLE I-3
BAT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

Subcategory		Selected Option	Dis. Flow (GPT)	BAT Effluent Concentrations (mg/l) Ammonia	Chlor.	Phenol (4AAP)	Toxic Organics (4)	(55)	(73)	(85)	Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Comb-Acid Pickling																
Rod, Wire, Coil	Avg	BPT	510								0.4			0.3		
	Max										1.0			0.9		
Bar, Billet, Bloom	Avg	BPT	230								0.4			0.3		
	Max										1.0			0.9		
Cont-S, S&P	Avg	BPT	1500								0.4			0.3		
	Max										1.0			0.9		
Bat.-S, S&P	Avg	BPT	460								0.4			0.3		
	Max										1.0			0.9		
P&T & Oth.	Avg	BPT	770								0.4			0.3		
	Max										1.0			0.9		
Fume Scrub.[1]	Avg	BPT	15 GPM								0.4			0.3		
	Max										1.0			0.9		
Cold Forming																
CR: Recir-Single	Avg	BPT	5					-		-	0.4[2]		0.15	0.3[2]	0.1	
	Max							0.1		0.15	1.0[2]		0.45	0.9[2]	0.3	
CR: Recir-Multi.	Avg	BPT	25					-		-	0.4[2]		0.15	0.3[2]	0.1	
	Max							0.1		0.15	1.0[2]		0.45	0.9[2]	0.3	
CR: Comb.	Avg	BPT	300					-		-	0.4[2]		0.15	0.3[2]	0.1	
	Max							0.1		0.15	1.0[2]		0.45	0.9[2]	0.3	
CR: DA-Single	Avg	BPT	90					-		-	0.4[2]		0.15	0.3[2]	0.1	
	Max							0.1		0.15	1.0[2]		0.45	0.9[2]	0.3	
CR: DA-Multi.	Avg	BPT	400					-		-	0.4[2]		0.15	0.3[2]	0.1	
	Max							0.1		0.15	1.0[2]		0.45	0.9[2]	0.3	
P&T	Avg	BPT	0													
	Max															
Alkaline Cleaning																
Batch	Avg	No ~~BAT Selected~~ BPT														
	Max															
Continuous	Avg	No BAT Selected BPT														
	Max															
Hot Coating (all operations)																
S, S&Misc. wo/scrub	Avg	BPT	600										0.15		0.1	0.02[3]
	Max												0.45		0.3	0.06[3]
W/Fast wo/scrub	Avg	BPT	2400										0.15		0.1	0.02[3]
	Max												0.45		0.3	0.06[3]
Fume Scrub.[1]	Avg	1	15 GPM										0.15		0.1	0.02[3]
	Max												0.45		0.3	0.06[3]

TABLE I-3
BAT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 4

(1) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation.
(2) This pollutant shall apply in lieu of lead and zinc when cold rolling wastewaters are treated with descaling or combination acid pickling wastewaters.
(3) This pollutant shall apply only to those galvanizing operations which discharge wastewaters from a chromate rinse step.

TABLE I-4

BAT EFFLUENT LIMITATIONS SUMMARY
IRON & STEEL INDUSTRY

Subcategory		Selected Option	Discharge Flow (GPT)	BAT Effluent Limitations (kg/kkg x 10^{-5}) Ammonia	Chlorine	Phenol (4AAP)	Toxic Organics (4)	(55)	(73)	(85)	Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Cokemaking																
I&S-Bio.	Avg	1	153	1600		3.19	-	-	-			351				
	Max			5430		6.38	3.19	3.19	3.19			638				
I&S-Phy. Chem.	Avg	1	103	3220		4.30	-	-	-							
	Max			6450		8.59	2.15	2.15	2.15							
Merch.-Bio.	Avg	1	170	1770		3.55	-	-	-			390				
	Max			6030		7.09	3.55	3.55	3.55			709				
Merch.-Phy. Chem.	Avg	1	120	3750		5.01	-	-	-							
	Max			7510		10.0	2.50	2.50	2.50							
Beehive	Avg	BPT	0													
	Max															
Sintering	Avg	1	120	501	-	5.01						50.1	12.5		15.0	
	Max			1500	25.0	10.0						100	37.5		45.1	
Ironmaking																
Iron	Avg	4	70	292	-	2.92						29.2	7.30		8.76	
	Max			876	14.6	5.84						58.4	21.9		26.3	
Ferromanganese	Avg	Reserved														
	Max															
Steelmaking																
BOF: Semi-Wet	Avg	BPT	0													
	Max															
BOF: Wet-Open	Avg	2	110										13.8		20.7	
	Max												41.3		62.0	
BOF: Wet-Sup.	Avg	2	50										6.26		9.39	
	Max												18.8		28.2	
Open Hearth	Avg	2	110										13.8		20.7	
	Max												41.3		62.0	
EAF: Semi-Wet	Avg	BPT	0													
	Max															
EAF: Wet	Avg	2	110										13.8		20.7	
	Max												41.3		62.0	
Vaccum Degassing	Avg	2	25										3.13		4.69	
	Max												9.39		14.1	
Continuous Casting	Avg	2	25										3.13		4.69	
	Max												9.39		14.1	
Hot Forming																
Prim.: C&S/wos	Avg	No BAT Selected														
	Max															
Prim.: C&S/ws	Avg	No BAT Selected														
	Max															
Sect.: Carb.	Avg	No BAT Selected														
	Max															
Sect.: Spec.	Avg	No BAT Selected														
	Max															

TABLE 1-4
BAT EFFLUENT LIMITAITONS SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

				BAT Effluent Limitations (kg/kkg x 10^{-5})												
							Toxic Organics									
Subcategory		Selected Option	Discharge Flow (GPT)	Ammonia	Chlorine	Phenol (4AAP)	(4)	(55)	(73)	(85)	Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Flat: HS&S (C&S)	Avg	No BAT Selected														
	Max															
Flat: Plate-Carb.	Avg	No BAT Selected														
	Max															
Flat: Plate-Spec.	Avg	No BAT Selected														
	Max															
P&T	Avg	No BAT Selected														
	Max															
Salt Bath-Descal.																
Ox.: Bat. S&P	Avg	BPT	700								117			87.6		
	Max										292			263		
Ox.: Bat. R&W	Avg	BPT	420								70.1			52.6		
	Max										175			158		
Ox.: Bat. P&T	Avg	BPT	1700								284			213		
	Max										709			638		
Ox.: Cont.	Avg	BPT	330								55.1			41.3		
	Max										138			124		
Red.: Bat.	Avg	BPT	325								54.2	33.9		40.7		
	Max										136	102		122		
Red.: Cont.	Avg	BPT	1820								304	190		228		
	Max										759	569		683		
Sulf. Acid Pickl.																
Rod, Wire, Coil	Avg	BPT	280										17.5		11.7	
	Max												52.6		35.0	
Bar, Billet, Bloom	Avg	BPT	90										5.63		3.75	
	Max												16.9		11.3	
Strip, Sheet, Plate	Avg	BPT	180										11.3		7.51	
	Max												33.8		22.5	
Pipe, Tube & Other	Avg	BPT	500										31.3		20.9	
	Max												93.9		62.6	
Fume Scrub.(1)	Avg	BPT	15 gpm										1230		819	
	Max												3680		2450	
Comb. Acid Pickling																
Rod, Wire & Coil	Avg	BPT	510								85.1			63.8		
	Max										231			191		
Bar, Billet & Bloom	Avg	BPT	230								38.4			28.8		
	Max										96.0			86.4		
Cont. S, S&P	Avg	BPT	1500								250			188		
	Max										626			563		
Bat. S, S&P	Avg	BPT	460								76.8			57.6		
	Max										192			173		
Pipe, Tube & Other	Avg	BPT	770								128			96.4		
	Max										321			289		
Fume Scrub.(1)	Avg	BPT	15 gpm								3270			2450		
	Max										8190			7350		

TABLE I-4
BAT EFFLUENT LIMITATIONS SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

				BAT Effluent Limitations (kg/kkg x 10^{-5})												
Subcategory		Selected Option	Discharge Flow (GPT)	Ammonia	Chlorine	Phenol (4AAP)	Toxic Organics (4)	Toxic Organics (55)	Toxic Organics (73)	Toxic Organics (85)	Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
HCl Acid Pickling																
Rod, Wire & Coil	Avg	BPT	490										30.7		20.4	
	Max												92.0		61.3	
Strip, Sheet & Plate	Avg	BPT	280										17.5		11.7	
	Max												52.6		35.0	
Pipe, Tube & Other	Avg	BPT	1020										63.9		42.6	
	Max												191		128	
Fume Scrubber[1]	Avg	BPT	15 GPM										1230		819	
	Max												3680		2450	
Acid Regeneration(1)	Avg	BPT	100 GPM										8190		5450	
	Max												24500		16300	
Cold Forming																
CR: Recir-Sing	Avg	BPT	5					-		-	0.83[2]		0.31	0.63[2]	0.21	
	Max							0.21		0.31	2.09[2]		0.94	1.88[2]	0.63	
CR: Recir-Multi	Avg	BPT	25					-		-	4.17[2]		1.56	3.13[2]	1.04	
	Max							1.04		1.56	10.4[2]		4.69	9.39[2]	3.13	
CR: Comb.	Avg	BPT	300					-		-	50.1[2]		18.8	37.5[2]	12.5	
	Max							12.5		18.8	125[2]		56.3	113[2]	37.8	
CR: DA-Sing	Avg	BPT	90					-		-	15.0[2]		5.63	11.3[2]	3.75	
	Max							3.75		5.63	37.5[2]		16.9	33.8[2]	11.3	
CR: DA-Multi	Avg	BPT	400					-		-	66.8[2]		25.0	50.1[2]	16.7	
	Max							16.7		25.0	167[2]		75.1	150[2]	50.1	
P&T	Avg	BPT	0													
	Max															
Alkaline Cleaning																
Batch	Avg	No BAT Selected														
	Max															
Continuous	Avg	No BAT Selected														
	Max															
Hot Coat-inc. all coat																
S, S&Misc. wo/scrub	Avg	BPT	600										37.5		25.0	5.01[3]
	Max												113		75.1	15.0[3]
W/Fast wo/scrub	Avg	BPT	2400										150		100	20.0[3]
	Max												451		300	60.1[3]
Fume Scrub.[1]	Avg	1	15 GPM										1230		819	164
	Max												3680		2450	490

(1) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation. The load is expressed in kg/day x 10^{-5}.
(2) This pollutant shall apply in lieu of lead and zinc when cold rolling wastewaters are treated with descaling or combination acid pickling wastewaters.
(3) This pollutant shall apply only to those galvanizing operations which discharge wastewaters from a chromate rinse step.
(4) The absorber vent scrubber load is expressed in kg/day x 10^{-5}.

TABLE I-5

PSNS/NSPS CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY

Subcategory		Selected Option	Discharge Flow (GPT)	TSS[1]	O & G[1]	Ammonia	Chlorine[1]	Phenol (4AAP)	Toxic Organics (4)	(55)	(73)	(85)
				PSNS/NSPS Effluent Concentrations (mg/l)								
Cokemaking												
Iron & Steel I[2]	Avg	NSPS-1	153	140	-	25		0.05	-	-	-	
	Max			270	10	85		0.1	0.05	0.05	0.05	
Iron & Steel [3]	Avg	PSNS-1	103			75		50				
	Max					150		100				
Merchant[2]	Avg	NSPS-1	170	140	-	25		0.05	-	-	-	
	Max			270	10	85		0.1	0.05	0.05	0.05	
Merchant[3]	Avg	PSNS-1	120			75		50				
	Max					150		100				
Beehive	Avg	BPT	0									
	Max											
Sintering	Avg	NSPS-1	120	15	-	10	-	0.1				
	Max	PSNS-2		40	10	30	0.5	0.2				
Ironmaking												
Iron	Avg	NSPS-5	70	15		10	-	0.1				
	Max	PSNS-5		40	10	30	0.5	0.2				
Ferromanganese	Avg	Reserved										
	Max											
Steelmaking												
BOF: Semi-wet	Avg	Reserved										
	Max											
BOF: Wet-Open	Avg	NSPS-2	110	25								
	Max	PSNS-3		70								
BOF: Wet-Supp.	Avg	NSPS-2	50	25								
	Max	PSNS-3		70								
Open Hearth - Wet	Avg	NSPS-2	110	25								
	Max	PSNS-3		70								
EAF: Semi-wet	Avg	Reserved										
	Max											
EAF: Wet	Avg	NSPS-2	110	25								
	Max	PSNS-3		70								
Vacuum Degassing	Avg	NSPS-3	25	25								
	Max	PSNS-3		70								
Continuous Casting	Avg	NSPS-3	25	25	10							
	Max	PSNS-3		70	30							
Hot Forming												
Prim.: C&S w/os[2]	Avg	NSPS-1	90	15	-							
	Max			40	10							
Prim.: C&S w/s[2]	Avg	NSPS-1	140	15	-							
	Max			40	10							
Sect.: Carb.[2]	Avg	NSPS-1	200	15	-							
	Max			40	10							
Sect.: Spec.[2]	Avg	NSPS-1	130	15	-							
	Max			40	10							
Flat: HS&S (C&S)[2]	Avg	NSPS-1	260	15	-							
	Max			40	10							
Flat: Plate-Carb.[2]	Avg	NSPS-1	140	15	-							
	Max			40	10							
Flat: Plate-Spec.[2]	Avg	NSPS-1	60	15	-							
	Max			40	10							
P&T[2]	Avg	NSPS-1	220	15	-							
	Max			40	10							

TABLE I-5
PSNS/NSPS CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 1 CONT.

Subcategory		PSNS/NSPS Effluent Concentrations (mg/l) Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Cokemaking							
Iron & Steel 1[2]	Avg		5.5				
	Max		10				
Iron & Steel [3]	Avg		20				
	Max		40				
Merchant[2]	Avg		5.5				
	Max		10				
Merchant[3]	Avg		20				
	Max		40				
Beehive	Avg						
	Max						
Sintering	Avg		1	0.25		0.3	
	Max		2	0.75		0.9	
Ironmaking							
Iron	Avg		1	0.25		0.3	
	Max		2	0.75		0.9	
Ferromanganese	Avg						
	Max						
Steelmaking							
BOF: Semi-wet	Avg						
	Max						
BOF: Wet-Open	Avg			0.3		0.45	
	Max			0.9		1.35	
BOF: Wet-Supp.	Avg			0.3		0.45	
	Max			0.9		1.35	
Open Hearth - Wet	Avg			0.3		0.45	
	Max			0.9		1.35	
EAF: Semi-wet	Avg						
	Max						
EAF: Wet	Avg			0.3		0.45	
	Max			0.9		1.35	
Vacuum Degassing	Avg			0.3		0.45	
	Max			0.9		1.35	
Continuous Casting	Avg			0.3		0.45	
	Max			0.9		1.35	
Hot Forming							
Prim.: C&S w/os[2]	Avg						
	Max						
Prim.: C&S w/s[2]	Avg						
	Max						
Sect.: Carb.[2]	Avg						
	Max						
Sect.: Spec.[2]	Avg						
	Max						
Flat: HS&S (C&S)[2]	Avg						
	Max						
Flat: Plate-Carb.[2]	Avg						
	Max						
Flat: Plate-Spec.[2]	Avg						
	Max						
P&T[2]	Avg						
	Max						

TABLE I-5
PSNS/NSPS CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

Subcategory		Selected Option	Discharge Flow (GPT)	PSNS/NSPS Effluent Concentrations (mg/l) TSS(1)	O & G(1)	Ammonia	Chlorine(1)	Phenol (4AAP)	Toxic Organics (4)	(55)	(73)	(85)
Salt Bath-Descal.												
Ox.-Bat. S&P	Avg	NSPS-1	280	30								
	Max	PSNS-1		70								
Ox.-Bat. R&W	Avg	NSPS-1	170	30								
	Max	PSNS-1		70								
Ox.-Bat. P&T	Avg	NSPS-1	1450	30								
	Max	PSNS-1		70								
Ox. -Cont.	Avg	NSPS-1	225	30								
	Max	PSNS-1		70								
Red.-Bat.	Avg	NSPS-1	100	30								
	Max	PSNS-1		70								
Red.-Cont	Avg	NSPS-1	1800	30								
	Max	PSNS-1		70								
Sulfuric Acid Pickling												
Rod, Wire, Coil	Avg	NSPS-1	50	30	10(4)							
	Max	PSNS-1		70	30(4)							
Bar, Billet, Bloom	Avg	NSPS-1	30	30	10(4)							
	Max	PSNS-1		70	30(4)							
Strip, Sheet, Plate	Avg	NSPS-1	40	30	10(4)							
	Max	PSNS-1		70	30(4)							
P&T & Oth.	Avg	NSPS-1	70	30	10(4)							
	Max	PSNS-1		70	30(4)							
Fume Scrub.(5)	Avg	NSPS-1	15 GPM	30	10(4)							
	Max	PSNS-1		70	30(4)							
HCl Acid Pickling												
Rod, Wire, Coil	Avg	NSPS-1	60	30	10(4)							
	Max	PSNS-1		70	30(4)							
Strip, Sheet & Plate	Avg	NSPS-1	40	30	70(4)							
	Max	PSNS-1		70	30(4)							
Pipe, Tube & Other	Avg	NSPS-1	110	30	10(4)							
	Max	PSNS-1	70	30(4)								
Fume Scrubber(5)	Avg	NSPS-1	15 GPM	30	10(4)							
	Max	PSNS-1		70	30(4)							
Combination Acid Pickling												
Rod, Wire, Coil	Avg	NSPS-1	70	30	10(4)							
	Max	PSNS-1	70	30(4)								
Bar, Billet, Bloom	Avg	NSPS-1	40	30	10(4)							
	Max	PSNS-1	70	30(4)								
Cont-S, S&P	Avg	NSPS-1	170	30	10(4)							
	Max	PSNS-1		70	30(4)							
Bat.-S, S&P	Avg	NSPS-1	60	30	10(4)							
	Max	PSNS-1		70	30(4)							
P&T & Oth.	Avg	NSPS-1	100	30	10(4)							
	Max	PSNS-1		70	30(4)							
Fume Scrub.(5)	Avg	NSPS-1	15 GPM	30	10(4)							
	Max	PSNS-1	70	30(4)								
Cold Forming												
CR: Recir-Sing	Avg	NSPS-1	5	30	10					-		-
	Max	PSNS-1		60	25					0.1		0.15
CR: Recir-Multi	Avg	NSPS-1	10	30	10					-		-
	Max	PSNS-1		60	25					0.1		0.15
CR: Comb.	Avg	NSPS-1	130	30	10					-		-
	Max	PSNS-1		60	25					0.1		0.15

TABLE I-5
PSNS/NSPS CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 2 CONT.

Subcategory		PSNS/NSPS Effluent Concentrations (mg/l) Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Salt Bath-Descal.							
Ox.-Bat. S&P	Avg	0.4			0.3		
	Max	1.0			0.9		
Ox.-Bat. R&W	Avg	0.4			0.3		
	Max	1.0			0.9		
Ox.-Bat. P&T	Avg	0.4			0.3		
	Max	1.0			0.9		
Ox. -Cont.	Avg	0.4			0.3		
	Max	1.0			0.9		
Red.-Bat.	Avg	0.4	0.25		0.3		
	Max	1.0	0.75		0.9		
Red.-Cont	Avg	0.4	0.25		0.3		
	Max	1.0	0.75		0.9		
Sulfuric Acid Pickling							
Rod, Wire, Coil	Avg			0.15		0.1	
	Max			0.45		0.3	
Bar, Billet, Bloom	Avg			0.15		0.1	
	Max			0.45		0.3	
Strip, Sheet, Plate	Avg			0.15		0.1	
	Max			0.45		0.3	
P&T & Oth.	Avg			0.15		0.1	
	Max			0.45		0.3	
Fume Scrub.[5]	Avg			0.15		0.1	
	Max			0.45		0.3	
HCl Acid Pickling							
Rod, Wire, Coil	Avg			0.15		0.1	
	Max			0.45		0.3	
Strip, Sheet & Plate	Avg			0.15		0.1	
	Max			0.45		0.3	
Pipe, Tube & Other	Avg			0.15		0.1	
	Max			0.45		0.3	
Fume Scrubber[5]	Avg			0.15		0.1	
	Max			0.45		0.3	
Combination Acid Pickling							
Rod, Wire, Coil	Avg	0.4			0.3		
	Max	1.0			0.9		
Bar, Billet, Bloom	Avg	0.4			0.3		
	Max	1.0			0.9		
Cont-S, S&P	Avg	0.4			0.3		
	Max	1.0			0.9		
Bat.-S, S&P	Avg	0.4			0.3		
	Max	1.0			0.9		
P&T & Oth.	Avg	0.4			0.3		
	Max	1.0			0.9		
Fume Scrub.[5]	Avg	0.4			0.3		
	Max	1.0			0.9		
Cold Forming							
CR: Recir-Sing	Avg	0.4[6]		0.15	0.3	0.1	
	Max	1.0[6]		0.45	0.9	0.3	
CR: Recir-Multi	Avg	0.4[6]		0.15	0.3	0.1	
	Max	1.0[6]		0.45	0.9	0.3	
CR: Comb.	Avg	0.4[6]		0.15	0.3	0.1	
	Max	1.0[6]		0.45	0.9	0.3	

TABLE I-5
PSNS/NSPS CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

Subcategory		Selected Option	Discharge Flow (GPT)	PSNS/NSPS Effluent Concentrations (mg/l) TSS[1]	O & G[1]	Ammonia	Chlorine[1]	Phenol (4AAP)	Toxic Organics (4)	(55)	(73)	(85)
Cold Forming Cont.												
CR: DA-Sing.	Avg	NSPS-1	25	30	10					-		-
	Max	PSNS-1		60	25					0.1		0.15
CR: DA-Multi.	Avg	NSPS-1	290	30	10					-		-
	Max	PSNS-1		60	25					0.1		0.15
P&T	Avg	BPT	0									
	Max											
Alkaline Cleaning[2] Batch & Cont.	Avg	NSPS-1	50	30	10							
	Max			70	30							
Hot Coating Inc. all coat												
S, S&Misc. wo/scrub.	Avg	NSPS-1	150	30	10							
	Max	PSNS-1		70	30							
W/Fast wo/scrub	Avg	NSPS-1	600	30	10							
	Max	PSNS-1		70	30							
Fume Scrub.[5]	Avg	NSPS-1	15 GPM	30	10							
	Max	PSNS-1		70	30							

TABLE I-5
PSNS/NSPS CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 3 CONT.

Subcategory		PSNS/NSPS Effluent Concentrations (mg/l) Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Cold Forming Cont.							
CR: DA-Sing.	Avg	0.4(6)		0.15	0.3(6)	0.1	
	Max	1.0(6)		0.45	0.9(6)	0.3	
CR: DA-Multi.	Avg	0.4(6)		0.15	0.3(6)	0.1	
	Max	1.0(6)		0.45	0.9(6)	0.3	
P&T	Avg						
	Max						
Alkaline Cleaning(2)							
Batch & Cont.	Avg						
	Max						
Hot Coating (All coating operations)							
S, S&Misc. wo/scurb.	Avg			0.15		0.1	0.02(7)
	Max			0.45		0.3	0.06(7)
W/Fast wo/scrub	Avg			0.15		0.1	0.02(7)
	Max			0.45		0.3	0.06(7)
Fume Scrub.(5)	Avg			0.15		0.1	0.02(7)
	Max			0.45		0.3	0.06(7)

NOTE: pH is also regulated in all subcategories and is limited to 6.0 - 9.0 standard units.

(1) This pollutant is limited only at NSPS.
(2) These values apply to the NSPS treatment level.
(3) These values apply to the PSNS treatment level.
(4) This pollutant is allowed only when these wastes are treated in combination with cold rolling mill wastes.
(5) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation.
(6) This pollutant shall apply in lieu of lead and zinc when cold rolling wastewaters are treated with descaling or combination acid pickling wastewaters.
(7) This pollutant shall apply only to those galvanizing operations which discharge wastewaters from a chromate rinse step.

TABLE I-6

PSNS/NSPS SUMMARY
IRON & STEEL INDUSTRY

Subcategory		Selected Option	Discharge Flow (GPT)	PSNS/NSPS ($kg/kkg \times 10^{-5}$) TSS(1)	O & G(1)	Ammonia	Chlorine(1)	Phenol (4AAP)	Toxic Organics (4)	(55)	(73)	(85)
Cokemaking												
Iron & Steel(2)	Avg	NSPS-1	153	8940	-	1600		3.19	-	-	-	
	Max			17200	638	5430		6.38	3.19	3.19	3.19	
Iron & Steel(3)	Avg	PSNS-1	103			3220		2150				
	Max					6450		4390				
Merchant(2)	Avg	NSPS-1	170	9930	-	1770		3.55	-	-	-	
	Max			19200	709	6030		7.09	3.55	3.55	3.55	
Merchant(3)	Avg	PSNS-1	120			3750		2500				
	Max					7510		5010				
Beehive	Avg	BPT Only										
	Max											
Sintering	Avg	NSPS-1	120	751	-	501	-	5.01				
	Max	PSNS-2		2000	501	1500	25.0	10.0				
Ironmaking												
Iron	Avg	NSPS-5	70	438	-	292	-	2.92				
	Max	PSNS-5		1170	292	876	14.6	5.84				
Ferromanganese	Avg	Reserved										
	Max											
Steelmaking												
BOF:Semi-Wet	Avg	Reserved										
	Max											
BOF:Wet-Open Combustion	Avg	NSPS-2	110	1150								
	Max	PSNS-3		3210								
BOF:Wet-Supp. Combustion	Avg	NSPS-2	50	522								
	Max	PSNS-3		1460								
Open Hearth-Wet	Avg	NSPS-2	110	1150								
	Max	PSNS-3		3210								
EAF:Semi-Wet	Avg	Reserved										
	Max											
EAF:Wet	Avg	NSPS-2	110	1150								
	Max	PSNS-3		3210								
Vacuum Degassing	Avg	NSPS-1	25	261								
	Max	PSNS-2		730								
Continuous Casting	Avg	NSPS-1	25	261	104							
	Max	PSNS-1		730	313							
Hot Forming												
Prim.: C&S w/os	Avg	NSPS-1	90	563	-							
	Max			1500	375							
Prim: C&S w/s	Avg	NSPS-1	140	876	-							
	Max			2340	584							
Sect: Carb.	Avg	NSPS-1	200	1250	-							
	Max			3340	834							
Sect: Spec.	Avg	NSPS-1	130	814	-							
	Max			2170	542							
Flat: HS&S (C&S)	Avg	NSPS-1	260	1630	-							
	Max			4340	1080							
Flat: Plate-Carb.	Avg	NSPS-1	140	876	-							
	Max			2340	584							
Flat: Plate-Spec.	Avg	NSPS-1	60	375	-							
	Max			1000	250							
Pipe & Tube	Avg	NSPS-1	220	1380	-							
	Max			3670	918							

TABLE I-6
PSNS/NSPS SUMMARY
IRON & STEEL INDUSTRY
PAGE 1 CONT.

Subcategory		PSNS/NSPS ($kg/kkg \times 10^{-5}$) Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Cokemaking							
Iron & Steel[2]	Avg		351				
	Max		638				
Iron & Steel[3]	Avg		859				
	Max		1720				
Merchant[2]	Avg		390				
	Max		709				
Merchant[3]	Avg		1000				
	Max		2000				
Beehive	Avg						
	Max						
Sintering	Avg		50.1	12.5		15.0	
	Max		100	37.5		45.1	
Ironmaking							
Iron	Avg		29.2	7.30		8.76	
	Max		58.4	21.9		26.3	
Ferromanganese	Avg						
	Max						
Steelmaking							
BOF: Semi-Wet	Avg						
	Max						
BOF: Wet-Open Combustion	Avg			13.8		20.7	
	Max			41.3		62.0	
BOF:Wet-Supp. Combustion	Avg			6.26		9.39	
	Max			18.8		28.2	
Open Hearth Wet	Avg			13.8		20.7	
	Max			41.3		62.0	
EAF: Semi-Wet	Avg						
	Max						
EAF: Wet	Avg			13.8		20.7	
	Max			41.3		62.0	
Vacuum Degassing	Avg			3.13		4.69	
	Max			9.39		14.1	
Continuous Casting	Avg			3.13		4.69	
	Max			9.39		14.1	
Hot Forming							
Prim.: C&S w/os	Avg						
	Max						
Prim.: C&S w/s	Avg						
	Max						
Sect.: Carb.	Avg						
	Max						
Sect.: Spec.	Avg						
	Max						
Flat: HS&S (C&S)	Avg						
	Max						
Flat: Plate-Carb.	Avg						
	Max						
Flat: Plate-Spec.	Avg						
	Max						
Pipe & Tube	Avg						
	Max						

TABLE I-6
PSNS/NSPS SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

Subcategory		Selected Option	Discharge Flow (GPT)	PSNS/NSPS (kg/kkg x 10^{-5}) TSS[1]	O & G[1]	Ammonia	Chlorine[1]	Phenol (4AAP)	Toxic Organics (4)	(55)	(73)	(85)
Salt Bath-Descal.												
Ox.-Bat. S&P	Avg	NSPS-1	700	8760								
	Max	PSNS-1		20400								
Ox.-Bat. R&W	Avg	NSPS-1	420	5260								
	Max	PSNS-1		12300								
Ox.-Bat. P&T	Avg	NSPS-1	1700	21300								
	Max	PSNS-1		49600								
Ox.-Cont.	Avg	NSPS-1	330	4130								
	Max	PSNS-1		9640								
Red.-Bat.	Avg	NSPS-1	325	4070								
	Max	PSNS-1		9490								
Red.-Cont.	Avg	NSPS-1	1820	22800								
	Max	PSNS-1		53200								
Sulf. Acid Pickl.												
Rod, Wire, Coil	Avg	NSPS-1	50	626	209[4]							
	Max	PSNS-1		1460	626[4]							
Bar, Billet, Bloom	Avg	NSPS-1	30	375	125[4]							
	Max	PSNS-1		876	375[4]							
Strip, Sheet, Plate	Avg	NSPS-1	40	501	167[4]							
	Max	PSNS-1		1170	501[4]							
Pipe, Tube & Other	Avg	NSPS-1	70	876	292[4]							
	Max	PSNS-1		2040	876[4]							
Fume Scrubber[5]	Avg	NSPS-1	15 GPM	245000	81900[4]							
	Max	PSNS-1		572000	245000[4]							
HCl Acid Pickl.												
Rod, Wire, Coil	Avg	NSPS-1	60	751	250[4]							
	Max	PSNS-1		1750	751[4]							
Strip, Sheet, Plate	Avg	NSPS-1	40	501	167[4]							
	Max	PSNS-1		1170	501[4]							
Pipe, Tube & Other	Avg	NSPS-1	110	1380	459[4]							
	Max	PSNS-1		3210	1380[4]							
Fume Scrubber.[5]	Avg	NSPS-1	15 GPM	245000	81900[4]							
	Max	PSNS-1		572000	245000[4]							
Comb-Acid Pickl.												
Rod, Wire, Coil	Avg	NSPS-1	70	876	292[4]							
	Max	PSNS-1		2040	876[4]							
Bar, Billet, Bloom	Avg	NSPS-1	40	501	167[4]							
	Max	PSNS-1		1170	501[4]							
Cont.-S, S&P	Avg	NSPS-1	170	2130	709[4]							
	Max	PSNS-1		4960	2130[4]							
Bat.-S, S&P	Avg	NSPS-1	60	751	250[4]							
	Max	PSNS-1		1750	751[4]							
Pipe, Tube & Other	Avg	NSPS-1	100	1250	417[4]							
	Max	PSNS-1		2920	1250[4]							
Fume Scrubber[5]	Avg	NSPS-1	15 GPM	245000	81900[4]							
	Max	PSNS-1		572000	245000[4]							
Cold Forming												
CR: Recir-Sing.	Avg	NSPS-1	5	62.6	20.9					-		-
	Max	PSNS-1		125	52.2					0.21		0.31
CR: Recir-Multi.	Avg	NSPS-1	10	125	41.7					-		-
	Max	PSNS-1		250	104					0.42		0.63
CR: Comb.	Avg	NSPS-1	130	1630	542					-		-
	Max	PSNS-1		3250	1360					5.42		8.13

TABLE I-6
PSNS/NSPS SUMMARY
IRON & STEEL INDUSTRY
PAGE 2 CONT.

Subcategory		PSNS/NSPS (kg/kkg x 10^{-5}) Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Salt Bath-Descal.							
Ox.-Bat. S&P	Avg	117			87.6		
	Max	292			263		
Ox.-Bat. R&W	Avg	70.1			52.6		
	Max	175			158		
Ox.-Bat. P&T	Avg	284			213		
	Max	709			638		
Ox.-Bat. Cont.	Avg	55.1			41.3		
	Max	138			124		
Red.-Bat.	Avg	54.2	33.9		40.7		
	Max	136	102		122		
Red.Cont.	Avg	304	190		228		
	Max	759	569		683		
Sulf. Acid Pickl.							
Rod, Wire, Coil	Avg			3.13		2.09	
	Max			9.39		6.26	
Bar, Billet, Bloom	Avg			1.88		1.25	
	Max			5.63		3.75	
Strip, Sheet, Plate	Avg			2.50		1.67	
	Max			7.51		5.01	
Pipe, Tube & Other	Avg			4.38		2.92	
	Max			13.1		8.76	
Fume Scrubber[5]	Avg			1230		819	
	Max			3680		2450	
HCl Acid Pickl.							
Rod, Wire, Coil	Avg			3.75		2.50	
	Max			11.3		7.51	
Strip, Sheet, Plate	Avg			2.50		1.67	
	Max			7.51		5.01	
Pipe, Tube & Other	Avg			6.88		4.59	
	Max			20.7		13.8	
Fume Scrubber[5]	Avg			1230		819	
	Max			3680		2450	
Comb-Acid Pickl.							
Rod, Wire, Coil	Avg	11.7			8.76		
	Max	29.2			26.3		
Bar, Billet, Bloom	Avg	6.68			5.01		
	Max	16.7			15.0		
Cont.-S, S&P	Avg	28.4			21.3		
	Max	70.9			63.8		
Bat.-S, S&P	Avg	10.0			7.51		
	Max	25.0			22.5		
Pipe, Tube & Other	Avg	16.7			12.5		
	Max	41.7			37.5		
Fume Scrubber[5]	Avg	3270			2450		
	Max	8190			7350		
Cold Forming							
CR: Recir-Sing.	Avg	0.83[6]		0.31	0.63[6]	0.21	
	Max	2.09[6]		0.94	1.88[6]	0.63	
CR: Recir-Multi.	Avg	1.67[6]		0.63	1.25[6]	0.42	
	Max	4.17[6]		1.88	3.75[6]	1.25	
CR: Comb.	Avg	21.7[6]		8.14	16.3[6]	5.42	
	Max	54.2[6]		24.4	48.8[6]	16.3	

TABLE I-6
PSNS/NSPS SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

Subcategory		Selected Option	Discharge Flow (GPT)	PSNS/NSPS (kg/kkg x 10^{-5}) TSS(1)	O & G(1)	Ammonia	Chlorine(1)	Phenol (4AAP)	(4)	Toxic Organics (55)	(73)	(85)
Cold Forming												
CR: DA-Sing.	Avg	NSPS-1	25	313	104					-		-
	Max	PSNS-1		626	261					1.04		1.56
CR: DA-Multi.	Avg	NSPS-1	290	3630	1210					-		-
	Max	PSNS-1		7260	3020					12.1		18.1
Pipe & Tube	Avg	BPT Only										
	Max											
Alkaline Cleaning(2)												
Bat. & Cont.	Avg	NSPS-1	50	626	209							
	Max			1460	626							
Hot Coating-inc. all coat												
S, S&Misc. wo/scrub	Avg	NSPS-1	150	1880	626							
	Max	PSNS-1		4380	1880							
W/Fast wo/scrub	Avg	NSPS-1	600	7510	2500							
	Max	PSNS-1		17500	7510							
Fume Scrubber(5)	Avg	NSPS-1	15 GPM	245000	81900							
	Max	PSNS-1		572000	245000							

TABLE 1-6
PSNS/NSPS SUMMARY
IRON & STEEL INDUSTRY
PAGE 3 CONT.

Subcategory		PSNS/NSPS (kg/kkg x 10^{-5}) Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Cold Forming							
CR: DA-Sing.	Avg	4.17(6)		1.56	3.13(6)	1.04	
	Max	10.4(6)		4.69	9.39(6)	3.13	
CR: DA-Multi.	Avg	48.4(6)		18.1	36.3(6)	12.1	
	Max	121(6)		54.4	109(6)	36.3	
Pipe & Tube	Avg						
	Max						
Alkaline Cleaning							
Bat. & Cont.	Avg						
	Max						
Hot Coat-inc. all coat							
S, S&Misc. wo/scrub	Avg			9.39		6.26	1.25(7)
	Max			28.2		18.8	3.75(7)
W/Fast wo/scrub	Avg			37.5		25.0	5.01(7)
	Max			113		75.1	15.0(7)
Fume Scrubbers(5)	Avg			1230		819	163(7)
	Max			3680		2450	490(7)

NOTE: pH is also regulated in all subcategories and is limited to 6.0 - 9.0 standard units.

(1) This pollutant applies only to the NSPS treatment level.

(2) These values apply to the NSPS treatment level.

(3) These values apply to the PSNS treatment level.

(4) This load is allowed only when these wastes are treated in combination with cold rolling mill wastes.

(5) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation. The load is expressed in kg/day x 10^{-5}.

(6) This load shall be applied in lieu of those for lead and zinc when cold rolling wastewaters are treated with descaling or combination acid pickling wastewaters.

(7) The load for hexavalent chromium shall apply only to those galvanizing operations which discharge wastewater from a chromate rinse step.

TABLE I-7

PSES CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY

Subcategory		Option Selected	Dis-charge Flow (GPT)	PSES Effluent Concentration (mg/l)									
				Ammonia	Phenal (4AAP)	CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	Toxic Organics 55	85
Cokemaking													
Iron & Steel	Avg	1	103	75	50	20							
	Max			150	100	40							
Merchant	Avg	1	120	75	50	20							
	Max			150	100	40							
Beehive	Avg	BPT	0										
	Max												
Sintering	Avg	2	120	10	0.1	1				0.3	0.25		
	Max			30	0.2	2				0.9	0.75		
Ironmaking													
Iron	Avg	5	70	10	0.1	1				0.3	0.25		
	Max			30	0.2	2				0.9	0.75		
Ferromanganese	Avg	Reserved											
	Max												
Steelmaking													
BOF:Semi-Wet	Avg	BPT	0										
	Max												
BOF:Wet-Open Combustion	Avg	3	110							0.45	0.3		
	Max									1.35	0.9		
BOF:Wet-Suppressed Combustion	Avg	3	50							0.45	0.3		
	Max									1.35	0.9		
Open Hearth-Wet	Avg	3	110							0.45	0.3		
	Max									1.35	0.9		
Elec. Arc Furnace: Semi-Wet	Avg	BPT	0										
	Max												
Elec. Arc Furnace: Wet	Avg	3	110							0.45	0.3		
	Max									1.35	0.9		
Vacuum Degassing	Avg	2	25							0.45	0.3		
	Max									1.35	0.9		
Continuous Casting	Avg	2	25							0.45	0.3		
	Max									1.35	0.9		

TABLE I-7
PSES CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 2

Subcategory		Option Selected	Discharge Flow (GPT)	PSES Effluent Concentration (mg/l): Ammonia	Phenol (4AAP)	Organics CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	Toxic Organics 55	Toxic Organics 85
Hot Forming													
Primary:Carbon & Spec. w/o scarf.	Avg Max	Subject to General Pretreatment Standards											
Primary:Carbon & Spec. w/ scarf.	Avg Max	Subject to General Pretreatment Standards											
Section:Carbon	Avg Max	Subject to General Pretreatment Standards											
Section: Specialty	Avg Max	Subject to General Pretreatment Standards											
Flat:Hot Strip & Sheet (Carbon & Specialty)	Avg Max	Subject to General Pretreatment Standards											
Flat:Plate-Carbon	Avg Max	Subject to General Pretreatment Standards											
Flat:Plate-Spec.	Avg Max	Subject to General Pretreatment Standards											
Pipe & Tube	Avg Max	Subject to General Pretreatment Standards											
Salt Bath Descaling													
Oxidizing-Batch, Sheet & Plate	Avg	1	700					0.4	0.3				
	Max							1.0	0.9				
Oxidizing-Batch, Rod & Wire	Avg	1	420					0.4	0.3				
	Max							1.0	0.9				
Oxidizing-Batch, Pipe & Tube	Avg	1	1700					0.4	0.3				
	Max							1.0	0.9				
Oxidizing-Cont.	Avg	1	330					0.4	0.3				
	Max							1.0	0.9				
Reducing-Batch	Avg	1	325		0.25			0.4	0.3				
	Max				0.75			1.0	0.9				
Reducing-Continuous	Avg	1	1820		0.25			0.4	0.3				
	Max				0.75			1.0	0.9				

TABLE I-7
PSES CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 3

Subcategory		Option Selected	Dis-charge Flow (GPT)	Ammonia	Phenol (4AAP)	Organics CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	Toxic Organics 55	Toxic Organics 85
				PSES Effluent Concentration (mg/l)									
Sulfuric Acid Pickl.													
Rod, Wire & Coil	Avg	1	280							0.1	0.15		
	Max									0.3	0.45		
Bar, Billet & Bloom	Avg	1	90							0.1	0.15		
	Max									0.3	0.45		
Strip, Sheet & Plate	Avg	1	180							0.1	0.15		
	Max									0.3	0.45		
Pipe, Tube & Other	Avg	1	500							0.1	0.15		
	Max									0.3	0.45		
Fume Scrubber(1)	Avg	1	15 GPM							0.1	0.15		
	Max									0.3	0.45		
HCl Acid Pickl.													
Rod, Wire & Coil	Avg	1	490							0.1	0.15		
	Max									0.3	0.45		
Strip, Sheet & Plate	Avg	1	280							0.1	0.15		
	Max									0.3	0.45		
Pipe, Tube & Other	Avg	1	1020							0.1	0.15		
	Max									0.3	0.45		
Fume Scrubber(1)	Avg	1	15 GPM							0.1	0.15		
	Max									0.3	0.45		
Acid Regeneration	Avg	1	100 GPM							0.1	0.15		
	Max									0.3	0.45		
Combination Acid Pickl.													
Rod, Wire & Coil	Avg	1	510					0.4	0.3				
	Max							1.0	0.9				
Bar, Billet & Bloom	Avg	1	230					0.4	0.3				
	Max							1.0	0.9				
Cont.-Strip, Sheet Sheet & Plate	Avg	1	1500					0.4	0.3				
	Max							1.0	0.9				
Batch-Strip, Sheet & Plate	Avg	1	460					0.4	0.3				
	Max							1.0	0.9				

TABLE I-7
PSES CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 4

Subcategory		Option Selected	Discharge Flow (GPT)	PSES Effluent Concentration (mg/l) Ammonia	Phenol (4AAP)	Organics CN-T	Cr^{+6}	Cr	Ni	Zn	Pb	Toxic Organics 55	Toxic Organics 85
Pipe, Tube & Other Products	Avg	1	770					0.4	0.3				
	Max							1.0	0.9				
Fume Scrubber(1)	Avg	1	15 GPM					0.4	0.3				
	Max							1.0	0.9				
Cold Forming													
Cold Rolling:Recir Single Stand	Avg	1	5					0.4(2)	0.3(2)	0.1	0.15	-	-
	Max							1.0(2)	0.9(2)	0.3	0.45	0.1	0.15
Cold Rolling:Recir Multi Stand	Avg	1	25					0.4(2)	0.3(2)	0.1	0.15	-	-
	Max							1.0(2)	0.9(2)	0.3	0.45	0.1	0.15
Cold Rolling: Combination	Avg	1	300					0.4(2)	0.3(2)	0.1	0.15	-	-
	Max							1.0(2)	0.9	0.3	0.45	0.1	0.15
Cold Rolling:Direct Appl. Single Stand	Avg	1	90					0.4(2)	0.3(2)	0.1	0.15	-	-
	Max							1.0(2)	0.9(2)	0.3	0.45	0.1	0.15
Cold Rolling:Direct Appl. Multi Stand	Avg	1	400					0.4(2)	0.3(2)	0.1	0.15	-	-
	Max							1.0(2)	0.9(2)	0.3	0.45	0.1	0.15
Pipe & Tube	Avg	BPT	0										
	Max												
Alkaline Cleaning													
Batch	Avg	Subject to General Pretreatment Standards											
	Max												
Continuous	Avg	Subject to General Pretreatment Standards											
	Max												
Hot Coating (Includes all abating operations)													
Strip/Sheet/Misc. wo/scrubbers	Avg	2	600				0.02(3)		0.1		0.15		
	Max						0.06(3)		0.3		0.45		
Wire/Fasteners wo/scrubbers	Avg	2	2400				0.02(3)		0.1		0.15		
	Max						0.06(3)		0.3		0.45		
Fume Scrubbers	Avg	2	15 GPM				0.02(3)		0.1		0.15		
	Max						0.06(3)		0.3		0.45		

TABLE I-7
PSES CONCENTRATION AND FLOW SUMMARY
IRON AND STEEL INDUSTRY
PAGE 5

(1) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation
(2) This pollutant shall apply in lieu of lead and zinc when cold rolling wastewates are treated with descaling or combination acid pickling wastewaters.
(3) This pollutant shall apply only to those galvanizing operations which discharge wastewaters from a chromate rinse step.

TABLE I-8

PSES SUMMARY
IRON & STEEL INDUSTRY

Subcategory		Selected Option	Discharge Flow (GPT)	PSES (kg/kkg x 10^{-5}) Ammonia	Chlorine	Phenol (4AAP)	Toxic Organics (55)	Toxic Organics (85)	Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Cokemaking														
Iron & Steel	Avg	1	103	3220		2150				859				
	Max			6450		4300				1720				
Merchant	Avg	1	120	3750		2500				1000				
	Max			7510		5010				2000				
Beehive	Avg	BPT	0											
	Max													
Sintering	Avg	2	120	501		5.01				50.1	12.5		15.0	
	Max			1500		10.0				100	37.5		45.1	
Ironmaking														
Iron	Avg	5	70	292		2.92				29.2	7.30		8.76	
	Max			876		5.84				58.4	21.9		26.3	
Ferromanganese	Avg	Reserved												
	Max													
Steelmaking														
BOF: Semi-Wet	Avg	BPT	0											
	Max													
BOF: Wet-Open	Avg	3	110								13.8		20.7	
	Max										41.3		62.0	
BOF: Wet-Suppressed	Avg	3	50								6.26		9.39	
	Max										18.8		28.2	
Open Hearth - Wet	Avg	3	110								13.8		20.7	
	Max										41.3		62.0	
EAF: Semi-Wet	Avg	BPT	0											
	Max													
EAF: Wet	Avg	3	110								13.8		20.7	
	Max										41.3		62.0	
Vacuum Degassing	Avg	2	25								3.13		4.69	
	Max										9.39		14.1	
Continuous Casting	Avg	2	25								3.13		4.69	
	Max										9.39		14.1	
Hot Forming														
Prim.: C&S w/o s	Avg	Subject to General Pretreatment Standards												
	Max													
Prim.: C&S w/s	Avg	Subject to General Pretreatment Standards												
	Max													
Section: Carbon	Avg	Subject to General Pretreatment Standards												
	Max													
Section: Specialty	Avg	Subject to General Pretreatment Standards												
	Max													

TABLE I-8
PSES SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

Subcategory		Selected Option	Discharge Flow (GPT)	PSES (kg/kkg x 10^{-5}) Ammonia	Chlorine	Phenol (4AAP)	Toxic Organics (55)	Toxic Organics (85)	Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
Flat: HS&S (C&S)	Avg	Subject to General Pretreatment Standards												
	Max													
Flat: Plate-Carbon	Avg	Subject to General Pretreatment Standards												
	Max													
Flat: Plate-Specialty	Avg	Subject to General Pretreatment Standards												
	Max													
Pipe & Tube	Avg	Subject to General Pretreatment Standards												
	Max													
Salt Bath Descaling														
Ox.-Bat. S&P	Avg	1	700						117			87.6		
	Max								292			263		
Ox.-Bat. R&W	Avg	1	420						70.1			52.6		
	Max								175			158		
Ox.-Bat. P&T	Avg	1	1700						284			213		
	Max								709			638		
Ox.-Cont.	Avg	1	330						55.1			41.3		
	Max								138			124		
Red.-Bat.	Avg	1	325						54.2	33.9		40.7		
	Max								136	102		122		
Red.-Cont.	Avg	1	1820						304	190		228		
	Max								759	569		683		
Sulfuric Acid Pickling														
Rod, Wire & Coil	Avg	1	280								17.5		11.7	
	Max										52.6		35.0	
Bar, Billet & Bloom	Avg	1	90								5.63		3.75	
	Max										16.9		11.3	
Strip, Sheet & Plate	Avg	1	180								11.3		7.51	
	Max										33.8		22.5	
Pipe, Tube & Other	Avg	1	500								31.3		20.9	
	Max										93.9		62.6	
Fume Scrubber(1)	Avg	1	15 GPM								1230		819	
	Max										3680		2450	
Hydrochloric Acid Pickling														
Rod, Wire & Coil	Avg	1	490								30.7		20.4	
	Max										92.0		61.3	
Strip, Sheet & Plate	Avg	1	280								17.5		11.7	
	Max										52.6		35.0	
Pipe, Tube & Other	Avg	1	1020								63.8		42.6	
	Max										192		128	
Fume Scrubber(1)	Avg	1	15 GPM								1230		819	
	Max										3680		2450	
Acid Regeneration(1)	Avg	1	100 GPM								8190		5450	
	Max										24500		16300	

TABLE 1-8
PSES SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

Subcategory		Selected Option	Discharge Flow (GPT)	Ammonia	Chlorine	Phenol (4AAP)	Toxic Organics (55)	Toxic Organics (85)	Cr (119)	CN(T) (121)	Pb (122)	Ni (124)	Zn (128)	Cr^{+6}
				PSES ($kg/kkg \times 10^{-5}$)										
Combination Acid Pickling														
Rod, Wire & Coil	Avg	1	510						85.1			63.8		
	Max								213			192		
Bar, Billet & Bloom	Avg	1	230						38.4			28.8		
	Max								96.0			86.4		
Continuous-S, S&P	Avg	1	1500						250			188		
	Max								626			563		
Bat.-S, S&P	Avg	1	460						76.8			57.6		
	Max								192			173		
Pipe, Tube & Other	Avg	1	770						129			96.4		
	Max								322			289		
Fume Scrubber(1)	Avg	1	15 GPM						3270			2450		
	Max								8190			7350		
Cold Forming														
CR: Recir.-Single Stand	Avg	1	5				–	–	0.83(2)		0.31	0.63(2)	0.21	
	Max						0.21	0.31	2.09(2)		0.94	1.88(2)	0.63	
CR: Recir.-Multi Stand	Avg	1	25				–	–	4.17(2)		1.56	3.13(2)	1.04	
	Max						1.04	1.56	10.4(2)		4.69	9.39(2)	3.13	
CR: Combination	Avg	1	300				–	–	50.1(2)		18.8	37.5(2)	12.5	
	Max						12.5	18.8	125(2)		56.3	113(2)	37.5	
CR: DA-Single Stand	Avg	1	90				–	–	15.0(2)		5.63	11.3(2)	3.75	
	Max						3.75	5.63	37.5(2)		16.9	33.8(2)	11.3	
CR: DA-Multi Stand	Avg	1	400				–	–	66.8(2)		25.0	50.1(2)	16.7	
	Max						16.7	25.0	167(2)		75.1	150(2)	50.1	
Pipe & Tube	Avg	BPT	0											
	Max													
Alkaline Cleaning														
Batch	Avg	Subject to General Pretreatment Standards												
	Max													
Continuous	Avg	Subject to General Pretreatment Standards												
	Max													
Hot Coating (includes all coating operations)														
SS&M w/o scrubbers	Avg	1	600								37.5		25.0	5.01(3)
	Max										113		75.1	15.0(3)
W&F w/o scrubbers	Avg	1	2400								150		100	20.0(3)
	Max										451		300	60.1(3)
Fume Scrubbers(1)	Avg	1	15 GPM								1230		819	163(3)
	Max										3680		2450	490(3)

TABLE I-8
PSES SUMMARY
IRON & STEEL INDUSTRY
PAGE 4

(1) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation. Load is expressed in kg/day x 10^{-5}.
(2) This load shall apply in lieu of lead and zinc when cold rolling wastewaters are treated with a descaling or combination acid pickling wastewaters.
(3) This load shall apply to those galvanizing operations which discharge wastewaters from a chromate rinse step.

TABLE I-9

BCT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY

Subcategory		Discharge Flow (GPT)	BCT Effluent Conc. (mg/1) TSS	O&G
Cokemaking				
Iron & Steel-Biological	Avg	225	140	11.6
	Max		270	34.8
Iron & Steel-Physical Chemical	Avg	175	179	14.9
	Max		346	44.8
Merchant-Biological	Avg	240	140	11.6
	Max		270	34.8
Merchant-Physical Chemical	Avg	190	177	14.6
	Max		341	43.9
Beehive	Avg	BPT		
	Max			
Sintering	Avg	Reserved		
	Max			
Ironmaking				
Iron	Avg	Reserved		
	Max			
Ferromanganese	Avg	Reserved		
	Max			
Steelmaking				
BOF: Semi-wet	Avg	BPT		
	Max			
BOF: Wet-Open Combustion	Avg	Reserved		
	Max			
BOF: Wet-Suppressed Combustion	Avg	Reserved		
	Max			
Open Hearth: Wet	Avg	Reserved		
	Max			
Electric Arc Furnace: Semi-wet	Avg	BPT		
	Max			
Electric Arc Furnace: Wet	Avg	Reserved		
	Max			
Vacuum Degassing	Avg	Reserved		
	Max			
Continuous Casting	Avg	Reserved		
	Max			
Hot Forming				
Primary: Carbon & Spec. w/o Scarfers	Avg	897	15	-
	Max		40	10
Primary: Carbon & Spec. w/Scarfers	Avg	1326	15	-
	Max		40	10
Section: Carbon	Avg	2142	15	-
	Max		40	10
Section: Specialty	Avg	1344	15	-
	Max		40	10

TABLE I-9
BCT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

Subcategory		Discharge Flow (GPT)	BCT Effluent Conc. (mg/l) TSS	O&G
Hot Forming				
Flat: Hot Strip & Sheet (Carbon & Spec.)	Avg	2560	15	-
	Max		40	10
Flat: Plate-Carbon	Avg	1360	15	-
	Max		40	10
Flat: Plate-Specialty	Avg	600	15	-
	Max		40	10
Pipe & Tube	Avg	1270	15	-
	Max		40	10
Salt Bath Descaling				
Oxidizing: Batch, Sheet & Plate	Avg	700	30	-
	Max		70	-
Oxidizing: Batch, Rod & Wire	Avg	420	30	-
	Max		70	-
Oxidizing: Batch, Pipe & Tube	Avg	1700	30	-
	Max		70	-
Oxidizing: Continuous	Avg	330	30	-
			70	-
Reducing: Batch	Avg	325	30	-
	Max		70	-
Reducing: Continuous	Avg	1820	30	-
	Max		70	-
Sulfuric Acid Pickling				
Rod, Wire & Coil	Avg	280	30	10(1)
	Max		70	30(1)
Bar, Billet & Bloom	Avg	90	30	10(1)
	Max		70	30(1)
Strip, Sheet & Plate	Avg	180	30	10(1)
	Max		70	30(1)
Pipe, Tube & Other	Avg	500	30	10(1)
	Max		70	30(1)
Fume Scrubber(2)	Avg	15 GPM	30	10(1)
	Max		70	30(1)
Hydrochloric Acid Pickling				
Rod, Wire & Coil	Avg	490	30	10(1)
	Max		70	30(1)
Strip, Sheet & Plate	Avg	280	30	10(1)
	Max		70	30(1)
Pipe, Tube & Other	Avg	1020	30	10(1)
	Max		70	30(1)
Fume Scrubber(2)	Avg	15 GPM	30	10(1)
	Max		70	30(1)

TABLE I-9
BCT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

Subcategory		Discharge Flow (GPT)	BCT Effluent Conc. (mg/l) TSS	O&G
Hydrochloric Acid Pickling				
Acid Regeneration	Avg	100 GPM	30	10[1]
	Max		70	30[1]
Combination Acid Pickling				
Rod, Wire & Coil	Avg	510	30	10[1]
	Max		70	30[1]
Bar, Billet & Bloom	Avg	230	30	10[1]
	Max		70	30[1]
Continuous: Strip, Sheet & Plate	Avg	1500	30	10[1]
	Max		70	30[1]
Batch: Strip, Sheet & Plate	Avg	460	30	10[1]
	Max		70	30[1]
Pipe, Tube & Other	Avg	770	30	10[1]
	Max		70	30[1]
Fume Scrubber[2]	Avg	15 GPM	30	10[1]
	Max		70	30[1]
Cold Forming				
Cold Rolling: Recir.-Single Stand	Avg	5	30	10
	Max		60	25
Cold Rolling: Recir.-Multi Stand	Avg	25	30	10
	Max		60	25
Cold Rolling: Combination	Avg	300	30	10
	Max		60	25
Cold Rolling: Direct Appl.-Single Stand	Avg	90	30	10
	Max		60	25
Cold Rolling: Direct Appl.-Multi Stand	Avg	400	30	10
	Max		60	25
Pipe & Tube	Avg	BPT		
	Max			
Alkaline Cleaning				
Batch	Avg	250	30	10
	Max		70	30
Continuous	Avg	350	30	10
	Max		70	30
Hot Coating-(all coating operations)				
Strip, Sheet & Misc. wo/Scrubbers	Avg	600	30	10
	Max		70	30
Wire & Fasteners wo/Scrubbers	Avg	2400	30	10
	Max		70	30
Fume Scrubbers[2]	Avg	100 GPM	30	10
	Max		70	30

TABLE I-9
BCT CONCENTRATION AND FLOW SUMMARY
IRON & STEEL INDUSTRY
PAGE 4

Note: pH is also regulated in all subcategories and is limited to 6.0 to 9.0 standard units.

(1) This pollutant applies only when these wastes are treated in combination with cold rolling mill wastes.
(2) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation.

TABLE I-10

BCT EFFLUENT LIMITATIONS SUMMARY
IRON & STEEL INDUSTRY

Subcategory		Discharge Flow (GPT)	BCT Effluent Limitations (kg/kkg) TSS	O&G
Cokemaking				
Iron & Steel-Biological	Avg	225	0.131	0.0109
	Max		0.253	0.0327
Iron & Steel-Physical Chemical	Avg	175	0.131	0.0109
	Max		0.253	0.0327
Merchant-Biological	Avg	240	0.140	0.0116
	Max		0.270	0.0348
Merchant-Physical Chemical	Avg	190	0.140	0.0116
	Max		0.270	0.0348
Beehive	Avg	BPT		
	Max			
Sintering	Avg	Reserved		
	Max			
Ironmaking				
Iron	Avg	Reserved		
	Max			
Ferromanganese	Avg	Reserved		
	Max			
Steelmaking				
BOF: Semi-wet	Avg	BPT		
	Max			
BOF: Wet-Open Combustion	Avg	Reserved		
	Max			
BOF: Wet-Suppressed Combustion	Avg	Reserved		
	Max			
Open Hearth: Wet	Avg	Reserved		
	Max			
Electric Arc Furnace: Semi-Wet	Avg	BPT		
	Max			
Electric Arc Furnace: Wet	Avg	Reserved		
	Max			
Vacuum Degassing	Avg	Reserved		
	Max			
Continuous Casting	Avg	Reserved		
	Max			

TABLE I-10
BCT EFFLUENT LIMITATIONS SUMMARY
IRON & STEEL INDUSTRY
PAGE 2

Subcategory		Discharge Flow (GPT)	BCT Effluent Limitations (kg/kkg) TSS	O&G
Hot Forming				
Primary: Carbon & Spec. w/o Scarfers	Avg	897	0.0561	-
	Max		0.150	0.0374
Primary: Carbon & Spec. w/Scarfers	Avg	1326	0.0830	-
	Max		0.221	0.0553
Section: Carbon	Avg	2142	0.134	-
	Max		0.357	0.0894
Section: Specialty	Avg	1344	0.0841	-
	Max		0.224	0.0561
Flat: Hot Strip & Sheet (Carbon & Spec.)	Avg	2560	0.160	-
	Max		0.427	0.107
Flat: Plate-Carbon	Avg	1360	0.0851	-
	Max		0.227	0.0567
Flat: Plate-Specialty	Avg.	600	0.0375	-
	Max		0.100	0.0250
Pipe & Tube	Avg	1270	0.0795	-
	Max		0.212	0.0530
Salt Bath Descaling				
Oxidizing: Batch, Sheet & Plate	Avg	700	0.0876	-
	Max		0.204	-
Oxidizing: Batch, Rod & Wire	Avg	420	0.0526	-
	Max		0.123	-
Oxidizing: Batch, Pipe & Tube	Avg	1700	0.213	-
	Max		0.496	-
Oxidizing: Continuous	Avg	330	0.0413	-
	Max		0.0964	-
Reducing: Batch	Avg	325	0.0407	-
	Max		0.0949	-
Reducing: Continuous	Avg	1820	0.228	-
	Max		0.532	-
Sulfuric Acid Pickling				
Rod, Wire & Coil	Avg	280	0.0350	0.0117(1)
	Max		0.0818	0.0350(1)
Bar, Billet & Bloom	Avg	90	0.0113	0.00375(1)
	Max		0.0263	0.0113(1)
Strip, Sheet & Plate	Avg	180	0.0225	0.00751(1)
	Max		0.0526	0.0225(1)
Pipe, Tube & Other	Avg	500	0.0626	0.0209(1)
	Max		0.146	0.0626(1)

TABLE I-10
BCT EFFLUENT LIMITATIONS SUMMARY
IRON & STEEL INDUSTRY
PAGE 3

Subcategory		Discharge Flow (GPT)	BCT Effluent Limitations (kg/kkg)	
			TSS	O&G
Sulfuric Acid Pickling				
Fume Scrubber[2]	Avg	15 GPM	2.45	0.819[1]
	Max		5.72	2.45[1]
Hydrochloric Acid Pickling				
Rod Wire & Coil	Avg	490	0.0613	0.0204[1]
	Max		0.143	0.0613[1]
Strip, Sheet & Plate	Avg	280	0.0350	0.0117[1]
			0.0818	0.0350[1]
Pipe, Tube & Other	Avg	1020	0.128	0.0426[1]
	Max		0.298	0.128[1]
Fume Scrubber[2]	Avg	15 GPM	2.45	0.0819[1]
	Max		5.72	2.45[1]
Acid Regeneration[2]	Avg	100 GPM	16.3	5.45[1]
	Max		38.1	16.3[1]
Combination Acid Pickling	Avg	510	0.0638	0.0213[1]
Rod Wire & Coil	Max		0.149	0.0638[1]
Bar, Billet & Bloom	Avg	230	0.0288	0.00960[1]
	Max		0.0672	0.0288[1]
Continuous-Strip, Sheet & Plate	Avg	1500	0.188	0.0626[1]
	Max		0.438	0.188[1]
Batch-Strip, Sheet & Plate	Avg	460	0.0576	0.0192[1]
	Max		0.134	0.0576[1]
Pipe, Tube & Other	Avg	770	0.0964	0.0321[1]
	Max		0.225	0.0964[1]
Fume Scrubber[2]	Avg	15 GPM	2.45	0.819[1]
	Max		5.72	2.45[1]
Cold Forming				
Cold Rolling: Recirc.-Single Stand	Avg	5	0.000626	0.000209
	Max		0.00125	0.000522
Cold Rolling: Recirc.-Multi Stand	Avg	25	0.00313	0.00104
	Max		0.00626	0.00261
Cold Rolling: Combination	Avg	300	0.0375	0.0125
	Max		0.0751	0.0313
Cold Rolling: Direct Appl.-Single Stand	Avg	90	0.0113	0.00375
	Max		0.0225	0.00939

TABLE 10
BCT EFFLUENT LIMITATIONS SUMMARY
IRON & STEEL INDUSTRY
PAGE 4

Subcategory		Discharge Flow (GPT)	BCT Effluent Limitations (kg/kkg) TSS	O&G
Cold Forming Cont.				
Cold Rolling: Direct Appl.-Multi Stand	Avg	400	0.0501	0.0167
	Max		0.100	0.0417
Pipe & Tube	Avg	BPT		
	Max			
Alkaline Cleaning				
Batch	Avg	250	0.0313	0.0104
	Max		0.0730	0.0313
Continuous	Avg	350	0.0438	0.0146
	Max		0.102	0.0438
Hot Coating-includes all coating operations				
Strip, Sheet & Misc. wo/Scrubbers	Avg	600	0.0751	0.0250
	Max		0.175	0.0751
Wire & Fasteners wo/Scrubbers	Avg	2400	0.300	0.100
	Max		0.701	0.300
Fume Scrubbers (2)	Avg	100 GPM	16.3	5.45
	Max		38.1	16.3

Note: pH is also regulated in all subcategories and is limited to 6.0 to 9.0 standard units.

(1) This load applies only when these wastes are treated in combination with cold rolling mill wastes.
(2) The fume scrubber allowance shall be applied to each fume scrubber associated with a pickling or hot coating operation.
Load is expressed in kg/day x 10^{-5}.

TABLE I-11

EFFLUENT LOAD SUMMARY
DIRECT AND INDIRECT DISCHARGERS

Subcategory	Treatment Level	Discharge Flow (MGD)	Effluent Loadings (tons/year) Toxic Organics(1)	Toxic Metals	Other
A. Cokemaking	Raw	32.5	23,200.8	128.8	67,088
	BAT/PSES	27.5	704.8	35.0	5,974
B. Sintering	Raw	99.2	78.8	317.5	960,420
	BAT/PSES	7.7	6.0	5.1	462
C. Ironmaking	Raw	864.0	19,948.2	34,935.5	2,546,149
	BAT/PSES	17.2	5.4	12.0	1,260
D. Steelmaking	Raw	273.3	12.3	22,220.4	1,231,042
	BAT/PSES	20.5	1.2	32.5	1,300
E. Vacuum Degassing	Raw	55.4	-	667.0	5,488
	BAT/PSES	0.9	-	1.3	33
F. Continuous Casting	Raw	233.2	-	575.4	30,193
	BAT/PSES	1.1	-	2.2	45
G. Hot Forming	Raw	3,974.4	-	52,964.9	6,510,673
	BPT/PSES	1,543.2	-	123.1	19,852
H. Salt Bath Descaling	Raw	1.1	-	191.2	503
	BPT/PSES	1.1	-	0.9	26
I. Acid Pickling	Raw	86.7	-	7,438.4	358,422
	BPT/PSES	69.1	-	56.5	2,955
J. Cold Forming	Raw	76.5	365.0	332.0	2,792,058
	BPT/PSES	28.3	4.3	21.7	945
K. Alkaline Cleaning	Raw	17.5	1.2	6.7	425
	BPT	17.5	1.2	5.3	492
L. Hot Coating	Raw	30.4	-	2,098.1	4,992
	BAT/PSES	23.9	-	12.8	755
Totals	Raw	5,744.2	43,606.3	121,875.9	14,507,453
	Treated	1,758.0	722.6	308.4	34,099

(1) Includes total cyanide and phenolic compounds (4AAP).

TABLE I-12

EFFLUENT LOAD SUMMARY
IRON AND STEEL INDUSTRY - DIRECT DISCHARGES

Subcategory	Treatment Level	Discharge Flow (MGD)	Effluent Loadings (Tons/Year) Toxic Organics(1)	Toxic Metals	Others
A. Cokemaking	Raw	25.1	17,922.0	99.5	51,824
	BPT	33.3	416.1	35.4	8,200
	BAT-1	22.7	120.3	24.2	3,042
B. Sintering	Raw	93.4	74.1	298.8	903,925
	BPT	7.2	5.7	14.0	844
	BAT-1	7.2	5.7	4.8	433
C. Ironmaking	Raw	825.6	19,061.6	33,382.8	2,432,987
	BPT	29.2	287.8	77.1	6,548
	BAT-4	16.4	5.1	11.4	1,199
D. Steelmaking	Raw	252.1	11.3	20,887.2	1,138,622
	BPT	18.9	1.1	116.0	2,250
	BAT-2(2)	18.9	1.1	29.7	1,202
E. Vacuum Degassing	Raw	55.4	-	667.0	5,488
	BPT	0.9	-	8.4	55
	BAT-2	0.9	-	1.3	33
F. Continuous Casting	Raw	199.9	-	493.2	25,880
	BPT	4.4	-	10.8	333
	BAT-2	0.9	-	1.7	35
G. Hot Forming	Raw	3,679.9	-	49,460.4	6,052,741
	BPT(3)	1,418.5	-	113.9	18,159
	BAT(3)	1,418.5	-	113.9	18,159
H. Salt Bath Descaling	Raw	1.0	-	161.2	432
	BPT(3)	1.0	-	0.8	22
	BAT(3)	1.0	-	0.8	22
I. Acid Pickling	Raw	72.5	-	6,384.5	306,145
	BPT(3)	58.4	-	48.4	2,524
	BAT(3)	58.4	-	48.4	2,524
J. Cold Forming	Raw	73.3	356.9	320.6	2,787,508
	BPT(3)	28.1	4.1	21.4	939
	BAT(3)	28.1	4.1	21.4	939

TABLE I-12
EFFLUENT LOAD SUMMARY
IRON AND STEEL INDUSTRY - DIRECT DISCHARGES
PAGE 2

Subcategory	Treatment Level	Discharge Flow (MGD)	Effluent Loadings (Tons/Year) Toxic Organics(1)	Toxic Metals	Others
K. Alkaline Cleaning	Raw	12.4	0.9	4.8	302
	BPT	12.4	0.9	3.4	369
	BAT(4)	12.4	0.9	3.4	369
L. Hot Coating	Raw	22.9	-	1,829.3	4,082
	BPT	22.8	-	12.2	724
	BAT-1(5)	18.3	-	9.8	580
Totals	Raw	5,313.5	37,426.8	113,989.3	13,709,936
	BPT	1,635.1	715.7	461.8	40,967
	BAT	1,603.7	137.2	270.8	28,537

(1) Includes total cyanide and phenolic compounds (4AAP).
(2) BPT for semi-wet steelmaking operations.
(3) BAT is being promulgated at a level equal to BPT in this subcategory.
(4) BAT is not being promulgated in this subcategory.
(5) BAT is being promulgated only for those operations with fume scrubbers.

TABLE I-13

EFFLUENT LOAD SUMMARY
IRON AND STEEL INDUSTRY - INDIRECT DISCHARGES

Subcategory	Treatment Level	Discharge Flow (MGD)	Effluent Loadings (Tons/Year) Toxic Organics(1)	Toxic Metals	Others
A. Cokemaking	Raw	7.4	5,278.8	29.3	15,264
	PSES-1	4.8	584.5	10.8	2,932
B. Sintering	Raw	5.8	4.7	18.7	56,495
	PSES-2	0.5	0.3	0.3	29
C. Ironmaking	Raw	38.4	886.6	1,552.7	113,162
	PSES-5	0.8	0.3	0.6	61
D. Steelmaking	Raw	21.2	1.0	1,333.2	92,420
	PSES-3(2)	1.6	0.1	2.8	98
E. Vacuum Degassing	Raw	*	*	*	*
	PSES-3	*	*	*	*
F. Continuous Casting	Raw	33.3	-	82.2	4,313
	PSES-3	0.2	-	0.5	10
G. Hot Forming	Raw	294.5	-	3,504.5	457,932
	PSES(3)	124.7	-	9.2	1,693
H. Salt Bath Descaling	Raw	0.1	-	30.0	71
	PSES-1(BPT)	0.1	-	0.1	4
I. Acid Pickling	Raw	14.2	-	1,053.9	52,277
	PSES-1(BPT)	10.7	-	8.1	431
J. Cold Forming	Raw	3.2	8.1	11.4	4,550
	PSES-1(BPT)(4)	0.2	0.2	0.3	6
K. Alkaline Cleaning	Raw	5.1	0.3	1.9	123
	PSES(3)	5.1	0.3	1.9	123
L. Hot Coating	Raw	7.5	-	268.8	910
	PSES-2(5)	5.6	-	3.0	175
Total	Raw	430.7	6,179.5	7,886.6	797,517
	PSES	154.3	585.4	37.6	5,562

*There are no indirect dischargers in this subcategory.
(1) Includes total cyanide and phenolic compounds (4AAP).
(2) PSES-1 for semi-wet steelmaking operations.
(3) Only general pretreatment standards are being promulgated in this subcategory.
(4) Only general pretreatment standards are being promulgated for cold worked pipe and tube operations using water.
(5) PSES-1 for those operations without fume scrubbers.

VOLUME I

SECTION II

INTRODUCTION

I. Legal Authority

The regulation which this Development Document supports has been promulgated by the Agency under authority of Sections 301, 304, 306, 307 and 501 of the Clean Water Act (the Federal Water Pollution Control Act Amendments of 1972, 33 U.S.C §§ 1251 et seq., as amended by the Clean Water Act of 1977, P.L. 95-217)(the "Act"). This regulation has also been promulgated in response to the "Settlement Agreement" in Natural Resources Defense Council, Inc., et al. v Train, 8 ERC 2120 (D.D.C. 1976), modified, 12 ERC 1833 (D.D.C. 1979).

II. Background

A. The Clean Water Act

The Federal Water Pollution Control Act Amendments of 1972 established a comprehensive program to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters," Section 101(a). By July 1, 1977, existing industrial dischargers were required to achieve "effluent limitations requiring the application of the best practicable control technology currently available" (BPT), Section 301(b)(1)(A); and, by July 1, 1983, these dischargers were required to achieve "effluent limitations requiring the application of the best available technology economically achievable...which will result in reasonable further progress toward the national goal of eliminating the discharge of all pollutants" (BAT), Section 301(b)(2)(A). New industrial direct dischargers were required to comply with Section 306 new source performance standards (NSPS) based upon best available demonstrated technology; and new and existing dischargers to publicly owned treatment works (POTWs) were subject to pretreatment standards under Sections 307(b) and (c) of the Act. While the requirements for direct dischargers were to be incorporated into National Pollutant Discharge Elimination System (NPDES) permits issued under Section 402 of the Act, pretreatment standards were made enforceable directly against dischargers to POTWs (indirect dischargers).

Although Section 402(a)(1) of the 1972 Act authorized the setting of requirements for direct dischargers on a case-by-case basis, Congress intended that, for the most part, control requirements would be based upon regulations promulgated by the Administrator of EPA. Section 304(b) of the Act required the Administrator to promulgate regulations providing guidelines for effluent limitations setting forth the degree of effluent reduction attainable through the application of BPT and BAT. Moreover, Sections 304(c) and 306 of the Act required promulgation of regulations for NSPS, and Sections 304(f), 307(b), and 307(c) required promulgation of regulations for pretreatment standards. In addition to these regulations for designated industry categories, Section 307(a) of the Act required the Administrator to promulgate effluent standards applicable to all dischargers of toxic pollutants. Finally, Section 501(a) of the Act authorized the Administrator to prescribe any additional regulations "necessary to carry out his functions" under the Act.

The Agency was unable to promulgate many of these regulations by the dates contained in the Act. In 1976, the Agency was sued by several environmental groups, and in settlement of this lawsuit, the Agency and the plaintiffs executed a "Settlement Agreement" which was approved by the Court. This Agreement required the Agency 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" pollutants and classes of pollutants for 21 major industries. See Natural Resources Defense Council, Inc. v. Train, 8 ERC 2120 (D.D.C. 1976), as modified 12 ERC 1833 (D.D.C. 1979).

On December 27, 1977, the President signed into law the Clean Water Act of 1977. This law makes several important changes in the Federal water pollution control program including several of the basic elements of the Settlement Agreement program for toxic pollution control. Sections 301(b)(2)(A) and 301(b)(2)(C) of the Act now require the achievement by July 1, 1984 of effluent limitations requiring application of BAT for "toxic" pollutants, including the 65 "priority" pollutants and classes of pollutants which Congress declared "toxic" under Section 307(a) of the Act. Likewise, the Agency's programs for new source performance standards and pretreatment standards are now aimed principally at toxic pollutant controls. Moreover, to strengthen the toxics control program, Section 304(e) of the Act authorizes the Administrator to prescribe "best management practices" (BMPs) to prevent the release of toxic and hazardous pollutants from plant site runoff, spillage or leaks, sludge or waste disposal, and drainage from raw material storage associated with, or ancillary to, the manufacturing or treatment process.

In keeping with its emphasis on toxic pollutants, the Clean Water Act of 1977 also revises the control program for nontoxic pollutants. Instead of BAT for "conventional" pollutants identified under Section 304(a)(4) (including biochemical oxygen demand, oil and grease, suspended solids, fecal coliform and pH), the new Section 301(b)(2)(E) requires achievement by July 1, 1984, of "effluent limitations requiring the application of the best conventional pollutant control technology" (BCT). The factors considered in assessing BCT for an industry include the costs of attaining a reduction in effluents and the effluent reduction benefits derived compared to the costs and effluent reduction benefits from the discharge of publicly owned treatment works (Section 304(b)(4)(B)). For nontoxic, nonconventional pollutants, Sections 301(b)(2)(A) and (b)(2)(F) require achievement of BAT effluent limitations within three years after their establishment or July 1, 1984, whichever is later, but not later than July 1, 1987.

This regulation includes effluent limitations for BPT, BAT and BCT, performance standards for new sources (NSPS), and pretreatment standards for new and existing sources (PSNS and PSES) which were promulgated under Sections 301,304,306,307 and 501 of the Clean Water Act.

B. Prior EPA Regulations

On June 28, 1974, EPA promulgated effluent limitations for BPT and BAT, new source performance standards, and pretreatment standards for new sources for basic steelmaking operations (Phase I) of the integrated steel industry, 39 FR 24114-24133, 40 CFR Part 420, Subparts A-L. That regulation covered 12 subcategories of the industry: By-Product Cokemaking, Beehive Cokemaking, Sintering, Blast Furnace (Iron), Blast Furnace (Ferromanganese), Basic Oxygen Furnace (Semi-Wet Air Pollution Control Methods), Basic Oxygen Furnace (Wet Air Pollution Control Methods), Open Hearth, Electric Arc Furnace (Semi-Wet Air Pollution Control Methods), Electric Arc Furnace (Wet Air Pollution Control Methods), Vacuum Degassing, and Continuous Casting and Pressure Slab Molding.

In response to several petitions for review, the United States Court of Appeals for the Third Circuit remanded that regulation on November 7, 1975, American Iron and Steel Institute, et al. v EPA, 526 F.2d 1027 (3rd Cir. 1975). While the Court rejected all technical challenges to the BPT limitations, it held that the BAT effluent limitations and NSPS for certain subcategories were "not demonstrated." In addition, the court questioned the entire regulation on the grounds that EPA had failed to consider adequately the impact of plant age on the cost or feasibility of retrofitting pollution controls, had failed to assess the impact of the regulations on water scarcity in arid and semi-arid regions of the country, and had failed to make adequate "net/gross" provisions for pollutants found in intake water supplies.[1]

[1]The court also held that the "form" of the regulations was improper, because they did not provide "ranges" of limitations to be selected by permit issuers. This holding, however, was recalled in American Iron and Steel Institute, et al. v EPA, (3d Cir.1977).

On March 29, 1976, EPA promulgated BPT effluent limitations and proposed BAT limitations, NSPS standards and PSNS standards for steel forming and finishing operations (Phase II) within the steel industry, 39 FR 12990-13030, 40 CFR Part 420, Subparts M-Z. That regulation covered 14 subcategories of the industry: Hot Forming- Primary; Hot Forming-Section; Hot Forming-Flat; Pipe & Tube; Pickling-Sulfuric Acid-Batch & Continuous; Pickling-Hydrochloric Acid-Batch & Continuous; Cold Rolling; Hot Coating-Galvanizing; Hot Coatings-Terne; Miscellaneous Runoffs-Storage Piles, Casting, and Slagging; Combination Acid Pickling-Batch and Continuous; Scale Removal-Kolene and Hydride; Wire Pickling and Coating, and Continuous Alkaline Cleaning.

The U.S. Court of Appeals for the Third Circuit remanded that regulation on September 14, 1977, American Iron and Steel Institute, et al. v EPA, 568 F.2d 284 (3d Cir. 1977). While the court again rejected all technical challenges to the BPT limitations, it again questioned the regulation in regard to the age/retrofit and water scarcity issues. In addition, the court invalidated the regulation for lack of proper notice to the specialty steel industry, and directed EPA to reevaluate its cost estimates in light of "site-specific costs" and to reexamine its economic impact analysis.[2]

On January 28, 1981 the Agency promulgated General Pretreatment Regulations applicable to existing and new indirect dischargers within the steel industry and other major industries, 46 FR 9404 et seq, 40 CFR Part 403. See also 47 FR 4518 (February 1, 1982).

C. Overview of the Industry

The manufacture of steel involves many processes which require large quantities of raw materials and other resources. Steel facilities range from comparatively small plants engaging in one or more production processes to extremely large integrated complexes engaging in several or all production processes. Even the smallest steel plant, however, represents a fairly large industrial facility. Because of the wide variety of products and processes, operations vary from plant to plant. Table II-1 lists the various products classified by the Bureau of the Census under Major Group 33 - Primary Metal Industries.

The steel industry can be segregated into two major components - raw steelmaking and forming and finishing operations. The Agency estimates that there are about 680 plant locations containing over 2000 individual steelmaking and forming and finishing operations. A listing of these plants is presented in Appendix

[2]The court also held that the Agency had no statutory authority to exempt plants in the Mahoning Valley region of Eastern Ohio from compliance with the BPT limitations.

B. Table II-2 is an inventory of production operations by subcategory.

In the first major process, coal is converted to coke which is then combined with iron ore and limestone in blast furnaces to produce iron. The iron is then converted into steel in either open hearth, basic oxygen, or electric arc furnaces. Finally, the steel can be further refined by vacuum degassing. Following these steelmaking operations, the steel is subjected to a variety of hot and cold forming and finishing operations. These operations produce products of various shapes and sizes, and impart desired mechanical and surface characteristics. Figure II-1 is a process flow diagram of the steelmaking segment of the industry.

Coke plants are operated at integrated facilities to supply coke for the production of iron in blast furnaces or as stand alone facilities to supply coke to other users. Nearly all active coke plants are by-product plants which produce, in addition to coke, such usable by-products as coke oven gas, coal tar, crude or refined light oils, ammonium sulfate or anhydrous ammonia, and naphthalene. A by-product coke plant consists of ovens in which bituminous coal is heated in the absence of air to drive off volatile components. The coke is supplied to blast furnaces, while the volatile components are recovered and processed into materials of potential value. Less than one percent of domestic coke is produced in beehive cokemaking processes.

The coke from by-product cokemaking and beehive cokemaking is then supplied to blast furnace processes where molten iron is produced for subsequent steelmaking. In blast furnaces, iron ore, limestone and coke are placed into the top of the furnace and heated air is blown into the bottom. Combustion of the coke provides heat and a reducing atmosphere which produce metallurgical reactions in the furnace. The limestone forms a fluid slag which combines with unwanted impurities in the ore. Two kkg (2.2 tons) of ore, 0.54 kkg (0.6 tons) of coke, 0.45 kkg (0.5 tons) of limestone, and 3.2 kkg (3.5 tons) of air produce approximately 0.9 kkg (1 ton) of iron, 0.45 kkg (0.5 tons) of slag, and 4.5 kkg (5 tons) of blast furnace gas containing the fines (flue dust) carried out by the blast. Molten iron and molten slag, which floats on top of the iron, are periodically withdrawn from the bottom of the furnace. Blast furnace flue gas, which has heating value, is cleaned and then burned in stoves to preheat the incoming air to the furnace.

Steel is an alloy of iron containing less than 1.0% carbon. The basic raw materials for steelmaking are hot metal, pig iron, or steel scrap, limestone, burned lime, dolomite, fluorspar, iron ores, and iron-bearing materials such as pellets or mill scale. In steelmaking operations, the furnace charge is melted and refined by oxidizing certain constituents, particularly carbon in the molten bath, to specified low levels. Various alloying elements are added to produce different grades of steel.

The principal steelmaking processes in use today are the Basic Oxygen Furnace (BOF or BOP), the Open Hearth Furnace, and the Electric Arc Furnace. These processes refine the product of the blast furnace (hot metal or, if cooled, pig iron) which contains approximately 6% carbon. About fifteen percent of the steel produced in this country is made in open hearth furnaces. However, the trend has been towards less steel production in open hearth furnaces because of inefficiencies in the process compared to BOF and electric furnace steelmaking. Open hearth furnaces are similar in design, but may vary widely in capacity. Furnaces in this country range in capacity from 9 to 545 kkg (10 to 600 tons) per heat. The steelmaking ingredients are charged into the front of the furnace through movable doors, while the flame to refine the steel is supplied by liquid or gaseous fuel ignited by hot air.

In the standard open hearth furnace, molten steel is tapped from the furnace eight to ten hours after the first charge. Many furnaces use oxygen lances which create more intense heat to reduce tap-to-tap time. The tap-to-tap time for the oxygen-lanced open hearth averages about eight hours. The average is about ten hours when oxygen is not used. The open hearth furnace allows the operator, in effect, to "cook" the steel to required specifications. The nature of the furnace permits the operator to continually sample the contents and make necessary additions. The major drawback of the process is the long time required to produce a "heat."

Since the introduction in the United States of the more productive basic oxygen process, open hearth production has declined from a peak of 93 million kkg (102 million tons) in 1956 to 19 million kkg (21 million tons) in 1978. Most basic oxygen furnaces can produce eight times the amount of steel produced by a comparable open hearth furnace during the same production time. The annual domestic production of steel by the basic oxygen process has increased from about 545,000 kkg (600,000 tons) in 1957 to 75 million kkg (83 million tons) in 1978.

Vessels for the basic oxygen process generally are vertical cylinders surmounted by a truncated cone. Scrap and molten iron are placed in the vessel and oxygen is then admitted. High-purity oxygen is supplied at high pressure through a water-cooled tube mounted above the center of the vessel. A violent reaction occurs immediately, bringing the molten metal and hot gases into intimate contact causing impurities to burn off quickly. An oxygen blow of 18 to 22 minutes is usually sufficient to refine the metal. Finally, alloys are added and the steel is then tapped. A basic oxygen furnace can produce 180 to 270 kkg (200 to 300 tons) of steel per hour and permits very close control of steel quality. Another major advantage of the process is the ability to process a wide range of raw materials. Scrap may be light or heavy, and the oxide charge may be iron ore, sinter, pellets, or mill scale.

The third process for making steel is the electric arc furnace. This process is uniquely adapted to the production of high quality steels and practically all stainless steel is produced in electric arc furnaces. Electric furnaces range up to nine meters (30 feet) in diameter and produce from 1.8 to 365 kkg (2 to 400 tons) per cycle in 1.5 to 5 hours.

The cycle in electric furnace steelmaking consists of a scrap charge, meltdown, a hot metal charge, a molten metal period, boil, a refining period, and the pour. The electric arc furnace generates heat by passing an electric current between electrodes through the charge in the furnace. The refining process is similar to that of the open hearth furnace, but more precise control is possible in the electric furnace. Use of oxygen in the electric furnace steelmaking process has been common practice for many years.

At many plants, only electric furnaces are operated with scrap as the raw material. In most "cold shops" the electric arc furnace is the sole steelmaking process. They are the principal steelmaking process employed by the so-called mini steel plants which have been built since World War II. The annual production of steel in electric arc furnace has increased from about 7.2 million kkg (8 million tons) in 1957 to 29 million kkg (32 million tons) in 1978. Although electric arc furnaces are usually smaller in capacity than open hearth or basic oxygen furnaces, the trend is toward furnaces with larger heating capacities.

The hot forming (including continuous casting) and cold finishing operations follow the basic steelmaking operations. These operations are so varied that simple classification and description is difficult. In general, hot forming primary mills reduce ingots to slabs or blooms and secondary hot forming mills reduce slabs or blooms to billets, plates, shapes, strip, and other forms. Continuous casting of molten steel into semi-finished shapes is used to bypass the primary hot forming operations. Steel finishing operations involve a number of other processes that are not used to substantially alter the dimensions of the hot rolled product, but are used to impart desirable surface or mechanical properties. The product flow of these operations is illustrated in Figures II-2 and II-3.

It is possible, and often economical, to roll ingots directly through the bloom, slab, or billet stages into more refined or finished steel products in one continuous mill, frequently without reheating. Large tonnages of standard rails, beams, and plates are produced by this practice. Most of the ingot tonnage, however, is rolled into bloom, slabs, or billets in one mill, then cooled, stored, and eventually reheated and rolled in other mills or forged.

The basic operation in a primary mill is the gradual compression of the steel ingot between two rotating rolls. Multiple passes through the rolls, ususally in a reversing mill, are required to reshape the ingot into a slab, bloom, or billet. As the ingot begins to pass through the rolls, high pressure water jets remove surface scale. The ingot is passed back and forth between the horizontal and vertical rolls while manipulators turn the ingot. When the desired shape is achieved in the rolling operation, the end pieces (or crops) are removed by electric or hydraulic shears. The semi-finished pieces are stored or sent to reheating furnaces for subsequent rolling operations.

As the demand for higher quality steel increases, the conditioning of semi-finished products has become more important. This conditioning involves the removal of surface defects from blooms, billets, and slabs prior to shaping. Defects such as rolled seams, light scabs, and checks generally retain their identity during subsequent forming processes and result in inferior products. Surface defects may be removed by manual chipping, machine chipping, scarfing, grinding, milling, and hot steel scarfing. The various mechanical means of surface preparation are common in all metal working and machine shop operations. Scarfing is a process of supplying jet streams of oxygen to the surface of the steel product, while maintaining high surface temperatures, resulting in rapid oxidation and localized melting of a thin layer of the metal. While the process may be manual (consisting of the continuous motion of an oxyacetylene torch along the length of the piece undergoing treatment), in recent years the hot scarfing machine has come into wide use. This machine is designed to remove a thin layer (1/8 in. or less) of metal from the steel passed through the machine in a manner analogous to the motion through rolling mills.

Merchant-bar, rod, and wire mills are continuous operations which produce a wide variety of products, ranging from shapes of small size through bars and rods. The designations of the various mills as well as the classification of their products are not very well defined within industry. In general, the small cross-sectional area and long lengths distinguish the products of these mills. The raw materials for these mills are reheated billets. Some older mills include hand looping operations in which the material is manually passed from mill stand to mill stand. Newer mills include mechanical methods for material transfer. As with other rolling operations, the billet is progressively compressed and shaped to the desired dimensions in a series of rolls. Water sprays are used throughout the operation to remove scale.

The continuous hot strip mill is used to process slabs which are brought to rolling temperatures in continuous reheating furnaces. The slabs then are passed through scale breakers and high pressure water sprays which dislodge loosened scale. A series of roughing stands and a rotary crop shear are used to produce a section that can be finished into a coil of the proper weight and gauge. A second scale breaker and high pressure water sprays precede the finishing stands where final size reductions are made. Cooling water is applied by sprays on the runout table, and the finished strip is coiled. On hot strip mills a six inch thick slab of steel can be formed into a thin strip or sheet a quarter of a mile long in three minutes or less. Strip up to ninty six inches in width can be produced with hot strip mills, although the most common width in newer mills is 80 in. Products of the hot strip mill are sold as produced, or are further processed in cold reduction mills. Cold rolled products are sold as produced or are used in producing plated or coated products.

Welded tubular products are made from hot-rolled skelp with square or slightly beveled edges. The width and thickness of the skelp are selected to suit the desired size and wall thicknesses. The coiled skelp is uncoiled, heated, and fed through forming and welding rolls where the edges are pressed together at high temperatures to form a weld. Welded pipe or tube can also be made by the electric weld processes, where the weld is made by either fusion or resistance welding. Seamless tubular products are made by rotary piercing of a solid round bar or billet, followed by various forming operations to produce the required size and wall thickness.

Correct surface preparation is the most important requirement for satisfactory application of protective and decorative coatings to steel. Without a properly cleaned surface, even the most expensive coatings will fail to adhere or prevent rusting of the steel base. A variety of cleaning methods are used to insure proper surface preparation for subsequent coating. The steel surface must also be cleaned at various production stages to insure that the oxides which form on the surface are not worked into the finished product causing marring, staining, or other surface imperfections.

The pickling process chemically removes oxides and scale from the surface of the steel by the action of water solutions of inorganic acids. While pickling is only one of several methods of removing undesirable surface oxides, this method is most widely used because of comparatively low operating costs and ease of operation.

Some products such as tubes and wire are pickled in batch operations. The product is immersed in an acid solution until the scale or oxide film is removed. The material is lifted from the bath, allowed to drain, and then rinsed by sequential immersion in rinse tanks.

Pickling lines for hot-rolled strip operate continuously on coils that are welded together. The steel passes through the pickler countercurrent to the flow of the acid solution, and is then sheared and recoiled. Most carbon steel is pickled with sulfuric or hydrochloric acid; stainless steels are pickled with hydrochloric, nitric, and hydrofluoric acids. Various organic chemicals are used in the pickling process to inhibit acid attack on the base metal, while permitting preferential attack on the oxides. Wetting agents are used to improve the effective contact of the acid solution with the metal surface. As in the batch operation, the steel passes from the pickling bath through a series of rinse tanks.

Alkaline cleaners are used, where necesssary, to remove mineral and animal fats and oils from the steel surface. Caustic soda, soda ash, alkaline silicates, and phosphates are common alkaline cleaning agents. Merely dipping the steel in alkaline solutions of various compositions, concentrations, and temperatures is often satisfactory. The use of electrolytic cleaning may be employed for large scale production, or where a cleaner product is desired. Sometimes the addition of wetting agents to the cleaning bath facilitates cleaning.

Blast cleaning is a process which uses abrasives such as sand, steel, iron grit, or shot to clean the steel. The abrasives come into contact with the steel by either a compressed air blast cleaning apparatus or by rotary type blasting cleaning machines. However, these methods usually result in a roughened surface. The degree of roughness must be regulated to insure that the product is satisfactory for its intended use. Newer methods of blast cleaning produce smooth finishes and, consequently, have potential as substitutes for some types of pickling.

Steel finishing also includes operations such as cold rolling, cold reduction, cold drawing, tin plating, galvanizing, coating with other metals, coating with organic as well as inorganic compounds, and tempering.

Cold reduced flat rolled products are made by cold rolling pickled strip steel. The thickness of the steel is reduced by 25% to 99% in this operation to produce a smooth, dense surface. The product may be sold as cold reduced, but is usually heat treated.

The cold reduction process generates heat that is dissipated by flooded lubrication systems. These systems use palm oil or synthetic oils which are emulsified in water and directed in jets against the rolls and the steel surface during rolling. The cold reduced strip is then cleaned with alkaline detergent solutions to remove the rolling oils prior to coating operations.

Tin plate is made from cleaned and pickled cold reduced strip by either the electrolytic or hot dip process. The hot dip process consists of passing the steel through a light pickling solution; a tin pot containing a flux and the molten tin; and a bath of palm oil. Effluent limitations for discharges from the electrolytic processes are not included in this regulation but are addressed in the Development Document for the Electroplating Point Source Category (40 CFR 413).

Hot dipped galvanized sheets are produced on either batch or continuous lines. The process consists of a light pickling in hydrochloric acid and the application of the zinc coating by dipping in a pot containing molten zinc. Variations in continuous hot dip operations include alkaline cleaning, continuous annealing in controlled atmosphere furnaces, and a variety of fluxing techniques.

In recent years, steel products which are coated with various synthetic resins have become commercially important. Other steel products are being produced with coatings of various metals and inorganic materials. Several major tin plate manufacturers are substituting chromium plating for tin plating for container products. Finishing operations for stainless steel products requiring a bright finish include rolling on temper mills or mechanical polishing.

A more detailed description of steel industry operations can be found in the individual subcategory reports of this Development Document, and in the references cited in Section XIV.

D. Summary of EPA Guidelines Development Methodology and Overview

Approach to the Study

In order to develop the effluent limitations and standards, the Agency first studied the steel industry to determine whether differences in raw materials, final products, manufacturing processes, equipment, age and size of plants, water usage, wastewater constituents, or other factors justified the development of separate effluent limitations and standards for different segments of the industry. This study included the identification of untreated wastewater and treated effluent characteristics including: (1) the sources and volume of water used, the processes employed, and the sources of pollutants and wastewaters in the plant, and (2) the constituents of wastewaters, including toxic pollutants. The Agency then identified the wastewater pollutants which were considered for effluent limitations and standards.

Next, the Agency identified several distinct control and treatment technologies, including both in-plant and end-of-process technologies, which are in use or capable of being used in the steel industry. The Agency compiled and analyzed historical data and recently obtained effluent quality data resulting from the application of these technologies. Long term performance, operating limitations, and the reliability of each control and treatment technology were also identified. In addition, the Agency considered the non-water quality environmental impacts of those technologies, including impacts on air quality, solid waste generation, water consumption, and energy requirements.

The Agency then developed the costs of each control and treatment technology by using standard engineering cost analyses as applied to steel industry wastewaters. Unit process costs were derived from model plant characteristics (production, flow and pollutant loads) applied to each treatment process unit (e.g., primary coagulation-sedimentation, activated sludge, multi-media filtration). These unit process costs were added to yield total costs of the model treatment facility developed for each treatment level. After confirming the reasonableness of this methodology by comparing EPA cost estimates to actual treatment system costs supplied by the industry and other data, the Agency evaluated the economic impacts of these costs. Costs are discussed in detail in each subcategory report and the economic impact on the industry is reviewed in the economic impact analysis done for this study.

Upon consideration of these factors, as more fully described below, the Agency identified various control and treatment technologies as models for the BPT, BCT, and BAT limitations and for the PSES, PSNS, and NSPS. The regulation Does not require the installation of any particular technology. Rather, it requires the achievement of effluent limitations and standards representative of the proper operation of the model technologies, equivalent technologies, or operating practices.

Nearly all of the BPT, BCT and BAT limitations and the PSES, PSNS, and NSPS are expressed as mass limits (kg/kkg of product) and were calculated by multiplying three values: (1) effluent concentrations determined from analysis of control technology performance data, (2) model wastewater flow (gal/ton) for each subcategory, and (3) an appropriate conversion factor. The effluent limitations and standards for scrubbers used at acid pickling and hot coating operations are established on the basis of mass load per day (kg/day), and were calculated by multiplying the same three factors, except that the model flows are expressed in gal/minute. The Agency performed the basic calculation for each limited pollutant for each subcategory of the industry.

<u>Data and Information Gathering Program</u>

Upon initiating this study, the Agency reviewed the data underlying its previous studies of the steel industry.[3] The Agency concluded that additional data were required to respond to the Third Circuit's remands and to develop limitations and standards in accordance with the Settlement Agreement and the Clean Water Act of 1977.

The Agency sent Data Collection Portfolios (DCPs) to owners or operators of all basic steelmaking operations and operators of at least 85% of the steel forming and finishing operations. The DCPs requested information concerning production processes, production capacity and rates, process water usage, wastewater generation rates, wastewater treatment and disposal methods, treatment costs, location, age of production and treatment facilities, as well as general analytical information. The Agency received responses from 391 steelmaking operations and from 1632 steel forming and finishing operations.

The Agency also sent Detailed Data Collection Portfolios (D-DCPs), under the authority of Section 308 of the Act, to owners or operators of 50 basic steelmaking facilities and 128 forming and finishing facilities. The D-DCPs requested detailed information concerning the cost of installing water pollution control equipment including capital, annual, and retrofit costs. The D-DCPs also requested long-term effluent monitoring data and data regarding specific production operations.

The Agency determined the presence and magnitude of the 129 specific toxic pollutants in steel industry wastewaters in a two-part sampling and analysis program that included 31 basic steelmaking facilities and 83 forming and finishing operations. Table II-3 is a listing of those facilities sampled for this study. Table II-4 is a summary of the number of sampled plants and the number of facilities for which the Agency received questionnaire responses.

The primary objective of the field sampling program was to obtain composite samples of wastewaters and flow measurements to determine the concentrations and discharge rates of toxic pollutants. Sampling visits were made during two or three consecutive days of plant operation, with raw wastewater samples taken either before treatment or after minimal preliminary

[3]See EPA 440/1-74-024a; Development Document for Effluent Limitation Guidelines and New Source Performance Standards for the Steel Making Segment of the Iron and Steel Manufacturing Point Source Category, June 1974; and EPA 440/1-76/048-d; Development Document for Interim Final Effluent Limitations Guidelines and Proposed New Source Performance Standards for the Forming, Finishing and Specialty Steel Segments of the Iron and Steel Manufacturing Point Source Category; March, 1976.

treatment. Treated effluent samples were taken following application of in-place treatment technologies. The Agency also sampled intake waters to determine the presence of toxic pollutants prior to contamination by steel industry processes.

This first phase of the sampling program detected and quantified wastewater constituents included in the list of 129 toxic pollutants. Wherever possible, each sample of an individual raw wastewater stream, a combined waste stream, or a treated effluent was collected by an automatic, time series compositor over three 24-hour sampling periods. Where automatic compositing was not possible, grab samples were taken and composited manually. The purpose of the second phase of the sampling program was to confirm the presence and further quantify the concentrations and waste loadings of the toxic pollutants found during the first phase of the program.

The Agency used the analytical techniques described in Sampling and Analysis Procedures for Screening of Industrial Effluents for Priority Pollutants, revised April, 1977. Analyses for metals were performed by AA spectrophotometry. However, the standard cold vapor method was used for mercury. This 304(h) method was modified in order to avoid excessive matrix interference that causes high limits of detection. Analyses for total cyanide and cyanide amenable to chlorination were also performed using 304(h) methods.

Analyses for asbestos fibers used transmission electron microscopy with selected area diffraction; results were reported as chrysotile fiber count.

Analyses for conventional pollutants (BOD_5, TSS, pH, and oil and grease) and nonconventional pollutants (total residual chlorine, iron, ammonia, fluoride, and COD) were performed using 304(h) methods.

Industry Subcategorization

The Agency has adopted a revised subcategorization of the steel industry to more accurately reflect production operations in the industry and to simplify the implementation of the regulation. The modified subcategorization is displayed in Table II-5. Table II-6 cross references the modified subcategorization with subparts of the previous regulations. Industry subcategorization is reviewed in detail in Section IV of this report and in Section IV of each subcategory report in the Development Document.

Regulated Pollutants

The basis upon which the Agency selected the pollutants specifically limited, as well as the general nature and environmental effects of these pollutants is set out in Section V.

A. BPT

The pollutants limited by this regulation include, for the most part, the same pollutants limited by the remanded BPT regulations. Some pollutants have been deleted from the list of limited pollutants because the sampling conducted subsequent to the promulgation of the prior regulations showed that only very low levels of these pollutants are present in the process wastewaters. For the finishing subcategories, BPT limitations for additional pollutants were promulgated to facilitate the co-treatment of compatible wastewaters and to regulate toxic pollutants where more stringent BAT limitations based upon more advanced wastewater treatment were not promulgated. The discharge of BPT limited pollutants is controlled by 30 day average and maximum daily mass effluent limitations in kilograms per 1000 kilograms (lbs/1000 lbs) of product, and in kilograms per day for fume scrubbers associated with acid pickling and hot coating operations.

B. BCT

The conventional pollutants controlled by this regulation include TSS, oil and grease, and pH. BCT limitations have been promulgated in seven steel industry subcategories and in all seven of those subcategories BCT is set equal to BPT. Therefore, no additional costs beyond BPT will be incurred to comply with the BCT limitations. In the remaining five subcategories, BCT has been reserved for further consideration.

C. BAT and NSPS

1. Nontoxic, Nonconventional Pollutants

Ammonia-N is a nontoxic, nonconventional pollutant limited by BAT and NSPS.

2. Toxic Pollutants

Forty-eight toxic pollutants were found at concentrations above treatability levels in steel industry wastewaters. (Section V contains a list of these pollutants.) Most of the toxic pollutants (29) are found in the cokemaking subcategory. The Agency has promulgated effluent limitations for the following toxic pollutants: total cyanide, benzene, naphthalene, benzo(a)pyrene, tetrachloroethylene, chromium, lead, nickel, and zinc. These pollutants are subject to numerical limitations expressed in kilograms per 1000 kilograms (lbs/1000 lbs) of product or in kg/day for fume scrubbers associated with acid pickling and hot coating operations. The remaining toxic pollutants, which are not specifically limited, will be controlled by limitations established for "indicator" pollutants (discussed below).

3. Indicator Pollutants

The cost of analyses for the many toxic pollutants found in steel industry wastewaters has prompted the Agency to adopt alternative methods of regulating certain toxic pollutants. Instead of promulgating specific effluent limitations for each of the forty-eight toxic pollutants found in steel industry wastewaters at significant levels, the Agency has promulgated effluent limitations for certain "indicator" pollutants. These include chromium, lead, nickel, zinc, phenols (4AAP) and certain toxic organic pollutants. The data available to the Agency generally show that the control of the "indicator" pollutants will result in comparable control of toxic pollutants not specifically limited. By establishing specific limitations for only the "indicator" pollutants, the Agency has reduced the high cost and delays of monitoring and analyses that would result from limitations for each toxic pollutant. The total annual monitoring cost to the industry is estimated to be about $3.8 million (including $3.2 million for current monitoring programs). The pollutants found and those that have been specifically limited at the BAT and NSPS levels of treatment are listed in Section V. The bases for selection of "indicator" pollutants is presented in Section X of each subcategory report.

D. PSES and PSNS

The pollutants for which PSES and PSNS have been promulgated are identical to those limited at BAT and NSPS, with the exception of the conventional pollutants. Limitations were promulgated for certain toxic pollutants, and other "indicator" pollutants to insure against POTW upsets, to prevent accumulation of toxic pollutants in POTW sludges, and primarily to minimize pass-through of certain toxic pollutants. The PSES and PSNS are expressed as 30 day average and maximum daily mass limitations in kilograms per 1000 kilograms (lbs/1000 lbs) of product and in kilograms per day.

Control and Treatment Technology

A. Status of In-Place Technology

There are several treatment technologies currently used by the steel industry. Generally, primary wastewater treatment systems rely upon physical/chemical methods including neutralization, sedimentation, flocculation and filtration. Treatment for toxic pollutants includes advanced technologies such as biological oxidation and carbon adsorption. Technologies such as ion exchange, ultrafiltration, multiple-effect evaporation, reverse osmosis, and more sophisticated chemical techniques are generally not currently used in the industry for wastewater treatment applications.

Within the cokemaking subcategory, treatment systems include a component to remove organic wastes. Organic removal steps include biological methods such as bio-oxidation lagoons and activated sludge plants, and physical/chemical methods including ammonia stills, dephenolizers and activated carbon systems. Sedimentation and filtration techniques are also used.

Treatment facilities at plants in the sintering, ironmaking, and steelmaking subcategories include sedimentation and flocculation systems followed by recycle of treated wastewaters. Wastewaters from nearly all hot forming operations are treated in scale pits followed by lagoons, clarifiers, filters, or combinations thereof, with recycle of treated or partially treated wastewaters. Coagulants aids such as lime, alum, polymeric flocculants, and ferric sulfate are normally used in conjunction with clarifiers. Filters are usually of the multi-media pressure type.

Cold finishing treatment techniques include equalization prior to further treatment, neutralization with lime, caustic or acid, flocculation with polymer and sedimentation. Central or combined treatment practices are used widely with these operations.

The use of recycle is a common practice throughout the steel industry. Recycle of treated process wastewaters can be effectively used as a means of significantly reducing discharge loadings to receiving streams. Systems including high recycle rates are demonstrated in several subcategories. Recycle may be applied to specific sources such as barometric condensers (coke) or fume scrubbers (pickling) or to the effluent from final treatment facilities.

B. Advanced Technologies Considered

The Agency considered advanced treatment systems to control the levels of toxic pollutants at the BAT, NSPS, PSES, and PSNS levels of treatment. Some of these systems include in-plant controls, however, most involve the installation of additional treatment components.

In-plant control has been demonstrated in several subcategories. As a result, such systems have been included in the treatment models at the BAT, BCT, NSPS, PSES, and PSNS levels. Rinse reduction technology, such as cascade rinsing, is a means of reducing wastewater volumes. This technology significantly reduces the volume of wastewater requiring treatment.

Other in-plant control measures such as reduction of wastewater generation by process water reduction and recycle and process modifications have been considered. These control measures are subcategory specific and are discussed in detail in the respective subcategory reports.

Add-on technology to the BPT model technology is also the basis for the BAT, NSPS, PSES, and PSNS levels of treatment. Some of these control measures for toxic pollutants include 2-stage or extended biological treatment (cokemaking); granular activated carbon; pressure filtration; and, multi-stage evaporation/condensation systems. Details on these advanced systems are presented in Section VI.

Capital and Annual Cost Estimates

Additional expenditures will be required by the steel industry to achieve compliance with the promulgated limitations. A short discussion of the in-place and required capital costs and annual costs are presented below for each level of treatment, based upon the size and status of the industry as of July 1, 1981. All costs are presented in July 1, 1978 dollars.

A. BPT

The Agency estimates that as of July 1, 1981 the steel industry had expended about $1.5 billion towards compliance with BPT limitations out of a total required cost of $1.7 billion. Industry will incur annualized costs (including interest, depreciation, operating and maintenance) of about $204 million when BPT has been fully implemented. The changes in the above costs are the result of the Agency's update of the status of the industry with respect to BPT compliance and the deletion of plants that have been shutdown.

Compliance with the BPT effluent limitations will result in the removal of about 36,700 tons per year of toxic organic pollutants, 113,500 tons per year of toxic metal pollutants and 13,670,000 tons per year of other pollutants from untreated wastewaters. The Agency believes that these effluent reduction benefits justify the associated costs, and other environmental impacts which are small in relation to these benefits.

B. BAT

The Agency estimates that as of July 1, 1981, compliance with the BAT and BCT limitations may require the steel industry to invest about $77 million in addition to the BPT investment and to the capital already spent on BAT systems. The annualized costs for the steel industry, in addition to the BPT costs, may equal a total of about $24 million.

Compliance with the BAT limitations will result in the removal of about 580 tons per year of toxic organic pollutants, 190 tons per year of toxic metal pollutants and 12,400 tons per year of other pollutants. The Agency believes that the costs of compliance with the BAT limitations and other environmental impacts are reasonable and justified in light of the effluent reduction benefits obtained.

C. PSES

The Agency estimates that as of July 1, 1981, compliance with the PSES may require the steel industry to invest about $41 million. The Agency estimates that POTW dischargers have already expended about $132 million for pretreatment facilities. The annualizes costs for the steel industry may equal a total of about $31 million.

Compliance with the PSES will resut in the removal of about 5600 tons/year of toxic organic pollutants, 7850 tons/year of toxic metal pollutants, and 792,000 tons/year of other pollutants from raw wastewaters. The Agency believes that the prevention of toxic pollutant pass through achieved with the promulgated PSES justify the associated costs.

Basis for Effluent Limitations and Standards

As noted briefly above, the effluent limitations and standards for BPT, BAT, BCT, NSPS, PSES, and PSNS are expressed as mass limitations in kilograms per 1000 kilograms (lbs/1000 lbs) of product and in kilograms per day. The mass limitation is derived by multiplying an effluent concentration (determined from the analysis of treatment system performance) by a model flow appropriate for each subcategory expressed in gallons per/ton of product, or gallons per day. Conversion factors were applied to yield the appropriate kg/kkg (lbs/1000 lbs) and kg/day value for each limited pollutant. The limitations neither require the installation of any specific control technology nor the attainment of any specific flow rate or effluent concentration. Various treatment alternatives or water conservation practices can be employed to achieve a particular effluent limitation and standard. The model treatment systems presented in the development document illustrate one of the means available to achieve the limitations and standards. In most cases, other technologies or operating practices are available to achieve the limitations and standards.

NPDES permit limitations are specified as mass limitations (kg/day or lbs/day). In order to convert the effluent limitations expressed as kg/kkg (lbs/1000 lbs) to a 30-day average or daily maximum permit limit, a production rate in either kkg/day or 1000 lbs/day must be used. The production rates previously used for NPDES permitting have been the highest actual monthly production in the last five years converted to a daily value, or production capacity. Where applicable, the effluent limitations expresses as kg/day are additive to the other permit limitations.

Suggested Monitoring Program

The suggested long term monitoring and analysis program includes continuous flow monitoring, grab sampling for pH and oil and grease (3 grabs/day, once/week) and the collection of 24-hour composite samples once per week for all other pollutants. The composite samples would be analyzed for those pollutants regulated at the BPT, BAT, BCT, and PSES treatment levels for each contributing subcategory. Due to the relatively high cost of organic analysis ($750-$1000 per sample in July 1978 dollars), monthly monitoring of limited organics in the cokemaking and cold forming subcategories is suggested.

More intensive monitoring is suggested for the period of time necesssary to determine initial compliance with the limitations. Accordingly, as of July 1, 1984, (the compliance date for BAT and BCT), monitoring and analysis should be carried out on a schedule of five daily composites per week (once per week for GC/MS pollutants). When the appropriate regulatory authority determines that compliance has been demonstrated, monitoring can then be decreased to the frequencies indicated in the long term program discussed above.

Although total suspended solids and pH are regulated for each subcategory, the total number of monitored pollutants ranges from three (alkaline cleaning) to eight (cokemaking). The type of analysis influences the overall cost with analysis for toxic organic pollutants being the most expensive, and pH and the metals analyses being the least expensive.

Updated cost estimates were developed using three alternative contractural arrangements (in-house laboratory, contract laboratory, and C.W. Rice Laboratory), to obtain an estimate of the range of monitoring costs and to demonstrate that the monitoring program is feasible with the resources available to the industry.

The subcategory with the largest annual monitoring expenses is cokemaking ($8862-$11,779/yr). The need for the GC/MS organic analyses accounts largely for the high cost. The lowest annual monitoring costs occur in the salt bath descaling-oxidizing subdivision ($2,513-$5,794/yr). Annual monitoring costs for the remaining subcategories are between $2,648 and $11,276.

The total annual monitoring cost to the industry is estimated to be approximately $3.8 million of which $2.3 are expended for monitoring at the BPT and PSES levels. However, actual expenses are likely to be less due to the preponderance of central treatment facilities in this industry. This substantially reduces the number of monitoring points compared to that required with completely separate treatment and monitoring at each process, as assumed by the Agency to estimate the monitoring costs. Total BPT/BAT/PSES annual operating costs are estimated to be $228 million. The monitoring cost is roughly 1.7% of the annual cost of pollution control. The Agency considers these costs reasonable in light of the size and complexity of this industry, and the potential adverse environmental impacts of these discharges.

Economic Impact on the Industry

The economic impact of the regulation on the steel industry is fully described in Economic Analysis of Effluent Guidelines - Integrated Iron and Steel Industry.

Energy and Non-water Quality Impacts

The elimination or reduction of one form of pollution may aggravate other environmental problems. Therefore, Sections 304(b) and 306 of the Act require the Agency to consider the non-water quality environmental impacts (including energy requirements) of certain regulations. In compliance with these provisions, the Agency considered the effect of this regulation on air pollution, solid waste generation, water scarcity, and energy consumption. There is no precise methodology for balancing pollution impacts against each other and against energy use. The Agency believes this regulation to be the best possible approach to serving these competing national goals with respect to environmental concerns and energy consumption.

The non-water quality environmental impacts (including energy requirements) associated with the regulation are described in general below and more specifically in the respective subcategory reports.

A. Air Pollution

Compliance with the BPT, BAT, and BCT limitations and the NSPS, PSES, and PSNS will not create any substantial air pollution problems. However, in several subcategories, slight air impacts may be expected. First, minimal amounts of volatile organic compounds may be released to the atmosphere by aeration in biological treatment systems used for the treatment of cokemaking wastewaters. Secondly, minor particulate air emissions may result as water vapor containing some particulate matter is released from cooling tower systems used in several of the subcategories. None of these impacts are considered significant.

B. Solid Wastes

EPA estimates that 22.2 million tons per year of solid wastes (at 30% solids for most dewatered sludges) will be generated by the industry when full compliance with BPT, BAT, BCT, and PSES is achieved. Of this amount, 20.0 million tons are generated at the BPT level and 2.2 million tons at PSES. Solid waste generation data by subcategory and by level is summarized in Table II-7. These solid wastes are comprised almost entirely of treatment plant sludges. Much larger quantities of other solid wastes are generated in the steel industry such as electric furnace dust and blast furnace and steelmaking slags. However, these and other solid wastes are generated by the process and not as a result of this water pollution control regulation.

The data gathered for this study demonstrate that most sludges are presently produced by treatment systems already installed in the industry. As a result, the industry is currently incurring disposal costs and finding necessary disposal sites. (It is unknown at this time how many of these disposal sites are secure, well maintained operations.) The cost per ton for disposal is related to the type of waste as well as to the amount. Tonnages to be disposed of in the steel industry are high enough so that lower costs per ton are incurred in relation to most other industries. For this evaluation the Agency, after an extensive evaluation, determined that sludge disposal costs of $5 per ton for non-hazardous wastes and $18 per ton for hazardous wastes are appropriate bases for cost estimating purposes. The costs for disposal of these sludges are included in the Agency's present cost estimate. The Agency has concluded that, the incremental solid waste impacts associated with this regulation will be minimal.

C. Consumptive Water Loss

The question of water consumption in the steel industry as a result of the installation of wastewater treatment systems is a remand issue of the 1974 and 1976 regulations dealt with in Section III. In summary, the Agency concludes that the water consumed as a result of compliance with this regulation is justified on both a national level and on a "water-scarce" regional level when compared to the effluent reduction benefits achieved.

D. Energy Requirements

The Agency estimates that compliance with the regulation will result in the consumption of electrical energy, at the BPT, BCT, BAT and PSES levels of treatment as follows:

Treatment Level	Net Energy Consumption (kwh)
BPT/BCT	1.25 billion
BAT	0.07 billion
PSES	0.12 billion
Total	1.44 billion

This represents 2.5% of the total 57 billion kwhs of electrical energy consumed by the steel industry in 1978, or about 0.4% of the total energy consumed by the industry. A summary, by subcategory and by level, of energy requirements due to water pollution control is presented in Table II-8. The Agency considers the expenditure of energy required for compliance with this regulation justified by the effluent reductions benefits achieved.

TABLE II-1

STANDARD INDUSTRIAL CLASSIFICATION LISTING
PART 420 - IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY

Subpart	Applicability; Description		Standard Industry[1] Classification Codes
Subpart A Cokemaking Subcategory	420.10	Applicability; description of the cokemaking subcategory. The provisions of this subpart are applicable to discharges and introduction of pollutants into publicly owned treatment works resulting from by-product and beehive cokemaking operations.	3312.05 Beehive coke products 3312.11 Chem. Rec. Coke 3312.12 Coal gas - coke 3312.13 Coal tar crudes 3312.14 Coke, beehive 3312.15 Chem. coke products 3312.17 Distillates 3312.52 Tar
Subpart B Sintering Subcategory	420.20	Applicability; description of the sintering subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from sintering operations conducted by the heating of iron bearing wastes (mill scale and dust from blast furnaces and steelmaking furnaces) together with fine iron ore, limestone, and coke fines in an ignition furnace and traveling grate to produce an agglomerate for charging to the blast furnace.	3312.30 Iron sinter
Subpart C Ironmaking Subcategory	420.30	Applicability; description of the ironmaking subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from ironmaking operations in which iron ore is reduced to molten iron in a blast furnace.	3312.08 Blast Furnace products 3312.19 Ferroalloys, BF 3312.29 Iron, pig

TABLE II-1
STANDARD INDUSTRIAL CLASSIFICATION LISTING
PART 420 - IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY
PAGE 2

Subpart	Applicability; Description		Standard Industry[1] Classification Codes
Subpart D Steelmaking Subcategory	420.40	Applicability; description of the steelmaking subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from steelmaking operations conducted in basic oxygen, open hearth, and electric arc furnaces.	3312.28 Ingots, steel 3312.47 Stainless steel 3312.58 Tool steel
Subpart E Vacuum Degassing Subcategory	420.50	Applicability; description of the vacuum degassing subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from vacuum degassing operations conducted by applying a vacuum to molten steel.	
Subpart F Continuous Casting Subcategory	420.60	Applicability; description of the continuous casting subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from the continuous casting of molten steel into intermediate or semi-finished steel products through water cooled molds.	

TABLE II-1
STANDARD INDUSTRIAL CLASSIFICATION LISTING
PART 420 - IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY
PAGE 3

Subpart	Applicability; Description		Standard Industry[(1)] Classification Codes	
Subpart G Hot Forming Subcategory	420.70	Applicability; description of the hot forming subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from hot forming operations conducted in primary, section, flat, and pipe and tube mills.	Primary	
			3312.06	Billets, steel
			3312.09	Blooms
			3312.43	Slabs, steel
			Section	
			3312.02	Axles, rolled
			3312.03	Bars, iron rolled
			3312.04	Bars, steel rolled
			3312.10	Carwheels, rolled
			3312.18	Fence posts, rolled
			3312.22	Frogs
			3312.26	Hoops, hot rolled
			3312.27	Hot rolled, iron & steel
			3312.31	Nut rods, rolled
			3312.34	Rail joints, etc.
			3312.35	Railroad crossings
			3312.36	Rails
			3312.37	Rods, rolled
			3312.38	Rounds, tube
			3312.39	Sheet pilings, rolled
			3312.41	Shell slugs, rolled
			3312.45	Spike rods, rolled
			3312.48	Steel works
			3312.51	Structural shapes
			3312.55	Tie plates
			3312.59	Tube rounds
			3312.63	Wheels
			3312.64	Wire products
			3315.01	Brads, steel
			3315.02	Cable, steel
			3315.03	Horseshoe, nails
			3315.04	Spikes, steel
			3315.05	Staples, steel
			3315.06	Tacks, steel

TABLE II-1
STANDARD INDUSTRIAL CLASSIFICATION LISTING
PART 420 - IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY
PAGE 4

Subpart	Applicability; Description	Standard Industry[(1)] Classification Codes
Subpart G Hot Forming Subcategory	420.70 Applicability; description of the hot forming subcategory.	**Section** 3315.07 Wire, ferrous 3315.08 Wire products, ferrous 3315.09 Wire, steel **Flat** 3312.01 Armor plate, rolled 3312.20 Flats, rolled 3312.33 Plates, rolled 3312.40 Sheets, rolled 3312.42 Skelp 3312.50 Strips, iron & steel **Pipe & Tube** 3312.60 Tubes, iron & steel 3312.61 Tubing, seamless 3312.62 Well casings 3317.03 Pipe, seamless 3317.05 Tubes, seamless 3317.07 Well casing
Subpart H Salt Bath Descaling Subcategory	420.80 Applicability; description of the salt bath descaling subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from oxidizing and reducing salt bath descaling operations.	

TABLE II-1
STANDARD INDUSTRIAL CLASSIFICATION LISTING
PART 420 - IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY
PAGE 5

Subpart	Applicability; Description	Standard Industry (1) Classification Codes
Subpart I Acid Pickling Subcategory	420.90 Applicability; description of the acid pickling subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from sulfuric acid, hydrochloric acid, or combination acid pickling operations.	
Subpart J Cold Forming Subcategory	420.100 Applicability; description of the cold forming subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works from cold rolling and cold working pipe and tube operations in which unheated steel is passed through rolls or otherwise processed to reduce its thickness to produce a smooth surface, or to develop controlled mechanical properties in the steel.	3312.07 Blackplate 3312.16 Cold Strip Steel 3312.32 Pipe 3312.65 Wrought pipe, tubing 3316.01 Cold finished bars 3316.02 Cold rolled strip 3316.03 Corrugating CR 3316.04 Flat bright CR 3316.05 Razor blade strip C 3316.06 Sheet steel CR 3316.07 Wire, flat 3317.01 Boiler tubes 3317.02 Conduit 3317.04 Pipe, wrought 3317.06 Tubing, mechanical 3317.08 Wrought pipe & tube

TABLE II-1
STANDARD INDUSTRIAL CLASSIFICATION LISTING
PART 420 - IRON AND STEEL MANUFACTURING POINT SOURCE CATEGORY
PAGE 6

Subpart	Applicability; Description	Standard Industry[1] Classification Codes
Subpart K Alkaline Cleaning Subcategory	420.110 Applicability; description of the alkaline cleaning subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from operations in which steel and steel products are immersed in alkaline cleaning baths to remove mineral and animal fats or oils from the steel, and those rinsing operations which follow such immersion.	
Subpart L Hot Coating Subcategory	420.120 Applicability; description of the hot coating subcategory. The provisions of this subpart are applicable to discharges and to the introduction of pollutants into publicly owned treatment works resulting from the operations in which steel is coated with zinc, terne metal, or other metals by the hot dip process, and those rinsing operations associated with that process.	3312.23 Galvanized products 3312.25 Hoop, hot galvanized rolled 3312.49 Strips, galvanized 3312.53 Terneplate 3312.54 Ternes 3312.57 Tin plate 3479.04 Coating (hot dipped) 3479.12 Galvanizing

(1) The EPA has added decimal digits to the standard four digit SIC code for easy reference to individual products.

TABLE II-2

SUBCATEGORY INVENTORY

Subcategory	No. of Active Plants[1]	No. of Individual Units[2]	No. of Plants Direct Discharging	No. of Plants Discharging to POTWs	No. of Plants With Zero Discharges
A. Cokemaking					
1. Iron & Steel	39	64	15	8	16[3]
2. Merchant	19	21	7	8	4[3]
B. Sintering	17	17	15	1	1
C. Ironmaking	45	161	39	2	4
D. Steelmaking					
1. BOF					
a. Semi-wet	9	9(20)	8	0	1
b. Wet-suppressed	6	6(15)	5	1	0
c. Wet-open	14	15(35)	13	1	0
2. Open Hearth - Wet	4	4(28)	4	0	0
3. Electric Arc Furnace					
a. Semi-wet	3	3(8)	2	0	1
b. Wet	7	9(20)	6	1	0
E. Vacuum Degassing	33	38	31	0	2
F. Continuous Casting	49	59	25	7	17

TABLE II-2
SUBCATEGORY INVENTORY
PAGE 2

Subcategory	No. of Active Plants[1]	No. of Individual Units[2]	No. of Plants Direct Discharging	No. of Plants Discharging to POTWs	No. of Plants With Zero Discharges
G. Hot Forming					
1. Primary	84	113	76	6	2
2. Section	80	241	65	8	7
3. Flat					
a. Hot Strip & Sheet	39	55	37	2	0
b. Plate	17	25	16	1	0
4. Pipe & Tube	34	50	33	1	0
H. Salt Bath Descaling					
1. Oxidizing	19	24	17	2	0
2. Reducing	7	8	6	1	0
I. Acid Pickling					
1. Sulfuric Acid	124	191	71	34	19[4]
2. Hydrochloric Acid	46	98	34	12	0
3. Combination Acid	67	129	46	18	3

TABLE II-2
SUBCATEGORY INVENTORY
PAGE 3

Subcategory	No. of Active Plants(1)	No. of Individual Units(2)	No. of Plants Direct Discharging	No. of Plants Discharging to POTWs	No. of Plants With Zero Discharges
J. Cold Forming					
1. Cold Rolling					
a. Recirculation	53	142	34	6	13(4)
b. Combination	10	21	10	0	0
c. Direct Application	21	67	19	0	2(4)
2. Pipe & Tube					
a. Water	15	72	9	2	4(4)
b. Oil Emulsions	19	52	2	0	17(4)
K. Alkaline Cleaning					
1. Batch	31	51	22	9	0
2. Continuous	31	123	22	9	0
L. Hot Coatings					
1. Galvanizing	63	146	40	17	6
2. Terne	5	6	4	1	0
3. Other Metals	10	18	5	4	1
TOTAL	1020	2023	741	162	117

( ) For steelmaking operations, the numbers in parentheses represent the number of furnaces at the specified number of shops.
(1) Active as of 7/1/81.
(2) Multiple operating units or pollution control facilities within a subcategory may exist at a plant site.
(3) These coke plant operations achieve zero discharge either by disposing of their effluent via quenching or deep well disposal.
(4) These plants achieve zero discharge by having their wastewater hauled off-site.

TABLE II-3

PLANTS SAMPLED DURING IRON AND STEEL STUDY

Subcategory	Sampling Code	Plant Reference Code	Plant Name	Type of Operation
A. Cokemaking				
1. By-Product	001[1]	0732A	Shenango (Neville Island)	
	002	0464C	Koppers (Erie)	
	003[1](2)	0868A	U.S.S. (Fairfield)	
	NA	0860H	U.S.S. (South Works)	
	006	0584B	National Steel (Great Lakes)	
	007	0320	Ford Motor Co. (Dearborn)	
	008	0920F	Wheeling-Pit (Follansbee)	
	009[1]	0684F	Republic STeel (Cleveland)	
	NA	0402	Ironton Coke (Ironton)	
	A	0432B	J & L (Pittsburgh)	
	B	0112	Bethlehem (Bethlehem)	
	C	0384A	Inland (East Chicago)	
	D	0272	Donner-Hanna (Buffalo)	
2. Beehive	E	0428A	Jewell (Vansant)	
	F	0428A	Jewell (Vansant)	
	G	0724A	Sharon (Carpenter)	
B. Sintering				
	016	0112D	Bethlehem (Burns Harbor)	
	017	0432A	J & L (Aliquippa)	
	019	0060F	Armco (Houston)	
	H	0432A	J & L (Aliquippa)	
	I	0291C	International Harvester (Chicago)	
	J	0396A	Interlake (Chicago)	
	K	0112B	Bethlehem (Buffalo-Lackawanna)	
C. Ironmaking				
	021	0196A	CF&I (Pueblo)	Iron
	022	0856N	U.S.S. (Lorain)	Iron
	023	0860B	U.S.S. (Gary Works)	Iron
	024	0860H	U.S.S. (Chicago-South)	Iron
	025	0112C	Bethlehem (Johnstown)	Iron
	026	0112D	Bethlehem (Burns Harbor)	Iron
	027	0432A	J & L (Aliquippa)	Iron
	028	0684H	Republic (Chicago)	Iron
	029	0684F	Republic (Cleveland)	Iron
	030	0112	Bethlehem (Bethlehem)	Iron

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 2

Subcategory	Sampling Code	Plant Reference Code	Plant Name	Type of Operation
	L	0291C	International Harvester (Chicago)	Iron
	M	0396A	Interlake (Chicago)	Iron
	N	0448A	Kaiser (Fontana)	Iron
	O	0060F	Armco (Houston)	Iron
	P	0112B	Bethlehem (Buffalo-Lackawanna)	Iron
	Q	0112C	Bethlehem (Johnstown)	FeMn
D. Steelmaking				
1. BOF	031	0020B	Allegheny-Ludlum (Brackenridge)	W-OC
	032	0384A	Inland (Indiana Harbor)	W-SC
	033	0856B	U.S.S. (Edgar Thompson)	W-OC
	034	0856N	U.S.S. (Lorain)	W-SC
	035	0868A	U.S.S. (Fairfield)	W-OC
	036	0112D	Bethlehem (Burns Harbor)	W-OC
	038	0684F	Republic (Chicago)	W-SC
	D*	0248A	Crucible (Midland)	W-OC
	R	0432A	J & L (Aliquippa)	Semi-wet
	S	0060	Armco (Middletown)	W-SC
	T	0112A	Bethlehem (Sparrows Point)	W-OC
	U	0396D	Interlake (Chicago)	Semi-Wet
	V	0584F	National (Weirton)	W-OC
2. Open Hearth	042	0492A	Lone Star (Lone Star)	Wet
	043	0864A	U.S.S. (Provo)	Semi-wet
	W	0112A	Bethlehem (Sparrows Point)	Wet
	Y	0060	Armco (Middletown)	Wet
3. Electric Arc Furnace	051	0612	Northwestern Steel & Wire (Sterling)	Wet
	052	0492A	Lone Star (Lone Star)	Wet
	059B	0060F	Armco (Houston)	Semi-wet
	AA	0060F	Armco (Houston)	Wet
	AB	0868B	U.S.S. (Texas Works, Baytown)	Wet
	Y	0432C	J & L (Cleveland)	Semi-wet
	Z	0584A & B	National (Ecorse)	Semi-wet
E. Vacuum Degassing				
	062	0496	Lukens (Coatesville)	
	065	0584F	National (Weirton)	
	068	0684H	Republic (Chicago)	

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 3

Subcategory	Sampling Code	Plant Reference Code	Plant Name	Type of Operation
	AC	0584F	National (Weirton)	
	AD	0868B	U.S.S. (Texas Works, Baytown)	
	E	0020B	Allegheny-Ludlum (Brackenridge)	
	G	0856R	U.S.S. (Duquesne)	
F. Continuous Casting				
	071	0284A	Eastern Stainless (Baltimore)	
	072	0496	Lukens (Coatesville)	
	075	0584F	National (Weirton)	
	079	0060K	Armco (Marion)	
	AE	0584F	National (Weirton)	
	AF	0868B	U.S.S. (Texas Works, Baytown)	
	B*	0900	Washington Steel (Washington)	
	D*	0248A & B	Crucible (Midland)	
	Q*	0684D	Republic (Massilon)	
G. Hot Forming				
1. Primary	081	0176	Carpenter Technology (Reading)	Bloom
	082	0496 (140" only)	Lukens (Coatesville)	Slab/Rough Plate
	082	0496 (140",206" in tandem)	Lukens (Coatesville)	Slab/Rough Plate
	083	0860H	U.S.S. (South Chicago)	Slab/Bloom
	D*	0248B	Crucible (Midland)	Slab
	E*	0020B	Allegheny-Ludlum (Brackenridge)	Slab
	H*	0248A	Crucible (Midland)	Bloom
	K*	0256K	Universal Cyclops (Bridgeville)	Slab/Bloom
	M*	0432J	J & L (Warren)	Slab/Bloom
	Q*	0684D	Republic (Massillon)	Bloom
	R*	0240A	Copperweld (Warren)	Bloom
	A-2	0112B	Bethlehem (Lackawanna)	Bloom
	B-2	0112B	Bethlehem (Lackawanna)	Slab
	C-2 & 088 (Revisited)	0684H	Republic (Chicago)	Bloom
	D-2	0946A	Wisconsin (Chicago)	Bloom
	L-2	0060	Armco (Middletown)	Slab
	285A(2)	0240A	Copperweld (Warren)	Bloom
	286A(2)	0432C	J & L (Cleveland)	Slab
	288A(2)	0584F	National (Weirton)	Slab/Bloom
	289A(2)	0684B	Republic (Warren)	Bloom

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 4

Subcategory	Sampling Code	Plant Reference Code	Plant Name	Type of Operation
	290A(2)	0856R	U.S.S. (Duquesne)	Slab/Bloom
	291(2)	0856B	U.S.S. (Edgar Thompson)	
	293A(2)	0856N	U.S.S. (Lorain)	Slab/Bloom
	294A(2)	0920N	Wheeling Pittsburgh (Mingo Jct.)	Slab
2. Section	083	0860H (02 & 03)	U.S.S. (South Chicago)	34" & Rod Mill
	087	0432-02	J & L (Aliquippa)	14" Mill
	088	0684H-02	Republic (Chicago)	34" Mill
	088	0684H (01,03,05,06,07)	Republic (Chicago)	36",32",14", 10",11" Mills
	C*	0424 (01-03)	Jessop (Washington)	Bar Mills
	H*	0248A	Crucible (Midland)	Merchant Mill
	K*	0256K	Universal Cyclops (Bridgeville)	Bar Mill
	M*	0432J	J & L (Warren)	Billet Mill
	O* & 081 (Revisited)	0176 (01-03)	Carpenter Technology (Reading)	Bar Mills
	A-2	0112B	Bethlehem (Lackawanna)	Rail Mill
	D-2	0946A	Wisconsin (Chicago)	#2, 5, & 6 Mills
	E-2	0196A (09 & 10)	CF&I (Pueblo)	Bar & Rod Mills
	F-2	0384A-06	Inland (East Chicago)	12" Bar Mill
	G-2	0652A (01 & 02)	Penn-Dixie (Joliet)	10" & 12" Mills
	H-2	0432A-04	J & L (Aliquippa)	Rod Mill
	I-2	08560	U.S.S. (Cleveland)	Rod Mill
	282B(2)	0088A	Babcock & Wilcox (Koppel)	Round Mill
	283(2)	0112	Bethlehem (Bethlehem)	
	285B(2)	0240A	Copperweld (Warren)	Round Mill
	290B(2)	0856R	U.S.S. (Duquesne)	
	293B(2)	0856N	U.S.S. (Lorain)	Rebar Mill
3. Flat	082	0496 (01 & 03)	Lukens (Coatesville)	140",112"/120", 140"/206"
	082	0496 (02 & 04)	Lukens (Coatesville)	112"/120",140" Mills
	083	0860H-01	U.S.S. (South Chicago)	30" Plate Mill

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 5

Subcategory	Sampling Code	Plant Reference Code	Plant Name	Type of Operation
	086	0112D-01	Bethlehem (Burns Harbor)	160" Plate Mill
	086	0112D-02	Bethlehem (Burns Harbor)	80 " Hot Strip
	087	0432A	J & L (Aliquippa)	44" Hot Strip
	D*	0248B	Crucible (Midland)	Hot Strip
	E*	0020B	Allegheny-Ludlum (Brackenridge)	Hot Strip
	F*	0856H	U.S.S. (Homestead)	160" Plate Mill
	O	0176	Carpenter Technology (Reading)	#4 Hot Mill
	J-2	0860B-01	U.S.S. (Gary Works)	84" Hot Strip
	K-2	0868B	U.S.S. (Baytown)	160" Plate Mill
	L-2	0060	Armco (Middletown)	Hot Strip & Sheet
	M-2	0384A-02	Inland (East Chicago)	80" Hot Strip
	N-2	0396D-02	Interlake (Riverdale)	#4 Hot Strip
	281(2)	0020B	Allegheny Ludlum (Brackenridge)	Hot Strip
	284(2)	0112D	Bethlehem (Burns Harbor)	Hot Strip & Plate
	286B(2)	0432C	J & L (Cleveland)	Hot Strip
	287(2)	0584B	National (Ecorse)	Hot Strip
	288B(2)	0584F	National (Weirton)	Hot Strip
	289B(2)	0684B	Republic (Warren)	Hot Strip
	292(2)	0860B	U.S.S. (Gary)	Hot Strip
	294B(2)	0920N	Wheeling Pittsburgh (Mingo Jct.)	Hot Strip
4. Pipe and Tube	087	0432A-01	J & L (Aliquippa)	Butt Weld
	088	0684H	Republic (Chicago)	Seamless
	E-2	0196A-01	CF&I (Pueblo)	Seamless
	GG-2	0240B-05	Ohio Steel & Tube (Shelby)	Seamless
	II-2	0916A	Wheatland (Wheatland)	Butt Weld
	JJ-2	0728	Sharon (Sharon)	Butt Weld
	KK-2	0256G	Cyclops (Sawhill)	Butt Weld
	293C(2)	0856N	U.S.S. (Lorain)	Seamless
	295(2)	0948A	J & L (Campbell)	Seamless

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 6

Subcategory	Sampling Code	Plant Reference Code	Plant Name	Type of Operation
H. Salt Bath Descaling				
1. Oxidizing	131	0424	Jessop (Washington, Pennsylvania)	Plate
	132	0176-04	Carpenter Technology (Reading)	Rod, Wire
	138	0440A	Joslyn (Fort Wayne)	Bar, Rod
	C*	0424	Jessop (Washington, Pennsylvania)	Plate
	L*	0440A	Joslyn (Fort Wayne)	Bar,Rod
2. Reducing	132	0176 (01-03)	Carpenter Technology (Reading)	Bar,Rod Strip,Wire
	139	0256N	Universal Cyclops (Titusville)	Bar,Billet
	L*	0440A	Joslyn (Fort Wayne)	Bar,Rod
	Q*	0684D	Republic (Massillon)	Strip
I. Acid Pickling				
1. Sulfuric Acid	092	088A	B&W (Beaver Falls)	B
	094	0948C	YS&T (Indiana Harbor)	C-N
	095	0584E	National (Midwest)	C
	096	0112I	Bethlehem (Lebanon)	B-N
	097	0760	Stanley (New Britain)	C-AU
	098	0684P	Republic (Massillon)	B
	R*	0240A	Copperweld (Warren)	B-N
	H-2	0432A	J & L (Aliquippa)	B-N, C-N
	I-2	0856P	U.S.S. (Cleveland)	B
	O-2	0590	Nelson Steel (Chicago)	B-AU
	P-2	0312	Fitzsimons (Youngstown)	B-AU
	Q-2	0894	Walker Steel & Wire (Ferndale)	B-AU
	R-2	0240B	Ohio Sheet & Tube (Shelby)	B-N
	S-2	0256G	Cyclops-Sawhill (Sharon)	B-N
	T-2	0792B	Thompson Steel (Chicago)	C-AU
	QQ-2	0584E	National (Midwest)	C-N
	SS-2	0112A	Bethlehem (Sparrows Pt.)	C-N
	TT-2	0856D	U.S.S. (Irwin)	C-N
	WW-2	0868A	U.S.S. (Fairfield)	C-N
2. Hydrochloric Acid	091	0612	Northwestern S&W (Sterling)	C-N
	093	0396D	Interlake (Riverdale)	C-N
	095	0584F	National (Weirton)	C-AR
	099	0528B	McLouth (Gibralter)	C-AR
	100	0384A	Inland (East Chicago)	C-N

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 7

Subcategory	Sampling Code	Plant Reference Code	Plant Name	Type of Operation
	I-2	0856P	U.S.S. (Cuyahoga)	C-N
	U-2	0480A	LaSalle (Hammond)	B-N
	V-2	0936	Wire Sales, Inc. (Chicago)	B-N
	W-2	-	Dominion (Hamilton)	C-AR
	X-2	0060B	Armco (Ashland)	C-AR
	Y-2	-	Steel Co. of Canada (Hamilton)	C-AR
	Z-2	0396D	Interlake (Riverdale)	C-N
	AA-2	0384A	Inland (East Chicago)	C-N
	BB-2	0060	Armco (Middletown)	C-N
3. Combination Acid	121	0900	Washington Steel (Washington)	C-N
	122	0176	Carpenter Technology	B-N
	123	0088A	Babcock & Wilcox (Beaver Falls)	B-N
	124	0088D	Babcock & Wilcox (Koppel)	B-N
	125	0674E	Plymouth Tube (Dunkirk)	B-N
	A*	0900	Washington Steel (Washington)	C-N
	C*	0424	Jessop (Washington, Pennsylvania)	B-N
	D*	0248A & B	Crucible (Midland)	C-N
	F*	0856H	U.S.S. (Homestead)	B-N
	I*	0432K	J & L (Louisville)	C-N
	L*	0440A	Joslyn (Fort Wayne)	B-N
	O*	0176	Carpenter Technology	C-N
	U*	0060O	Tube Associates (Houston)	B-N
J. Cold Forming				
1. Cold Rolling	101 A & B[(1)]	0020 B & C	Allegheny-Ludlum (W. Leechburg)	Recirc.
	102	0384A	Inland (East Chicago)	Recirc.
	105	0584F	National (Weirton)	Direct Appl.
	105	0584F	National (Weirton)	Recirc.
	106	0112B	Bethlehem (Lackawanna)	Direct Appl.
	D*	0248B	Crucible (Midland)	Recirc.
	I*	0432K	J & L (Louisville)	Recirc.
	P*	0156B	Cabot Steel (Kokomo)	Recirc.
	X-2	0060B	Armco (Ashland)	Recirc.
	BB	0060	Armco (Middleton)	Recirc.
	DD-2	0584E	National (Midwest)	Combination
	EE-2	0112D	Bethlehem (Burns Harbor)	Recirc.
	FF-2	0384A	Inland (East Chicago)	Recirc.
	VV-2	0584F	National (Weirton)	Direct Appl.
	XX-2	0684I	Republic (Gadsden)	Recirc.
	YY-2	0432D	J & L (Hennepin)	Combination

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 8

Subcategory	Sampling Code	Plant Reference Code	Plant Name	Type of Operation
	301(2)	0020B	Allegheny Ludlum (W. Leechburg)	Recirc.
	302(2)	0060E	Armco (Zanesville)	Recirc.
	304(2)	0176	Carpenter Technology (Reading)	Recirc. & Direct Appl.
	305(2)	0176	Carpenter Technology (Reading)	Recirc. & Direct Appl.
	306(2)	0248B	Crucible (Midland)	Recirc.
	307(2)	0248B	Crucible (Midland)	Recirc.
	308(2)	0320	Ford Motor Co (Dearborn)	Recirc.
	310(2)	0432C	J & L (Cleveland)	Recirc.
	311(2)	0432D	J & L (Hennepin)	Combination
	312(2)	0948C	J & L (E. Chicago)	Combination
	313(2)	0584B	National Steel (Detroit)	Combination
	315(2)	0684	Republic Steel (Cleveland)	Recirc.
	316(2)	0684B	Republic Steel (Warren)	Recirc.
	318(2)	0856P	U.S.S. (Cuyahoga Works)	Recirc.
	319(2)	0856F	U.S.S. (Fairless)	Combination
	321(2)	0684D	Republic Steel (Massillon)	Recirc.
	323(2)	0060	Armco Steel (Middletown)	Recirc.
2. Pipe & Tube	HH-2	0492A	Lone Star Steel (Lone Star)	Water
	331(2)	0256G	Cyclops (Sharon)	Water & Oil
	332(2)	0684L	Republic (Elyria OH)	Oil
	333(2)	0684A	Republic (Youngstown)	Oil
	335(2)	0856N	U.S.S. (Lorain)	Oil
	336(2)	0856Q	U.S.S. (McKeesport)	Water & Oil
	337(2)	0678C	Quanex (Shelby)	Oil
	338(2)	0240B	Copperweld (Shelby)	Oil
K. Alkaline Cleaning	152	0176	Carpenter Technology (Reading)	Continuous
	156	0112I	Bethlehem (Lebanon)	Batch & Cont.
	157	0432K	J & L (Louisville)	Cont.
	I*	0432K	J & L (Louisville)	Cont.
	317(2)	0796A	Timken (Canton)	Batch
L. Hot Coating				
1. Galvanizing	111	0612	Northwestern Steel (Sterling)	
	112	0396D	Interlake (Riverdale)	
	114	0948C	YS&T (East Chicago)	
	116	0112I	Bethlehem (Lebanon)	

TABLE II-3
PLANTS SAMPLED DURING IRON AND STEEL STUDY
PAGE 9

Subcategory	Sampling Code	Plant Reference Code	Plant Name	Type of Operation
	118	0920E	Wheeling-Pitt (Martins Ferry)	
	119	0476A	Laclede (Alton)	
	I-2	08560	U.S.S. (Cleveland)	
	V-2	0936	Wire Sales (Chicago)	
	MM-2	0856F	U.S.S. (Fairless)	
	NN-2	0920E	Wheeling-Pitt (Martins Ferry)	
2. Terne	113	0856D	U.S.S. (Irwin)	
	OO-2	0060R	Armco (Middletown)	
	PP-2	0856D	U.S.S. (Irwin)	
3. Other	116	0112I	Bethlehem (Lebanon)	Aluminum

(1) Data exists for more than one visit.
(2) Verification analyses protocol used at this plant visit.
NA: Sample code number was not assigned.
*: Sampled by Datagraphics.

Key to Abbreviations:

W-OC: "Wet-Open Combustion" type air pollution control system.
W-SC: "Wet-Suppressed Combustion" type air pollution control system
B : Batch
C : Continuous
AU : Acid Recovery
AR : Acid Regeneration

TABLE II-4

INDUSTRY-WIDE DATA BASE
IRON & STEEL INDUSTRY

	No. of Operations
Number Sampled for Original Guidelines Study	133
Number Sampled for Toxic Pollutant Studies	161
Total Number Sampled (Not including re-visits)	244
Number Responding to the D-DCP's	174 incl. 44 above
Total Number Sampled or Surveyed via D-DCP's	374
Number Responding to the DCP's	2023

TABLE II-5

REVISED STEEL INDUSTRY SUBCATEGORIZATION

A. Cokemaking

   1. Byproduct

      a. Iron & Steel - Biological
      b. Iron & Steel - Physical Chemical
      c. Merchant - Biological
      d. Merchant - Physical Chemical

   2. Beehive

B. Sintering

C. Ironmaking
   1. Iron
   2. Ferromanganese (BPT only)

D. Steelmaking

   1. BOF

      a. Semi-wet
      b. Wet - Open Combustion
      c. Wet - Suppressed Combustion

   2. Open Hearth - Wet

   3. Electric Arc Furnace

      a. Semi-wet
      b. Wet

E. Vacuum Degassing

F. Continuous Casting

G. Hot Forming

   1. Primary

      a. Carbon and Specialty w/o scarfing
      b. Carbon and Specialty w/scarfing

   2. Section

      a. Carbon
      b. Specialty

3. Flat

   a. Hot Strip and Sheet (Carbon and Specialty)
   b. Plate - Carbon
   c. Plate - Specialty

4. Pipe and Tube

H. Salt Bath Descaling

1. Oxidizing

   a. Batch Sheet/Plate
   b. Batch Rod/Wire/Bar
   c. Batch Pipe/Tube
   d. Continuous

2. Reducing

   a. Batch
   b. Continuous

I. Acid Pickling

1. Sulfuric Acid

   a. Rod, Wire and Coil
   b. Bar, Billet, and Bloom
   c. Strip, Sheet and Plate
   d. Pipe, Tube and Other Products
   e. Fume Scrubber

2. Hydrochloric Acid

   a. Rod, Wire and Coil
   b. Strip, Sheet and Plate
   c. Pipe, Tube and Other Products
   d. Fume Scrubber
   e. Acid Regeneration

3. Combination Acid Pickling

   a. Rod, Wire and Coil
   b. Bar, Billet, and Bloom
   c. Cont. - Strip, Sheet and Plate
   d. Batch - Strip, Sheet and Plate
   e. Pipe, Tube and Other Products
   f. Fume Scrubber

TABLE II-5
REVISED STEEL INDUSTRY SUBCATEGORIZATION
PAGE 3

J. Cold Forming

   1. Cold Rolling

      a. Recirculation - Single Stand
      b. Recirculation - Multi Stand
      c. Combination
      d. Direct Application - Single Stand
      e. Direct Application - Multi Stand

   2. Pipe and Tube

      a. Water
      b. Oil Emulsion

K. Alkaline Cleaning

   1. Batch
   2. Continuous

L. Hot Coatings

   1. Galvanizing, Terne & Other
   2. Fume Scrubber

TABLE II-6

CROSS REFERENCE OF REVISED STEEL INDUSTRY SUBCATEGORIZATION TO PRIOR SUBCATEGORIZATION

Revised Subcategorization	Prior Subcategorization (1974 and 1976 Regulations)	Remarks
A. Cokemaking	A. By-Product Coke	
1. By-Product	B. Beehive Coke	
a. Iron & Steel - Biological		
b. Iron & Steel - Physical Chemical		
c. Merchant - Biological		Segment Added
d. Merchant - Physical Chemical		Segment Added
2. Beehive		
B. Sintering	C. Sintering	
C. Blast Furnace	D. Blast Furnace - Iron	
1. Iron	E. Blast Furnace - FeMn	
2. Ferromanganese (BPT only)		
D. Steelmaking		
1. BOF	F. BOF - Semi-wet	
a. Semi-wet	G. BOF - Wet	
b. Wet - Open Combustion		Segment Added
c. Wet - Suppressed Combustion		Segment Added
2. Open Hearth - Wet	H. Open Hearth - Wet	
3. EAF	I. EAF - Semi-wet	
a. Semi-wet	J. EAF - Wet	
b. Wet		
E. Vacuum Degassing	K. Vacuum Degassing	
F. Continuous Casting	L. Continuous Casting	
G. Hot Forming	M. Hot Forming - Primary	
1. Primary	1. Carbon wo/scarfers	Segments
	2. Carbon w/scarfers	Changed
a. Carbon and Specialty wo/scarfers	3. Specialty	
b. Carbon and Specialty w/scarfers		

TABLE II-6
CROSS REFERENCE OF REVISED STEEL INDUSTRY
SUBCATEGORIZATION TO PRIOR SUBCATEGORIZATION
PAGE 2

Revised Subcategorization	Prior Subcategorization (1974 and 1976 Regulations)	Remarks
2. Section	N. Hot Forming - Section	
a. Carbon	1. Carbon	
b. Specialty	2. Specialty	
3. Flat	O. Hot Forming - Flat	
a. Hot Strip and Sheet	1. Hot Strip & Sheet	
b. Plate - Carbon	2. Plate	
c. Plate - Specialty		
	P. Hot Forming - Pipe and Tube	
4. Pipe and Tube	1. Isolated	Segment
	2. Integrated	Changed
H. Scale Removal	X. Scale Removal	
1. Oxidizing		
	a. Kolene	Segments
a. Batch Sheet/Plate		Changed
b. Batch Rod/Wire/Bar		
c. Batch Pipe/Tube		
d. Continuous		
2. Reducing	b. Hydride	Segments
		Changed
a. Batch		
b. Continuous		
I. Acid Pickling	Q. Pickling - Sulfuric Acid - Batch and Continuous	
1. Sulfuric Acid		
	a. Batch - spent liquor,	Segments
a. Rod, Wire and Coil	no rinses	Changed
b. Bar, Billet and Bloom	b. Continuous - Neutralization	
c. Strip, Sheet and Plate	(liquor)	
d. Pipe, Tube and Other Products	c. Continuous - Neutralization	
e. Fume Scrubber	(R, FHS)	
2. Hydrochloric Acid	d. Continuous - Acid Recovery	
	(new facilities)	
a. Rod, Wire and Coil		
b. Strip, Sheet and Plate	R. Pickling - Hydrochloric Acid -	
c. Pipe, Tube and Other Products	Batch and Continuous	
d. Fume Scrubber		
e. Acid Regeneration	a. Concentrates -	Segments
	nonregenerative	Changed
	b. Regeneration	
	c. Rinses	
	d. Fume hood scrubbers	

TABLE II-6
CROSS REFERENCE OF REVISED STEEL INDUSTRY
SUBCATEGORIZATION TO PRIOR SUBCATEGORIZATION
PAGE 3

Revised Subcategorization	Prior Subcategorization (1974 and 1976 Regulations)	Remarks
3. Combination Acid	W. Combination Acid Pickling (Batch and Continuous) Subcategory	Segments Changed
a. Rod, Wire and Coil		
b. Bar, Billet and Bloom		
c. Cont. - Strip, Sheet and Plate	a. Continuous	
d. Batch - Strip, Sheet and Plate	b. Batch - Pipe and Tube	
e. Pipe, Tube and Other Products	c. Batch - other	
f. Fume Scrubber		
J. Cold Forming	S. Cold Rolling	
1. Cold Rolling		
a. Recirculation - Single Stand	a. Recirculation	Segments Added
b. Recirculation - Multi Stand		
c. Combination	b. Combination	
d. Direct Application - Single Stand	c. Direct Application	
e. Direct Application - Multi Stand		
2. Pipe and Tube		
a. Water		Segment Added
b. Oil emulsion		Segment Added
K. Alkaline Cleaning	Z. Continuous Alkaline Cleaning	
a. Batch		Subdivision Added
b. Continuous		
L. Hot Coatings	T. Hot Coatings - Galvanizing	Segments Changed
1. Galvanizing, Terne & Other	a. Galvanizing	
2. Fume Scrubber	b. Fume scrubber	

TABLE II-7

SOLID WASTE GENERATION DUE TO WATER POLLUTION CONTROL
IRON AND STEEL INDUSTRY

Subcategory	BPT (tons/yr) No. of Plants	BPT Model Plant	BPT Subcategory	BAT (tons/yr) No. of Plants	BAT Model Plant	BAT Subcategory	PSES (tons/yr) No. of Plants	PSES Model Plant	PSES Subcategory
A. Cokemaking									
1. Iron & Steel	31	1,239	38,409	28	*	*	8	1,314	10,512
2. Merchant	11	546	6,006	9	*	*	8	292	2,336
B. Sintering	16	165,940	2,655,040	15	*	*	1	165,940	165,940
C. Ironmaking	43	119,465	5,136,995	39	550	21,450	2	120,015	240,030
D. Steelmaking									
1. BOF									
a. Semi-Wet	9	800	7,200	8	-	-	0	800	0
b. Wet Suppressed	5	7,550	37,750	5	70	350	1	7,620	7,620
c. Wet Open	13	63,260	822,380	13	200	2,600	1	63,460	63,460
2. Open Hearth - Wet	4	30,360	121,440	4	265	1,060	0	30,625	0
3. Electric Furnace									
a. Semi-Wet	3	1,500	4,500	3	-	-	0	1,500	0
b. Wet	6	19,270	115,620	6	42	252	1	19,310	19,310
E. Vacuum Degassing	33	80	2,640	31	40	1,240	0	120	0
F. Continuous Casting	42	400	16,800	25	40	1,000	7	440	3,080
G. Hot Forming									
1. Primary									
a. Carbon w/Scarfer	30	80,262	2,407,860	30	-	-	2	80,262[1]	160,524
b. Carbon wo/Scarfer	30	20,718	621,540	29	-	-	2	20,718[1]	41,436
c. Spec. w/Scarfer	5	19,738	98,690	5	-	-	0	19,738[1]	0
d. Spec. wo/Scarfer	12	6,498	77,976	11	-	-	2	6,498[1]	12,996
2. Section									
a. Carbon	52	16,577	862,004	48	-	-	7	16,577[1]	116,039
b. Specialty	20	6,578	131,560	17	-	-	1	6,578[1]	6,578
3. Flat									
a. Carbon HS&S	30	38,479	1,154,370	30	-	-	2	38,479[1]	76,958
b. Spec. HS&S	7	4,883	34,181	7	-	-	0	4,883[1]	0
c. Carbon Plate	11	16,979	186,769	11	-	-	1	16,979[1]	16,979
d. Spec. Plate	5	5,342	26,710	5	-	-	0	5,342[1]	0
4. Pipe & Tube									
a. Carbon	25	759	18,975	25	-	-	1	759[1]	759
b. Specialty	8	2,479	19,832	8	-	-	0	2,479[1]	0
H. Salt Bath Descaling									
1. Oxidizing									
a. Batch Sheet/Plate	5	380	1,900	5	-	-	0	380	0
b. Batch Rod/Wire	3	440	1,320	3	-	-	1	440	440
c. Batch Pipe/Tube	2	540	1,080	2	-	-	0	540	0
d. Continuous	7	420	2,940	7	-	-	1	420	420
2. Reducing									
a. Batch	4	160	640	4	-	-	1	160	160
b. Continuous	2	60	120	2	-	-	0	60	0

TABLE II-7
SOLID WASTE GENERATION DUE TO WATER POLLUTION CONTROL
IRON AND STEEL INDUSTRY
PAGE 2

	BPT (tons/yr)			BAT (tons/yr)			PSES (tons/yr)		
Subcategory	No. of Plants	Model Plant	Subcategory	No. of Plants	Model Plant	Subcategory	No. of Plants	Model Plant	Subcategory
I. Acid Pickling									
1. Sulfuric									
a. S/S/P Neut	23	74,780	1,719,940	23	-	-	4	74,780	299,120
b. R/W/C Neut	16	16,260	260,160	16	-	-	18	16,260	292,680
c. B/B/B Neut	15	22,720	340,800	15	-	-	3	22,720	68,160
d. P/T Neut	17	13,360	227,120	17	-	-	9	13,360	120,240
e. S/S/P AU[2]	2	13,440	26,880	2	-	-	0	-	-
f. R/W/C AU[2]	5	2,340	11,700	5	-	-	0	-	-
g. B/B/B AU[2]	0	4,680	0	0	-	-	0	-	-
h. P/T AU[1]	1	1,560	1,560	1	-	-	0	-	-
2. Hydrochloric									
a. S/S/P Neut	21	85,280	1,790,880	21	-	-	3	85,280	255,840
b. R/W/C Neut	7	3,640	25,480	7	-	-	8	3,640	29,120
c. P/T Neut	2	3,140	6,280	2	-	-	1	3,140	3,140
d. S/S/P AR	4	41,440	165,760	4	-	-	0	-	-
3. Combination									
a. Batch S/S/P	9	5,080	45,720	9	-	-	0	5,080	0
b. Continuous S/S/P	14	27,640	386,960	14	-	-	1	27,640	27,640
c. R/W/C	9	8,120	73,080	9	-	-	8	8,120	64,960
d. B/B/B	3	4,560	13,680	3	-	-	1	4,560	4,560
e. P/T	11	4,740	52,140	11	-	-	8	4,740	37,920
J. Cold Forming									
1. Cold Rolling									
a. Single Stand Recirc	13	40	520	13	-	-	3	40	120
b. Multi Stand Recirc	21	700	14,700	21	-	-	3	700	2,100
c. Combination	10	9,300	93,000	10	-	-	0	9,300	0
d. Single Stand DA	9	340	3,060	9	-	-	0	340	0
e. Multi Stand DA	10	1,800	18,000	10	-	-	0	1,800	0
2. CF - Pipe & Tube									
a. Water	9	140	1,260	9	-	-	2	-	-
b. Oil	19	420	7,980	19	-	-	0	1,320	0
K. Alkaline Cleaning									
1. Batch	22	20	440	22	-	-	9	-	-
2. Continuous	22	260	5,720	22	-	-	9	-	-
L. Hot Coating									
1. Galvanizing									
a. S/S/M wo/FS	18	1,380	24,840	14	-	-	2	1,380	2,760
b. S/S/M w/FS	12	1,640	19,680	11	*	*	1	1,640	1,640
c. WP/F wo/FS	10	440	4,400	9	-	-	7	440	3,080
d. WP/F w/FS	6	520	3,120	6	*	*	7	520	3,640
2. Terne									
a. S/S/M wo/FS	1	240	240	1	-	-	1	240	240
b. S/S/M w/FS	3	340	1,020	3	*	*	0	340	0
3. Other									
a. S/S/M wo/FS	4	960	3,840	3	-	-	0	960	0
b. S/S/M w/FS	0	1,220	0	0	*	*	0	1,220	0
c. WP/F wo/FS	2	80	160	2	-	-	4	80	320
d. WP/F w/FS	0	100	0	0	*	*	0	100	0
TOTALS			19,963,367			27,952			2,162,857

(1): Based upon current practices of POTW discharges.
(2): Ferrous sulfate crystal disposal
\- : No limitations/standards are being promulgated for this subdivision.
* : Sludge generation at this level is minimal and is included in the BPT sludge generation load.

TABLE II-8

ENERGY REQUIREMENTS DUE TO WATER POLLUTION CONTROL
IRON AND STEEL INDUSTRY

Subcategory	BPT (kwh) No. of Plants	BPT (kwh) Model	BPT (kwh) Subcategory	BAT (kwh) No. of Plants	BAT (kwh) Model	BAT (kwh) Subcategory	PSES (kwh) No. of Plants	PSES (kwh) Model	PSES (kwh) Subcategory
A. Cokemaking									
1. Iron & Steel	31	1,668,000	51,708,000	28	1,416,000	39,648,000	8	620,000	4,960,000
2. Merchant	11	804,000	8,844,000	9	588,000	5,292,000	8	216,000	1,728,000
B. Sintering	16	2,512,000	40,192,000	15	152,000	2,280,000	1	2,664,000	2,664,000
C. Ironmaking	43	9,768,000	420,024,000	39	340,000	13,260,000	2	10,064,000	20,128,000
D. Steelmaking									
1. BOF									
a. Semi-Wet	9	44,000	396,000	8	-	-	0	44,000	0
b. Wet Suppressed	5	1,048,000	5,240,000	5	76,000	380,000	1	1,124,000	1,124,000
c. Wet Open	13	2,904,000	37,752,000	13	160,000	2,080,000	1	3,064,000	3,064,000
2. Open Hearth - Wet	4	1,696,000	6,784,000	4	168,000	672,000	0	1,864,000	0
3. Electric Furnace									
a. Semi-Wet	3	28,000	84,000	3	-	-	0	28,000	0
b. Wet	6	776,000	4,656,000	6	80,000	480,000	1	856,000	856,000
E. Vacuum Degassing	33	1,044,000	34,452,000	31	48,000	1,488,000	0	1,052,000	0
F. Continuous Casting	42	2,588,000	108,696,000	25	48,000	1,200,000	7	2,600,000	18,200,000
G. Hot Forming									
1. Primary									
a. Carbon w/Scarfer	30	732,000	21,960,000	30	-	-	2	732,000 (1)	1,464,000
b. Carbon wo/Scarfer	30	1,140,000	34,200,000	29	-	-	2	1,140,000 (1)	2,280,000
c. Spec. w/Scarfer	5	408,000	2,040,000	5	-	-	0	408,000 (1)	0
d. Spec. wo/Scarfer	12	548,000	6,576,000	11	-	-	2	548,000 (1)	1,096,000
2. Section									
a. Carbon	52	1,000,000	52,000,000	48	-	-	7	1,000,000 (1)	7,000,000
b. Specialty	20	452,000	9,040,000	17	-	-	1	452,000 (1)	452,000
3. Flat									
a. Carbon HS&S	30	1,304,000	39,120,000	30	-	-	2	1,304,000 (1)	2,608,000
b. Spec. HS&S	7	568,000	3,976,000	7	-	-	0	568,000 (1)	0
c. Carbon Plate	11	616,000	6,776,000	11	-	-	1	616,000 (1)	616,000
d. Spec. Plate	5	240,000	1,200,000	5	-	-	0	240,000 (1)	0

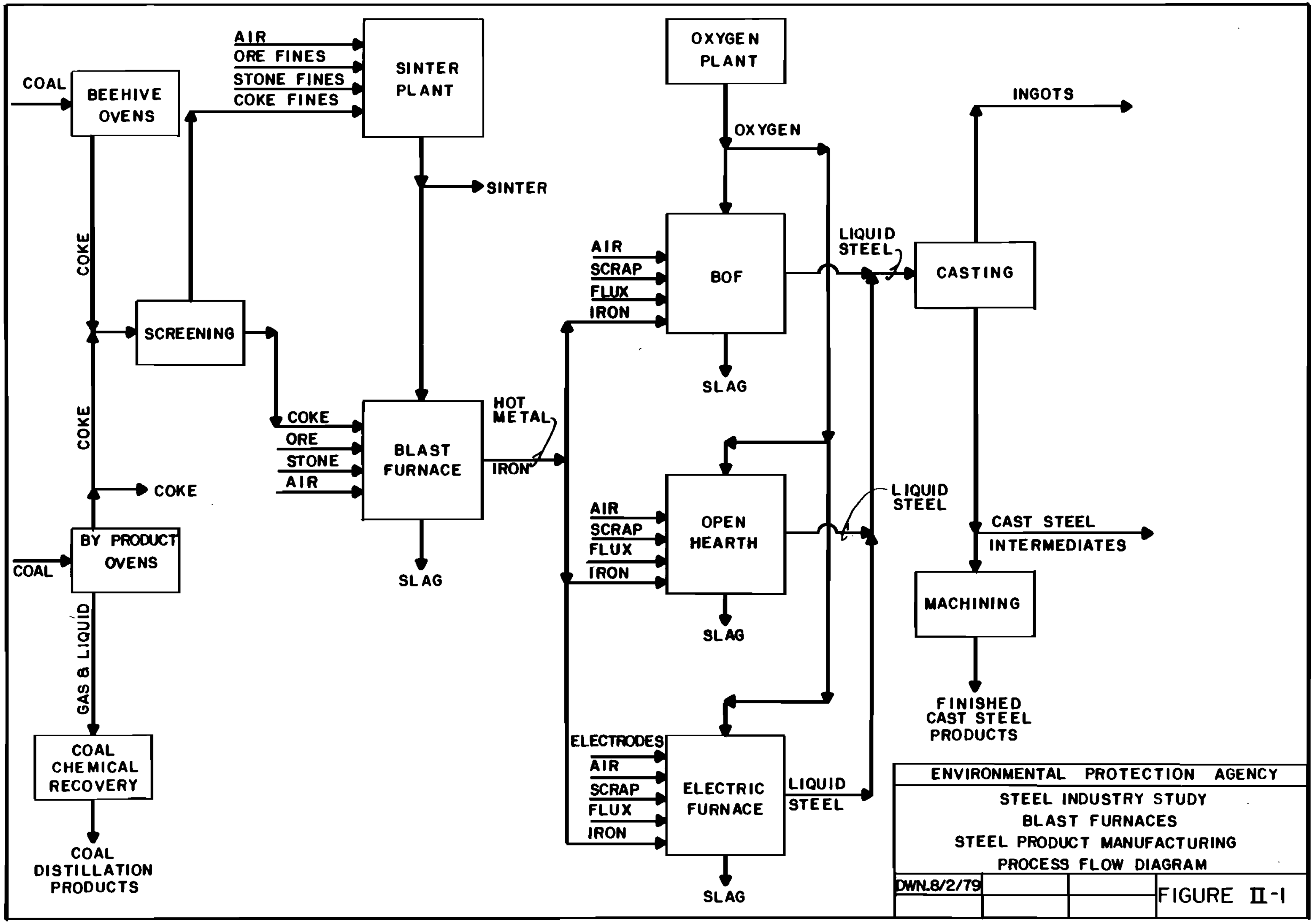
TABLE II-8
ENERGY REQUIREMENTS DUE TO WATER POLLUTION CONTROL
IRON AND STEEL INDUSTRY
PAGE 2

Subcategory	BPT (kwh) No. of Plants	BPT (kwh) Model	BPT (kwh) Subcategory	BAT (kwh) No. of Plants	BAT (kwh) Model	BAT (kwh) Subcategory	PSES (kwh) No. of Plants	PSES (kwh) Model	PSES (kwh) Subcategory
4. Pipe & Tube									
a. Carbon	25	428,000	10,700,000	25	-	-	1	428,000(1)	428,000
b. Specialty	8	768,000	6,144,000	8	-	-	0	768,000(1)	0
H. Salt Bath Descaling									
1. Oxidizing									
a. Batch Sheet/Plate	5	188,000	940,000	5	-	-	0	188,000	0
b. Batch Rod/Wire	3	196,000	588,000	3	-	-	1	196,000	196,000
c. Batch Pipe/Tube	2	200,000	400,000	2	-	-	0	200,000	0
d. Continuous	7	200,000	1,400,000	7	-	-	1	200,000	200,000
2. Reducing									
a. Batch	4	76,000	304,000	4	-	-	1	76,000	76,000
b. Continuous	2	76,000	152,000	2	-	-	0	76,000	0
I. Acid Pickling									
1. Sulfuric									
a. S/S/P Neut	23	860,000	19,780,000	23	-	-	4	860,000	3,440,000
b. R/W/C Neut	16	448,000	7,168,000	16	-	-	18	448,000	8,064,000
c. B/B/B Neut	15	424,000	6,360,000	15	-	-	3	424,000	1,272,000
d. P/T Neut	17	404,000	6,868,000	17	-	-	9	404,000	3,636,000
e. S/S/P AU	2	2,148,000	4,296,000	2	-	-	0	-	-
f. R/W/C AU	5	396,000	1,980,000	5	-	-	0	-	-
g. B/B/B AU	0	744,000	0	0	-	-	0	-	-
h. P/T AU	1	232,000	232,000	1	-	-	0	-	-
2. Hydrochloric									
a. S/S/P Neut	21	7,040,000	147,840,000	21	-	-	3	7,040,000	21,120,000
b. R/W/C Neut	7	332,000	2,324,000	7	-	-	8	332,000	2,656,000
c. P/T Neut	2	316,000	632,000	2	-	-	1	316,000	316,000
d. S/S/P AR	4	11,716,000	46,864,000	4	-	-	0	-	-
3. Combination									
a. Batch S/S/P	9	332,000	2,988,000	9	-	-	0	332,000	0
b. Continuous S/S/P	14	1,112,000	15,568,000	14	-	-	1	1,112,000	1,112,000
c. R/W/C	9	388,000	3,492,000	9	-	-	8	388,000	3,104,000
d. B/B/B	3	316,000	948,000	3	-	-	1	316,000	316,000
e. P/T	11	324,000	3,564,000	11	-	-	8	324,000	2,592,000

TABLE II-8
ENERGY REQUIREMENTS DUE TO WATER POLLUTION CONTROL
IRON AND STEEL INDUSTRY
PAGE 3

Subcategory	BPT (kwh) No. of Plants	BPT (kwh) Model	BPT (kwh) Subcategory	BAT (kwh) No. of Plants	BAT (kwh) Model	BAT (kwh) Subcategory	PSES (kwh) No. of Plants	PSES (kwh) Model	PSES (kwh) Subcategory
J. Cold Forming									
1. Cold Rolling									
a. Single Stand Recirc	13	120,000	1,560,000	13	-	-	3	120,000	360,000
b. Multi Stand Recirc	21	220,000	4,620,000	21	-	-	3	220,000	660,000
c. Combination	10	1,444,000	14,440,000	10	-	-	0	1,444,000	0
d. Single Stand DA	9	292,000	2,628,000	9	-	-	0	292,000	0
e. Multi Stand DA	10	1,104,000	11,040,000	10	-	-	0	1,104,000	0
2. CF - Pipe & Tube									
a. Water	9	8,000	72,000	9	-	-	2	-	-
b. Oil	19	8,000	152,000	1	-	-	0	8,000	0
K. Alkaline Cleaning									
1. Batch	22	60,000	1,320,000	22	-	-	9	-	-
2. Continuous	22	96,000	2,112,000	22	-	-	9	-	-
L. Hot Coating									
1. Galvanizing									
a. S/S/M wo/FS	18	352,000	6,336,000	14	-	-	2	362,000	724,000
b. S/S/M w/FS	12	452,000	5,424,000	11	32,000	352,000	1	484,000	484,000
c. WP/F wo/FS	10	244,000	2,440,000	9	-	-	7	244,000	1,708,000
d. WP/F w/FS	6	348,000	2,088,000	6	32,000	192,000	7	380,000	2,660,000
2. Terne									
a. S/S/M wo/FS	1	192,000	192,000	1	-	-	1	192,000	192,000
b. S/S/M w/FS	3	248,000	744,000	3	24,000	72,000	0	272,000	0
3. Other									
a. S/S/M wo/FS	4	300,000	1,200,000	3	-	-	0	300,000	0
b. S/S/M w/FS	0	332,000	0	0	24,000	0	0	60,000	0
c. WP/F wo/FS	2	60,000	120,000	2	-	-	4	136,000	544,000
d. WP/F w/FS	0	136,000	0	0	24,000	0	0	160,000	0
TOTALS			1,243,736,000			67,396,000			124,100,000

(1) Based upon current treatment practices.

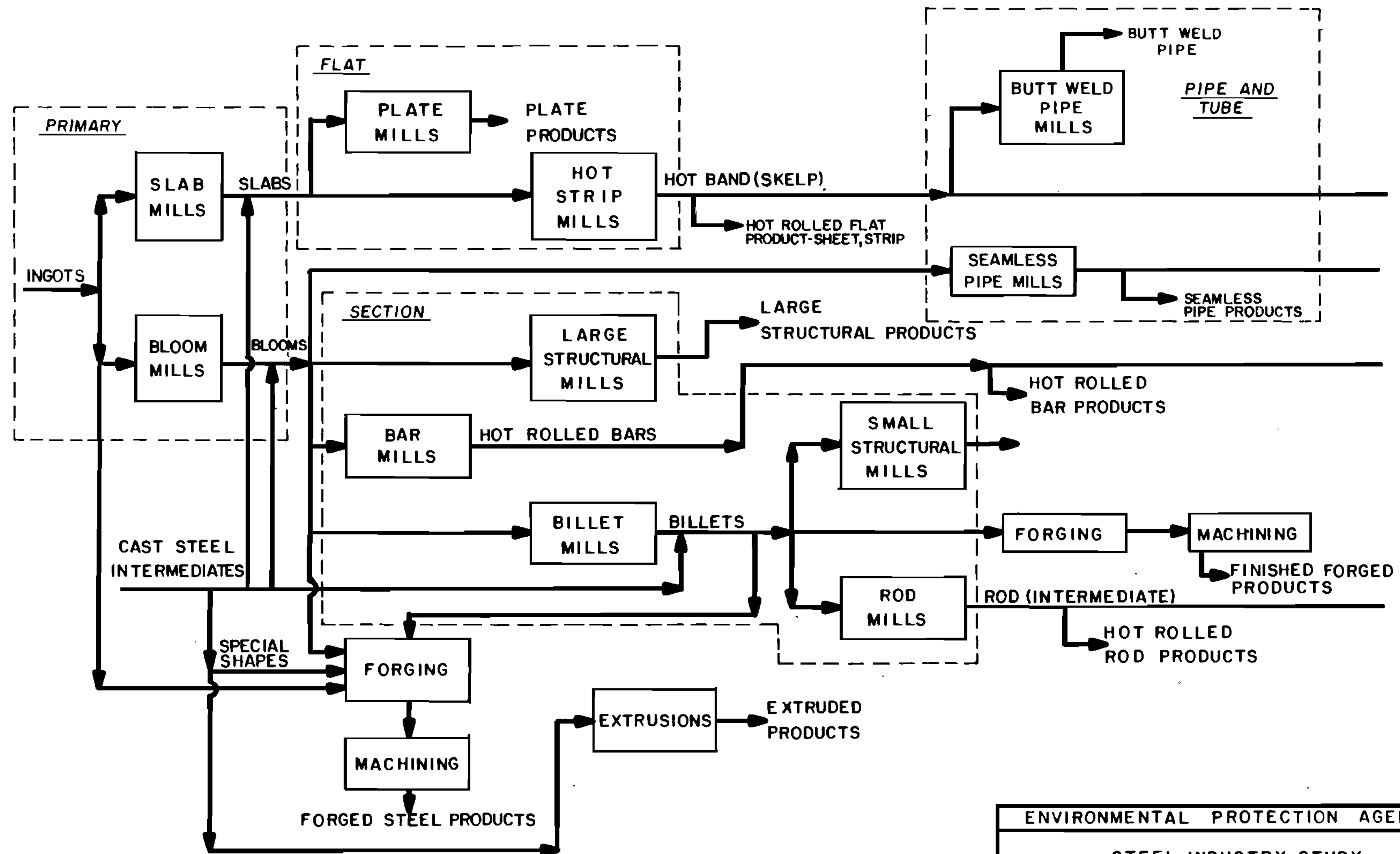


ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
BLAST FURNACES
STEEL PRODUCT MANUFACTURING
PROCESS FLOW DIAGRAM

DWN.8/2/79

FIGURE II-1

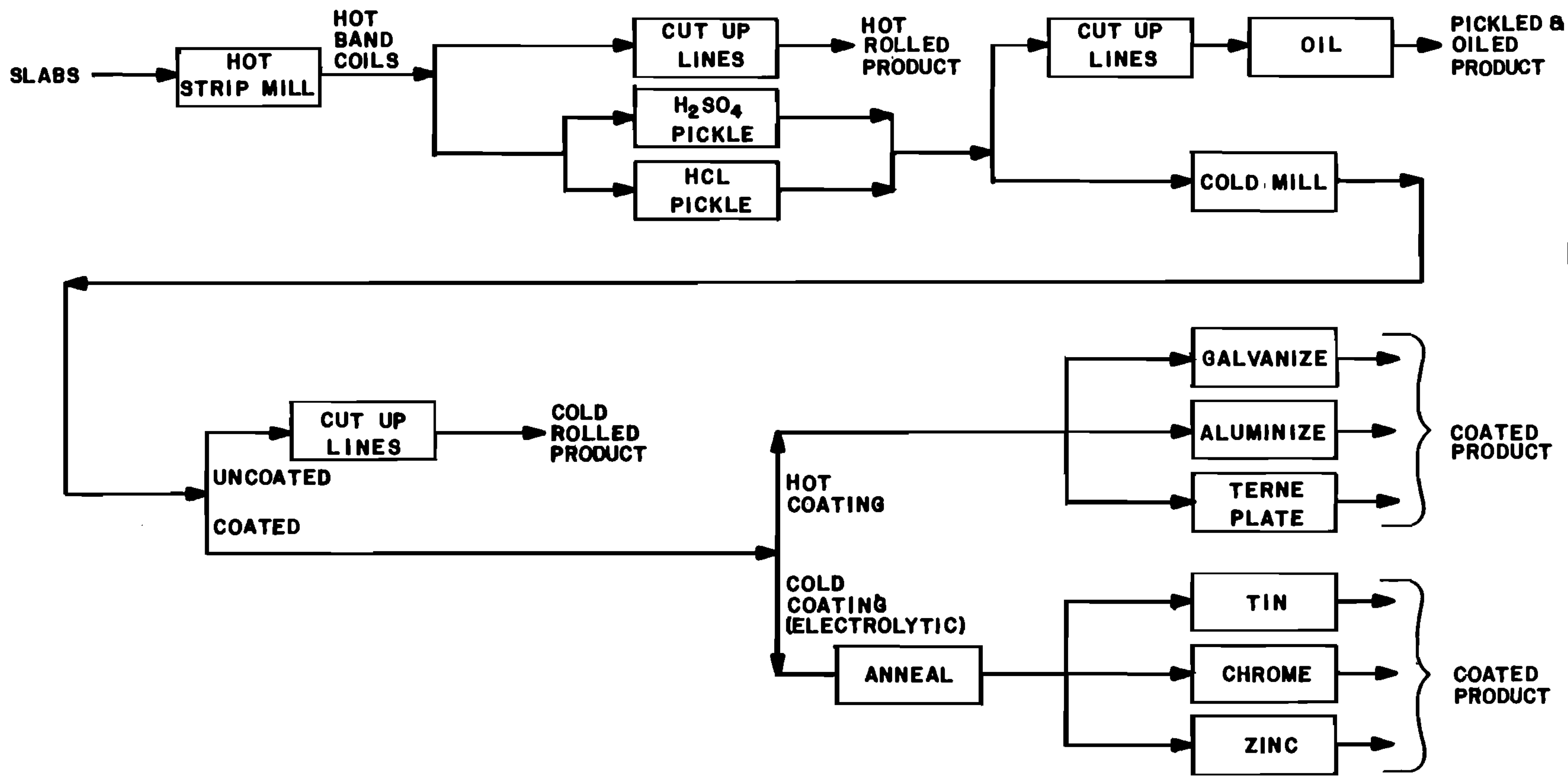


ENVIRONMENTAL PROTECTION AGENCY

STEEL INDUSTRY STUDY
HOT FORMING
PROCESS FLOW DIAGRAM

Dwn. 4/25/79

FIGURE II-2



ENVIRONMENTAL PRODUCTION AGENCY

STEEL INDUSTRY STUDY
FLAT PRODUCTS GENERAL
PROCESS FLOW DIAGRAM

Dwn. 7/15/80

FIGURE II-3

VOLUME I

SECTION III

REMAND ISSUES ON PRIOR REGULATIONS

Introduction

After reviewing the 1974 (Phase I) and 1976 (Phase II) regulations for the steel industry, the Court of Appeals ordered EPA to reconsider several matters. This section provides a summary of the Agency's evaluation and response to the "remand issues". The respective subcategory reports provide the Agency's responses to subcategory specific remand issues.

1. Site-Specific Costs

In its challenge to the Phase I regulation, the industry asserted that EPA's cost estimates did not include allowances for "site-specific" costs. The industry submitted no data showing the magnitude of site-specific costs. The Agency responded that it included all costs which could be reasonably estimated and that it believed its estimates were sufficiently generous to cover site-specific costs. On this basis, the court rejected this challenge to the regulation. American Iron and Steel Institute v. EPA, 526 F.2d 1027 (3d Cir. 1975), modified in part, 560 F.2d 589 (3d Cir. 1977), cert. den. 98 S. Ct 1467 (1978).

In the Phase II proceedings, however, evidence of the possible magnitude of "site-specific" cost was presented.[4] On this basis, the court ordered EPA to reevaluate its cost estimates in light of site-specific costs. In particular, the court ordered EPA to include these costs, or analyze the generosity of its estimates by comparing model cost estimates with actual reported costs, or explain why such an analysis could not be done.

In response to the court's decisions, the Agency reevaluated its cost estimates for Phase I and Phase II operations. First, the Agency included in its estimates many "site-specific" costs which were not included in prior estimates.[5] In the Agency's view, it has included all "site-specific costs" that can be reasonably and accurately estimated without detailed site-specific studies. The

[4]This evidence consisted of the plant-by-plant compliance estimates for facilities located in the Mahoning Valley region of Eastern Ohio.

[5]These newly added cost items include: land acquisition costs, site clearance costs, utility connections, and miscellaneous utility requirements. (Reference is made to Section VII)

remaining "site-specific" costs not included are so highly variable and inherently site-specific that reasonably accurate estimates would require an evaluation of the factors as they apply to each operation. It should be noted that studies commissioned by AISI, itself, also exclude site-specific costs. For example, in Arthur D. Little's Steel and the Environment - A Cost Impact Analysis, site-specific costs and land acquisition costs were excluded "...because detailed site-specific studies would be required."

Second, the Agency included in its cost estimates allowances for unforeseen expenses. The model-based cost estimates for each subcategory include a 15% contingency fee.[6]

Third, the Agency has based its cost estimates on many conservative assumptions. For instance, in most subcategories, the Agency's cost estimates are based upon individual treatment of wastewaters from all operations within each subcategory at each plant site. In fact, however, the industry has installed and will continue to install less costly "central treatment" systems to treat combined waste streams from several subcategories. Additionally, EPA's model based estimates reflect off the shelf parts and costs for "outside" engineering and construction services.[7] In fact, however, the industry often uses "in-house" engineering and construction resources, and improves wastewater quality by "gerrymandering" existing treatment systems and upgrading operating and maintenance practices. The Agency's cost estimates reflect treatment in place as of 1976 and treatment to have been installed by January 1978 [based upon survey (DCP) responses]; and facilities in place as of July 1, 1981. The Agency updated the status of the industry from January 1978 to July 1981 from personal knowledge of Agency experts on the industry; NPDES records; and, in some cases, telephone surveys.

Fourth, EPA has compared its model-based cost estimates to the costs reported by the industry. This comparison shows that the Agency's estimates are sufficiently generous to reflect all costs, including "site-specific" costs. Model-based estimates cannot be expected to precisely reflect the costs incurred or to be incurred by each individual plant. Variations of greater than ±50% would not be considered outside normal confidence levels. For example, in Steel and the Environment - A Cost Impact Analysis, a study by Arthur D. Little, Inc., commissioned by the AISI, the authors indicated that cost estimates were within ± 50%

[6]This contingency fee was also included in previous cost estimates.
[7]The model estimates include 15% for engineering services.

for individual process steps and ± 85% for individual plants.[8] Often, variations from model estimates cannot be explained. The validity of model estimates, therefore, should be judged by the ability to depict actual costs for subcategories of the industry for the industry, as a whole where several treatment systems are evaluated collectively.

The Agency's comparison of model-based cost estimates and costs reported by industry involved two complimentary analyses. First, the Agency compared actual reported treatment costs (including all site-specific costs) to the model cost estimates for the treatment components in place at the reporting plants. These comparisions include costs for all plants for which sufficiently detailed cost information were provided, taking into account the level of treatment in place. To generate valid comparisons, the model cost estimate was scaled to the actual production of the reporting plant by the application of the accepted engineering "six-tenths" factor. The Agency scaled production of the model to actual production of the reporting plant because, in its view, this produces the most reliable cost comparison. Another possible method of comparison would be to scale the flow of the model to the actual flow of the reporting plant. This method of scaling would overstate treatment costs because costs are highly dependent on flow volume (higher flows require larger and more costly treatment systems) and many plants in the industry use and discharge more water than necessary. Also, flow data are not available for all plants while production data are available for most operations and plants in the industry. This comparative analysis is summarized below for those subcategories where the Agency was able to obtain reliable subcategory-specific costs from the industry.

[8]See pages B-64 and B-65 of Steel and the Environment - A Cost Impact Analysis which AISI submitted to EPA during the Phase II rulemaking.

Treatment In Place v. Model Estimates for Same Treatment

Subpart (process)	Actual Cost ($\$ \times 10^{-6}$)	EPA Model Estimate ($\$ \times 10^{-6}$)	Actual as % of Model
A. Cokemaking	56.05	54.24	103
B. Sintering	6.43	10.53	61
C. Ironmaking	110.12	123.39	89
D. Steelmaking	37.61	42.32	89
E. Vacuum Degassing	2.19	2.32	94
F. Continuous Casting	29.38	23.00	128
G. Hot Forming	78.87	107.46	73
Total	320.65	363.26	88.3

This summary shows that actual reported costs for the industry (including all site-specific costs) represent about 88% of the model estimates for the same treatment components. On this basis, the Agency concludes that its model estimates are sufficiently generous to reflect site-specific costs.

In the second comparison of reported costs and model estimates, the Agency compared the reported costs (including all site-specific costs) of plants meeting BPT (or BAT) to the model estimates for the BPT (or BAT) treatment system. This methodology, which the Agency presented in its brief in the Phase II proceedings, demonstrates that the effluent limitations and standards can be achieved with treatment systems comparable to the Agency's treatment models at costs comparable to the Agency's estimated costs. This comparison, which also is based upon scaling of production by the "six-tenths factor," is summarized below:

SUMMARY

Complying Plant Costs v. Model Compliance Estimates

Subcategory (process)	Actual Costs ($\$ x10^{-6}$)	Model Estimate ($\$ x10^{-6}$)	Actual as % of Model
A. Cokemaking	40.71	40.60	100
B. Sintering	5.92	6.35	93
C. Ironmaking	33.16	51.97	64
D. Steelmaking	37.61	47.74	79
E. Vacuum Degassing	2.08	2.48	84
F. Continuous Casting	19.36	18.61	104
G. Hot Forming	77.64	106.22	73
Total	216.48	273.97	79.0

Again, this summary shows that total reported costs (including all site-specific costs) for plants meeting required effluent levels is about 79% of model estimates. On this basis, EPA likewise concludes that its model-based cost estimates are sufficiently generous to reflect site-specific costs.

As noted in the subcategory reports for many of the Phase II operations, central treatment of wastewaters from finishing operations is common in the steel industry. The cost data reported by the industry for these central treatment systems are often not directly usable for the purpose of verifying the Agency's cost estimates for individual subcategory treatment systems. As noted earlier, the Agency considered co-treatment of wastewaters at plants within subcateogries, but did not consider co-treatment or central treatment across subcategories in developing cost estimates. To determine the impact of the extensive amount of central treatment in the industry on the Agency's ability to accurately estimate costs, the Agency compared actual industry central treatment costs with the Agency's model based cost estimates for the respective subcategories included in the industry's central treatment systems. This comparison is shown below.

ACTUAL COSTS vs. EPA CO-TREATMENT ESTIMATES

PLANT	SUBCATEGORIES	ACTUAL COST	MODEL COST
0112B	Hot Forming (Primary, Section)	$ 2,578,000	$ 5,133,000
0112H	Pickling (HCl, Combination)	746,000	882,000
0432K	Pickling, Scale Removal, Alkaline Cleaning	9,350	1,374,000
0796 & 0796A	Vacuum Degassing, Continuous Casting, Hot Forming (Primary, Section, Pipe and Tube), Pickling (H_2SO_4), Cold Rolling	16,770,000	15,793,000
0868A	Cold Rolling, Pickling (HCl, H_2SO_4), Hot Coating, Alkaline Cleaning	4,857,000	5,235,000
0868A	Hot Forming (Primary, Section)	303,000	2,317,000
0176	Hot Forming (Primary and Section), Cold Rolling (Direct Application), Cold Worked Pipe and Tube, Pickling (HCl, H_2SO_4, Combination), Scale Removal, Alkaline Cleaning	3,060,000	5,587,000
0460A	Hot Forming (Primary, Section)	340,000	1,017,000
0612	Hot Coating (Galvanizing), Pickling (HCl)	1,645,000	3,914,000
0728	Hot Forming (Pipe and Tube), Pickling (H_2SO_4), Hot Coating (Galvanizing)	198,000	437,000
	TOTAL	31,432,000	41,689,000

These data clearly indicate that in total, the Agency's estimates for separate subcategory-specific treatment systems far exceed those costs reported by the industry for central treatment. Of particular interest are the data reported for plants 0796-0796A, a central treatment facility that achieves the BAT limitations for the operations included in the central treatment facility. The Agency's estimate is within six percent of the actual cost reported by the company. This system includes several miles of retrofitted wastewater collection and distribution piping not likely to be included in most central treatment systems. Based upon the above, the Agency concludes that its separate subcategory-specific cost estimates for the Phase II operations are sufficiently generous to include those site specific costs likely to be incurred for most central treatment facilities, and may be overly generous in depicting potential costs for steel finishing operations as a whole.

Another approach to judging the sufficiency of the Agency's model estimates, to account for "site-specific" costs, is to determine the adequacy of the Agency's cost estimates for several steel mills located in the Mahoning Valley of Ohio. Studies of these plants completed in 1977 included cost estimates for compliance with the previously promulgated and proposed Phase I and Phase II requirements. These eight plants were among the oldest in the country. Estimated compliance costs were furnished by the owners of the plants, based upon actual site inspections and engineering studies, and were verfied by the Agency's engineering contractor.

The tables summarizing those studies, which were part of the record of the Phase II rulemaking, are reproduced as Tables III-1 through III-3. Table III-1 summarizes the estimated compliance costs for the Youngstown Sheet and Tube Corporation Brier Hill, Campbell, and Struthers Works. Column #1 shows YS&T's estimate of BAT compliance costs, totaling $54,106,000, including all site-specific costs.[9] The Agency's contractor estimates, $51,214,000, is shown in Column #2. In Columns #3 and #4, the Agency's contractor scaled the flow and production of the BAT cost model to the actual flow and production of the mills involved, yielding cost estimates of $53,218,000 and $60,568,000, respectively. By either method of scaling, the Agency's estimate is representative of YS&T's estimate which includes site-specific costs. In fact, the estimate scaled by production (the method now used for all cost estimates) more than accounted for the significant "site-specific" costs the industry claimed the model could not reflect.[10]

Analyses of estimated compliance costs for facilities owned by United States Steel Corporation and Republic Steel Corporation yield similar results. Table III-2 shows that U.S. Steel's $33,110,000 BAT estimate (including $13,145,000 site costs) for its McDonald Mills and Ohio Works plants is within 4% of EPA's model estimate of $34,389,000 (scaled by production). Similarly, Table III-3 shows that Republic Steel's BPT estimate of $70,099,000 (including $15,590,000 site costs) for its Warren, Youngstown, and Niles plants is within 4% of the Agency's model estimated cost of $72,640,000 for physical/chemical treatment (scaled by production) and within 5% of the Agency's model estimate of $73,486,000 for biological treatment (scaled by production).

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[9]Column #5 reflects the judgment of the Agency's contractor that YS&T's $54,106,000 estimate (Column #1) included "site-specific" costs of $18,176,000.

[10]Columns #6 and #7 add site-specific costs to model estimates scaled by flow and production, yielding $71,394,000 and $78,744,000, respectively. If accurate estimation required addition of "site-specific" costs to model estimates, as industry claimed, then YS&T's compliance costs would be overstated by $17,288,000 (scaled by flow) or $24,638,000 (scaled by production).

As a final comparison, the Agency has compared its model Cost[11] estimate for a blast furnace wastewater treatment facility against that prepared by an engineering company as comissioned by one of its clients. This company costs the BAT-2 system (as identified in the 1979 draft development document) for blast furnaces and supplied its costs estimate to the Agency in its comments to the October 1979 draft development document. The company's cost and flow basis is compared below to the estimate made by the Agency. Both estimates are based upon the same model size ironmaking operation.

	EPA Estimate	Company Estimate
Flow	50 gal/ton	100 gal/ton
Capital	$2.49 million	$3.94 million

If both estimates are costed on the same flow basis (100 gal/ton) the costs are as follows:

EPA Estimate	Company Estimate
$3.78 million	$3.94 million

These data show that the Agency's estimate is within 4.1% of the estimate made by the engineering firm. This comparison further substantiates the reasonableness and accuracy of the Agency's cost models and costing methodology.

In summary, EPA has thoroughly reevaluated its model cost estimates in light of "site-specific" costs. It has added additional site costs to the models (see Section VII); included contingency fees in the models; used conservative cost assumptions; compared reported costs for treatment in place to model estimates for similar treatment; compared reported costs for compliance and model estimates for compliance; and, compared plant-by-plant compliance estimates with model-based cost estimates. Based upon the above, the Agency concludes that its cost estimates are sufficiently generous to reflect "site-specific" costs and other compliance costs likely to be incurred by the industry.

2. The Impact of Plant Age on the Cost or Feasibility of Retrofitting Control Facilities

The industry challenged both the 1974 and 1976 regulations on the basis that the Agency had failed to adequately consider the impact of plant age. In the Phase I decision, the Court held

[11] Volume 3, Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category; the Agency 440/1-79/024a, October 1979.

that while the Agency had adequately considered the impact of age on wastewater characteristics and treatability, it had failed to adequately consider the impact of age on the "cost or feasibility of retrofitting" controls.

In the Phase II proceedings, the Agency strenuously argued that plant age was not a meaningful criteria in the steel industry because plants are continually rebuilt and modernized. In response to this argument, the Court stated:

"Were we writing on a clean slate, we might find this argument convincing. But since the facts in this case cannot be properly distinguished from the facts in the earlier case we must reject EPA's contention ... We note, however, that we have not dismissed the EPA's resolution of the retrofit question on the merits. We merely require that the Agency reexamine the relevance of age specifically as it bears on retrofit." 568 F.2d at 299-300.

In light of these decisions, the Agency has throughly examined the impact of plant "age" on the "cost or feasibility" of retrofitting controls. First, in the basic Data Collection Portfolio (DCP) sent to owners or operators of all "steelmaking" operations and about 85% of "forming and finishing" operations, the Agency solicited information on the "age" of plants (including the first year of on-site production and the dates of major rebuilds and modernizations); and, the "age" of treatment facilities in place. Next, the Agency sent Detailed Data Collection Portfolios (D-DCPs) for a selected number of plants, asking owners of these plants, among other things, for a detailed report of the costs of treatment in place and the portion of those costs attributable to "retrofitting" controls. Finally, the Agency and its engineering consultant evaluated these data to determine whether plant "age" affected the "cost or feasibility of retrofitting" and, if so, whether altered subcategorization or relaxed requirements for "older" plants are warranted.

The Agency's evaluation of all available data confirms its earlier conclusion that plant "age" does not significantly affect the "cost or feasibility of retrofitting" pollution controls to existing production facilities in the steel industry. In the first place, plant "age" is not a particularly meaningful criteria in the industry. "Age" is extremely difficult to define. Judging from the first year of on-site production, the industry, as a whole, is "old." But, production facilities are continually rebuilt and modernized, some on periodic "campaign" schedules. Moreover, "campaign" schedules for operations in different subcategories, or even for operations within the same process (e.g., coke batteries) are different. Complicating this further is the fact that integrated mills contain many processes of different "ages" with different dates of first on-site production and different rebuild schedules.

Therefore, the year of first on-site production does not represent the true plant "age." For instance, at the "oldest" (1901) cokemaking facility (based upon first year of production), the "oldest" active battery dates from 1968. At several "old" plants (based upon first year of production), the "oldest" active batteries range between 1953 and 1973 and the "newest" active batteries date between 1967 and 1980.

The "age" of coke plants, therefore, changes dramatically with the criteria for determining "age." Based upon the "oldest" active battery, 7.4% of the plants date from 1920 or before; 5.9% date between 1921- 1940; 65.5% date between 1941-1960; and 20.8% date between 1961 and the present. Based on "newest" active battery, 4.4% of the plants date from 1920 or before, 40.2% date between 1941-1960, and the "age" of most (55.2%) of the plants is between 1960 and the present. Depending on the criteria selected, the age of a particular cokemaking plant, or the cokemaking industry as a whole, can vary significantly.

In the ironmaking subcategory, the date of first on-site production ranges between 1883 and 1974. However, most blast furnaces undergo major rebuilds every 9 or 10 years. Therefore, the age when determined by the last year of major rebuild would be significantly less than that based upon the first year of production.

Among most of the other subcategories, the situation is similar. Table III-4 summarizes, by subcategory, the "age" of plants in the steel industry. In each case, the "age" of plants is difficult to define because production facilities are periodically rebuilt and modernized. In many of the remaining subcategories and subdivisions, such as electric arc furnaces, "age" is not relevant because all plants are of essentially the same vintage.

Modernization of production facilities provides an impetus for construction or modernization of treatment facilities. Thus, the Agency concluded that because of the continual rebuilding and modernization of production facilities, plant "age" is not a meaningful factor in the steel industry. This conclusion is supported by studies commissioned by the industry. For example, in Steel and the Environment - A Cost Impact Analysis, which AISI submitted to EPA in its comments on the 1976 rulemaking, Arthur D. Little, Inc. concluded (at page 484) that:

"In the iron and steel industry it is difficult to define the age of a plant because many of the unit operations were installed at different times and also are periodically rebuilt on different schedules. Thus, by definition, the age of steel facilities should offer only limited benefits as a means of categorizing plants for purposes of standard setting or impact analysis."

Despite the difficulty of defining plant "age," the Agency did not terminate its analysis of the impact of "age" on the "cost or feasibility" of retrofitting controls. On the contrary, the Agency selected determinants of "age" and then analyzed the impact on the "cost or feasibility" of retrofitting.

With regard to the "feasibility" of retrofitting, the evidence is conclusive: Plant "age" does not affect the "ease" or "feasibility" of retrofitting pollution controls. Table III-5 shows that, in all subcategories, some of the "oldest" facilities (based on first year of on-site production) have among the "newest" and most efficient wastewater treatment systems. The characteristics and treatability of wastewaters from plants of all ages within each subcategory are similar. Moreover, the Agency found that treatment systems applied to wastewaters within each subcategory produced similar effluent loads, and that the same effluent limitations can be met regardless of the age of the plant. Among coke plants, for example, the oldest by-product plant (0024B) was retrofitted with water pollution control facilities as recently as 1977. Moreover, Plant 0868A, which is one of the oldest coke plants (first year of production in 1912), retrofitted pollution control facilities. This treatment facility produces an effluent which is among the best observed in the industry. In fact, the Agency has used this treatment facility as a model and has established the BAT limitations based upon the performance of this plant. Clearly, age has no affect on the feasibility of retrofitting pollution control equipment. The Agency did find, however, that the "ease" or "feasibility" of retrofitting and, to some extent, the cost of retrofitting one of its model treatment technologies (cascade rinse systems for acid pickling and hot coating operations) is significantly different for new sources vs. existing sources of any age. Accordingly, the Agency selected this technology as the basis for new source performance standards and pretreatment standards for new sources and did not use this technology to establish limitations and standards for existing sources. The factors considered by the Agency in making this determination are set out in the Acid Pickling subcategory report.

With regard to the cost of retrofitting, the impact of plant "age" is more difficult to ascertain. Costs attributable to retrofitting pollution control facilities were reported for only 15% of the plants for which responses to Agency questionnaires were received. For those plants where "retrofit" costs were reported, retrofit costs of less than 6% of pollution control costs were reported for 73% of the plants. On the basis of these survey responses, the Agency concludes that "age" of plants does not have a significant impact on the cost of retrofitting pollution controls on an industry wide basis.

The Agency's examination of the Mahoning Valley plants also supports the conclusion that "age" of plants does not significantly impact the "cost or feasibility" of retrofitting.

This examination, discussed above in regard to "site-specific" costs, showed that, for eight of the oldest plants in the country, the industry's estimated compliance costs do not vary significantly from the agency's model cost estimates.

On the basis of the foregoing, the Agency concludes that plant "age" does not significantly affect the "cost or feasibility" of retrofitting water pollution controls. However, even assuming that "age" does significantly impact the "cost or feasibility" of retrofitting, the Agency concludes that altered subcategorization or relaxed requirements within subcategories for "older" plants are not warranted. "Older" steel facilities are responsible for as much water pollution as "newer" facilities. Thus, even if it could be shown that plant "age" did affect the "cost or feasibility" of retrofitting controls, the Agency would not alter its subcategorization or provide relaxed effluent limitations or standards within subcategories for "older" plants as control of the discharge of pollutants from those plants justify the expenditures of reasonable additional costs.

Based upon the above, the Agency finds that both old and newer production facilities within each subcategory generate similar raw wastewater pollutant loadings; that pollution control facilities can be and have been retrofitted to both old and newer production facilities without substantial retrofit costs; that these pollution control facilities can and are achieving the same effluent quality; and, that further subcategorization or further segmentation within each subcategory on the basis of age is not appropriate.

3. The Impact of the Regulation on Consumptive Water Loss

In the 1974 BPT and BAT regulation for the steelmaking segment, many of the Agency's model treatment systems include partial recycle of wastewaters. Some of these model systems included evaporative cooling towers to insure that the temperature of recycled wastewater not reach excessive levels for process use.[12] CF&I Steel Corporation, located in Pueblo, Colorado, claimed that cooling through evaporative means would cause additional consumptive water losses which would be inconsistent with state law and would aggravate water scarcity in arid and semi-arid regions of the country. The Court held that to the extent that the regulations were inconsistent with state law, the Supremacy Clause of the U.S. Constitution required that federal law and

[12]The treatment models that included evaporative cooling towers were the BPT and BAT models in the cokemaking, blast furnace, steelmaking, vacuum degassing, and continuous casting subcategories. Although there are other available means of temperature equalization (such as lagoons and nonevaporative coolers), only cooling towers were included in those treatment models.

regulations prevail. The Court agreed with CF&I, however, in holding that the Agency had failed to adequately consider the impact of the regulation on water sources in arid and semi-arid regions.

The 1976 regulation for the forming and finishing segment also included treatment models with evaporative cooling towers.[13] In its response to CF&I's comments, the Agency stated:

"A means to dissipate heat is frequently a necessity if a recycle system is to be employed. The evaporation of water in cooling towers or from ponds is the most commonly employed means to accomplish this. However, fin-tube heat exchangers can be used to achieve cooling without evaporation of water. Such systems are used in the petroleum processing and electric utility industries.

The Agency also feels that recognition of the evaporation of water in recycle systems (and hence loss of availability to potential downstream users) should be balanced with recognition that evaporation also occurs in once-through systems, when the heated discharge causes evaporation in the stream. This is not an obvious phenomenon, since it occurs downstream of the discharge point, but to the downstream user it is as real as with consumptive in-plant usage. Assuming that the stream eventually gets back to temperature equilibrium with its environment, it will get there primarily by evaporation, i.e., with just as certain a loss of water. Additionally, the use of a recycle system permits lessening the intake flow requirements." 41 FR 12990.

In addition, in its brief the Agency argued that, because of current evaporative losses, the impact of the regulations was not as severe as claimed by CF&I, and that the water scarcity issue was pertinent only in arid and semi-arid regions of the country. The Court, however, held:

"...Since EPA may have proceeded under a mistaken assumption of fact as to the water loss attributable to the interim final [Phase II] regulations, the matter will be remanded to the Agency for further consideration of whether fin-tube heat exchangers or dry type cooling towers may be employed despite any fouling or scaling problems - assuming that cooling systems of some kind will be employed in order to meet the effluent limitations prescribed in the regulations.

Also, the Agency may not decline to estimate the water loss due to the interim final regulations as accurately as possible on the

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[13]The treatment models that included evaporative cooling towers were the BAT models in the hot forming subcategories.

grounds that, whatever the cost in water consumption, the specified effluent limitations are justified. In order to insure that the Agency completes a sufficiently specific and definite study of the water consumption problem on remand, the Agency must address the question of how often the various cooling systems will be employed, or present reasons why it cannot make such an assessment."

In light of these decisions, the Agency has evaluated the "consumptive water loss" issue in the context of this regulation. Several of the underlying model treatment systems include recycle of wastewaters with evaporative cooling systems. Although cooling can be accomplished by several means (i.e.,lagoons, spray ponds, dry cooling towers), the model treatment systems are based upon evaporative cooling towers, which are the most commonly used, least space intensive, and among the least costly means of cooling wastewaters. Additionally, evaporative cooling towers have the highest water consumption rates. Thus, the Agency's estimates of water loss are conservative and overstate actual water loss. In evaluating possible consumptive water losses, however, the Agency has also analyzed the effects of several cooling mechanisms other than evaporative cooling towers.

On the average, the steel industry currently uses 5.7 billion gallons of process water per day. Not all of the process water requires cooling. A breakdown of this water usage by subcategory is given in Table III-6. Large volumes of this process water are currently recycled through cooling towers, cooling ponds, and spray ponds as shown below:

Cooling Device*	Approximate Evaporation Rate	% Utilization
(1) Cooling Tower (wet-mechanical draft)	2.0%	75%
(2) Cooling ponds	1.7%	20%
(3) Spray ponds	2.0%	5%

* The Agency does not expect any significant use of dry cooling towers in the steel industry.

Based upon the foregoing, the Agency estimates that evaporative losses from currently installed recycle/cooling systems, and from once-through discharges of heated water is about 16.0 MGD or 0.3% of total industry process water usage. The Agency estimates that nearly 50% of this consumption results from the once-through discharge of heated wastewater and run-of-the-river cooling.

Assuming that the relative utilization rate of the various cooling mechanisms remains the same, the Agency estimates that total evaporative water losses will be 19.8 MGD or 0.3% of process water usage at the BPT level, and 20.2 MGD or 0.4% of process water usage at the BAT level when fully implemented.

The important factor for regulatory purposes, however, is not the above gross water losses, but the additional or net water loss attributable to compliance with the regulation. This analysis indicates that net water losses attributable to compliance with the regulation will be 3.8 MGD or less than 0.1% of process water usage at the BPT level and 4.2 MGD or 0.1% of process water usage at the BAT level, including water consumed at the BPT level. This analysis is detailed for those subcategories, where recycle and cooling systems are envisioned, in Table III-7 and is summarized below:

	Flow per Day (MGD)	% of Total
Total process water used	5744	100.0
Present water consumption[1]	16.0	0.3
Gross water consumption @ BPT	19.8	0.3
Net water consumption @ BPT	3.8	0.07
Gross water consumption @ BAT[2]	20.2	0.4
Net water consumption @ BAT[2]	4.2	0.07

[1] As of January 1, 1978.
[2] This total includes the water consumed at BPT.

Assuming that cooling towers will be installed at all plants requiring additional cooling (rather than current utilization devices), the net water losses attributable to compliance with the regulation would be 5.7 MGD or 0.1% of total process water usage at the BPT level and 6.0 MGD or 0.1% of process water usage at the BAT level. For purposes of estimating consumptive water losses on a subcategory basis, the Agency made the conservative assumption that evaporative cooling towers would be used in all cases where a cooling device of some kind was deemed necessary.
12454

In the Agency's view, the water consumption attributable to compliance with the regulation is not significant when compared to the benefits derived from the use of recycle systems. The use of recycle systems at the BPT, BAT, and PSES levels will result in a 70% reduction in the total process water usage of the industry. This reduction will prevent 4.0 billion gallons of water per day from being contaminated in steel manufacturing processes. Moreover, recycle systems permit a reduction in the load of pollutants by over 11 million tons per year at the BAT level (including 131,500 tons/year of toxic organic and toxic inorganic pollutants). Finally, it is significant to note that the use of recycle systems is often the least costly means to reduce pollution. On a nation-wide basis, therefore, EPA concludes that the environmental and economic benefits of recycle systems justify the evaporative water losses attributable to cooling mechanisms.

In addition, the Agency evaluated the water consumption issue as it relates to plants in arid and semi-arid regions. The Agency surveyed the four major steel plants it considers to be in arid or semi-arid regions of the country. Those plants are as follows.

0196A	CF&I Steel Corporation Pueblo, Colorado
0448A	Kaiser Steel Corporation Fontana, California
0492A	Lone Star Steel Company Lone Star, Texas
0864A	United States Steel Corporation Provo, Utah

The Agency finds that most of the recycle and evaporative cooling systems included in the model treatment systems which are the bases for the promulgated limitations and standards have been installed at those plants. Thus, these plants are already incurring most, if not all, of the consumptive water losses associated with compliance with the regulation. Hence, the incremental impact of the regulation on water consumption at steel plants located in arid or semi-arid regions is either minimal or nonexistant.

Despite the significant benefits and relatively small evaporative losses from recycle/cooling systems, CF&I of Pueblo, Colorado, claims that recycle/cooling systems will cause severe problems by compounding the water scarcity problems in the arid and semi-arid regions of the country. Therefore, this company suggests that required effluent levels be based on once-through systems or less stringent recycle rates in arid or semi-arid areas.

The Agency believes this proposal to be deficient in several respects. First, discharging the heated wastewaters once-through would not conserve a significant amount of water. For example, for an average sized steel mill with a 100 MGD process flow, discharging wastewaters once-through would only conserve 0.4 MGD or 0.4% of the total process water flow, a very small water savings. The savings is small because even in a once-through system, a certain amount of water is evaporated (the evaporation will occur in the receiving body of water as the temperature of the heated wastewaters approaches the equilibrium temperature of the receiving stream or lake). In this case, the evaporation rate is approximately one-half of the evaporation rate of a cooling tower. However, while a small water savings is achieved, certain disadvantages result, some of which are outlined below:

a. A heated discharge (potentially up to 150°) which may cause localized environmental damage will be allowed to enter a receiving water.

b. The once-through system will allow a significantly higher pollutant load to enter the receiving water.

c. The once-through system will require additional water to be taken from the water supply to meet the water requirements of the steelmaking operations.

While the use of recycle/cooling systems now results in some additional evaporative water losses in arid and semi-arid regions, the Agency believes that here, too, the benefits of recycle systems justify these losses. The Agency considered establishing alternative limitations for facilities located in arid and semi-arid regions, but concluded that alternative limitations and, thus, separate subcategories are not appropriate.

With respect to fouling and scaling of wet cooling towers, the Agency believes that the only operation at which this could possibly be a problem is blast furnace recirculation systems. The industry, however, has not indicated it has had no significant fouling or scaling problems with these systems.

TABLE III-1

YOUNGSTOWN SHEET AND TUBE CAPITAL COSTS

	Treatment Systems	YS&T	EPA	BATEA Scaled By Flow	BATEA Scaled By Production Rate	Site Costs	BATEA + Site Costs Scaled By Flow	BATEA + Site Costs Scaled By Production Rate
I	Electric Weld Tube Brier Hill	1,018,000	985,000	216,000	1,113,000	602,000	818,000	1,715,000
II	Blooming Mill Brier Hill	5,390,000	5,141,000	5,114,000	10,645,000	1,150,000	6,264,000	11,795,000
III	Blast Furnace Brier Hill	1,576,000*	1,522,000	980,000	1,466,000	1,151,000	2,131,000	2,617,000
IV	Seamless Tube Campbell	3,562,000	3,595,000	2,890,000	2,284,000	748,000	3,638,000	3,032,000
V&VA	Cold Reduced Mill Campbell	3,817,000	3,523,000	2,466,000	2,771,000	507,000	2,973,000	3,278,000
VI	Central Treatment Campbell	25,221,000	25,007,000	28,656,000	30,331,000	10,321,000	38,997,000	40,652,000
VII	Coke Plant Campbell	8,973,000	7,300,000	6,822,000	7,691,000	2,074,000	8,896,000*	9,765,000
VIII	Galvanized Conduit Struthers	1,179,000	860,000	596,000	493,000	266,000	862,000	759,000
IX	Merchant Mill Struthers	3,370,000	3,283,000	5,478,000	3,774,000	1,357,000	6,835,000	5,131,000
TOTAL		54,106,000	51,214,000	53,218,000	60,568,000	18,176,000	71,394,000	78,744,000
HCl Regeneration Campbell		3,470,000						
Blast Furnace Cambpill		2,262,000						
Cold Drawn Bar Brier Hill		84,000						
TOTAL		59,922,000						

*: Includes 325,000 for blowdown treatment.

TABLE III-2

UNITED STATES STEEL CAPITAL COSTS

Treatment Systems	USS	EPA	BATEA T.M. Scaled by Flow	BATEA T.M< Scaled by Production	Site Costs	BATEA T.M. + Site Costs by Flow	BATEA T.M. + Site Costs by Production
McDonald Plant	12,800,000	12,131,000	17,612,000	19,787,000	4,400,000	22,012,000	24,187,000
Rolling Mills (Outfall 005)							
Batch & Continuous Pickling (Outfall 006)	550,000	549,000	586,000	586,000	35,000	621,000	603,000
Ohio Plant	13,440,000(1)	11,479,000	5,288,000(2)	5,179,000(2)	6,000,000(2)	11,288,000(2)	11,179,000(2)
Blast Furnace (Outfall 001)							
Rolling Mills (Outfall 003)	5,800,000	5,675,000	3,842,000	8,453,000	2,500,000	6,342,000	10,953,000
Batch Pickling (Outfall 004)	520,000	540,000	441,000	402,000	210,000	651,000	612,000
TOTAL	33,110,000	30,374,000	27,769,000	34,389,000	13,145,000	40,914,000	47,534,000

(1) Including dismantling of blast furnace.
(2) With base level of treatment.

TABLE III-3

REPUBLIC STEEL CAPITAL COSTS**

Treatment Systems	Republic BPCTCA	BPCTCA Module Scaled By Flow	BPCTCA Module Scaled By Production	BATEA Module Scaled By Flow	BATEA Module Scaled By Production	Site Costs	BPCTCA By Flow + Site Costs	BPCTCA By Production + Site Costs	BATEA By Flow + Site Costs	BATEA By Production + Site Costs
Warren Plant										
Finishing Mills Area	8,000,000	5,879,000	14,387,000	8,765,000	23,943,000	1,294,000	7,458,000	15,681,000	10,059,000	25,237,000
Finishing Mills Pickling	8,800,000	9,610,000	12,243,000	9,678,000	12,330,000	0	9,610,000	12,243,000	9,678,000	12,330,000
Hot Rolling Mills Area	9,700,000	8,518,000	12,543,000	11,826,000	21,075,000	7,645,000	16,163,000	20,188,000	19,471,000	28,720,000
Blast Furnace Area	7,300,000	3,676,000	4,444,000	4,105,000	4,968,000	1,468,000	5,144,000	5,912,000	5,571,000	6,436,000
Coke Plant										
Physical/Chemical	8,000,000	187,000	189,000	1,121,000	937,000	566,000	753,000	755,000	1,681,000	1,503,000
		5,173,000*	5,218,000*	6,106,000*	5,966,000*	566,000	5,739,000*	5,784,000*	6,672,000*	6,532,000*
Biological	8,000,000	414,000	519,000	1,207,000	1,074,000	566,000	1,080,000	1,085,000	1,773,000	1,640,000
		5,500,000*	5,548,000*	6,193,000*	6,103,000*	566,00	6,066,000*	6,144,000*	6,759,000*	6,699,000*
Youngstown Plant										
Poland Avenue	10,899,000	4,501,000	8,010,000	8,742,000	14,633,000	3,314,000	7,815,000	11,324,000	12,056,000	17,947,000
Blast Furnaces	7,900,000	5,388,000	5,417,000	6,023,000	6,054,000	0	5,388,000	5,417,000	6,023,000	6,054,000
Coke Plant										
Physical/Chemical	7,700,000	193,000	296,000	959,000	1,466,000	535,000	728,000	831,000	1,494,000	2,001,000
		5,333,000*	8,164,000*	6,099,000*	9,335,000	535,000	5,868,000*	8,699,000*	6,634,000*	9,870,000
Biological	7,700,000	530,000	812,000	1,054,000	1,680,000	535,000	1,065,000	1,347,000	1,594,000	2,215,000
		5,670,000*	8,680,000*	6,239,000*	9,549,000	535,000	6,205,000*	9,216,000*	6,774,000*	10,084,000
Niles Plant	1,800,000	2,852,000	2,214,000	3,160,000	2,386,000	768,000	3,620,000	2,982,000	3,928,000	3,154,000
TOTAL	70,099,000									
Physical/Chemical*		50,930,000	72,640,000	64,504,000	100,690,000	15,590,000	66,815,000	88,230,000	80,094,000	116,280,000
Biological*		51,594,000	73,486,000	64,731,000	101,041,000	15,590,000	67,479,000	89,076,000	80,321,000	116,631,000

* : Including Level A Costs.
**: BPCTCA and BATEA costs are based on March, 1975 dollar values.

TABLE III-4

PLANT AGE ANALYSIS[1]
IRON & STEEL INDUSTRY

Subcategory	1919 and before	1920 to 1929	1930 to 1939	1940 to 1949	1950 to 1959	1960 to 1969	1970 and later
A. Cokemaking	33	16	0	6	5	3	3
B. Sintering	0	0	1	7	8	2	3
C. Ironmaking	68	12	8	31	28	11	6
D. Steelmaking							
1. BOF	0	0	0	0	2	21	8
2. Open Hearth	0	0	0	1	4	0	0
3. Electric Arc	0	0	0	1	2	4	5
E. Vacuum Degassing	0	0	0	0	7	21	10
F. Continuous Casting	0	0	0	0	0	23	36
G. Hot Forming							
1. Primary	33	12	11	14	26	11	4
2. Section	67	49	21	29	33	23	14
3. Flat							
a. Strip & Sheet	4	9	11	3	14	12	2
b. Flat Plate	10	1	3	1	2	6	2
4. Pipe & Tube[2]	5	8	11	7	11	4	2

TABLE III-4
PLANT AGE ANALYSIS
IRON & STEEL INDUSTRY
PAGE 2

Subcategory	1919 and before	1920 to 1929	1930 to 1939	1940 to 1949	1950 to 1959	1960 to 1969	1970 and later
H. Scale Removal	0	0	0	4	12	9	4
I. Acid Pickling							
1. Sulfuric Acid	15	16	25	41	43	31	14
2. Hydrochloric Acid	1	1	17	14	17	38	7
3. Combination Acid	6	16	9	22	25	36	11
J. Cold Forming							
1. CR-Recirculation	21	4	11	23	28	32	13
2. CR-Combination	0	0	1	3	5	8	2
3. CR-Direct	0	28	18	5	8	7	1
4. Pipe & Tube	0	4	7	8	23	34	20
K. Alkaline Cleaning	0	4	20	14	41	59	23
L. Hot Coating	5	16	20	26	40	51	12

(1) Ages based on first year of production.
(2) Does not include the ages for four confidential plants.
Note: Count based on number of individual operations.

TABLE III-5

EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE ABILITY TO RETROFIT POLLUTION CONTROL EQUIPMENT BY SUBCATEGORY

Subcategory	Plant Reference Code	Plant Age* (Year)	Treatment Age (Year)
A. Cokemaking	012A	1920	1977
	024A	1916	1953-1977
	024B	1901	1969-1977
	112A	1920	1977
	272	1919	1957-1977
	396A	1906-1955	1972
	432B	1919-1961	1930-1972
	464C	1925-1973	1971
	464E	1914-1970	1914-1977
	584F	1923-1971	1977
	And Others		
B. Sintering	060B	1958	1968
	060F	1957	1975
	112B	1950	1970
	112C	1948	1960
	448A	1943	1971
	548C	1959	1965
	584C	1959	1965
	864A	1944	1962
	868A	1941	1954
	920F	1944	1973
	946A	1939	1972
C. Ironmaking	060B	1942	1958
	112A	1941	1948
	320	1920-1947	1976
	396A	1907-1909	1929
	396C	1903-1905	1929
	426	1958	1979
	432A	1910-1919	1951
	432B	1900-1966	1930
	584C	1956-1961	1965
	584D	1904-1911	1953
	And Others		

TABLE III-5
EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE
ABILITY TO RETROFIT POLLUTION CONTROL EQUIPMENT BY SUBCATEGORY
PAGE 2

Subcategory	Plant Reference Code	Plant Age* (Year)	Treatment Age (Year)
D. Steelmaking			
1. Basic Oxygen Furnace	432C	1961	1964
	684C	1970	1971
	684F	1966	1976
	724F	1966	1976
2. Open Hearth	060	1952	1970
	112A	1957	1971
	492A	1953	1966
	864A	1944	1962
	748C	1952	1967
3. Electric Furnace	060F	1951	1968
	432C	1959	1964
	528A	1949	1954
	612	1936	1971
E. Vacuum Degassing	88A	1963-1968	1971
	496	1965	1971
F. Continuous Casting	084A	1970-1975	1975
	432A	1969	1974
	476A	1969	1977
	584	1968	1970
	652	1968	1971
	780	1966-1975	1975
G. Hot Forming			
1. Hot Forming - Primary	020B	1948	1971
	060D	1910	1959
	060I	1941	1958
	088D	1959	1971
	112	1907	1979
	112A	1930	1970
	112B	1928	1970
	176	1917	1965
	188A	1959	1970
	188B	1940	1946
	248C	1962	1975
	320	1936	1952
	And Others		

TABLE III-5
EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE
ABILITY TO RETROFIT POLLUTION CONTROL EQUIPMENT BY SUBCATEGORY
PAGE 3

Subcategory	Plant Reference Code	Plant Age* (Year)	Treatment Age (Year)
2. Hot Forming - Section	060C	1913	1920-1975
	060F	1942	1965
	060I	1956	1958
	060K	1920	1955
	088D	1962	1971
	112	1907	1954-1979
	112A	1937	1971-1977
	112F	1922	1947-1978
	136B	1908	1959-1969
	316	1959	1966
3. Hot Forming - Flat			
a. Plate	112C	1902	1964
	424	1970	1971-1978
	448A	1943	1948
	496	1918	1948-1977
	860B	1936	1967
b. Hot Strip & Sheet	020B	1953	1971
	396D	1960	1970
	432A	1957	1974
	476A	1915	1977
	684F	1937	1969
	856D	1938	1980
	856P	1929	1966
4. Pipe and Tube	060C	1913	1948
	060F	1950	1971
	060R	1930-1947	1961
	432A	1957-1958	1974
	476A	1930	1977
	548A	1945-1960	1969
	652A	1954	1962
	728	1929	1952
	856N	1930	1961
	856Q	1930	1963
	And Others		

TABLE III-5
EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE
ABILITY TO RETROFIT POLLUTION CONTROL EQUIPMENT BY SUBCATEGORY
PAGE 4

Subcategory	Plant Reference Code	Plant Age* (Year)	Treatment Age (Year)
H. Scale Removal	060I	1970	1972
	088A	1962	1969
	256L	1962	1969
	424	1971	1978
	284A	1957	1971
	176	1941	1965
	256K	1956	1971
	248B	1950	1978
I. Acid Pickling			
1. Sulfuric Acid	020B	1954	1974
	048F	1944	1969
	060D	1957	1968
	060M	1970	1977
	088A	1936	1969
	088D	1962	1971
	112	1922	1977
	112C	1926	1977
	256F	1953	1975
	384A	1958	1964
	And Others		
2. Hydrochloric Acid	020C	1946	1977
	112B	1936	1971
	176	1961	1956
	320	1936	1955
	384A	1932	1970
	396D	1967	1969
	432C	1952	1964
	448A	1954	1970
	580A	1962	1967
	And Others		
3. Combination Acid	020B	1947	1974
	088A	1952	1969
	112A	1926	1977
	112H	1940	1951
	256F	1953	1975
	284A	1957	1971
	584D	1940	1970
	860F	1962	1977
	And Others		

TABLE III-5
EXAMPLES OF PLANTS THAT HAVE DEMONSTRATED THE
ABILITY TO RETROFIT POLLUTION CONTROL EQUIPMENT BY SUBCATEGORY
PAGE 5

Subcategory	Plant Reference Code	Plant Age* (Year)	Treatment Age (Year)
J. Cold Forming			
	020C	1951	1975
	060	1936	1967
	112A	1947	1971
	112B	1936	1971
	176	1921	1963
	396D	1938	1959
	432B	1937	1966
	448A	1952	1969
	584A	1948	1971
	684D	1939	1970
	And Others		
K. Alkaline Cleaning	112A	1936	1971-1977
	112I	1927	1950-1977
	240B	1938	1968
	256N	1956	1973
	384A	1968	1970
	432A	1940	1970
	448A	1959	1969
	476A	1960	1977
	548A	1957	1967
	580A	1962	1967
	And Others		
L. Hot Coating	112B	1962	1971
	112G	1922	1973
	384A	1968	1970
	448A	1967	1970
	460A	1932	1968
	476A	1930	1977
	492A	1962	1976
	580A	1962	1967
	584C	1956	1965
	640	1936	1961

* Where ranges of ages are listed, this shows that these are multiple facilities on site that vary in age as indicated.

TABLE III-6

WATER USAGE IN THE STEEL INDUSTRY

Subcategory	Total Process Water Usage (MGD)	Water Recycled Over Cooling Systems at BPT (MGD)	Water Recycled Over Cooling Systems at BAT (MGD)
A. Cokemaking	32.5	32.4(1)	42.0(1)
B. Sintering	99.2	0	0
C. Ironmaking	864.0	738.0	751.2
D. Steelmaking	273.3	0	0
E. Vacuum Degassing	55.4	54.4	54.4
F. Continuous Casting	233.2	220.1	226.4
G. Hot Forming	3,974.4	0	0
H. Salt Bath Descaling	1.1	0	0
I. Acid Pickling	86.7	0	0
J. Cold Forming	76.5	0	0
K. Alkaline Cleaning	17.5	0	0
L. Hot Coating	30.4	0	0
	5,744.2	1012.5	1032.4

(1) Flow not included as part of the total process water flow.

TABLE III-7

CONSUMPTIVE USE OF WATER (BY EVAPORATION IN COOLING SYSTEMS) IN THE STEEL INDUSTRY[1]

Subcategory	Present Water Consumption (MGD)	Additional Consumption at BPT over Present (MGD)	Water Consumption Anticipated at BPT (MGD)	Additional Consumption at BAT over Present (MGD)	Water Consumption Anticipated at BAT (MGD)
A. Cokemaking	0.69	0.16	0.85	0.40	1.09
C. Ironmaking	11.21	2.99	14.20	3.09	14.30
E. Vacuum Degassing	0.70	0.25	0.95	0.25	0.95
F. Continuous Casting	3.44	0.40	3.84	0.25	3.88
	16.04	3.80	19.84	4.18	20.22

(1) Only those subcategories which utilize recycle and cooling systems are included in this analysis.

VOLUME I

SECTION IV

INDUSTRY SUBCATEGORIZATION

To develop the regulation it was necessary for the Agency to determine whether different effluent limitations and standards should be developed for distinct segments or subcategories of the steel industry. The Agency's subcategorization of the industry included an examination of the same factors and rationale described in the Agency's previous studies. Those factors are:

1. Manufacturing processes and equipment
2. Raw materials
3. Final products
4. Wastewater characteristics
5. Wastewater treatment methods
6. Size and age of facilities
7. Geographic location
8. Process water usage and discharge rates
9. Costs and economic impacts

For this regulation, the Agency has adopted a revised subcategorization of the industry to more accurately reflect production operations and to simplify the use of the regulation. The Agency found that the manufacturing process is the most significant factor and divided the industry into 12 main process subcategories on this basis. Section IV of each subcategory report contains a detailed discussion of the factors considered and the rationale for selecting and subdividing the subcategories. The Agency determined that process-based subcategorization is warranted in many cases because the wastewaters of the various processes contain different pollutants requiring treatment by different control systems (e.g., phenols by biological systems in cokemaking). However, in some cases, the wastewaters of different processes were found to have similar characteristics. In those instances, the Agency determined that subcategorization was appropriate because the process water usage and discharge flow rates varied significantly, thus affecting estimates of treatment system costs and pollutant discharges. The twelve subcategories of the steel industry are as follows:

A. Cokemaking
B. Sintering
C. Ironmaking
D. Steelmaking
E. Vacuum Degassing
F. Continuous Casting
G. Hot Forming
H. Salth Bath Descaling
I. Acid Pickling
J. Cold Forming
K. Alkaline Cleaning
L. Hot Coating

The subcategories of the steel industry are defined below. Also discussed are any subdivisions and segments within the main subcategories and the rationale for the subdivision and segmentation.

Subcategory A: Cokemaking

Cokemaking operations involve the production of coke in by-product or beehive ovens. The production of metallurgical coke is an essential part of the steel industry, since coke is one of the basic raw materials necessary for the operation of ironmaking blast furnaces.

Significant variations exist in the quantity and quality of waste generated between the old beehive ovens and the newer by-product ovens. In order to prepare effluent limitations and standards that would adequately reflect these variations, a subdivision of the Cokemaking subcategory was necessary. The first subdivision is By-Product Cokemaking, a method employed by 99 percent of the coke plants in the U.S. In by-product ovens, coke oven gas, light oil, ammonium sulfate and sodium phenolate are recovered rather than allowed to escape to the atmosphere. This subdivision has been further segmented to reflect the slightly different wastewater volume generation rates between coke plants located at integrated steel plants and at merchant coke plants. Within both segments, there are further distinctions based upon type of treatment (physical/chemical and biological), type of ammonia recovery process utilized (semi-direct vs. indirect) and an added allowance for plants employing wet desulfurization systems.

Beehive Cokemaking is the other subdivision in the Cokemaking subcategory. This process is only found in one percent of the U.S. cokemaking operations. In beehive ovens no effort is made to recover volatile materials generated by the process so there is no wastewater generated from gas cleaning as in the by-product plants. The wastewater results from the direct spraying of water on the hot coke to stop the coking process.

Subcategory B: Sintering

Sintering operations involve the production of an agglomerate which is then reused as a feed material in iron and steelmaking processes.

This agglomerate or "sinter" is made up of large quantities of particulate matter (fines, mill scale, flue dust) which have been generated by blast furnaces, open hearth furnaces, and basic oxygen furnaces, and scale recovered from hot forming operations.

Wastewaters are generated in sintering operations as a result of the scrubbing of dusts and gases produced in the sintering process. Quenching and cooling of the sinter, practiced at some plants, generates additional wastewaters. The Agency determined that model plant effluent flow rates can be achieved at sinter plants with wet air pollution controls on all parts of the sintering operation. Since there are no significant variations in wastewater quality from these operations, the Agency did not subdivide sintering operations on the basis of the type of wet air pollution control system used or the part of the sintering operation controlled by wet air pollution control systems.

Subcategory C: Ironmaking

Ironmaking operations involve the conversion of iron bearing materials, limestone, and coke into molten iron in a reducing atmosphere in a tall cylindrical furnace. The gases produced as a result of this combustion are a valuable heat source but require cleaning prior to reuse. Blast furnace wastewaters are generated as a result of the scrubbing and cooling of these off-gases. Both pig-iron and ferromanganese can be produced in blast furnace operations. Because the wastewaters produced at these two types of operations vary significantly, different BPT limitations were promulgated. However, BAT, NSPS, PSES and PSNS were promulgated only for ironmaking blast furnaces since no ferromanganese furnaces are in operation or scheduled for operation and ferroalloy production has shifted to electric furnaces.

Subcategory D: Steelmaking

Steelmaking operations involve the production of steel in basic oxygen, open hearth, and electric arc furnaces. These furnaces receive iron produced in blast furnaces along with scrap metal and fluxing materials. During steelmaking, large quantities of fume, smoke, and waste gases are generated which require cleaning prior to emission to the atmosphere. Steelmaking wastewaters are generated as a result of some of the gas cleaning operations.

Each of the three types of furnaces operates differently. These differences result in significant variations in wastewater volume, pollutant loads generated, and wastewater characteristics. In order to develop effluent limitations that would adequately reflect these variations, the Agency determined that subdivision of the Steelmaking subcategory into the following three subdivisions is appropriate: Basic Oxygen Furnace; Open Hearth Furnace; and Electric Arc Furnace. The Agency also determined that further segmentation of the BOF and EAF subdivisions is appropriate because of differences in the methods used to clean and condition furnace gases.

Three different scrubbing systems, each of which could result in a wastewater discharge, are presently used to clean waste gases from basic oxygen furnaces: semi-wet; wet-suppressed combustion; and wet-open combustion. Water is used in semi-wet systems to cool and condition furnace gases to optimize the performance of the electrostatic precipitators or baghouses that are relied upon to clean the gases. These systems are characterized by wastewaters containing relatively small quantities of particulate matter having a large particle size. Wet systems result in much higher raw wastewater pollutant loadings due to the increased amount of water used. In an open combustion system, 90 percent of the particulates are of a submicron size, because combustion is more complete. By comparison, suppressed combustion systems generate larger particles, of which only 30-40 percent are of submicron size. Since much of the heavier particulate matter remains in the furnace, the suspended solids loadings in the wastewaters from suppressed combustion systems are much lower.

Both semi-wet and wet systems are used at electric furnaces while only wet systems are used at open hearth furnaces. The subdivision of the Steelmaking subcategory takes the wastewater flow and quality differences into account.

Subcategory E: Vacuum Degassing

Vacuum degassing is the process whereby molten steel is subjected to a vacuum in order to remove gaseous impurities. It is advantageous to remove hydrogen, nitrogen, and oxygen from the molten steel as these gases can impart undesirable qualities to certain grades of steel. The vacuum is most commonly produced through the use of steam ejectors. The venturi action of the steam in the ejector throat and the condensation of the steam combine to produce the vaccum. The particle laden steam coming from the steam ejectors is condensed in barometric condensers, thus producing a wastewater which requires treatment.

The industry uses various types of degassers and degasses steels containing a variety of different components. However, the Agency has determined these variations do not affect the quantity or quality of wastewaters produced in the vacuum degassing operations to the extent that further subdivision of this subcategory is warranted.

Subcategory F: Continuous Casting

The continuous casting process is used to produce semi-finished steel directly from molten steel. The molten steel from the steelmaking operation is ladeled into a tundish from where it is continuously cast into water cooled copper molds of the desired shapes. After leaving the copper mold, the semi-solidified steel is sprayed with water for further cooling solidifications. In addition to cooling, the water sprays also serve to remove scale and other impurities from the steel surface. The water that directly cools the steel and guide rollers contains particulates and roller lubricating oils, and must be treated prior to discharge.

Although there are three types of continuous casters in use, they only differ in physical orientation. When the Agency analyzed these and other factors relating to the continuous casting subcategory, it found no significant variations in the quantity or quality of wastewaters generated. Therefore, the Agency determined that further subdivision of the Continuous Casting subcategory is not appropriate.

Subcategory G: Hot Forming

Hot forming is the steel forming process in which hot steel is transformed in size and shape through a series of forming steps to ultimately produce semi-finished and finished steel products. Feed materials may be ingots, continuous caster billets, or blooms and slabs from primary hot forming mills (as feed to hot forming section or hot forming flat mills). The steel products consist of many types of cross-sections, sizes and lengths. Four different types of hot forming mills are used to produce the many types of hot formed steel products. The four types of mills (primary, section, flat, and pipe and tube) are the bases for the principal subdivisions of the Hot Forming subcategory. Variations in flow rates and configurations among these subdivisions were the most important factors in making these subdivisions. The Agency found that further segmentation is necessary to reflect variations due to product shape, type of steel, and process used.

Wastewaters result from several sources in hot forming operations. The hot steel is reduced in size by a number of rolling steps where contact cooling water is continuously sprayed over the rolls and hot steel product to cool the steel rolls and the flush away scale as it is broken off from the surface. Scarfing is used at some mills to remove imperfections in order to improve the quality of steel surfaces. Scarfing generates large quantities of fume, smoke, and waste gases which require scrubbing. Scrubbing of these fumes generates additional wastewater.

The Agency found variations in the quantity of wastewaters generated in the four subdivisions of the Hot Forming subcategory. The quality and treatability of hot forming wastewaters is not significantly different.

The Primary mill subdivision has been split into two segments: (1) carbon and specialty mills without scarfing, and (2) carbon and specialty mills with scarfing. The use of scarfing equipment results in an additional applied process flow of 1100 gal/ton.

The Section mill subdivision has also been separated into two segments, carbon and specialty steels. On the average, 1900 gal/ton more water is used on carbon section mills. For this reason, the Agency determined that it is appropriate to further divide the section mill subdivision into carbon and specialty mill segments.

The Flat mill subdivision has been split into three segments: (1) hot strip and sheet (both carbon and specialty), (2) plate (carbon) and (3) plate (specialty). As with section mills, carbon and specialty plate operations differ significantly in several areas. About 1900 gal/ton more water is used in carbon flat plate operations than in specialty flat plate operations. Also, carbon plate mills are about three times as large as specialty plate mills. While no differences were noted between carbon and specialty hot strip and sheet operations, hot strip operations in general require 3900 gal/ton more water than do plate operations. That difference resulted in the hot strip and sheet segment in the hot forming flat subdivision.

TH;w;We Agency determined that the distinction between isolated and integrated operations in the Hot Worked Pipe and Tube subdivision made in the prior regulation is not appropriate. This former segment was deleted.

Subcategory H: Salt Bath Descaling

Salt bath descaling is the operation in which specialty steel products are processed in molten salt solutions for scale removal. Two types of scale removal operations are in use: oxidizing and reducing. The oxidizing process uses highly oxidizing salt baths which react far more aggressively with the scale than with base metal. This chemical action causes surface scale to crack so that subsequent pickling operations are more effective in removing the scale. Reducing baths depend upon the strong reducing properties of sodium hydride to accomplish the same purpose. During that operation most scale forming oxides are reduced to base metal.

Flow rates and wastewater characteristics differ between the two types of operations. Wastewaters from reducing operations can contain quantities of cyanide not contained in wastewaters from oxidizing operations. Wastewaters from oxidizing operations contain large amounts of hexavalent chromium, which are not usually found in reducing bath wastewaters. In order to develop effluent limitations that would adequately reflect these variations, the Agency determined that subdivision of the scale removal subcategory into oxidizing and reducing operations is appropriate.

The Agency has also concluded that the method of operation, i.e., batch or continuous, significantly affects water use requirements. Hence, it has segmented both subdivisions. In addition, because of variations in water use rates, related to the type of product being processed in batch oxidizing operations, the Agency has segmented this subdivision further to reflect these differences.

Subcategory I: Acid Pickling

Acid pickling is the process of chemically removing oxides and scale from the surface of the steel by the action of water solutions of inorganic acids. The three major wastewater sources associated with acid pickling operations are spent pickle liquor, rinse waters, and the water used to scrub acid vapors and mists. These wastewaters contain free acids and ferrous salts in addition to other organic and inorganic impurities. Most carbon steels are pickled in sulfuric or hydrochloric acids. Most stainless and alloy steels are pickled in a mixture of nitric and hydrofluoric acids. Since wastewater characteristics are dependent on the acid used, the Agency has established three primary subdivisions of this subcategory; i.e., sulfuric, hydrochloric, and combination acid pickling operations.

The Agency has concluded that, within each of the three acid pickling subdivisions, further segmentation, primarily on the basis of product type rather than on wastewater source or treatment technique, is appropriate. Additionally, segments have been established in each subdivision to separately limit the discharges from scrubbers.

The Sulfuric Acid Pickling subdivision has been further separated into five segments, four of which reflect the different water use rates associated with product groupings and one reflective of the water use rate in fume scrubbers. Since water use in a fume scrubber is not related to the tonnage of product pickled, limitations and standards for this segment have been established on the basis of kg/day rather than kg/kkg of product.

The Hydrochloric Acid Pickling subdivision was further separated into five segments, three of which reflect the different water use rates associated with product groupings, and the other two reflective of water use rates on fume scrubbers. In this subdivision, scrubbers are used for fume collection over the pickling baths and for fume collection at the acid regeneration plant absorber vents. The differences in water use rates are reflected in the further segmentation. Limitations and standards in both fume scrubber segments are established on the basis of kg/day.

The Combination Acid Pickling subdivision was further separated into six segments, five of which reflect the different water use rates associated with product groupings, and the other based upon the water use rate in fume scrubbers. As above, limitations and standards in the fume scrubber segment have been established on the basis of kg/day.

Subcategory J: Cold Forming

The Cold Forming subcategory is separated into two subdivisions: Cold Rolling and Cold Worked Pipe and Tube. The Agency concluded that subdivision is appropriate because of the differences in equipment used to form flat sheets and tubular shapes, and because of differences in rolling solution characteristics, wastewater flow rates and treatment and disposal methods.

Cold rolling is used to reduce the thickness of a steel product, which produces a smooth dense surface and develops controlled mechanical properties in the metal. An oil-water emulsion lubricant is sprayed on the material as it enters the work rolls of a cold rolling mill, and the material is usually coated with oil prior to recoiling after it has passed through the mill. The oil prevents rust while the material is in transit or in storage. It must be removed before the material can be further processed or formed. Oil from the oil water emulsion lubricant is the major pollutant load in wastewaters resulting from this operation.

In the Cold Rolling subdivision three methods of oil application are used. The methods are direct application, recirculation, and combinations of the two. Because recycle rate is dependent upon the oil application system, flow rates vary for the three systems. These differences in flow rates make further segmentation of the Cold Rolling subdivision appropriate. Within the recirculation and direct application segments, the number of rolling stands used affects the water use rate. This is reflected in separate limitations within these segments based upon whether a mill has a single stand or whether the mill has multiple stands.

In the Pipe and Tube subdivision of the Cold Forming subcategory, cold flat steel strips are formed into hollow cylindrical products. Wastewaters are generated as a result of continuous flushing with water or soluble oil lubricating solutions, resulting in significant differences in the quantity and quality of wastewaters generated by these methods. Therefore, the Agency determined that further separation of the Pipe and Tube subdivision into water type operations and oil solution type operations, is warranted.

Subcategory K: Alkaline Cleaning

Alkaline cleaning baths are used to remove mineral and animal fats and oils from steel. The cleaning baths used are not very aggressive and therefore do not generate many pollutants. The alkaline cleaning solution is usually a dispersion of chemicals such as carbonates, alkaline silicates, and phosphates in water. The cleaning bath itself and the rinse water used are the two sources of wastewaters in the alkaline cleaning process. Both continuous and batch operations are used by the industry. The Agency, after further review of available wastewater flow data, has concluded that significant differences in the quantity of wastewaters generated at batch and continuous operations should be reflected in the limitations and standards for alkaline cleaning operations. Therefore, the Alkaline Cleaning subcategory has been subdivided into batch and continuous operations.

Subcategory L: Hot Coating

Hot coating processes involve the immersion of clean steel into baths of molten metal for the purpose of depositing a thin layer of the metal onto the steel surface. These metal coatings can impart such desirable qualities as corrosion resistance or a decorative appearance to the steel. Hot coating processes can be carried out in continuous or batch operations. The physical configuration of the product being coated usually determines the method of coating to be used.

The Hot Coating subcategory has been divided into three subdivisions based upon the type of coating used. Galvanizing is a zinc coating operation. Terne coating consists of a lead and tin coating of five or six parts lead to one part tin. Other metal coatings can include aluminum, hot dipped tin, or mixtures of these and other metals. These operations generate different polutants due to the variety of metals used.

However, the control technologies, except for hexavalent chromium reduction required for galvanizing lines with chromate passivating dips, are the same for all hot coating operations. The lime precipitation and clarification process will adequately control each of the toxic metals. There is a considerable difference in the water use rates based upon the type of product coated. Therefore the Agency has concluded that further separation of the galvanizing, and terne and other coatings subdivisions into two segments based upon product type is warranted. These segments are the strip, sheet, and miscellaneous products segment and the wire product and fasteners segment. The Agency has also provided a segment for fume scrubbers applicable to any hot coating operation with fume scrubbers.

VOLUME I

SECTION V

SELECTION OF REGULATED POLLUTANTS

Introduction

Three types of pollutants were considered for regulation in the steel industry: conventional pollutants, nonconventional pollutants, and toxic pollutants. To determine the presence and level of these pollutants in steel industry wastewaters, the Agency conducted extensive monitoring at several representative plants in the industry. Average wastewater concentrations of each pollutant were determined for each subcategory. These concentrations, in conjunction with the waste loading, formed the basis for determining whether a particular pollutant was considered for regulation.

Development of Regulated Pollutants

The concentration data were reviewed for 141 pollutants; 130 toxic, 8 nontoxic nonconventional, and 3 conventional. These values ranged from "not detected" to 71,000 mg/l (ppm). The concentration values were reviewed and each pollutant was assigned to one of four categories.

1. Not Detected - Reserved for any pollutant which was not detected during industry-wide plant sampling.

2. Environmentally Insignificant - Pollutants detected at levels of 0.010 mg/l (10 ppb) or less in industry-wide sampling; or, pollutants not normally occurring in wastewaters from these sources.

3. Not Treatable - Pollutants detected at levels greater than 10 ppb but at levels below the treatability level determined for that pollutant.

4. Regulation Considered - Any pollutant detected at a level greater than the corresponding treatability level was considered for regulation.

The results of the categorization are presented in Table V-1. Of the 141 pollutants initially considered, 60 (50 toxics and 10 others) have been considered for regulation. In order to further analyze the source of these pollutants, their presence by subcategory was tabulated. Table V-2 lists pollutants appearing in the twelve subcategories at levels greater than treatability. The physical properties, toxic effects in humans and aquatic life, and behavior in POTWs of these 60 pollutants are discussed in Appendix D to this document. In compiling this material, particular weight was given to documents generated by the Criteria and Standards, and Monitoring and Data Support Divisions of EPA.

Regulated Pollutants

Most of the toxic pollutants (29) are found in two subcategories: Cold Forming and Cokemaking. In order to avoid costly analytical work, four organic pollutants (benzene, naphthalene, benzo-a-pyrene and tetrachloroethylene) are limited and serve as indicator pollutants. Other toxic pollutants known to be present in wastewaters in significcant quantities are also limited.

The list of pollutants directly limited by the regulation is found in Table V-3. This list consists of 16 pollutants; 9 toxic, 4 nontoxic nonconventional, and 3 conventional. Table V-4 lists the pollutants limited in each subcategory.

TABLE V-1

DEVELOPMENT OF REGULATED POLLUTANT LIST
IRON & STEEL INDUSTRY

No.	Pollutant	Not Detected	Environmentally Insignificant (1)	Not Treatable (2)	Regulation Considered
001	Acenaphthene	-	-	-	X
002	Acrolein	X	-	-	-
003	Acrylonitrile	-	-	-	X
004	Benzene	-	-	-	X
005	Benzidine	X	-	-	-
006	Carbon tetrachloride	-	-	-	X
007	Chlorobenzene	X	-	-	-
008	1,2,4-trichlorobenzene	X	-	-	-
009	Hexachlorobenzene	-	-	X	-
010	1,2-dichloroethane	-	-	X	-
011	1,1,1-trichloroethane	-	-	-	X
012	Hexachlorethane	X	-	-	-
013	1,1-dichloroethane	-	-	-	X
014	1,1,2-trichloroethane	-	X	-	-
015	1,1,2,2-tetrachloroethane	-	-	X	-
016	Chloroethane	X	-	-	-
017	bis(chloromethyl)ether	X	-	-	-
018	bis(2-chloroethyl)ether	X	-	-	-
019	2-chloroethyl vinyl ether	X	-	-	-
020	2-chloronaphthalene	-	-	X	-
021	2,4,6-trichlorophenol	-	-	-	X
022	Parachlorometacresol	-	-	-	X
023	Chloroform	-	-	-	X
024	2-chlorophenol	-	-	X	-
025	1,2-dichlorobenzene	-	-	X	-
026	1,3-dichlorobenzene	X	-	-	-
027	1,4-dichlorobenzene	-	-	X	-
028	3,3'-dichlorobenzidine	X	-	-	-
029	1,1-dichloroethylene	-	X	-	-
030	1,2-trans-dichloroethylene	-	-	X	-
031	2,4-dichlorophenol	-	-	X	-
032	1,2-dichloropropane	X	-	-	-
033	1,2-dichloropropylene	X	-	-	-
034	2,4-dimethyl phenol	-	-	-	X
035	2,4-dinitrotoluene	-	-	-	X
036	2,6-dinitrotoluene	-	-	-	X
037	1,2-diphenylhydrazine	-	-	X	-
038	Ethylbenzene	-	-	-	X
039	Fluoranthene	-	-	-	X
040	4-chlorophenyl phenyl ether	X	-	-	-
041	4-bromophenyl phenyl ether	X	-	-	-
042	bis(2-chloroisopropyl) ether	X	-	-	-
043	bis(2-chloroethoxy) methane	X	-	-	-
044	Methylene chloride	-	-	X	-

TABLE V-1
DEVELOPMENT OF REGULATED POLLUTANT LIST
IRON & STEEL INDUSTRY
PAGE 2

No.	Pollutant	Not Detected	Environmentally Insignificant(1)	Not Treatable(2)	Regulation Considered
045	Methyl chloride	X	-	-	-
046	Methyl bromide	X	-	-	-
047	Bromoform	X	-	-	-
048	Dichlorobromomethane	-	-	X	-
049	Trichlorofluoromethane	X	-	-	-
050	Dichlorodifluoromethane	X	-	-	-
051	Chlorodibromomethane	X	-	-	-
052	Hexachlorobutadiene	X	-	-	-
053	Hexachlorocyclopentadiene	X	-	-	-
054	Isophorone	-	-	X	-
055	Naphthalene	-	-	-	X
056	Nitrobenzene	-	-	X	-
057	2-nitrophenol	-	-	X	-
058	4-nitrophenol	-	-	-	X
059	2,4-dinitrophenol	-	-	X	-
060	4,6-dinitro-o-cresol	-	-	-	X
061	N-nitrosodimethylamine	X	-	-	-
062	N-nitrosodiphenylamine	X	-	-	-
063	N-nitrosodi-n-propylamine	X	-	-	-
064	Pentachlorophenol	-	-	-	X
065	Phenol	-	-	-	X
066	bis(2-ethylhexyl)phthalate	-	-	-	X
067	Butyl benzyl phthalate	-	-	-	X
068	Di-n-butyl phthalate	-	-	-	X
069	Di-n-octyl phthalate	-	-	-	X
070	Diethyl phthalate	-	-	-	X
071	Dimethyl phthalate	-	-	-	X
072	Benzo(a)anthracene	-	-	-	X
073	Benzo(a)pyrene	-	-	-	X
074	3,4-benzofluoranthene	-	X	-	-
075	Benzo(k)fluoranthene	-	X	-	-
076	Chrysene	-	-	-	X
077	Acenaphthylene	-	-	-	X
078	Anthracene	-	-	-	X
079	benzo(ghi)perylene	-	X	-	-
080	Fluorene	-	-	-	X
081	Phenathrene	-	-	-	X
082	Dibenzo(a,h)anthracene	-	X	-	-
083	Indeno(1,2,3,cd)pyrene	-	X	-	-
084	Pyrene	-	-	-	X
085	Tetrachloroethylene	-	-	-	X
086	Toluene	-	-	-	X
087	Trichlorethylene	-	-	-	X
088	Vinyl chloride	-	X	-	-
089	Aldrin	-	X	-	-

TABLE V-1
DEVELOPMENT OF REGULATED POLLUTANT LIST
IRON & STEEL INDUSTRY
PAGE 3

No.	Pollutant	Not Detected	Environmentally Insignificant(1)	Not Treatable(2)	Regulation Considered
090	Dieldrin	-	X	-	-
091	Chlordane	-	X	-	-
092	4,4'-DDT	-	X	-	-
093	4,4'-DDE	-	X	-	-
094	4,4'-DDD	-	X	-	-
095	a-endosulfan-Alpha	-	X	-	-
096	b-endosulfan-Beta	-	X	-	-
097	Endosulfan sulfate	-	X	-	-
098	Endrin	-	X	-	-
099	Endrin aldehyde	-	X	-	-
100	Heptachlor	-	X	-	-
101	Heptachlor epoxide	-	X	-	-
102	a-BHC-Alpha	-	X	-	-
103	b-BHC-Beta	-	X	-	-
104	r-BHC-Gamma	-	X	-	-
105	g-BHC-Delta	-	X	-	-
106	PCB-1242	-	X	-	-
107	PCB-1254	-	X	-	-
108	PCB-1221	-	X	-	-
109	PCB-1232	-	X	-	-
110	PCB-1248	-	X	-	-
111	PCB-1260	-	X	-	-
112	PCB-1016	-	X	-	-
113	Toxaphene	-	X	-	-
114	Antimony	-	-	-	X
115	Arsenic	-	-	-	X
116	Asbestos	-	X	-	-
117	Beryllium	-	-	X	-
118	Cadmium	-	-	-	X
119	Chromium	-	-	-	X
120	Copper	-	-	-	X
121	Cyanide	-	-	-	X
122	Lead	-	-	-	X
123	Mercury	-	-	X	-
124	Nickel	-	-	-	X
125	Selenium	-	-	-	X
126	Silver	-	-	-	X
127	Thallium	-	-	-	X
128	Zinc	-	-	-	X
129	2,3,7,8-tetrachlordibenzo-p-dioxin	X	-	-	-
130	Xylene	-	-	-	X

TABLE V-1
DEVELOPMENT OF REGULATED POLLUTANT LIST
IRON & STEEL INDUSTRY
PAGE 4

No.	Pollutant	Not Detected	Environmentally Insignificant(1)	Not Treatable(2)	Regulation Considered
	Aluminum	-	-	-	X
	Ammonia	-	-	-	X
	Dissolved Iron	-	-	-	X
	Fluoride	-	-	-	X
	Hexavalent Chromium	-	-	-	X
	Manganese	-	-	-	X
	Oil and Grease	-	-	-	X
	pH	-	-	-	X
	Phenol (4AAP)	-	-	-	X
	Chlorine Residual	-	-	-	X
	Total Suspended Solids	-	-	-	X

X: Indicates heading which applies to pollutant.
-: Indicates heading which does not apply to pollutant.

(1) Pollutants detected at levels of 0.01 mg/l or less for pollutants not normally occuring in wastewater from these sources.
(2) Concentration of pollutant found at levels below treatability. However, pollutant load could be reduced by recycle.

TABLE V-2

POLLUTANTS CONSIDERED FOR REGULATION BY SUBCATEGORY
IRON & STEEL INDUSTRY

No.	Pollutant	Coke-making	Sintering	Iron-making	Steel-making	Vacuum Degassing	Continuous Casting	Hot Forming	Salt Bath Descaling	Acid Pickling	Cold Forming	Alkaline Cleaning	Hot Coatings
1	Acenaphthene	-	-	-	-	-	-	-	-	-	X	-	-
3	Acrylonitrile	X	-	-	-	-	-	-	-	-	-	-	-
4	Benzene	X	-	-	-	-	-	-	-	-	-	-	-
6	Carbon Tetrachloride	-	-	-	-	-	-	-	-	-	X	-	-
9	Hexachlorobenzene	-	-	X	-	-	-	-	-	-	-	-	-
11	1,1,1-trichloroethane	-	-	-	-	-	-	-	-	-	X	-	-
13	1,1-dichloroethane	-	-	-	-	-	-	-	-	-	X	-	-
21	2,4,6-trichlorophenol	X	-	-	-	-	-	-	-	-	-	-	-
22	Parachlorometacresol	X	-	-	-	-	-	-	-	-	-	-	-
23	Chloroform	X	-	-	X	-	-	-	X	-	X	-	-
24	2-chlorophenol	-	-	-	-	-	-	-	-	-	-	-	-
31	2,4-Dichlorophenol	-	-	X	-	-	-	-	-	-	-	-	-
34	2,4-dimethylphenol	X	-	X	-	-	-	-	-	-	-	-	-
35	2,4-dinitrotoluene	X	-	-	-	-	-	-	-	-	-	-	-
36	2,6-dinitrotoluene	X	-	-	-	-	-	-	-	-	-	X	-
38	Ethylbenzene	X	-	-	-	-	-	-	-	-	-	-	-
39	Fluoranthene	X	X	X	X	-	-	-	-	-	X	X	-
54	Isophorone	X	-	-	-	-	-	-	-	-	-	-	-
55	Naphthalene	X	-	-	-	-	-	-	-	-	X	-	-
58	4-Nitrophenol	-	-	-	X	-	-	-	-	-	-	-	-
60	4,6-dinitro-o-cresol	X	-	-	-	-	-	-	-	-	X	-	-
64	Pentachlorophenol	X	-	-	X	-	-	-	-	-	-	-	-
65	Phenol	X	X	X	-	-	-	-	-	-	X	-	-
66	-												
71	Phthalates, total	X	-	-	-	-	-	-	-	-	-	-	-
72	Benzo(a)anthracene	X	-	-	-	-	-	-	-	-	X	-	-
73	Benzo(a)pyrene	X	-	X	-	-	-	-	-	-	-	-	-
76	Chrysene	X	X	X	-	-	-	-	-	-	X	-	-
77	Acenaphthylene	X	-	-	-	-	-	-	-	-	X	-	-
78	Anthracene	-	-	-	-	-	-	-	-	-	X	-	-
80	Fluorene	X	-	-	-	-	-	-	-	-	X	-	-
81	Phenanthrene	-	-	-	-	-	-	-	-	-	X	-	-
84	Pyrene	X	X	X	-	-	-	-	-	-	X	X	-
85	Tetrachloroethylene	-	-	-	-	-	-	-	-	-	X	-	-
86	Toluene	X	-	-	-	-	-	-	-	-	X	-	-
87	Trichloroethylene	-	-	-	-	-	-	-	-	-	X	-	-

TABLE V-2
POLLUTANTS CONSIDERED FOR REGULATION BY SUBCATEGORY
IRON & STEEL INDUSTRY
PAGE 2

No.	Pollutant	Coke-making	Sintering	Iron-making	Steel-making	Vacuum Degassing	Continuous Casting	Hot Forming	Salt Bath Descaling	Acid Pickling	Cold Forming	Alkaline Cleaning	Hot Coatings
114	Antimony	X	-	X	X	-	-	-	X	X	X	X	-
115	Arsenic	X	-	X	X	-	-	-	X	X	X	-	X
118	Cadmium	-	X	X	X	-	-	-	X	X	X	-	X
119	Chromium	-	X	X	X	X	X	X	X	X	X	X	X
120	Copper	-	X	X	X	X	X	X	X	X	X	X	X
121	Cyanide	X	X	X	-	-	-	-	X	-	-	X	-
122	Lead	-	X	X	X	X	X	X	X	X	X	X	X
124	Nickel	-	X	X	X	X	-	X	X	X	X	X	X
125	Selenium	X	-	X	X	-	X	-	X	-	-	X	-
126	Silver	-	-	-	X	-	-	-	X	X	-	-	-
127	Thallium	-	-	-	X	-	-	-	X	-	-	-	-
128	Zinc	X	X	X	X	X	X	X	X	X	X	X	X
130	Xylene	X	-	-	-	-	-	-	-	-	-	-	-
	Aluminum	-	-	-	-	-	-	-	-	-	-	-	X
	Ammonia	X	-	X	-	-	-	-	-	-	-	-	-
	Dissolved Iron	-	-	-	-	-	-	-	X	X	X	X	X
	Fluoride	-	X	X	X	-	-	-	-	X	-	-	-
	Hexavalent Chromium	-	-	-	-	-	-	-	X	-	-	-	-
	Manganese	-	-	-	-	X	-	-	-	-	-	-	-
	Oil and Grease	X	X	-	-	-	X	X	-	X	X	X	X
	pH	X	X	X	X	X	X	X	X	X	X	X	X
	Phenolic Compounds	X	X	X	-	-	-	-	-	-	-	-	-
	TRC	-	X	X	-	-	-	-	-	-	-	-	-
	Total Suspended Solids	X	X	X	X	X	X	X	X	X	X	X	X

X: Selected for consideration in development of regulated pollutant list in this subcategory.
-: Not selected for consideration in development of regulated pollutant list in this subcategory.

TABLE V-3

REGULATED POLLUTANT LIST
IRON & STEEL INDUSTRY

4	Benzene
55	Naphthalene
73	Benzo(a)pyrene
85	Tetrachloroethylene
119	Chromium
121	Cyanide
122	Lead
124	Nickel
128	Zinc
	Ammonia
	Oil & Grease
	pH
	Phenol (4AAP)
	Chlorine Residual
	Total Suspended Solids
	Hexavalent Chromium

TABLE V-4

REGULATED POLLUTANT LIST BY SUBCATEGORY
IRON & STEEL INDUSTRY

No.	Pollutant	Cokemaking	Sintering	Ironmaking	Basic Oxygen Furnace (Steelmaking)	Open Hearth Furnace (Steelmaking)	Electric Arc Furnace (Steelmaking)	Vacuum Degassing	Continuous Casting	Hot Forming
004	Benzene	X	-	-	-	-	-	-	-	-
055	Naphthalene	X	-	-	-	-	-	-	-	-
073	Benzo(a)pyrene	X	-	-	-	-	-	-	-	-
085	Tetrachloroethylene	-	-	-	-	-	-	-	-	-
119	Chromium	-	-	-	-	-	-	-	-	-
121	Cyanide	X	X	X	-	-	-	-	-	-
122	Lead	-	X	X	X	X	X	X	X	-
124	Nickel	-	-	-	-	-	-	-	-	-
128	Zinc	-	X	X	X	X	X	X	X	-
	Ammonia	X	X	X	-	-	-	-	-	-
	Fluoride	-	-	-	-	-	-	-	-	-
	Oil & Grease	X	X	X	-	-	-	-	X	X
	pH	X	X	X	X	X	X	X	X	X
	Phenol (4AAP)	X	X	X	-	-	-	-	-	-
	Chlorine (Residual)	-	X	X	-	-	-	-	-	-
	Total Suspended Solids	X	X	X	X	X	X	X	X	X
	Hexavalent Chromium	-	-	-	-	-	-	-	-	-

TABLE V-4
REGULATED POLLUTANT LIST BY SUBCATEGORY
IRON & STEEL INDUSTRY
PAGE 2

No.	Pollutant	Salt Bath Descaling (Oxidizing)	Salt Bath Descaling (Reducing)	Sulfuric Acid Pickling	Hydrochloric Acid Pickling	Combination Acid Pickling	Cold Rolling	Alkaline Cleaning	Hot Coating
004	Benzene	-	-	-	-	-	-	-	-
055	Naphthalene	-	-	-	-	-	X	-	-
073	Benzo(a)pyrene	-	-	-	-	-	-	-	-
085	Tetrachloroethylene	-	-	-	-	-	X	-	-
119	Chromium	X	X	-	-	X	X	-	-
121	Cyanide	-	X	-	-	-	-	-	-
122	Lead	-	-	X	X	-	X	-	X
124	Nickel	X	X	-	-	X	X	-	-
128	Zinc	-	-	X	X	-	X	-	X
	Ammonia	-	-	-	-	-	-	-	-
	Fluoride	-	-	-	-	-	-	-	-
	Oil & Grease	-	-	X	X	X	X	X	X
	pH	X	X	X	X	X	X	X	X
	Phenol (4AAP)	-	-	-	-	-	-	-	-
	Chlorine Residual	-	-	-	-	-	-	-	-
	Total Suspended Solids	X	X	X	X	X	X	X	X
	Hexavalent Chromium	-	-	-	-	-	-	-	X

X: Selected for regulation in this subcategory.
-: Not selected for regulation in this subcategory.

VOLUME I

SECTION VI

WATER POLLUTION CONTROL AND TREATMENT TECHNOLOGY

A. Introduction

This section describes in-plant and end-of-pipe wastewater treatment technologies currently in use or available for use in the steel industry. The technology descriptions are grouped as follows: recycle; suspended solids removal; oil removal; toxic metal pollutant removal; toxic organic pollutant removal; advanced technologies; and, zero discharge technologies. The application and performance; advantages and limitations; reliability; maintainability; and demonstration status of each technology are presented. The treatment processes include both technologies presently demonstrated within the steel industry, and those demonstrated in other industries with similar wastewaters.

B. End of Pipe Treatment

Recycle Systems

Recycle is both an in-plant and end of pipe treatment operation used to reduce the volume of wastewater discharged. Wastewater reuse reduces the discharge flow and the pollutant load discharged from the process.

Application and Performance

Recycle is included in the model treatment systems for nine of the twelve steel industry subcategories. The Agency estimates that the use of these recycle systems can result in a 68.5% reduction in process water discharges at the BPT level and a 69% reduction at the BAT level. To achieve these reductions, high degrees of recycle demonstrated in the industry have been included in model treatment systems as shown below:

Subcategory	BAT Recycle Rate (%)
Cokemaking (Barometric Condenser)	95
Sintering	92
Ironmaking	98
Steelmaking	96-100
Vacuum Degassing	98
Continuous Casting	99
Hot Forming	60-77
Acid Pickling (fume scrubber)	95-98
Hot Coating (fume scrubber)	85

Higher rates of recycle are demonstrated in these and other subcategories. For example, rates of recycle up to 99% are common for hot forming operations.

At high recycle rates, two problems can be encountered. First, if the wastewater is contaminated, a build-up of dissolved solids in the recycled water can cause plugging and corrosion. This problem can be avoided by providing sufficient treatment of the wastewater prior to recycle, by adding chemicals that inhibit scaling or corrosion, and by having sufficient blowdown to limit the build-up of dissolved solids and other pollutants. The second problem that can occur is excessive heat build-up in the recycled water. If the temperature of the water to be recycled is too high for its intended purpose, it must be cooled prior to recycle. The most common method of reducing the heat load of recycled water in the steel industry is with mechanical draft cooling towers. Mechanical draft evaporative cooling systems are capable of handling the wide range of operating conditions encountered in the steel industry. Cooling towers are included in the model treatment systems for four of the eight subcategories (cokemaking final cooler and barometric condenser recycle systems, ironmaking, vacuum degassing, and continuous casting) where recycle systems are considered. Heat accumulation in the other subcategory recycle systems is not detrimental to the operation.

Advantages and Limitations

As discussed above, recycle systems can achieve significant pollutant load reductions at relatively low cost. The system is controlled by simple instrumentation and relatively little operator attention is required.

A potential limitation on the use of recycle systems is plugging and scaling. However, based upon the industry's response to basic and detailed questionnaires, the Agency believes that with proper attention and maintenance, plugging and scaling should not present a significant problem with achieving the recycle rates used as a basis for this regulation.

Operational Factors

1. Reliability

The reliability of recycle systems is high, although proper monitoring and control are required for high rate systems. Chemical aids are often used in the recycle loops to maintain optimum operating conditions.

2. Maintainability

Most recycle systems include only simple pump stations and piping. These components require very little attention aside from routine maintenance. However, for those recycle systems associated with wet air pollution control devices, higher maintenance costs are incurred to chemically control the recycled water to remove suspended and dissolved constituents and to prevent fouling and scaling.

Demonstration Status

Recycle systems are well demonstrated in the steel industry as well as in numerous other industral applications. Full scale recycle systems have been used in the steel industry for many years. The recycle rates used to develop effluent limitations and standards for each subcategory are demonstrated on a full scale basis in the industry.

Suspended Solids Removal

Many types of suspended solids removal devices are in use in the steel industry including clarifiers, thickeners, inclined plate separators, settling lagoons, and filtration (mixed or single media; pressure or gravity). Three broad categories that encompass virtually all methods of suspended solids removal are reviewed: (1) settling lagoons, (2) clarification which includes clarifiers, thickeners, and inclined plate separators and (3) filtration.

1. Settling Lagoon (or Basin)

Settling (sedimentation) is a process which removes solid particles from a liquid matrix by gravitational force. The operation reduces the velocity of the wastewater stream in a large volume tank or lagoon so that gravitational settling can occur. Because of the large wastewater volumes involved in the steel industry, lagoons are generally large, on the order of 0.1 to 10 acres of surface area, typically with a standard working depth of 7 to 10 feet. The industry has found lagoons up to 400 acres.

Long retention times are generally required for sedimentation. Accumulated sludge is removed either periodically or continuously and either manually or mechanically. But because simple sedimentation may require an excessively large settling area, and because high retention times (days as compared with hours) are usually required to effectively treat the wastewater, the addition of settling aids such as alum or polymeric flocculants is often used.

Sedimentation is often preceded by chemical precipitation and coagulation. Chemical precipitation converts dissolved pollutants to solid form, while coagulation enhances settling by gathering together suspended precipitates into larger, faster settling particles.

Application and Performance

Settling lagoons are used to treat wastewaters from all steel industry subcategories. Most are terminal treatment lagoons which serve as a final treatment step prior to discharge. Often these lagoons are a main component in central treatment systems and are used to settle out suspended solids from several process waste streams.

A properly operated sedimentation system is capable of efficiently removing suspended solids (including metal hydroxides), and other impurities from wastewaters. The performance of the lagoon depends primarily on overflow rate and a variety of other factors, including the density and particle size of the solids, the effective charge of the suspended particles, and the types of chemicals used for pretreatment, if any.

Advantages and Limitations

The major advantage of suspended solids removal by sedimentation is the simplicity of the process. The major problem with simple settling is the long retention time necessary to achieve a high degree of suspended solids removal, especially if the specific gravity of the suspended matter is close to that of water. Retention time is directly related to lagoon volume. Thus, long retention time means large area requirements not available at some steel plants. Another limitation is that dissolved or soluble pollutants are not removed by sedimentation.

Operational Factors

a. Reliability: Sedimentation is a highly reliable technology for removing suspended solids. Sufficient retention time and regular sludge removal are important factors affecting the reliability of all settling systems. The proper control of pH, chemical precipitation, and coagulation or flocculation are additional factors which affect settling efficiencies.

b. Maintainability: Little maintenance is required for lagoons other than periodic sludge removal.

Demonstration Status

Based upon the survey of the industry through questionnaires and sampling surveys, the Agency estimates that there are over 140 settling lagoons in use at 39 steel plant sites. Hence, settling lagoons are well demonstrated in the steel industry.

2. Clarifiers

Clarifiers are another type of sedimentation device widely used in the steel industry. The chief benefits of clarifiers over lagoons are that clarifiers are less land intensive and provide for centralized sludge collection. Suspended SOlids removal efficiencies are generally in the same range as that for settling lagoons. Conventional clarifiers consist of a circular or rectangular tank with either a mechanical sludge collecting device or with a sloping funnel-shaped bottom designed for sludge collection. In alternative clarifier designs, inclined plates or tubes may be placed in the clarifier tank to increase the effective settling area and thus increase the capacity of the clarifier. As with settling lagoons, chemical aids are often added prior to clarification to enhance suspended solids removal.

Application and Performance

The application of clarification is very similar to that described above for settling lagoons. Clarifiers are used to treat wastewaters from every subcategory for suspended solids removal. Performance data are presented in Appendix A.

The Agency statistically analyzed long-term data for several clarification systems. The Agency calculated the mean, standard deviation and other common statistical values, as well as the 30-day average and daily maximum performance standards. A 30-day average concentration was calculated based upon a 95 percentile value while the daily maximum concentration was calculated with a 99 percentile value. The methods used to determine these values are explained in Appendix A.

Based upon the data presented above, and other data presented in the subcategory reports, the Agency concludes that a 30-day average concentration of 30 mg/l TSS and a daily maximum concentration of 70 mg/l TSS or less are attainable with clarifiers for most steel industry wastewaters. Biological treatment of cokemaking wastewaters produces low density suspended solids that are difficult to settle. Higher concentrations have been used in developing the limitations for this subcategory.

Advantages and Limitations

Clarification is more effective for removing suspended solids than simple settling lagoons, requires less area, and provides for centralized sludge collection. However, the cost of installing and maintaining clarifiers is greater than the costs associated with simple settling lagoons.

Inclined plate and slant tube settlers have removal efficiencies similar to conventional clarifiers, but have a greater capacity per unit area.

Operational Factors

a. Reliability: Similar to lagoon systems with proper control and maintenance. Clarifiers can achieve consistently low concentrations of solids and other pollutants in the wastewater.

   Those advanced clarifiers using slanted tubes or inclined plates may require prescreening of the wastewater in order to eliminate any materials which could potentially clog the system.

b. Maintainability: The systems used for chemical pretreatment and sludge dragout must be maintained on a regular basis. Routine maintenance of mechanical parts is also necessary.

Demonstration Status

Clarifiers are used extensively to treat wastewaters from all subcategories of the steel industry. While the design may vary slightly depending on the wastewaters being treated (i.e., steelmaking vs. pickling), all systems operate in a similar manner.

3. Filtration

Filtration is another common method used to remove suspended solids, oil and grease, and toxic metals from steel industry wastewaters. Several types of filters and filter media are used in the industry and all work by similar mechanisms. Filters may be pressure or gravity type; single, dual, or mixed media; and the media can be sand, diatomaceous earth, walnut shells or some other material.

A filter may use a single media such as sand. However, by using dual or mixed (multiple) media, higher flow rates and efficiencies can be achieved. The dual media filter usually consists of a fine bed of sand under a coarser bed of another media. The coarse media removes most of the influent solids, while the fine sand performs final polishing.

In the steel industry, several considerations are important when filter systems are designed. While either pressure or gravity systems may be used, the pressure systems are more common and provide some advantages, including smaller land area requirements.

For typical steel industry applications, filter rates are in the range of 6 gpm per square foot to perhaps 18 gpm per square foot. The efficiency of suspended solids removal is dependent upon the filtration rate, the filter media and the particle size. A knowledge of particle density, size distribution, and chemical composition is useful when selecting a filter design rate and media.

Filter media must be selected in conjunction with the filter design rate. The size and depth of the media is a primary consideration and other important factors are the chemical composition, sphericity, and hardness of the media chosen. The presence of relatively large amounts of oil in the wastewater to be filtered also affects the selection of the appropriate media.

During the filtration process, suspended solids and oils accumulate in the bed and reduce the ability of the wastewater to flow through the media. To function properly, all filters are backwashed. The method of backwashing and the design of backwash systems is an integral part of any deep-bed filtration system. Solids penetrate deeply into the bed and must be adequately removed during the backwashing cycle or problems may develop within the filtration system. Occasionally, auxiliary means are employed to aid filter cleaning. Water jets used just below the surface of the expanded bed will aid solids and oil removals. Also, air can be used to augment the cleaning action of the backwash water to "scour" the bed free of solids and oils.

Filter system operation may be manual or automatic. The filter backwash cycle may be on a timed basis, a pressure drop basis with a terminal value which triggers backwash, or on a suspended solids carryover basis from turbidity monitoring of the outlet stream. Each of these methods is well demonstrated.

Application and Performance

In wastewater treatment plants, filters are often employed for final treatment following clarification, sedimentation or other similar operations. Filtration thus has potential application in nearly all industrial plants. Chemical additives which enhance the upstream treatment equipment may or may not be compatible with or enhance the filtration process. Normal operating flow rates for various types of filters are as follows:

Slow Sand	2.04-5.30 l/sq m/hr
Rapid Sand	40.74-51.48 l/sq m/hr
High Rate Mixed Media	81.48-122.22 l/sq m/hr

Suspended solids are commonly removed from wastewater streams by filtering through a deep 0.3-0.9 m (1-3 feet) granular filter bed. The porous media bed can be designed to remove practically all suspended particles. Even colloidal suspensions (roughly 1 to 100 microns) are adsorbed on the surface of the media grains as they pass in close proximity in the narrow bed passages.

Data gathered from short-term sampling visits show that filter plants in all subcategories readily produce effluents with less than 10 mg/l TSS (See Appendix A). However, the analysis of long-term data for ten filtration systems has shown that higher values are more appropriate for performance standards. Based upon the statistical analysis for long-term TSS data the Agency has determined that a 30-day average of 15 mg/l TSS and a daily maximum of 40 mg/l TSS are attainable with filtration. Moreover, data for many steel industry subcategories demonstrate that these limits can be applied to most wastewaters treated by filtration.

Advantages and Limitations

The principal advantages of filtration are low initial and operating costs, modest land requirements, lower effluent solids concentration, and the reduction or elimination of chemical additions which add to the discharge stream. However, the filter may require pretreatment if the suspended solids level is high (over 100 mg/l). In addition, operator training is necessary due to the controls and periodic backwashing involved.

Operational Factors

a. Reliability: Filtration is a highly reliable method of wastewater treatment.

b. Maintainability: Deep bed filters may be operated with either manual or automatic backwashing. In either case, they must be periodically inspected for media retention, partial plugging and particulate leakage.

Demonstration Status

Filtration is one of the more common treatment methods used for steel industry wastewaters especially in the hot forming subcategory. This technology is used to treat a variety of wastewaters with similar results. Its ability to reduce the amount of solids, oils and metals in the wastewater is well demonstrated with both short and long-term data in the steel industry.

Oil Removal

Oils and greases are removed from process wastewaters by several methods in the steel industry including oil skimming, filtration, and air flotation. Also, ultrafiltration is used at one cold rolling plant to remove oils. Oils may also be incidentally removed through other treatment processes such as clarification. The source of these oils is usually lubricants and preservative coatings used in the various steelmaking and finishing operations.

As a general matter, the most effective first step in oil removal is to prevent the oil from mixing with the large volume wastewater flows by segregating the sumps in all cellars and by appropriate maintenance of the lubrication and greasing systems. If the segregation is accomplished, more efficient removals of the oils and greases from wastewaters can be accomplished. The oil removal equipment used in the steel industry is described below.

1. Skimming

Pollutants with a specific gravity less than water will often float unassisted to the surface of the wastewater. Skimming is used to remove these floating wastes. Skimming normally takes place in a tank designed to allow the floating debris to rise and remain on the surface, while the liquid flows to an outlet located below the floating layer. Skimming devices are therefore suited to the removal of nonemulsified oils from untreated wastewaters. Common skimming mechanisms include the rotating drum type, which picks up oil from the surface of the water as the drum rotates. A doctor blade scrapes oil from the drum and collects it in a trough for disposal or reuse. The water portion is allowed to flow under the rotating drum. An underflow baffle is usually installed after the drum; this has the advantage of retaining any floating oil which escapes the drum skimmer. The belt type skimmer is pulled vertically through the water, collecting oil which is then scraped off from the belt surface and collected in a storage tank. The industry also uses rope and belt skimmers of various design that function in the same fashion. Gravity separators, such as the API type, use overflow and underflow baffles to skim a layer of floating oil from the surface of the wastewater. An overflow-underflow baffle allows a small amount of wastewater (the oil portion) to flow over into a trough for disposition or reuse while most of the water flows underneath the baffle. This is followed by an overflow baffle, which is set at a height relative to the first baffle such that only the oil bearing portion will flow over the first baffle during normal plant operation. A diffusion device, such as a vertical slot baffle, aids in creating a uniform flow through the system and increasing oil removal efficiency.

Application and Performance

Skimming may be used on any wastewater containing pollutants which float to the surface. It is commonly used to remove free oil, grease, and soaps. Skimming is always used with air flotation and often with clarification to improve removal of both settling and floating materials.

The removal efficiency of a skimmer is a function of the density of the material to be floated and the retention time of the wastewater in the tank. The retention time required to allow phase separation and subsequent skimming varies from 1 to 15 minutes, depending upon wastewater characteristics.

API or other gravity-type separators tend to be more suitable for use where the amount of surface oil flowing through the system is fairly high and consistent. Drum and belt type skimmers are suitable where oil can be allowed to collect in a treatment device for periodic or continuous removal. Data for various oil skimming operations are presented in Appendix A.

Advantages and Limitations

Skimming as pretreatment is effective in removing naturally floating waste material. It also improves the performance of subsequent downstream treatments.

Many pollutants, particularly dispersed or emulsified oil, will not float "naturally" but require additional treatment. Therefore, skimming alone may not remove all the pollutants capable of being removed by air flotation or other more sophisticated technologies.

Operational Factors

a. Reliability: Because of its simplicity, skimming is a very reliable technique. During cold weather, heating is usually required for the belt-type skimmers.

b. Maintainability: The skimming mechanism requires periodic lubrication, adjustment, and replacement of worn parts.

Demonstration Status

Skimming is a common method used to remove floating oil in many industrial categories, including the steel industry. Skimming is used extensively to treat wastewaters from hot forming, continuous casting, and cold forming operations.

2. Filtration

As explained above, filtration is also used to remove oils and greases from steel industry wastewaters. The mechanism for removing oils is very similar to the solids removal mechanism. The oils and greases, either floating or emulsified types, are directed into the filter where they are adsorbed on the filter media. Significant oil reductions can be achieved with filtration, and problems with the oils are not experienced unless high concentrations of oils are allowed to reach the filter bed. When this occurs the bed can be "blinded" and must be backwashed immediately. If too much oil is in the filter wastewater, frequent backwashing is necessary which makes the use of the technology unworkable. Therefore, proper pretreatment is essential for the proper operations of filtration equipment.

Application and Performance

The discussion presented above for filtration systems applies here as well. The filter will reduce oil from moderate levels down to extremely low levels. Long-term data for eight filtration systems demonstrate that an oil and grease performance standard as low as 3.5 mg/l can be readily attained on a 30-day average basis and 10 mg/l oil and grease can be readily attained on a daily maximum basis. However, because of problems with obtaining consistent analytical results in the range of 5 mg/l, the Agency has decided to establish only a maximum effluent limitation and standard based upon a daily maximum concentration of 10 mg/l for hot forming operations and other operations with similar wastewaters.

Operational Factors and Demonstrated Status

See prior discussion on filtration.

3. Flotation

Flotation is a process which causes particles such as metal hydroxides or oils to float to the surface of a tank where they are concentrated and removed. Gas bubbles are released in the wastewater and attach to the solid particles, which increase their buoyancy and causes them to float. In principle, this process is the opposite of sedimentation.

Flotation is used primarily in the treatment of wastewaters that carry finely divided suspended solids or oil. Solids having a specific gravity only slightly greater than 1.0, which require abnormally long sedimentation times, may be removed by flotation.

This process may be performed in several ways: foam, dispersed air, dissolved air, gravity, and vacuum flotation are the most commonly used techniques. Chemical additives are often used to enhance the performance of the flotation process. For example, acid and chemical aids are often used to break oil emulsions in cold rolling wastewaters. The emulsions are part of rolling solutions used in the process. Emulsion breaking is necessary for proper treatment of most cold rolling wastewaters by flotation.

The principal difference between types of flotation techniques is the method of generating the minute gas bubbles (usually air) needed to float the oil. Chemicals may be used to improve the efficiency of any of the basic methods. The different flotation techniques and the method of bubble generation for each process are described below.

Froth Flotation: Froth flotation is based upon the differences in the physiochemical properties of various particles. Wetability and surface properties affect particle affinity to gas bubbles. In froth flotation, air is blown through the solution containing flotation reagents. The particles with water repellent surfaces stick to air bubbles and are brought to the surface. A mineralized froth layer, with mineral particles attached to air bubbles, is formed. Particles of other minerals which are readily wetted by water do not stick to air bubbles and remain in suspension.

Dispersed Air Flotation: In dispersed air flotation, gas bubbles are generated by introducing the air by mechanical agitation with impellers or by forcing air through porous media. Dispersed air flotation is used mainly in the metallurgical industry.

Dissolved Air Flotation: In dissolved air flotation, bubbles are produced as a result of the release of air from a supersaturated solution under relatively high pressure.

There are two types of contact between the gas bubbles and particles. The first involves the entrapment of rising gas bubbles in the flocculated particles as they increase in size. The bond between the bubble and particle is one of physical capture only. This is the predominant type of contact. The second type of contact is one of adhesion. Adhesion results from the intermolecular attraction exerted at the interface between the solid particle and gaseous bubble.

Vacuum Flotation: This process consists of saturating the wastewater with air, either directly in an aeration tank or by permitting air to enter the suction of a pump. A partial vacuum causes the dissolved air to come out of solution as minute bubbles. The bubbles attach to solid particles and form a scum blanket on the surface, which is normally removed by a skimming mechanism. Grit and other heavy solids which settle to the bottom are generally raked to a central sludge pump for removal. A typical vacuum flotation unit consists of a covered cylindrical tank in which a partial vacuum is maintained. The tank is equipped with scum and sludge removal mechanisms. The floating material is continuously swept to the tank periphery, automatically discharged into a scum trough, and removed from the unit by a pump also under partial vacuum.

Application and Performance

Flotation is commonly used to treat cokemaking and cold forming wastewaters. Gas (hydrogen) flotation is used at several cokemaking operations to control oil levels. Dissolved air flotation is used extensively to treat cold rolling wastewaters. The flotation process is used after emulsion breaking and prior to final settling. Data for three steel industry flotation units are presented below.

Performance of Flotation Units

Plant	Oil & Grease (mg/l) In	Oil & Grease (mg/l) Out
0684F (cokemaking)	93	45
0684F (cold rolling)	NA	7.3
0060B	41,140	98

Advantages and Limitations

The advantages of the flotation process include the high levels of solids and oil separation which are achieved in many applications; relatively low energy requirements; and, the capability to adjust air flow to meet the varying requirements of treating different types of wastewaters. The limitations of flotation are that it often requires addition of chemicals to enhance process performance; it requires properly trained and attentive operators; and it generates large quantities of solid wastes.

Operational Factors

a. Reliability: The reliability of a flotation system is normally high and is governed by proper operation of the sludge collector mechanism and by the motors and pumps used for aeration.

b. Maintainability: Maintenance of the scraper blades used to remove the floated material is critical for proper operations. Routine maintenance is required on the pumps and motors. The sludge collector mechanism is subject to possible corrosion or breakage and may require periodic replacement.

Demonstration Status

Flotation is extensively demonstrated in the steel industry, particularly for the treatment of cokemaking and cold rolling wastewaters.

4. Ultrafiltration

Ultrafiltration (UF) includes the use of pressure and semipermeable polymeric membranes to separate emulsified or colloidal materials suspended in a liquid phase. The membrane of an ultrafiltration unit forms a molecular screen which retains molecular particles based upon their differences in size, shape, and chemical structure. The membrane permits passage of solvents and lower molecular weight molecules. At present, ultrafiltration systems are used to remove materials with molecular weights in the range of 1,000 to 100,000 and particles of comparable or larger sizes.

In the ultrafiltration process, the wastewater is pumped through a tubular membrane unit. Water and some low molecular weight materials pass through the membrane under the applied pressure of 10 to 100 psig. Emulsified oil droplets and suspended particles are retained, concentrated, and removed continuously. In contrast to ordinary filtration, retained materials are washed off the membrane filter rather than held by it.

Application and Performance

Ultrafiltration has potential application in cold rolling operations for separating oils and residual solids from the process wastes. Because of the ability to remove emulsified oils with little or no pretreatment, ultrafiltration is well suited for many of the wastewaters generated at cold rolling mills. Also, some organic compounds of suitable molecular weight may be bound in the oily wastes which are removed. Hence, ultrafiltration could prove to be an effective means to achieve toxic organic pollutant removal for the cold rolling subdivision.

The following test data depict ultrafiltration performance for the treatment of cold rolling wastewaters at one plant:

Ultrafiltration Performance

	Feed (mg/l)	Permeate (mg/l)
Oil (freon extractable)	82,210	140
TSS	2,220	199
Chromium	6.5	1.2
Copper	7.5	0.07
2-chlorophenol	35.5	ND
2-nitrophenol	70.0	0.02

When the concentration of pollutants in the wastewater is high (as above) the ultrafiltration unit alone may not adequately treat the wastewater. Additional treatment may be required prior to discharge.

Advantages and Limitations

Ultrafiltration is an attractive alternative to chemical treatment in certain applications because of lower installation and operating costs, high oil and suspended solids removal, and little required pretreatment. It places a positive barrier between pollutants and effluent which reduces the possibility of extensive pollutant discharge due to operator error or upset in settling and skimming systems. Another possible application is recovering alkaline values from alkaline cleaning solutions.

A limitation on the use of ultrafiltration for treating wastewaters is its narrow temperature range (18 to 30 degrees C) for satisfactory operation. Membrane life is decreased with higher temperatures, but flux increases at elevated temperatures. Therefore, the surface area requirements are a function of temperature and become a tradeoff between initial costs and replacement costs for the membrane. Ultrafiltration is not suitable for certain solutions. Strong oxidizing agents, solvents, and other organic compounds can dissolve the membrane. Fouling is sometimes a problem, although the high velocity of the wastewater normally creates enough turbulence to keep fouling at a minimum. Large solids particles are also sometimes capable of puncturing the membrane and must be removed by gravity settling or filtration prior to ultrafiltration.

Operational Factors

a. Reliability: The reliability of ultrafiltration systems is dependent upon the proper filtration, settling or other treatment of incoming wastewaters to prevent damage to the membrane. Pilot studies should be completed for each application to determine necessary pretreatment steps and the specific membrane to be used.

b. Maintainability: A limited amount of regular maintenance is required for the pumping system. In addition, membranes must be periodically changed. The maintenance associated with membrane plugging can be reduced by selecting a membrane with optimum physical characteristics and providing sufficient velocity of the wastewater. It is necessary to pass a detergent solution through the system at regular intervals to remove an oil and grease film which accumulates on the membrane. With proper maintenance membrane life can be greater than twelve months.

Demonstration Status

The ultrafiltration process is well developed and commercially available for treatment of wastewater or recovery of certain high molecular weight liquid and solid contaminants. Over 100 units are presently in operation in the United States. Ultrafiltration is demonstrated in the steel industry in the cold forming subcategory.

Metals Removal

Steel industry wastewaters contain significant levels of toxic metal pollutants including chromium, copper, lead, nickel, zinc and others. These pollutants are generally removed by chemical precipitation and sedimentation or filtration. Most can be effectively removed by precipitating metal hydroxides or carbonates through reactions with lime, sodium hydroxide, or sodium carbonate. Sodium sulfide, ferrous sulfide, or sodium bisulfite can also be used to precipitate metals as sulfide compounds with low solubilities.

Hexavalent chromium is generally present in galvanizing and oxidizing salt bath descaling wastewaters. Reduction of this pollutant to the trivalent form is required if precipitation as the hydroxide is to be achieved. Where sulfide precipitation is used, hexavalent chromium can be reduced directly by the sulfide. Chromium reduction using sulfur dioxide or sodium bisulfite or by electrochemical techniques may be necessary, however, when hydroxides are precipitated.

Details on various metal removal technologies are presented below with typical treatability levels where data are available.

1. Chemical Precipitation

Dissolved toxic metal ions and certain anions may be chemically precipitated and removed by physical means such as sedimentation, filtration, or centrifugation. Several reagents are commonly used to effect this precipitation.

a. Alkaline compounds such as lime or sodium hydroxide may be used to precipitate many toxic metal ions as metal hydroxides. Lime also may precipitate phosphates as insoluble calcium phosphate and fluorides as calcium fluoride.

b. Both soluble sulfides such as hydrogen sulfide or sodium sulfide and insoluble sulfides such as ferrous sulfide may be used to precipitate many heavy metal ions as insoluble metal sulfides.

c. Carbonate precipitates may be used to remove metals either by direct precipitation using a carbonate reagent such as calcium carbonate or by converting hydroxides into carbonates using carbon dioxide.

These treatment chemicals may be added to a flash mixer or rapid mix tank, a presettling tank, or directly to a clarifier or other settling device. Coagulating agents may be added to facilitate settling. After the solids have been removed, a final pH adjustment may be required to reduce the high pH created by the alkaline treatment chemicals.

Chemical precipitation as a mechanism for removing metals from wastewater is a complex process made up of at least two steps: precipitation of the unwanted metals and removal of the precipitate. A small amount of metal will remain dissolved in the wastewater after complete precipitation. The amount of residual dissolved metal depends on the treatment chemicals used, the solubility of the metal and co-precipitation effects. The effectiveness of this method of removing any specific metal depends on the fraction of the specific metal in the raw waste (and hence in the precipitate) and the effectiveness of suspended solids removal.

<u>Application and Performance</u>

Chemical precipitation is used extensively in the steel industry for precipitation of dissolved metals including aluminum, antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, molybdenum, nickel, tin, and zinc. The process is also applicable to any substance that can be transformed into an insoluble form such as fluorides, phosphates, soaps, sulfides, and others. Chemical precipitation is simple and effective.

The performance of chemical precipitation depends on several variables; the most important are:

a. Maintenance of an alkaline pH throughout the precipitation reaction and subsequent settling.

b. Addition of a sufficient excess of treatment ions to drive the precipitation reaction to completion.

c. Addition of an adequate supply of sacrifical ions (such as iron or aluminum) to ensure precipitation and removal of specific target ions.

d. Effective removal of precipitated solids (see appropriate technologies discussed under "Solids Removal").

A discussion of the performance of some of the chemical precipitation technologies used in the steel industry is presented below.

<u>Lime Precipitation - Sedimentation Performance</u>

Lime is sometimes used in conjunction with sedimentation technology to precipitate metals. Numerous examples of this technology are demonstrated in the steel industry, mostly for treatment of steel finishing wastewaters. Data for one plant and the median effluent concentration of long term averages for several plants using this technology are shown below. Plant 0584E has a lime precipitation/sedimentation treatment system which treats wastewaters from several finishing operations, including electroplating which is not covered as part of the steel industry category. The median data for the other plants were used to establish the effluent limitation for carbon steel finishing operations and are review in Appendix A of this volume.

Lime Precipitation - Sedimentation Performance

Pollutant	Concentration of Pollutants (mg/l) Plant 0584E In	Out	Median Performance* Out
Dissolved Iron	0.25	0.01	<0.02
Chromium	4.4	0.054	0.03
Copper	-	-	0.04
Lead	-	-	0.10
Nickel	-	-	0.15
Tin	4.4	0.0	-
Zinc	0.11	0.02	0.06
TSS	322	4.5	25
pH	2.9-6.8	7.0-7.4	6.0-9.0

*See Appendix A

Lime Precipitation - Filtration Performance

A metals removal technology that is used in the steel industry similar to the lime/sedimentation system includes lime precipitation and filtration. These systems accomplish better solids and oil removal and also achieves slightly better control of the effluent concentration of the metallic elements. Data for two plants that employ lime precipitation/filtration technology are shown below. Pickling and galvanizing wastewaters are treated at plant 0612, while pickling, galvanizing and alkaline cleaning wastewaters are treated at plant 0112I. The median effluent concentrations of long term average for several plants which were used to establish the effluent limitations for filtration systems are also presented below. These effluent data are more thoroughly, reviewed in Appendix A of this volume. Pilot plant data for steelmaking wastewaters are also presented in Appendix A.

Lime Precipitation - Filtration Performance

Pollutant	Concentration of Pollutants (mg/l) Plant 0612 In	Plant 0612 Out	Plant 0112I In	Plant 0112I Out	Median Performance* Out
Chromium	1.60	0.04	0.12	0.03	0.03
Copper	0.60	0.08	0.17	0.02	0.03
Lead	2.400	0.18	0.19	<0.10	0.06
Nickel	0.60	0.02	0.08	0.03	0.04
Zinc	285.00	0.12	18.00	0.13	0.10
TSS	350.00	11.00	199.00	1.00	9.8
pH	2.9-3.9	8.3-8.5	5.2-5.6	7.3-7.7	6.0-9.0

*See Appendix A

Sulfide Precipitation

Most metal sulfides are less soluble than hydroxides and the precipitates are frequently more dependably removed from water. Solubilities for selected metal hydroxides and sulfide precipitates are shown below:

Theoretical Solubilities of Hydroxides and Sulfides of Heavy Metals in Pure Water

Metal	Solubility of Metal, mg/l As hydroxide	As sulfide
Cadmium (Cd^{+2})	2.3×10^{-5}	6.7×10^{-10}
Chromium (Cr^{+3})	8.4×10^{-5}	No precipitate
Copper (Cu^{+2})	2.2×10^{-2}	5.8×10^{-18}
Iron (Fe^{+2})	8.9×10^{-1}	3.4×10^{-5}
Lead (Pb^{+2})	2.1×10^{-0}	3.8×10^{-9}
Nickel (Ni^{+2})	6.9×10^{-3}	6.9×10^{-8}
Silver (Ag^{+2})	13.0×10^{-0}	7.4×10^{-12}
Tin (Sn^{+2})	1.1×10^{-4}	2.3×10^{-7}

Sulfide treatment has not been used in the steel industry on a full-scale basis. However, it has been used in other manufacturing process (e.g. electroplating) to remove metals from wastewaters with similar characteristics and pollutants to those of the steel industry.

In assessing whether this technology is transferable for use in steel industry, the Agency consulted numerous references; contacted sulfide precipitation equipment manufacturers, and gathered data from operating sulfide precipitation systems. The wastewaters treated by these sulfide precipitation systems were contaminated with many of the same toxic metals found in steel industry wastewaters and at similar concentrations. Accordingly, the Agency concluded that a transfer of the effectiveness of this technology is possible. However, as noted above there are no full scale systems currently in use in the steel industry.

Data for several sulfide/filtration systems are shown below.

Sulfide Precipitation/Filtration Performance

Concentration of Pollutants (mg/l)

Pollutant	Data Set #1 In	Data Set #1 Out	Data Set #2 In	Data Set #2 Out
Chromium	2.0	<0.1	2.4	<0.1
Iron	85.0	0.04	108	0.60
Nickel	0.6	0.10	0.68	<0.1
Zinc	27.0	<0.1	33.9	<0.1
TSS	320	4.0	-	-
pH	2.9	8.2	7.7	7.4

Another benefit of the sulfide precipitation technology is the ability to precipitate hexavalent chromium (Cr^{+6}) without prior reduction to the trivalent state as is required in the hydroxide process. When ferrous sulfide is used as the precipitant, iron and sulfide act as reducing agents for the hexavalent chromium according to the reaction:

$$CrO_4^{=} + FeS + 4H_2O \rightarrow Cr(OH)_3 + Fe(OH)_3 + S + 2OH^-$$

In this reaction, the sludge produced consists mainly of ferric hydroxides, chromic hydroxides and various metallic sulfides. Some excess hydroxyl ions are generated in this process, possibly requiring a downward pre-adjustment of pH.

Advantages and Limitations

Chemical precipitation is an effective technique for removing many pollutants from industrial wastewaters. It operates at ambient conditions and is well suited to automatic control. The use of chemical precipitation may be limited due to interference of chelating agents, chemical interferences from mixing wastewaters and treatment chemicals, and potentially hazardous situations involved with the storage and handling of those chemicals. Lime is usually added as a slurry when used in hydroxide precipitation. The slurry must be well mixed and the addition lines periodically checked to prevent fouling. In addition, hydroxide precipitation usually makes recovery of the precipitated metals difficult, because of the heterogeneous nature of most hydroxide sludges. As shown above, lime precipitation of steel industry finishing wastewaters can produce effluent quality similar to that shown for sulfide precipitation.

The low solubility of most metal sulfides, allow for high metal removal efficiencies. Also, the sulfide process has the ability to remove chromates and dichromates without preliminary reduction of the chromium to the trivalent state. Sulfide precipitation can be used to precipitate metals complexed with most complexing agents. However, Sulfids precipitation can be used to care must be taken to maintain the pH of the solution at approximately 10 in order to prevent the generation of toxic sulfide gas during this process. For this reason ventilation of the treatment tanks may be a necessary precaution in most installations. The use of ferrous sulfide reduces or virtually eliminates the problem of hydrogen sulfide evolution. As with hydroxide precipitation, excess sulfide ion must be present to drive the precipitation reaction to completion. Since the sulfide ion itself is toxic, sulfide addition must be carefully controlled to maximize heavy metals precipitation with a minimum of excess sulfide to avoid the necessity of post treatment. Where excess sulfide is present, aeration of the effluent stream can aid in oxidizing residual sulfide to the less harmful sodium sulfate (Na_2SO_4). The cost of sulfide precipitants is high in comparison with hydroxide precipitants, and disposal of metallic sulfide sludges may pose problems. An essential element in effective sulfide precipitation is the removal of precipitated solids from the wastewater and proper disposal in an appropriate site. Sulfide precipitation will also generate a higher volume of sludge than hydroxide precipitation, resulting in higher disposal and dewatering costs. This is especially true when ferrous sulfide is used as the precipitant.

Sulfide precipitation may be used as a final tratement step after hydroxide precipitation-sedimentation. This treatment configuration may provide the better treatment effectiveness of sulfide precipitation while minimizing the variability caused by changes in raw waste and reducing the amount of sulfide precipitant required.

Operational Factors

a. Reliability: The reliability of alkaline chemical precipitation is high, although proper monitoring and control are necessary. Sulfide precipitation systems provide similar reliability.

b. Maintainability: The major maintenance needs involve periodic upkeep of monitoring equipment, automatic feeding equipment, mixing equipment, and other hardware. Removal of accumulated sludge is necessary for the efficient operation of precipitation-sedimentation systems.

Demonstration Status

Chemical precipitation of metal hydroxides is a classic wastewater treatment technology used throughout the steel industry. Chemical precipitation of metals in the carbonate form alone has been found to be feasible and, is used in commercial application to permit metals recovery and water reuse. Full scale commercial sulfide precipitation units are in operation at numerous installations, however, none are presently installed in the steel industry.

2. Filtration (for Metal Removal)

As discussed previously, filtration is a proven technology for the control of suspended solids and oil and grease. The filtration mechanism which reduces the concentrations of the suspended solids and oils also treats the metallic elements present in particulate form. To determine the treatability levels for metals using filtration the Agency compiled all available data for such systems. Data for seventeen filtration systems were averaged to develop the treated effluent concentrations. The average treated effluent concentrations and the proposed monthly average concentration for five toxic metals are shown below:

Metal Removal with Filtration Systems

Pollutant	Monthly Average Concentration (mg/l)	Daily Maximum Concentration (mg/l)
Chromium	0.04	0.12
Copper	0.04	0.12
Lead	0.08	0.24
Nickel	0.05	0.16
Zinc	0.08	0.24

For purposes of developing effluent limitations, the Agency is using 30 day average concentrations of 0.10 mg/l and daily maximum concentrations of 0.30 mg/l for each toxic metal except zinc. For zinc, the Agency is using a 30 day average concentration of 0.15 mg/l and daily maximum concentration of 0.45 mg/l, since the performance standard for zinc was greater than 0.10 mg/l. The Agency rounded the zinc performance standard to 0.15 mg/l. Reference is made to Appendix A for development of toxic metals effluent concentrations.

Advantages and Limitations

See prior discussion on filtration systems.

Operational Factors and Demonstration Status

See prior discussion on filtration systems.

Organic Removal

Thirty-three organic toxic pollutants were detected in steel industry wastewaters above treatability levels. Because some of these pollutants are present in significant levels, the Agency considered two demonstrated treatment alternatives for these pollutants in several subcategories: carbon adsorption and biological treatment (activated sludge). These technologies are discussed separately below.

1. Carbon Adsorption

The use of activated carbon for removal of dissolved organics from water and wastewater has been demonstrated and is one of the most efficient organic removal processes available. Activated carbon has also been shown to be an effective adsorbent for many toxic metals, including mercury. This process is reversible, thus allowing activated carbon to be regenerated and reused by the application of heat and steam or solvent. Regeneration of carbon which has adsorbed significant metals, however, may be difficult.

The term activated carbon applies to any amorphous form of carbon that has been specially treated to give high adsorption capacities. Typical raw materials include coal, wood, coconut shells, petroleum base residues and char from sewage sludge pyrolysis. A carefully controlled process of dehydration, carbonization, and oxidation yields a product which is called activated carbon. This material has a high capacity for adsorption due primarily to the large surface area available for adsorption (500- 1500 square meters/gram) which result from a large number of internal pores. Pore sizes generally range in radius from 10-100 angstroms.

Activated carbon removes contaminants from water by the process of adsorption (the attraction and accumulation of one substance on the surface of another). Activated carbon preferentially adsorbs organic compounds and, because of this selectivity, is particularly effective in removing toxic organic pollutants from wastewaters.

Carbon adsorption requires pretreatment (usually filtration) to remove excess suspended solids, oils, and greases. Suspended solids in the influent should be less than 50 mg/l to minimize backwash requirements. A downflow carbon bed can handle much higher levels (up to 2000 mg/l), but frequent backwashing is required. Backwashing more than two or three times a day is not desirable. Oil and grease should be less than about 15 mg/l. A high level of dissolved inorganic material in the influent may cause problems with thermal carbon reactivation (i.e., scaling and loss of activity) unless appropriate preventive steps are taken. Such steps might include pH control, softening, or the use of an acid wash on the carbon prior to reactivation.

Activated carbon is available in both powdered and granular form. Powdered carbon is less expensive per unit weight and may have slightly higher adsorption capacity but it is more difficult to handle and to regenerate.

Application and Performance

Activated carbon has been used in a variety of applications involving the removal of objectional organics from wastewater streams. One of the more frequent uses is to reduce the concentration of oxygen demanding substances in POTW effluents. It is also used to remove specific organic contaminants in the wastewaters of various manufacturing operations such as petroleum refining. There are two full scale activated carbon systems in use in the steel industry for treating cokemaking wastewaters.

Tests performed on single compound systems indicate that processing with activated carbon can achieve residual levels on the order of 1 microgram per liter for many of the toxic organic pollutants. Compounds which respond well to adsorption include carbon tetrachloride, chlorinated benzenes, chlorinated ethanes, chlorinated phenols, haloethers, phenols, nitrophenols, DDT and metabolites, pesticides, polynuclear aromatics and PCB's. Plant scale systems treating a mixture of many organic compounds must be carefully designed to optimize certain critical factors.

Factors which affect overall adsorption of mixed solutes include relative molecular size, the relative adsorptive affinities, and the relative concentration of the solutes. Data indicate that column treatment with granular carbon provides for better removal of organics than clarifier contact treatment with powdered carbon.

Data from two activated carbon column systems used in the steel industry and EPA treatability data for carbon adsorption systems were combined to develop performance standards for carbon column systems. The average concentration values attainable with carbon adsorption systems are shown in Table VI-1 for those toxic organics found above treatability levels in steel industry wastewaters.

Advantages and Limitations

The major benefits of carbon treatment include applicability to a wide variety of organics, and a high removal efficiency. The system is not sensitive to fairly wide variations in concentration and flow rates. The system is compact, and recovery of adsorbed materials is sometimes practical. However, the destruction of adsorbed compounds often occurs during thermal regeneration. If carbon cannot be thermally desorbed, it must be disposed of along with any adsorbed pollutants. When thermal regeneration is used, capital and operating costs are generally economical when carbon usage exceeds about 1,000 lb/day. Carbon does not efficiently remove low molecular weight or highly soluble organic compounds.

Operational Factors

a. Reliability: This system is very reliable with proper pretreatment and proper operation and maintenance.

b. Maintainability: This system requires periodic regeneration or replacement of spent carbon and is dependent upon raw waste load and process efficiency.

Demonstration Status

Carbon adsorption systems have been demonstrated to be practical and economical for the reduction of COD, BOD and related pollutants in secondary municipal and industrial wastewaters; for the removal of toxic or refractory organics from isolated industrial wastewaters; for the removal and recovery of certain organics from wastewaters; and for the removal, at times with recovery, of selected inorganic chemicals from aqueous wastes. Carbon adsorption is considered a viable and economic process for organic waste streams containing up to 1 to 5 percent of refractory or toxic organics. It also has been used to remove toxic inorganic pollutants such as metals.

Granular carbon adsorption is demonstrated on a full scale basis at tow plants in the cokemaking subcategory and one blast furnace and sintering operation. Additionally, a powered carbon addition study has been piloted for biological treatment of cokemaking wasterwaters.

2. Biological Oxidation

Biological treatment is another method of reducing the concentration of ammonia-n, cyanide, phenols (4AAP) and toxic organic pollutants from process wastewaters. Biological systems, both single and two-stage, have been used effectively to treat sanitary wastewaters. The activated sludge system is well demonstrated in the steel industry, although other systems including rotating biological disks have also been studied.

In the activated sludge process, wastewater is stablized biologically in a reactor under aerobic conditions. The aerobic environment is achieved by the use of diffused or mechanical aeration. After the wastewater is treated in the reactor, the resulting biological mass is separated from the liquid in a settling tank. A portion of the settled biological solids is recycled and the remaining mass is wasted. The level at which the biological mass should be maintained in the system depends upon the desired treatment efficiency, the particular pollutants that are to be removed and other considerations related to growth kinetics.

The activated sludge system generally is sensitive to fluctuations in hydraulic and pollutant loadings, temperature and certain pollutants. Temperature not only influences the metabolic activities of the microbiological population, but also has an effect on such factors as gas transfer rates and the settling characteristics of the biological solids. Some pollutants are extremely toxic to the microorganisms in the system, such as ammonia at high concentrations and tocix metals. Therefore, sufficient equalization and pretreatment must be installed ahead of the biological reactor so that high levels of toxic pollutants do not enter the system and "kill" the microorganism population. If the biological conditions in an activated sludge plant are upset, it can be a matter of days or weeks before biological activity returns to normal.

Application and Performance

Although a great deal of information is available on the performance of activated sludge units in controlling phenolic compounds, cyanides, ammonia, and BOD, limited long-term data are available regarding toxic pollutants other than phenolic compounds, cyanides, and ammonia. Only lately has there been an emphasis upon the performance of the activated sludge units on the toxic organic pollutants.

Originally, advanced levels of treatment using a biological system were expected to involve multiple stages for accomplishing selective degradation of pollutants in series, e.g., phenolic compounds and cyanide removal, nitrification, and dentrification. The Agency sampled the wastewaters of two well operated biological plants in the cokemaking subcategory. Both of these plants achieved good removals of toxic pollutants with organic removal averaging better than

90% and completely eliminating phenolic compounds, naphthalene, and xylene. The monitoring data for one of these plants were used to develop performance standards for ammonia-N, cyanide, phenols (4AAP), and toxic organic pollutants for biological oxidation systems. These standards are shown in Table VI-1 for those toxic pollutants found in the steel industry wastewaters above treatability levels.

Advantages and Limitations

The activated sludge system achieves significant reductions of most toxic organic pollutants at significantly less capital and operating costs than for carbon adsorption. Also, consistent effluent quality can be maintained if sufficient pretreatment is practiced and shock loadings of specific pollutants are eliminated. The temperature, pH and oxygen levels in the system must be maintained within certain ranges or fluctuating removal efficiencies of some pollutants will occur.

Operational Factors

a. Reliability: This system is very reliable with proper pretreatment and proper operation and maintenance.

b. Maintainability: As long as adequate pretreatment is practiced, high effluent quality can be maintained. If the system is upset, the operation can be brought under control by seeding with biological floc or POTW sludges.

Demonstration Status

Activated sludge systems are well demonstrated in the steel industry. Biological oxidation systems are installed at eighteen cokemaking operations.

Advanced Technologies

The Agency considered other advanced treatment technologies as possible alternative treatment systems. Ion exchange and reverse osmosis were considered because of their treatment effectiveness and because, in certain applications, they allow the recovery of certain process material.

1. Ion Exchange

Ion exchange is a process in which ions, held by electrostatic forces to charged functional groups on the surface of the ion exchange resin, are exchanged for ions of similar charge from the solution in which the resin is immersed. This is classified as an absorption process because the exchange occurs on the surface of the resin, and the exchanging ion must undergo a phase transfer from solution phase to solid phase. Thus, ionic contaminants in a wastewater can be exchanged for the harmless ions of the resin.

Low exchange systems used to treat wastewaters are always preceeded by filters to remove suspended matter which could foul the low exchange resin. The wastewater then passes through a cation exchanger which contains the ion exchange resin. The exchanger retains metallic impurities such as copper, iron, and trivalent chromium. The wastewater is then passed through the anion exchanger which has a different resin. Hexavalent chromium, for example, is retained in this stage. If the wastewater is not effectively treated in one pass through it may be passed through another series of exchangers. Many ion exchange systems are equipped with more than one set of exchangers for this reason.

The other major portion of the ion exchange process is the regeneration of the resin, which holds impurities removed from the wastewater. Metal ions such as nickel are removed by an acid cation exchange resin, which is regenerated with hydrochloric or sulfuric acid, replacing the metal ion with one or more hydrogen ions. Anions such as dichromate are removed by a basic anion exchange resin, which is regenerated with sodium hydroxide, replacing the anion with one or more hydroxyl ions. The three principal methods used by industry for regenerating the spent resins are:

a. Replacement Service: A regeneration service replaces the spent resin with regenerated resin, and regenerates the spent resin at its own facility. The service then treats and disposes of the spent regenerant.

b. In-Place Regeneration: Some establishments may find it less expensive to conduct on-site regeneration. The spent resin column is shut down for perhaps an hour, and the spent resin is regenerated. This results in one or more waste streams which must be treated in an appropriate manner. Regeneration is performed as the resins require it, usually every few months.

c. Cyclic Regeneration: In this process, the regeneration of the spent resins takes place within the ion exchange unit itself in alternating cycles with the ion removal process. A regeneration permits operation with a very small quantity of resin and with fairly concentrated solutions, resulting in a very compact system. Again, this process varies according to application, but the regeneration cycle generally begins with caustic being pumped through the anion exchanger, which carries out hexavalent chromium, for example, as sodium dichromate. The sodium dichromate stream then passes through a cation exchanger, converting the sodium dichromate to chromic acid. After being concentrated by evaporation or other means, the chromic acid can be returned to the process line. Meanwhile, the cation exchanger is regenerated with sulfuric acid, resulting in a waste acid stream containing the metallic impurities removed earlier. Flushing the exchangers with water completes the cycle. Thus, the wastewater is purified and, in this example, chromic acid is recovered. The ion exchangers, with newly regenerated resin, then enter the ion removal cycle again.

Application and Performance

The list of pollutants for which the ion exchange system has proven effective includes, among others, aluminum, arsenic, cadmium, chromium (hexavalent and trivalent), copper, cyanide, gold, iron, lead, manganese, nickel, selenium, silver, tin, and zinc. Thus, it can be applied at a wide variety of industrial concerns. Because of the heavy concentrations of metals in metal finishing wastewaters, ion exchange is used extensively in that industry. As an end-of-pipe treatment, ion exchange is certainly feasible, but its greatest value is in recovery applications. It is commonly used as an integrated treatment to recover rinse water and process chemicals. At some electroplating facilities ion exchange is used to concentrate and purify plating baths.

Ion exchange is highly efficient at recovering metal bearing solutions. Recovery of chromium, nickel, phosphate solutions, and sulfuric acid from anodizing is commercially viable. A chromic acid recovery efficiency of 99.5 percent has been demonstrated. Ion exchange systems are reported to be installed at three pickling operations, however, none of these systems were sampled during this study. Data for two plants in the coil coating category are shown below.

Ion Exchange Performance

Pollutant All Values mg/l	Plant A Prior to Purification	Plant A After Purification	Plant B Prior to Purification	Plant B After Purification
Al	5.6	0.20	-	-
Cd	5.7	0.00	-	-
Cr^{+3}	3.1	0.01	-	-
Cr^{+6}	7.1	0.01	-	-
Cu	4.5	0.09	43.0	0.10
CN	9.8	0.04	3.40	0.09
Au	-	-	2.30	0.10
Fe	7.4	0.01	-	-
Pb	-	-	1.70	0.01
Mn	4.4	0.00	-	-
Ni	6.2	0.00	1.60	0.01
Ag	1.5	0.00	9.10	0.01
SO_4	-	-	210.00	2.00
Sn	1.7	0.00	1.10	0.10
Zn	14.8	0.40	-	-

Advantages and Limitations

Ion exchange is a versatile technology applicable to a great many situations. This flexibility, along with its compact nature and performance, makes ion exchange an effective method of wastewater treatment. However, the resins in these systems can prove to be a limiting factor. The thermal limits of the anion resins, generally placed in the vicinity of 60°C, could prevent its use in certain situations. Similarly, nitric acid, chromic acid, and hydrogen peroxide can all damage the resins as will iron, manganese, and copper when present with sufficient concentrations of dissolved oxygen. Removal of a particular trace contaminant may be uneconomical because of the presence of other ionic species that are preferentially removed. The regeneration of the resins presents its own problems. The cost of the regenerative chemicals can be high. In addition, the wastewater streams originating from the regeneration process are extremely high in pollutant cncentrations, although low in volume. These must be further processed for proper disposal.

Operational Factors

a. Reliability: With the exception of occasional clogging or fouling of the resins, ion exchange is a highly dependable technology.

b. Maintainability: Only the normal maintenance of pumps, valves, piping and other hardware used in the regeneration process is usually encountered.

Demonstration Status

All of the applications mentioned in this section are available for commercial use, and industry sources estimate the number of units currently in the field at well over 120. The research and development in ion exchange is focusing on improving the quality and efficiency of the resins, rather than new applications. Ion exchange is used in at least three different plants in the steel industry. Also, ion exchange is used in a variety of other metal finishing operations.

2. Reverse Osmosis

Reverse osmosis (RO) is an operation in which pressure is applied to a solution on the outside of a semi-permeable membrane causing a permeate to diffuse through the membrane leaving behind concentrated higher molecular weight compounds. The concentrate can be further treated or returned to the original operation for continued use, while the permeate water can be recycled for use as clean water.

There are three basic configurations used in commercially available RO modules: tubular, sprial-wound, and hollow fiber. All of these operate on the principle described above, the major difference being their mechanical and structural design characteristics.

The tubular membrane module has a porous tube with a cellulose acetate membrane-lining. A common tubular module consists of a length of 2.5 cm (1 inch) diameter tube wound on a supporting spool and encased in a plastic shroud. Feed water is driven into the tube under pressures varying from 40-55 atm (600-800 psi). The permeate passes through the walls of the tube and is collected in a manifold while the concentrate is drained off at the end of the tube. A less widely used tubular RO module has a straight tube contained in a housing, and is operated under the same conditions.

Spiral-wound membranes consist of a porous backing sandwiched between two cellulose acetate membrane sheets and bonded along three edges. The fourth edge of the composite sheet is attached to a large permeate collector tube. A spacer screen is then placed on top of the membrane sandwich and the entire stack is rolled around the centrally located tubular permeate collector. The rolled up package is inserted into a pipe able to withstand the high operating pressures employed in this process, up to 55 atm (800 psi). When the system is operating, the pressurized product water permeates the membrane and flows through the backing material to the central collector tube. The concentrate is drained off at the end of the container pipe and can be reprocessed or sent to further treatment facilities.

The hollow fiber membrane configuration is made up of a bundle of polyamide fibers of approximately 0.0075 cm (0.003 in.) OD and 0.0043 cm (0.0017 in.) ID. A commonly used hollow fiber module contains several hundred thousand of the fibers placed in a long tube, wrapped around a flow screen, and rolled into a spiral. The fibers are bent in a U-shape and their ends are supported by an epoxy bond. The hollow fiber unit is operated under 27 atm (400 psi), the feed water being dispersed from the center of the module through a porous distributor tube. The permeate flows through the membrane to the hollow interiors of the fibers and is collected at the ends of the fibers.

The hollow fiber and spiral-wound modules have a distinct advantage over the tubular system in that they contain a very large membrane surface area in a relatively small volume. However, these membranes types are much more susceptible to fouling than the tubular system, which has a larger flow channel. This characteristic also makes the tubular membrane easier to clean and regenerate than either the spiral-wound or hollow fiber modules.

Application and Performance

At a number of metal processing plants, the overflow from the first rinse in a countercurrent setup is directed to a reverse osmosis unit, where it is separated into two streams. The concentrated stream contains dragged out chemicals and is returned to the bath to replace the loss of solution due to evaporation and dragout. The dilute stream (the permeate) is routed to the last rinse tank to provide water for the rinsing operation. The rinse flows from the last tank to the first tank and the cycle is complete.

The closed-loop system described above may be supplemented by the addition of a vacuum evaporator after the RO unit in order to further reduce the volume of reverse osmosis concentrate. The evaporated vapor can be condensed and returned to the last rinse tank or sent on for further treatment.

The largest application of reverse osmosis systems is for the recovery of nickel and other metal solutions. It has been shown that RO can generally be applied to most acid metal baths with a high degree of performance, providing that the membrane unit is not overtaxed. The limitations most critical are the allowable pH range and maximum operating pressure for each particular configuration.

Adequate prefiltration is also essential. Only three membrane types are readily available in commercial RO units. For the purpose of calculating performance predictions of this technology, a rejection rate of 98 percent was assumed for dissolved salts, with 95 percent permeate recovery.

Advantages and Limitations

The major advantage of reverse osmosis for treating wastewaters is the ability to concentrate dilute solutions for recovery of salts and chemicals with low power requirements. No latent heat of vaporization or fusion is required for effecting separations; the main energy requirement is for a high pressure pump. RO requires relatively little floor space for compact, high capactiy units, and exhibits high recovery and rejection rates for a number of typical process solutions. A limitation of the reverse osmosis process is the limited temperature range for satisfactory operation. For cellulose acetate systems, the preferred limits are 18 to 30°C (65 to 85°F); higher temperatures will increase the rate of membrane hydrolysis and reduce system life, while lower temperatures will result in decreased fluxes with no damage to the membrane. Another limitation is the inability to handle certain solutions. Strong oxidizing agents, strong acidic or basic solutions, solvents, and other organic compounds can cause dissolution of the membrane. Poor rejection of some compounds such as borates and low molecular weight organics is another problem. Fouling of membranes by failures, and fouling of membranes by wastewaters with high levels of suspended solids can be a problem. A final limitation is the inability to treat or achieve high concentration with some solutions. Some concentrated solutions may have initial osmotic pressures which are so high that they either exceed available operating pressures or are uneconomical to treat.

Operational Factors

a. Reliability: RO systems are reliable provided the proper precautions are taken to minimize the chances of fouling or degrading the membrane. Sufficient testing of the wastewater stream prior to application of an RO system will provide the information needed to insure a successful application.

b. Maintainability: Membrane life is estimated to fall between 6 months and 3 years, depending upon the use of the system. Down time for flushing or cleaning is on the order of two hours as often as once each week; a substantial portion of maintenance time must be spent on cleaning any prefilters installed ahead of the reverse osmosis unit.

Demonstration Status

There are presently at least one hundred reverse osmosis wastewater applications in a variety of industries. In addition to these, thirty to forty units are used to provide pure process water for several industries. Despite the many types and configurations of membranes, only the spiral-wound cellulose acetate membrane has had widespread success in commercial applications. There are no known RO units presently in operation in the steel industry to treat wastewaters.

Zero Discharge Technologies

Zero discharge of process wastewater is achieved in several subcategories of the steel industry. The most commmonly used method is to treat the wastewater sufficiently so it can be completely reused in the originating process or to control water application in semi-wet air pollution control systems so that no discharge results. This method is used principally in steelmaking.

Another potential means to achieve zero discharge is by the use of evaporation technology. Evaporation systems concentrate the wastewater constituents and produce a distillate quality water that can be recycled to the process. Although this technology is very costly and energy intensive, it may be the only method available to attain zero discharge in many steel industry subcategories.

Evaporation

Evaporation is a concentration process. Water is evaporated from a solution, increasing the concentration of solute in the remaining solution. If the resulting water vapor is condensed back to liquid water, the evaporation-condensation process is called distillation. However evaporation is used in this report to describe both processes. Both atmospheric and vacuum evaporation are commonly used in industry today. Atmospheric evaporation could be accomplished simply by boiling the liquid. However, to aid evaporation, heated liquid is sprayed on an evaporation surface, and air is blown over the surface and subsequently released to the atmosphere. Thus, evaporation occurs by humidification of the air stream, similar to a drying process. Equipment for carrying out atmospheric evaporation is quite similar for most applications. The major element is generally a packed column with an accumulator bottom. Accumulated wastewater is pumped from the base of the column, through a heat exchanger, and back into the top of the column, where it is sprayed into the packing. At the same time, air drawn upward through the packing by a fan is heated as it contacts the hot liquid. The liquid partially vaporizes and humidifies the air stream. The fan then blows the hot, humid air to the outside atmosphere.

Another form of atmospheric evaporator also works on the air humidification principle, but the evaporated water is recovered for reuse by condensation. These air humidification techniques operate well below the boiling point of water and can use waste process heat to supply some of the energy required.

In vacuum evaporation, the evaporation pressure is lowered to cause the liquid to boil at reduced temperature. All of the water vapor is condensed and, to maintain the vacuum condition, noncondensible gases (air in particular) are removed by a vacuum pump. Vacuum evaporation may be either single or double effect. In double effect evaporation, two evaporators are used, and the water vapor from the first evaporator (which may be heated by steam) is used to supply heat to the second evaporator. As it supplies heat, the water vapor from the first evaporator condenses. Approximately equal quantities of wastewater are evaporated in each unit; thus, the double effect system evaporates twice the amount of water that a single effect system does, at nearly the same energy cost. The double effect technique is thermodynamically possible because the second evaporator is maintained at lower pressure (high vacuum) and, therefore, lower evaporation temperature. Another means of increasing energy efficiency is vapor recompression (thermal or mechanical), which enables heat to be transferred from the condensing water vapor to the evaporating wastewater. Vacuum evaporation equipment may be classified as sumberged tube or climbing film evaporation units.

In the most commonly used submerged tube evaporator, the heating and condensing coil are contained in a single vessel to reduce capital cost. The vacuum in the vessel is maintained by an ejector-type pump, which creates the required vacuum by the flow of the condenser cooling water through a venturi. Wastewater accumulates in the bottom of the vessel, and is evaporated by means of submerged steam coils. The resulting water vapor condenses as it contacts the condensing coils in the top of the vessel. The condensate then drips off the condensing coils into a collection trough that carries it out of the vessel. Concentrate is also removed from the bottom of the vessel.

The major elements of the climbing film evaporator are the evaporator, separator, condenser, and vacuum pump. Wastewater is "drawn" into the system by the vacuum so that a constant liquid level is maintained in the separator. Liquid enters the steam-jacketed evaporator tubes, and part of it evaporates so that a mixture of vapor and liquid enters the separator. The design of the separator is such that the liquid is continuously circulated from the separator to the evaporator. The vapor entering the separator flows out through a mesh entrainment separator to the condenser, where it is condensed as it flows down through the condenser tubes. The condensate, along with any entrained air, is pumped out of the bottom of the condenser by a liquid ring vacuum pump. The liquid seal provided by the condensate keeps the vacuum in the system from being broken.

Application and Performance

Both atmospheric and vacuum evaporation are used in many industrial plants, mainly for the concentration and recovery of process solutions. Many of these evaporators also recover water for rinsing. Evaporation has also been used to recover phosphate metal cleaning solutions.

Advantages and Limitations

Advantages of the evaporation process are that it permits recovery of a wide variety of process chemicals, and it is applicable for concentration or removal of compounds which cannot be accomplished by other means. The major disadvantage is that the evaporation process consumes relatively large amounts of energy. However, the recovery of waste heat from many industrial processes (e.g., diesel generators, incinerators, boilers and furnaces) should be considered as a source of this heat for a totally integrated evaporation system. Also, in some cases solar heating could be inexpensively and effectively applied to evaporation units. For some applications, pretreatment may be required to remove suspended solids or bacteria which tend to cause fouling in the condenser or evaporator. The buildup of scale on the evaporator surfaces reduces the heat transfer efficiency and may present a maintenance problem or increase operating cost. However, it has been demonstrated that fouling of the heat transfer surfaces can be avoided or minimized for certain dissolved solids by precipitate deposition. In addition, low temperature differences in the evaporator will eliminate nucleate boiling and supersaturation effects. Steam distillable impurities in the process stream are carried over with the product water and must be handled by pre or post-treatment.

Operational Factors

1. Reliability: Proper maintenance will ensure a high degree of reliability for the system. Wthout such attention, rapid fouling or deterioration of vacuum seals may occur, especially when handling corrosive liquids.

2. Maintainability: Operating parameters can be automatically controlled. Pretreatment may be required, as well as periodic cleaning of the system. Regular replacement of seals, especially in a corrosive environment, may be necessary.

Demonstration Status

Evaporation is a fully developed, commercially available wastewater treatment technology. It is used extensively to recover plating chemicals in the electroplating industry and a pilot scale unit has been used in connection with phosphating of aluminum. Evaporation technology is not used in steel industry applications for wastewater treatment.

C. In-Plant Controls and Process Modifications

In-plant technology is used in the steel industry to reduce or eliminate the pollutant load requiring end-of-pipe treatment and thereby improve the efficiency of existing wastewater treatment systems or to reduce the requirements of new treatment facilities. In-plant technologies demonstrated in the steel industry includes alternate rinsing procedures, water conservation, reduction of dragout, automatic controls, good housekeeping practices, recycle of untreated process waters and process modifications.

1. In-Process Treatment and Controls

In-process treatment and controls apply to both existing and new installations and include existing technologies and operating practices. The data received from the industry indicates that water conservation practices are widely used in many subcategories. Within any particular subcategory process wastewater can vary substantially. In many cases, these variations are directly related to in-process water conservation and control measures. Although the effluent limitations and standards do not regulate flow, they are based upon model flow rates demonstrated in the respective subcategories.

While effective control over operating practices is one method of in-plant control, others are more complex and require greater expenditures of capital. One of these is the installation of cascade rinsing (counter-current) rinsing systems. Cascade rinsing is a demonstrated in-process control for pickling and hot coating operations and may be implemented at other processes that use conventional rinsing techniques.

Another in-process control is the recycle of process water. In several steel industry processes, wastewaters are recycled "in- plant" even prior to treatment. For example, in the cold rolling process, oil emulsions can be collected and returned to the mill in recirculation systems thereby reducing the volumes of wastewater discharged. This control method may not necessarily be used in all processes because of the product quality or recycle system problems that may be encountered.

Other simple in-process controls that can affect discharge quality include good housekeeping practices and automatic equipment. For example, if tight control over the process is maintained and spills are controlled, excessive "dumps" of waste solutions can be averted. Also, automatic controls can be installed that control applied water rates to insure that water is applied only when a mill is actually operating. For mills or lines that are not operated continuously the volume of watar that can be conserved with this practice can be significant.

2. Process Substitutions

There are several instances in the steel industry where process substitutions can be used to effectively control wastewater discharges. One is a cold rolling operations where mills can be designed to operate either in a once-through or recycle mode. If those mills with once-through systems operated in a recycle mode, oil usage would be reduced and savings could be achieved since a smaller treatment system would be required.

Another area where in-process substitutions can achieve significant reductions in wastewater flows and pollutant loads is by selecting dry air pollution control systems over wet systems.

TABLE VI-1

TOXIC ORGANIC CONCENTRATIONS
ACHIEVABLE BY TREATMENT

No.	Priority Pollutant	Achievable Concentration(μg/l) Carbon Adsorption	Biological Oxidation[(1)]
003	Acrylonitrile	200	100
004	Benzene	50	50
009	Hexachlorobenzene	1	*
011	1,1,1-Trichloroethane	100	*
021	2,4,6-Trichlorophenol	25	50
022	Parachlorometacresol	50	*
023	Chloroform	20	200
024	2-Chlorophenol	50	50
034	2,4-Dimethylphenol	25	5
035	2,4-Dinitrotoluene	50	50
036	2,6-Dinitrotoluene	50	100
038	Ethylbenzene	50	25
039	Fluoranthene	10	5
054	Isophorone	50	100
055	Naphthalene	25	5
057	2-Nitrophenol	25	100
060	4,6-Dinitro-o-cresol	25	25
064	Pentachlorophenol	50	*
065	Phenol	50	25
066-071	Phthalates, Total	100	200
072	Benzo(a)anthracene	10	5
073	Benzo(a)pyrene	1	5
076	Chrysene	5	10
077	Acenaphthylene	10	10
078	Anthracene	1	1
080	Fluorene	10	5
084	Pyrene	10	10
085	Tetrachlorethylene	50	100
086	Toluene	50	50
130	Xylene	10	100

* No significant removal over influent level.
(1) Two-stage activated sludge system.

VOLUME I

SECTION VII

DEVELOPMENT OF COST ESTIMATES

Introduction

This section reviews the Agency's methodology for developing cost estimates for the alternative water pollution control systems considered for each subcategory. The economic impacts due to these costs and to other factors affecting the steel industry are reviewed in the above references report.

Basis of Cost Estimates

Costs developed for the various levels of treatment (i.e., BPT, BAT, NSPS and Pretreatment) are presented in detail in each subcategory report of the Development Document. Model costs include investment, capital depreciation, land rental interest, operating and maintenance, and energy. The costs for BPT and BAT are summarized and presented in Sections VIII and IX of this report. Costs for PSES are presented in Section XII. Only model costs are presented for NSPS and PSNS while total industry costs are presented for the other levels of control. The Agency did not include estimates of capacity addition in this report. However, estimates of capacity additions, retirements, and reworks are included in <u>Economic Analysis of Effluent Guidelines - Integrated Iron and Steel Industry</u>.

The Agency developed model wastewater treatment systems and cost estimates for those systems. Industry-wide costs to comply with this regulation were determined from application of the costs for the selected model treatment systems to each plant taking into account treatment in place as of a reference date. For each subcategory, the model costs were developed as follows:

1. National annual production and capacity data for each subdivision or segment along with the number of plants in each subdivision were determined. From these data, an "average" plant size was established for each subdivision.

2. For finishing operations, where more than one mill or line of the same operation exists at one plant site, the capacities of these mills or lines were summed to develop a site size and costs for one wastewater treatment facility were developed as noted below. This manner of sizing model plants more accurately represents actual wastewater treatment practices in the industry. Wastewaters from all cold mills at a given site are usually treated in central treatment systems. By using site sizes, where appropriate, wastewater treatment within subcategories was more accurately reflected in the cost estimates.

3. If different product types or steel types within a subcategory were found to have different average sizes, separate cost models were developed to more accurately define the costs for these groupings.

4. Applied model process flow rates were established based upon data obtained from questionnaires and accumulated during field sampling visits. The model flows are expressed in l/kkg or gal/ton of product.

5. A treatment process model and flow diagram was developed for each subcategory based upon appropriate subcategory treatment systems and effluent flow rates representative of the application of established water pollution control practices.

6. Finally, a detailed cost estimate was made on the basis of each alternative treatment system. All cost estimated were developed in July 1978 dollars.

Total annual costs were developed by summing the operating costs (including those for chemicals, maintenance, labor, and energy) and capital recovery costs. Capital recovery costs were calculated using a capital recovery factor (CRF) derived specifically for the steel industry. Separate CRF's were derived for capital investments and for land costs. An explanation of the derivation of these factors is provided below.

The purpose of a capital recovery factor is to annualize capital investment costs over the useful life of an asset. Annualizing capital investment costs using a capital recovery factor procedure should be distinguished from using a depreciation schedule to calculate depreciation expense for accounting purposes. The purpose of a depreciation schedule is to match the historic cost or book value of an investment with accounting revenues occurring over the useful life of the asset. A capital recovery factor indicates the magnitude of a series of periodic cash flows which, over the useful life of the asset, will have a discounted present value equal to the discounted present value of the investment. The discounted present value of an investment is generally not the same as its book value due to the impact of investment tax credits, tax-deductible non-cash expenses such as depreciation, and tax-deductible investment-related expenses such as interest and property taxes.

<u>Assumption Underlying Capital Recovery Factors</u>

For purposes of this study, it was assumed that pollution control capital expenditures would be financed 20 percent by non-tax exempt corporate debt and 80 percent by tax-exempt industrial revenue bonds. The interest rate on the corporate debt was determined by adding a premium of 2.7 percent to the inflation rate assumed for the period 1981-1982. The tax-exempt interest rate was assumed to be two-thirds of the non-exempt interest rate. A marginal income tax rate of 50.1 percent was assumed, based on a marginal federal rate of 46 percent and a tax-deductible average state tax rate of 7.55 percent. An investment tax credit of 10 percent and the five-year "capital recovery" tax depreciation factors were assumed to apply to investments in pollution control equipment associated with steel mill equipment. A property tax rate of 2.38 percent of net book value was also assumed, based on 14-year straightline depreciation for book purposes.

The capital recovery factor used by the Agency in this report is different from and more appropriate than that used in the December 1980 Development Document. This formula is more appropriate as it accounts for the tax effects of the industry's investment in capital.

Calculation of Capital Recovery Factors

Given the assumption listed above, the 9.4 percent inflation rate projection for 1981 implies a weighted average interest rate on pollution control debt of 8.91 percent:

$$(9.4 + 2.7)* .2 + .67*(9.4 + 2.7)* .8 = 8.91\%$$

Using the discount rate to calculate the present value of a $1.0 million investment in pollution control equipment yields an estimated present value of -$351,020. Annualizing this outlay over a 14-year period at the assumed rate of interest results in a level annual payment of $44,854 after taxes, which implies an outlay of $89,889 before taxes. Normalizing the before-tax outlay by the initial investment of $1.0 million results in the capital recovery factor for pollution control equipment of 0.0899.

The calculation of an annualized charge for land is slightly diferent because land does not qualify for an investment tax credit and is not a depreciable wasting asset. Instead, land investments are characterized by capital appreciation which is recovered at the and of the investment period. For purposes of this study, the Agency assumed that property taxes would be based on an assessed value rising at the average rate of inflation over the period, and that a recovery or reversion of the appreciated land would occur at the end of the 14-year period. Based upon this assumption, a $1.0 million investment in land financed at the weighted average interest rate used for pollution control equipment would have a present value of -$247,340. Recovery of this cost over a 14-year period would require receiving an annual rent after-tax of $31,660 per year. This corresponds to a before-tax imputed rental of $63,340. Normalizing this imputed rental by the initial investment of $1.0 million yields the required capital recovery factor for land of 0.0634.

Basis for Direct Costs

Construction costs are highly variable and in order to determine these costs in a consistent manner, the following parameters were established as the basis of estimates. The cost estimates reflect average costs.

1. The treatment facilities are contained within a "battery limit" site location and are erected on a "green field" site. Site clearance costs have been estimated based upon average site conditions with no allowances for equipment relocation. Equipment relocation costs could not be included because equipment relocation is highly site specific and in fact not required at most facilities.

2. Equipment costs for most components are based upon specific effluent water rates and pollutant loads. A change in water flow rates will affect costs. For vacuum filters, costs are based on the square feet (ft^2) of surface area of the filter which is a function of the amount of solid waste to be dewatered. Costs for rinse reduction technology (i.e., cascade rinse) is based upon production capacity. For these two components, costs are affected more by these variables than by flow.

3. The treatment facilities are assumed to be located in reasonable proximity to the wastewater source. Piping and other utility costs for interconnecting utility runs from the production facility to the battery limits of the treatment facility are based upon a linear distance estimate of 2500 feet. The Agency considers 2500 ft to be generous for most applications. The cost of return piping is included in recycle system costs.

4. Land acquisition costs are included in the cost estimates prepared for this study. An average land cost of $38,000/acre (1978 dollars) is used to estimate land cost requirements for the model treatment components. Total land costs were then adjusted to represent an annual charge to be incurred over the life or the treatment system by applying the land cost capital recovery factor explained above.

5. Costs for all nessary instrumentation to operate the model wastewater treatment facilities have been included in the Agency's cost estimates, including pH and ORP control, flow meters, level controls, and various vacuum instruments, as appropriate.

6. The Agency's cost estimates include costs for standard safety items including fencing, walkways, guard rails, telephone service, showers, and lighting.

7. The Agency's cost estimates are based upon delivered prices of the water pollution control equipment and related items, thus freight charges are included in the Agency's cost estimates. However, because of the highly variable nature of sales and use taxes imposed by state, regional, country, and local governments, the Agency did not include such taxes in its cost estimates.

8. Control and treatment system buildings are prefabricated buildings; not of brick or block construction.

In general, the cost estimates reflect an on-site installed cost for a treatment plant with electrical substation and equipment for powering the facilities, all necessary pumps, essential controls and instrumentations, treatment plant interconnecting feed pipe lines, chemical feed and treatment facilities, foundations, structural steel, and a control house. Access roadways within battery limits are included in estimates based upon 3.65 cm (1.5 inch) thick bituminous wearing course and 10 cm (4 inch) thick sub-base with sealer, binder, and gravel surfacing. A nine gauge chain link fence with three strand barb wire and one truck gate were included for fencing. The cost estimates also include a 15% contingency fee, 10% contractor's overhead and profit allowance, and engineering fees of 15%.

Sources of cost data for wastewater treatment system components and other direct cost items include vendor quotations and cost manuals commonly used for estimating construction costs. These manuals include:

a - The Richardson Rapid System, Process Plant Contruction Estimating Standards; 1978-1979 Edition; Richardson Engineering Services, Inc.
b - Building Construction Cost Data; 1978; Robert Snow Means Company, Inc.

Basis for Indirect Costs

In addition to developing estimates for individual treatment components, the Agency has also included indirect costs in its total cost estimates for water pollution control equipment. Indirect costs cover such items as engineering expenses, taxes and insurance, contractor's fees and overheads and other miscellaneous expenses. Normally, these indirect costs are represented by three broad expense categories: engineering, overhead and profit, and contingencies.

Cost manuals, vendor quotes and actual installation costs generally show a range for total indirect costs of between 15% and 40% of total direct costs. The Agency's estimates contain indirect cost factors which total 45% of the total direct costs. The factors used by the Agency and an example of how they are applied to direct costs are shown below:

	Incremental Costs ($)	Total Cost ($)
Total Direct Cost	1,000,000	1,000,000
Contingency @ 15%	150,000	1,150,000
Overhead and Profit @ 10%	115,000	1,265,100
Engineering @ 15%	189,750	1,454,750
Total Indirect Costs	454,750 (45.5% of direct costs)	

Cost comparisons made between the Agency's estimates and actual installation costs have demonstrated that the Agency's methodology, including its method of applying indirect costs, is proper and can be used to accurately estimate industry-wide costs.

BPT, BAT, NSPS, PSES and PSNS Cost Estimates

Two cost estimates were made for this study for the BPT, BAT and PSES levels of treatment. The first deals with the capital costs for the systems already installed and the second accounts for the capital costs for the treatment components still required at each of these levels. Additionally, both in-place and required annual costs were calculated and these costs are included in all cost summaries presented in this document.

Because DCP responses were received from all major steel operations and almost all minor steel facilities, the data base on installed treatment components (as of January 1, 1978) was fairly complete. Additionally, the Agency updated the information to July 1, 1981, based upon personal knowledge of EPA Staff, NPDES records, and contact with the industry during the public comment period on the proposed regulation. Using this data base, a plant-by-plant inventory was completed which tabulated the treatment components presently installed and those components which are required to bring the systems up to the BPT, BAT and PSES treatment levels. Hence, an estimate of capital cost requirements was made for each plant and subcategory by scaling individual plants to the developed treatment model and factoring costs based upon production by the "six-tenth factor". By this method, the Agency estimated the expenditures already made by the steel industry. These data were summarized earlier in Section II and are also summarized in each subcategory report.

For NSPS and PSNS, total industry costs have not been presented in this report since predictions of future expansion in the industry were not made as part of this study.

VOLUME I

SECTION VIII

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST PRACTICABLE CONTROL TECHNOLOGY CURRENTLY AVAILABLE

Introduction

Best Practicable Control Technology Currently Available (BPT) is generally based upon the average of the best existing performances at plants of various sizes, ages, and unit processes within the industrial subcategory. This average is not based upon a broad range of mills within the subcategory, but is based upon performance levels achieved at plants known to be equipped with the best wastewater treatment facilities.

The Agency also considered the following factors:

1. The size and age of equipment and facilities involved.

2. The processes employed.

3. Non-water quality environmental impacts (including sludge generation and energy requirements).

4. The engineering aspects of the applications of various types of control techniques.

5. Process changes.

6. The total cost of application of technology in relation to the effluent reduction benefits to be achieved from such application.

BPT emphasizes treatment facilities at the end of a manufacturing process but can also include control technologies within the process itself when they are considered to be normal practice within the industry.

The Agency also considered the degree of economic and engineering reliability in order to determine whether a technology is "currently available." As a result of demonstrations, projects, pilot plants and general use, the Agency must have a high degree of confidence in the engineering and economic practicability of the technology at the time of commencement of construction or installation of the control facilities.

Identification of BPT

For the most part, the proposed BPT limitations are the same as those contained in prior steel industry water pollution control regulations. The Agency proposed less stringent limitations where the prior limitations were not being achieved in the industry, or more recent and complete data indicated the prior limitations were not appropriate because of changes in subcategorization or the absence of specific limited pollutants in the respective wastewaters.

The major changes between the proposed BPT limitations and those contained in the prior regulation are summarized below:

Subcategory	Change: Prior Regulations to Proposed Regulation
A. Cokemaking	The suspended solids limitation for cokemaking operations was increased.
B. Sintering	All of the limitations for sintering operations were increased based upon increased model treatment system flow rates.
D. Steelmaking	Segments were added for BOF wet-suppressed combustion operations.
H. Scale Removal	For scale removal operations, the dissolved chromium limitations were changed to total chromium limitations; and, for Kolene® operations, the cyanide limitations were deleted.
I. Acid Pickling	For combination acid pickling operations, limitations for dissolved chromium and nickel were changed to total chromium and total nickel.
J. Cold Rolling	Separate zero discharge limitations for cold worked pipe and tube operations were proposed. These operations had been included in the subdivision for hot worked pipe and tube operations in prior regulations.
K. Alkaline Cleaning	Limitations for dissolved iron, dissolved chromium, and dissolved nickel were deleted for alkaline cleaning operations.
L. Hot Coating	Separate limitations were proposed for galvanizing hot coating operations of wire products and fasteners and all hot coating operations using metals other than zinc and terne metal. These operations were not regulated separately in the prior regulation.

Other than the changes noted above, the Agency proposed the same BPT limitations that were contained in the prior regulations, even though in many instances, more stringent limitations might be justified. The Agency chose this course of action for the following reasons:

1. The technological bases of the prior regulations were upheld by the Court in AISI-I and AISI-II and the Agency believes the limitations and standards are appropriate.

2. For virtually every subcategory, the Agency proposed BAT and BCT limitations more stringent than the proposed BPT limitations. Thus, upon promulgation, the BAT and BCT limitations would become the operative limitations for NPDES permits and, in most cases, the BPT limitations would have little or no impact on the permitting process.

Based upon comments received on the proposed regulation, the Agency has made some substantial changes to the BPT limitations from those that were proposed, particularly for the forming and finishing operations. In some cases, more stringent BPT limitations were promulgated. In other cases, less stringent BPT limitations were promulgated. For the basic steelmaking operations, most of the proposed BPT limitations were promulgated. In all cases, however, the Agency used the same basic model treatment technologies to develop the proposed BPT limitations as were used to develop the final BPT limitations.

The public comments caused the Agency to re-examine the subdivision of each subcategory, in terms of whether or not model treatment system flows based upon product type or operating mode are appropriate, whether or not in-process of end-of-pipe flow reduction systems are appropriate, and, the performance of the model treatment systems in achieving the desired effluent quality. For the basic steelmaking operations, the response to public comments did not cause the Agency to substantially alter its conclusions regarding the appropriateness of the proposed BAT limitations. Thus, upon promulgation of more stringent BAT limitations for these operations, the Agency saw no reason to alter the proposed BPT limitations except where public comments provided compelling evidence that they are too stringent. For many of the forming and finishing operations, the response to public comments caused the Agency to substantially alter the subdivision of the subcategories, change model treatment system flow rates and, reevaluate the performance of the model treatment systems. Also, the Agency found that substantial flow reduction systems included in many of the BAT alternatives are not warranted. Thus, for these operations, the Agency believes that revised BPT limitations are appropriate. Alternatively, the Agency could have promulgated the proposed BPT limitations and more stringent BAT limitations, but chose not to do so because no additional technology would be required to achieve the more stringent BAT limitations; and, the Regulation would be confusing and not in accordance with the Agency's policy of co-treatment of compatible wastewaters.

The Agency revised the BPT limitations for the forming and finishing operations for the following reasons:

1. Based upon data and comments received on the proposed regulation, the Agency decided not to promulgate more stringent BAT limitations in several subcategories (Hot Forming, Salt Bath Descaling (formerly Scale Removal), Cold Rolling, Acid Pickling, Alkaline Cleaning, and part of Hot Coating). Because additional wastewater treatment technology beyond that used to develop the BPT limitations would not be required, the Agency believes it is appropriate to limit those toxic pollutants found in the wastewaters from the respective subcategories at the BPT level.

2. In some cases, the Agency's response to comments involved a complete reevaluation of the new and previously available data for particular subcategories. For some operations, the data demonstrate that the model treatment technologies perform substantially better than indicated by data used to develop the prior regulations (Hot Forming, Acid Pickling, Hot Coating). In the absence of more stringent BAT limitations for these operations, the Agency believes it is appropriate that the BPT limitations are based upon these data. For other operations, the Agency found the subdivision of certain subcategories contained in the proposed regulation is not appropriate (Salt Bath Descaling (formerly Scale Removal), Acid Pickling, Cold Forming, Alkaline Cleaning). Revised subdivision of these subcategories based upon product-related process water requirements or mode of operation was provided.

3. The selection of limited pollutants was modified in several instances to facilitate co-treatment of compatible wastewaters not possible with the proposed BPT limitations; (Salt Bath Descaling (formerly Scale Removal), Acid Pickling, Cold Rolliing, Hot Coating).

The bases for all of these changes is set out in detail in the subcategory reports presented in the development document. A summary is provided below:

<u>Subcategory</u>	<u>Change-Proposed Regulation to Final Regulation</u>
A. Cokemaking	The suspended solids limitations were increased further based upon additional data. A separate segment was provided for merchant cokemaking operations.
B. Sintering	All of the sintering limitations were increased further based upon an increase in the model treatment system flow rate.
D. Steelmaking	The Open Hearth Semi-Wet segment was deleted.

		Less stringent limitations were promulgated for BOF Wet-Open Combustion and Wet Electric Arc Furnace operations based upon changes in respective model treatment system flow rates.
G.	Hot Forming	The limitations for all hot forming operations were revised to reflect actual performance of the model treatment system.
H.	Salt Bath Descaling	The Salt Bath Descaling subcategory (formerly Scale Removal) was subdivided differently to take into account product-related process water requirements and modes of operation (batch and continuus). Performance data submitted by the industry were used as a basis for the limitations.
I.	Acid Pickling	The Acid Pickling subcategory was treated in the same fashion as the Scale Removal Subcategory. Fume scrubber operations are limited separately on a daily mass basis not related to production rate.
J.	Cold Forming	Separate limitations were promulgated for Single Stand Recirculation and Direct Application Cold Rolling Mills. Limitations for two toxic organic pollutants were promulgated for all cold rolling operations.
k.	Alkaline Cleaning	The Alkaline Cleaning subcategory has been subdivided to take into account higher process water requirements for both batch and continuous operations.
L.	Hot Coating	Limitations for the Hot Coating subcategory were made consistent with those for acid pickling and cold rolling operations to facilitate co-treatment.

Development of BPT Limitations

Model Treatment Systems

As noted above, the Agency used the same model treatment systems to develop the promulgated BPT limitations as were used to develop the prior and proposed BPT limitations. These technologies are installed throughout the industry and are well demonstrated. The model treatment systems are described in detail in the subcategory reports of this development document.

Model Treatment System Flow Rates

The Agency's approach to developing the BPT limitations based upon the model treatment systems includes specification of a model treatment system effluent flow rate and performance standards for the limited pollutants. The model treatment system flow rates have either been retained from the proposed or prior regulations; or, in several cases revised based upon some of the factors noted above. The Agency has established model treatment system effluent flow rates based upon the best performing plants in each subcategory rather than upon averages of all plants or upon statistically derived flows because, to a large extent, flow rates are within the control of the operator.

For the basic steelmaking operations where recycle of air pollution control system wastewaters or process wastewaters is an integral part of the model treatment systems, the "average of the best" blowdown rates or recycle rates formed the basis for the model treatment system effluent flow rates used to develop the BPT limitations. The hot forming operations were evaluated in much the same fashion in that the primary scale pit recycle rates and thus the model treatment system effluent flow rate for each subcategory were determined from the average of the best or most appropriate recycle rates.

For the other finishing operations, the Agency used two approaches for developing the model treatment system effluent flow rates. Production weighted flow rates were developed by product for Salt Bath Descaling and Acid Pickling operations. As noted above, the Agency substantially revised the subdivision of these subcategories to take into account product related rinsewater flow requirements. In doing so, the Agency believes that production weighted flows are appropriate because it could not develop discreet groups of the best plants in each segment. Thus, the production weighted flow provides the best measure of a model plant. For Cold Rolling, Alkaline Cleaning, and Hot Coating operations, the average of the best discharge flows were used to establish the model BPT effluent flow rates. The Agency believes the "average of the best" flows for these operations are appropriate because it could identify the best plants. In any event, in all but a few cases, the production weighted average flow rates for these operations are about the same as, or less than, the "average of the best" flow rates.

The development of the respective model treatment system flow rates is set out in detail in each subcategory report.

Model Treatment System Effluent Quality

The Agency used the model treatment system effluent flow rates and performance standards for the limited pollutants to develop the BPT limitations. The development of the performance standards for the limited pollutants is presented in Appendix A. In several cases, particularly in the forming and finishing operations, the Agency used data from central treatment facilities that treat compatible wastewaters to establish and demonstrate compliance with the BPT limitations. The Agency believes use of central treatment plant data for these purposes is appropriate because it is consistent with the manner in which the Agency structured the Regulation with respect to co-treatment of compatible wastewaters and is consistent with current treatment practices in the industry.

BPT Effluent Limitations

Table I-2 summarizes the 1974 and 1976 BPT limitations, along with the changes that have been made and the requirements of the promulgated regulation. Where no changes are noted, the limitations are the same as the original limitations. The guidelines are based on mass limitations in kilograms per 1000 kilograms (lbs/1000 lbs) except for fume scrubbers at acid pickling and hot coating operations where the limitations are in kg per day. As noted earlier, these mass limitations do not require the attainment of any particular discharge flow or effluent concentration. There are virtually an infinite number of combinations of flow and concentration that can be used to achieve the appropriate limitations. This is illustrated in Figure VIII-1 which shows the BPT limitation for suspended solids for the Blast Furnace subcategory. Also shown on this figure, are the relative positions of the sampled plants, some of which are in compliance and some of which did not achieve the limitations. As shown by this diagram, those plants that do not presently achieve the discharge limitation could do so by reducing either discharge flow or effluent concentration, or a combination of the two.

Costs to Achieve the BPT Limitations

Based upon the cost estimates developed by the Agency, the industry-wide investment costs to achieve full compliance with the BPT limitations is approximately $1.7 billion (in July 1, 1978 dollars). The Agency estimates that as of July 1, 1981, about $0.21 billion of this amount remained to be spent by the industry. The total annual cost associated with the BPT regulation is about $0.20 billion. A breakdown of these BPT costs by subcategory is presented in Table VIII-1. The Agency believes that the effluent reduction benefits resulting from compliance with the BPT limitations justify the associated costs.

These costs are different than those presented in the Draft Development Document. As noted earlier, the Agency updated the status of the industry with respect to the installation of pollution control facilities from January 1978 to July 1981. Also, the installed and required costs for production facilities shut down during the mid to late 1970's were deleted. These facilities were included in the data base for the proposed regulation. The above estimates do not include costs for treatment facilities installed by the industry which are not required to achieve the BPT limitations or for facilities installed which provide treatment more stringent than required to achieve the BPT and BAT limitations (e.g. cascade rinse and acid recovery systems for acid pickling operations; high rate recycle for hot forming operations).

TABLE VIII-1

BPT COST SUMMARY
IRON AND STEEL INDUSTRY

Subcategory/Subdivision	Capital		Annual	
	In-place	Required	In-Place	Required
A. Cokemaking				
1. I&S - Biological	96.98	41.50	25.45	9.51
2. I&S - Physical-Chemical	1.84	3.70	0.55	0.88
3. Merchant - Biological	19.43	2.45	4.08	0.54
4. Merchant - Physical-Chemical	2.69	0.00	0.59	0.00
5. Beehive	0.78	0.00	0.13	0.00
*Cokemaking Total	121.72	47.65	30.80	10.93
B. Sintering	58.82	5.07	12.10	1.34
C. Ironmaking	412.34	22.40	52.53	2.74
D. Steelmaking				
1. BOF: Semi-Wet	2.70	1.61	0.41	0.24
2. BOF: Wet-SC	15.81	0.00	4.22	0.00
3. BOF: Wet-OC	57.20	1.42	13.30	0.34
4. Open Hearth	17.78	0.00	3.75	0.00
5. EAF: Semi-Wet	0.79	0.22	0.13	0.03
6. EAF: Wet	14.48	0.00	2.82	0.00
*Steelmaking Total	108.76	3.25	24.63	0.61
E. Vacuum Degassing	20.43	7.47	2.99	1.11
F. Continuous Casting	59.55	4.84	8.62	0.76
G. Hot Forming				
1. Primary C w/s	76.45	20.78	-29.62	2.68
2. Primary C wo/s	34.15	9.85	-5.29	1.32
3. Primary S w/s	6.74	0.00	-0.75	0.00
4. Primary S wo/s	6.49	0.76	-0.15	0.00
5. Section Carbon	88.95	19.05	-0.96	2.48
6. Section Spec	13.28	4.17	-0.15	0.30
7. Flat C HS&S	102.04	23.26	-4.83	3.06
8. Flat S HS&S	5.05	0.14	0.23	0.02
9. Flat C Plate	13.66	6.49	-1.23	0.87
10. Flat S Plate	3.01	0.18	0.07	0.02
11. Pipe & Tube-Carbon	12.76	9.35	1.42	1.23
12. Pipe & Tube-Spec	3.68	0.00	0.27	0.00
*Hot Forming Total	366.26	94.03	-40.99	11.98

TABLE VIII-1
BPT COST SUMMARY
IRON AND STEEL INDUSTRY
PAGE 2

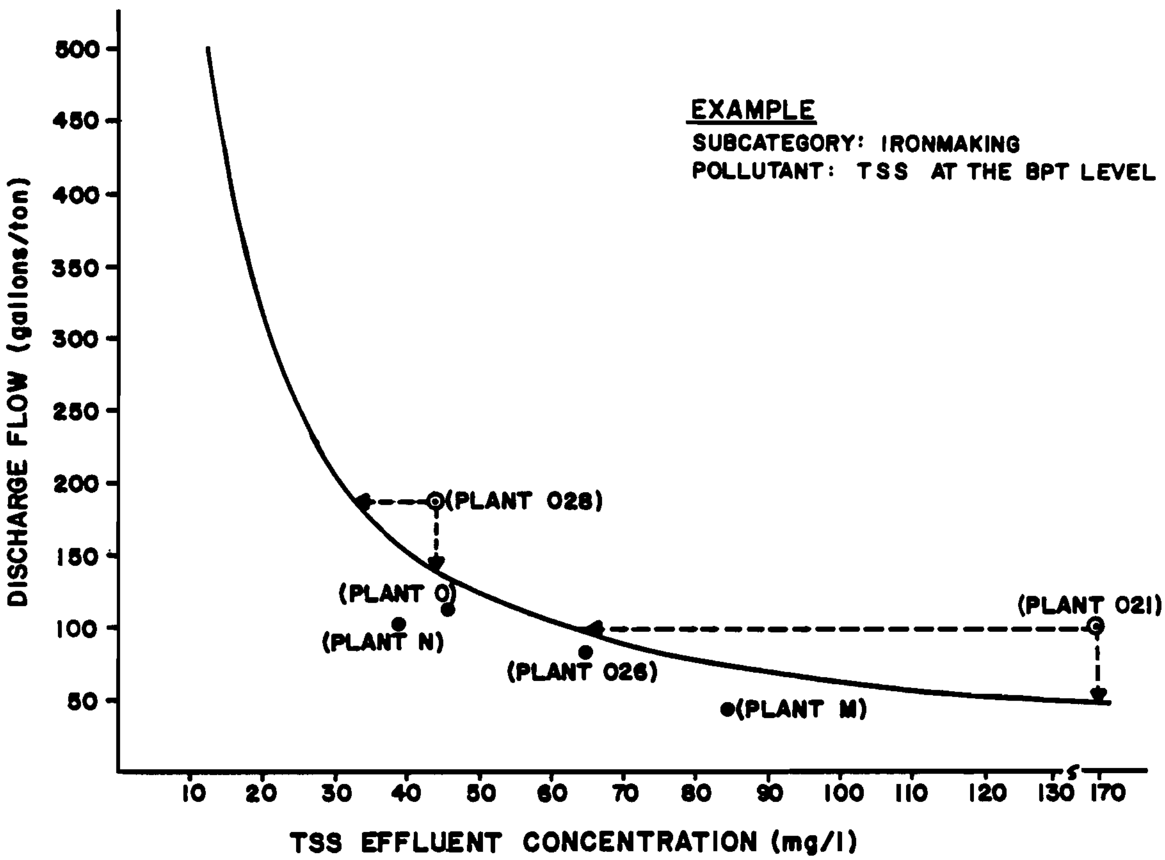
Subcategory/Subdivision	Capital In-place	Capital Required	Annual In-Place	Annual Required
H. Salt Bath Descaling				
1. Oxidizing - B S/P	0.58	0.20	0.08	0.03
2. Oxidizing - B R/W/B	0.86	0.02	0.13	0.00
3. Oxidizing - B P/T	0.76	0.00	0.11	0.00
4. Oxidizing - Cont	1.53	0.16	0.23	0.02
5. Reducing - Batch	0.61	0.00	0.09	0.00
6. Reducing - Cont	0.20	0.00	0.03	0.00
*Salt Bath Descaling Total	4.54	0.38	0.67	0.05
I. Acid Pickling				
1. Sulfuric-R/W/C-Neut	12.96	0.51	3.37	0.13
2. Sulfuric-S/S/P-Neut	21.30	1.86	13.13	1.23
3. Sulfuric-B/B/B-Neut	9.22	0.00	2.93	0.00
4. Sulfuric-P/T/O-Neut	7.55	0.42	1.92	0.08
5. Sulfuric-S/S/P Au	3.55	0.00	0.54	0.00
6. Sulfuric-R/W/C Au	3.75	0.00	0.58	0.00
7. Sulfuric-B/B/B Au	0.66	0.00	0.00	0.00
8. Sulfuric-P/T Au	0.77	0.00	0.12	0.00
9. Hydrochloric-R/W/C	3.70	0.15	0.75	0.02
10. Hydrochloric-S/S/P	35.81	1.65	22.87	1.46
11. Hydrochloric-P/T	0.85	0.10	0.19	0.01
12. Hydrochloric-S/S/P Ar	15.00	0.00	-4.87	0.00
13. Combination-R/W/C	5.70	0.14	1.54	0.02
14. Combination-B S/S/P	3.17	0.03	0.74	0.00
15. Combination-C S/S/P	17.49	0.08	6.54	0.02
16. Combination-B/B/B	0.61	0.00	0.20	0.00
17. Combination-P/T	2.56	0.44	0.61	0.08
*Acid Pickling Total	144.65	5.38	51.16	3.05
J. Cold Forming				
1. CR-Recirc Single	0.56	0.54	0.08	0.08
2. CR-Recirc Multi	4.22	1.61	0.12	0.28
3. CR-Combination	7.57	0.00	1.29	0.00
4. CR-DA Single	3.68	0.33	0.53	0.05
5. CR-DA Multi	6.59	2.61	0.77	0.44
6. CW Pipe&Tube Water	3.30	0.76	0.43	0.10
7. CW Pipe & Tube Oil	3.06	0.02	0.40	0.00
*Cold Forming Total	28.98	5.87	3.62	0.95

TABLE VIII-1
BPT COST SUMMARY
IRON AND STEEL INDUSTRY
PAGE 3

Subcategory/Subdivision	Capital In-place	Capital Required	Annual In-Place	Annual Required
K. Alkaline Cleaning				
1. Batch	1.67	0.31	0.21	0.04
2. Continuous	10.01	0.27	1.39	0.04
*Alkaline Cleaning Total	11.68	0.58	1.60	0.08
L. Hot Coating				
1. Galv. SS wo/s	9.87	1.47	1.48	0.26
2. Galv. SS w/s	9.80	0.44	1.55	0.08
3. Galv. Wire wo/s	5.44	0.66	0.69	0.10
4. Galv. Wire w/s	1.10	0.66	0.17	0.10
5. Terne wo/s	0.52	0.05	0.07	0.01
6. Terne w/s	1.32	0.32	0.20	0.05
7. Other SS wo/s	0.73	1.00	0.11	0.16
8. Other SS w/s	-	-	-	-
9. Other Wire wo/s	0.31	0.00	0.04	0.00
10. Other Wire w/s	0.74	0.00	0.00	0.00
*Hot Coating Total	29.83	4.60	4.31	0.76
Total	1,367.56	201.52	152.04	34.36
Confidential Plants	39.83	4.44	4.98	0.91
Costs for Components Installed Beyond BPT	84.10	0.00	11.71	0.00
Industry Total	1,491.49	205.96	168.73	35.27

NOTES: Costs are in millions of 7/1/78 dollars.
Basis: Facilities in-place as of 7/1/81.

FIGURE VIII-1
POTENTIAL FOR ACHIEVING
AN EFFLUENT LIMITATION



——: SOLID LINE REPRESENTS TSS LIMIT OF 0.026 kg/kkg (lbs/1000 lbs)

NOTE: PLANTS ABOVE THE SOLID LINE DO NOT MEET TSS LIMITATIONS. HOWEVER, THEY COULD ATTAIN THE APPROPRIATE LOAD BY EITHER REDUCING THEIR FLOW OR EFFLUENT CONCENTRATION AS SHOWN BY THE DASHED ARROWS OR ANY COMBINATION OF THE TWO.

GENERAL

SECTION IX

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF THE BEST AVAILABLE TECHNOLOGY ECONOMICALLY ACHIEVABLE

Introduction

The effluent limitations which must be achieved by July 1, 1984 are to specify the degree of effluent reduction attainable through the application of the best available technology economically achievable. Best available technology is not based upon an "average of the best" performance within an industrial category, but is determined by identifying the best control and treatment technology used by a specific point source within the industrial subcategory. Also, where a technology is readily transferable from one industry to another, such technology may be identified as BAT technology.

Consideration was also given to:

1. The size and age of equipment and facilities involved.

2. The processes employed.

3. Non-water quality environmental impact (including energy requirements).

4. The engineering aspects of the application of various types of control techniques.

5. Process changes.

6. The cost of achieving the effluent reduction resulting from application of BAT technology.

Best available technology may be the highest degree of control technology that has been achieved or has been demonstrated to be capable of being designed for plant scale operation up to and including "no discharge" of pollutants. Although economic factors are considered in the development, the level of control is intended to be the top-of-the-line current technology, subject to limitations imposed by economic and engineering feasibility. However, this level may be characterized by some technical risk with respect to performance and with respect to certainty of costs.

Development of BAT Effluent Limitations

Model Treatment Systems

The Agency considered from two to five BAT alternative treatment systems for each of the twelve steel industry subcategories. These alternatives are designed to be compatible with the BPT model treatment systems in each subcategory from the standpoint of retrofitting the necessary water pollution control facilities. For those operations where BAT limitations more stringent than the respective BPT limitations have been promulgated, the required water pollution control facilities can be installed without significant retrofit costs. For most subcategories (Sintering, Ironmaking, Steelmaking, Vacuum Degassing, and Continuous Casting), flows amounting to only a few percent of the model BPT treatment system flow rates require treatment in the BAT model treatment systems. For cokemaking operations, additional biological treatment compatible with the BPT model biological treatment system is the model BAT technology. The BAT alternative treatment systems are reviewed in detail in the respective subcategory reports of the development documents.

Model Treatment System Flow Rates

The Agency's selection of model BAT flow rates is highly subcategory specific. In every case the Agency sought to determine the best flow rate that could be achieved on a subcategory wide basis. In some cases, the model BAT flow rates for the alternative treatment systems are significantly more restrictive than the respective model BPT flow rates. However, for most forming and finishing operations, where more stringent BAT limitations were not promulgated, the model BAT flow rates are the same as the model BPT flow rates. The Agency considered zero discharge alternatives based upon evaporative technologies in all subcategories. These technologies were rejected because of energy and cost considerations.

A summary of the model BPT and BAT effluent flow rates for those operations where more stringent BAT limitations were promulgated is presented below:

Subcategory	Model BPT Flow Rate	Model BAT Flow Rate
A. Cokemaking		
Iron and Steel	225 gal/ton	153 gal/ton
Merchant	240	170
b. Sintering	120	120
C. Ironmaking	125	70
D. Steelmaking		
BOF, semi-wet	0	0
BOF, wet-supp. comb.	50	50

	BOF, wet-open comb.	110	110
	Open Hearth, wet	110	110
	EAF, semi-wet	0	0
	EAF, wet	110	110
E.	Vacuum Degassing	25	25
F.	Continuous Casting	125	25
L.	Hot Coating Fume Scrubbers	100 gpm	15gpm

The lower BAT model flow rates for cokemaking operations are based upon recycle of barometric condenser cooling water, or replacement of the barometric condenser with a surface condensor. The ironmaking BAT model flow was set at 70 gal/ton based upon demonstrated performance at plants in this subcategory. The BAT model flow rate for continuous casting operations was set at 25 gal/ton based upon widespread demonstration of flows of 25 gal/ton and less in that subcategory. Finally, the hot coating fume scrubber BAT model flow of 15 gpm is based upon recycle of fume scrubber wastewaters, a common practice in the industry. The Agency did not set more restrictive BAT model flow rates for the other operations listed above because it does not have sufficient information and data at this time to demonstrate that more restrictive flow rates are achievable on a subcategory-wide basis. Reference is made to the respective subcategory reports for additional information on the selection of the BAT model treatment system flow rates.

<u>Model Treatment System Effluent Quality</u>

The performance standards for the model BAT treatment systems were determined in the same fashion as described in Section VIII for the BPT limitations. Where more stringent BAT limitations were promulgated, the Agency based the limitations upon the best performing representative plant or plants in the subcategory; upon pilot scale demonstration studies at plants within the subcategory; or upon pilot scale demonstration studies at plants with similar, more highly contaminated wastewaters. In all cases, however, the BAT limitations are achieved on a full scale basis in the industry.

<u>Summary of Changes From Proposed Regulation</u>

Based upon comments on the proposed regulation, the Agency made several changes in promulgating the final BAT effluent limitations.

For the most part, BAT effluent limitations more stringent than the BPT limitations were promulgated for the basic steelmaking operations and BAT limitations no more stringent than the BPT limittaions were promulgated for the forming and finishing operations. These changes are summarized below:

Subcategory	Changes from Proposed to Promulgated Regulation
A. Cokemaking	While the model BAT treatment systems have not changed substantially, slightly less stringent limitations for all pollutants were promulgated based upon analysis of additional data received for the best treatment facilities.
B. Sintering	The selected model technology was changed from alkaline chlorination to filtration. Limitations for ammonia-N, total cyanide, and phenols (4AAP) were provided for sintering operations with wastewaters that are co-treated with ironmaking wastewaters.
C. Ironmaking	Less stringent ammonia-N limitations were promulgated on the basis of comments and data received on the proposed limitations.
D. Steelmaking	The selected model technology was changed to delete post filtration of the lime precipitation effluent. Slightly less stringent limitations for lead and zinc were promulgated and the limitations for chromium were deleted.
E. Vacuum Degassing F. Continuous Casting	The model treatment technology was changed to lime precipitation and sedimentation from filtration. Less stringent limitations for lead and zinc were promulgated and the limitation for chromium was deleted. The limitations for these operations are now consistent with those for steelmaking operations.
G. Hot Forming	High rate recycle of hot forming wastewaters was not selected as the model BAT treatment technology. Thus, BAT limitations for hot forming operations were not promulgated.
H. Salt Bath Descaling	Filtration of the BPT model treatment system effluent was not selected as the model BAT treatment system. Thus, BAT limitations no more stringent than the BPT limitations were promulgated.

I.	Acid Pickling	Cascade rinsing of acid pickling rinsewaters was not selected as the BAT model treatment system. Thus, BAT limitations no more stringent than the BPT limitations were promulgated.
J.	Cold Forming	BAT limitations no more stringent than the BPT limitations were promulgated.
K.	Alkaline Cleaning	BAT limitations were not proposed and not promulgated.
L.	Hot Coating	Cascade rinsing of hot coating rinsewaters was not selected as the model BAT treatment technology. BAT limitations no more stringent than the BPT limitations were promulgated for those hot coating operations without fume scrubbers. More stringent BAT limitations were promulgated for those hot coating operations with fume scrubbers.

Best Available Technology Effluent Limitations and Associated Costs

Based upon the information contained in Sections II through VIII of this report and upon data presented in the respective subcategory reports, various treatment systems were considered for the BAT level of treatment. A short description of the model BAT treatment systems is presented in Table I-15. The BAT effluent limitations are summarized in Table I-4. The costs associated with the model BAT systems are summarized in Table IX-14 by subcategory. As with the BPT effluent limitations, the Agency has concluded that the effluent reduction benefits associated with the selected BAT limitations justify the costs and non-water quality environmental impacts, including energy consumption, water consumption, air pollution, and solid waste generation.

Co-Treatment with Non-Steel Industry Finishing Wastewaters

The steel industry produces a number of finished products that are coated with various metals for protective or decorative purposes. This regulation contains effluent limitations and standards for the hot coating processes (i.e., coating of steel by immersion in molten baths of zinc, terne metal, or other metals). However, the regulation does not include specific limitations for cadmium, copper, chromium, nickel, tin, and zinc electroplating operations found at many steel plants. It is common practice in the industry to co-treat wastewaters from these operations with wastewaters from acid pickling, cold rolling, alkaline cleaning, and hot coating operations. Often, pretreatment of wastestreams with high levels of cyanide or a particular metal is practiced prior to final neutralization and settling (i.e., reduction of hexavalent chromium; separate neutralization and settling for zinc). The model BPT and BAT treatment systems for steel industry finishing operations are installed at many co-treatment plants and, effluent data from some of the co-treatment systems were considered in developing the limitations and standards in this regulation.

Application of the limitations and standards contained in this regulation to plants with electroplating operations without any allowance for those operations will present problems, both to permit writers and to the industry. The following guidance is provided to permit writers to develop plant specific NPDES permit conditions for these facilities:

a. Treatment Plants with BPT/BAT Treatment Facilities In-Place
   1) Determine the plant specific BPT/BAT effluent limitations for those steel industry finishing operations included in this regulation. Compare the mass loadings to current performance of the treatment facility in question for periods of relatively high production.
   2) If the applicable effluent limitations for the steel operations included in this regulation are determined not to be achievable considering appropriate historical performance data, alternate BAT limitations should be developed for those plants with well operated treatment facilities. These treatment facilities should include all of the BPT/BAT treatment components and not include a substantial amount of cooling waters, surface runoff, or process wastewaters from hot forming or any of the basic steelmaking operations. These alternate mass effluent limitations should be based upon the current performance of the treatment facility on a concentration basis, and treatment system flow rates which take into account those finishing operations included in this regulation and flows from the electroplating operations. In some cases, in-process flow reduction including recycle of fume scrubbers, reduction in rinsewater flows, etc., may be required to further reduce the discharge from current levels. In general, the concentrations determined from actual performance data should be in the immediate range of those concentrations presented in the Development Document used to develop the BPT and BAT effluent limitations.

b. Treatment Plants Without BPT/BAT Treatment Facilities In-Place
   1) Determine the plant specific BPT/BAT effluent limitations for those steel industry finishing operations included in this regulation.
   2) Determine an allowance for the electroplating operations based upon the process flow rates from those operations (after appropriate flow minimization steps are implemented i.e., fume scrubber recycle), and the

performance data presented in the Development Document for similar co-treatment systems.

Technical assistance for permit writers may be obtained from the Effluent Guidelines Division for developing limitations for treatment systems that treat wastewaters from operations covered by this regulation and wastewaters from other operations.

TABLE IX-1

BAT COST SUMMARY
IRON AND STEEL INDUSTRY

Subcategory/Subdivision	Capital		Annual	
	In-place	Required	In-Place	Required
A. Cokemaking				
1. I&S - Biological	4.83	28.62	0.92	6.96
2. I&S - Physical-Chemical	3.74	0.00	1.62	0.00
3. Merchant - Biological	0.39	4.33	0.07	0.94
4. Merchant - Physical-Chemical	2.16	0.00	0.98	0.00
*Cokemaking Total	11.12	32.95	3.59	7.90
B. Sintering	0.51	5.51	0.05	0.74
C. Ironmaking	7.63	23.20	2.27	6.77
D. Steelmaking				
1. BOF: Semi-Wet	-	-	-	-
2. BOF: Wet-SC	1.20	0.34	0.16	0.06
3. BOF: Wet-OC	0.56	5.32	0.08	0.78
4. Open Hearth	0.33	1.44	0.05	0.23
5. EAF: Semi-Wet	-	-	-	-
6. EAF: Wet	0.46	1.09	0.06	0.17
*Steelmaking Total	2.55	8.19	0.35	1.24
E. Vacuum Degassing	0.20	2.82	0.03	0.39
F. Continuous Casting	0.82	2.23	0.11	0.31
L. Hot Coating				
1. Galv. SS wo/s	-	-	-	-
2. Galv. SS w/s	0.31	0.32	0.04	0.04
3. Galv. Wire wo/s	-	-	-	-
4. Galv. Wire w/s	0.04	0.03	0.01	0.00
5. Terne wo/s	-	-	-	-
6. Terne w/s	0.00	0.16	0.00	0.02
7. Other SS wo/s	-	-	-	-
8. Other SS w/s	-	-	-	-
9. Other Wire wo/s	-	-	-	-
10. Other Wire w/s	0.10	0.00	0.00	0.00
*Hot Coating Total	0.45	0.51	0.05	0.06
Total	23.28	75.41	6.45	17.41
Confidential Plants	0.80	1.94	0.18	0.43
Industry Total	24.08	77.35	6.63	17.84

NOTES: Costs are in millions of 7/1/78 dollars.
Basis: Facilities in-place as of 7/1/81.
: BAT limitations equal to BPT are being promulgated in the other subcategories/subdivisions. There is no additional costs in these subcategories/subdivisions.

TABLE IX-2

ADVANCED TREATMENT SYSTEMS CONSIDERED
FOR BAT
IRON AND STEEL INDUSTRY

Advanced Treatment System	Coke-making	Sintering	Iron-making	Basic Oxygen Furnace	Open Hearth	Electric Arc	Vacuum Degassing	Cont. Casting	Hot Forming	Salt Bath Descaling	H2SO4 Pickling	HCL Pickling	Comb Pickling	Cold Forming	Alkaline Cleaning	Hot Coating
Acid Recovery/ Regeneration											X	X				
Activated Sludge System	X															
2 Stage Chlorination		X	X							X						
Rinse Reduction System											X	X	X			X
Evaporation		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Evaporation as Quench	X															
Evaporation on Slag			X													
Filtration (Pressure or Gravity)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Granular Carbon Columns	X	X	X											X		
Lime Precipitation		X	X	X	X	X	X	X								
Powdered Carbon Addition	X													X		
Recycle System	X	X	X	X	X	X			X		X	X	X			X
Sulfide Precipitation		X	X	X	X	X	X	X	X	X	X	X	X			X

VOLUME I

SECTION X

BEST CONVENTIONAL POLLUTANT CONTROL TECHNOLOGY

Introduction

The 1977 Amendments added Section 301(b)(2)(E) to the Act, 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(a)(4) [biochemical oxygen demanding pollutants (BOD_5), total suspended solids (TSS), fecal coliform, and pH], and any additional pollutants defined by the Administrator as "conventional" (oil and grease, 44 FR 44501, July 30, 1979).

BCT is not an additional limitation but replaces BAT for the control of conventional pollutants. In addition to other factors specified in Section 304(b)(4)(B), the Act requires that BCT limitations be assessed in light of a two part "cost-reasonableness" test. American Paper Institute v. EPA, 660 F. 2d 954 (4th Cir. 1981). The first test compares the cost for private industry to reduce its conventional pollutants with the costs at publicly owned treatment works for similar levels of reduction in their discharge of these pollutants. The second test examines the cost-effectiveness of additional industrial treatment beyond BPT. EPA must find that limitations are "reasonable" under both tests before establishing them as BCT. In no case may BAT be less stringent than BPT.

Because of the remand in American Paper Institute v. EPA (No. 79-115), the regulation does not contain BCT limitations except for those operations for which the BAT limitations are not more stringent than the respective BPT limitations.

VOLUME I

SECTION XI

EFFLUENT QUALITY ATTAINABLE THROUGH THE APPLICATION OF NEW SOURCE PERFORMANCE STANDARDS

Introduction

NSPS are to specify the degree of effluent reduction achievable through the application of the best available demonstrated control technology, processes, operating methods, or other alternatives, including, where applicable, a standard requiring no discharge of pollutants.

For new source plants, a zero discharge of pollutants limit was sought for each subcategory. There are several facilities in some subcategories that demonstrate zero discharge. However, the Agency determined that for most of these subcategories zero discharge is not attainable for all new sources without the use of costly evaporative technologies. For these wastewater operations, treatment systems at lowest achievable flow rates have been considered.

Because new plants can be designed with water conservation and innovative technology in mind, costs can be minimized by treating the lowest possible wastewater flows. No considerations had to be given to the "add-on" approach that was characteristic of the BPT and BAT systems and therefore the NSPS Alternatives consider the most efficient treatment components and systems. NSPS systems are generally the same as the BAT systems; however, in some subcategories, alternate treatment components are included.

Identification of NSPS

The alternative treatment systems considered for NSPS are the same as the alternatives considered for BAT with minor exceptions. However, as noted above, in many subcategories lower discharge flows are considered for NSPS. Since the criteria for NSPS is to consider only the very best systems, the lowest demonstrated flow could be used to develop NSPS standards. Table XI-1 lists the treatment systems used as models for NSPS. The standards associated with the model NSPS systems are summarized in Table I-15. Additional details on the development of NSPS are provided in the individual subcategory reports. All of the NSPS are demonstrated in the steel industry.

NSPS Costs

The Agency did not estimate the number of new source plants to be built. However, the Agency did consider the potential economic impacts of NSPS in <u>Economic Analysis of Effluent Guidelines -</u>

Integrated Iron and Steel Industry. Model costs for the NSPS systems are detailed in the individual subcategory reports.

VOLUME I

SECTION XII

PRETREATMENT STANDARDS FOR PLANTS DISCHARGING TO PUBLICLY OWNED TREATMENT WORKS

Introduction

The industry discharges untreated or partially treated wastewaters to publicly owned treatment works (POTWs) from operations in nearly every subcategory. Table XII-1 lists all plants which reported discharges to POTWs. In the individual subcategory reports, two classes of discharges to POTWs were addressed: existing sources and new sources. Also, the national pretreatment standards developed for indirect discharges fall into two separate groups: prohibited discharges, covering all POTW users, and categorical standards applying to specific industrial subcategories.

As was done for BAT, BCT and NSPS, various alternative treatment systems were considered for pretreatment standards. Up to six alternatives were considered for each subcategory.

National Pretreatment Standards

The Agency has developed national standards that apply to all POTW discharges. For detailed information on the Agency's approach to Pretreatment Standards refer to 46 FR 9404 et seq, "General Pretreatment Regulations for Existing and New Sources of Pollution, (January 28, 1981). See also 47 FR 4518 (February 1, 1982). In particular, Part 403, Section 403.5 et. seq. describes national standards, prohibited discharges and categorical standards, POTW pretreatment programs, and a national pretreatment strategy.

Categorical Pretreatment Standards

The Agency based the categorical pretreatment standards for the steel industry on the minimization of pass through of toxic pollutants at POTWs. For each subcategory, the Agency compared the removal rates for each toxic pollutant limited by the PSES to the removal rate for that pollutant at well operated POTWs. The POTW removal rates were determined through an extensive study conducted by the Agency at over forty POTWs. The POTW removal rates are presented below:

Toxic Pollutant	POTW Removal Rate
Cadmium	38%
Chromium	65%
Copper	58%
Lead	48%
Nickel	19%

Silver	66%
Zinc	65%
Cyanide	52%

As shown in the respective subcategory reports, the pretreatment alternatives selected by the Agency in all cases provide for significantly more removal of toxic pollutants than would occur if steel industry wastewaters were discharged to POTWs untreated. Thus, the pass through of these pollutants at POTWs will be minimized. Except for the Cokemaking subcategory, all selected PSES and PSNS alternatives are the same as the respective BAT and NSPS alternatives. For cokemaking operations, the Agency's selected PSES alternative is based upon the same physical/chemical pretreatment the industry provides for its on-site coke plant biological treatment systems.

The PSES and PSNS are set out in Tables I-8 and I-6, respectively. The associated industry-wide PSES costs are presented in Table XII-14. PSNS model treatment system costs are presented in the respective subcategory reports.

TABLE XII-1
LIST OF PLANTS WITH INDIRECT DISCHARGES TO POTW SYSTEMS

PLANT	COKEMAKING	SINTERING	IRONMAKING	B.O.F. STEELMAKING	O.H. STEELMAKING	E.A.F. STEELMAKING	VACUUM DEGASSING	CONTINUOUS CASTING	HOT FORMING-PRIMARY	HOT FORMING-SECTION	HOT FORMING-FLAT	HOT FORMING-PIPE & TUBE	SALT BATH DESCALING-OXIDIZING	SALT BATH DESCALING-REDUCING	SULFURIC ACID PICKLING	HYDROCHLORIC ACID PICKLING	COMBINATION ACID PICKLING	COLD ROLLING	COLD FORMING-PIPE & TUBE	ALKALINE CLEANING	HOT COATINGS		
0020B																		X					
0020C																		X					
0024A	X																						
0048D															X								
0048F															X								
0060	X																						
0060G															X						X		
0060H								X															
0060I																	X						
0060L																X							
0060M															X								
0060R																					X		
0060S															X						X		
0068									X	X					X	X				X	X		
0088																				X			
0088B															X								
0112F															X						X		
0112G															X						X		
0112I															X								
0136B										X													
0136C										X													
0176C																	X		X				
0176D																	X		X				
0180								X															
0212	X																						
0248A	X																						
0248E																	X						
0256A															X								
0256K														X									
0256N																				X			
0264															X						X		
0264A																					X		
0264C															X								
0264D															X						X		
0280B	X																						
0320	X																						
0380	X																						
0384A	X																						
0396A	X	X	X																				
0396C	X																						
0396D									X		X					X							
0432B																					X		
0432E															X		X						
0432J									X														
0432L																	X						

TABLE XII-1
LIST OF POTW DISCHARGERS
PAGE 2

PLANT	COKEMAKING	SINTERING	IRONMAKING	B.O.F. STEELMAKING	O.H. STEELMAKING	E.A.F. STEELMAKING	VACUUM DEGASSING	CONTINUOUS CASTING	HOT FORMING-PRIMARY	HOT FORMING-SECTION	HOT FORMING-FLAT	HOT FORMING-PIPE & TUBE	SALT BATH DESCALING-OXIDIZING	SALT BATH DESCALING-REDUCING	SULFURIC ACID PICKLING	HYDROCHLORIC ACID PICKLING	COMBINATION ACID PICKLING	COLD ROLLING	COLD FORMING-PIPE & TUBE	ALKALINE CLEANING	HOT COATINGS		
0440A										X			X				X						
0444								X															
0448A											X					X				X	X		
0460A								X															
0460B										X													
0460C															X						X		
0460F															X						X		
0460G															X						X		
0460H															X					X	X		
0464B	X																						
0464C	X																						
0528													X							X			
0548B															X		X			X			
0580															X	X	X			X			
0580B																X				X			
0580C															X	X							
0580E																X				X			
0580F																X							
0580G																	X			X	X		
0584B	X																						
0636															X		X			X			
0640A										X													
0640B																	X				X		
0648																	X	X			X		
0656A	X																						
0672B									X														
0684H	X		X	X					X	X		X											
0684K															X		X						
0684Z																					X		
0696A								X															
0740A								X															
0760															X					X			
0776C																	X			X			
0776D															X					X			
0776J																	X						
0792A																	X				X		
0792C															X								
0810	X																						
0856F															X								
0860H				X		X		X	X	X	X												
0884E																	X		X				
0936																					X		
0946A	X									X													
0948B															X								
0948C	X																						
TOTAL (90 Sites)	18	1	2	2	0	1	0	7	6	9	3	1	2	1	29	9	18	3	3	16	20		

TABLE XII-2

PRETREATMENT COST SUMMARY
IRON AND STEEL INDUSTRY

Subcategory/Subdivision	Capital In-place	Capital Required	Annual In-Place	Annual Required
A. Cokemaking				
1. I&S - Plants	28.21	7.52	7.04	1.12
2. Merchant - Plants	2.66	7.41	0.56	1.45
*Cokemaking Total	30.87	14.93	7.60	2.57
B. Sintering	3.23	0.36	0.78	0.05
C. Ironmaking	13.21	0.65	2.26	0.18
D. Steelmaking				
1. BOF: Semi-Wet	-	-	-	-
2. BOF: Wet-SC	3.06	0.00	0.82	0.00
3. BOF: Wet-OC	5.73	0.00	1.30	0.00
4. Open Hearth	-	-	-	-
5. EAF: Semi-Wet	-	-	-	-
6. EAF: Wet	2.90	0.00	0.55	0.00
*Steelmaking Total	11.69	0.00	2.67	0.00
E. Vacuum Degassing	-	-	-	-
F. Continuous Casting	9.01	0.34	1.34	0.05
G. Hot Forming				
1. Primary C w/s	3.93	0.43	-1.08	0.05
2. Primary C wo/s	5.64	0.00	-0.29	0.00
3. Primary S w/s	-	-	-	-
4. Primary S wo/s	0.67	0.30	-0.08	0.04
5. Section Carbon	11.47	2.66	0.00	0.18
6. Section Spec	0.05	0.00	-0.01	0.00
7. Flat C HS&S	3.39	0.00	-0.33	0.00
8. Flat S HS&S	-	-	-	-
9. Flat C Plate	2.81	0.00	0.07	0.00
10. Flat S Plate	-	-	-	-
11. Pipe & Tube-Carbon	1.16	0.00	0.14	0.00
12. Pipe & Tube-Spec	-	-	-	-
*Hot Forming Total	29.12	3.39	-1.58	0.27

TABLE XII-2
PRETREATMENT COST SUMMARY
IRON AND STEEL INDUSTRY
PAGE 2

Subcategory/Subdivision	Capital In-place	Capital Required	Annual In-Place	Annual Required
H. Salt Bath Descaling				
1. Oxidizing - B S/P	-	-	-	-
2. Oxidizing - B R/W/B	0.07	0.20	0.01	0.03
3. Oxidizing - B P/T	-	-	-	-
4. Oxidizing - Cont	0.09	0.72	0.01	0.11
5. Reducing - Batch	0.04	0.08	0.01	0.01
6. Reducing - Cont	-	-	-	-
*Salt Bath Descaling Total	0.20	1.00	0.03	0.15
I. Acid Pickling				
1. Sulfuric-R/W/C-Neut	3.05	3.82	1.05	1.16
2. Sulfuric-S/S/P-Neut	1.11	1.44	0.80	0.79
3. Sulfuric-B/B/B-Neut	0.53	1.18	0.23	0.42
4. Sulfuric-P/T/O-Neut	1.42	0.64	0.41	0.20
5. Sulfuric-S/S/P Au	-	-	-	-
6. Sulfuric-R/W/C Au	-	-	-	-
7. Sulfuric-B/B/B Au	-	-	-	-
8. Sulfuric-P/T Au	-	-	-	-
9. Hydrochloric-R/W/C	1.18	3.52	0.40	0.75
10. Hydrochloric-S/S/P	1.74	0.02	1.59	0.01
11. Hydrochloric-P/T	0.01	0.02	0.00	0.00
12. Hydrochloric-S/S/P Ar	-	-	-	-
13. Combination-R/W/C	1.28	1.93	0.39	0.48
14. Combination-B S/S/P	-	-	-	-
15. Combination-C S/S/P	0.02	0.33	0.00	0.12
16. Combination-B/B/B	0.44	0.11	0.15	0.03
17. Combination-P/T	0.25	0.85	0.07	0.21
*Acid Pickling Total	11.03	13.86	5.09	4.17
J. Cold Forming				
1. CR-Recirc Single	0.00	0.03	0.00	0.00
2. CR-Recirc Multi	0.00	0.03	0.00	0.00
3. CR-Combination	-	-	-	-
4. CR-DA Single	-	-	-	-
5. CR-DA Multi	-	-	-	-
6. CW Pipe&Tube Water	0.09	0.00	0.01	0.00
7. CW Pipe&Tube Oil	-	-	-	-
*Cold Forming Total	0.09	0.06	0.01	0.00

TABLE XII-2
PRETREATMENT COST SUMMARY
IRON AND STEEL INDUSTRY
PAGE 3

Subcategory/Subdivision	Capital In-place	Capital Required	Annual In-Place	Annual Required
K. Alkaline Cleaning				
1. Batch	0.00	0.00	0.00	0.00
2. Continuous	0.47	0.00	0.06	0.00
*Alkaline Cleaning Total	0.47	0.00	0.06	0.00
L. Hot Coating				
1. Galv. SS wo/s	0.27	0.75	0.04	0.10
2. Galv. SS w/s	0.14	0.00	0.02	0.00
3. Galv. Wire wo/s	0.92	0.37	0.13	0.05
4. Galv. Wire w/s	1.24	0.70	0.18	0.11
5. Terne wo/s	0.01	0.05	0.00	0.01
6. Terne w/s	-	-	-	-
7. Other SS wo/s	-	-	-	-
8. Other SS w/s	-	-	-	-
9. Other Wire wo/s	0.07	0.43	0.01	0.06
10. Other Wire w/s	-	-	-	-
*Hot Coating Total	2.65	2.30	0.38	0.33
Total	111.57	36.89	18.64	7.77
Confidential Plants	2.14	4.02	0.70	0.85
Costs for Components Installed Beyond PSES	18.27	0.00	2.75	0.00
Industry Total	131.98	40.91	22.09	8.62

NOTES: Costs in millions of 7/1/78 dollars.
Basis: Facilities in-place as of 7/1/81.

VOLUME I

SECTION XIII

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Ludlum Steel Corporation, Wheeling-Pittsburgh Steel Corporation, Republic Steel Corporation, Lukens Steel Company, Laclede Steel Company, Plymouth Tube Co., The Stanley Steel Division, Youngstown Sheet & Tube Co., McLouth Steel Corp., Carpenter Technology, Universal Cyclops, Joslyn Steel, Crucible Inc., Babcock & Wilcox Company, Washington Steel, and Jessop Steel.

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VOLUME I

SECTION XIV

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VOLUME I

APPENDIX A

STATISTICAL METHODOLOGY AND DATA ANALYSIS

Introduction

Statistical Methodology

This section provides an overview of the statistical methodology used by the Agency to develop effluent limitations for the steel industry. The methodology consists essentially of determining long term average pollutant discharges expected from well designed and operated treatment systems, and multiplying these long term averages by variability factors designed to allow for random fluctuations in treatment system performance. The resulting products yield daily maximum and 30-day average concentrations for each pollutant. The daily maximum and 30-day average concentrations were then multipled by an appropriate conversion factor and the respective treatment system model effluent flow rate to determine mass limitations. A general description of the methods employed to derive long term averages, variability factors, and the resulting concentrations follows. The development of the model treatment system flow rates are presented in each subcategory report.

Determination of Long Term Average

For each wastewater treatment facility, an average pollutant concentration was calculated from the daily observations. The median of the plant averages for a pollutant was then used as the long term average for the industry. The long term average was determined for each pollutant to be limited and used to obtain the corresponding limitations for that pollutant.

The long term average (LTA) is defined as the expected discharge concentration (in mg/l) of a pollutant from a well designed, maintained, and operated treatment system. The long-term average is not a limitation, but rather a design value which the treatment system should be designed to attain over the long term.

Determination of Variability Factors

Fluctuations in the pollutant concentrations discharged occur at well designed and properly operated treatment systems. These fluctuations may reflect temporary imbalances in the treatment system caused by fluctuations in flow, raw waste load of a particular pollutant, chemical feed, mixing flows within tanks, or a variety of other factors.

Allowance for the day-to-day variability in the concentration of a pollutant discharged from a well designed and operated treatment system is accounted for in the standards by the use of a "variability factor." Under certain assumptions discussed below, application of a variability factor allows the calculation of an upper bound for the concentration of a particular pollutant. On the average a specified percent of the randomly observed daily values from treatment systems discharging this pollutant at a known mean concentration would be expected to fall below this bound. The 99th percentile for the daily maximum value is a commonly used and accepted level in the steel and other industrial categories. Also, this percentile has been chosen to provide a balance between appropriate considerations of day-to-day variation in a properly operating plant and the necessity to insure that a plant is operating properly.

The derivation of the variability factor for plants with more than 10 but less than 100 observations is based upon the assumption that the daily pollutant concentrations follow a lognormal distribution. This assumption is supported by plots of the empirical distribution function of observed concentrations for various pollutants (Figures A-1 to A-4). The plots of these data on lognormal probability paper approximated straight lines as would be expected of data that is lognormally distributed. It is also assumed that monitoring at a given plant was conducted responsibly and in such a way that resulting measurements can be considered independent and amenable to standard statistical procedures. A final assumption is that treatment facilities and monitoring techniques had remained substantially constant throughout the monitoring period.

The daily maximum variability factor is estimated by the equation (derived in Appendix XII-A1 of the Development Document for Electroplating Pretreatment Standards, EPA 440/1-79/003, August, 1979),

$$\ln(VF) = Z(\text{Sigma}) - .5(\text{Sigma})^2 \qquad (1)$$

where

VF is the variability factor

Z is 2.33, which is the 99th percentile for the standard normal distribution, and

Sigma is the standard deviation of the natural logarithm of the concentrations.

For plants with 100 or more observations for a pollutant, there are enough data to use nonparametric statistics to calculate the daily maximum variability factor. For these cases, the variability factor was calculated by dividing the empirical 99th percentile by the pollutant average. The empirical 99th percentile is that observation whose percentile is nearest 0.99.

The estimated single-day variability factor for each pollutant discharged from a well designed and operated plant was calculated in the following manner:

1. For each plant with 10 or more but less than 100 observations, Sigma was calculated according to the standard statistical formula[14] and was then substituted into Equation (1) to find the VF.

2. For those plants with over 100 observations, the VF was estimated directly by dividing the 99th percentile of the observed sample values by their average.

3. The median of the plant variability factors was then calculated for each pollutant.

The variability factor for the average of a random sample of 30 daily observations about the mean value of a pollutant discharged from a well designed and operated treatment system was obtained by use of the Central Limit Theorem. This theorem states that the average of a sufficiently large sample of independent and identically distributed observations from any of a large class of population distributions will be approximately normally distributed. This approximation improves as the size of the sample, n, increases. It is generally accepted that a sample size of 25 or 30 is sufficient for the normal distribution to adequately approximate the distribution of the sample average. For many populations, sample sizes as small as 10 to 15 are sufficient.

The 30-day average variability factor, VF*, allows the calculation of an upper bound for the concentration of a particular pollutant. Under the same assumptions stated above, it would be expected that 95 percent of the randomly observed 30-day average values from a treatment system discharging the pollutant at a known mean concentration will fall below this bound. Thus, a well operated plant would be expected, on the average, to incur approximately one violation of the 30-day average limitation during a 20 month period. The 95th percentile was chosen in a manner analogous to that explained previously in the discussion of the daily variability factor.

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[14] $[\Sigma(xi - \bar{x})^2/(n-1)]^{1/2}$

where

xi is the ln of observation i
$\bar{x}$ is the average of observations
n is the number of observations

The 30-day average variability factor was estimated by the following equation (based on the Central Limit Theorem and previous assumptions),

$$(VF^*) = 1.0 + Z\ (S^*/A) \qquad (2)$$

where

- VF^* is the 30-day average variability factor;
- Z is 1.64, which is the 95th percentile of the standard normal distribution;
- S^* is the estimated standard deviation of the 30-day averages, obtained by dividing the estimated standard deviation of the daily pollutant concentrations by the square root of 30; and,
- A is the average pollutant concentration.

In the case of biological treatment of cokemaking wastewaters, the Agency determined that the general assumption of statistical independence between successive observations, which is a basis of the general formula, is not valid. The other assumptions underlying the application of the Central Limits Theorem valid. An analysis of the data for the biological treatment system at Plant 0868A indicated that sample measurements made over a number of succesive days are not independent. As a result, the Agency modified its method for calculating the 30-day average concentrations to account for this correlation. It should be noted that the Agency did not find correlations of any significance between successive sample measurements made at physical-chemical treatment systems used to treat other steel industry wastewaters.

The application of the Central Limit Theorem to the effluent data from biological treatment of cokemaking wastewaters remains valid. Thus, the variability factors, VF*, for the 30-day average concentrations are calculated using equation (2) above. However, to account for the statistical dependence of the effluent data, the correlation (covariance) terms are included in the calculation of the standard deviation of the 30-day averages, S*, as shown in Table A-51.

The effect of the dependency of the effluent data is to increase the standard deviation, and, thus, increase the 30-day average concentrations. The 30-day average concentration bases for total suspended solids, ammonia-N and total cyanide for the BAT (biological) limitations and NSPS for the cokemaking subcategory were calculated on this basis. The phenols (4AAP) concentration was determined using the original method since the Agency determined that the dependency of the effluent data for phenols (4AAP) are not significant.

Determination of Limitations

Daily maximum and 30-day average concentrations (L and L*, respectively) were calculated for each pollutant from the long term average (LTA), the daily variability factor (VF), and the 30-day average variability factor (VF*) for that polluant by the following equations:

$$L = VF \times LTA \quad (3)$$
$$L^* = VF^* \times LTA \quad (4)$$

The above concentrations were multiplied by the effluent flow (gal/ton) developed for each treatment subcategory and an appropriate conversion factor to obtain mass limitations and standards in units of kg/1,000 kg of product.

The daily maximum limitation calculated for each pollutant is a value which is not to be exceeded on any one day by a plant discharging that pollutant. The 30-day average maximum limitation is a value which is not to be exceeded by the average of up to 30 consecutive single-day observations for the regulated pollutant. Long term data analyses are presented in Tables A-2 through A-50.

Analysis of Data From Filtration and Clarification Treatment Systems

The observations used to derive daily maximum and 30-day average concentrations include both long term data obtained from the D-DCPs and agency requests, and short term data obtained through sampling visits. Engineering judgment[15] was used to delete some data from the long term data sets analyzed. Generally those data deleted indicate possible upsets, lack of proper operation of treatment facilities, or bypasses. These values typically could be considered effluent violations under the NPDES permit system. The number of observations deleted for each pollutant is identified in Tables A-9 to A-50. Table A-1 presents a key to the long-term data summaries for all plants included in the analyses. A discussion of the analyses for filtration and for clarification treatment systems follows.

Filtration Treatment System

Table A-2 presents average concentrations and variability factors for total suspended solids for those plants[16] with long term effluent data for filtration treatment systems. Detailed descriptive statistics for all relevant pollutants sampled at these plants are presented in

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[15]The Agency's justification for using engineering judgment to delete values from monitoring data sets was upheld in U.S. Steel Corp. v. Train, 556 F.2d 822 (7th Cir. 1977).
[16]Plant 920N was not included in this long term data analysis. Visits to this plant by EPA personnel have demonstrated that the treatment system was not properly operated.

Tables A-9 to A-18. The median of the long term averages is multiplied by the apporpriate median variability factor to obtain the daily maximum and 30-day average concentrations for TSS as presented in Table A-2. Table A-3 presents, in a similar manner, averages, variability factors and daily maximum and 30-day average concentations for oil and grease.

The average concentrations for five toxic metals (chromium, copper, lead, nickel and zinc) calculated from long and short term data are presented with the respective medians in Table A-4. Variability factors, presented in Table A-5, were calculated for those plants having long term toxic metals data. The median daily maximum variability factors for the metals range from 2.0 to 4.5 and the 30-day variability factor for all of the toxic metals is 1.2. These values are similar to those obtained for TSS and oil and grease, in which case the daily maximum variability factors are 3.9 and 4.2 for TSS, and oil and grease, respectively; and the 30-day average variability factor is 1.3 for both pollutants. Since these variability factors were calculated from a larger data base, the Agency decided to use the average of these to represent the variability of the toxic metals. Therefore, variability factors of 4.0 and 1.3 were used to obtain the daily maximum and 30-day average concentrations, respectively. The results are presented in Table A-5. The daily maximum and 30-day average concentrations were rounded up to 0.3 and 0.1 mg/l, respectively, for all toxic metals except zinc. For zinc the daily maximum and 30-day average concentrations were rounded to 0.45 and 0.15 mg/l, respectively. These values were used to calculate the toxic metals mass limitations for filtration systems, where applicable.

<u>Clarification/Sedimentation Treatment System</u>

Tables A-6 and A-7 present the average concentrations of long term data, the variability factors and the calculations used to derive the daily maximum and 30-day average concentrations for TSS and oil and grease, respectively. The long term effluent data and the resultant concentrations apply to clarifacation/sedimentation wastewater treatment systems. Detailed descriptive statistics of these plants are presented in Tables A-18 to A-37 and A-50. For Plants 0112, 0684F, and 0684H, long term data were provided for several parallel treatment systems in one central treatment facility. In these situations the data from the clarifier providing the best treatment were used.

Screening and verification data were used to calculate the average concentrations for toxic metals removal by clarification treatment systems treating wastewaters from carbon steel operations. These average concentrations are presented in Table A-8. Variability factors of 3.0 and 1.2 were used to calculate the daily maximum and 30-day average concentrations (shown in Table A-8), respectively, for all the metals. The above variability factors were based upon:

1. the variability factors for TSS and oil and grease in Tables A-6 and A-7; and,

2. the variability factors[17] derived from toxic metals discharged from clarification treatment systems in the electroplating category.

The daily maximum and 30-day average concentrations were rounded to 0.3 and 0.1 mg/l, respectively for chromium, copper, and zinc, and 0.45 and 0.2 mg/l for nickel, and 0.30 and 0.15 mg/l for lead. These concentrations were used to establish the toxic metals mass limitations for all forming and finishing operations, with the exception of combination acid pickling and salt bath descaling operations.

For combination acid pickling and salt bath descaling operations, both of which process speciality steels, the Agency relied on long term effluent data from a clarification treatment facility located at Plant 0060B. This treatment facility treated wastewaters from both of these specialty steel operations. The descriptive statistical data are presented in Table A-34. The daily maximum and the 30-day average concentrations used to establish the mass effluent limitations for chromium are 1.0 mg/l and 0.4 mg/l, respectively; and for nickel 0.7 mg/l and 0.3 mg/l, respectively.

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[17]Daily maximum variability factors presented in the "Development Document for Electro- plating Pretreatment Standards"; are: Cu - 3.2, Cr - 3.9, Ni - 2.9, Zn - 3.0, Pb - 2.9.

TABLE A-1

KEY TO LONG-TERM DATA SUMMARIES
IRON & STEEL INDUSTRY

Table No.	Reference Code	Subcategory	Treatment
A-9	0112B-5A	Hot Forming	Filtration
A-10	0112C-011	Hot Forming	Filtration
A-11	0112C-122	Hot Forming	Filtration
A-12	0112C-334	Hot Forming	Filtration
A-13	0112C-617	Hot Forming	Filtration
A-14	0112I-5A	Pickling/Al. Cleaning	Filtration
A-15	0384A-3E	Cont. Casting	Filtration
A-16	0384A-4L	Cont. Casting	Filtration
A-17	0684H-EF	Pipe & Tube	Filtration
A-18	0684F-4I	Hot Forming	Lagoons/Filtration
A-19	0112-5B	Ironmaking	Polymer/Clarifier
A-20	0112A-5A	Sintering	Thickener
A-21	0112H-5A	Comb. Acid Pickling	Clarifier/Lagoons
A-22	0320-5A	Hot Forming	Lagoons
A-23	0384A-5E	Ironmaking	Thickener
A-24	0384A-5F	Steelmaking (BOF)	Thickener/Clarifier
A-25	0584A-5F	Hot Forming	Settling Basin
A-26	0584B-5F	Hot Forming	Lagoons
A-27	0684F-5B	Ironmaking	Clarifier
A-28	0684F-5E	Ironmaking	Clarifier
A-29	0684H-5C	Ironmaking	Clarifier
A-30	0856N-5B	Hot Forming	Settling Basin
A-31	0860B	Ironmaking	Clarifier
A-32	0920G-5A	Cold Rolling	Clarifier
A-33	0060B	Comb. Acid Pickling	Lime/Lagoons
A-34	0060B	Comb. Acid Pickling	Lime/Clarifier
A-35	0860B	Forming & Finishing	Chem. Addition/Clarifiers
A-36	0584E	Misc. Finishing Operations	Chem. Addition/Clarifiers
A-37	0856D	Forming & Finishing	Chem. Addition/Clarifiers
A-38	0860B	Ironmaking	A. Chlorination/Filtration
A-39	0012A-5F	Cokemaking	Single-Stage Biological
A-40	0060A	Cokemaking	Single-Stage Biological
A-41	0868A	Cokemaking	2-Stage Biological
A-42	0684F	Cokemaking	Phys-Chem (Carbon Columns)
A-43	0684F	Cold Rolling	Gas Flotation
A-44	0060	Sintering	Filtration (Pilot)
A-45	0060	Sintering	Lime/Clarifier (Pilot)
A-46	0060	Sintering	Lime/Clar/Filter (Pilot)
A-47	0612	Steelmaking - EAF	Filter (Pilot)
A-48	0612	Steelmaking - EAF	Hydroxide/Clarifier (Pilot)
A-49	0612	Steelmaking - EAF	Lime/Filter (Pilot)
A-50	0948C	Misc. Finishing Operations	Chem. Addition/Clarifiers

TABLE A-2

LONG-TERM DATA ANALYSIS
FILTRATION SYSTEMS
TOTAL SUSPENDED SOLIDS

Plant	Number of Sample Points	Average (mg/l)	Variability Factors	
			Average	Maximum*
0112C-334	415	2.3	1.4	6.8
0112I-5A	59	3.6	1.5	8.9
0112C-617	399	4.8	1.3	5.4
0684H-EF	40	6.0	1.3	5.3
0112C-011	580	8.9	1.3	3.5
0112B-5A	87	10.6	1.1	2.3
0384A-4L	289	10.8	1.3	3.0
0112C-122	496	13.3	1.3	4.0
0384A-3E	305	17.4	1.2	2.5
0684F-4I	78	22.2	1.2	3.7
Median Values		9.8	1.3	3.9

30-Day Average Concentration Basis = (9.8 mg/l) (1.3) = 12.7 mg/l

Daily Maximum Concentration Basis = (9.8 mg/l) (3.9) = 38.2 mg/l

Note: For the purposes of developing effluent limitations and standards, the following values were used for total suspended solids.

Average = 15 mg/l
Maximum = 40 mg/l

* For plants with more than 100 observations:

$$\text{Daily Variability Factor} = \frac{\text{99th Percentile}}{\text{Average}}$$

TABLE A-3

LONG-TERM DATA ANALYSIS
FILTRATION SYSTEMS
OIL AND GREASE

Plant	Number of Sample Points	Average (mg/l)	Variability Factors Average	Variability Factors Maximum*
0112B-5A	87	1.1	1.1	2.9
0112C-334	727	1.3	1.4	5.3
0112C-617	647	1.3	1.4	4.5
0112C-122	684	2.0	1.3	5.3
0684H-EF	27	3.4	1.4	3.8
0112C-011	690	6.7	1.3	5.1
0384A-4L	290	6.7	1.2	3.4
Median Values		2.0	1.3	4.5

30-Day Average Concentration Basis = (2.0 mg/l) (1.3) = 2.6 mg/l

Daily Maximum Concentration Basis = (2.0 mg/l) (4.5) = 9.0 mg/l

Note: A maximum value of 10 mg/l has been used to develop effluent limitations and standards for oil and grease.

* For plants with more than 100 observations:

$$\text{Daily Variability Factor} = \frac{\text{99th Percentile}}{\text{Average}}$$

TABLE A-4

DATA ANALYSIS
FILTRATION SYSTEMS
REGULATED METALLIC POLLUTANTS

Plant	Number of Sample Points	Average (mg/l)
A. Chromium		
0112I-5A	61	0.02
0684F-4I	11	0.03
0684H	3	0.03
0584E	3	0.03
0496	3	0.03
0612	3	0.04
MEDIAN		0.03
B. Copper		
0584F	3	0.015
0684F-4I	11	0.02
0684H	3	0.02
0612	3	0.03
0496	3	0.05
0112I-5A	60	0.05
0868B	3	0.25
MEDIAN		0.03
C. Lead		
0684F-4I	11	0.03
0684H	3	0.05
0496	3	0.05
0112I	3	0.07
0612	3	0.18
0868B	3	0.32
MEDIAN		0.06

TABLE A-4
DATA ANALYSIS
FILTRATION SYSTEMS
REGULATED METALLIC POLLUTANTS
PAGE 2

Plant	Number of Sample Points	Average (mg/1)
D. Nickel		
0684H	3	0.02
0612	3	0.025
0496	3	0.04
0112I-5A	27	0.07
0684F-4I	11	0.09
MEDIAN		0.04
E. Zinc		
0684H	3	0.02
0584E	3	0.02
0496	3	0.02
0112I-5A	58	0.10
0612	3	0.12
0684F	45	0.39
0868B	3	1.6
MEDIAN		0.10

TABLE A-5

DERIVATION OF VARIABILITY FACTORS AND PROPOSED LIMITS
FILTRATION SYSTEMS
REGULATED METALLIC POLLUTANTS

Derivation of Variability Factors

Parameter	No. of Sample Points	Variability Factors Average	Variability Factors Maximum
A. Chromium			
0112I-5A	61	1.2	2.9
0684F-4I	11	1.2	3.6
MEDIAN		1.2	3.3
B. Copper			
0112I-5A	60	1.2	5.1
0684F-4I	11	1.1	2.7
MEDIAN		1.2	3.9
C. Lead			
0684F-4I	11	1.1	2.0
D. Nickel			
0112I-5A	27	1.2	3.3
0684F-4I	11	1.2	5.6
MEDIAN		1.2	4.5
E. Zinc			
0112I-5A	58	1.2	3.0
0684F-4I	45	1.2	4.2
MEDIAN		1.2	3.6

Note: Use for all regulated metals
Average Variability Factor = 1.3
Maximum Variability Factor = 4.0

TABLE A-5
DERIVATION OF VARIABILITY FACTORS AND PROPOSED LIMITS
FILTRATION SYSTEMS
REGULATED METALLIC POLLUTANTS
PAGE 2

Derivation of Concentration Values

A. Chromium

30-Day Average Concentration Basis = (0.03)(1.3) = 0.04
Daily Maximum Concentration Basis = (0.03)(4.0) = 0.12

B. Copper

30-Day Average Concentration Basis = (0.03)(1.3) = 0.04
Daily Maximum Concentration Basis = (0.03)(4.0) = 0.12

C. Lead

30-Day Average Concentration Basis = (0.06)(1.3) = 0.08
Daily Maximum Concentration Basis = (0.06)(4.0) = 0.24

D Nickel

30-Day Average Concentration Basis = (0.04)(1.3) = 0.05
Daily Maximum Concentration Basis = (0.04)(4.0) = 0.16

E. Zinc

30-Day Average Concentration Basis = (0.10)(1.3) = 0.13
Daily Maximum Concentration Basis = (0.10)(4.0) = 0.40

Note: For the purposes of developing effluent limitations and standards, the following values were used for all metals except zinc:

Average = 0.10 mg/l
Maximum = 0.30 mg/l

For zinc, the following values have been used:

Average = 0.15 mg/l
Maximum = 0.45 mg/l

All concentration values are in mg/l.

TABLE A-6

LONG-TERM DATA ANALYSIS
CLARIFICATION/SEDIMENTATION SYSTEMS
TOTAL SUSPENDED SOLIDS

Plant	Number of Sample Points	Average (mg/1)	Variability Factors Average	Variability Factors Maximum*
0584E	853	5.2	1.1	2.3
0860B	102	8.9	1.1	2.3
0112-5B	291	9.9	1.3	4.0
0112H-5A	49	11.7	1.2	3.2
0060B	24	14.5	1.2	5.3
0320-5A	151	15.8	1.2	2.3
0384A-5F	97	16.1	1.1	2.8
0684H-5C	74	19.0	1.2	5.4
0060B	24	23.1	1.1	2.5
0684F-5B	380	24.5	1.1	2.4
0584B-5F	98	24.6	1.1	2.3
0920G-5A	195	25.0	1.2	3.1
0584A-5F	101	25.4	1.1	1.8
0384A-5E	383	26.7	1.2	2.5
0856N-5B	101	32.1	1.2	3.2
0856D	17	33.1	1.2	3.4
0112A-5A	175	35.7	1.2	2.5
0684F-5E	528	45.5	1.0	3.6
Median Values		23.8	1.2	2.7

30-Day Average Concentration Basis = (23.8 mg/1) (1.2) = 28.6 mg/1

Daily Maximum Concentration Basis = (23.8 mg/1) (2.7) = 64.3 mg/1

Note: For the purposes of developing effluent limitations and standards, the following values were used for total suspended solids:

Average = 30 mg/1
Maximum = 70 mg/1

*: For plants with more than 100 observations:

$$\text{Daily Variability Factor} = \frac{\text{99th Percentile}}{\text{Average}}$$

TABLE A-7

CLARIFICATION/OIL SKIMMING SYSTEMS OIL AND GREASE

Plant	Number of Sample Points	Average (mg/l)	Variability Factors Average	Variability Factors Maximum*
0320-5A	35	0.1	1.2	4.0
0584E	853	1.6	1.2	3.7
0684F-5E	5	2.8	1.1	2.3
0856D	17	4.0	1.1	1.7
0860B	260	4.8	1.1	3.3
0584A-5F	98	5.9	1.2	6.7
0856N-5B	103	7.0	1.1	2.0
0584B-5F	58	8.4	1.2	2.9
MEDIAN VALUES		4.4	1.2	3.1

30-Day Average Concentration Basis = (4.4 mg/l)(1.2) = 5.3 mg/l
Daily Maximum Concentration Basis = (4.4 mg/l)(3.1) = 13.6 mg/l

Note: For the purposes of developing effluent limitations and standards, the following values were used for oil and grease:

Average = 10 mg/l
Maximum = 30 mg/l

* For plants with more than 100 observations:

$$\text{Daily Variability Factor} = \frac{\text{99th Percentile}}{\text{Average}}$$

TABLE A-8

DATA ANALYSIS
CLARIFICATION/SEDIMENTATION SYSTEMS
REGULATED METALLIC POLLUTANTS

Plant	Subcategory	Number of Sample Points	Average (mg/l)
A. Chromium			
0856D	Forming & Finishing Wastes	17	0.02
0948C	Pickling	3	0.02
NN-2	Galvanizing	3	0.03
0476A	Pickling	3	0.03
0528	Pickling	3	0.03
0584E	Finishing Wastes	853	0.04
0948C	Finishing Wastes	236	0.04
0396A	Pickling	3	0.08
0920E	Galvanizing	3	0.27
0424-01	Pickling	3	1.32
MEDIAN			0.04

30-Day Average Concentration Basis = (0.04 mg/l)(1.2) = 0.05 mg/l
Daily Maximum Concentration Basis = (0.04 mg/l)(3.0) = 0.12 mg/l

Plant	Subcategory	Number of Sample Points	Average (mg/l)
B. Copper			
0948C	Pickling	3	0.02
0476A	Pickling	3	0.03
0528	Pickling	3	0.03
0920E	Galvanizing	3	0.04
0424-01	Pickling	3	0.08
0396A	Pickling	3	0.17
MEDIAN			0.04

30-Day Average Concentration Basis = (0.04 mg/l)(1.2) = 0.05 mg/l
Daily Maximum Concentration Basis = (0.04 mg/l)(3.0) = 0.12 mg/l

Plant	Subcategory	Number of Sample Points	Average (mg/l)
C. Lead			
0856D	Forming & Finishing Wastes	17	0.02
0948C	Pickling	3	0.05
0476A	Pickling	3	0.10
0528	Pickling	3	0.10
0396A	Pickling	3	0.57
0920E	Galvanizing	3	0.60
MEDIAN			0.10

30-Day Average Concentration Basis = (0.10 mg/l)(1.2) = 0.12 mg/l
Daily Maximum Concentration Basis = (0.10 mg/l)(3.0) = 0.30 mg/l

TABLE A-8
DATA ANALYSIS
CLARIFICATION/SEDIMENTATION SYSTEMS
REGULATED METALLIC POLLUTANTS
PAGE 2

Plant	Subcategory	Number of Sample Points	Average mg/l
D. Nickel			
0948C	Pickling	3	0.03
0476A	Pickling	3	0.03
0528	Pickling	3	0.03
0396A	Pickling	3	0.27
0424-01	Pickling	3	2.50
0920E	Galvanizing	3	2.90
MEDIAN			0.15

30-Day Average Concentration Basis = (0.15 mg/l)(1.2) = 0.18 mg/l
Daily Maximum Concentration Basis = (0.15 mg/l)(3.0) = 0.45 mg/l

Plant	Subcategory	Number of Sample Points	Average mg/l
E. Zinc			
0528	Pickling	3	0.02
0424-01	Pickling	3	0.035
0584E	Finishing Wastes	853	0.04
0476A	Pickling	3	0.05
0948C	Finishing Wastes	236	0.05
0948C	Pickling	3	0.07
0856D	Forming & Finishing Wastes	17	0.13
0396A	Pickling	3	0.24
0920E	Galvanizing	3	6.7
MEDIAN			0.05

30-Day Average Concentration Basis = (0.05 mg/l)(1.2) = 0.06 mg/l
Daily Maximum Concentration Basis = (0.05 mg/l)(3.0) = 0.15 mg/l

Note: For the purposes of developing effluent limitations and standards, the following values were used:

For chromium, copper and zinc:

Average = 0.10 mg/l
Maximum = 0.30 mg/l

For nickel:

Average = 0.20 mg/l
Maximum = 0.60 mg/l

For lead:

Average = 0.15 mg/l
Maximum = 0.45 mg/l

TABLE A-9

LONG-TERM DATA ANALYSIS

Plant : 0112B-5A
Subcategory: Hot Forming
Treatment : Filtration

Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
	Daily Maximum Analysis						Monthly Average Analysis	
TSS	87	1.6	24.4	10.6	3.9	2.3	0.7	1.1
Oil & Grease	87	0.2	3.8	1.1	0.6	2.9	0.1	1.1

S_m : Monthly standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: Monthly variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-10

LONG-TERM DATA ANALYSIS

Plant : 0112C-011
Subcategory: Hot Forming
Treatment : Filtration

Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
	Daily Maximum Analysis						30-Day Average Analysis	
TSS	580(2)	0.1	44.0	8.9	7.0	3.5	1.3	1.3
Oil & Grease	690(1)	0.1	47.1	6.7	6.5	5.1	1.2	1.3

(1) 5 observations deleted
(2) 11 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-11

LONG-TERM DATA ANALYSIS

Plant : 0112C-122
Subcategory: Hot Forming
Treatment : Filtration

Pollutant	No. of Obs	Daily Maximum Analysis: Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
TSS	496(2)	0.1	63.4	13.3	12.4	4.0	2.3	1.3
Oil & Grease	684(1)	0.1	20.3	2.0	2.2	5.3	0.4	1.3

(1) 1 observation deleted
(2) 7 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-12

LONG-TERM DATA ANALYSIS

Plant : 0112C-334
Subcategory: Hot Forming
Treatment : Filtration

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	415	0.1	23.5	2.3	3.0	6.8	0.5	1.4
Oil & Grease	727	0.1	12.2	1.3	1.4	5.3	0.3	1.4

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-13

LONG-TERM DATA ANALYSIS

Plant : 0112C-617
Subcategory: Hot Forming
Treatment : Filtration

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	399	0.1	33.8	4.8	5.5	5.4	1.0	1.3
Oil & Grease	647	0.1	7.9	1.3	1.3	4.5	0.3	1.4

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-14

LONG-TERM DATA ANALYSIS

Plant : 01121-5A
Subcategory: Pickling/Alkaline Cleaning
Treatment : Filtration

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	59(2)	0.1	30.0	3.6	6.4	8.9	1.2	1.5
Iron	60(1)	0.1	0.9	0.4	0.2	2.6	0.04	1.2
Chromium	61	0.01	0.06	0.02	0.01	2.9	0.002	1.2
Copper	60(1)	0.01	0.2	0.05	0.04	5.1	0.007	1.2
Zinc	58(3)	0.03	0.3	0.1	0.06	3.0	0.01	1.2
Nickel	27	0.02	0.2	0.07	0.04	3.3	0.007	1.2
Aluminum	27	0.2	0.4	0.2	0.03	1.3	0.006	1.0
Phenol	15	0.0005	0.01	0.006	0.003	4.2	0.0005	1.1

(1) 1 observation deleted
(2) 2 observations deleted
(3) 3 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-15

LONG-TERM DATA ANALYSIS

Plant : 0384A-3E
Subcategory: Continuous Casting
Treatment : Filtration

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	305(1)	1.0	45.0	17.4	9.3	2.5	1.7	1.2

(1) 3 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-16

LONG-TERM DATA ANALYSIS

Plant : 0384A-4L
Subcategory: Continuous Casting
Treatment : Filtration

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	273(2)	1.0	33.0	10.8	7.0	3.0	1.3	1.3
Oil & Grease	275(1)	0.1	28.0	6.7	6.0	3.4	1.1	1.2

(1) 18 observations deleted
(2) 19 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-17

LONG-TERM DATA ANALYSIS

Plant : 0684H-EF
Subcategory: Pipe & Tube
Treatment : Deep Bed Filter

Pollutant	Daily Maximum Analysis: No. of Obs	Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
TSS	40(1)	1.0	21.0	6.0	5.5	5.3	1.0	1.3
Oil & Grease	27	1.0	20.0	3.4	4.0	3.8	0.7	1.4

(1) 1 observation deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-18

LONG-TERM DATA ANALYSIS

Plant : 0684F-41
Subcategory: Hot Forming
Treatment : Lagoon & Filtration

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	78	4.0	60.0	22.2	13.7	3.7	2.5	1.2
Oil & Grease	79(1)	4.0	27.0	9.6	4.3	2.3	0.8	1.1
Ammonia	6(2)	0.1	0.5	0.3	0.2	4.2	0.04	1.2
Cyanide (Total)	6	0.01	0.05	0.02	0.01	3.6	0.002	1.2
Zinc	45(3)	0.03	1.0	0.39	0.23	4.2	0.2	1.2
Chromium	11	0.01	0.09	0.03	0.02	3.6	0.004	1.2
Copper	11	0.01	0.05	0.02	0.01	2.7	0.002	1.1
Nickel	11	0.01	0.2	0.09	0.07	5.6	0.01	1.2

TABLE A-18
LONG-TERM DATA ANALYSIS
PAGE 2

Plant : 0684F-4I
Subcategory: Hot Forming
Treatment : Lagoon & Filtration

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
Phenol	6	0.01	0.4	0.1	0.1	9.0	0.02	1.3
Cadmium	11	0.001	0.009	0.004	0.002	3.4	0.0004	1.2
Iron	9	1.6	10.3	5.4	3.3	3.9	0.6	1.2
Zinc (Diss.)	74 (3)	0.02	3.4	0.5	0.7	7.2	0.6	1.2
Lead	11	0.02	0.06	0.03	0.01	2.0	0.002	1.1

(1) 1 observation deleted
(2) 2 observations deleted
(3) 24 observations deleted**

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

** : These observations were deleted since the hot forming wastewater treatment system was contaminated with the filtrate from sludges removed from a cold rolling, pickling and galvanizing central treatment system. This filtrate contains high zinc concentrations and resulted in NPDES permit violations for the hot forming discharge.

TABLE A-19

LONG-TERM DATA ANALYSIS

Plant : 0112-5B
Subcategory: Ironmaking
Treatment : Polymer/Clarifier

Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
	Daily Maximum Analysis						30-Day Average Analysis	
TSS	291[(1)]	1.0	92.4	9.9	9.2	4.0	1.7	1.3

(1) 7 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-20

LONG-TERM DATA ANALYSIS

Plant : 0112A-5A
Subcategory: Sintering
Treatment : Thickener

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	175(2)	10.0	104.0	35.7	19.7	2.5	3.6	1.2
Ammonia	180	18.0	60.0	34.9	6.9	1.6	1.3	1.1
Cyanide (Total)	180	0.005	0.4	0.1	0.08	3.6	0.1	2.6
Phenol	178(1)	0.006	0.4	0.05	0.06	6.2	0.01	1.3

(1) 2 observations deleted
(2) 5 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-21

LONG-TERM DATA ANALYSIS

Plant : 0112H-5A
Subcategory: Combination Acid Pickling
Treatment : Clarifier/Lagoon

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	49	2.8	25.6	11.7	5.9	3.2	1.1	1.2
Iron	47(2)	0.01	1.4	0.1	0.2	7.3	0.04	1.8
Zinc	49(1)	0.01	1.3	0.2	0.2	11.4	0.04	1.3

(1) 1 observation deleted
(2) 2 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m : 30-Day variability factor
VF_d : Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-22

LONG-TERM DATA ANALYSIS

Plant : 0320-5A
Subcategory: Hot Forming
Treatment : Lagoons

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	151 (1)	0.1	39.0	15.8	7.4	2.3	1.4	1.2
Oil & Grease	35	0.03	0.3	0.1	0.06	4.0	0.01	1.2
Ammonia	146	0.1	14.0	3.3	2.2	2.7	0.4	1.2

(1) 2 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-23

LONG-TERM DATA ANALYSIS

Plant : 0384A-5E
Subcategory: Ironmaking
Treatment : Thickener

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	383(1)	3.0	74.0	26.7	13.8	2.5	2.5	1.2

(1) 4 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-24

LONG-TERM DATA ANALYSIS

Plant : 0384A-5F
Subcategory: Steelmaking, Basic Oxygen Furnace
Treatment : Thickener/Clarifier

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	97	3.0	47.0	16.1	8.3	2.8	1.5	1.1
Iron	22	2.4	21.0	9.5	4.9	2.8	0.9	1.1

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-25

LONG-TERM DATA ANALYSIS

Plant : 0584A-5F
Subcategory: Hot Forming
Treatment : Settling Basin

Pollutant	Daily Maximum Analysis						30-Day Average Analysis	
	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	101(1)	4.0	55.0	25.4	9.1	1.8	1.7	1.1
Oil & Grease	98	0.1	20.6	5.9	4.3	6.7	0.8	1.2

(1) 1 observation deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-26

LONG-TERM DATA ANALYSIS

Plant : 0584B-5F
Subcategory: Hot Forming
Treatment : Lagoons

Pollutant	Daily Maximum Analysis						30-Day Average Analysis	
	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	98(1)	10.0	50.0	24.6	8.6	2.3	1.6	1.1
Oil & Grease	58	2.0	29.0	8.4	4.2	2.9	0.8	1.2

(1) 3 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-27

LONG-TERM DATA ANALYSIS

Plant : 0684F-5B
Subcategory: Ironmaking
Treatment : Clarifier

Pollutant	No. of Obs	Daily Maximum Analysis: Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
TSS	380[1]	6.0	64.0	24.5	11.2	2.4	2.0	1.1

(1) 1 observation deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-28

LONG-TERM DATA ANALYSIS

Plant : 0684F-5E
Subcategory: Ironmaking
Treatment : Clarifier

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	528[4]	4.0	206.0	45.5	34.4	3.6	0.7	1.0
Oil & Grease	5	2.0	4.0	2.8	1.1	2.3	0.2	1.1
Ammonia	61[2]	6.9	67.4	29.5	12.8	2.5	2.3	1.1
Cyanide (Total)	62[1]	0.03	1.9	0.5	0.5	8.3	0.09	1.3
Zinc	5	0.1	0.4	0.2	0.1	3.6	0.02	1.2
Chromium	5	0.01	0.05	0.03	0.01	3.2	0.002	1.1
Copper	5	0.02	0.06	0.04	0.02	2.5	0.004	1.2
Nickel	5	0.03	0.08	0.06	0.02	2.1	0.004	1.1
Phenol	60[3]	0.01	0.3	0.06	0.04	3.2	0.007	1.2

TABLE A-28
LONG-TERM DATA ANALYSIS
PAGE 2

Plant : 0684F-5E
Subcategory: Ironmaking
Treatment : Clarifier

		Daily Maximum Analysis					30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
Cadmium	5	0.006	0.008	0.007	0.0009	1.3	0.0002	1.0
Iron	6	6.2	23.9	14.1	7.4	3.3	1.4	1.2
Lead	5	0.05	0.1	0.08	0.02	2.0	0.004	1.1

(1) 2 observations deleted
(2) 3 observations deleted
(3) 5 observations deleted
(4) 11 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \dfrac{\text{99th Percentile}}{\text{Average}}$

TABLE A-29

LONG-TERM DATA ANALYSIS

Plant : 0684H-5C
Subcategory: Ironmaking
Treatment : Clarifier

Pollutant	No. of Obs	Daily Maximum Analysis: Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
TSS	74(2)	1.0	64.0	19.0	15.4	5.4	2.8	1.2
Ammonia	73(3)	0.1	36.0	13.4	8.0	5.1	1.5	1.2
Cyanide (Total)	75(1)	0.02	6.98	0.8	1.5	9.8	0.3	1.6
Phenol	72(4)	0.008	4.68	1.6	1.2	8.0	0.2	1.2
Iron (Diss.)	76	0.1	0.6	0.2	0.1	2.8	0.02	1.3

(1) 1 observation deleted
(2) 2 observations deleted
(3) 3 observations deleted
(4) 4 observations delted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-30

LONG-TERM DATA ANALYSIS

Plant : 0856N-5B
Subcategory: Hot Forming
Treatment : Settling Basin

Pollutant	No. of Obs	Daily Maximum Analysis: Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
TSS	101(2)	9.0	114.0	32.1	21.6	3.2	3.9	1.2
Oil & Grease	103(1)	1.8	20.3	7.0	2.7	2.0	0.5	1.1
Chromium	43(1)	0.005	0.2	0.06	0.05	7.4	0.009	1.2
Zinc	44	0.04	0.5	0.1	0.1	3.4	0.02	1.2

(1) 1 observation deleted
(2) 3 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m : 30-Day variability factor
VF_d : Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-31

LONG-TERM DATA ANALYSIS

Plant : 0860B
Subcategory: Ironmaking
Treatment : Clarifier

Pollutant	Daily Maximum Analysis: No. of Obs	Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
TSS	102	1.0	26.0	8.9	4.3	2.3	0.8	1.1
Ammonia (N)	102	4.7	98.1	53.1	15.4	1.7	2.8	1.1
Cyanide (Total)	102	0.01	6.2	1.9	1.6	3.3	0.3	1.3
Phenol	102	0.001	0.6	0.04	0.08	6.8	0.01	1.4
Zinc	18	0.1	0.7	0.4	0.2	4.0	0.04	1.2

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-32

LONG-TERM DATA ANALYSIS

Plant : 0920G-5A
Subcategory: Cold Rolling
Treatment : Clarifier

Pollutant	Daily Maximum Analysis						30-Day Average Analysis	
	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	195	2.0	81.0	25.0	13.3	3.1	2.4	1.2

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-33

LONG-TERM DATA ANALYSIS

Plant : 0060B
Subcategory: Combination Acid Pickling
Treatment : Lime/Lagoons

Pollutant	Daily Maximum Analysis: No. of Obs	Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
TSS	24	8.5	49.0	23.1	10.3	2.5	1.9	1.1
Chromium	21(1)	0.02	0.59	0.14	0.15	5.4	0.03	1.4
Nickel	12(2)	0.06	0.55	0.19	0.14	3.8	0.03	1.3

(1) 2 observations deleted
(2) 1 observation deleted

Note: All values are in mg/l unless otherwise noted.

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-34

LONG-TERM DATA ANALYSIS

Plant : 0060B
Subcategory: Combination Acid Pickling
Treatment : Lime/Clarifier

Pollutant	Daily Maximum Analysis: No. of Obs	Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
TSS	24	1.0	36.0	14.5	9.8	5.3	1.8	1.2
Chromium	22 (1)	0.02	0.61	0.28	0.17	5.2	0.03	1.2
Nickel	19 (2)	0.10	0.63	0.25	0.14	2.8	0.03	1.2

(1) 1 observation deleted
(2) 2 observations deleted

Note: All values are in mg/l unless otherwise noted.

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-35

LONG-TERM DATA ANALYSIS

Plant : 0860B
Subcategory: (1)
Treatment : Chemical Addition, Clarifiers

Pollutant	No. of Obs	Daily Maximum Analysis: Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
Oil & Grease	260	1.0	18.0	4.8	2.4	3.3	0.43	1.1
Chromium	260	0.05	0.51	0.06	0.04	2.2	0.008	1.2
Zinc	260	0.05	0.30	0.06	0.02	2.5	0.005	1.1

(1) Treatment system receives wastes from numerous steel forming & finishing operations (pickling, cold rolling, alkaline cleaning, galvanizing, electroplating).

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-36

LONG-TERM DATA ANALYSIS

Plant : 0584E
Subcategory: (1)
Treatment : Chemical Addition, Clarifiers

Pollutant	Daily Maximum Analysis						30-Day Average Analysis	
	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	853	0.99	23.4	5.2	1.4	2.3	0.25	1.1
Oil & Grease	853	ND	15.8	1.6	1.2	3.7	0.22	1.2
Cyanide	853	0.09	0.29	0.10	0.015	1.6	0.003	1.0
Chromium	853	0.01	2.85	0.04	0.10	3.2	0.018	1.8
Fluoride	853	0.10	9.14	0.78	0.80	5.6	0.15	1.3
Iron	853	ND	8.0	0.63	0.46	3.5	0.08	1.2
Zinc	853	0.01	0.56	0.045	0.043	4.7	0.008	1.3

(1) Treatment system receives wastes from numerous steel finishing operations (pickling, cold rolling, alkaline cleaning, hot coating, galvanizing).

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-37

LONG-TERM DATA ANALYSIS

Plant : 0856D
Subcategory: (1)
Treatment : Chemical Addition, Clarifiers

Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
	Daily Maximum Analysis						30-Day Average Analysis	
TSS	17	7.5	88.9	33.1	20.2	3.4	1.18	1.2
Oil & Grease	17	2.2	5.2	4.0	0.90	1.7	0.16	1.1
Chromium	17	ND	0.12	0.02	0.035	4.8	0.006	1.4
Lead	17	ND	0.14	0.018	0.032	3.6	0.006	1.5
Zinc	17	ND	0.45	0.13	0.13	10.5	0.024	1.3

(1) Treatment system receives wastes from numerous steel finishing operations (pickling, galvanizing, alkaline cleaning, electroplating)

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-38

LONG-TERM DATA ANALYSIS

Plant : 0860B
Subcategory: Ironmaking
Treatment : Alkaline Chlorination/Filtration

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	36(1)	0.5	18.0	3.6	4.0	7.1	0.7	1.3
Oil & Grease	39(2)	0.5	4.7	2.5	1.1	3.0	0.2	1.1
Ammonia	37(1)	0.1	16.5	4.5	4.0	7.0	0.7	1.3
Cyanide	36(3)	0.01	0.15	0.02	0.03	4.0	0.006	1.5
Phenol	38(1)	0.001	0.048	0.01	0.01	10.8	0.003	1.5
Zinc	6(2)	0.05	0.15	0.08	0.04	2.4	0.007	1.1

(1) 3 observations deleted
(2) 1 observation deleted
(3) 4 observations deleted

Note: All values are in mg/l unless otherwise noted.

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-39

LONG-TERM DATA ANALYSIS

Plant : 0012A-5F
Subcategory: By-product Cokemaking
Treatment : One-stage Biological

Pollutant	Daily Maximum Analysis: No. of Obs	Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
TSS	292(4)	4.0	220.0	81.6	40.7	2.5	7.4	1.2
Oil & Grease	54	4.0	36.0	18.6	8.2	3.0	1.5	1.1
Ammonia (N)	298(2)	14.0	224.0	61.7	41.6	3.4	7.6	1.2
Cyanide (Total)	173(1)	0.5	6.8	2.6	1.4	2.5	0.3	1.2
Phenol	281(3)	0.008	16.2	0.5	1.7	6.4	0.3	2.0

(1) 1 observation deleted
(2) 2 observations deleted
(3) 4 observations deleted
(4) 7 observations deleted

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-40

LONG-TERM DATA ANALYSIS

Plant : 0060A
Subcategory: By-product Cokemaking
Treatment : Single-Stage Biological Oxidation

Pollutant	Daily Maximum Analysis: No. of Obs	Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
TSS	632	1.00	5551.0	133.1	455.0	13.1	83.1	2.0
Cyanide	214	0.01	18.0	2.93	3.2	5.0	0.58	1.3
Phenols (4AAP)	298	0.001	0.13	0.006	0.009	4.3	0.002	1.5
Ammonia	635	0.20	200.0	21.9	36.5	7.7	6.7	1.5

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-41

LONG-TERM DATA ANALYSIS

Plant : 0868A
Subcategory: By-Product Coke
Treatment : 2-stage Biological

Pollutant	Daily Maximum Analysis: No. of Obs	Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
TSS	1159(1)	4	300	76	59	3.6	10.8	1.2
Ammonia-(N)	1303	0.07	124	7.0	16.8	7.5	3.1	1.7
Cyanide (Total)	1302	0.25	17.1	2.75	2.0	3.6	0.4	1.2
Phenol	1303	0.005	0.246	0.021	0.017	2.8	0.003	1.2
Naphthalene, ppb	21	10.0	10.0	10.0	0.0	1.0	0.0	1.0
Benzo(a)pyrene, ppb	20(2)	10.0	52.0	13.4	10.7	2.6	2.0	1.2
Benzene, ppb	21	10.0	10.0	10.0	0.0	1.0	0.0	1.0

(1) 78 observations deleted
(2) 1 observation deleted

Note: All concentration values are in mg/l unless otherwise noted.

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-42

LONG-TERM DATA ANALYSIS

Plant : 0684F
Subcategory: Cokemaking
Treatment : Phys-Chem (Carbon Columns)

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
Ammonia	103	11.8	860.0	129.8	115.9	5.1	21.2	1.3
Cyanide	102	0.4	68.0	19.8	11.0	3.8	2.0	1.2
Phenol	102	0.001	0.8	0.04	0.1	14.0	0.02	1.9
TSS	104	3.0	146.0	25.6	20.5	4.5	3.7	1.2

Note: All values are in mg/l unless otherwise noted.

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-43

LONG-TERM DATA ANALYSIS

Plant : 0684F
Subcategory: Cold Rolling
Treatment : Gas Flotation

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	104(1)	1.00	66.0	15.8	11.2	3.8	2.0	1.2
Oil & Grease	105	2.0	21.0	7.3	4.3	3.2	0.8	1.2
Benzene	17	ND	0.028	0.003	0.007	4.8	0.001	1.5
Chloroform	17	ND	0.018	0.002	0.004	4.0	0.001	1.8
1,2-trans-dichloroethylene	1	0.13	0.13	0.13	0.00	1.0	0.00	1.0
Methylene Chloride	17	ND	0.042	0.008	0.014	10.3	0.003	1.6
Trichlorofluoromethane	5	0.023	0.16	0.059	0.06	4.7	0.01	1.3
Isophorone	1	0.004	0.004	0.004	0.00	1.0	0.00	1.0
Naphthalene	16	ND	0.092	0.012	0.028	11.8	0.005	1.7
2-Nitrophenol	16	ND	0.013	0.002	0.003	3.6	0.001	1.8
4-Nitrophenol	1	0.47	0.47	0.47	0.00	1.0	0.00	1.0
Phenol	16	ND	0.77	0.093	0.22	15.2	0.04	1.7
Bis(2-ethylhexyl)phthalate	16	ND	0.016	0.002	0.004	4.0	0.001	1.8

TABLE A-43
LONG-TERM DATA ANALYSIS
PAGE 2

Plant : 0684F
Subcategory: Cold Rolling
Treatment : Gas Flotation

Pollutant	No. of Obs	Daily Maximum Analysis Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis S_m	VF_m
Diethyl Phthalate	16	0.024	0.27	0.18	0.06	3.2	0.011	1.1
Dimethyl Phthalate	14	0.05	0.11	0.07	0.03	3.1	0.005	1.1
Tetrachloroethylene	17	ND	0.15	0.035	0.05	14.9	0.009	1.4
Toluene	17	ND	0.032	0.004	0.008	6.8	0.001	1.4
Trichloroethylene	17	ND	0.010	0.002	0.002	3.2	0.00	1.0

(1) 1 observation deleted

Note: All concentration values are in mg/l unless otherwise noted.

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m : 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-44

LONG-TERM DATA ANALYSIS

Plant : 0060
Subcategory: Sintering
Treatment : Filtration (Pilot)

Pollutant	Daily Maximum Analysis						30-Day Average Analysis	
	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	11(1)	1.00	7.0	3.1	1.7	3.0	0.3	1.2
Oil & Grease	6	5.0	9.0	5.7	1.6	1.7	0.3	1.1
Cyanide	12	0.03	0.26	0.13	0.07	3.4	0.01	1.1
Phenol	12	0.01	0.22	0.07	0.06	4.6	0.01	1.2
Chromium	12	0.01	0.43	0.17	0.17	10.0	0.03	1.3
Copper	12	0.02	0.03	0.02	0.00	1.2	0.00	1.0
Nickel	12	0.01	0.02	0.01	0.01	1.9	0.00	1.0
Lead	12	0.02	0.03	0.02	0.00	1.3	0.00	1.0
Zinc	12	0.02	0.47	0.18	0.15	5.8	0.03	1.3

(1) 1 observation deleted

Note: All values are in mg/l unless otherwise noted.

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-45

LONG-TERM DATA ANALYSIS

Plant : 0060
Subcategory: Sintering
Treatment : Lime/Clarifier (Pilot)

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	12	4.0	92.0	47.4	26.3	5.0	4.8	1.2
Oil & Grease	8	1.0	5.0	2.9	1.5	3.5	0.3	1.2
Fluoride	12	12.0	43.0	18.4	8.8	2.2	1.6	1.1
Cyanide	12	0.02	0.11	0.07	0.03	2.8	0.005	1.1
Phenol	12	0.10	0.43	0.2	0.1	2.6	0.02	1.2
Chromium	12	0.03	0.29	0.14	0.08	4.4	0.15	1.2
Nickel	12	0.01	0.03	0.01	0.008	2.4	0.001	1.3
Lead	12	0.02	0.18	0.03	0.05	3.6	0.008	1.4
Zinc	12	0.02	0.08	0.04	0.02	2,5	0.003	1.1

Note: All values are in mg/l unless otherwise noted.

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m : 30-Day variability factor
VF_d : Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-46

LONG-TERM DATA ANALYSIS

Plant : 0060
Subcategory: Sintering
Treatment : Lime/Clarifier/Filter (Pilot)

Pollutant	Daily Maximum Analysis: No. of Obs	Min	Max	Ave	S_d	VF_d*	30-Day Average Analysis: S_m	VF_m
TSS	12	1.0	61.0	9.8	19.7	10.4	3.6	1.6
Oil & Grease	8	1.0	4.0	2.1	1.1	3.2	0.2	1.2
Fluoride	12	11.0	24.0	15.9	4.4	1.8	0.8	1.1
Cyanide	12	0.03	0.11	0.07	0.03	2.3	0.005	1.1
Phenol	12	0.03	0.30	0.15	0.09	3.9	0.02	1.2
Chromium	12	0.02	0.24	0.13	0.08	4.6	0.01	1.2

Note: All values are in mg/l unless otherwise noted.

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m : 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-47

LONG-TERM DATA ANALYSIS

Plant : 0612
Subcategory: Steelmaking - Electric Furnace
Treatment : Filter (Pilot)

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	11	4.0	16.0	9.5	4.7	3.1	0.9	1.2
Cadmium	11	0.05	6.0	1.9	1.6	8.7	0.30	1.3
Chromium	11	0.04	0.5	0.2	0.2	5.7	0.03	1.3
Copper	11	0.04	0.2	0.09	0.04	2.4	0.01	1.2
Nickel	11	0.05	0.5	0.2	0.2	5.4	0.03	1.3
Lead	11	0.10	2.6	1.0	0.7	6.6	0.14	1.2
Zinc	11	1.10	79.0	37.0	28.7	11.1	5.2	1.2

Note: All values are in mg/l unless otherwise noted.

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-48

LONG-TERM DATA ANALYSIS

Plant : 0612
Subcategory: Steelmaking - Electric Furnace
Treatment : Hydroxide/Clarifier (Pilot)

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	8	9.0	33.0	21.9	9.8	3.0	1.8	1.1
Cadmium	8	0.02	0.10	0.04	0.03	3.4	0.01	1.4
Chromium	8	0.07	2.8	1.04	0.9	9.0	0.17	1.3
Copper	8	0.01	0.03	0.03	0.01	2.3	0.00	1.0
Nickel	8	0.05	0.10	0.06	0.02	1.9	0.00	1.0
Lead	8	0.06	0.21	0.14	0.06	3.0	0.01	1.1
Zinc	8	0.23	0.75	0.40	0.17	2.3	0.03	1.1

Note: All values are in mg/l unless otherwise noted.

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m : 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-49

LONG-TERM DATA ANALYSIS

Plant : 0612
Subcategory: Steelmaking, Electric Furnace
Treatment : Lime Precipitation/Filtration (Pilot)

	Daily Maximum Analysis						30-Day Average Analysis	
Pollutant	No. of Obs	Min	Max	Ave	S_d	VF_d*	S_m	VF_m
TSS	12	4.0	14.0	8.8	3.3	2.4	0.6	1.1
Cadmium	12	0.02	0.5	0.07	0.14	5.6	0.03	1.7
Chromium	12	0.05	2.9	0.9	0.9	11.0	0.16	1.3
Copper	12	0.01	0.5	0.08	0.15	8.7	0.03	1.6
Nickel	12	0.05	0.13	0.08	0.03	2.5	0.01	1.2
Lead	12	0.03	0.8	0.23	0.2	4.9	0.04	1.3
Zinc	12	0.1	0.66	0.28	0.15	2.7	0.03	1.2

S_m : 30-Day standard deviation = $S_d/(30)^{.5}$
S_d : Daily standard deviation
VF_m: 30-Day variability factor
VF_d: Daily variability factor

* : For plants with more than 100 observations: $VF_d = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-50

LONG-TERM DATA ANALYSIS

Plant : 0948C
Subcategory: Misc. Finishing Operations[1]
Treatment : Chemical Addition and Clarification

Pollutant	No. of Obs	Daily Maximum Analysis: Min	Max	Ave	Sd	VFd*	30-Day Average Analysis: Sm	VFm
Cyanide	237	0.010	0.21	0.056	0.029	2.8	0.005	1.15
Chromium	236[2]	0.010	0.28	0.040	0.14	5.0	0.025	2.03
Ammonia-N	237	0.30	1.80	0.95	0.29	1.8	0.053	1.09
Oil & Grease	237	1.00	4.00	1.67	0.70	1.8	0.13	1.13
Phenol	237	0.0010	0.14	0.0080	0.009	2.5	0.002	1.41
TSS	237	1.00	41.00	8.84	6.19	3.2	1.13	1.21
Zinc	236[2]	0.010	0.30	0.048	0.069	4.4	0.013	1.44

(1) Treatment system receives waste from numerous steel finishing operations (pickling, cold rolling, hot coating and tin mills).
(2) One observation deleted.

Sm : 30-day standard deviation = $Sd/(30)^{0.5}$
Sd : Daily standard deviation
VFm: 30-day variability factor
VFd: Daily variability factor
* : For plant with more than 100 observations: $VFd = \frac{\text{99th Percentile}}{\text{Average}}$

TABLE A-51

STANDARD DEVIATION OF THE 30-DAY AVERAGES

$$S^* = [\ \mathrm{Var}\ (\bar{X}_n)]^{1/2}$$

where, $\mathrm{Var}\ (\bar{X}_n) = \dfrac{S^2}{n^2} \left[n + 2 \sum_{k=1}^{n-1} (n-k)\ r_k \right]$

$$S^2 = \sum_{i=1}^{N} \frac{(X_i - \bar{x})^2}{N-1}$$

$$r_k = \frac{\sum_{j=1}^{N-k} (X_j - \bar{x})\ (X_j + k - \bar{x})\ /\ (N-k)}{\sum_{i=1}^{N} (X_i - \bar{x})^2\ /\ (N-1)}$$

FIGURE A-1
LOG-PROBABILITY PLOT
PLANT 0112C-334
FILTRATION

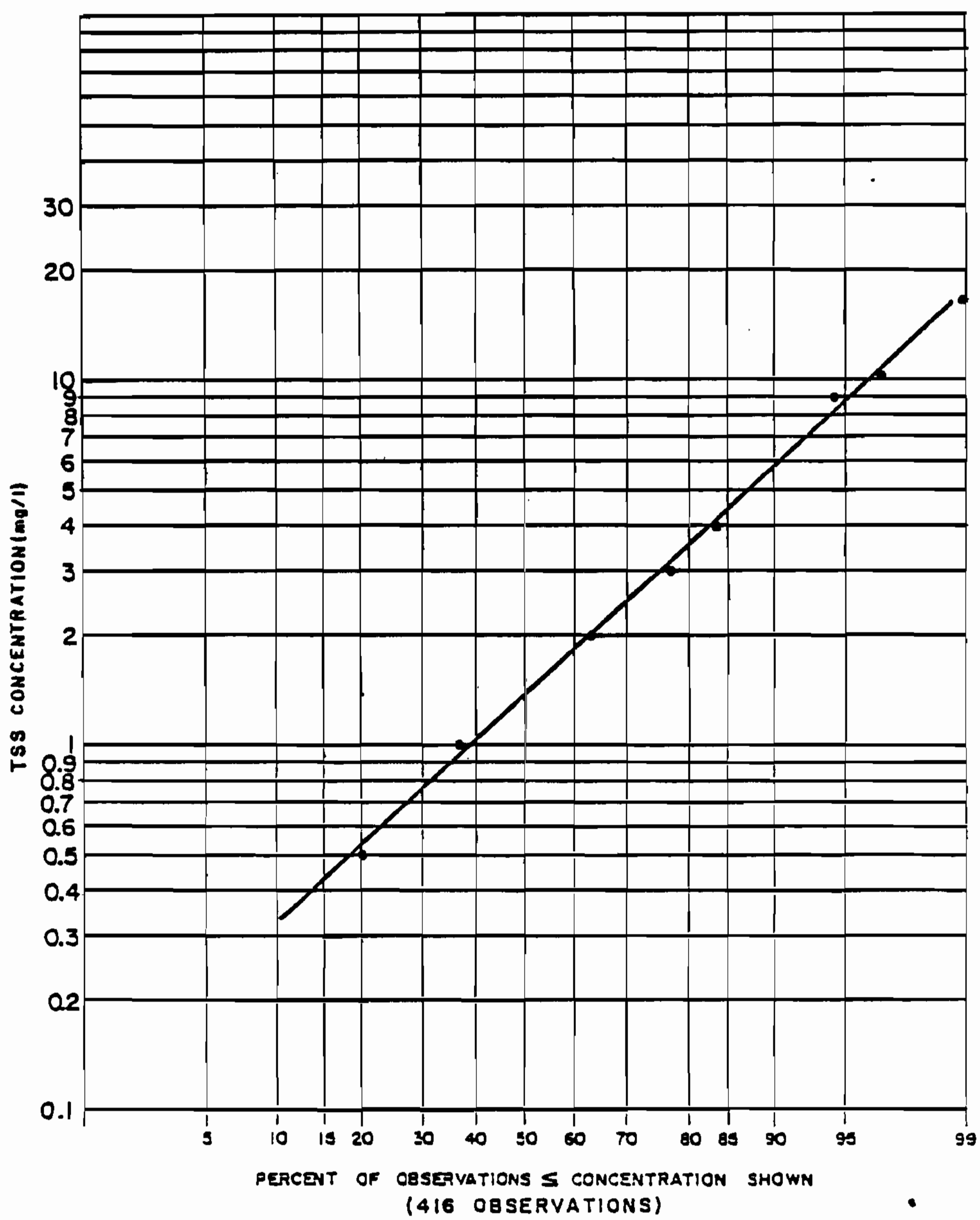


FIGURE A-2
LOG-PROBABILITY PLOT
PLANT 0112C-334
FILTRATION

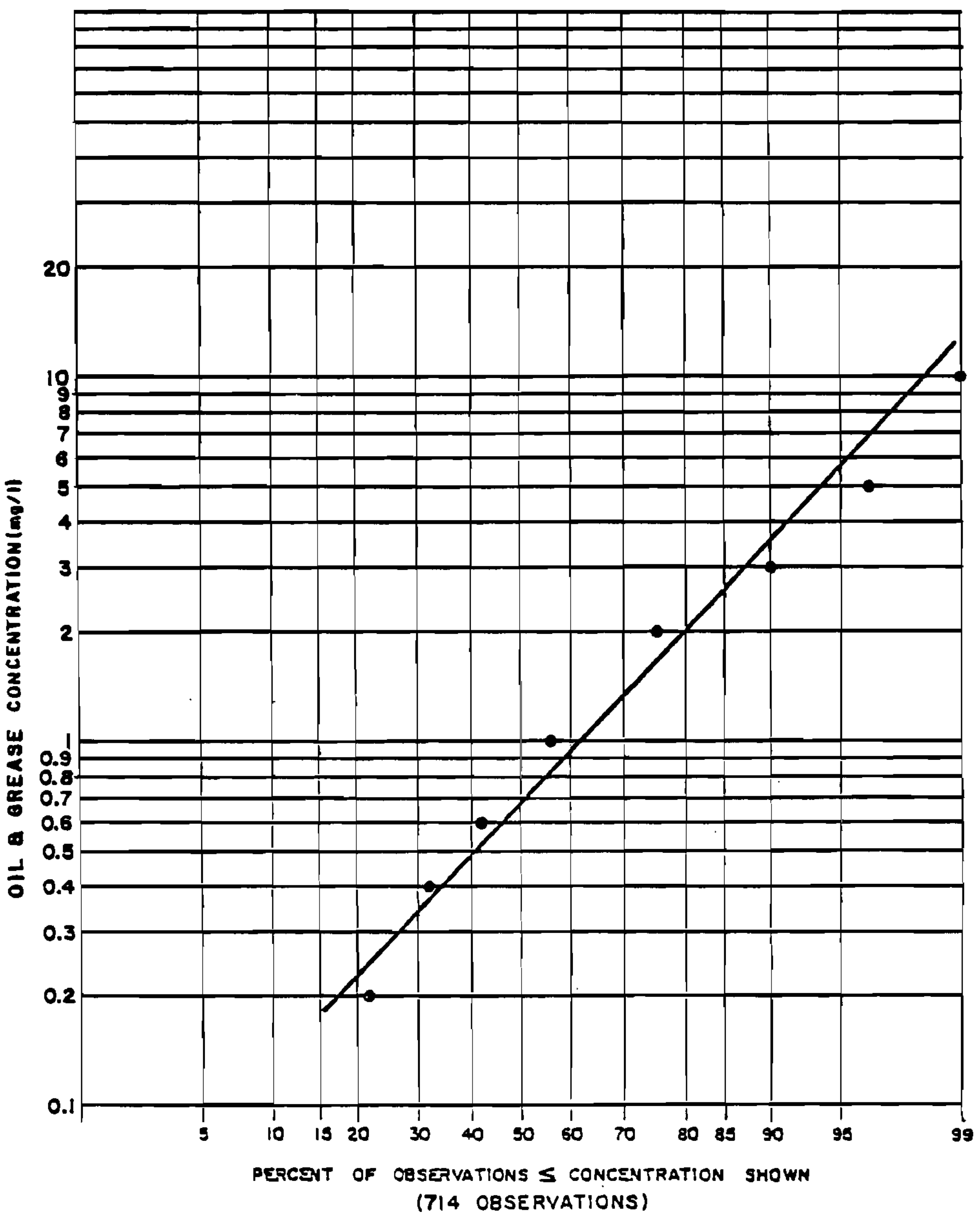


FIGURE A-3
LOG-PROBABILITY PLOT
PLANT 0684H-5C
CLARIFIER

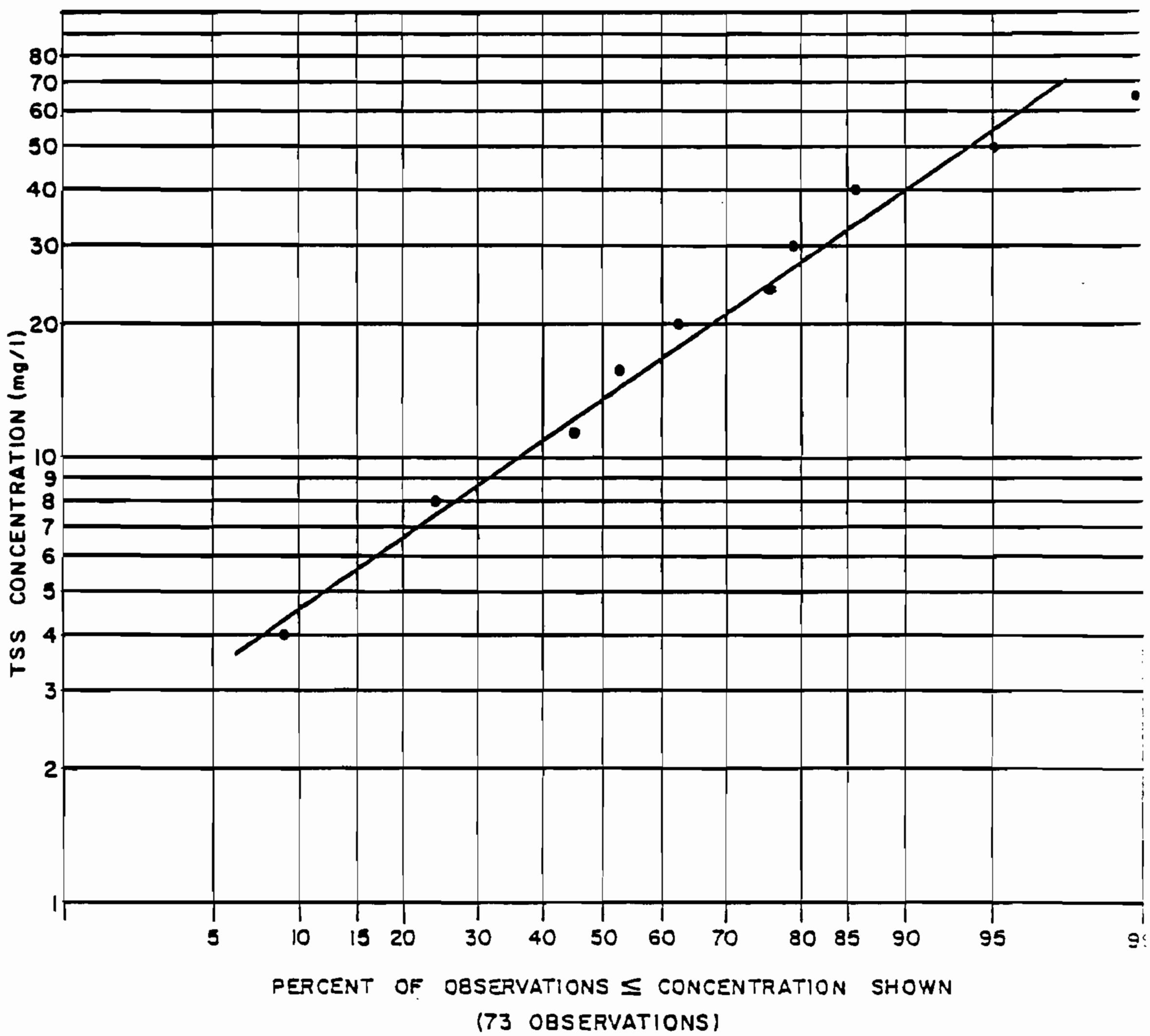
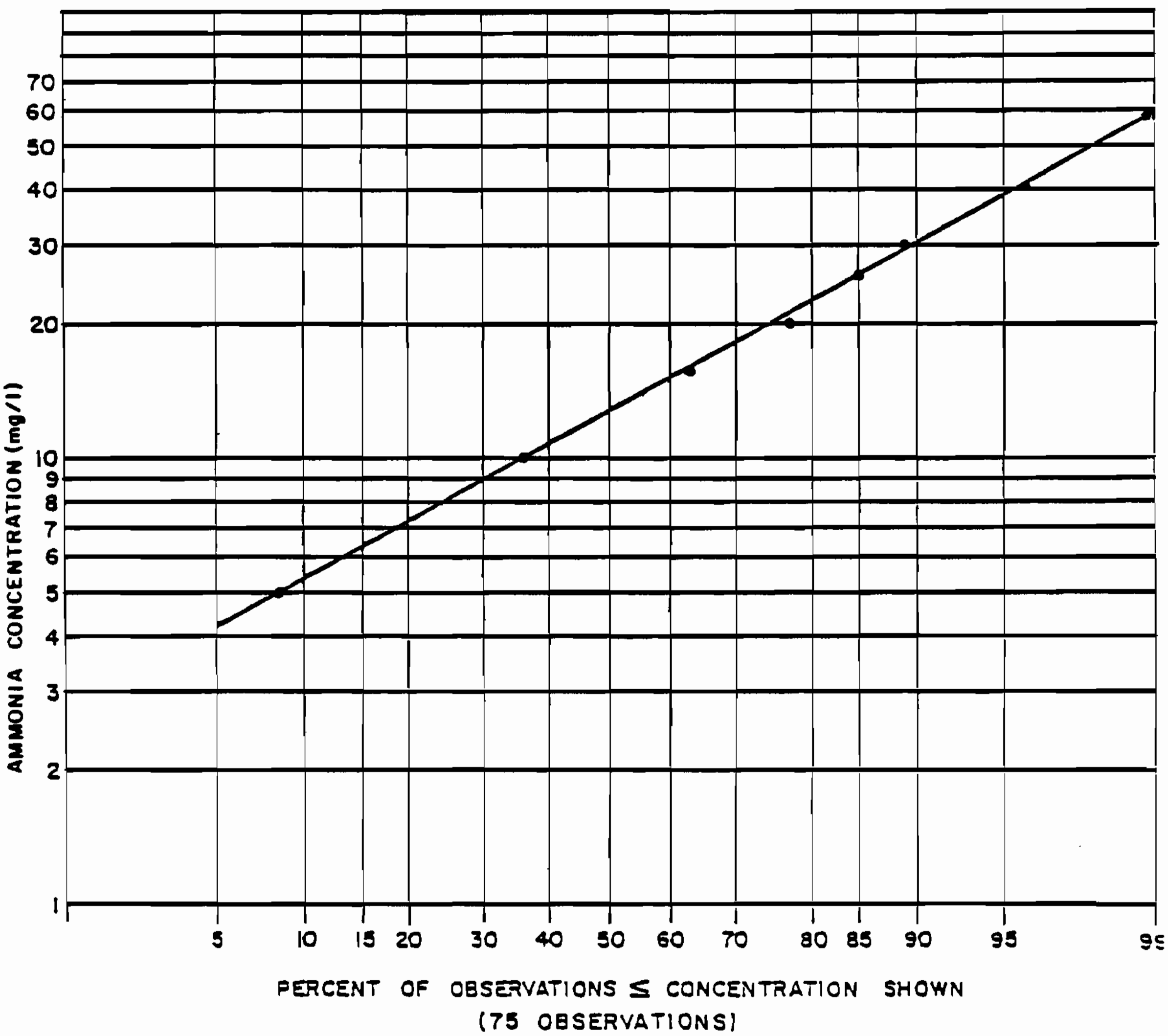


FIGURE A-4
LOG-PROBABILITY PLOT
PLANT 0684H-5C
CLARIFIER



VOLUME I

APPENDIX B

IRON AND STEEL PLANT INVENTORY

IRON AND STEEL PLANT INVENTORY

PLANT CODE	COMPANY / PLANT NAME CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0004	ACCO BRIDGEPORT	CT	06602		NO	
A	PAGE FENCE DIVISION MONESSEN	PA	15062		NO	
B	AMERICAN CHAIN DIVISION YORK	PA	17403		NO	
C	CABLE CONTROLS DIVISION ADRIAN	MI	49221		NO	
0008	ADCOM METALS COMPANY, INC. JACKSONVILLE	FL	32202		NO	
A	ADCOM METALS COMPANY, INC. NICHOLASVILLE	KY	40356		NO	
B	CONTAINER WIRE PRODUCTS COMPANY JACKSONVILLE	FL	32202		NO	
0012	ALABAMA BY-PRODUCTS CORPORATION BIRMINGHAM	AL	35202		YES	
A	TARRANT COKE PLANT TARRANT	AL	35217	A	YES	
B	KEYSTONE COKE CONSHOHOCKEN	PA	19428	A	YES	FORMERLY 0016A
0016	ALAN WOOD STEEL COMPANY CONSHOHOCKEN	PA	19428	D1	YES	
A						SEE 0012B
B	ALAN WOOD STEEL COMPANY IVY ROCK	PA	19248		NO	
C	ALAN WOOD COATED METALS CORNWELLS HEIGHTS	PA	19020		NO	
0020	ALLEGHENY LUDLUM STEEL CORPORATION PITTSBURGH	PA	15222		YES	
A	ALLEGHENY LUDLUM STEEL CORPORATION PITTSBURGH	PA	15222		NO	

PLANT CODE	COMPANY / PLANT NAME	CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0020 B	BRACKENRIDGE PLANT	BRACKENRIDGE	PA	15014	D1,D3,E,G1,G3,H,I1,I3, J1	YES	
C	WEST LEECHBURG PLANT	LEECHBURG	PA	15656	I2,I3,J1	YES	
D	BAR PRODUCTS DIVISION	DUNKIRK	NY	14048		NO	
E	BAR PRODUCTS DIVISION	WATERVLIET	NY	12189		NO	
F	AJAX FORGING & CASTING COMPANY	FERNDALE	MI	48220		NO	
G	SPECIAL METALS CORPORATION	NEW HARTFORD	NY	13413		NO	
H	WALLINGFORD STEEL	WALLINGFORD	CT	06492		NO	
I	ARNOLD ENGINEERING COMPANY	MARENGO	IL	60152	D3	YES	
J	CARMET COMPANY	PITTSBURGH	PA	15222		NO	
K	ALJAX STEEL CORPORATION	BUFFALO	NY	14207	D3	YES	
L	NEW CASTLE PLANT	NEW CASTLE	IN	47362	I3,J1	YES	
0024	ALLIED CHEMICAL CORPORATION	MORRISTOWN	NJ	07960		NO	
A	ASHLAND COKE PLANT	ASHLAND	KY	41101	A	YES	
B	DETROIT COKE PLANT	DETROIT	MI	48231	A	NO	
C							SEE 0402
D							SEE 0810

PLANT CODE	COMPANY / PLANT NAME	CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0028	ALLIED TUBE & CONDUIT CORPORATION	HARVEY	IL	60426		NO	
0032	AMERICAN CAST IRON PIPE COMPANY	BIRMINGHAM	AL	35202		YES	
A	ACIPCO STEEL PRODUCTS DIVISION	BIRMINGHAM	AL	35207	D3	YES	
0036	AMERICAN COMPRESSED STEEL CORPORATION	CINCINNATI	OH	45202		NO	
0040	AMERICAN HOIST & DERRICK COMPANY	ST. PAUL	MN	55107		NO	
A	BAY CITY STEEL CASTINGS DIVISION	BAY CITY	MI	48706	D3	YES	
0044	AMERON, INC.	MONTEREY PARK	CA	91754		YES	
A	AMERON STEEL & WIRE DIVISION	ETIWANDA	CA	91739	D3,F	YES	
0048	AMPCO-PITTSBURGH CORPORATION	MILWAUKEE	WI	53201		NO	
A	WYCKOFF STEEL DIVISION	PITTSBURGH	PA	15219		NO	
B	WYCKOFF STEEL DIVISION	AMBRIDGE	PA	15003		NO	
C	WYCKOFF STEEL DIVISION	PLYMOUTH	MI	48170		NO	
D	WYCKOFF STEEL DIVISION	CHICAGO	IL	60690		NO	
E	WYCKOFF STEEL DIVISION	NEWARK	NJ	07102		NO	
F	WYCKOFF STEEL DIVISION	PUTNAM	CT	06260	I1	YES	
0052	AMSTED INDUSTRIES, INC.	CHICAGO	IL	60690		NO	

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0052	A	MAC WHYTE COMPANY KENOSHA	WI	53140		NO	
0056		ANGELL NAIL & CHAPLET COMPANY CLEVELAND	OH	44105		NO	
0060		ARMCO STEEL CORPORATION MIDDLETOWN	OH	45043	A,B,C,D1,D2,E,F,G1,G3, I2,I3,J1,J2,L1,L2	YES	
	A	HAMILTON PLANT HAMILTON	OH	45011	A,C	YES	
	B	ASHLAND WORKS ASHLAND	KY	41101	B,C,D1,G1,G3,I2,J1,L1	YES	
	C	AMBRIDGE WORKS AMBRIDGE	PA	15003	G2,G4,I1	YES	
	D	BUTLER WORKS BUTLER	PA	16001	D3,E,F,G1,G3,H,I1,I2,I3 J1,K	YES	
	E	ZANESVILLE PLANT ZANESVILLE	OH	43701	I3,J1	YES	
	F	HOUSTON WORKS HOUSTON	TX	77015	A,B,C,D3,E,G1,G2,G3,G4	YES	
	G	KANSAS CITY WORKS KANSAS CITY	MO	64125	D3,G1,G2,I1,L1	YES	
	H	SAND SPRING WORKS SAND SPRING	OK	74063	D3,F,G2	YES	
	I	BALTIMORE WORKS BALTIMORE	MD	21203	D3,G1,G2,H,I3,J1	YES	
	J	NATIONAL SUPPLY COMPANY TORRANCE	CA	90509	D3,E	YES	
	K	MARION WORKS MARION	OH	43302	D3,F,G2	YES	
	L	HITCO DIVISION ATLANTA	GA	30318	I2	YES	
	M	LEGGET & PLATT DIVISION CARTHAGE	MO	64836	I1	YES	

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0060	N	ADVANCED MATERIALS DIVISION	HOUSTON	TX	77044	I3,J2,K	YES	
	O	TUBE ASSOCIATES	HOUSTON	TX	77028		NO	
	P	WILDWOOD PLANT	WILDWOOD	FL	32785	I3,J2	YES	
	Q	UNION WIRE ROPE						
	R	MIDDLETOWN FABRICATING	MIDDLETOWN	OH	45042	G4,L1	YES	
	S	UNION WIRE ROPE	KANSAS CITY	MO	84126	I1,L1	YES	
0064		BARNES GROUP, INC.	BRISTOL	CT	06010		NO	
	A	WALLACE BARNES STEEL DIVISION	BRISTOL	CT	06010		NO	
0068		ATLANTIC STEEL COMPANY	ATLANTA	GA	30301	D3,G1,G2,I1,I2,I3,K,L1	YES	
	A	ATLANTA BUILDING SYSTEMS, INC.	ATLANTA	GA	30301		NO	
	B	CARTERSVILLE FACILITY	CARTERSVILLE	GA	30120	D3,F,G2	YES	
0072		ATLANTIC WIRE COMPANY	BRANFORD	CT	08405		NO	
0076		AUBURN STEEL COMPANY, INC.	AUBURN	NY	13021	D3,F	YES	
0080		AUTOMATION INDUSTRIES, INC.	LOS ANGELES	CA	90002		NO	
	A	HARRIS TUBE DIVISION	LOS ANGELES	CA	90002	G4	YES	
	B	SOUTHWEST STEEL DRILLING MILLS, INC.	LOS ANGELES	CA	90002	D3	YES	

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0084	AZCON CORPORATION	KNOXVILLE	TN	37921		NO	
A	KNOXVILLE IRON DIVISION	KNOXVILLE	TN	37921	D3,F	NO	
0088	BABCOCK & WILCOX	NEW YORK	NY	10017		NO	
A	TUBULAR PRODUCTS DIVISION	BEAVER FALLS	PA	15010	D3,E,G1,G2,G4,I1,I2,I3, K	YES	
B	TUBULAR PRODUCTS DIVISION	ALLIANCE	OH	44601	I1	YES	
C	TUBULAR PRODUCTS DIVISION	MILWAUKEE	WI	53201	G4,I3,K	YES	
D	TUBULAR PRODUCTS DIVISION	BEAVER FALLS	PA	15010	G1,G2,I2,I3	YES	
0092	BARON DRAWN STEEL CORPORATION	TOLEDO	OH	43607		NO	
0096	BARRY STEEL CORPORATION	DETROIT	MI	48238		NO	
0104	BEKAERT STEEL WIRE CORPORATION	NEW YORK	NY	10017		NO	
A	BEKAERT STEEL WIRE CORPORATION	RUME	GA	30161		NO	
B	BEKAERT STEEL WIRE CORPORATION	RENO	NV	89501		NO	
C	BEKAERT STEEL WIRE CORPORATION	ACWORTH	GA	30101		NO	
0108	BERGER INDUSTRIES, INC.	MASPETH	NY	11378		NO	
A	BERGER INDUSTRIES, INC.	METUCHEN	NJ	08840		NO	
0112	BETHLEHEM STEEL CORPORATION	BETHLEHEM	PA	18016	A,B,C,D1,D3,E,G1,G2,I1	YES	

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0112 A	SPARROWS POINT PLANT	SPARROWS POINT	MD	21219	A,B,C,D1,D2,G1,G2,G3, I1,I3,J1,J2,K,L1	YES	
B	LACKAWANNA PLANT	BUFFALO	NY	14219	A,B,C,D1,D2,E,G1,G2,G3, I1,I2,J1,L1	YES	
C	JOHNSTOWN PLANT	JOHNSTOWN	PA	15907	A,B,C,D2,G1,G2,G3,I1, I3,K	YES	
D	BURNS HARBOR PLANT	CHESTERTON	IN	46304	A,B,C,D1,F,G1,G3,I1,I2, J1,K	YES	
E	STEELTON PLANT	STEELTON	PA	17113	D3,G1,G2,J2	YES	
F	LOS ANGELES PLANT	LOS ANGELES	CA	90051	D3,G1,G2,I1,K,L1	YES	
G	SEATTLE PLANT	SEATTLE	WA	98124	D3,G1,G2,I1,L1	YES	
H	WILLIAMSPORT PLANT	WILLIAMSPORT	PA	17701	I2,I3,L1	YES	
I	LEBANON PLANT	LEBANON	PA	17042	G2,I1,K,L1	YES	
J	SAN FRANCISCO PLANT	SAN FRANCISCO	CA	94080	G2	YES	
K	MORGANTOWN PLANT	MORGANTOWN	PA	19543		NO	
0116	BIRDSBORO CORPORATION	BIRDSBORO	PA	19508	D3	YES	
0120	BISHOP TUBE COMPANY	FRAZER	PA	19355		NO	
0124	BLAIR STRIP STEEL COMPANY	NEW CASTLE	PA	16103		NO	
0128	BLISS & LAUGHLIN INDUSTRIES, INC.	OAK BROOK	IL	60521		NO	
A	BLISS & LAUGHLIN STEEL COMPANY, DIVISION	HARVEY	IL	60426		NO	

PLANT CODE		COMPANY / PLANT NAME / CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0128	B	BLISS & LAUGHLIN STEEL COMPANY, DIVISION DETROIT	MI	48089		NO	
	C	BLISS & LAUGHLIN STEEL COMPANY, DIVISION MEDINA	OH	44256		NO	
	D	BLISS & LAUGHLIN STEEL COMPANY, DIVISION LOS ANGELES	CA	90040		NO	
	E	BLISS & LAUGHLIN STEEL COMPANY, DIVISION SEATTLE	WA	98108		NO	
	F	BLISS & LAUGHLIN STEEL COMPANY, DIVISION HOUSTON	TX	77011		NO	
0132		BORDER STEEL MILL, INC. VINTON	TX	79912	D3,F	YES	
0136		BORG-WARNER CORPORATION CHICAGO	IL	60604		NO	
	A	BORG-WARNER STEEL, INC. CHICAGO HEIGHTS	IL	60411		NO	
	B	CALUMET STEEL COMPANY CHICAGO HEIGHTS	IL	60411	D3,F,G2	YES	
	C	FRANKLIN STEEL COMPANY FRANKLIN	PA	16323	G2	YES	
	D						SEE 0430C
	E	INGERSOLL PRODUCTS DIVISION CHICAGO	IL	60643		NO	
0140		BORTZ COAL COMPANY UNIONTOWN	PA	15401		NO	
	A	BORTZ COAL COMPANY SMITHFIELD	PA	15478		NO	
0144		BUCKEYE STEEL CASTINGS COMPANY COLUMBUS	OH	43215	D3	YES	
0148		BUCYRUS-ERIE COMPANY SOUTH MILWAUKEE	WI	53172	D3	YES	

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0148 A	GLASSPORT PLANT GLASSPORT	PA	15045	D2,D3	YES	SHUTDOWN
0152	BUNDY CORPORATION DETROIT	MI	48226		NO	
A	BUNDY CORPORATION WINCHESTER	KY	40391		NO	
B	BUNDY CORPORATION COLDWAVE	MI	49036		NO	
C	BUNDY CORPORATION MT. CLEMENS	MI	48043		NO	
D	BUNDY CORPORATION WARREN	MI	48089		NO	
E	BUNDY CORPORATION HOMETOWN	PA	18252		NO	
F	BUNDY CORPORATION CYNTHIANA	KY	41031		NO	
G	BUNDY CORPORATION MALVERN	PA	19355		NO	
0156	CABOT CORPORATION BOSTON	MA	02110		NO	
A	MACHINERY DIVISION PAMPA	TX	79065	D3,E	YES	
B	STELLITE DIVISION KOKOMO	IN	46901	B,D3	YES	
0160	CALIFORNIA STEEL & TUBE CITY OF INDUSTRY	CA	91744		NO	
0164	CAL-METAL CORPORATION IRWINDALE	CA	91706		NO	
0168	CAMERON IRON WORKS, INC. HOUSTON	TX	77001	D3,E	YES	
0172	G.O. CARLSON, INC. THORNDALE	PA	19372		NO	

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0174	CARONDELET COKE CORPORATION	ST. LOUIS	MO	63111	A	YES	FORMERLY 0348A
0176	CARPENTER TECHNOLOGY CORPORATION	READING	PA	19601	D3,G1,G2,G3,H,I1,I2,I3, J1,K	YES	
A	CARPENTER STEEL DIVISION	BRIDGEPORT	CT	06607	D3	YES	
B	CARPENTER STEEL DIVISION	READING	PA	19601		NO	
C	UNION PLANT TUBE DIVISION	UNION	NJ	07083	I3,J2	YES	
D	JAMESBURG PLANT TUBE DIVISION	CRANBURY	NJ	08512	I3,J2	YES	SHUTDOWN
0180	CASCADE STEEL ROLLING MILLS, INC.	MCMINNVILLE	OR	97128	D3,F	NO	
0184	CAVERT WIRE COMPANY, INC.	UNIONTOWN	PA	15401		NO	
0188	CECO CORPORATION	CHICAGO	IL	60650		NO	
A	LEMONT MANUFACTURING COMPANY	LEMONT	IL	60439	D3,G1	YES	
B	MILTON MANUFACTURING COMPANY	MILTON	PA	17847	D3,G1,G2	YES	
C	SOUTHERN ELECTRIC STEEL COMPANY	BIRMINGHAM	AL	35202	D3,F,G2	YES	
0192	CENTRAL STEEL TUBE COMPANY	CLINTON	IA	52732		NO	
0196	CF&I STEEL CORPORATION	PUEBLO	CO	81002		NO	
A	PUEBLO PLANT	PUEBLO	CO	81004	A,B,C,D1,D3,F,G1,G2,G4, I1,L1	YES	
0200	CHAMPION STEEL COMPANY	ORWELL	OH	44076		NO	

PLANT CODE		COMPANY / PLANT NAME	CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0204		CHAPARAL STEEL COMPANY	MIDLOTHIAN	TX	76065	D3,F	YES	
0208		CHRISTIE COAL & COKE COMPANY	NORTON	VA	24273		NO	
0212		CITIZENS GAS & COKE UTILITY	INDIANAPOLIS	IN	46202	A	YES	
0216		COLUMBIA STEEL CASTING COMPANY, INC.	PORTLAND	OR	97203	D3	YES	
0220		COLUMBIA TOOL STEEL COMPANY	CHICAGO HEIGHTS	IL	60411		NO	
0224		COLUMBIAN STEEL TANK COMPANY	KANSAS CITY	MO	64101		NO	
0226		COMMERCIAL METALS, INC.	DALLAS	TX	75247	D3,F	YES	FORMERLY 0764
	A	ARKANSAS STEEL ROLLING MILLS, INC.	MAGNOLIA	AR	71753		NO	FORMERLY 0764A
0228		CONSOLIDATED METALS CORPORATION	NEWTON	NJ	07860		NO	
0232		CONSTELLATION STEEL MILL EQUIPMENT CORP.	CINCINNATI	OH	45216		NO	
0236		CONTINENTAL COPPER & STEEL INDUSTRIES	CRANFORD	NJ	07016		NO	
	A	BRADBURN ALLOY STEEL DIVISION	LOWER BURRELL	PA	15068	D3	YES	
0240		COPPERWELD CORPORATION	PITTSBURGH	PA	15219		NO	
	A	COPPERWELD STEEL COMPANY	WARREN	OH	44482	D3,E,F,G1,G2,I1	YES	
	B	OHIO STEEL TUBE COMPANY	SHELBY	OH	44875	G4,I1,K	YES	
	C	REGAL TUBE COMPANY	CHICAGO	IL	60638	G4,I1,K	YES	

PLANT CODE		COMPANY / PLANT NAME CITY , STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0240	D	BIMETALLICS DIVISION GLASSPORT PA 15045		NO	
	E	FLEXCO WIRE DIVISION OSWEGO NY 13126		NO	
0244		COREY STEEL COMPANY CICERO IL 60650		NO	
0248		COLT INDUSTRIES NEW YORK NY 10022		NO	
	A	ALLOY DIVISION MIDLAND PA 15059	A,C,D1,G1,G2,I1	YES	
	B	STAINLESS STEEL DIVISION MIDLAND PA 15059	D3,E,F,H,I3,J1	YES	
	C	SPECIALTY METALS DIVISION GEDDES NY 13209	G1,G2,I3,J1,K	YES	
	D	TRENT TUBE DIVISION EAST TROY WI 53120		NO	
	E	TRENT TUBE DIVISION FULLERTON CA 92634		NO	
	F	TRENT TUBE DIVISION CARROLLTON GA 30117		NO	
	G	TRENT TUBE DIVISION BREMEN GA 30110		NO	
0252		CUMBERLAND STEEL COMPANY CUMBERLAND MD 21502		NO	
0256		CYCLOPS CORPORATION PITTSBURGH PA 15228		NO	
	A	DETROIT STRIP DIVISION DETROIT MI 48217	I1,J1	YES	
	B	DETROIT STRIP DIVISION NEW HAVEN CT 06507	I1,J1	YES	
	C	EMPIRE DETROIT STEEL DIVISION MANSFIELD OH 44901	D1,D3	YES	

354

PLANT CODE		COMPANY / PLANT NAME CITY STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0256	D	EMPIRE DETROIT STEEL DIVISION DOVER OH 44622		NO	
	E	EMPIRE DETROIT STEEL DIVISION PORTSMOUTH OH 45662	A,C,D2	YES	
	F	SAWHILL TUBULAR DIVISION WHEATLAND PA 16161	I1,I3,J2	YES	
	G	SAWHILL TUBULAR DIVISION SHARON PA 16146	G4,I1,L1	YES	
	H	SAWHILL TUBULAR DIVISION MINNEAPOLIS MN 55406		NO	
	I	TEX-TUBE DIVISION HOUSTON TX 77007		NO	
	J	UNIVERSAL CYCLOPS SPECIALTY STEEL DIV. PITTSBURGH PA 15228		NO	
	K	BRIDGEVILLE PLANT BRIDGEVILLE PA 15017	D3,G1,G2,H	YES	
	L	PITTSBURGH PLANT PITTSBURGH PA 15201	G3,H,I3,J1	YES	
	M	ALIQUIPPA FORGE DEPARTMENT ALIQUIPPA PA 15001		NO	
	N	TITUSVILLE PLANT TITUSVILLE PA 16354	D3,G2,H,I3,J1,K	YES	
	O	COSHOCTON PLANT COSHOCTON OH 43812	H,I3,J1,K	YES	
0260		DAMASCUS STEEL CASTING COMPANY NEW BRIGHTON PA 15066	D3	YES	
0264		DAVIS WALKER CORPORATION LOS ANGELES CA 90040		NO	
	A	DAVIS WALKER CORPORATION CITY OF INDUSTRY CA 91744		NO	
	B	DAVIS WALKER CORPORATION RIVERSIDE CA 92501		NO	

PLANT CODE		COMPANY / PLANT NAME CITY STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0264	C	DAVIS WALKER CORPORATION KENT WA 98031		NO	
0272		DONNER-HANNA COKE CORPORATION BUFFALO NY 14220	A	NO	
0276		DONOVAN STEEL TUBE COMPANY TOLEDO OH 43611		NO	
0280		EASTERN GAS & FUEL ASSOCIATION PHILADELPHIA PA 19137		NO	
	A	EASTERN ASSOCIATION COAL CORPORATION PITTSBURGH PA 15219		NO	
	B	PHILADELPHIA COKE DIVISION PHILADELPHIA PA 19137	A	YES	
0284		EASTMET CORPORATION COCKEYSVILLE MD 21030		NO	
	A •	EASTERN STAINLESS STEEL COMPANY BALTIMORE MD 21224	F,G3,H,I3,J1	YES	
0288		EDGEWATER CORPORATION OAKMONT PA 15139		NO	
	A	EDGEWATER STEEL COMPANY OAKMONT PA 15139	D3	YES	
	C	JANNEY CYLINDER COMPANY PHILADELPHIA PA 19136		NO	
0292		EDWARDS COMPANY, E.H. SAN FRANCISCO CA 94080		NO	
0296		ELECTRALLOY CORPORATION NEW YORK NY 10019		NO	
	A	ELECTRALLOY CORPORATION OIL CITY PA 16301		NO	
0300		ELLIOT BROTHERS STEEL COMPANY NEW CASTLE PA 16103		NO	
0304		EMPIRE COKE COMPANY HOLT AL 35401		NO	

356

PLANT CODE	COMPANY / PLANT NAME	CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0308	EMPIRE STEEL CASTINGS, INC.	READING	PA	19603		NO	
A	EMPIRE STEEL CASTINGS, INC.	TEMPLE	PA	19560		NO	
0312	FITZSIMMONS STEEL COMPANY	YOUNGSTOWN	OH	44501		NO	
0316	FLORIDA STEEL CORPORATION	TAMPA	FL	33623	D3,F,G2	YES	
A	INDIANTOWN STEEL MILL DIVISION	INDIANTOWN	FL	33456	D3,F,G2	YES	
B	CHARLOTTE STEEL MILL DIVISION	CHARLOTTE	NC	28213	D3,F,G2	YES	
C	JACKSONVILLE STEEL MILL DIVISION	JACKSONVILLE	FL	32234	G2	YES	
0320	FORD MOTOR COMPANY	DEARBORN	MI	48121	A,C,D1,D3,G1,G2,G3,I2, J1	YES	
0324	FORT HOWARD STEEL & WIRE	GREEN BAY	WI	54305		NO	
0328	FOSBRINK MACHINE COMPANY	CONNELLSVILLE	PA	15425		NO	
0332	GENERAL CABLE CORPORATION	GREENWICH	CT	06830		NO	
A	INDIANA STEEL & WIRE DIVISION	MUNCIE	IN	47302		NO	
0336	GENERAL MOTORS CORPORATION	DETROIT	MI	48202		NO	
A	GENERAL MOTORS CORPORATION	WAUKEGAN	IL	60085		NO	
0340	GENERAL STEEL INDUSTRIES, INC.	ST. LOUIS	MO	63105		NO	
A	NATIONAL ROLL DIVISION	AVONMORE	PA	15618	D3	NO	

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0344	GILBERT & BENNETT MANUFACTURING COMPANY GEORGETOWN CT 06829		NO	
A	GILBERT & BENNETT MANUFACTURING COMPANY BLUE ISLAND IL 60406		NO	
B	COATINGS ENGINEERING CORPORATION SUDBURY MA 01776		NO	
0348	GREAT LAKES CARBON CORPORATION NEW YORK NY 10017		NO	
A				SEE 0174
0352	GREER STEEL COMPANY DOVER OH 44622		NO	
A	GREER STEEL COMPANY FERNDALE MI 48220		NO	
0356	HARSCO CORPORATION CAMP HILL PA 17011		NO	
A	HARRISBURG STEEL COMPANY HARRISBURG PA 17105		NO	
B	QUAKER ALLOY CASTING COMPANY MYERSTOWN PA 17067	D3	YES	
0360	HAWAIIAN WESTERN STEEL LTD. EWA HI 96706	D3	YES	
0364	HEPPENSTALL COMPANY PITTSBURGH PA 15201		NO	
A	MIDVALE-HEPPENSTALL PHILADELPHIA PA 19140		NO	
0368	HOOVER BALL & BEARING COMPANY SOLON OH 44139		NO	
A	CUYAHOGA STEEL & WIRE DIVISION SOLON OH 44139		NO	
0372	HYDE PARK FOUNDRY & MACHINE COMPANY HYDE PARK PA 15641		NO	

PLANT CODE	COMPANY / PLANT NAME	CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0376	IGOE BROTHERS, INC.	NEWARK	NJ	07114		NO	
0380	INDIANA GAS & CHEMICAL CORPORATION	TERRE HAUTE	IN	47808		NO	
0384	INLAND STEEL COMPANY	CHICAGO	IL	60603		NO	
A	INDIANA HARBOR WORKS	EAST CHICAGO	IN	46312	A,B,C,D1,D2,D3,F,G1,G2, G3,I1,I2,J1,K,L1	YES	
0388	INTERCOASTAL STEEL CORPORATION	CHESAPEAKE	VA	23324		NO	
A	GILMERTON PLANT	CHESAPEAKE	VA	23323	D3	YES	
0392	INTERCONTINENTAL STEEL CORPORATION	CHICAGO	IL	60628		NO	
0396	INTERLAKE, INC.	OAK BROOK	IL	60521		NO	
A	IRON & STEEL DIVISION	SOUTH CHICAGO	IN	60617	A,B,C	YES	
C	TOLEDO PLANT	TOLEDO	OH	43605	A,C	YES	SHUTDOWN,COKEMAKING SOLD TO 0464
D	RIVERDALE STATION	RIVERDALE	IL	60627	D1,G1,G2,G3,I2,J1	YES	
E	NEWPORT MILDER PLANT	NEWPORT	KY	41072	D3,G1,G4,I1,J1	YES	
F	GARY STEEL SUPPLY COMPANY	BLUE ISLAND	IL	60406		NO	
G	BEVERLY PLANT	BEVERLY	OH	45715		NO	
H	ALABAMA METALLURGICAL CORPORATION	SELINA	AL	36701		NO	
I	HOEGANAES CORPORATION	RIVERTON	NJ	08077		NO	

PLANT CODE		COMPANY / PLANT NAME CITY STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0400					SEE 0946
	A				SEE 0946A
0402		IRONTON COKE COMPANY IRONTON OH 45638	A	YES	FORMERLY 0024C
0404		ITT HARPER, INC. MORTON GROVE IL 60053	D3	NO	
0408		IVY STEEL & WIRE COMPANY JACKSONVILLE FL 32205		NO	
0412		JACKSON IRON & STEEL COMPANY JACKSON OH 45640		NO	
0416		JAMES STEEL & TUBE COMPANY ROYAL OAK MI 48067		NO	
	A	JAMES STEEL & TUBE COMPANY MADISON HEIGHTS MI 48071		NO	
0420		JERSEY SHORE STEEL COMPANY JERSEY SHORE PA 17740		NO	
	A	JERSEY SHORE STEEL COMPANY SOUTH AVIS PA 17721		NO	
0424		JESSOP STEEL COMPANY WASHINGTON PA 15301	D3,G1,G2,G3,H,I3	YES	
	A	GREEN RIVER STEEL OWENSBORO KY 42301	D3,E	YES	
0426		JIM WALTER RESOURCES BIRMINGHAM AL 35202	A,C	YES	FORMERLY 0848
0428		JEWELL SMOKELESS COAL CORPORATION KNOXVILLE TN 37902		NO	
	A	JEWELL SMOKELESS COAL CORPORATION VANSANT VA 24656		NO	
0430		JOHNSON STEEL & WIRE COMPANY WORCESTER MA 01607		NO	FORMERLY 0920H

360

PLANT CODE	COMPANY / PLANT NAME	CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0430 A	AKRON PLANT	AKRON	OH	44309		NO	FORMERLY 0920I
B	LOS ANGELES PLANT	LOS ANGELES	CA	90059		NO	FORMERLY 0920J
C	INGERSOLL STEEL	NEW CASTLE	IN	47362	D3,G1,G3	YES	FORMERLY 0136D
0432	JONES & LAUGHLIN STEEL CORPORATION	PITTSBURGH	PA	15230		YES	
A	ALIQUIPPA WORKS	ALIQUIPPA	PA	15001	A,B,C,D1,F,G1,G2,G3,I1, J1,J2,K,L1	YES	
B	PITTSBURGH WORKS	PITTSBURGH	PA	15203	A,C,D2,G1,G2,G3,I1,J1, L1	YES	
C	CLEVELAND WORKS	CLEVELAND	OH	44101	B,C,D1,D3,G1,G3,I2,J1	YES	
D	HENNEPIN WORKS	HENNEPIN	IL	61327	I2,J1,L1	YES	
E	OIL CITY WORKS	OIL CITY	PA	16301	I1,I3	YES	
F	JONES & LAUGHLIN STEEL CORPORATION	GAINESVILLE	TX	76240		NO	
G	JONES & LAUGHLIN STEEL CORPORATION	MUNCY	PA	17756		NO	
H	JONES & LAUGHLIN STEEL CORPORATION	HAMMOND	IN	46320		NO	
I	JONES & LAUGHLIN STEEL CORPORATION	WILLIMANTIC	CT	06226		NO	
J	WARREN PLANT	WARREN	MI	48090	D3,G1,G2	YES	
K	JONES & LAUGHLIN STEEL CORPORATION	LOUISVILLE	OH	44641		NO	
L	YOUNGSTOWN WORKS	YOUNGSTOWN	OH	44501	H,I1,I3	YES	

PLANT CODE		COMPANY / PLANT NAME CITY STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0432	M	INDIANAPOLIS WORKS INDIANAPOLIS IN 46241	I1	YES	
	N	JONES & LAUGHLIN STEEL CORPORATION LOS ANGELES CA 90052		NO	
	O	JONES & LAUGHLIN STEEL CORPORATION NILES OH 44446		NO	
	P	JONES & LAUGHLIN STEEL CORPORATION NEW KENSINGTON PA 15068		NO	
0436		JORGENSEN COMPANY, E.M. LOS ANGELES CA 90054	D3,E	YES	
0440		JOSLYN MANUFACTURING & SUPPLY COMPANY CHICAGO IL 60606		NO	
	A	JOSLYN STAINLESS STEELS DIVISION FORT WAYNE IN 46804	D3,G1,G2,H,I3	YES	
0444		JUDSON STEEL CORPORATION EMERYVILLE CA 94608	D3,F	NO	
0448		KAISER STEEL CORPORATION OAKLAND CA 94612		NO	
	A	STEEL MANUFACTURING DIVISION FONTANA CA 92335	A,B,C,D1,D2,G1,G2,G3,G4 ,I2,J1,K,L1	YES	
	B	KAISER STEEL CORPORATION NAPA CA 94558		NO	
0452		KENNAMETAL, INC. LATROBE PA 15650		NO	
0456		KENTUCKY ELECTRICAL STEEL COMPANY ASHLAND KY 41101		NO	
	A	KENTUCKY ELECTRICAL STEEL COMPANY ASHLAND KY 41101	D3,F	YES	
0460		KEYSTONE CONSOLIDATED INDUSTRIES, INC. PEORIA IL 61601		YES	
	A	KEYSTONE STEEL AND WIRE PEORIA IL 61641	D3,F,G1,G2,I2,L1	YES	

PLANT CODE		COMPANY / PLANT NAME CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0460	B	KEYSTONE STEEL AND WIRE CHICAGO HEIGHTS	IL	60411	G2	YES	
	C	SANTA CLARA PLANT SANTA CLARA	CA	95052	I1,L1	YES	
	D	MID-STATES STEEL AND WIRE CRAWFORDSVILLE	IN	47933	I1,K,L1	YES	
	E	JACKSONVILLE PLANT JACKSONVILLE	FL	32201	I1,L1	YES	
	F	MID-STATES STEEL AND WIRE SHERMAN	TX	75091	I1,L1	YES	
	G	GREENVILLE PLANT GREENVILLE	MS	38701	I1,K,L1	YES	
	H	CHICAGO STEEL AND WIRE CHICAGO	IL	60617	I1,K,L1	YES	
0464		KOPPERS COMPANY, INC. PITTSBURGH	PA	15219		YES	
	A	ORGANIC MATERIALS DIVISION PITTSBURGH	PA	15219		NO	
	B	ST. PAUL DIVISION ST. PAUL	MN	55104	A	YES	
	C	ERIE DIVISION ERIE	PA	16512	A	YES	
	D	ORGANIC MATERIALS DIVISION KEARNY	NJ	07032		NO	
	E	WOODARD COKE BESSEMER	AL	35020	A	YES	
0468		KORF INDUSTRIES, INC. CHARLOTTE	NC	28280		NO	
	A	MIDREX CORPORATION CHARLOTTE	NC	28280		NO	
	B	GEORGETOWN STEEL CORPORATION GEORGETOWN	SC	29440	D3,F,G2	YES	

PLANT CODE	COMPANY / PLANT NAME	CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0468 C	GEORGETOWN FERREDUCTION CORPORATION	GEORGETOWN	SC	29440		NO	
D	ANDREWS WIRE CORPORATION	ANDREWS	SC	29510		NO	
E	ANDREWS WIRE OF TENNESSEE	GALLATIN	TN	37066		NO	
F	GEORGETOWN TEXAS STEEL CORPORATION	BEAUMONT	TX	77704	D3,F	NO	
0472	MICHAEL KRAL INDUSTRIES, INC.	NEW YORK	NY	10019		NO	
A	KOKOMO TUBE COMPANY	KOKOMO	IA	46901		NO	
B	VENANGO METALLURGICAL PRODUCTS	OIL CITY	PA	16301		NO	
0476	LACLEDE STEEL COMPANY	ST. LOUIS	MO	63102		YES	
A	ALTON PLANT	ALTON	IL	62002	D3,F,G1,G2,G3,G4,I3,K, L1	YES	
B	MADISON PLANT	MADISON	IL	62060		NO	
C	BEAUMONT PLANT	BEAUMONT	TX	77706		NO	
D	DALLAS PLANT	DALLAS	TX	75206		NO	
E	MEMPHIS PLANT	MEMPHIS	TN	38107		NO	
F	NEW ORLEANS PLANT	NEW ORLEANS	LA	70126		NO	
G	TAMPA PLANT	TAMPA	FL	33611		NO	
0480	LASALLE STEEL COMPANY	CHICAGO	IL	60680		NO	

PLANT CODE		COMPANY / PLANT NAME	CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0480	A	HAMMOND PLANT	HAMMOND	IN	46327		NO	
	B	KEYSTONE DRAWN STEEL COMPANY	SPRING CITY	PA	19475		NO	
	C	FLUID POWER DIVISION	CHICAGO	IL	60680		NO	
	D	FLUID POWER DIVISION	GRIFFITH	IN	46319		NO	
0488		LOFLAND STEEL MILL, INC.	OKLAHOMA CITY	OK	73108		NO	
0492		LONE STAR STEEL COMPANY	DALLAS	TX	75235		NO	
	A	LONE STAR STEEL COMPANY	LONE STAR	TX	75668	A,B,C,D2,G1,G3,I1,J2,K, L1	YES	
	B	LONE STAR STEEL COMPANY	FORT COLLINS	CO	80521		NO	
0496		LUKENS STEEL COMPANY	COATESVILLE	PA	19320	D3,E,F,I3	YES	
0500		MADISON WIRE COMPANY	BUFFALO	NY	14220		NO	
0504		MAGNA CORPORATION	FLOWOOD	MS	39208		YES	
	A	MISSISSIPPI STEEL DIVISION	FLOWOOD	MS	39208	D,F	YES	
0508		MARATHON MANUFACTURING COMPANY	HOUSTON	TX	77002		NO	
	A	MARATHON LETOURNEAU COMPANY	LONGVIEW	TX	75601	D3	YES	
	B	MARATHON STEEL COMPANY	PHOENIX	AZ	85005		NO	
	C	ROLLING MILL DIVISION	TEMPE	AZ	85282	D3	YES	

PLANT CODE	COMPANY / PLANT NAME CITY STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0512	MARKIN TUBING, INC. WYOMING NY 14591		NO	
0516	MARYLAND SPECIALTY WIRE, INC. COCKEYSVILLE MD 21030		NO	
0520	MCCONWAY AND TORLEY CORPORATION PITTSBURGH PA 15201	D3	YES	
0524	MCINNES STEEL COMPANY CORRY PA 16407		NO	
0528	MCLOUTH STEEL CORPORATION DETROIT MI 48209	H,J1,K	YES	
A	TRENTON PLANT TRENTON MI 48183	C,D1,D3,F,G1,G3,I1	YES	
B	GIBRALTAR PLANT GIBRALTAR MI 48173	I2,J1	YES	
0532	MEAD CORPORATION DAYTON OH 45402		NO	
B	CHATTANOOGA DIVISION CHATTANOOGA TN 37401		NO	
0536	MERCER ALLOYS CORPORATION GREENVILLE PA 16125		NO	
0538	MERCIER CORPORATION BIRMINGHAM MI 48001		NO	
A	ERIE COKE AND CHEMICAL COMPANY FAIRPORT HARBOR OH 44077		NO	
0540	MERIDIAN INDUSTRIES, INC. SOUTHFIELD MI 48075		NO	
A	FORMED TUBES, INC. STURGIS MI 49091		NO	
B	FORMED TUBES, INC. HALEYVILLE AL 35565		NO	
C	FORMED TUBES, INC. ALBION IN 46701		NO	

PLANT CODE	COMPANY / PLANT NAME CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0544	MESTA MACHINE COMPANY PITTSBURGH	PA	15230		NO	
A	MESTA MACHINE COMPANY PITTSBURGH	PA	15230	D2,D3	YES	
B	MESTA MACHINE COMPANY NEW CASTLE	PA	16101		NO	
0548						SEE 0678
A						SEE 0678A
B						SEE 0678B
C						SEE 0678C
D						SEE 0678D
E						SEE 0678E
0552	MID-AMERICA STEEL CORPORATION CLEVELAND	OH	44127		NO	
0556	MID-WEST WIRE COMPANY CLEVELAND	OH	44104		NO	
0560	MINNEAPOLIS ELECTRIC STEEL CASTINGS CO. MINNEAPOLIS	MN	55421	D3	YES	
0564	MISSOURI ROLLING MILL CORPORATION ST. LOUIS	MO	63143		NO	
0568	MOLTRUP STEEL PRODUCTS COMPANY BEAVER FALLS	PA	15010		NO	
0572	MSL INDUSTRIES, INC. PIQUA	OH	45356		NO	
A	MIAMI INDUSTRIES, DIVISION PIQUA	OH	45356		NO	

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0576	NATIONAL FORGE COMPANY IRVINE PA 16329	D3,E	YES	
A	ERIE DIVISION ERIE PA 16512	D3,E	YES	
0580	NATIONAL STANDARD COMPANY NILES MI 49120	I1,I2,I3,K	YES	
A	WOVEN PRODUCTS DIVISION CORBIN KY 40701	I2,K,L1	YES	
B	MT. JOY PLANT MT. JOY PA 17552	I2,K	NO	
C	ATHENIA STEEL DIVISION CLIFTON NJ 07015	I1,I2,J1	YES	
D	COLUMBIANA PLANT COLUMBIANA AL 35051	I2,K	NO	
E	AKRON PLANT AKRON OH 44310	I2,K	NO	
F	LOS ANGELES PLANT LOS ANGELES CA 90001	I2	NO	
G	WORCESTER WIRE DIVISION WORCESTER MA 01603	I3,K,L1	YES	
0584	NATIONAL STEEL PITTSBURGH PA 15219		YES	
A	GREAT LAKES STEEL DIVISION DETROIT MI 48229	D1,D3,G1,I2,J1	YES	
B	GREAT LAKES STEEL DIVISION DETROIT MI 48229	A,B,C,G3	YES	
C	GRANITE CITY STEEL DIVISION GRANITE CITY IL 62040	A,B,C,D1,G1,G3,I2,J1,L1	YES	
D	THE HANNA FURNACE CORPORATION BUFFALO NY 14240	C	YES	
E	MIDWEST STEEL DIVISION PORTAGE IN 46368	I1,J1,K,L1	YES	

PLANT CODE	COMPANY / PLANT NAME CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0584 F	WEIRTON STEEL WEIRTON	WV	26062	A,B,C,D1,E,F,G1,G2,G3,I1,J1,L1	YES	
G	STEUBENVILLE PLANT STEUBENVILLE	PA	43952		NO	
H	NATIONAL PIPE AND TUBE LIBERTY	TX	77575	J2	YES	
0588	NAYLOR PIPE COMPANY CHICAGO	IL	60619		NO	
0592	NEW ENGLAND HIGH CARBON WIRE CORPORATION MILLBURY	MA	01527		NO	
0596	NEW JERSEY STEEL & STRUCTURAL CORPORATION SAYREVILLE	NJ	08872	D3,F	YES	
0600	NEWMAN-CROSBY STEEL, INC. PAWTUCKET	RI	02861		NO	
0604	NEWPORT NEWS SHIP BUILDING & DRYDOCK CO. NEWPORT NEWS	VA	23607		NO	
0608	NORTH STAR STEEL COMPANY ST. PAUL	MN	55165		NO	
A	WILTON PLANT WILTON	IA	52778	D3,F	YES	
0612	NORTHWESTERN STEEL AND WIRE COMPANY STERLING	IL	61081	D3,G1,G2,I1,I2,L1	YES	
0616	NORTHWEST STEEL ROLLING MILLS, INC. SEATTLE	WA	98107		NO	
A	KENT PLANT KENT	WA	98031	D3	YES	
0620	NUCOR CORPORATION CHARLOTTE	NC	28211		NO	
A	NUCOR STEEL DARLINGTON	SC	29532	D3,F	YES	
B	NUCOR STEEL NORFOLK	NC	68701	D3,F	YES	

PLANT CODE		COMPANY / PLANT NAME CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0620	C	NUCOR STEEL JEWETT	TX	75846	D3,F	YES	
0624		GILMORE STEEL CORPORATION PORTLAND	OR	97208		YES	
	A	OREGON STEEL MILLS DIVISION PORTLAND	OR	97209		NO	
	B	RIVERGATE PLANT PORTLAND	OR	97203	D3	YES	
0628		OWEN ELECTRIC STEEL OF SOUTH CAROLINA COLUMBIA	SC	29202		NO	
	A	OWEN ELECTRIC STEEL OF SOUTH CAROLINA CAYCE	SC	29033	D3	YES	
0632		PACIFIC STATES STEEL CORPORATION UNION CITY	CA	94587		NO	
0636		PACIFIC TUBE COMPANY LOS ANGELES	CA	90040	G4,I1,I3,K	YES	
0640		PENN-DIXIE STEEL COMPANY KOKOMO	IN	46901	D3,G1,G2,I1,L1	YES	
	A	PENN-DIXIE STEEL COMPANY JOLIET	IL	60434		NO	
	B	ENTERPRISE WIRE COMPANY BLUE ISLAND	IL	60406		NO	
	C	HAUSMAN CORPORATION KOKOMO	IN	46901		NO	
	D	HAUSMAN CORPORATION DENVER	CO	80203		NO	
	E	CENTERVILLE DIVISION CENTERVILLE	IA	52544	D3	YES	
0644		PETTIBONE CORPORATION CHICAGO	IL	60651		NO	
0648		PHILADELPHIA STEEL AND WIRE COMPANY PHILADELPHIA	PA	19154		NO	

PLANT CODE	COMPANY / PLANT NAME CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0652	PHOENIX STEEL CORPORATION			D3,F	YES	
	CLAYMONT	DE	19703			
A	PHOENIX STEEL CORPORATION			G1,G2,G4	YES	
	PHOENIXVILLE	PA	19460			
0656	PICKANDS MATHER AND COMPANY				NO	
	CLEVELAND	OH	44114			
A	MILWAUKEE SOLVAY COKE COMPANY			A	YES	
	MILWAUKEE	WI	53204			
0660	PIPER INDUSTRIES, INC.				NO	
	MEMPHIS	TN	38113			
A	PIPER INDUSTRIES, INC.				NO	
	ST. LOUIS	MO	63155			
B	PIPER INDUSTRIES, INC.				NO	
	GREENVILLE	MS	38701			
0664	PITTSBURGH TUBE COMPANY				NO	
	MONACA	PA	15061			
A	PITTSBURGH INTERNATIONAL CORPORATION				NO	
	FAIRBURY	IL	61739			
0668	PORTEC, INC.				NO	
	OAK BROOK	IL	60521			
A	TROY PLANT				NO	
	TROY	NY	12180			
B	FORGINGS DIVISION				NO	
	CANTON	OH	44701			
C	MEMPHIS PLANT				NO	
	MEMPHIS	TN	38128			
0672	CONNORS STEEL COMPANY				NO	
	BIRMINGHAM	AL	35212			
A	CONNERS STEEL DIVISION			D3,F,G2	YES	
	BIRMINGHAM	AL	35212			
B	WEST VIRGINIA WORKS			D3,F,G1,G2	YES	
	HUNTINGTON	WV	25706			

PLANT CODE	COMPANY / PLANT NAME CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0674	PLYMOUTH TUBE COMPANY WINFIELD	IL	60190		YES	FORMERLY 0884
A	ELLWOOD IVINS PLANT HORSHAM	PA	19044		NO	FORMERLY 0884A
B	PLYMOUTH TUBE DIVISION WINFIELD	IL	60190		NO	FORMERLY 0884B
C	WINAMAC PLANT WINAMAC	IN	46996	G4,I1	YES	FORMERLY 0884C
D	STREATOR PLANT STREATOR	IL	61364	I1	YES	FORMERLY 0884D
E	PLYMOUTH TUBE DIVISION DUNKIRK	NY	14048	G4,I3	YES	FORMERLY 0884E
F	PLYMOUTH TUBE DIVISION HORSHAM	PA	19044	I3	YES	FORMERLY 0884F
G	BIRMINGHAM PLANT PINSON	AL	35126	I1	YES	FORMERLY 0884G
H	WEST MONROE PLANT WEST MONROE	LA	71291	G4	YES	FORMERLY 0884H
0676	PREDCO, INC. PENNSAUKEN	NJ	08110		NO	
A	PRECISION STEEL DIVISION PENNSAUKEN	NJ	08110		NO	
B	SOUTHERN PRECISION STEEL COMPANY GULFPORT	MS	39501		NO	
C	COMPRESSED STEEL SHAFTING COMPANY, INC. READVILLE	MA	02136		NO	
0678	QUANEX COPORATION HOUSTON	TX	77056	G4	NO	FORMERLY 0548
A	GULF STATES TUBE CORPORATION DIVISION ROSENBERG	TX	77471	G4,I3,K	YES	FORMERLY 0548A
B	THE STANDARD TUBE COMPANY DETROIT	MI	48239	G4,I1,I3,K	NO	FORMERLY 0548B

PLANT CODE	COMPANY / PLANT NAME CITY STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0678 C	THE STANDARD TUBE COMPANY SHELBY OH 44875	G4	YES	FORMERLY 0548C
D	MAC STEEL COMPANY, DIVISION JACKSON MI 48201	D3,F	NO	FORMERLY 0548D
E	U.S. BROACH AND MACHINE COMPANY DETROIT MI 48234		NO	FORMERLY 0548E
0680	RAMCO STEEL, INC. BUFFALO NY 14240		NO	
0684	REPUBLIC STEEL CLEVELAND OH 44101		YES	
*	YOUNGSTOWN MANUFACTURING YOUNGSTOWN OH 44545	K	YES	
A	YOUNGSTOWN WORKS YOUNGSTOWN OH 44501	A,C,G1,G2,J2,L1	YES	
B	WARREN WORKS WARREN OH 44181	A,B,C,D1,G1,G3,I2,J1,L1 ,L2	YES	
C	NILES WORKS NILES OH 44446	I1,J1,K	YES	SHUTDOWN
D	MASSILLON WORKS MASSILLON OH 44646	A,G1,G2,I1,I3,J1	YES	
E	CANTON SOUTH WORKS CANTON OH 44706	D3,E,F,G1,G2,I1	YES	
F	CLEVELAND DISTRICT WORKS CLEVELAND OH 44127	A,C,D1,D2,G1,G2,G3,I2,J 1	YES	
G	BUFFALO WORKS BUFFALO NY 14220	C,D1,G1,G2,I1	YES	
H	CHICAGO DISTRICT WORKS CHICAGO IL 60617	A,C,D2,D3,E,G1,G2,G4,I1	YES	
I	SOUTHERN DISTRICT GADSDEN AL 35901	A,B,C,D1,G1,G3,I2,J1,L1	YES	
J	THOMAS WORKS BIRMINGHAM AL 35202	A	YES	

PLANT CODE	COMPANY / PLANT NAME	CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0684 K	STEEL AND TUBE DIVISION	CLEVELAND	OH	44108	I2,I3,J2	YES	
L	STEEL AND TUBE DIVISION	ELYRIA	OH	44035	G4	YES	
M	STEEL AND TUBE DIVISION	FERNDALE	MI	48220	G4	YES	
N	STEEL AND TUBE DIVISION	BROOKLYN	NY	11237	G4,I1	YES	
O	STEEL AND TUBE DIVISION	COUNCE	TN	38326	G4	YES	
P	UNION DRAWN DIVISION	MASSILLON	OH	44646	I1,I3	YES	
Q	UNION DRAWN DIVISION	BEAVER FALLS	PA	15010	I1	YES	
R	UNION DRAWN DIVISION	GARY	IN	46401		NO	
S	UNION DRAWN DIVISION	EAST HARTFORD	CT	06108		NO	
T	UNION DRAWN DIVISION	LOS ANGELES	CA	90052		NO	
U	A. FINKE AND SONS COMPANY	CHICAGO	IL	60614	D3,E	YES	
V	CANTON WORKS	CANTON	OH	44706	G3,H,I1,I3	YES	
W	GEORGIA TUBING	CEDAR SPRINGS	GA	31732	G4	YES	
X	INDUSTRIAL PRODUCTS DIVISION	CANTON	OH	44705	K	YES	
Y	DRAINAGE PRODUCTS DIVISION	CANTON	OH	44705	I1,K,L1	YES	
Z	NILES DOOR PLANT	NILES	OH	44446	K	YES	

PLANT CODE	COMPANY / PLANT NAME CITY STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0688	REVERE COPPER AND BRASS, INC. NEW YORK NY 10016		NO	
A	ROME MANUFACTURING COMPANY DIVISION ROME NY 13440		NO	
0692	RMI COMPANY NILES OH 44446		NO	
A	RMI COMPANY ASHTABULA OH 44004		NO	
0696	ROBLIN INDUSTRIES, INC. BUFFALO NY 14202		NO	
A	ROBLIN STEEL COMPANY DUNKIRK NY 14048	D3,E,F	YES	
B	ROBLIN STEEL COMPANY NORTH TONAWANDA NY 14120		NO	
0700	ROME STRIP STEEL COMPANY ROME NY 13440	J1	NO	
0704	ROSS-MEEHAN FOUNDRIES CHATTANOOGA TN 37401		NO	
0708	ROSS STEEL WORKS, INC. AMITE LA 70422		NO	
0712	SANDVIK STEEL, INC. FAIR LAWN NJ 07410		NO	
A	SCRANTON WORKS CLARKS SUMMIT PA 18501		NO	
B	BENTON HARBOR WORKS BENTON HARBOR MI 49022		NO	
0716	SENECA STEEL SERVICE BUFFALO NY 14217		NO	
0720	SENECA WIRE AND MANUFACTURING COMPANY FOSTORIA OH 44830		NO	
0724	SHARON STEEL CORPORATION SHARON PA 16146		YES	

PLANT CODE	COMPANY / PLANT NAME CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0724 A	STEEL OIVISION SHARON	PA	16146	C,D1,D3,E,H,I2,I3,J1,L1	YES	
B	UNION STEEL CORPORATION UNION	PA	07083		NO	
C	DEARBORN DIVISION DETROIT	MI	48228		NO	
D	BRAINARO STRAPPING DIVISION WARREN	OH	44482		NO	
E	DAMASCUS TUBE DIVISION GREENVILLE	PA	16125		NO	
F	FAIRMONT COKE WORKS FAIRMONT	WV	26554	A	NO	SHUTDOWN
G	CARPENTERTOWN COAL ANO COKE COMPANY TEMPLETON	PA	16259		NO	
H	MACOMBER, INC. CANTON	OH	44711		NO	
0728	SHARON TUBE COMPANY SHARON	PA	16146	G4,I1,K,L1	YES	
0732	SHENANGO, INC. PITTSBURGH	PA	15222		NO	
A	NEVILLE ISLAND PLANT PITTSBURGH	PA	15225	A,C	YES	
B	BUFFALO PLANT BUFFALO	NY	14240		NO	
C	SHARPSVILLE PLANT SHARPSVILLE	PA	16150		NO	
0736	SIMONDS STEEL DIVISION OF WALLACE MURRAY NEW YORK	NY	10017	D3	YES	
0740	SOULE STEEL COMPANY SAN FRANCISCO	CA	94124		NO	
A	STEEL MILL OPERATIONS CARSON	CA	90745	D3,F	YES	

PLANT CODE		COMPANY / PLANT NAME CITY STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0744		SOUTHERN FABRICATING COMPANY SHEFFIELD AL 35660		NO	
	A	DIXIE TUBE AND STEEL, INC. DOTHAN AL 36301		NO	
0748		SOUTHWESTERN PIPE, INC. HOUSTON TX 77001		NO	
	A	SOUTHWESTERN PIPE, INC. BOSSIER CITY LA 71010		NO	
0752		STANDARD FORGINGS CORPORATION EAST CHICAGO IN 46312		NO	
0756		STANDARD STEEL SPECIALTY COMPANY BEAVER FALLS PA 15010		NO	
	A	SUPERIOR DRAWN STEEL COMPANY MONACA PA 15061		NO	
0760		THE STANLEY STEEL DIVISION NEW BRITAIN CT 06050	I1,J1,K	YES	
	A	THE STANLEY STEEL DIVISION NEW BRITAIN CT 06053		NO	
0764					SEE 0226
	A				SEE 0226A
0768		STUPP BROTHERS BRIDGE AND IRON COMPANY ST. LOUIS MO 63125		NO	
	A	STUPP CORPORATION BATON ROUGE LA 70821		NO	
	B	MENGEL ROAD PLANT BATON ROUGE LA 70821		NO	
	C	THOMAS ROAD PLANT BATON ROUGE LA 70821		NO	
0772		SUPERIOR TUBE COMPANY NORRISTOWN PA 19404		NO	

PLANT CODE	COMPANY / PLANT NAME CITY STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0776	TELEDYNE VASCO LATROBE PA 15650		YES	
A	TELEDYNE ALLVAC MONROE NC 28110		NO	
B	TELEDYNE COLUMBIA-SUMMERILL PITTSBURGH PA 15230		NO	
C	SCOTTDALE PLANT SCOTTDALE PA 15683	I3,K	NO	
D	CARNEGIE PLANT CARNEGIE PA 15106	I1,K	NO	
E	TELEDYNE OHIO STEEL COMPANY LIMA OH 45802	D3,E	NO	
F	TELEDYNE PITTSBURGH TOOL STEEL MONACA PA 15061	I3	NO	
G	ROD AND WIRE DEPARTMENT LATROBE PA 15650	D3,G2,H,I3,K	YES	
H	COLONIAL PLANT MONACA PA 15061	G2,G3,H,I3	YES	
I	TELEDYNE SURFACE ENGINEERING PITTSBURGH PA 15206		NO	
J	TELEDYNE VASCO-CK COMPANY SOUTH BOSTON VA 24592	I3	NO	
0780	TENNESSEE FORGING STEEL ROANOKE VA 24015	D3,F	YES	
A	NEWPORT DIVISION NEWPORT AR 72112		NO	
B	JONES AND MCKNIGHT CORPORATION CHICAGO IL 60623		NO	
C	KANKAKEE ELECTRICAL STEEL WORKS KANKAKEE IL 60901		NO	
0784	TEXAS STEEL COMPANY FT. WORTH TX 76110	D3	YES	

PLANT CODE	COMPANY / PLANT NAME CITY STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0788	THOMAS STEEL STRIP CORPORATION WARREN OH 44485		NO	
0792	THOMPSON STEEL COMPANY, INC. BRAINTREE MA 02184		NO	
A	THOMPSON STEEL COMPANY, INC. WORCESTER MA 01603	G2,I3,L1	YES	
B	THOMPSON STEEL COMPANY, INC. CHICAGO IL 60131	I1,J1,L1	YES	
C	THOMPSON STEEL COMPANY, INC. SPARROWS POINT MD 21219	I1,J1	YES	
0796	THE TIMKEN COMPANY CANTON OH 44706		YES	
A	GAMBRINUS PLANT CANTON OH 44706	D3,E,F,G1,G2,G4,I1,I3,K	YES	
B	WOOSTER PLANT WOOSTER OH 44691	G4,I1	YES	
C	LATROBE STEEL COMPANY LATROBE PA 15650	D3,E	YES	
0800	TIPPINS MACHINERY COMPANY, INC. ETNA PA 15223		NO	
A	TIPPINS MACHINERY COMPANY, INC. LAWRENCEVILLE PA 15201		NO	
0804	TITANIUM METALS CORPORATION OF AMERICA TORONTO OH 43964		NO	
A	STANDARD STEEL DIVISION BURNHAM PA 17009	D3,E	YES	
B	LATROBE FORGE AND SPRING LATROBE PA 15650	D3,E	YES	
0808	TOLEDO PICKLING AND STEEL SERVICE TOLEDO OH 43607		NO	
0810	TONAWANDA COKE COMPANY HARRIET NY 00240	A	NO	FORMERLY 0024D

PLANT CODE	COMPANY / PLANT NAME	CITY	STATE	ZIP CODE	SUBCATEGORIES	OCP RSP	COMMENTS
0812	TONAWANDA IRON DIVISION	NORTH TONAWANDA	NY	14120		NO	
0816	TOWNSEND COMPANY	BEAVER FALLS	PA	15010		NO	
A	TOWNSEND PLANT	NEW BRIGHTON	PA	15066		NO	
0820	TREDEGAR COMPANY	RICHMOND	VA	23211		NO	
0824	TUBE METHODS, INC.	BRIDGEPORT	PA	19405		NO	
0828	TULL, J.M. INDUSTRIES, INC.	ATLANTA	GA	30301		NO	
A	TAMPCO DIVISION	NORCROSS	GA	30091		NO	
0832	ULBRICH STAINLESS & SPECIALTY METALS	WALLINGFORD	CN	06492		NO	
0836	UNARCO-LEAVITT TUBE DIVISION	CHICAGO	IL	60643		NO	
0840	UNION ELECTRIC STEEL CORPORATION	PITTSBURGH	PA	15106		YES	
A	UNION ELECTRIC STEEL CORPORATION	CARNEGIE	PA	15106		NO	
B	HARMON CREEK	BURGETTSTOWN	PA	15021	D3,E	YES	
C	HARMON CREEK	VALPARAISO	IN	46383		NO	
0844	UNION SPECIALTY STEEL CASTING CORP.	VERONA	PA	15147		NO	
0848							SEE 0426
0852	UNITED STATES STEEL CORPORATION	PITTSBURGH	PA	15230		YES	

PLANT CODE	COMPANY / PLANT NAME CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0852 A	UNITED STATES STEEL CORPORATION NEW YORK	NY	10022		NO	
0856	UNITED STATES STEEL - EASTERN PITTSBURGH	PA	15219		NO	
A	CLAIRTON WORKS CLAIRTON	PA	15025	A,C,G2	YES	
B	EDGAR THOMSON WORKS BRADDOCK	PA	15104	C	YES	
C	CHRISTY PARK MCKEESPORT	PA	15132	G4	YES	
D	IRVIN WORKS DRAVOSBURG	PA	15034	G3,I1,J1,K,L1,L2	YES	
E	VANDERGRIFT WORKS VANDERGRIFT	PA	15690	G3,H,I1,I3,J1,K	YES	
F	FAIRLESS WORKS FAIRLESS HILLS	PA	19030	A,B,C,D1,D3,E,F,G1,G2,G 3G4,I1,K2,J1,K,L1	YES	
G	FAIRLESS WORKS TRENTON	NJ	08608		NO	
H	HOMESTEAD WORKS HOMESTEAD	PA	15120	D2,E,G1,G2,G3,I3	YES	
I	HOMESTEAD WORKS HOMESTEAD	PA	15120	C	YES	
J	HOMESTEAD WORKS HOMESTEAD	PA	15120	B	YES	
K	HOMESTEAD WORKS HOMESTEAD	PA	15120	G2	YES	
L	JOHNSTOWN PLANT JOHNSTOWN	PA	15902		NO	
M	CANTON PLANT CANTON	OH	44706		NO	
N	LORAIN PLANT LORAIN	OH	44055	A,B,C,D1,G1,G2,I1,J2,K, L1	YES	

PLANT CODE		COMPANY / PLANT NAME CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0856	O	CENTRAL FURNACES PLANT CLEVELAND	OH	44115	C	YES	SHUTDOWN
	P	CUYAHOGA PLANT CUYAHOGA HEIGHTS	OH	44125	G2,G3,I1,I2,J1,L1	YES	
	Q	NATIONAL PLANT MCKEESPORT	PA	15132	B,C,G1,G2,I1,J2,K	YES	
	R	DUQUESNE PLANT DUQUESNE	PA	15110	C,D1,D3,E,G1,G2,I1	YES	
	S	NEW HAVEN WORKS NEW HAVEN	CT	06507	I1,I2,L	YES	
	T	YOUNGSTOWN WORKS YOUNGSTOWN	OH	44509	B,C,D2,G1,I1	YES	SHUTDOWN
	U	MACDONALD WORKS MACDONALD	OH	44437	G2,G3,I1	YES	SHUTDOWN
0860		UNITED STATES STEEL - CENTRAL PITTSBURGH	PA	15230		NO	
	A	DULUTH PLANT DULUTH	MN	55808	A	YES	SHUTDOWN
	B	GARY WORKS GARY	IN	46401	A,B,C,D1,D2,F,G1,G2	YES	
	C	GARY TUBE WORKS GARY	IN	46401		NO	
	D	ELLWOOD PLANT ELLWOOD CITY	PA	16117		NO	
	F	JOLIET PLANT JOLIET	IL	60432	G2,I1,I2,I3,L1	YES	
	G	WAUKEGAN PLANT WAUKEGAN	IL	60085	I1,L1	YES	SHUTDOWN
	H	SOUTH WORKS CHICAGO	IL	60617	B,C,D1,D3,E,F,G1,G2,G3	YES	
0864		UNITED STATES STEEL - WESTERN PITTSBURGH	PA	15230		NO	

PLANT CODE		COMPANY / PLANT NAME CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0864	A	GENEVA WORKS PROVO	UT	84601	A,B,C,D2,G1,G2,G3,J2	YES	
	B	PITTSBURGH WORKS PITTSBURGH	CA	94546	G2,I1,I2,J1,K,L1	YES	
	C	TORRANCE WORKS TORRANCE	CA	90501	D2,F,G1,G2	YES	SHUTDOWN
0868		UNITED STATES STEEL - SOUTHERN PITTSBURGH	PA	15230		NO	
	A	FAIRFIELD WORKS FAIRFIELD	AL	35064	A,B,C,D1,G1,G2,I1,I2,J1 K,L1	YES	
	B	TEXAS WORKS BAYTOWN	TX	77520	D3,E,F,G3,J2	YES	
	C	AMERICAN BRIDGE DIVISION ORANGE	TX	77630		NO	
0872		VALLEY MOULD AND IRON HUBBARD	OH	44425		NO	
	A	CHICAGO PLANT CHICAGO	IL	60617		NO	
	B	CLEVELAND PLANT CLEVELAND	OH	44105		NO	
0876		VALMONT INDUSTRIES, INC. VALLEY	NB	68064		NO	
0880		VAN DORN HEAT TREATING COMPANY CLEVELAND	OH	44101		NO	
	A	HEAT TREATING DIVISION MCKEES ROCKS	PA	15136		NO	
0884							SEE 0674
	A						SEE 0674A
	B						SEE 0674B

PLANT CODE	COMPANY / PLANT NAME CITY	STATE	ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0884 C						SEE 0674C
D						SEE 0674D
E						SEE 0674E
F						SEE 0674F
G						SEE 0674G
H						SEE 0674H
0888	VULCAN, INC. LATROBE	PA	15650		NO	
A	VULCAN MOULD AND IRON COMPANY LATROBE	PA	15650		NO	
B	VULCAN MOULD AND IRON COMPANY LANSING	IL	60438		NO	
C	VULCAN MOULD AND IRON COMPANY TRENTON	MI	48183		NO	
0892	WALKER MANUFACTURING COMPANY RACINE	WI	53402		NO	
A	ABERDEEN PLANT ABERDEEN	MS	39730		NO	
B	ARDEN PLANT ARDEN	NC	28704		NO	
C	GREENVILLE PLANT GREENVILLE	TX	75401		NO	
D	HARRISONBURG PLANT HARRISONBURG	VA	22801		NO	
E	JACKSON PLANT JACKSON	MI	49201		NO	

PLANT CODE		COMPANY / PLANT NAME CITY STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0892	F	NEWARK PLANT NEWARK OH 43055		NO	
	G	SEWARD PLANT SEWARD NB 58434		NO	
0894		WALKER STEEL AND WIRE COMPANY FERNDALE MI		NO	
0896		WASHBURN WIRE COMPANY EAST PROVIDENCE RI 02916	D3,E	YES	
	A	WASHBURN WIRE COMPANY NEW YORK NY 10035		NO	
0900		WASHINGTON STEEL CORPORATION WASHINGTON PA 15301		YES	
	A	FITCH WORKS HOUSTON PA 15342	D3	YES	
	B	CALSTRIP STEEL COMPANY LOS ANGELES CA 90022		NO	
0904		WELDED TUBES, INC. ORWELL OH 44076		NO	
0908		WELDED TUBE COMPANY OF AMERICA PHILADELPHIA PA 19148	J2	YES	
	A	WELDED TUBE COMPANY OF AMERICA CHICAGO IL 60633	J2	YES	
0912		WESTERN COLD DRAWN STEEL DIVISION ELYRIA OH 44035		NO	
	A	WESTERN COLD DRAWN STEEL DIVISION GARY IN 46401		NO	
0916		WHEATLAND TUBE COMPANY PHILADELPHIA PA 19106		NO	
	A	WHEATLAND STEEL PRODUCTS WHEATLAND PA 16161	G4,I1,K,L1	YES	
0920		WHEELING-PITTSBURGH STEEL CORPORATION PITTSBURGH PA 15230		YES	

PLANT CODE		COMPANY / PLANT NAME CITY STATE ZIP CODE			SUBCATEGORIES	DCP RSP	COMMENTS
0920	A	STEUBENVILLE NORTH PLANT STEUBENVILLE	OH	43952	C,G1,I2,J1	YES	
	B	MONESSEN PLANT MONESSEN	PA	15062	A,B,C,D1,G1,G2	YES	
	C	ALLENPORT PLANT ALLENPORT	PA	15412	G3,G4,I2,J1	YES	
	D	BENWOOD PLANT BENWOOD	WV	26031	I1,J2,L1	YES	
	E	MARTINS FERRY PLANT MARTINS FERRY	OH	43935	L1	YES	
	F	STEUBENVILLE EAST PLANT FOLLANSBEE	WV	26037	A,B,L2	YES	
	G	YORKVILLE PLANT YORKVILLE	OH	43971	I2,J1,K	YES	
	H						SEE 0430
	I						SEE 0430A
	J						SEE 0430B
	K	WHEELING CORRUGATION COMPANY WHEELING	WV	26003		NO	
	L	BEECH BOTTOM PLANT BEECH BOTTOM	WV	26030	K	YES	
	M	LABELLE PLANT WHEELING	WV	26003		NO	
	N	STEUBENVILLE SOUTH PLANT MINGO JUNCTION	OH	43938	C,D1,G1,G3	YES	
	O	CANFIELD PLANT CANFIELD	OH	44406	K	YES	
0924		WHITTAKER CORPORATION DETROIT	MI	48234		NO	

386

PLANT CODE	COMPANY / PLANT NAME CITY STATE ZIP CODE	SUBCATEGORIES	DCP RSP	COMMENTS
0924 A	WHITTAKER STRIP STEEL DIVISION DETROIT MI 48234		NO	
0928	WILSON STEEL AND WIRE COMPANY CHICAGO IL 60609		NO	
0932	WIRE ROPE CORPORATION OF AMERICA ST. JOSEPH MO 64502		NO	
0936	WIRE SALES COMPANY CHICAGO IL 60632		NO	
0940	WITTEMAN STEEL MILLS FONTANA CA 92335	D3,G1	NO	
0944	WRIGHT STEEL AND WIRE COMPANY WORCESTER MA 01603		NO	
0946	WSC CORPORATION CHICAGO IL 60617		NO	FORMERLY 0400
A	WISCONSIN STEEL WORKS CHICAGO IL 60617	A,B,C,D1,E,F,G1,G2,G3	YES	SHUTDOWN FORMERLY 0400A
0948	YOUNGSTOWN SHEET AND TUBE COMPANY YOUNGSTOWN OH 44501		YES	
A	CAMPBELL WORKS STRUTHERS OH 44471	A,B,C,D2,G1,G3,G4,I1,I2 J1,L1	YES	
B	BRIER HILL WORKS YOUNGSTOWN OH 44510	C,D2,G1,G2,I1,J2	YES	
C	INDIANA HARBOR WORKS EAST CHICAGO IN 46312	A,B,C,D1,D2,G1,G3,G4,I1 J1,L1	YES	
D	VAN HUFFEL TUBE CORPORATION WAREN OH 44481		NO	
E	VAN HUFFEL TUBE CORPORATION GARDNER MA 01440		NO	
F	CAMPBELL WORKS-STRUTHERS DIVISION STRUTHERS OH 44471	G2,I3,K	YES	SHUTDOWN

DEFINITION OF SUBCATEGORY ABBREVIATIONS

A : BY-PRODUCT COKEMAKING

B : SINTERING

C : IRONMAKING

D1 : STEELMAKING, BASIC OXYGEN FURNACE

D2 : STEELMAKING, OPEN HEARTH FURNACE

D3 : STEELMAKING, ELECTRIC ARC FURNACE

E : VACUUM DEGASSING

F : CONTINUOUS CASTING

G1 : HOT FORMING, PRIMARY

G2 : HOT FORMING, SECTION

G3 : HOT FORMING, FLAT

G4 : HOT FORMING, PIPE & TUBE

H : SALT BATH DESCALING

I1 : ACID PICKLING, SULFURIC

I2 : ACID PICKLING, HYDROCHLORIC

I3 : ACID PICKLING, COMBINATION

J1 : COLD FORMING, COLD ROLLING

J2 : COLD FORMING, PIPE & TUBE

K : ALKALINE CLEANING

L1 : HOT COATING, GALVANIZING

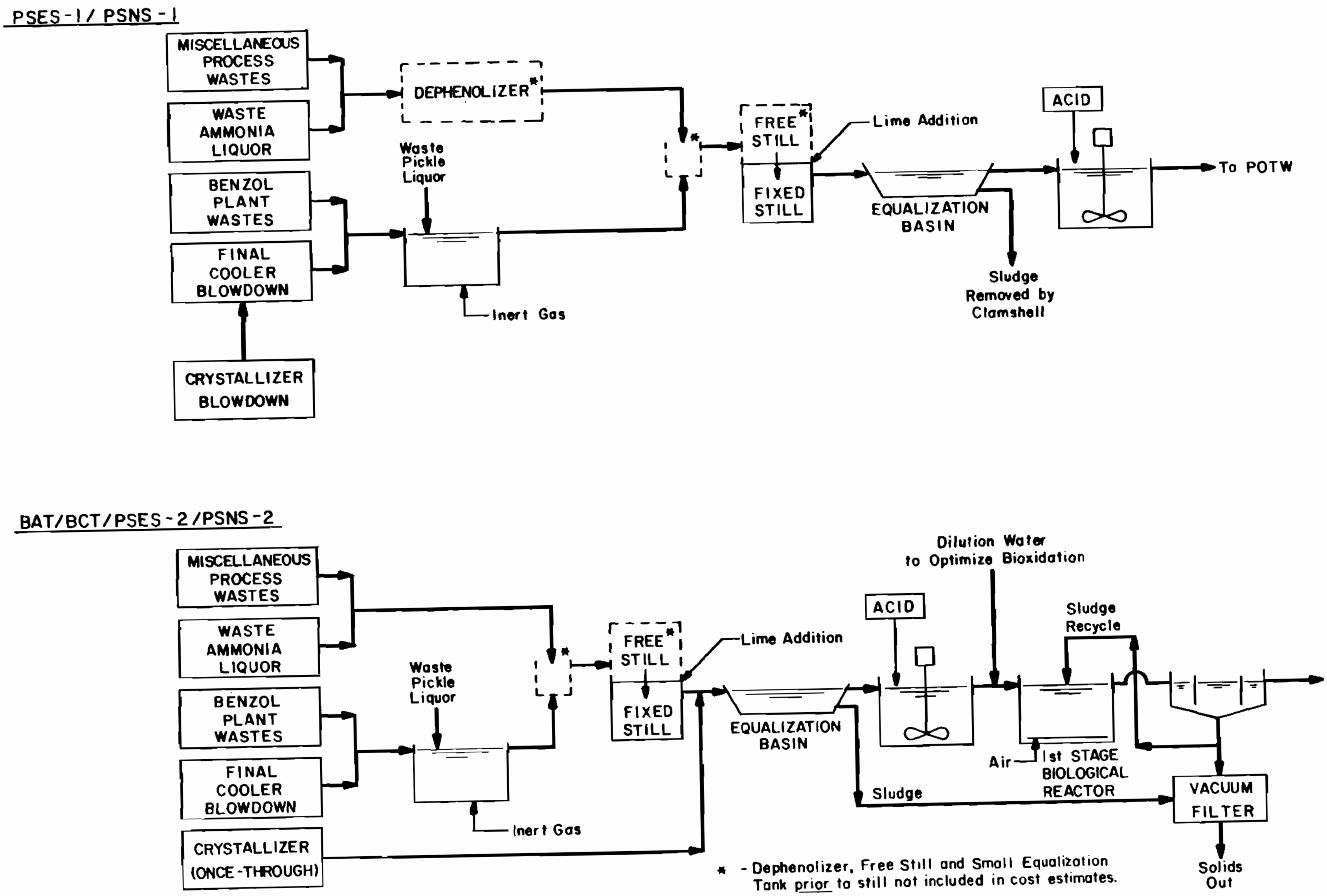
L2 : HOT COATING, TERNE & OTHER METALS

VOLUME I

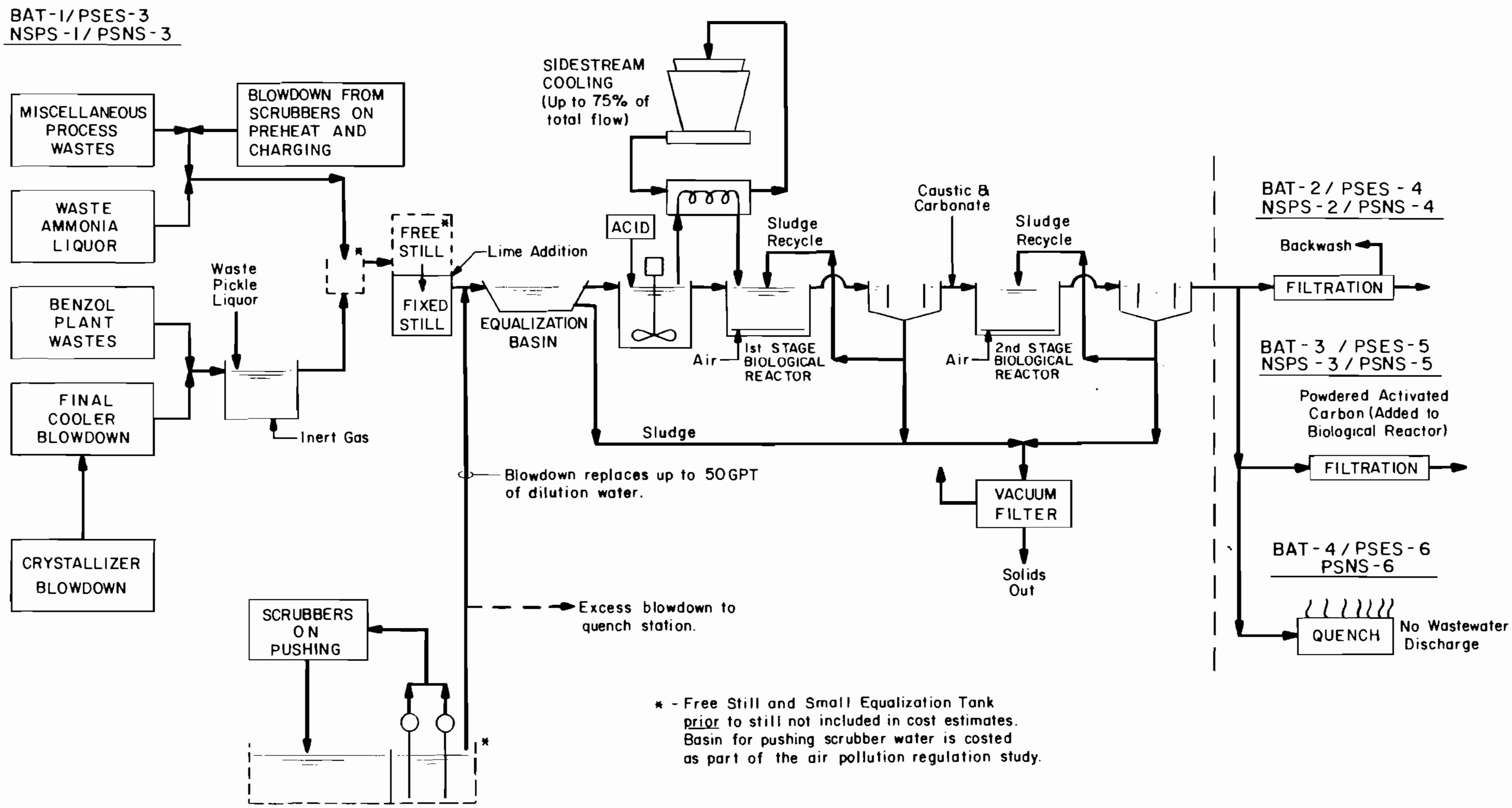
APPENDIX C

SUBCATEGORY SUMMARIES

BYPRODUCT COKEMAKING
TREATMENT MODELS SUMMARY
(PAGE 1 OF 2)



BYPRODUCT COKEMAKING
TREATMENT MODELS SUMMARY
(PAGE 2 OF 2)



* - Free Still and Small Equalization Tank prior to still not included in cost estimates. Basin for pushing scrubber water is costed as part of the air pollution regulation study.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: By-Product Cokemaking
: Merchant Coke Producers

	POTW USERS	ALL OTHERS
MODEL SIZE (TPD):	920	1690
OPER. DAYS/YEAR :	365	365
TURNS/DAY :	3	3

RAW WASTE FLOWS

Model Plant		
	Indirect Discharger	0.2 MGD
	All Others	0.3 MGD
7	Direct Dischargers	2.1 MGD
2	To Quenching Operations	0.6 MGD
8	Indirect Dischargers	1.3 MGD
2	Zero Dischargers	0.3 MGD
19	Active Plants	4.3 MGD

MODEL COSTS ($X10^{-3})	PSES-1 PSNS-1	BPT BCT PSES-2 PSNS-2	BAT-1 PSES-3 PSNS-3	BAT-2 PSES-4 PSNS-4	BAT-3 PSES-5 PSNS-5	BAT-4 PSES-6 PSNS-6
Investment						
Indirect Dischargers	1658	2180	506	647	672	610
Other Dischargers-Biological	-	3097	721	924	959	870
Other Dischargers-Physical-Chemical	-	2455	2104	2435	-	2225
Annual						
Indirect Dischargers	336	442	99.0	118	169	112
Other Dischargers-Biological	-	688	152	179	271	170
Other Dischargers-Physical-Chemical	-	538	907	1070	-	922
$/Ton of Production						
Indirect Dischargers	1.00	1.32	0.29	0.35	0.50	0.33
Other Dischargers-Biological	-	1.12	0.25	0.29	0.44	0.28
Other Dischargers-Physical-Chemical	-	0.87	1.47	1.73	-	1.49

	NSPS-1	NSPS-2	NSPS-3
Investment	3762	3965	4000
Annual	983	1010	1102
$/Ton of Production	1.59	1.64	1.79

WASTEWATER CHARACTERISTICS	RAW WASTE	PSES-1 PSNS-1	BPT BCT PSES-2 PSNS-2	BAT-1 NSPS-1 PSES-3 PSNS-3	BAT-2 NSPS-2 PSES-4 PSNS-4	BAT-3 NSPS-3 PSES-5 PSNS-5	BAT-4 PSES-6 PSNS-6
Flow (GPT)	178	120	240	170	170	170	0
pH (SU)	7-10	6-9	6-9	6-9	6-9	6-9	-
Ammonia-N	600	(75)60	(97)75	(25)7	(25)7	(20)5	-
Oil and Grease	75	(25)15	(11.6)8	(5**)4.4	(5**)4.4	(5**)2.0	-
Phenolic Compounds (4AAP)	300	(50)36	(1.6)0.5	(0.05)0.02	(0.05)0.02	(0.025)0.01	-
Sulfides	150	50	1	0.4	0.4	0.3	-
Thiocyanates	480	180	2	0.3	0.3	0.2	-
Total Suspended Solids	50	(140)100	(140)66	(140)66	(20)15	(20)15	-

SUBCATEGORY SUMMARY DATA
BY-PRODUCT COKEMAKING
PAGE 2

	WASTEWATER CHARACTERISTICS	RAW WASTE	PSES-1 PSNS-1	BPT BCT PSES-2 PSNS-2	BAT-1 NSPS-1 PSES-3 PSNS-3	BAT-2 NSPS-2 PSES-4 PSNS-4	BAT-3 NSPS-3 PSES-5 PSNS-5	BAT-4 PSES-6 PSNS-6
3	Acrylonitrile	1.2	0.25	0.05	0.02	0.02	0.01	-
4	Benzene*	35	10	0.3	(0.05)0.04	(0.05)0.04	(0.03)0.02	-
21	2,4,6-Trichlorophenol	0.1	0.05	0.02	0.005	0.005	<0.005	-
22	Parachlorometacresol	0.6	0.15	0.05	0.005	0.005	<0.005	-
23	Chloroform*	0.3	0.2	0.2	0.2	0.1	0.05	-
34	2,4-Dimethylphenol	5	1	0.02	0.005	0.005	<0.005	-
35	2,4-Dinitrotoluene	0.2	0.1	0.02	0.01	0.01	0.005	-
36	2,6-Dinitrotoluene	0.1	0.05	0.02	0.01	0.01	0.005	-
38	Ethylbenzene*	3	0.8	0.05	0.03	0.03	0.02	-
39	Fluoranthene*	0.8	0.2	0.05	0.02	0.02	0.01	-
54	Isophorone	0.5	0.3	0.1	0.01	0.01	0.005	-
55	Naphthalene*	30	5	0.05	(0.05)0.005	(0.05)0.005	(0.03)<0.005	-
60	4,6-Dinitro-o-cresol	0.12	0.08	0.01	0.005	0.005	<0.005	-
64	Pentachlorophenol	0.12	0.08	0.01	0.005	0.005	<0.005	-
65	Phenol*	275	30	0.3	0.005	0.005	<0.005	-
66-71	Total Phthalates*	5	2	1	0.2	0.2	0.1	-
72	Benzo (a) Anthracene	0.3	0.2	0.05	0.01	0.01	0.005	-
73	Benzo (a) Pyrene*	0.1	0.05	0.05	(0.05)0.01	(0.05)0.01	(0.03)0.005	-
76	Chrysene*	0.4	0.2	0.05	0.01	0.01	0.005	-
77	Acenaphthylene*	3.5	1	0.08	0.02	0.02	0.01	-
80	Fluorene*	0.6	0.2	0.05	0.02	0.02	0.01	-
84	Pyrene*	0.6	0.2	0.1	0.03	0.03	0.02	-
86	Toluene*	25	5	0.3	0.05	0.05	0.04	-
114	Antimony*	0.2	0.1	0.1	0.1	0.05	0.04	-
115	Arsenic*	2	1	0.4	0.4	0.25	0.25	-
121	Cyanide*	50	(20)16	(23)5	(5.5)2.75	(5.0)2.75	(5.0)2	-
125	Selenium*	0.2	0.2	0.1	0.1	0.05	0.05	-
128	Zinc*	0.2	0.2	0.1	0.1	0.05	0.05	-
130	Xylene*	12	3	0.2	0.02	0.02	0.01	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-3 through PSES-6 and PSNS-3 through PSNS-6 costs are incremental over BPT, PSES-2 and PSNS-2 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS BY-PRODUCT COKEMAKING SUBCATEGORY

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3	BAT-4
Flow (MGD)	25.1	33.3	22.7	22.7	22.7	0
Ammonia (N)	22,947.7	3,796.8	242.0	242.0	172.9	-
Oil and Grease	2,868.5	404.9	152.1	152.1	69.2	-
Phenolic Compounds (4AAP)	11,473.9	25.3	0.6	0.6	0.3	-
Sulfide	5,736.9	50.7	13.8	13.8	10.4	-
Thiocyanate	18,358.3	101.2	10.4	10.4	6.9	-
Total Cyanides	1,912.2	253.1	95.0	86.4	69.2	-
Total Suspended Solids	1,912.2	3,846.2	2,623.5	518.7	518.7	-
Total Toxic Metals	99.5	35.4	24.2	13.8	13.5	-
Total Organics (1)	4,535.9	137.7	24.7	21.2	11.3	-
SUBCATEGORY COST SUMMARY (2) ($X10^{-6})						
Investment	-	168.6	44.1	62.0	64.2	54.6
Annual	-	41.61	11.49	14.22	20.71	12.77

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4	PSES-5	PSES-6
Flow (MGD)	7.4	4.8	10.3	7.1	7.1	7.1	0
Ammonia (N)	6,759.1	434.4	1,167.3	74.6	74.6	53.3	-
Oil and Grease	844.9	108.6	124.5	46.9	46.9	21.3	-
Phenolic Compounds (4AAP)	3,379.5	260.6	7.7	0.2	0.2	0.1	-
Sulfide	1,689.8	361.9	15.6	4.3	4.3	3.2	-
Thiocyanate	5,407.2	1,303.0	31.2	3.2	3.2	2.2	-
Total Cyanides	563.3	115.8	77.8	29.3	26.7	21.3	-
Total Suspended Solids	563.3	723.9	1,182.3	809.8	159.9	159.9	-
Total Toxic Metals	29.3	10.8	10.9	7.4	4.3	4.1	-
Total Organics (1)	1,336.0	208.1	42.3	7.7	6.6	3.4	-
SUBCATEGORY COST SUMMARY (3) ($X10^{-6})							
Investment	-	45.8	52.7	13.7	18.5	19.1	16.3
Annual	-	10.17	13.10	3.61	3.73	5.74	3.39

(1) Individual phenolic compounds (e.g., 2,4-Dinitrophenol, Pentachlorophenol) are not included in Toxic Organics.
(2) Two confidential plants have been excluded from costs shown.
(3) The cost summary totals do not include one confidential plant.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
BY-PRODUCT COKEMAKING SUBCATEGORY
IRON AND STEEL PLANTS

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3	BAT-4
Flow (MGD)	22.1	29.6	20.1	20.1	20.1	0
Ammonia (N)	20,200.5	3,380.1	214.5	214.5	153.2	-
Oil and Grease	2,525.1	360.5	134.8	134.8	61.3	-
Phenolic Compounds (4AAP)	10,100.3	22.5	0.6	0.6	0.3	-
Sulfide	5,050.1	45.1	12.2	12.2	9.2	-
Thiocyanate	16,160.5	90.1	9.2	9.2	6.1	-
Total Cyanides	1,683.3	225.3	84.2	76.6	61.3	-
Total Suspended Solids	1,683.3	3,424.0	2,325.1	459.7	459.7	-
Total Toxic Metals	87.6	31.5	21.4	12.2	12.0	-
Total Organics(1)	3,992.9	122.6	21.9	18.8	10.0	-
SUBCATEGORY COST SUMMARY(2) ($X10^{-6})						
Investment		144.0	37.2	53.0	54.9	46.2
Annual		36.39	9.50	11.87	17.69	10.64

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4	PSES-5	PSES-6
Flow (MGD)	6.1	3.9	8.5	5.8	5.8	5.8	0
Ammonia (N)	5,562.7	353.7	965.7	61.3	61.3	43.8	-
Oil and Grease	695.3	88.4	103.0	38.5	38.5	17.5	-
Phenolic Compounds (4AAP)	2,781.3	212.2	6.4	0.2	0.2	0.1	-
Sulfide	1,390.7	294.7	12.9	3.5	3.5	2.6	-
Thiocyanate	4,450.1	1,061.0	25.8	2.6	2.6	1.8	-
Total Cyanides	463.6	94.3	64.4	24.1	21.9	17.5	-
Total Suspended Solids	463.6	589.5	978.6	665.1	131.3	131.3	-
Total Toxic Metals	24.1	8.8	9.0	6.1	3.5	3.4	-
Total Organics(1)	1099.6	169.5	35.0	6.3	5.4	2.8	-
SUBCATEGORY COST SUMMARY ($X10^{-6})							
Investment	-	35.7	39.7	10.7	14.6	15.1	12.7
Annual	-	8.17	10.46	2.48	3.02	4.73	2.73

(1) Individual phenolic compounds (e.g., 2,4-Dinitrophenol, Pentachlorophenol) are not included in Toxic Organics.
(2) One confidential plant has been excluded from costs shown.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
BY-PRODUCT COKEMAKING SUBCATEGORY
MERCHANT PLANTS

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3	BAT-4
Flow (MGD)	3.0	3.7	2.6	2.6	2.6	0
Ammonia (N)	2,747.2	416.7	27.5	27.5	19.7	-
Oil and Grease	343.4	44.4	17.3	17.3	7.9	-
Phenolic Compounds (4AAP)	1,373.6	2.8	<0.1	<0.1	<0.05	-
Sulfide	686.8	5.6	1.6	1.6	1.2	-
Thiocyanate	2,197.8	11.1	1.2	1.2	0.8	-
Total Cyanides	228.9	27.8	10.8	9.8	7.9	-
Total Suspended Solids	228.9	422.2	298.4	59.0	59.0	-
Total Toxic Metals	11.9	3.9	2.8	1.6	1.5	-
Total Organics(1)	543.0	15.1	2.8	2.4	1.3	-
SUBCATEGORY COST SUMMARY(2) ($X10^{-6})						
Investment	-	24.6	6.9	9.0	9.3	8.4
Annual	-	5.22	1.99	2.35	3.02	2.13

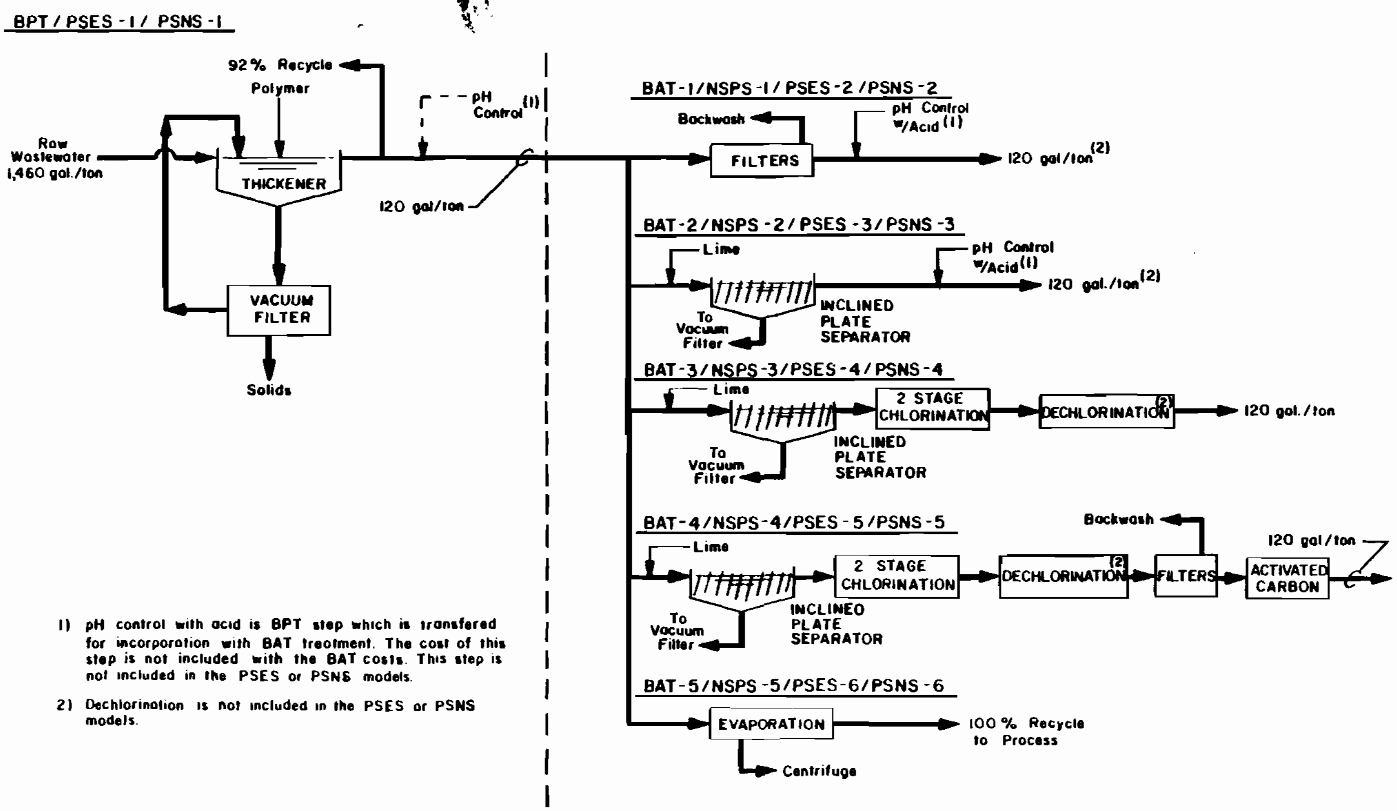
INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4	PSES-5	PSES-6
Flow (MGD)	1.3	0.9	1.8	1.3	1.3	1.3	0
Ammonia (N)	1,196.4	80.7	201.6	13.3	13.3	9.5	-
Oil and Grease	149.6	20.2	21.5	8.4	8.4	3.8	-
Phenolic Compounds (4AAP)	598.2	48.4	1.3	<0.1	<0.05	<0.05	-
Sulfide	299.1	67.2	2.7	0.8	0.8	0.6	-
Thiocyanate	957.1	242.0	5.4	0.6	0.6	0.4	-
Total Cyanides	99.7	21.5	13.4	5.2	4.8	3.8	-
Total Suspended Solids	99.7	134.4	203.7	144.7	28.6	28.6	-
Total Toxic Metals	5.2	2.0	1.9	1.3	0.8	0.7	-
Total Organics(1)	236.4	38.6	7.3	1.4	1.2	0.6	-
SUBCATEGORY COST SUMMARY(3) ($X10^{-6})							
Investment	-	10.1	13.0	3.0	3.9	4.0	3.6
Annual	-	2.00	2.64	0.59	0.71	1.01	0.66

(1) Individual phenolic compounds (e.g., 2,4-Dinitrophenol, Pentachlorophenol) are not included in Toxic Organics.
(2) One confidential plant has been excluded from costs shown.
(3) The cost summary totals do not include confidential plants.

SINTERING
TREATMENT MODELS SUMMARY

BPT, BAT, PSES MODEL PLANT - 4,000 TPD
NSPS, PSNS MODEL PLANT - 7,000 TPD



1) pH control with acid is BPT step which is transfered for incorporation with BAT treatment. The cost of this step is not included with the BAT costs. This step is not included in the PSES or PSNS models.

2) Dechlorination is not included in the PSES or PSNS models.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Sintering

BPT, BAT, PSES MODEL SIZE (TPD)	4000
NSPS, PSNS MODEL SIZE (TPD)	7000
OPER. DAYS/YEAR	365
TURNS/DAY	3

RAW WASTE FLOWS

	Model Plant	5.8 MGD
15	Direct Dischargers	87.6 MGD
1	Indirect Discharger	5.8 MGD
1	Zero Discharger	5.8 MGD
17	Active Plants	99.2 MGD

MODEL COSTS ($X10^{-3})	BPT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4	BAT-4 PSES-5	BAT-5 PSES-6
Investment	3615	401	316	647	3127	4936
Annual	1430	54.0	42.4	151	473	1016
$/Ton of Production	0.98	0.037	0.029	0.10	0.32	0.70

MODEL COSTS ($X10^{-3})	PSNS-1	NSPS-1 PSNS-2	NSPS-2 PSNS-3	NSPS-3 PSNS-4	NSPS-4 PSNS-5	NSPS-5 PSNS-6
Investment	4822	5362	5219	5594	8524	11,459
Annual	2299	1399	1380	1462	1842	2799
$/Ton of Production	0.90	0.55	0.54	0.57	0.72	1.10

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT PSES-1 PSNS-1	BAT-1 NSPS-1 PSES-2 PSNS-2	BAT-2 NSPS-2 PSES-3 PSNS-3	BAT-3 NSPS-3 PSES-4 PSNS-4	BAT-4 NSPS-4 PSES-5 PSNS-5	BAT-5 NSPS-5 PSES-6 PSNS-6
	Flow (GPT)	1460	120	120	120	120	120	0
	pH (SU)	6-12	6-9	6-9	6-9	6-9	6-9	-
	Ammonia (N)	6	7	7	7	(10**)6	(10**)6	-
	Fluoride	6	25	20	20	20	20	-
	Oil and Grease	240	(10)7	(5***)3.5	(10)7	(10)7	(5***)3.5	-
	Phenols (4AAP)	0.2	0.2	0.2	0.2	(0.1**)0.015	(0.1**)0.015	-
	Residual Chlorine (Max. Only)	-	-	-	-	(0.5**)0.05	(0.5**)0.05	-
	Total Suspended Solids	6100	(50)39	(15)10	(25)22	(25)22	(15)10	-
39	Fluoranthene	0.10	0.1	0.1	0.1	0.1	0.01	-
65	Phenol*	0.03	0.05	0.05	0.05	0.01	0.01	-
76	Chrysene	0.01	0.01	0.01	0.01	0.01	0.01	-
84	Pyrene*	0.01	0.01	0.01	0.01	0.01	0.01	-
118	Cadmium*	0.05	0.01	0.01	0.01	0.01	0.01	-
119	Chromium*	0.7	0.6	0.2	0.15	0.15	0.15	-
120	Copper*	0.1	0.03	0.02	0.02	0.02	0.02	-
121	Cyanide (Total)*	0.2	0.2	0.2	0.2	(1**)0.03	(1**)0.03	-
122	Lead	0.15	0.12	(0.25)0.02	(0.25)0.02	(0.25)0.02	(0.25)0.02	-
124	Nickel*	0.1	0.02	0.01	0.015	0.015	0.01	-
128	Zinc*	1	0.5	(0.3)0.18	(0.3)0.04	(0.3)0.04	(0.3)0.01	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-6 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** When co-treated with ironmaking wastewaters. These values are based upon the selected BAT alternative in the Ironmaking Subcategory.
***Limit for oil and grease is based upon 10 mg/l (maximum only).

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
SINTERING SUBCATEGORY

DIRECT DISCHARGERS(1)

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT	BAT-1	BAT-2	BAT-3	BAT-4	BAT-5
Flow (MGD)	93.4	7.2	7.2	7.2	7.2	7.2	0
Ammonia (N)	853.8	65.8	65.8	65.8	65.8	65.8	-
Cyanide (Total)	28.5	2.2	2.2	2.2	0.3	0.3	-
Fluoride	853.8	274.1	219.3	219.3	219.3	219.3	-
Oil and Grease	34,153.3	76.8	38.4	76.8	76.8	38.4	-
Phenols (4AAP)	28.5	2.2	2.2	2.2	0.2	0.2	-
Residual Chlorine	-	-	-	-	0.5	0.5	-
Total Suspended Solids	868,064.2	427.6	109.7	241.2	241.2	109.7	-
Total Toxic Metals	298.8	14.0	4.8	2.8	2.8	2.4	-
Total Organics(2)	17.1	1.3	1.3	1.3	1.3	0.3	-

SUBCATEGORY COST SUMMARY ($X10^-6)	RAW WASTE	BPT	BAT-1	BAT-2	BAT-3	BAT-4	BAT-5
Investment	-	63.89	6.02	4.98	10.33	47.86	74.80
Annual	-	22.00	0.79	0.64	2.29	7.15	15.40

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4	PSES-5	PSES-6
Flow (MGD)	5.8	0.5	0.5	0.5	0.5	0.5	0
Ammonia (N)	53.4	4.4	4.4	4.4	4.4	4.4	-
Cyanide (Total)	1.8	0.1	0.1	0.1	0.02	0.02	-
Fluoride	53.4	18.3	14.6	14.6	14.6	14.6	-
Oil and Grease	2,134.6	5.1	2.6	5.1	5.1	2.6	-
Phenols (4AAP)	1.8	0.1	0.1	0.1	0.01	0.01	-
Total Suspended Solids	54,254.0	28.5	7.3	16.1	16.1	7.3	-
Total Toxic Metals	18.7	0.9	0.3	0.2	0.2	0.2	-
Total Organics(2)	1.1	0.09	0.09	0.09	0.09	0.02	-

SUBCATEGORY COST SUMMARY ($X10^-6)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4	PSES-5	PSES-6
Investment	-	3.23	0.36	0.28	0.58	2.79	4.99
Annual	-	1.28	0.048	0.038	0.14	0.42	1.04

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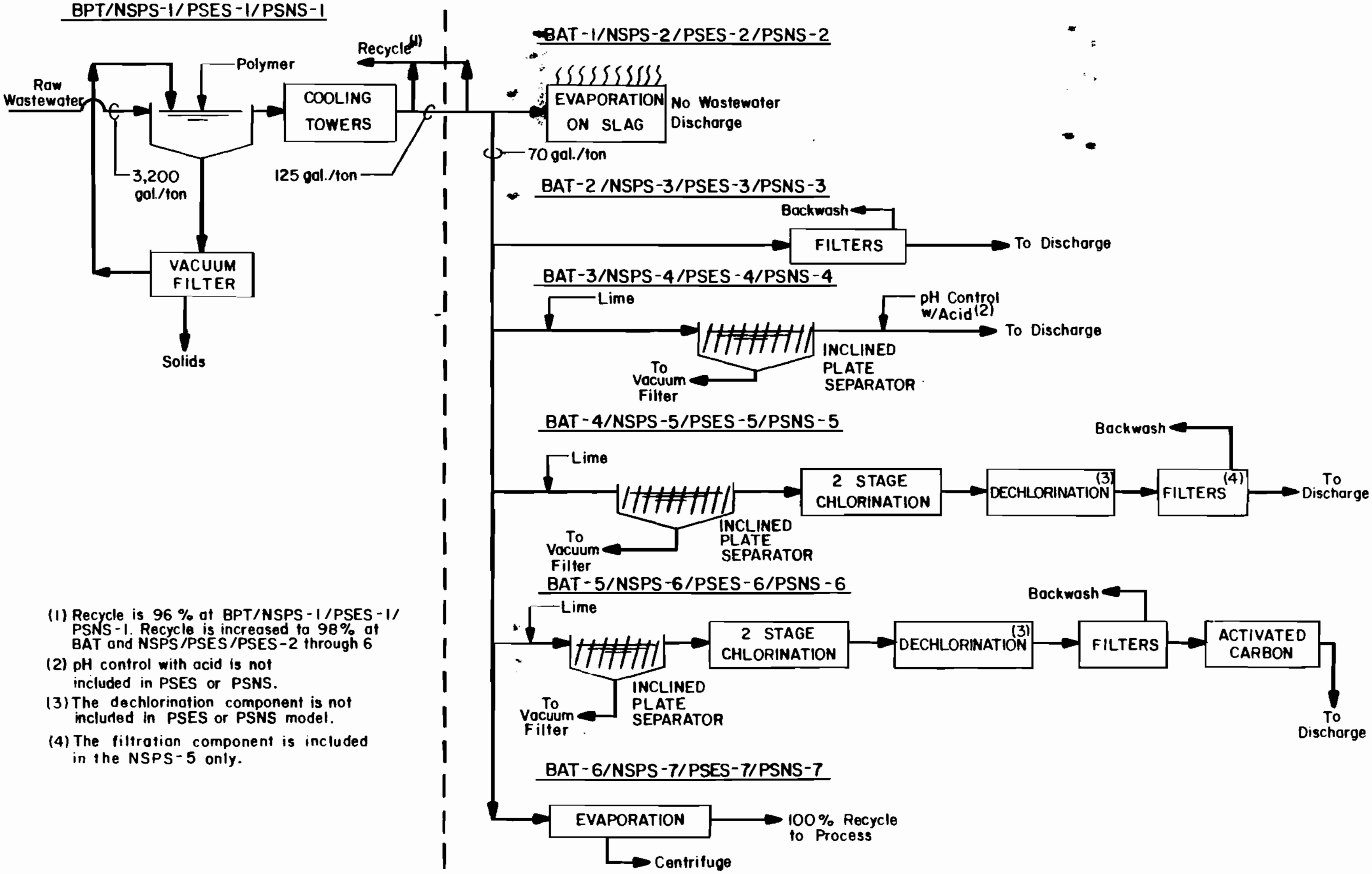
(1) The raw waste load and BPT cost contributions of the zero discharge operation are included in the direct discharger data. As this plant has no wastewater discharge, it does not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) Individual phenolic compounds (e.g., 2,4-dinitrophenol, pentachlorophenol) are not included in total organics.

IRONMAKING
TREATMENT MODELS SUMMARY

MODEL PLANT - 6000 TPD



(1) Recycle is 96 % at BPT/NSPS-1/PSES-1/PSNS-1. Recycle is increased to 98% at BAT and NSPS/PSES/PSES-2 through 6

(2) pH control with acid is not included in PSES or PSNS.

(3) The dechlorination component is not included in PSES or PSNS model.

(4) The filtration component is included in the NSPS-5 only.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Ironmaking

MODEL SIZE (TPD): 6000
OPER. DAYS/YEAR : 365
TURNS/DAY : 3

RAW WASTE FLOWS

	Model Plant	19.2 MGD
39	Direct Dischargers	748.8 MGD
2	Indirect Dischargers	38.4 MGD
4	Zero Dischargers(1)	76.8 MGD
45	Active Plants	864.0 MGD

MODEL COSTS ($X10^{-3})	BPT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4	BAT-4 PSES-5	BAT-5 PSES-6	BAT-6 PSES-7
Investment	9542	172	286	384	784	3149	4408
Annual							
(with Sinter Plant)(2)	972	24.2	38.2	58.9	234	541	900
(without Sinter Plant)	2248	24.2	38.2	58.9	234	541	900
$/Ton of Production							
(with Sinter Plant)(2)	0.44	0.011	0.017	0.027	0.11	0.25	0.41
(without Sinter Plant)	1.03	0.011	0.017	0.027	0.11	0.25	0.41

	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3	NSPS-4 PSNS-4	NSPS-5 PSNS-5	NSPS-6 PSNS-6	NSPS-7 PSNS-7
Investment	9542	9714	9828	9926	10,326	12,691	13,950
Annual							
(with Sinter Plant)(2)	972	996	1010	1031	1206	1512	1872
(without Sinter Plant)	2248	2272	2286	2306	2482	2788	3148
$/Ton of Production							
(with Sinter Plant)(2)	0.44	0.45	0.46	0.47	0.55	0.69	0.85
(without Sinter Plant)	1.03	1.04	1.04	1.05	1.13	1.27	1.44

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3	BAT-3 NSPS-4 PSES-4 PSNS-4	BAT-4 NSPS-5 PSES-5 PSNS-5	BAT-5 NSPS-6 PSES-6 PSNS-6	BAT-6 NSPS-7 PSES-7 PSNS-7
	Flow (GPT)	3200	125	0	70	70	70	70	0
	pH (SU)	6-9	6-9	-	6-9	6-9	6-9	6-9	-
	Ammonia (N)	20	(103)60	-	(103)65	(103)65	(10)6	(10)6	-
	Fluoride	15	45	-	40	20	20	20	-
	Phenols (4AAP)	3	(4)2.3	-	(4)2.3	(4)2.3	(0.1)0.015	(0.1)0.015	-
	Residual Chlorine (Max. Only)	-	-	-	-	-	(0.5)0.05	(0.5)0.05	-
	Total Suspended Solids	1900	(50)42	-	(15)10	(25)22	(25)22	(15)10	-
9	Hexachlorobenzene	0.01	0.01	-	0.01	0.01	0.01	0.01	-
31	2,4-Dichlorophenol	0.01	0.03	-	0.03	0.03	0.02	0.02	-
34	2,4-Dimethylphenol	0.05	0.15	-	0.15	0.15	0.02	0.02	-
39	Fluoranthene	0.08	0.08	-	0.08	0.08	0.08	0.01	-
65	Phenol*	0.65	2.1	-	2.1	2.1	0.01	0.01	-
73	Benzo (a) pyrene	0.01	0.01	-	0.01	0.01	0.01	0.01	-
76	Chrysene	0.01	0.01	-	0.01	0.01	0.01	0.01	-
84	Pyrene*	0.05	0.05	-	0.05	0.05	0.05	0.01	-
114	Antimony	0.04	0.04	-	0.04	0.04	0.04	0.04	-
115	Arsenic*	0.1	0.05	-	0.05	0.05	0.05	0.05	-
118	Cadmium*	0.1	0.1	-	0.1	0.01	0.01	0.01	-
119	Chromium*	0.5	0.2	-	0.2	0.15	0.15	0.15	-
120	Copper*	0.25	0.03	-	0.03	0.02	0.02	0.02	-
121	Cyanide (Total)*	12	(15)4	-	(5)4	(5)4	(1)0.03	(1)0.03	-
122	Lead	5	0.5	-	(0.25)0.1	(0.25)0.08	(0.25)0.08	(0.25)0.08	-
124	Nickel*	0.5	0.1	-	0.015	0.015	0.015	0.01	-
125	Selenium	0.06	0.01	-	0.01	0.01	0.01	0.01	-
128	Zinc*	20	0.7	-	(0.3)0.18	(0.3)0.08	(0.3)0.08	(0.3)0.02	-

Notes: All concentrations are in mg/l unless otherwise noted.
: Cost for the BAT-1 through BAT-6 and PSES-2 through PSES-7 are incremental over the BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
(1) Wastewaters from ironmaking operations are disposed of by evaporation on slag.
(2) Credits for recovery of ironmaking wastewater sludges are included.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
IRONMAKING SUBCATEGORY

DIRECT DISCHARGERS[1]

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT	BAT-1	BAT-2	BAT-3	BAT-4	BAT-5	BAT-6
Flow (MGD)	825.6	29.2	0	16.4	16.4	16.4	16.4	0
Ammonia (N)	25,147.2	2,672.8	-	1,621.5	1,621.5	149.7	149.7	-
Cyanide (Total)	15,088.3	178.2	-	99.8	99.8	0.7	0.7	-
Fluoride	18,860.4	2,004.6	-	997.8	498.9	498.9	498.9	-
Phenols (4AAP)	3,772.1	102.5	-	57.4	57.4	0.4	0.4	-
Residual Chlorine	-	-	-	-	-	1.2	1.2	-
Total Suspended Solids	2,388,979.8	1,871.0	-	249.5	548.8	548.8	249.5	-
Total Toxic Metals	33,382.8	77.1	-	18.1	11.4	11.4	9.7	-
Total Organics[2]	201.2	7.1	-	4.0	4.0	4.0	1.2	-
SUBCATEGORY COST SUMMARY[3] $(\$X10^{-6})$								
Investment	-	434.74	7.28	11.28	14.80	30.84	123.09	171.64
Annual	-	55.27[4]	1.02	1.49	2.26	9.04	21.03	35.06

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4	PSES-5	PSES-6	PSES-7
Flow (MGD)	38.4	1.5	0	0.8	0.8	0.8	0.8	0
Ammonia (N)	1,169.6	137.1	-	83.2	83.2	7.7	7.7	-
Cyanide (Total)	701.8	9.1	-	5.1	5.1	0.04	0.04	-
Fluoride	877.2	102.8	-	51.2	25.6	25.6	25.6	-
Phenols (4AAP)	175.4	5.3	-	2.9	2.9	0.02	0.02	-
Total Suspended Solids	111,115.3	95.9	-	12.8	28.1	28.1	12.8	-
Total Toxic Metals	1,552.7	4.0	-	0.9	0.6	0.6	0.5	-
Total Organics[2]	9.4	0.4	-	0.2	0.2	0.2	0.06	-
SUBCATEGORY COST SUMMARY $(\$X10^{-6})$								
Investment	-	12.92	0.23	0.39	0.45	0.95	4.15	5.97
Annual	-	2.13[4]	0.033	0.052	0.064	0.30	0.71	1.22

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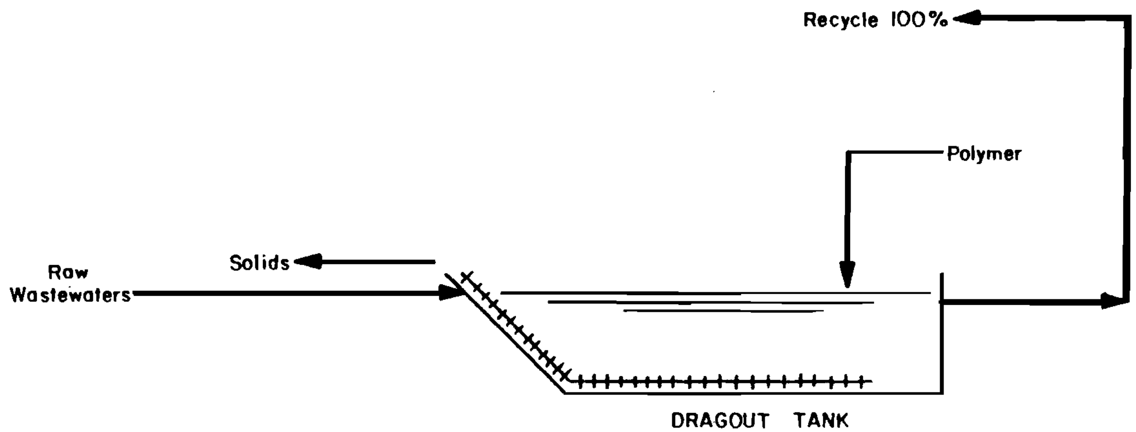
(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharge, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.
(2) Individual phenolic compounds (e.g., 2,4-dinitrophenol, pentachlorophenol) are not included in total organics.
(3) The cost summary totals do not include confidential plants.
(4) A credit for recovery of sludges in sinter plants has been applied for those ironmaking operations which have sintering operations on-site or available for use.

BASIC OXYGEN FURNACE - SEMI-WET
TREATMENT MODELS SUMMARY

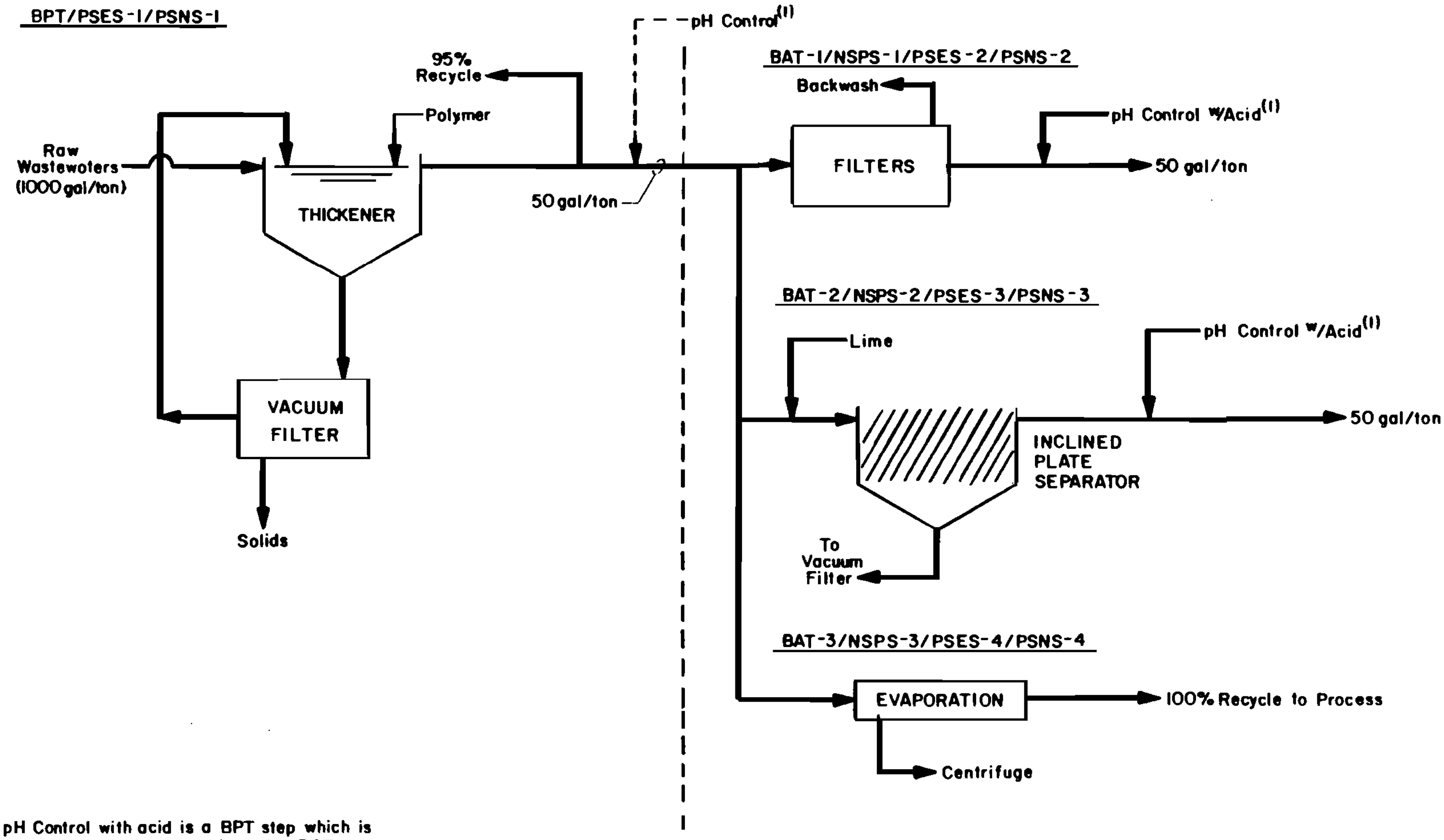
MODEL PLANT - 5300 TPD

BPT/BAT/BCT/PSES



BASIC OXYGEN FURNACE-WET-SUPPRESSED COMBUSTION TREATMENT MODELS SUMMARY

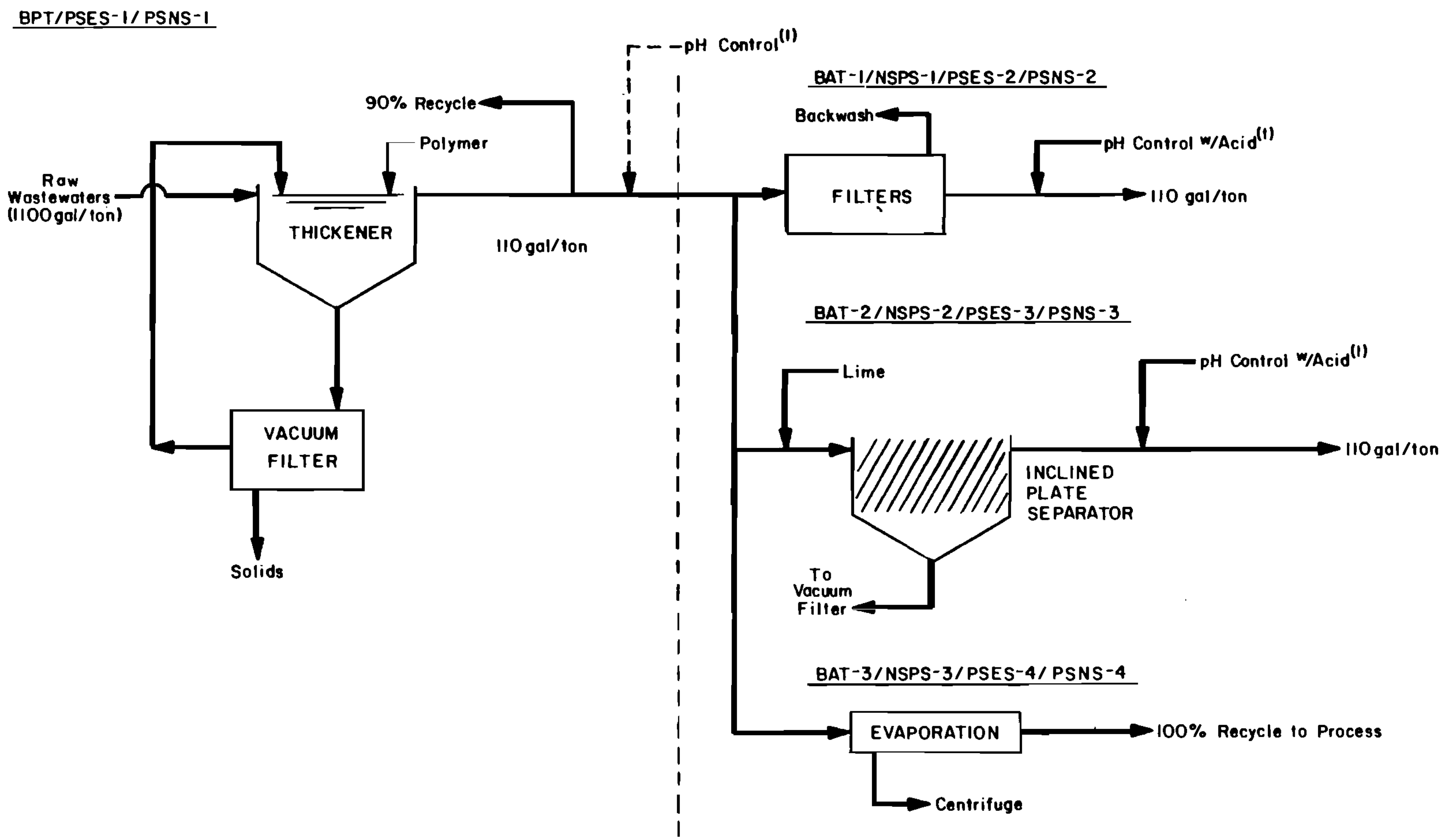
MODEL PLANT-7400 TPD



(1) pH Control with acid is a BPT step which is transferred for incorporation with BAT treatment. The cost of this step is not included with the BAT costs, nor is it included in the PSES/PSNS models.

BASIC OXYGEN FURNACE-WET-OPEN COMBUSTION TREATMENT MODELS SUMMARY

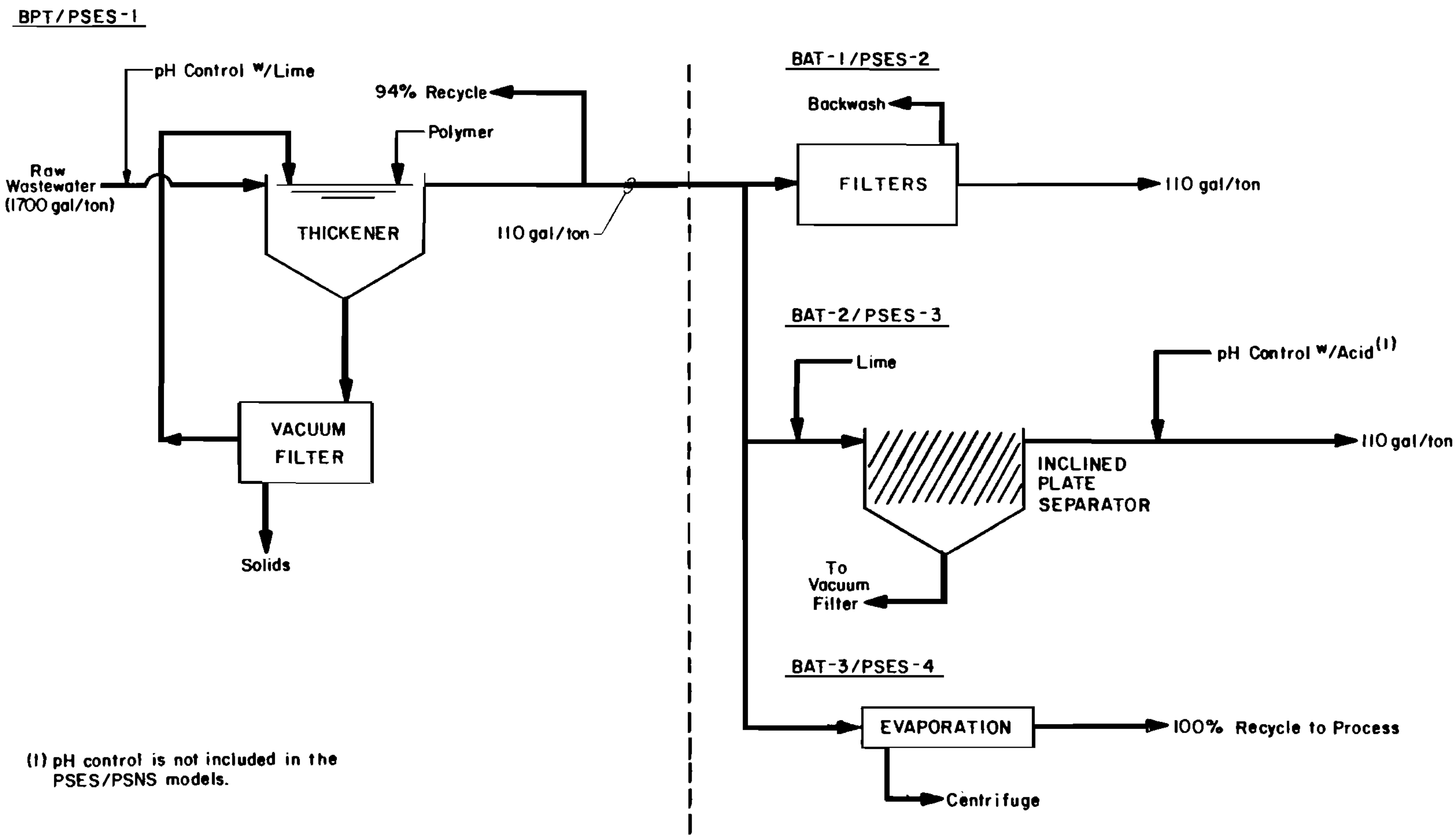
MODEL PLANT-9100 TPD



(1) pH Control with acid is a BPT step which is transferred for incorporation with BAT treatment. The cost of this step is not included with the BAT costs, nor is it included in the PSES/PSES models.

OPEN HEARTH FURNACE - WET
TREATMENT MODELS SUMMARY

MODEL PLANT - 6700 TPD

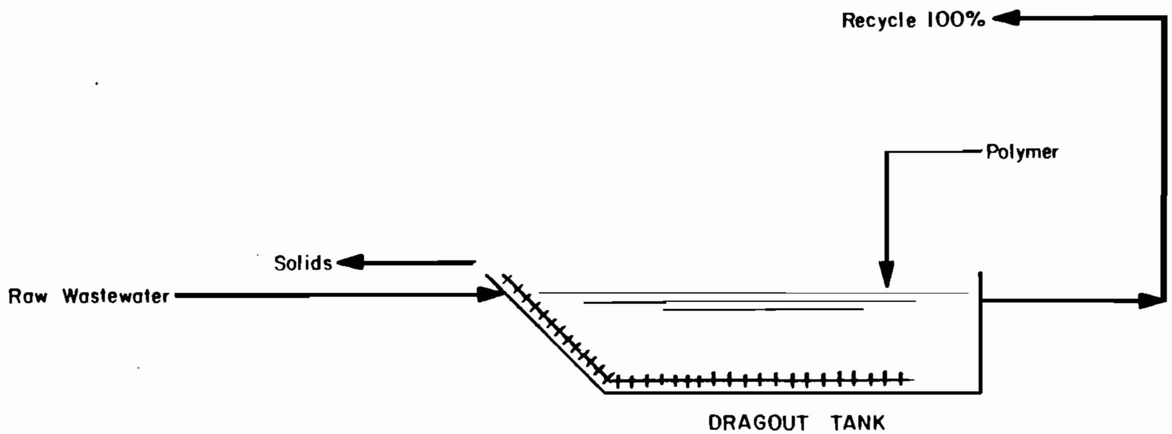


(1) pH control is not included in the PSES/PSNS models.

ELECTRIC ARC FURNACE-SEMI-WET
TREATMENT MODELS SUMMARY

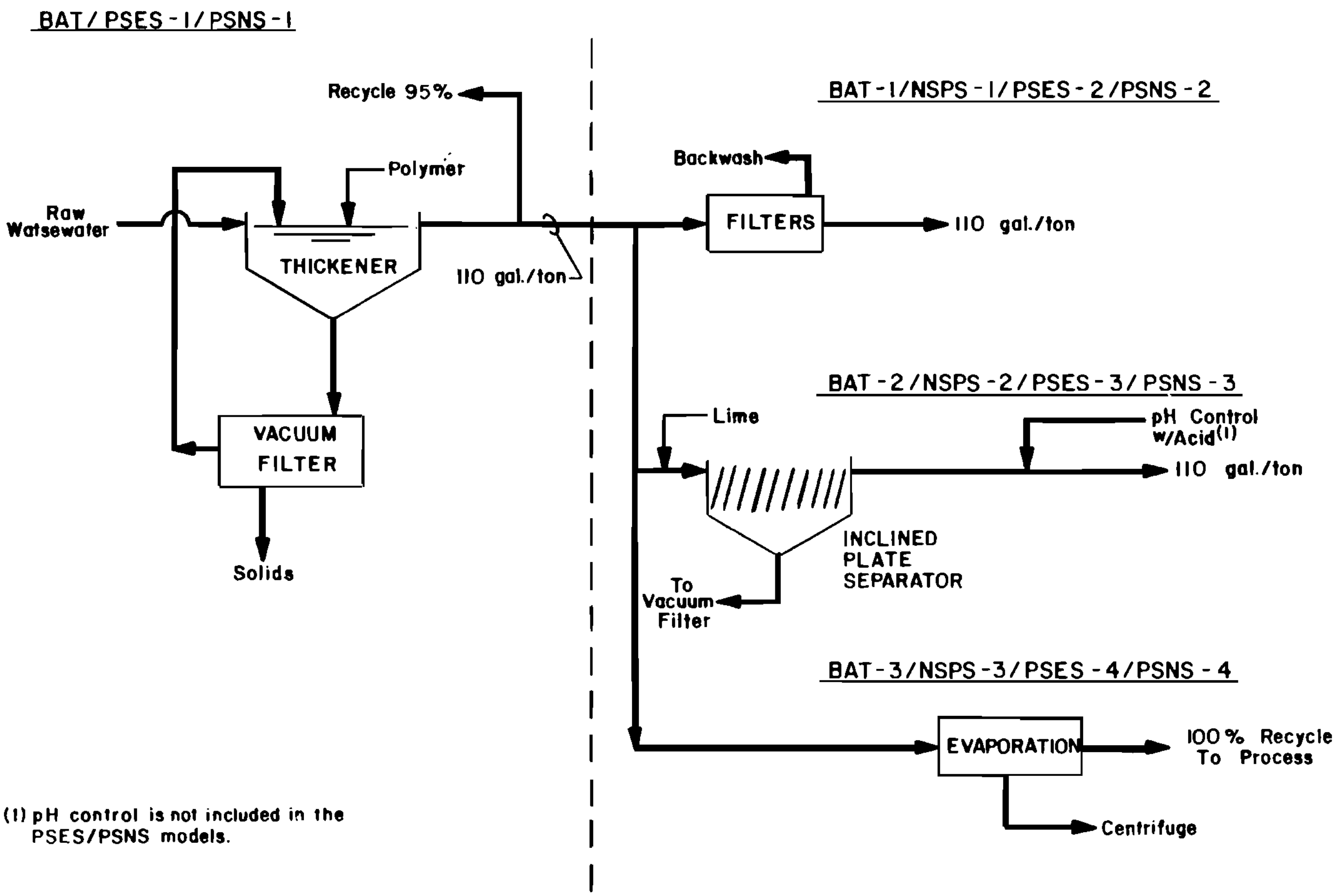
MODEL SIZE - 3100 TPD

BPT/BAT/BCT/PSES



ELECTRIC ARC FURNACE - WET
TREATMENT MODELS SUMMARY

MODEL PLANT - 1800 TPD



(1) pH control is not included in the PSES/PSNS models.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Steelmaking	MODEL SIZE (TPD):	5300
:	Basic Oxygen Furnace	OPER. DAYS/YEAR :	365
:	Semi-Wet	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		1.9 MGD
8	Direct Dischargers	15.3 MGD
0	Indirect Discharger	0.0 MGD
1	Zero Discharger	0.0 MGD
9	Active Plants	15.3 MGD

MODEL COSTS ($\$X10^{-3}$)	BPT/BCT BAT/PSES
Investment	590
Annual	100
$/Ton of Production	0.052

	WASTEWATER CHARACTERISTICS	RAW WASTE	
	Flow (GPT)	360	0
	pH (SU)	10-12	-
	Fluoride	10	-
	Total Suspended Solids	375	-
120	Copper*	0.04	-
122	Lead*	1.2	-
123	Mercury	0.002	-
128	Zinc*	1	-

Notes: All concentrations are in mg/l unless otherwise noted.
: NSPS and PSNS are reserved.

* Toxic pollutant found in all raw waste samples.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Steelmaking	MODEL SIZE (TPD):	7400
:	Basic Oxygen Furnace	OPER. DAYS/YEAR :	365
:	Wet-Suppressed Combustion	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant	7.4 MGD
5 Direct Dischargers	37.0 MGD
1 Indirect Discharger	7.4 MGD
6 Active Plants	44.4 MGD

MODEL COSTS ($X10^{-3})	BPT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	3170	247	308	4082
Annual	846	33.0	42.9	817
$/Ton of Production	0.31	0.012	0.016	0.30

	PSNS-1	NSPS-1 PSNS-2	NSPS-2 PSNS-3	NSPS-3 PSNS-4
Investment	3122	3417	3478	7204
Annual	836	879	889	1653
$/Ton of Production	0.31	0.33	0.33	0.61

WASTEWATER CHARACTERISTICS	RAW WASTE	BPT PSES-1 PSNS-1	BAT-1 NSPS-1 PSES-2 PSNS-2	BAT-2 NSPS-2 PSES-3 PSNS-3	BAT-3 NSPS-3 PSES-4 PSNS-4
Flow (GPT)	1000	50	50	50	0
pH (SU)	7-12	6-9	6-9	6-9	-
Fluoride	15	15	15	15	-
Total Suspended Solids	720	(50)36	(15)10	(25)22	-
118 Cadmium	0.06	0.01	0.01	0.01	-
119 Chromium	0.6	0.1	0.1	0.05	-
120 Copper*	0.15	0.15	0.1	0.05	-
122 Lead*	8	0.5	(0.5)0.4	(0.3)0.2	-
124 Nickel*	0.3	0.3	0.25	0.15	-
126 Silver	0.02	0.02	0.02	0.02	-
128 Zinc*	6.8	0.7	(0.5)0.4	(0.45)0.4	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Steelmaking	MODEL SIZE (TPD):	9100
:	Basic Oxygen Furnace	OPER. DAYS/YEAR :	365
:	Wet-Open Combustion	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		10.0 MGD
13	Direct Dischargers	130.1 MGD
1	Indirect Discharger	10.0 MGD
14	Active Plants	140.1 MGD

MODEL COSTS ($X10^{-3})	BPT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	4,738	539	474	7,549
Annual	1,102	74.8	69.6	1,774
$/Ton of Production	0.33	0.023	0.021	0.53

	PSNS-1	NSPS-1 PSNS-2	NSPS-2 PSNS-3	NSPS-3 PSNS-4
Investment	4,617	5,277	5,212	12,166
Annual	1,076	1,177	1,172	2,850
$/Ton of Production	0.32	0.36	0.35	0.86

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT PSES-1 PSNS-1	BAT-1 NSPS-1 PSES-2 PSNS-2	BAT-2 NSPS-2 PSES-3 PSNS-3	BAT-3 NSPS-3 PSES-4 PSNS-4
	Flow (GPT)	1,100	110	110	110	0
	pH (SU)	8-11	6-9	6-9	6-9	-
	Fluoride	20	20	20	20	-
	Total Suspended Solids	4,200	(50)38	(15)10	(25)22	-
23	Chloroform	0.05	0.05	0.05	0.05	-
115	Arsenic*	0.06	0.06	0.06	0.06	-
118	Cadmium	0.4	0.01	0.01	0.01	-
119	Chromium*	5.2	0.1	0.1	0.05	-
120	Copper*	1	0.15	0.1	0.05	-
122	Lead*	3.9	0.5	(0.5)0.4	(0.3)0.2	-
123	Mercury	0.02	0.001	0.001	0.001	-
124	Nickel	0.4	0.3	0.25	0.15	-
125	Selenium	0.02	0.02	0.02	0.02	-
126	Silver	0.08	0.01	0.01	0.01	-
127	Thallium	0.03	0.03	0.03	0.03	-
128	Zinc*	14	0.7	(0.5)0.4	(0.45)0.4	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Steelmaking
: Open Hearth
: Wet

MODEL SIZE (TPD): 6700
OPER. DAYS/YEAR : 365
TURNS/DAY : 3

RAW WASTE FLOWS

Model Plant		11.4 MGD
4	Direct Dischargers	45.6 MGD
0	Indirect Discharger	0 0 MGD
4	Active Plants	45.6 MGD

MODEL COSTS ($X10^{-3})	BPT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	4531	521	452	6336
Annual	957	70.8	72.1	1404
$/Ton of Production	0.39	0.029	0.029	0.57

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
	Flow (GPT)	1700	110	110	110	0
	pH (SU)	3-7	6-9	6-9	6-9	-
	Fluoride	150	140	140	20	-
	Total Suspended Solids	1700	(50)40	(15)10	(25)22	-
120	Copper*	1.4	0.05	0.4	0.05	-
122	Lead*	2.8	1.5	(0.35)0.3	(0.3)0.2	-
128	Zinc*	140	4.4	(5.0)4.4	(0.45)0.4	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT and PSES-1 costs.
: NSPS and PSNS are reserved.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Steelmaking	MODEL SIZE (TPD):	3100
:	Electric Arc Furnace	OPER. DAYS/YEAR :	365
:	Semi-Wet	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		0.5 MGD
2	Direct Dischargers	0.9 MGD
0	Indirect Discharger	0 MGD
1	Zero Discharge	0.5 MGD
3	Active Plants	1.4 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT BAT/PSES
Investment	368
Annual	79.2
$/Ton of Production	0.070

WASTEWATER CHARACTERISTICS		RAW WASTE	
	Flow (GPT)	150	0
	pH (SU)	6-9	-
	Fluoride	30	-
	Total Suspended Solids	2200	-
120	Copper*	2.4	-
122	Lead*	33	-
128	Zinc*	120	-

Notes: All concentrations are in mg/l unless otherwise noted.
: NSPS and PSNS are reserved.

* Toxic pollutant found in all raw waste samples.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Steelmaking
: Electric Arc Furnace
: Wet

MODEL SIZE (TPD): 1800
OPER. DAYS/YEAR : 365
TURNS/DAY : 3

RAW WASTE FLOWS

Model Plant		3.8 MGD
6	Direct Dischargers	22.7 MGD
1	Indirect Discharger	3.8 MGD
7	Active Plants	26.5 MGD

MODEL COSTS ($X10^{-3})	BPT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	2268	162	242	2782
Annual	596	21.5	35.5	512
$/Ton of Production	0.91	0.033	0.054	0.78

	PSNS-1	NSPS-1 PSNS-2	NSPS-2 PSNS-3	NSPS-3 PSNS-4
Investment	2268	2430	2510	5049
Annual	596	617	631	1107
$/Ton of Production	0.91	0.94	0.96	1.69

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT PSES-1 PSNS-1	BAT-1 NSPS-1 PSES-2 PSNS-2	BAT-2 NSPS-2 PSES-3 PSNS-3	BAT-3 NSPS-3 PSES-4 PSNS-4
	Flow (GPT)	2100	110	110	110	0
	pH (SU)	6-9	6-9	6-9	6-9	-
	Fluoride	40	35	35	20	-
	Total Suspended Solids	3400	(50)47	(15)10	(25)22	-
39	Fluoranthene	0.02	0.02	0.02	0.02	-
58	4-Nitrophenol	0.01	0.01	0.01	0.01	-
64	Pentachlorophenol	0.01	0.01	0.01	0.01	-
114	Antimony*	0.7	0.7	0.7	0.5	-
115	Arsenic*	1.2	0.01	0.01	0.01	-
118	Cadmium*	3.3	1.5	1.4	0.1	-
119	Chromium*	4.3	2	1.5	1.3	-
120	Copper*	1.3	0.15	0.15	0.1	-
122	Lead*	23	1.5	(1)0.95	(0.3)0.2	-
124	Nickel*	0.05	0.05	0.05	0.05	-
126	Silver*	0.06	0.06	0.06	0.06	-
128	Zinc*	100	20	(20)19	(0.45)0.4	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
STEELMAKING SUBCATEGORY

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT	BAT-1	BAT-2	BAT-3
Flow (MGD)	252.1	18.9	18.9	18.9	0
Fluoride	16,894.6	1,130.6	1,130.6	564.9	-
Total Suspended Solids	1,121,727.4	1,119.1	289.4	636.6	-
Total Toxic Metals	20,887.2	116.0	95.4	29.7	-
Total Organics	11.3	1.1	1.1	1.1	-
SUBCATEGORY COST SUMMARY(1) ($X10^{-6})					
Investment	-	112.00	11.00	10.74	156.60
Annual	-	26.28	1.51	1.58	34.87

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	21.2	1.6	1.6	1.6	0
Fluoride	704.2	49.6	49.6	45.0	-
Total Suspended Solids	91,715.8	92.4	23.8	52.5	-
Total Toxic Metals	1,333.2	11.7	10.0	2.8	-
Total Organics	1.0	0.09	0.09	0.09	-
SUBCATEGORY COST SUMMARY ($X10^{-6})					
Investment	-	11.16	0.00	0.55	0.00
Annual	-	2.79	0.00	0.071	0.00

(1) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
STEELMAKING SUBCATEGORY
BASIC OXYGEN FURNACE - SEMI-WET

	DIRECT DISCHARGERS	
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT
Flow (MGD)	15.3	0
Fluoride	232.5	-
Total Suspended Solids	8,717.4	-
Total Toxic Metals	52.1	-
Total Organics	-	-
SUBCATEGORY COST SUMMARY(1) (X10^{-6}$)		
Investment	-	4.31
Annual	-	0.65

Note: There are no indirect dischargers in this segment.

(1) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
STEELMAKING SUBCATEGORY
BASIC OXYGEN FURNACE - WET-SUPPRESSED COMBUSTION

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT	BAT-1	BAT-2	BAT-3
Flow (MGD)	37.0	1.8	1.8	1.8	0
Fluoride	845.2	42.3	42.3	42.3	-
Total Suspended Solids	40,571.7	101.4	28.2	62.0	-
Total Toxic Metals	897.6	5.0	3.6	2.5	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	15.81	1.23	1.54	20.36
Annual	-	4.22	0.16	0.21	4.08

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	7.4	0.4	0.4	0.4	0
Fluoride	169.0	8.5	8.5	8.5	-
Total Suspended Solids	8,114.3	20.3	5.6	12.4	-
Total Toxic Metals	179.5	1.0	0.7	0.5	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	3.06	0.00	0.00	0.00
Annual	-	0.82	0.00	0.00	0.00

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
STEELMAKING SUBCATEGORY
BASIC OXYGEN FURNACE - WET-OPEN COMBUSTION

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT	BAT-1	BAT-2	BAT-3
Flow (MGD)	130.1	13.0	13.0	13.0	0
Fluoride	3,963.7	396.4	396.4	396.4	-
Total Suspended Solids	832,369.1	753.1	198.2	436.0	-
Total Toxic Metals	4,976.4	37.3	27.4	19.4	-
Total Organics	9.9	1.0	1.0	1.0	-
SUBCATEGORY COST SUMMARY(1) ($X10^{-6})					
Investment	-	58.62	6.69	5.88	93.59
Annual	-	13.64	0.93	0.86	22.00

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	10.0	1.0	1.0	1.0	0
Fluoride	304.9	30.5	30.5	30.5	-
Total Suspended Solids	64,028.4	57.9	15.2	33.5	-
Total Toxic Metals	382.8	2.9	2.1	1.5	-
Total Organics	0.8	0.08	0.08	0.08	-
SUBCATEGORY COST SUMMARY ($X10^{-6})					
Investment	-	5.37	0.00	0.37	0.00
Annual	-	1.25	0.00	0.048	0.00

(1) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
STEELMAKING SUBCATEGORY
OPEN HEARTH - WET

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT	BAT-1	BAT-2	BAT-3
Flow (MGD)	45.6	2.9	2.9	2.9	0
Fluoride	10,407.9	628.6	628.6	89.8	-
Total Suspended Solids	117,956.5	179.6	44.9	98.8	-
Total Toxic Metals	10,005.5	26.7	21.3	2.9	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	17.78	2.05	1.77	24.89
Annual	-	3.75	0.28	0.28	5.52

Note: There are no indirect dischargers in this subdivision.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
STEELMAKING SUBCATEGORY
ELECTRIC ARC FURNACE - SEMI-WET

	DIRECT DISCHARGERS	
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT
Flow (MGD)	1.4	0
Fluoride	63.7	-
Total Suspended Solids	4,674.0	-
Total Toxic Metals	330.2	-
Total Organics	-	-
SUBCATEGORY COST SUMMARY ($X10^{-6})		
Investment	-	1.00
Annual	-	0.22

Note: There are no indirect dischargers in this segment.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
STEELMAKING SUBCATEGORY
ELECTRIC ARC FURNACE - WET

DIRECT DISCHARGERS

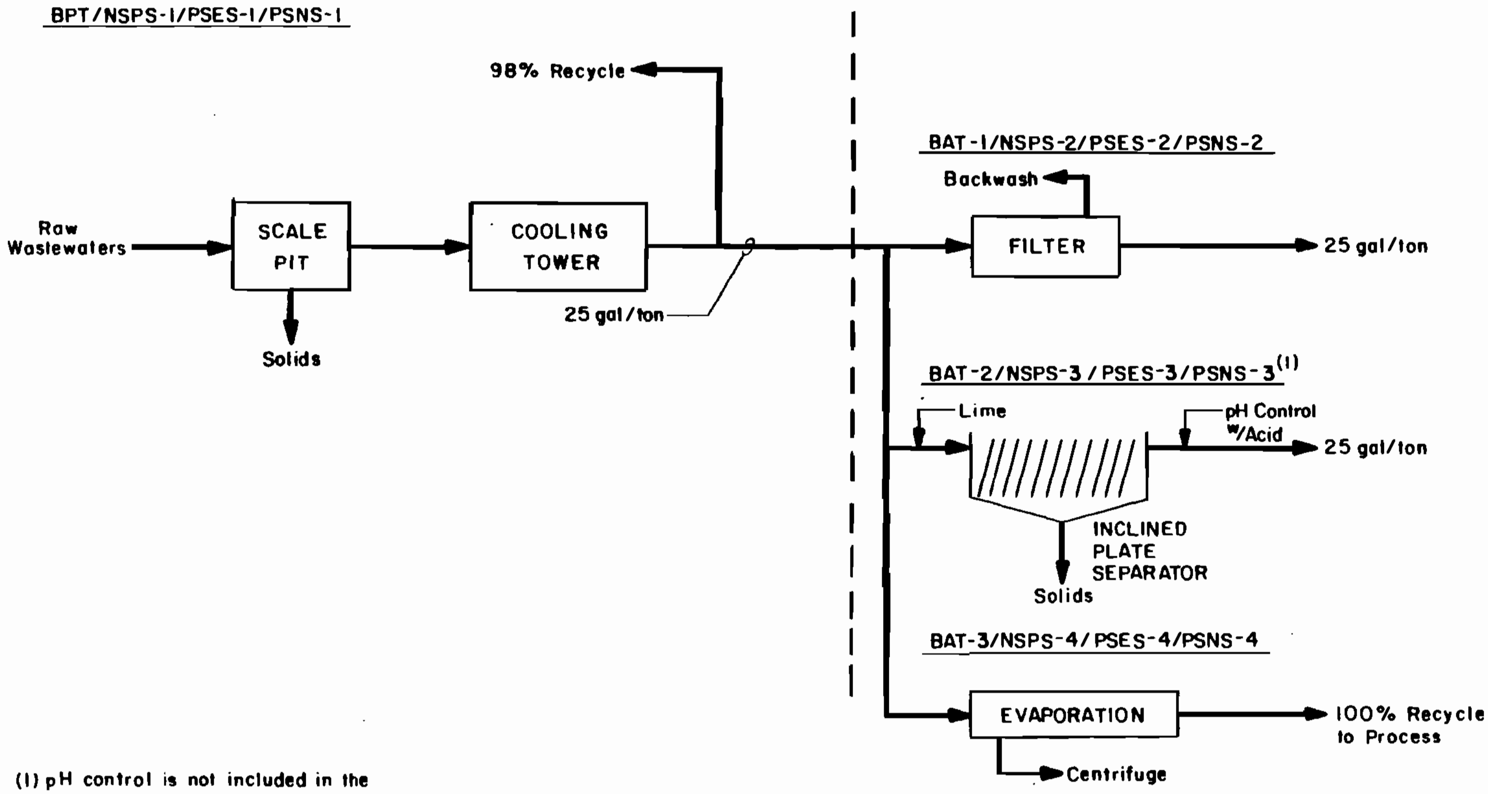
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT	BAT-1	BAT-2	BAT-3
Flow (MGD)	22.7	1.2	1.2	1.2	0
Fluoride	1,381.6	63.3	63.3	36.2	-
Total SuspendedSolids	117,438.7	85.0	18.1	39.8	-
Total Toxic Metals	4,625.4	47.0	43.1	4.9	-
Total Organics	1.4	0.07	0.07	0.07	-
SUBCATEGORY COST SUMMARY ($X10^{-6})					
Investment	-	14.48	1.03	1.55	17.76
Annual	-	3.80	0.14	0.23	3.27

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	3.8	0.2	0.2	0.2	0
Fluoride	230.3	10.6	10.6	6.0	-
Total Suspended Solids	19,573.1	14.2	3.0	6.6	-
Total Toxic Metals	770.9	7.8	7.2	0.8	-
Total Organics	0.2	0.01	0.01	0.01	-
SUBCATEGORY COST SUMMARY ($X10^{-6})					
Investment	-	2.73	0.00	0.18	0.00
Annual	-	0.72	0.00	0.023	0.22

VACUUM DEGASSING
TREATMENT MODELS SUMMARY

MODEL PLANT-1200 TPD



(1) pH control is not included in the PSES/PSNS models.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Vacuum Degassing
: Carbon and Specialty

MODEL SIZE (TPD): 1200
OPER. DAYS/YEAR : 365
TURNS/DAY : 3

RAW WASTE FLOWS

	Model Plant	1.7 MGD
31	Direct Dischargers	52.1 MGD
0	Indirect Dischargers	0.0 MGD
2	Zero Dischargers	3.4 MGD
33	Active Plants	55.5 MGD

MODEL COSTS ($X10^{-3})	BPT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	1116	32.0	124	1479
Annual	166	4.3	17.3	201
$/Ton of Production	0.38	0.0098	0.039	0.46

	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3	NSPS-4 PSNS-4
Investment	1116	1148	1240	2595
Annual	166	171	184	368
$/Ton of Production	0.38	0.39	0.42	0.84

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3	BAT-3. NSPS-4 PSES-4 PSNS-4
	Flow (GPT)	1400	25	25	25	0
	pH (SU)	6-9	6-9	6-9	6-9	-
	Manganese	5	5	5	1	-
	Total Suspended Solids	60	(50)34	(15)10	(25)22	-
119	Chromium*	0.5	0.5	0.5	0.1	-
120	Copper*	0.3	0.1	0.1	0.1	-
122	Lead*	1	0.7	(0.7)0.7	(0.3)0.2	-
124	Nickel	0.1	0.1	0.1	0.1	-
128	Zinc*	6	4.5	(4.5)4.5	(0.45)0.4	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
VACUUM DEGASSING SUBCATEGORY

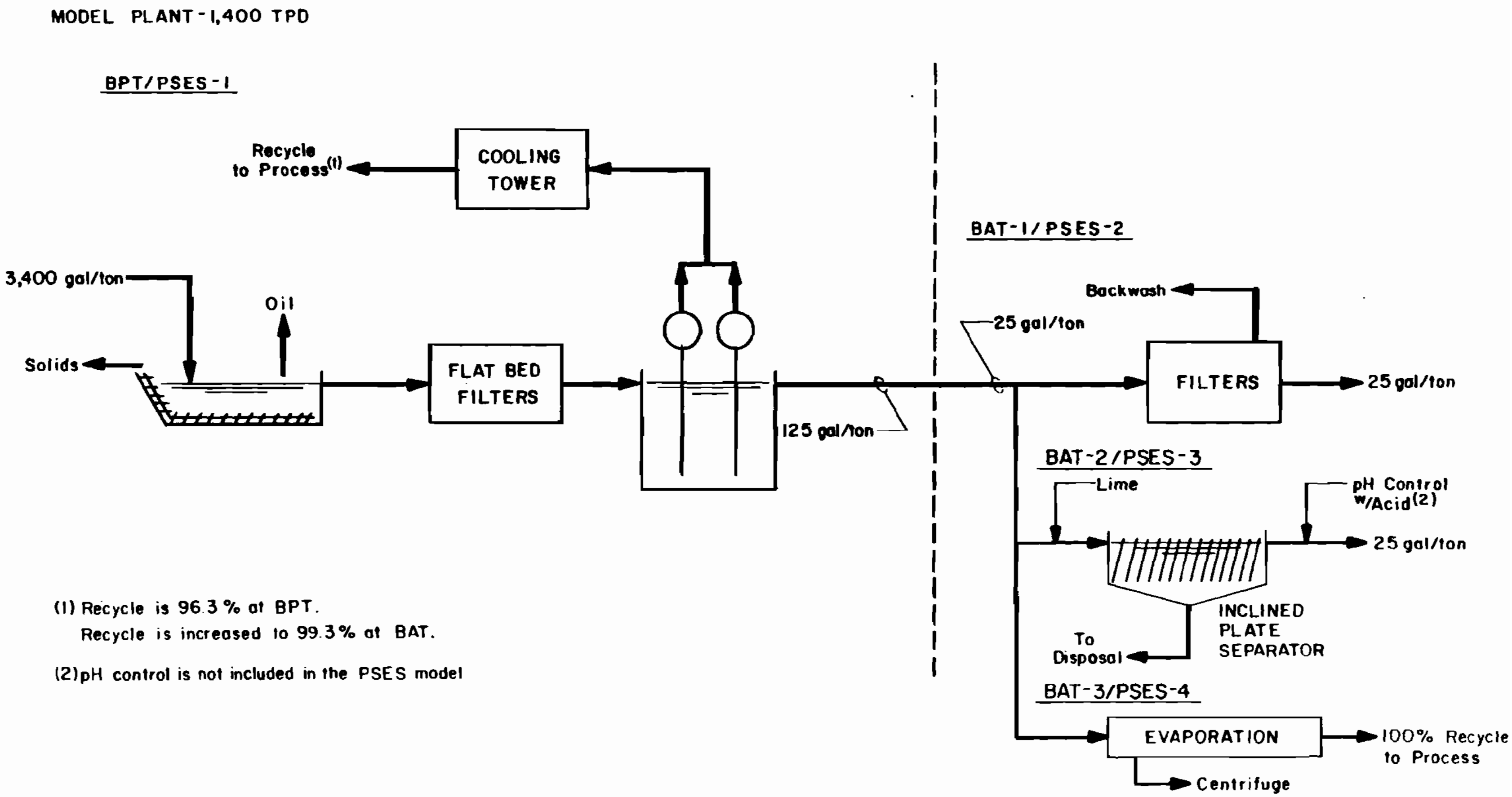
	DIRECT DISCHARGERS[1]				
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT	BAT-1	BAT-2	BAT-3
Flow (MGD)	55.4	0.9	0.9	0.9	0
Manganese	422.2	7.1	7.1	1.4	-
Total Suspended Solids	5,066.0	48.2	14.2	31.2	-
Total Toxic Metals	667.0	8.4	8.4	1.3	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY[2] ($\$X10^{-6}$)					
Investment	-	27.90	0.78	3.03	36.00
Annual	-	4.10	0.10	0.42	4.90

Note: There are no indirect dischargers in this subcategory.

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in this data. However, as these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) The cost summary totals do not include confidential plants.

CONTINUOUS CASTING
BPT/BAT/PSES
TREATMENT MODELS SUMMARY



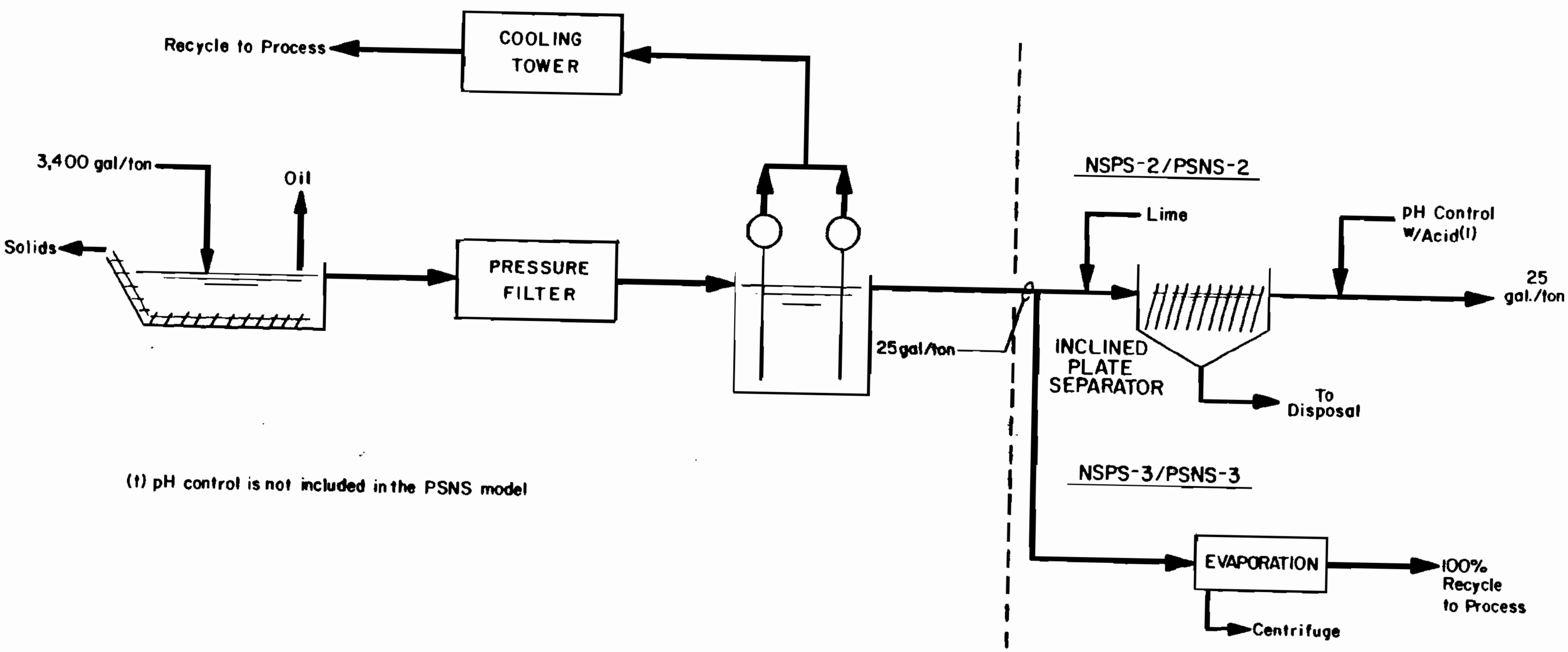
(1) Recycle is 96.3 % at BPT.
Recycle is increased to 99.3% at BAT.

(2) pH control is not included in the PSES model

CONTINUOUS CASTING
NSPS/PSNS
TREATMENT MODELS SUMMARY

MODEL PLANT - 1,400 TPD

NSPS - 1 / PSNS - 1



(1) pH control is not included in the PSNS model

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Continuous Casting

MODEL SIZE (TPD): 1400
OPER. DAYS/YEAR : 365
TURNS/DAY : 3

RAW WASTE FLOWS

Model Plant		4.8 MGD
25	Direct Dischargers	119.0 MGD
7	Indirect Dischargers	33.3 MGD
17	Zero Dischargers	80.9 MGD
49	Active Plants	233.2 MGD

MODEL COSTS ($X10^{-3})	BPT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	2304	35.4	124	1581
Annual	356	4.8	17.3	219
$/Ton of Production	0.70	0.0094	0.034	0.43

	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3
Investment	3442	3566	5023
Annual	499	516	718
$/Ton of Production	0.98	1.01	1.40

WASTEWATER CHARACTERISTICS	RAW WASTE	BPT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2	BAT-3 NSPS-3 PSES-4 PSNS-3
Flow (GPT)	3400	125	25	25	0
pH (SU)	6-9	6-9	6-9	6-9	-
Oil and Grease	25	(15)10	(5**)2.0	(10)4.4	-
Total Suspended Solids	60	(50)40	(15)9.8	(25)22	-
119 Chromium	0.65	0.65	0.65	0.65	-
120 Copper	0.11	0.11	0.11	0.1	-
122 Lead	0.08	0.08	(0.1)0.08	(0.3)0.08	-
125 Selenium	0.08	0.08	0.08	0.08	-
128 Zinc	0.7	0.7	(0.7)0.7	(0.45)0.4	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
CONTINUOUS CASTING SUBCATEGORY

DIRECT DISCHARGERS[(1)]

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT	BAT-1	BAT-2	BAT-3
Flow (MGD)	199.9	4.4	0.9	0.9	0
Oil and Grease	7,611.8	66.6	2.7	5.9	-
Total Suspended Solids	18,268.2	266.5	13.1	29.3	-
Total Toxic Metals	493.2	10.8	2.2	1.7	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY[(2)] ($\$X10^{-6}$)					
Investment	-	64.39	0.88	3.05	39.75
Annual	-	9.38	0.12	0.42	5.50

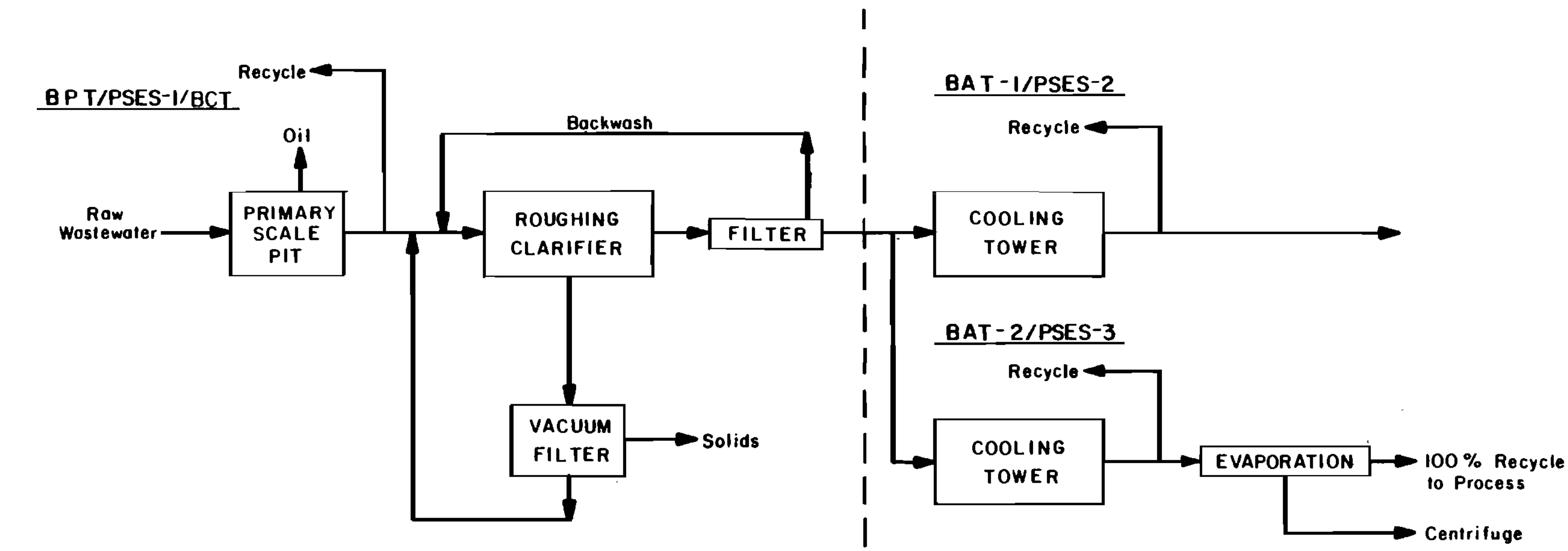
INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	33.3	1.2	0.2	0.2	0
Oil and Grease	1,268.6	18.7	0.7	1.6	-
Total Suspended Solids	3,044.7	74.6	3.7	8.2	-
Total Toxic Metals	82.2	3.0	0.6	0.5	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	8.90	0.14	0.77	8.54
Annual	-	1.33	0.02	0.09	1.18

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) The cost summary totals do not include confidential plants.

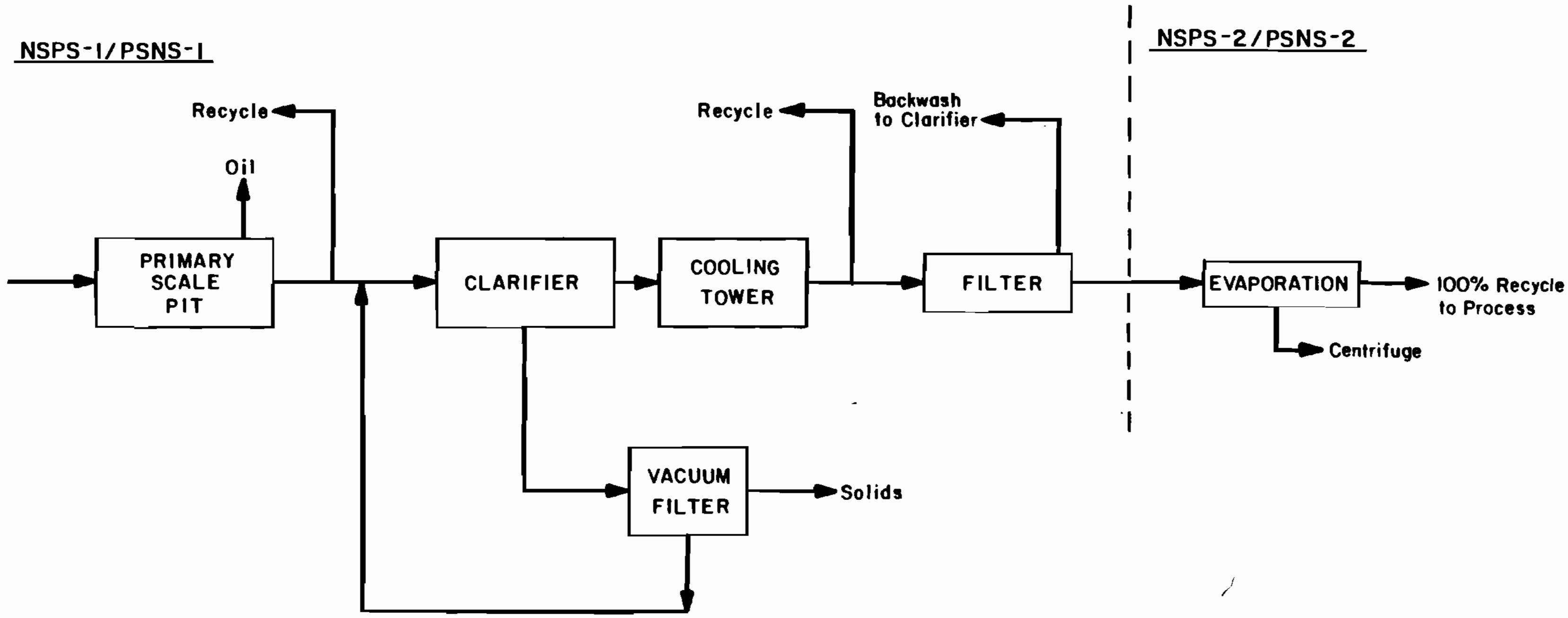
HOT FORMING
BPT/BCT/BAT/PSES
TREATMENT MODELS SUMMARY



HOT FORMING FLOW RATES

SUBDIVISION		APPLIED FLOW (GPT)	PSP RECYCLE (%)	BPT DISCHARGE FLOW (GPT)	BAT RECYCLE (%)[1]	BAT DISCHARGE FLOW (GPT)
PRIMARY	w/o Scarfer	2300	61	897	35	90
	w/Scarfer	3400	61	1326	35	140
SECTION	Carbon	5100	58	2142	38	200
	Specialty	3200	58	1344	38	130
FLAT	Hot Strip	6400	60	2560	36	260
	Carbon Plate	3400	60	1360	36	140
	Specialty Plate	1500	60	600	36	60
PIPE & TUBE		5520	77	1270	19	220

HOT FORMING
NSPS/PSNS
TREATMENT MODELS SUMMARY



SUBDIVISION		NSPS FLOW RATES APPLIED FLOW(GPT)	COMBINED RECYCLE RATE(%)	DISCHARGE FLOW (GPT)
PRIMARY	wo/scarfer	2300	96	90
	w/scarfer	3400	96	140
SECTION	Carbon	5100	96	200
	Specialty	3200	96	130
FLAT	Hot Strip	6400	96	260
	Carbon Plate	3400	96	140
	Specialty Plate	1500	96	60
PIPE & TUBE		5520	96	220

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: All Subdivisions

RAW WASTE FLOWS

227	Direct Dischargers	3,594.6 MGD
18	Indirect Dischargers	294.5 MGD
9	Zero Dischargers	85.2 MGD
262	Active Plants	3,974.3 MGD

	WASTEWATER CHARACTERISTICS	RAW WASTE	BAT-1 BPT BCT PSES-1	BAT-2 NSPS-1 PSES-2 PSNS-1	NSPS-2 PSES-3 PSNS-2
	pH (SU)	6-9	6-9	6-9	-
	Oil and Grease	30-130	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	790-3300	(15)9.8	(15)9.8	-
119	Chromium	<0.05-12	0.001	(0.10)0.001	-
120	Copper	0.3-20	0.011	0.011	-
122	Lead	<0.05-11	0.007	(0.10)0.007	-
124	Nickel	0.8-20	0.006	0.006	-
128	Zinc	0.6-5.4	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: Values in parentheses represent the concentrations used to develop the limitations for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Hot Forming	MODEL SIZE (TPD):	7400
:	Primary	OPER. DAYS/YEAR :	260
:	Carbon With Scarfers	TURNS/DAY :	3

RAW WASTE FLOWS

	Model Plant	25.2 MGD
30	Direct Dischargers	754.8 MGD
2	Indirect Dischargers	50.3 MGD
32	Active Plants	805.1 MGD

MODEL COSTS ($X10^{-3})	BPT BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	NSPS-1 PSNS-1	NSPS-2 PSNS-2
Investment	4863	2558	10132	5568	13141
Annual	-698	392	1934	-556	986
$/Ton of Production	-0.36	0.20	1.01	-0.29	0.51

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT BCT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2
	Flow (GPT)	3400	1326	140	0
	pH (SU)	6-9	6-9	6-9	-
	Oil and Grease	56	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	3000	(15)9.8	(15)9.8	-
119	Chromium	1.3	0.001	(0.10)0.001	-
120	Copper	5.7	0.011	0.011	-
122	Lead	6.5	0.007	(0.10)0.007	-
124	Nickel	5.7	0.006	0.006	-
128	Zinc	3.1	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: Primary
: Carbon Without Scarfers

MODEL SIZE (TPD): 3800
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Model Plant		8.7 MGD
30	Direct Dischargers	262.2 MGD
2	Indirect Dischargers	17.5 MGD
1	Zero Discharger	8.7 MGD
33	Active Plants	288.4 MGD

MODEL COSTS ($\$X10^{-3}$)	BPT BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	NSPS-1 PSNS-1	NSPS-2 PSNS-2
Investment	2300	1240	5187	2868	6816
Annual	-44.5	184	884	46	746
$/Ton of Production	-0.04	0.19	0.89	0.05	0.76

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT BCT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2
	Flow (GPT)	2300	897	90	0
	pH (SU)	6-9	6-9	6-9	-
	Oil and Grease	85	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	2200	(15)9.8	(15)9.8	-
119	Chromium	1.9	0.001	(0.10)0.001	-
120	Copper	11	0.011	0.011	-
122	Lead	7.5	0.007	(0.10)0.007	-
124	Nickel	4.6	0.006	0.006	-
128	Zinc	4.0	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Hot Forming	MODEL SIZE (TPD):	1850
:	Primary	OPER. DAYS/YEAR :	260
:	Specialty With Scarfers	TURNS/DAY :	3

RAW WASTE FLOWS

	Model Plant	6.3 MGD
5	Direct Dischargers	31.4 MGD
0	Indirect Dischargers	0.0 MGD
5	Active Plants	31.4 MGD

MODEL COSTS ($X10^{-3})	BPT BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	NSPS-1 PSNS-1	NSPS-2 PSNS-2
Investment	1963	1022	4243	2610	5832
Annual	-68.9	151	703	27.8	580
$/Ton of Production	-0.14	0.31	1.46	0.06	1.21

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT BCT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2
	Flow (GPT)	3400	1326	140	0
	pH (SU)	6-9	6-9	6-9	-
	Oil and Grease	56	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	3000	(15)9.8	(15)9.8	-
119	Chromium	12	0.001	(0.10)0.001	-
120	Copper	20	0.001	0.001	-
122	Lead	2.8	0.007	(0.10)0.007	-
124	Nickel	12	0.006	0.006	-
128	Zinc	4.1	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Hot Forming	MODEL SIZE (TPD):	1200
:	Primary	OPER. DAYS/YEAR :	260
:	Specialty Without Scarfers	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		2.8 MGD
11	Direct Dischargers	30.4 MGD
2	Indirect Dischargers	5.5 MGD
1	Zero Discharger	2.8 MGD
14	Active Plants	38.7 MGD

MODEL COSTS ($X10^{-3})	BPT BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	NSPS-1 PSNS-1	NSPS-2 PSNS-2
Investment	1361	676	2946	1804	4073
Annual	71.5	95.8	445	134	484
$/Ton of Production	0.23	0.31	1.43	0.43	1.55

WASTEWATER CHARACTERISTICS	RAW WASTE	BPT BCT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2
Flow (GPT)	2300	897	90	0
pH (SU)	6-9	6-9	6-9	-
Oil and Grease	85	(5**)2.0	(5**)2.0	-
Total Suspended Solids	2200	(15)9.8	(15)9.8	-
119 Chromium	<0.05	0.001	(0.10)0.001	-
120 Copper	0.3	0.011	0.011	-
122 Lead	<0.05	0.007	(0.10)0.007	-
124 Nickel	13	0.006	0.006	-
128 Zinc	1.9	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: Section
: Carbon

MODEL SIZE (TPD): 3050
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

	Model Plant	15.6 MGD
48	Direct Dischargers	746.6 MGD
7	Indirect Dischargers	108.9 MGD
4	Zero Discharges	62.2 MGD
59	Active Plants	917.7 MGD

MODEL COSTS ($\$X10^{-3}$)	BPT BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	NSPS-1 PSNS-1	NSPS-2 PSNS-2
Investment	3985	1715	7446	4163	9894
Annual	267	266	1350	327	1411
$/Ton of Production	0.34	0.34	1.70	0.41	1.78

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT BCT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2
	Flow (GPT)	5100	2142	200	0
	pH (SU)	6-9	6-9	6-9	-
	Oil and Grease	38	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	990	(15)9.8	(15)9.8	-
119	Chromium	0.4	0.001	(0.10)0.001	-
120	Copper	1.9	0.011	0.011	-
122	Lead	0.4	0.007	(0.10)0.007	-
124	Nickel	1.3	0.006	0.006	-
128	Zinc	5.4	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Hot Forming		MODEL SIZE (TPD):	1200
:	Section		OPER. DAYS/YEAR :	260
:	Specialty		TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		3.8 MGD
17	Direct Dischargers	65.3 MGD
1	Indirect Dischargers	3.8 MGD
3	Zero Dischargers	11.5 MGD
21	Active Plants	80.6 MGD

MODEL COSTS ($\$X10^{-3}$)	BPT BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	NSPS-1 PSNS-1	NSPS-2 PSNS-2
Investment	1525	815	3297	1891	4372
Annual	94.0	117	518	150	550
$/Ton of Production	0.30	0.38	1.66	0.48	1.76

WASTEWATER CHARACTERISTICS	RAW WASTE	BPT BCT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2
Flow (GPT)	3200	1344	130	0
pH (SU)	6-9	6-9	6-9	-
Oil and Grease	60	(5**)2.0	(5**)2.0	-
Total Suspended Solids	1600	(15)9.8	(15)9.8	-
119 Chromium	0.8	0.001	(0.10)0.001	-
120 Copper	2.9	0.011	0.011	-
122 Lead	3.2	0.007	(0.10)0.007	-
124 Nickel	6.3	0.006	0.006	-
128 Zinc	1.4	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Hot Forming	MODEL SIZE (TPD):	7250
:	Flat	OPER. DAYS/YEAR :	260
:	Carbon Hot Strip and Sheet	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		46.4 MGD
30	Direct Dischargers	1392.0 MGD
2	Indirect Dischargers	92.8 MGD
32	Active Plants	1484.8 MGD

MODEL COSTS ($\$X10^{-3}$)	BPT BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	NSPS-1 PSNS-1	NSPS-2 PSNS-2
Investment	6589	3941	18253	8314	22625
Annual	270	617	3504	585	3472
$/Ton of Production	0.14	0.33	1.86	0.31	1.84

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT BCT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2
	Flow (GPT)	6400	2560	260	0
	pH (SU)	6-9	6-9	6-9	-
	Oil and Grease	30	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	790	(15)9.8	(15)9.8	-
119	Chromium	1.8	0.001	(0.10)0.001	-
120	Copper	0.4	0.011	0.011	-
122	Lead	0.7	0.007	(0.10)0.007	-
124	Nickel	0.8	0.006	0.006	-
128	Zinc	1.3	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Hot Forming	MODEL SIZE (TPD):	900
:	Flat	OPER. DAYS/YEAR :	260
:	Specialty Hot Strip and Sheet	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		5.8 MGD
7	Direct Dischargers	40.3 MGD
0	Indirect Dischargers	0.0 MGD
7	Active Plants	40.3 MGD

MODEL COSTS ($X10^{-3})	BPT BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	NSPS-1 PSNS-1	NSPS-2 PSNS-2
Investment	1871	1000	4053	2318	5371
Annual	174	148	666	246	764
$/Ton of Production	0.74	0.63	2.85	1.05	3.26

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT BCT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2
	Flow (GPT)	6400	2560	260	0
	pH (SU)	6-9	6-9	6-9	-
	Oil and Grease	30	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	790	(15)9.8	(15)9.8	-
119	Chromium	1.9	0.001	(0.10)0.001	-
120	Copper	0.3	0.011	0.011	-
122	Lead	<0.05	0.007	(0.10)0.007	-
124	Nickel	3.4	0.006	0.006	-
128	Zinc	0.6	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: Flat
: Specialty Plate

MODEL SIZE (TPD): 1000
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Model Plant		1.5 MGD
5	Direct Dischargers	7.5 MGD
0	Indirect Dischargers	0.0 MGD
5	Active Plants	7.5 MGD

MODEL COSTS ($X10^{-3})	BPT BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	NSPS-1 PSNS-1	NSPS-2 PSNS-2
Investment	1112	642	2588	1343	3289
Annual	53.6	91.5	370	90.9	370
$/Ton of Production	0.20	0.35	1.42	0.35	1.42

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT BCT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2
	Flow (GPT)	1500	600	60	0
	pH (SU)	6-9	6-9	6-9	-
	Oil and Grease	130	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	3400	(15)9.8	(15)9.8	-
119	Chromium	2.9	0.001	(0.10)0.001	-
120	Copper	5.1	0.011	0.011	-
122	Lead	11	0.007	(0.10)0.007	-
124	Nickel	20	0.006	0.006	-
128	Zinc	1.9	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based on 10 mg/l (maximum only).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Forming
: Flat
: Carbon Plate

MODEL SIZE (TPD): 3150
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Model Plant		10.7 MGD
11	Direct Dischargers	117.8 MGD
1	Indirect Dischargers	10.7 MGD
12	Active Plants	128.5 MGD

MODEL COSTS ($\$X10^{-3}$)	BPT BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	NSPS-1 PSNS-1	NSPS-2 PSNS-2
Investment	2619	1390	5851	3258	7720
Annual	63.8	210	802	172	764
$/Ton of Production	0.08	0.26	0.98	0.21	0.93

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT BCT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2
	Flow (GPT)	3400	1360	140	0
	pH (SU)	6-9	6-9	6-9	-
	Oil and Grease	56	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	1500	(15)9.8	(15)9.8	-
119	Chromium	1.3	0.001	(0.10)0.001	-
120	Copper	4.9	0.011	0.011	-
122	Lead	2.1	0.007	(0.10)0.007	-
124	Nickel	3.9	0.006	0.006	-
128	Zinc	1.8	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Hot Forming	MODEL SIZE (TPD):	900
:	Pipe and Tube	OPER. DAYS/YEAR :	260
:	Carbon	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		5.0 MGD
25	Direct Dischargers	124.2 MGD
1	Indirect Dischargers	5.0 MGD
26	Active Plants	129.2 MGD

MODEL COSTS ($X10^{-3})	BPT BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	NSPS-1 PSNS-1	NSPS-2 PSNS-2
Investment	1572	676	3470	1871	4664
Annual	197	95.8	562	241	708
$/Ton of Production	0.84	0.41	2.40	1.03	3.02

WASTEWATER CHARACTERISTICS		RAW WASTE	BPT BCT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2
	Flow (GPT)	5520	1270	220	0
	pH (SU)	6-9	6-9	6-9	-
	Oil and Grease	56	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	1500	(15)9.8	(15)9.8	-
119	Chromium	2.9	0.001	(0.10)0.001	-
120	Copper	5.1	0.011	0.011	-
122	Lead	11	0.007	(0.10)0.007	-
124	Nickel	20	0.006	0.006	-
128	Zinc	1.9	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Hot Forming	MODEL SIZE (TPD):	500
:	Pipe and Tube	OPER. DAYS/YEAR :	260
:	Specialty	TURNS/DAY :	3

RAW WASTE FLOWS

	Model Plant	2.8 MGD
8	Direct Dischargers	22.1 MGD
0	Indirect Dischargers	0.0 MGD
8	Active Plants	22.1 MGD

MODEL COSTS ($\$X10^{-3}$)	BPT BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	NSPS-1 PSNS-1	NSPS-2 PSNS-2
Investment	1264	642	2911	1544	3814
Annual	125	91.5	440	167	516
$/Ton of Production	0.95	0.70	3.38	1.29	3.97

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT BCT PSES-1	BAT-1 NSPS-1 PSES-2 PSNS-1	BAT-2 NSPS-2 PSES-3 PSNS-2
	Flow (GPT)	5520	1270	220	0
	pH (SU)	6-9	6-9	6-9	-
	Oil and Grease	56	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	1500	(15)9.8	(15)9.8	-
119	Chromium	0.2	0.001	(0.10)0.001	-
120	Copper	0.9	0.011	0.011	-
122	Lead	2.1	0.007	(0.10)0.007	-
124	Nickel	1.3	0.006	0.006	-
128	Zinc	1.7	0.049	(0.15)0.049	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES-2 and PSES-3 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

**Limit for oil and grease is based upon 10 mg/l (maximum only).

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING SUBCATEGORY

	DIRECT DISCHARGERS[1]			
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW[2] WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	3,679.9	1,418.5	145.2	0
Oil and Grease	174,540.2	3,077.6	314.5	-
Total Suspended Solids	5,878,201.0	15,081.0	1,540.8	-
Total Toxic Metals	49,460.4	113.9	11.6	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY[3] ($X10^{-6})				
Investment	-	460.28	279.24	1,454.59
Annual	-	-29.03	42.86	267.05

	INDIRECT (POTW) DISCHARGERS			
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3
Flow (MGD)	294.5	124.7	11.9	0
Oil and Grease	13,776.7	355.2	25.7	-
Total Suspended Solids	444,155.8	1,337.6	125.6	-
Total Toxic Metals	3,504.5	9.2	0.9	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY[3] ($X10^{-6})				
Investment	-	32.50	23.10	108.61
Annual	-	-1.30	3.68	19.26

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.
(2) Raw waste loads for zero discharge plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING - PRIMARY
CARBON WITH SCARFERS

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	754.8	294.4	31.1	0
Oil and Grease	45,857.4	638.7	67.4	-
Total Suspended Solids	2,456,647.6	3,129.8	330.4	-
Total Toxic Metals	18,261.1	23.6	2.5	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)				
Investment	-	97.23	61.21	271.62
Annual	-	-26.94	9.65	52.49

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3
Flow (MGD)	50.3	19.6	2.1	0
Oil and Grease	3,057.2	42.6	4.5	-
Total Suspended Solids	163,776.5	208.7	22.0	-
Total Toxic Metals	1,217.4	1.6	0.2	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)				
Investment	-	4.36	3.10	12.28
Annual	-	-1.03	0.47	2.34

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING - PRIMARY
CARBON WITHOUT SCARFERS

DIRECT DISCHARGERS[1]

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW[2] WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	270.9	102.3	10.3	0
Oil and Grease	24,985.1	221.9	22.3	-
Total Suspended Solids	646,674.2	1,087.2	109.1	-
Total Toxic Metals	8,524.3	8.2	0.8	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY[3] ($X10^{-6})				
Investment	-	44.00	25.10	120.77
Annual	-	-3.97	3.63	20.60

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3
Flow (MGD)	17.5	6.8	0.7	0
Oil and Grease	1,611.9	14.8	1.5	-
Total Suspended Solids	41,720.9	72.5	7.3	-
Total Toxic Metals	550.0	0.6	0.05	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY[3] ($X10^{-6})				
Investment	-	5.64	2.82	14.50
Annual	-	-0.29	0.42	2.49

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.
(2) Raw waste loads for zero discharge plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING - PRIMARY
SPECIALTY WITH SCARFERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	DIRECT DISCHARGERS RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	31.5	12.3	1.3	0
Oil and Grease	1,910.7	26.6	2.8	-
Total Suspended Solids	102,360.3	130.4	13.8	-
Total Toxic Metals	1,736.7	1.0	0.1	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)				
Investment	-	6.74	4.72	25.22
Annual	-	-0.75	0.67	4.18

Note: There are no indirect (POTW) dischargers in this segment.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING - PRIMARY
SPECIALTY WITHOUT SCARFERS

DIRECT DISCHARGERS(1)

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW(2) WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	33.1	11.8	1.2	0
Oil and Grease	3,054.1	25.7	2.6	-
Total Suspended Solids	79,050.2	125.9	12.6	-
Total Toxic Metals	546.2	1.0	0.1	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY(3) ($X10^{-6})				
Investment	-	7.25	3.02	16.41
Annual	-	-0.15	0.36	2.42

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3
Flow (MGD)	5.5	2.2	0.2	0
Oil and Grease	509.0	4.7	0.5	-
Total Suspended Solids	13,175.0	22.9	2.3	-
Total Toxic Metals	91.0	0.2	0.02	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY(3) ($X10^{-6})				
Investment	-	0.97	0	5.44
Annual	-	-0.03	0.14	0.67

(1) The raw waste load and BPT cost contributions of the zero discharge operation are included in the direct discharger data. As this plant has no wastewater discharge, it does not contribute to BAT costs or to the BPT and BAT effluent waste loads.
(2) Raw waste loads for zero discharge plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING - SECTION
CARBON

DIRECT DISCHARGERS(1)

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW(2) WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	808.9	313.6	29.3	0
Oil and Grease	33,346.2	680.4	63.5	-
Total Suspended Solids	868,756.9	3,334.1	311.3	-
Total Toxic Metals	8,247.4	25.2	2.4	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY(3) ($X10^{-6})				
Investment	-	108.01	58.53	319.92
Annual	-	1.52	8.80	58.25

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3
Flow (MGD)	108.9	52.0	4.3	0
Oil and Grease	4,488.9	197.3	9.3	-
Total Suspended Solids	116,948.0	563.8	45.4	-
Total Toxic Metals	885.8	3.3	0.3	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY(3) ($X10^{-6})				
Investment	-	14.12	10.05	43.61
Annual	-	0.18	1.55	7.90

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.
(2) Raw waste loads for zero discharge plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING - SECTION
SPECIALTY

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	DIRECT DISCHARGERS[1] RAW[2] WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	76.8	27.4	2.7	0
Oil and Grease	4,999.2	59.5	5.8	-
Total Suspended Solids	133,312.5	291.5	28.2	-
Total Toxic Metals	1,216.5	2.2	0.2	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY[3] ($X10^{-6})				
Investment	-	17.44	6.26	41.54
Annual	-	0.14	0.87	6.56

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	INDIRECT (POTW) DISCHARGERS RAW WASTE	PSES-1	PSES-2	PSES-3
Flow (MGD)	3.8	1.6	0.2	0
Oil and Grease	250.0	3.5	0.3	-
Total Suspended Solids	6,665.6	17.2	1.7	-
Total Toxic Metals	60.8	0.1	0.01	-
Total Organics	-	-		
SUBCATEGORY COST SUMMARY[3] ($X10^{-6})				
Investment	-	0.05	0.05	0.39
Annual	-	-0.01	0.01	0.06

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.
(2) Raw waste loads for the zero discharge plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING - FLAT
HOT STRIP AND SHEET - CARBON

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	1,392.0	556.8	56.6	0
Oil and Grease	45,305.4	1,208.1	122.7	-
Total Suspended Solids	1,193,042.8	5,919.9	601.2	-
Total Toxic Metals	7,550.9	44.7	4.5	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)				
Investment	-	125.29	86.06	483.37
Annual	-	-1.78	13.91	95.79

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3
Flow (MGD)	92.8	37.1	3.8	0
Oil and Grease	3,020.4	80.5	8.2	-
Total Suspended Solids	79,536.2	394.7	40.1	-
Total Toxic Metals	503.4	3.0	0.3	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)				
Investment	-	3.39	5.09	23.57
Annual	-	-0.33	0.80	4.53

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING - FLAT
HOT STRIP AND SHEET - SPECIALTY

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	40.3	16.1	1.6	0
Oil and Grease	1,312.3	35.0	3.6	-
Total Suspended Solids	34,557.1	171.5	17.4	-
Total Toxic Metals	271.2	1.3	0.1	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY[1] ($\$X10^{-6}$)				
Investment	-	5.19	5.40	22.58
Annual	-	0.25	0.80	3.71

Note: There are no indirect (POTW) discharges in this segment.

(1) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING - FLAT
PLATE - CARBON

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	117.8	47.1	4.9	0
Oil and Grease	7,157.5	102.2	10.5	-
Total Suspended Solids	191,718.1	501.0	51.6	-
Total Toxic Metals	1,789.4	3.8	0.4	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)				
Investment	-	20.15	11.72	58.97
Annual	-	-0.36	1.76	8.03

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3
Flow (MGD)	10.7	4.3	0.4	0
Oil and Grease	650.7	9.3	1.0	-
Total Suspended Solids	17,428.9	45.6	4.7	-
Total Toxic Metals	162.7	0.3	0.04	-
Total Organics	-	-		
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)				
Investment	-	2.81	1.49	6.27
Annual	-	0.07	0.22	0.86

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING - FLAT
PLATE - SPECIALTY

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	DIRECT DISCHARGERS[1] RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	7.5	3.0	0.3	0
Oil and Grease	1,057.8	6.5	0.7	-
Total Suspended Solids	27,665.0	31.9	3.2	-
Total Toxic Metals	332.8	0.2	0.02	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY[2] ($\$X10^{-6}$)				
Investment	-	3.19	2.11	8.28
Annual	-	0.10	0.30	1.18

Note: There are no indirect (POTW) dischargers in this segment.

(1) The raw waste load and BPT cost contributions of the zero discharge operation are included in the direct discharger data. As this plant has no wastewater discharge, it does not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING - PIPE AND TUBE
CARBON

DIRECT DISCHARGERS[1]

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	124.2	28.6	5.0	0
Oil and Grease	4,716.1	62.0	10.7	-
Total Suspended Solids	122,617.6	303.8	52.6	-
Total Toxic Metals	835.4	2.3	0.4	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY[2] ($X10^{-6})				
Investment	-	22.11	13.38	72.59
Annual	-	2.64	1.87	11.81

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3
Flow (MGD)	5.0	1.1	0.2	0
Oil and Grease	188.6	2.5	0.4	-
Total Suspended Solids	4,904.7	12.2	2.1	-
Total Toxic Metals	33.4	0.09	0.02	0
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY[2] ($X10^{-6})				
Investment	-	1.16	0.50	2.55
Annual	-	0.14	0.07	0.41

(1) The raw waste load and BPT cost contributions of the zero discharge operation are included in the direct discharger data. As this plant has no wastewater discharge, it does not contribute to BAT costs or to the BPT and BAT effluent waste loads.
(2) The cost summary totals do not include confidential plants.

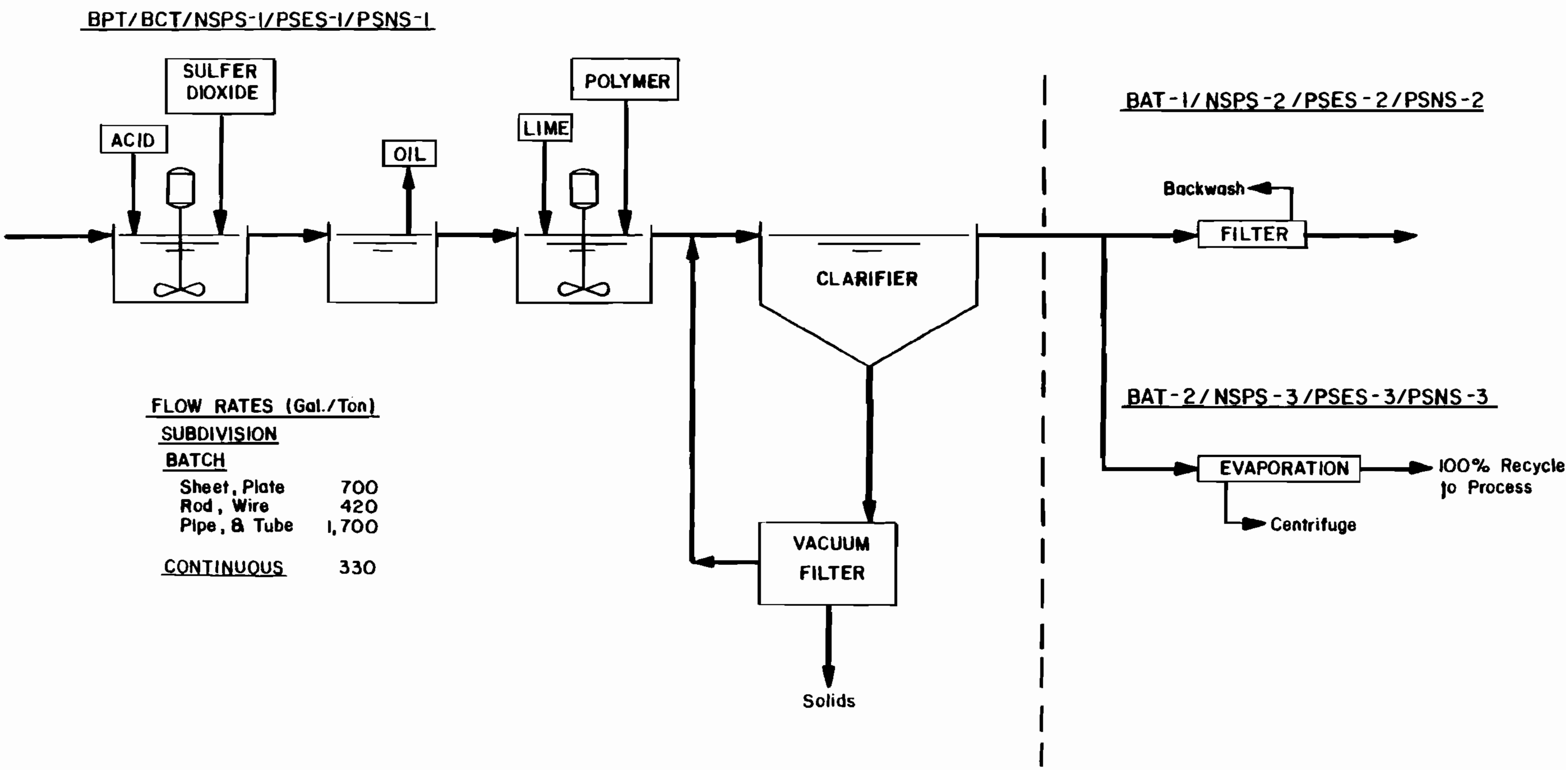
SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT FORMING - PIPE AND TUBE
SPECIALTY

	DIRECT DISCHARGERS			
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	22.1	5.1	0.9	0
Oil and Grease	838.4	11.0	1.9	-
Total Suspended Solids	21,798.7	54.0	9.4	-
Total Toxic Metals	148.5	0.4	0.07	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY(1) ($X10^{-6})				
Investment	-	3.68	1.73	13.32
Annual	-	0.27	0.24	2.03

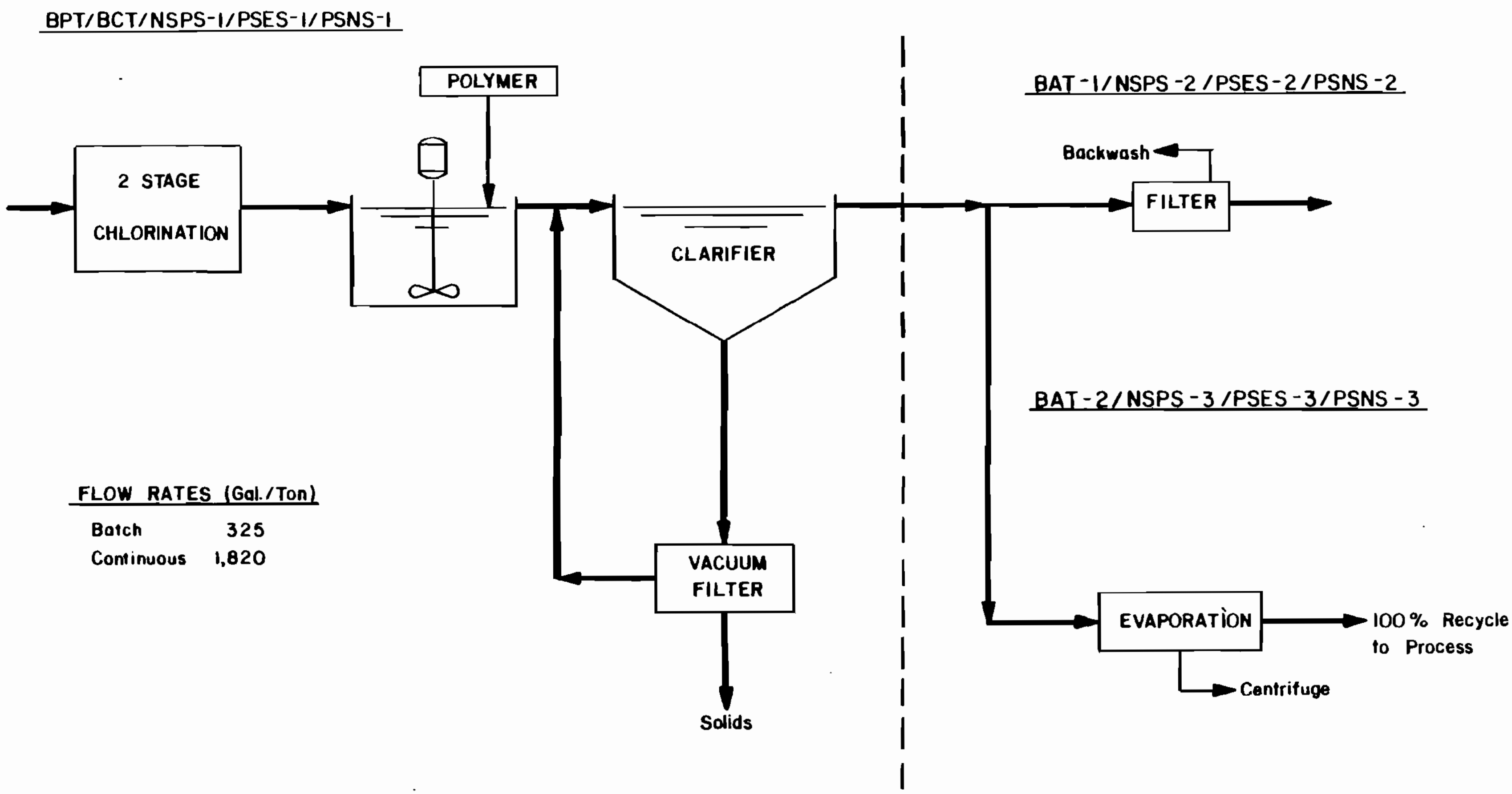
Note: There are no indirect (POTW) dischargers in this segment.

(1) The cost summary totals do not include confidential plants.

SALT BATH DESCALING
OXIDIZING
TREATMENT MODELS SUMMARY



SALT BATH DESCALING
REDUCING
TREATMENT MODELS SUMMARY



SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Salt Bath Descaling
: Oxidizing
: Batch-Sheet/Plate

MODEL SIZE (TPD): 60
OPER. DAYS/YEAR : 260
TURNS/DAY : 2

RAW WASTE FLOWS

	Model Plant	0.04 MGD
5	Direct Dischargers	0.2 MGD
0	Indirect Dischargers	0 MGD
5	Active Plants	0.2 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3
Investment	364	50.9	1984
Annual	53.9	6.8	285
$/Ton of Production	3.46	0.44	18.27

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3
	Flow (GPT)	700	700	700	0
	pH (SU)	11-13	6-9	6-9	-
	Chromium (Hexavalent)	200	0.05	0.05	-
	Total Suspended Solids	500	(30)23.8	(15)9.8	-
23	Chloroform	0.04	0.04	0.04	-
114	Antimony	0.2	0.1	0.1	-
115	Arsenic*	0.024	0.024	0.024	-
119	Chromium*	240	(0.4)0.28	(0.1)0.03	-
120	Copper*	1	0.04	0.03	-
123	Mercury	0.015	0.015	0.015	-
124	Nickel	7	(0.3)0.25	(0.1)0.04	-
125	Selenium*	0.024	0.024	0.024	-
127	Thallium	0.12	0.12	0.12	-
128	Zinc	0.1	0.06	0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, NSPS,PSES and PSNS costs are incremental over BPT/NSPS-1/PSES-1/PSNS-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

*Toxic pollutant found in all raw waste samples.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Salt Bath Descaling	MODEL SIZE (TPD): 115
: Oxidizing	OPER. DAYS/YEAR : 260
: Batch - Rod/Wire/Bar	TURNS/DAY : 2

RAW WASTE FLOWS

Model Plant	0.05 MGD
3 Direct Dischargers	0.1 MGD
1 Indirect Dischargers	0.05 MGD
4 Active Plants	0.2 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3
Investment	387	54.9	2042
Annual	57.4	7.2	298
$/Ton of Production	1.92	0.24	9.97

WASTEWATER CHARACTERISTICS		RAW WASTE	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3
	Flow (GPT)	420	420	420	0
	pH (SU)	11-13	6-9	6-9	-
	Chromium (Hexavalent)	200	0.05	0.05	-
	Total Suspended Solids	500	(30)23.8	(15)9.8	-
23	Chloroform	0.04	0.04	0.04	-
114	Antimony	0.2	0.1	0.1	-
115	Arsenic*	0.024	0.024	0.024	-
119	Chromium*	240	(0.4)0.28	(0.1)0.03	-
120	Copper*	1	0.04	0.03	-
123	Mercury	0.015	0.015	0.015	-
124	Nickel	7	(0.3)0.25	(0.1)0.04	-
125	Selenium*	0.024	0.024	0.024	-
127	Thallium	0.12	0.12	0.12	-
128	Zinc	0.1	0.06	0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, NSPS, PSES and PSNS costs are incremental over BPT/NSPS-1/PSES-1/PSNS-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Salt Bath Descaling	MODEL SIZE (TPD):	35
:	Oxidizing	OPER. DAYS/YEAR :	260
:	Batch - Pipe and Tube	TURNS/DAY :	2

RAW WASTE FLOWS

Model Plant		0.06 MGD
2	Direct Dischargers	0.1 MGD
0	Indirect Dischargers	0 MGD
2	Active Plants	0.1 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3
Investment	435	62.5	2278
Annual	64.3	8.2	337
$/Ton of Production	7.07	0.90	37.03

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3
	Flow (GPT)	1700	1700	1700	0
	pH (SU)	11-13	6-9	6-9	-
	Chromium (Hexavalent)	200	0.05	0.05	-
	Total Suspended Solids	500	(30)23.8	(15)9.8	-
23	Chloroform	0.04	0.04	0.04	-
114	Antimony	0.2	0.1	0.1	-
115	Arsenic*	0.024	0.024	0.024	-
119	Chromium*	240	(0.4)0.28	(0.1)0.03	-
120	Copper*	1	0.04	0.03	-
123	Mercury	0.015	0.015	0.015	-
124	Nickel	7	(0.3)0.25	(0.1)0.04	-
125	Selenium*	0.024	0.024	0.024	-
127	Thallium	0.12	0.12	0.12	-
128	Zinc	0.1	0.06	0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, NSPS, PSES, and PSNS costs are incremental over BPT/NSPS-1/PSES-1/PSNS-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Salt Bath Descaling	MODEL SIZE (TPD):	140
:	Oxidizing	OPER. DAYS/YEAR :	260
:	Continuous	TURNS/DAY :	2

RAW WASTE FLOWS

Model Plant	0.05 MGD
7 Direct Dischargers	0.3 MGD
1 Indirect Dischargers	0.05 MGD
8 Active Plants	0.4 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3
Investment	375	53.6	2042
Annual	55.7	7.0	296
$/Ton of Production	1.53	0.19	8.13

WASTEWATER CHARACTERISTICS	RAW WASTE	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3
Flow (GPT)	330	330	330	0
pH (SU)	11-13	6-9	6-9	-
Chromium (Hexavalent)	200	0.05	0.05	-
Total Suspended Solids	500	(30)23.8	(15)9.8	-
23 Chloroform	0.04	0.04	0.04	-
114 Antimony	0.2	0.1	0.1	-
115 Arsenic*	0.024	0.024	0.024	-
119 Chromium*	240	(0.4)0.28	(0.1)0.03	-
120 Copper*	1	0.04	0.03	-
123 Mercury	0.015	0.015	0.015	-
124 Nickel	7	(0.3)0.25	(0.1)0.04	-
125 Selenium*	0.024	0.024	0.024	-
127 Thallium	0.12	0.12	0.12	-
128 Zinc	0.1	0.06	0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES, PSNS and NSPS costs are incremental over BPT/PSES-1/PSNS-1/NSPS-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Salt Bath Descaling	MODEL SIZE (TPD):	130
:	Reducing	OPER. DAYS/YEAR :	260
:	Batch	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		0.04 MGD
4	Direct Dischargers	0.2 MGD
1	Indirect Dischargers	0.04 MGD
5	Active Plants	0.2 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3
Investment	291	39.6	1582
Annual	41.5	5.2	215
$/Ton of Production	1.23	0.15	6.36

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3
	Flow (GPT)	325	325	325	0
	pH (SU)	11-12	6-9	6-9	-
	Chromium (Hexavalent)	0.26	0.05	0.05	-
	Iron (Dissolved)	12.4	1	0.5	-
	Total Suspended Solids	420	(30)23.8	(15)9.8	-
114	Antimony*	0.48	0.1	0.1	-
118	Cadmium	0.042	0.042	0.042	-
119	Chromium*	5.6	(0.4)0.28	(0.1)0.03	-
120	Copper*	0.4	0.04	0.03	-
121	Cyanide	0.038	(0.25)0.038	(0.25)0.038	-
122	Lead*	0.45	0.1	0.06	-
124	Nickel*	3	(0.3)0.25	(0.1)0.04	-
125	Selenium*	0.018	0.018	0.018	-
126	Silver	0.06	0.06	0.06	-
128	Zinc*	0.092	0.06	0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, PSES,PSNS and NSPS costs are incremental over BPT/PSES-1/PSNS-1/NSPS-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Salt Bath Descaling	MODEL SIZE (TPD):	20
:	Reducing	OPER. DAYS/YEAR :	260
:	Continuous	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		0.04 MGD
2	Direct Dischargers	0.08 MGD
0	Indirect Dischargers	0 MGD
2	Active Plants	0.08 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3
Investment	354	36.2	1582
Annual	48.8	4.9	212
$/Ton of Production	9.38	0.94	40.77

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3
	Flow (GPT)	1820	1820	1820	0
	pH (SU)	11-12	6-9	6-9	-
	Chromium (Hexavalent)	0.26	0.05	0.05	-
	Iron (Dissolved)	12.4	1	0.5	-
	Total Suspended Solids	420	(30)23.8	(15)9.8	-
114	Antimony*	0.48	0.1	0.1	-
118	Cadmium	0.042	0.042	0.042	-
119	Chromium*	5.6	(0.4)0.28	(0.1)0.03	-
120	Copper*	0.4	0.04	0.03	-
121	Cyanide	0.038	(0.25)0.038	(0.25)0.038	-
122	Lead*	0.45	0.1	0.06	-
124	Nickel*	3	(0.3)0.25	(0.1)0.04	-
125	Selenium*	0.018	0.018	0.018	-
126	Silver	0.06	0.06	0.06	-
128	Zinc*	0.92	0.06	0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT, NSPS, PSES, and PSNS costs are incremental over BPT/NSPS-1/PSES-1/PSNS-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
SALT BATH DESCALING SUBCATEGORY

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	1.0	1.0	1.0	0
Dissolved Iron	3.3	0.3	0.1	-
Total Suspended Solids	429.2	21.4	8.9	-
Total Cyanide	(1)	(1)	(1)	-
Total Toxic Metals	161.2	0.8	0.4	-
Total Organics	(1)	(1)	(1)	-
SUBCATEGORY COST SUMMARY(2) ($X10^{-6})				
Investment	-	4.92	0.92	35.23
Annual	-	0.73	0.11	5.05

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3
Flow (MGD)	0.1	0.1	0.1	0
Dissolved Iron	0.6	(1)	(1)	-
Total Suspended Solids	70.6	3.5	1.4	-
Total Cyanide	(1)	(1)	(1)	-
Total Toxic Metals	30.0	0.1	(1)	-
Total Organics	(1)	(1)	(1)	-
SUBCATEGORY COST SUMMARY ($X10^{-6})				
Investment	-	1.19	0.26	9.52
Annual	-	0.18	0.04	1.37

(1) Load is less than 0.05 tons/year.
(2) Cost Summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
SALT BATH DESCALING SUBCATEGORY - OXIDIZING

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	0.8	0.8	0.8	0
Total Suspended Solids	319.0	15.2	6.3	-
Total Toxic Metals	158.5	0.6	0.3	-
Total Organics	(1)	(1)	(1)	-
SUBCATEGORY COST SUMMARY(2) ($X10^{-6})				
Investment	-	4.11	0.72	27.07
Annual	-	0.61	0.09	3.95

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3
Flow (MGD)	0.1	0.1	0.1	0
Total Suspended Solids	51.3	2.4	1.0	-
Total Toxic Metals	25.5	0.1	(1)	-
Total Organics	(1)	(1)	(1)	-
SUBCATEGORY COST SUMMARY ($X10^{-6})				
Investment	-	1.08	0.24	8.90
Annual	-	0.16	0.04	1.29

(1) Load is less than 0.05 tons/year.
(2) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
SALT BATH DESCALING SUBCATEGORY - REDUCING

DIRECT DISCHARGERS

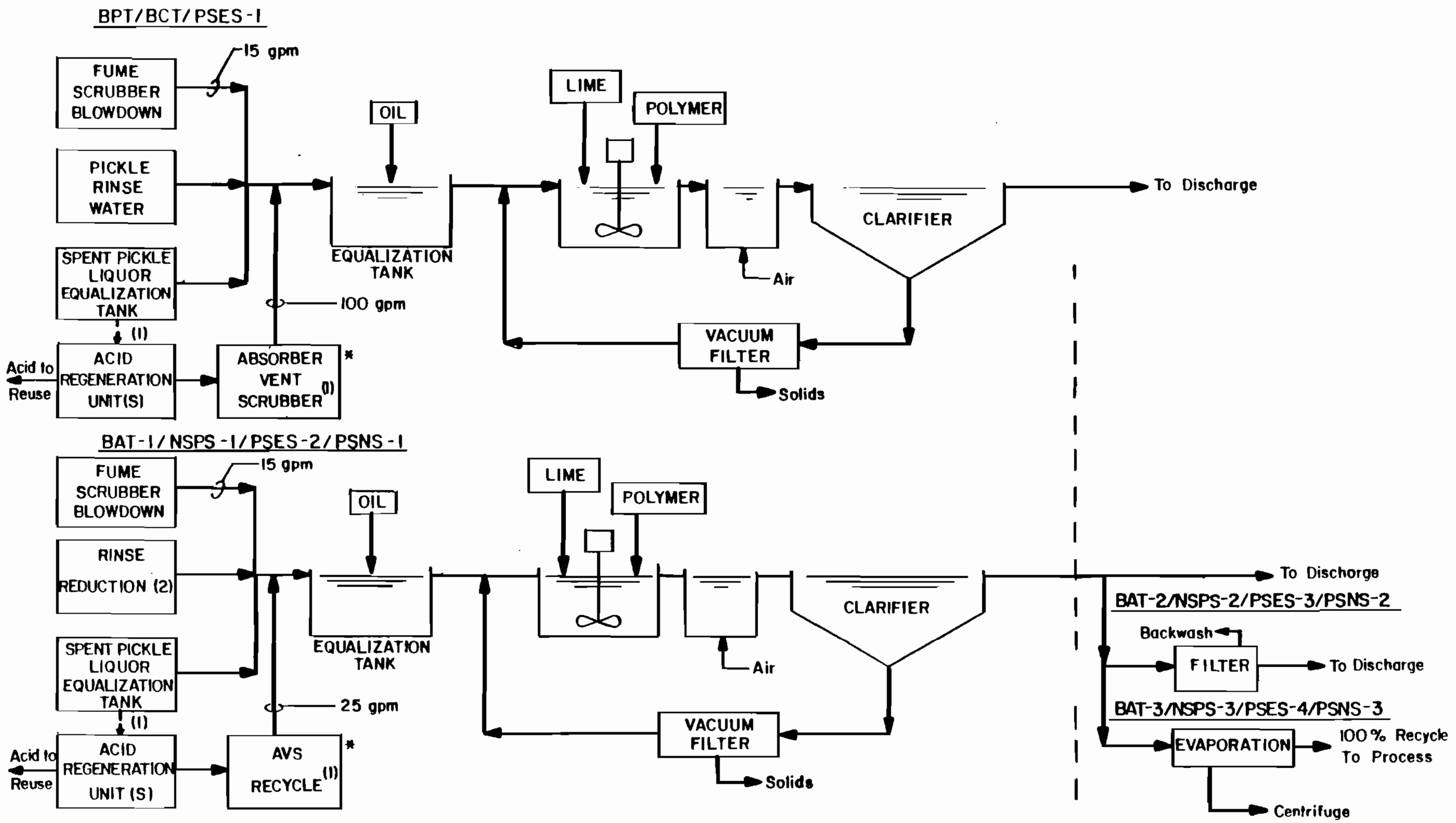
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	0.2	0.2	0.2	0
Dissolved Iron	3.3	0.3	0.1	-
Total Suspended Solids	110.2	6.2	2.6	-
Total Cyanide	(1)	(1)	(1)	-
Total Toxic Metals	2.7	0.2	0.1	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)				
Investment	-	0.81	0.20	8.16
Annual	-	0.12	0.02	1.10

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3
Flow (MGD)	0.04	0.04	0.04	0
Dissolved Iron	0.6	(1)	(1)	-
Total Suspended Solids	19.3	1.1	0.4	-
Total Cyanide	(1)	(1)	(1)	-
Total Toxic Metals	0.5	(1)	(1)	-
Total Organics	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)				
Investment	-	0.11	0.02	0.62
Annual	-	0.02	0.002	0.08

(1) Load is less than 0.05 tons/year.

ACID PICKLING
TREATMENT MODELS SUMMARY



(1) Hydrochloric Acid Regeneration Systems Only at BPT, BAT, BCT and PSES.

(2) Reduces Rinse Flows by 90%

* Replaces Spent Pickle Liquor Allowance for Hydrochloric Acid Regeneration System.

BPT/BCT/PSES-1 RINSEWATER FLOW RATES (gal/ton)

	SULFURIC	HYDROCHLORIC	COMBINATION
ROD/WIRE/COIL	260	480	490
BAR/BILLET/BLOOM	70	—	210
PIPE/TUBE/OTHER	480	1,010	750
STRIP/SHEET/PLATE (Cont.)	160	270	1,480
STRIP/SHEET/PLATE (Batch)	—	—	440
SPENT PICKLE LIQUOR	20	10	20

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Sulfuric Acid Pickling
: Strip/Sheet/Plate
: Neutralization and Acid Recovery

MODEL SIZE (TPD): 1660
OPER. DAYS/YEAR : 320
TURNS/DAY : 3

RAW WASTE FLOWS

Rinses and Concentrates		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.3 MGD	Model Plant	0.19 MGD	
23 Direct Dischargers	6.9 MGD	14 Direct Dischargers	2.7 MGD	9.6 MGD
4 Indirect Dischargers	1.2 MGD	2 Indirect Dischargers	0.4 MGD	1.6 MGD
1 Plant Hauling All Wastes	0.3 MGD	0 Plants Hauling All Wastes	0 MGD	0.3 MGD
2 Acid Recovery Plants	0.6 MGD	0 Acid Recovery Plants	0 MGD	0.6 MGD
30 Active Plants	9.0 MGD	16 Active Plants	3.1 MGD	12.1 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment				
Neutralization	1545	598	703	2969
Acid Recovery	3048	-	-	-
Annual				
Neutralization	1060	74.7	88.4	441
Acid Recovery	567	-	-	-
$/Ton of Production				
Neutralization	1.99	0.14	0.17	0.83
Acid Recovery	1.07	-	-	-

	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3
Investment	1955	2060	4326
Annual	1106	1119	1472
$/Ton of Production	2.08	2.11	2.77

WASTEWATER CHARACTERISTICS	RAW WASTE Conc	Rinse	FS (1)	Total (1)	BPT/BCT(2) PSES-1 Conc & Rinse	FS (1)	BAT-1/PSES-2-1 NSPS-1/PSNS-1 Conc & Rinse	FS (1)	BAT-2/PSES-3 NSPS-2/PSNS-2 Conc & Rinse	FS (1)	BAT-3/PSES-4 NSPS-3/PSNS-3
Flow (GPT)	20	160	135	342	180	15	40	15	40	15	0
pH (SU)	<1-2	<1-6.4	<1-3	<1-6.4	6-9		6-9		6-9		
Dissolved Iron	49,000	3900	560	5600	1		1		0.5		-
Oil and Grease	25	24	4.6	16	(10)4.4		(10)4.4		(5**)2		-
Total Suspended Solids	2100	190	16	250	(30)23.8		(30)23.8		(15)9.8		-
115 Arsenic*	0.18	0.35	0.08	0.23	0.1		0.1		0.1		-
118 Cadmium	0.33	0.032	-	0.04	0.04		0.04		0.04		-
119 Chromium*	170	6.4	1.1	15	0.04		0.04		0.03		-
120 Copper*	3.4	2.5	0.63	1.8	0.04		0.04		0.03		-
122 Lead*	1.1	0.47	0.03	0.34	(0.15)0.1		(0.15)0.1		(0.1)0.06		-
124 Nickel*	24	2.5	1.6	3.6	0.15		0.15		0.04		-
126 Silver	0.44	0.016	-	0.04	0.04		0.04		0.04		-
128 Zinc*	50	13	0.29	10	(0.1)0.06		(0.1)0.06		(0.1)0.06		-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
\- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).
(2) Zero discharge of process wastewater pollutants can be achieved with acid recovery systems.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Sulfuric Acid Pickling
: Rod/Wire/Coil
: Neutralization and Acid Recovery

MODEL SIZE (TPD): 370
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Rinses and Concentrates			Fume Scrubbers (Additional Flow)			Total Flow
Model Plant		0.10 MGD	Model Plant		0.19 MGD	
16	Direct Dischargers	1.7 MGD	2	Direct Dischargers	0.4 MGD	2.1 MGD
18	Indirect Dischargers	1.9 MGD	2	Indirect Dischargers	0.4 MGD	2.3 MGD
2	Plants Hauling All Wastes	0.2 MGD	0	Plants Hauling All Wastes	0 MGD	0.2 MGD
5	Acid Recovery Plants	0.5 MGD	0	Acid Recovery Plants	0 MGD	0.5 MGD
41	Active Plants	4.3 MGD	4	Active Plants	0.8 MGD	5.1 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment				
Neutralization	1026	133	173	1715
Acid Recovery	1092	-	-	-
Annual				
Neutralization	325	16.8	22.1	239
Acid Recovery	170	-	-	-
$/Ton of Production				
Neutralization	3.38	0.17	0.23	2.48
Acid Recovery	1.77	-	-	-

	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3
Investment	1033	1073	2615
Annual	324	329	546
$/Ton of Production	3.37	3.42	5.68

	WASTEWATER CHARACTERISTICS	RAW WASTE				BPT/BCT(2) PSES-1		BAT-1/PSES-2 NSPS-1/PSNS-1		BAT-2/PSES-3 NSPS-2/PSNS-2		BAT-3/PSES-4 NSPS-3/PSNS-3
		Conc	Rinse	FS (1)	Total (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	
	Flow (GPT)	20	260	135	207	280	15	50	15	50	15	0
	pH (SU)	<1-2	<1-6.4	<1-3	<1-6.4	6-9		6-9		6-9		
	Dissolved Iron	49,000	3,900	560	2,800	1		1		0.5		-
	Oil and Grease	25	24	4.6	11	(10)4.4		(10)4.4		(5**)2.0		-
	Total Suspended Solids	2,100	190	16	120	(30)23.8		(30)23.8		(15)9.8		-
115	Arsenic*	0.18	0.35	0.08	0.17	0.1		0.1		0.1		-
118	Cadmium	0.33	0.032	-	0.02	0.02		0.02		0.02		-
119	Chromium*	170	6.4	1.1	6.9	0.04		0.04		0.03		-
120	Copper*	3.4	2.5	0.63	1.3	0.04		0.04		0.03		-
122	Lead*	1.1	0.47	0.03	0.2	(0.15)0.1		(0.15)0.1		(0.1)0.06		-
124	Nickel*	24	2.5	1.6	2.4	0.15		0.15		0.04		-
126	Silver	0.44	0.016	-	0.02	0.02		0.02		0.02		-
128	Zinc*	50	13	0.29	5.6	(0.1)0.06		(0.1)0.06		(0.1)0.06		-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease based upon mg/l (maximum only).
\- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).
(2) Zero discharge of process wastewater pollutants can be achieved with acid recovery systems.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Sulfuric Acid Pickling
: Bar/Billet/Bloom
: Neutralization and Acid Recovery

MODEL SIZE (TPD): 720
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Rinses and Concentrates		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.06 MGD	Model Plant	0.19 MGD	
15 Direct Dischargers	1.0 MGD	2 Direct Dischargers	0.2 MGD	1.2 MGD
3 Indirect Dischargers	0.2 MGD	0 Indirect Dischargers	0 MGD	0.2 MGD
4 Plants Hauling All Wastes	0.3 MGD	0 Plants Hauling All Wastes	0 MGD	0.3 MGD
0 Acid Recovery Plants	0 MGD	0 Acid Recovery Plants	0 MGD	0 MGD
22 Active Plants	1.5 MGD	2 Active Plants	0.2 MGD	1.7 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment				
Neutralization	1122	259	305	1894
Acid Recovery	1744	-	-	-
Annual				
Neutralization	407	32.5	38.5	268
Acid Recovery	283	-	-	-
$/Ton of Production				
Neutralization	2.17	0.17	0.20	1.43
Acid Recovery	1.51	-	-	-

	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3
Investment	1293	1339	2927
Annual	428	434	663
$/Ton of Production	2.29	2.32	3.54

WASTEWATER CHARACTERISTICS	RAW WASTE				BPT/BCT(2) PSES-1		BAT-1/PSES-2 NSPS-1/PSNS-1		BAT-2/PSES-3 NSPS-2/PSNS-2		BAT-3/PSES-4 NSPS-3/PSNS-3
	Conc	Rinse	FS (1)	Total (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	
Flow (GPT)	20	70	135	180	90	27	30	15	30	15	0
pH (SU)	<1-2	<1-6.4	<1-3	<1-6.4	6-9		6-9		6-9		
Dissolved Iron	49,000	3900	560	3900	1		1		0.5		-
Oil and Grease	25	24	4.6	10	(10)4.4		(10)4.4		(5**)2		-
Total Suspended Solids	2100	190	16	170	(30)23.8		(30)23.8		(15)9.8		-
115 Arsenic*	0.18	0.35	0.08	0.14	0.1		0.1		0.1		-
118 Cadmium	0.33	0.032	-	0.02	0.02		0.02		0.02		-
119 Chromium*	170	6.4	1.1	12	0.04		0.04		0.03		-
120 Copper*	3.4	2.5	0.63	1.1	0.04		0.04		0.03		-
122 Lead*	1.1	0.47	0.03	0.18	(0.15)0.1		(0.15)0.1		(0.1)0.06		-
124 Nickel*	24	2.5	1.6	3.0	0.15		0.15		0.04		-
126 Silver	0.44	0.016	-	0.03	0.03		0.03		0.03		-
128 Zinc*	50	13	0.29	5.5	(0.1)0.06		(0.1)0.06		(0.1)0.06		-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-3 and PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease based upon 10 mg/l (maximum only).
\- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).
(2) Zero discharge of process wastewater pollutants can be achieved with acid recovery systems.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Sulfuric Acid Pickling
: Pipe/Tube/Other
: Neutralization and Acid Recovery

MODEL SIZE (TPD): 220
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Rinses and Concentrates		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.11 MGD	Model Plant	0.19 MGD	
17 Direct Dischargers	1.9 MGD	3 Direct Dischargers	0.6 MGD	2.5 MGD
9 Indirect Dischargers	1.0 MGD	1 Indirect Discharger	0.2 MGD	1.2 MGD
4 Plants Hauling All Wastes	0.4 MGD	0 Plants Hauling All Wastes	0 MGD	0.4 MGD
1 Acid Recovery Plant	0.1 MGD	0 Acid Recovery Plants	0 MGD	0.1 MGD
31 Active Plants	3.4 MGD	6 Active Plants	0.8 MGD	4.2 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment				
Neutralization	971	79.2	121	1661
Acid Recovery	873	-	-	-
Annual				
Neutralization	286	10.0	15.6	235
Acid Recovery	131	-	-	-
$/Ton of Production				
Neutralization	5.00	0.17	0.27	4.11
Acid Recovery	2.29	-	-	-

	PSNS-1 NSPS-1	PSNS-2 NSPS-2	PSNS-3 NSPS-3
Investment	918	960	2500
Annual	278	284	503
$/Ton of Production	4.86	4.96	8.79

WASTEWATER CHARACTERISTICS	RAW WASTE				BPT/BCT(2) PSES-1		BAT-1/PSES-2 NSPS-1/PSNS-1		BAT-2/PSES-3 NSPS-2/PSNS-2		BAT-3/PSES-4 NSPS-3/PSNS-3
	Conc	Rinse	FS (1)	Total (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	
Flow (GPT)	20	480	135	211	500	15	70	15	70	15	0
pH (SU)	<1-2	<1-6.4	<1-3	<1-6.4	6-9		6-9		6-9		
Dissolved Iron	49,000	3900	560	2400	1		1		0.5		-
Oil and Grease	25	24	4.6	12	(10)4.4		(10)4.4		(5**)2.0		-
Total Suspended Solids	2100	190	16	110	(30)23.8		(30)23.8		(15)9.8		-
115 Arsenic*	0.18	0.35	0.08	0.17	0.1		0.1		0.1		-
118 Cadmium	0.33	0.032	-	0.02	0.02		0.02		0.02		-
119 Chromium*	170	6.4	1.1	5.3	0.04		0.04		0.03		-
120 Copper*	3.4	2.5	0.63	1.3	0.04		0.04		0.03		-
122 Lead*	1.1	0.47	0.03	0.2	(0.15)0.1		(0.15)0.1		(0.1)0.06		-
124 Nickel*	24	2.5	1.6	2.2	0.15		0.15		0.04		-
126 Silver	0.44	0.016	-	0.01	0.01		0.01		0.01		-
128 Zinc*	50	13	0.29	5.4	(0.1)0.06		(0.1)0.06		(0.1)0.06		-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
\- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).
(2) Zero discharge of process wastewater pollutants can be achieved with acid recovery systems.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Hydrochloric Acid Pickling	MODEL SIZE (TPD):	4020
:	Strip/Sheet/Plate	OPER. DAYS/YEAR :	320
:	Neutralization and Acid Regeneration	TURNS/DAY :	3

RAW WASTE FLOWS

Rinses and Concentrates		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	1.13 MGD	Model Plant	0.19 MGD	
21 Direct Dischargers	23.6 MGD	20 Direct Dischargers	3.8 MGD	27.4 MGD
3 Indirect Dischargers	3.4 MGD	2 Indirect Dischargers	0.4 MGD	3.8 MGD
4 Acid Regeneration Plants	4.5 MGD	4 Acid Regeneration Plants	0.8 MGD	5.3 MGD
28 Active Plants	31.5 MGD	26 Active Plants	5.0 MGD	36.5 MGD

MODEL COSTS ($\$X10^{-3}$)	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment				
Neutralization	2231	1447	1608	4204
Acid Regeneration	5057	1592	1770	4645
Annual				
Neutralization	1734	181	202	667
Acid Regeneration	-765	202	225	751
$/Ton of Production				
Neutralization	1.35	0.14	0.16	0.52
Acid Regeneration	-0.59	0.16	0.17	0.58

	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3
Investment	3189	3350	5946
Annual	1836	1857	2322
$/Ton of Production	1.43	1.44	1.80

SUBCATEGORY SUMMARY DATA
HYDROCHLORIC ACID PICKLING
STRIP/SHEET/PLATE
PAGE 2

	WASTEWATER CHARACTERISTICS	RAW WASTE Conc	RAW WASTE Rinse	RAW WASTE FS(1)	RAW WASTE Total(1)	BPT/BCT PSES-1 Conc & Rinse	BPT/BCT PSES-1 FS(1)
	Flow (GPT) (Neutralization)	10	270	135	917	280	15
	Flow (GPT) (Acid Regeneration)	10	270	135	917	270	15
	pH (SU)	<1-5	<1-5	<1-3	<1-5	6-9	
	Dissolved Iron	73,000	1,700	560	3,700	1	
	Oil and Grease	3.9	12	4.6	11	(10)4.4	
	Total Suspended Solids	400	45	16	52	(30)23.8	
114	Antimony*	2.2	0.2	0.6	0.32	0.1	
115	Arsenic*	0.21	0.25	0.08	0.22	0.1	
118	Cadmium	0.22	-	0.01	0.01	0.01	
119	Chromium*	16	0.27	1.1	0.87	0.04	
120	Copper*	16	0.63	0.63	1.1	0.04	
122	Lead*	390	0.32	0.3	12	(0.15)0.1	
124	Nickel*	12	0.52	1.6	1.0	0.15	
128	Zinc*	18	37	0.29	31	(0.1)0.06	

	WASTEWATER CHARACTERISTICS	BAT-1/PSES-2 NSPS-1/PSNS-1 Conc & Rinse	BAT-1/PSES-2 NSPS-1/PSNS-1 FS(1)	BAT-2/PSES-3 NSPS-2/PSNS-2 Conc & Rinse	BAT-2/PSES-3 NSPS-2/PSNS-2 FS(1)	BAT-3/PSES-4 NSPS-3/PSNS-3
	Flow (GPT) (Neutralization)	40	15	40	15	0
	Flow (GPT) (Acid Regeneration)	30	15	30	15	0
	pH (SU)	6-9		6-9		-
	Dissolved Iron	1		0.5		-
	Oil and Grease	(10)4.4		(5**)2.0		-
	Total Suspended Solids	(30)23.8		(15)9.8		-
114	Antimony*	0.1		0.1		-
115	Arsenic*	0.1		0.1		-
118	Cadmium	0.01		0.01		-
119	Chromium*	0.04		0.03		-
120	Copper*	0.04		0.03		-
122	Lead*	(0.15)0.1		(0.1)0.06		-
124	Nickel*	0.15		0.04		-
128	Zinc*	(0.1)0.06		(0.1)0.06		-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.
: The absorber vent scrubber flow only applies to acid regeneration systems. The flow is 100 GPM at the BPT treatment level. The AVS flow is reduced to 25 GPM at the BAT-1 and BAT-2 treatment levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
\- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Hydrochloric Acid Pickling	MODEL SIZE (TPD):	90
:	Rod/Wire/Coil	OPER. DAYS/YEAR :	260
:	Neutralization	TURNS/DAY :	3

RAW WASTE FLOWS

Rinses and Concentrates		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.04 MGD	Model Plant	0.19 MGD	
7 Direct Dischargers	0.3 MGD	4 Direct Dischargers	0.8 MGD	1.1 MGD
8 Indirect Dischargers	0.4 MGD	3 Indirect Dischargers	0.6 MGD	1.0 MGD
15 Active Plants	0.7 MGD	7 Active Plants	1.4 MGD	2.1 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	787	32.4	79.0	1932
Annual	190	4.1	10.2	274
$/Ton of Production	8.08	0.18	0.44	11.67
		NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3
Investment		739	786	2638
Annual		183	189	452
$/Ton of Production		7.82	8.08	19.32

WASTEWATER CHARACTERISTICS	RAW WASTE				BPT/BCT PSES-1		BAT-1/PSES-2 NSPS-1/PSNS-1		BAT-2/PSES-3 NSPS-2/PSNS-2		BAT-3/PSES-4 NSPS-3/PSNS-3
	Conc	Rinse	FS (1)	Total (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	
Flow (GPT)	10	480	135	166	490	15	60	15	60	15	0
pH (SU)	<1-5	<1-5	<1-3	<1-5	6-9		6-9		6-9		
Dissolved Iron	73,000	1,700	560	1,200	1		1		0.2		-
Oil and Grease	3.9	12	4.6	10	(10)4.4		(10)4.4		(5**)3.5		-
Total Suspended Solids	400	45	16	30	(30)23.8		(30)23.8		(15)9.8		-
114 Antimony*	2.2	0.2	0.6	0.54	0.1	0.1	0.1		0.1		-
115 Arsenic*	0.21	0.25	0.08	0.11	0.1		0.1		0.1		-
118 Cadmium	0.22	-	0.01	0.01	0.01		0.01		0.01		-
119 Chromium*	16	0.27	1.1	1.0	0.04		0.04		0.03		-
120 Copper*	16	0.63	0.63	0.72	0.04		0.04		0.03		-
122 Lead*	390	0.32	0.3	2.6	(0.15)0.1		(0.15)0.1		(0.1)0.06		-
124 Nickel*	12	0.52	1.6	1.5	0.15		0.15		0.04		-
128 Zinc*	18	37	0.29	7.0	(0.1)0.06		(0.1)0.06		(0.1)0.06		-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
\- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Hydrochloric Acid Pickling	MODEL SIZE (TPD):	110
:	Pipe/Tube	OPER. DAYS/YEAR :	260
:	Neutralization	TURNS/DAY :	3

RAW WASTE FLOWS

Rinses and Concentrates		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.11 MGD	Model Plant	0.19 MGD	
2 Direct Dischargers	0.2 MGD	1 Direct Discharger	0.2 MGD	0.4 MGD
1 Indirect Discharger	0.1 MGD	0 Indirect Dischargers	0 MGD	0.1 MGD
3 Active Plants	0.3 MGD	1 Active Plant	0.2 MGD	0.5 MGD

MODEL COSTS ($\$X10^{-3}$)	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	825	39.6	75.0	1621
Annual	174	5.1	9.8	223
$/Ton of Production	6.08	0.18	0.34	7.80
		NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3
Investment		721	756	2302
Annual		160	165	378
$/Ton of Production		5.59	5.77	13.22

WASTEWATER CHARACTERISTICS	RAW WASTE				BPT/BCT PSES-1		BAT-1/PSES-2 NSPS-1/PSNS-1		BAT-2/PSES-3 NSPS-2/PSNS-2		BAT-3/PSES-4 NSPS-3/PSNS-3
	Conc	Rinse	FS (1)	Total (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	
Flow (GPT)	10	1010	135	213	1020	15	110	15	110	15	0
pH (SU)	<1-5	<1-5	<1-3	<1-5	6-9		6-9		6-9		
Dissolved Iron	73,000	1,700	560	1,200	1		1		0.5		-
Oil and Grease	3.9	12	4.6	10	(10)4.4		(10)4.4		(5**)2.0		-
Total Suspended Solids	400	45	16	30	(30)23.8		(30)23.8		(15)9.8		-
114 Antimony*	2.2	0.2	0.6	0.46	0.1		0.1		0.1		-
115 Arsenic*	0.21	0.25	0.08	0.14	0.1		0.1		0.1		-
118 Cadmium	0.22	-	0.01	0.01	0.01		0.01		0.01		-
119 Chromium*	16	0.27	1.1	1.0	0.04		0.04		0.03		-
120 Copper*	16	0.63	0.63	0.69	0.04		0.04		0.03		-
122 Lead*	390	0.32	0.3	2.6	(0.15)0.1		(0.15)0.1		(0.1)0.06		-
124 Nickel*	12	0.52	1.6	1.5	0.15		0.15		0.04		-
128 Zinc*	18	37	0.29	7.0	(0.1)0.06		(0.1)0.06		(0.1)0.06		-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
\- Concentration is less than 0.01 mg/l.
(1) Flow in gallon per minute (GPM).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Combination Acid Pickling
: Batch Strip/Sheet/Plate

MODEL SIZE (TPD): 150
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Rinses and Concentrates		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.07 MGD	Model Plant	0.19 MGD	
9 Direct Dischargers	0.6 MGD	6 Direct Dischargers	1.1 MGD	1.7 MGD
0 Indirect Dischargers	0 MGD	0 Indirect Dischargers	0 MGD	0 MGD
1 Plant Hauling All Wastes	0.1 MGD	0 Plants Hauling All Wastes	0 MGD	0.1 MGD
10 Active Plants	0.7 MGD	6 Active Plants	1.1 MGD	1.8 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	807	54.0	87.6	1574
Annual	188	6.9	11.4	216
$/Ton of Production	4.82	0.18	0.29	5.54

	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3
Investment	752	786	2272
Annual	180	185	389
$/Ton of Production	4.62	4.74	9.97

	WASTEWATER CHARACTERISTICS	RAW WASTE Conc	RAW WASTE Rinse	RAW WASTE FS (1)	RAW WASTE Total (1)	BPT/BCT PSES-1 Conc & Rinse	BPT/BCT PSES-1 FS (1)	BAT-1/PSES-2 NSPS-1/PSNS-1 Conc & Rinse	BAT-1/PSES-2 NSPS-1/PSNS-1 FS (1)	BAT-2/PSES-3 NSPS-2/PSNS-2 Conc & Rinse	BAT-2/PSES-3 NSPS-2/PSNS-2 FS (1)	BAT-3/PSES-4 NSPS-3/PSNS-3
	Flow (GPT)	20	440	135	183	460	15	60	15	60	15	0
	pH (SU)	<1-2.3	1.9-8.2	<1-3	<1-8.2	6-9		6-9		6-9		
	Dissolved Iron	20,000	170	560	670	1		1		0.5		-
	Fluoride	6100	170	1800	1400	15		15		15		-
	Oil and Grease	2.1	4.6	4.6	10	(10)4.4		(10)4.4		(5**)2		-
	Total Suspended Solids	140	93	16	37	(30)23.8		(30)23.8		(15)9.8		-
114	Antimony*	NA	0.069	0.6	0.46	0.1		0.1		0.1		-
118	Cadmium	0.14	-	0.01	0.01	0.01		0.01		0.01		-
119	Chromium*	3500	37	1.1	48	(0.4)0.28		(0.4)0.28		(0.1)0.03		-
120	Copper*	170	1.2	0.63	2.6	0.04		0.04		0.03		-
122	Lead	2	-	0.03	0.04	0.04		0.04		0.04		-
124	Nickel*	4600	37	1.6	61	(0.3)0.25		(0.3)0.25		(0.1)0.04		-
128	Zinc*	11	0.7	0.29	0.51	0.06		0.06		0.06		-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
\- Concentration is less than 0.01 mg/l.
NA Not analyzed.
(1) Flow in gallon per minute (GPM).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Combination Acid Pickling
: Continuous Strip/Sheet/Plate

MODEL SIZE (TPD): 600
OPER. DAYS/YEAR : 320
TURNS/DAY : 3

RAW WASTE FLOWS

Rinses and Concentrates		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.90 MGD	Model Plant	0.19 MGD	
14 Direct Dischargers	12.6 MGD	13 Direct Dischargers	2.5 MGD	15.1 MGD
1 Indirect Discharger	0.9 MGD	1 Indirect Discharger	0.2 MGD	1.1 MGD
15 Active Plants	13.5 MGD	14 Active Plants	2.7 MGD	16.2 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	1973	216	368	2823
Annual	697	27.1	47.0	482
$/Ton of Production	3.63	0.14	0.24	2.51
		NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3
Investment		1742	1894	4350
Annual		654	674	1109
$/Ton of Production		3.41	3.51	5.78

WASTEWATER CHARACTERISTICS	RAW WASTE				BPT/BCT PSES-1	BAT-1/PSES-2 NSPS-1/PSNS-1	BAT-2/PSES-3 NSPS-2/PSNS-2	BAT-3/PSES-4 NSPS-3/PSNS-3
	Conc	Rinse	FS (1)	Total (1)	Conc & Rinse FS (1)	Conc & Rinse FS (1)	Conc & Rinse FS (1)	
Flow (GPT)	20	1480	135	760	1500 15	170 15	170 15	0
pH (SU)	<1-2.3	1.9-8.2	<1-3	<1-8.2	6-9	6-9	6-9	
Dissolved Iron	20,000	170	560	450	1	1	0.5	-
Fluoride	6100	170	1800	520	15	15	15	-
Oil and Grease	2.1	4.6	4.6	10	(10)4.4	(10)4.4	(5**)2	-
Total Suspended Solids	140	93	16	80	(30)23.8	(30)23.8	(15)9.8	-
114 Antimony*	NA	0.069	0.6	0.16	0.1	0.1	0.1	-
118 Cadmium	0.14	-	0.01	0.01	0.01	0.01	0.01	-
119 Chromium*	3500	37	1.1	67	(0.4)0.28	(0.4)0.28	(0.1)0.03	-
120 Copper*	170	1.2	0.63	2.9	0.04	0.04	0.03	-
122 Lead	2	-	0.03	0.03	0.03	0.03	0.03	-
124 Nickel*	4600	37	1.6	79	(0.3)0.25	(0.3)0.25	(0.1)0.04	-
128 Zinc*	11	0.7	0.29	0.74	0.06	0.06	0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
\- Concentration is less than 0.01 mg/l.
NA Not analyzed.
(1) Flow in gallon per minute (GPM).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Combination Acid Pickling
: Rod/Wire/Coil

MODEL SIZE (TPD): 270
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Rinses and Concentrates		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.14 MGD	Model Plant	0.19 MGD	
9 Direct Dischargers	1.2 MGD	5 Direct Dischargers	1.0 MGD	2.2 MGD
8 Indirect Dischargers	1.1 MGD	5 Indirect Dischargers	1.0 MGD	2.1 MGD
17 Active Plants	2.3 MGD	10 Active Plants	2.0 MGD	4.3 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	977	97.2	140	1679
Annual	256	12.2	17.8	238
$/Ton of Production	3.65	0.17	0.25	3.39
		NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3
Investment		930	973	2512
Annual		248	254	474
$/Ton of Production		3.53	3.62	6.75

WASTEWATER CHARACTERISTICS		RAW WASTE				BPT/BCT PSES-1		BAT-1/PSES-2 NSPS-1/PSNS-1		BAT-2/PSES-3 NSPS-2/PSNS-2		BAT-3/PSES-4 NSPS-3/PSNS-3
		Conc	Rinse	FS (1)	Total (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	
	Flow (GPT)	20	490	135	231	510	15	70	15	70	15	0
	pH (SU)	<1-2.3	1.9-8.2	<1-3	<1-8.2	6-9		6-9		6-9		
	Dissolved Iron	20,000	170	560	740	1		1		0.5		-
	Fluoride	6100	170	1800	1200	15		15		15		-
	Oil and Grease	2.1	4.6	4.6	10	(10)4.4		(10)4.4		(5**)2		-
	Total Suspended Solids	140	93	16	49	(30)23.8		(30)23.8		(15)9.8		-
114	Antimony*	NA	0.069	0.6	0.38	0.1		0.1		0.1		-
118	Cadmium	0.14	-	0.01	0.01	0.01		0.01		0.01		-
119	Chromium*	3500	37	1.1	76	(0.4)0.28		(0.4)0.28		(0.1)0.03		-
120	Copper*	170	1.2	0.63	3.8	0.04		0.04		0.03		-
122	Lead	2	-	0.03	0.05	0.05		0.05		0.05		-
124	Nickel*	4600	37	1.6	95	(0.3)0.25		(0.3)0.25		(0.1)0.04		-
128	Zinc*	11	0.7	0.29	0.64	0.06		0.06		0.06		-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
\- Concentration is less than 0.01 mg/l.
NA Not analyzed.
(1) Flow in gallon per minute (GPM).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Combination Acid Pickling
: Bar/Billet/Bloom

MODEL SIZE (TPD): 60
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Rinses and Concentrates		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.01 MGD	Model Plant	0.19 MGD	
3 Direct Dischargers	0.04 MGD	1 Direct Discharger	0.2 MGD	0.24 MGD
1 Indirect Discharger	0.01 MGD	0 Indirect Dischargers	0 MGD	0.01 MGD
1 Plant Hauling All Wastes	0.01 MGD	0 Plants Hauling All Wastes	0 MGD	0.01 MGD
5 Active Plants	0.06 MGD	1 Active Plant	0.2 MGD	0.26 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	669	21.6	53.3	1500
Annual	164	2.8	7.0	205
$/Ton of Production	10.51	0.18	0.45	13.14
		NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3
Investment		672	704	2151
Annual		164	168	366
$/Ton of Production		10.51	10.77	23.46

	WASTEWATER CHARACTERISTICS	RAW WASTE				BPT/BCT PSES-1		BAT-1/PSES-2 NSPS-1/PSNS-1		BAT-2/PSES-3 NSPS-2/PSNS-2		BAT-3/PSES-4 NSPS-3/PSNS-3
		Conc	Rinse	FS (1)	Total (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	Conc & Rinse	FS (1)	
	Flow (GPT)	20	210	135	145	230	15	40	15	40	15	0
	pH (SU)	<1-2.3	1.9-8.2	<1-3	<1-8.2	6-9		6-9		6-9		
	Dissolved Iron	20,000	170	560	670	1		1		0.5		-
	Fluoride	6100	170	1800	1700	15		15		15		-
	Oil and Grease	2.1	4.6	4.6	10	(10)4.4		(10)4.4		(5**)2		-
	Total Suspended Solids	140	93	16	25	(30)23.8		(30)23.8		(15)9.8		-
114	Antimony*	NA	0.069	0.6	0.57	0.1		0.1		0.1		-
118	Cadmium	0.14	-	0.01	0.01	0.01		0.01		0.01		-
119	Chromium*	3500	37	1.1	27	(0.4)0.28		(0.4)0.28		(0.1)0.03		-
120	Copper*	170	1.2	0.63	1.8	0.04		0.04		0.03		-
122	Lead	2	-	0.03	0.04	0.04		0.04		0.04		-
124	Nickel*	4600	37	1.6	36	(0.3)0.25		(0.3)0.25		(0.1)0.04		-
128	Zinc*	11	0.7	0.29	0.39	0.06		0.06		0.06		-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
\- Concentration is less than 0.01 mg/l.
NA Not analyzed.
(1) Flow in gallon per minute (GPM).

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Combination Acid Pickling
: Pipe/Tube

MODEL SIZE (TPD): 60
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Rinses and Concentrates		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.05 MGD	Model Plant	0.19 MGD	
11 Direct Dischargers	0.5 MGD	3 Direct Dischargers	0.6 MGD	1.1 MGD
8 Indirect Dischargers	0.4 MGD	3 Indirect Dischargers	0.6 MGD	1.0 MGD
1 Plant Hauling All Wastes	0.05 MGD	0 Plants Hauling All Wastes	0 MGD	0.05 MGD
20 Active Plants	0.95 MGD	6 Active Plants	1.2 MGD	2.15 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	719	21.6	55.2	1542
Annual	173	2.8	7.3	212
$/Ton of Production	11.09	0.18	0.47	13.59

	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3
Investment	686	719	2206
Annual	169	173	377
$/Ton of Production	10.83	11.09	24.17

WASTEWATER CHARACTERISTICS	RAW WASTE Conc	Rinse	FS (1)	Total (1)	BPT/BCT PSES-1 Conc & Rinse	FS (1)	BAT-1/PSES-2 NSPS-1/PSNS-1 Conc & Rinse	FS (1)	BAT-2/PSES-3 NSPS-2/PSNS-2 Conc & Rinse	FS (1)	BAT-3/PSES-4 NSPS-3/PSNS-3
Flow (GPT)	20	750	135	167	770	15	100	15	100	15	0
pH (SU)	<1-2.3	1.9-8.2	<1-3	<1-8.2	6-9		6-9		6-9		
Dissolved Iron	20,000	170	560	580	1		1		0.5		-
Fluoride	6100	170	1800	1500	15		15		15		-
Oil and Grease	2.1	4.6	4.6	10	(10)4.4		(10)4.4		(5**)2		-
Total Suspended Solids	140	93	16	31	(30)23.8		(30)23.8		(15)9.8		-
114 Antimony*	NA	0.069	0.6	0.5	0.1		0.1		0.1		-
118 Cadmium	0.14	-	0.01	0.01	0.01		0.01		0.01		-
119 Chromium*	3500	37	1.1	25	(0.4)0.28		(0.4)0.28		(0.1)0.03		-
120 Copper*	170	1.2	0.63	1.5	0.04		0.04		0.03		-
122 Lead	2	-	0.03	0.03	0.03		0.03		0.03		-
124 Nickel*	4600	37	1.6	30	(0.3)0.25		(0.3)0.25		(0.1)0.04		-
128 Zinc*	11	0.7	0.29	0.42	0.06		0.06		0.06		-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
\- Concentration is less than 0.01 mg/l.
NA Not analyzed.
(1) Flow in gallon per minute (GPM).

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
ACID PICKLING - ALL SUBDIVISIONS
ALL PRODUCTS

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW[1][2] WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	72.5	58.4	9.8	9.8	0
Dissolved Iron	277,873.5	75.8	12.6	6.4	-
Fluoride	18,512.6	302.4	44.7	44.7	-
Oil and Grease	1,070.8	342.1	56.1	26.6	-
Total Suspended Solids	8,688.1	1,803.7	303.9	125.2	-
Total Toxic Metals	6,384.5	48.4	8.0	4.9	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY[3] ($X10^{-6})					
Investment	-	150.06	64.62	76.91	362.69
Annual	-	54.22	7.93	9.56	55.32

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	14.2	10.7	2.1	2.1	0
Dissolved Iron	45,495.0	13.1	2.5	1.3	-
Fluoride	5,035.1	45.5	8.5	8.5	-
Oil and Grease	192.4	58.1	10.8	4.7	-
Total Suspended Solids	1,554.2	314.3	58.7	24.1	-
Total Toxic Metals	1,053.9	8.1	1.4	0.9	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY[3] ($X10^{-6})					
Investment	-	24.88	5.48	7.15	63.20
Annual	-	9.26	0.68	0.91	9.04

(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Raw waste loads for the acid recovery plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
SULFURIC ACID PICKLING SUBCATEGORY
STRIP/SHEET/PLATE: NEUTRALIZATION AND ACID RECOVERY

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW(1)(2) WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	10.5	7.8	1.8	1.8	0
Dissolved Iron	78,438.0	10.4	2.4	1.2	-
Oil and Grease	224.1	45.7	10.7	4.9	-
Total Suspended Solids	3,501.7	247.0	58.1	23.9	-
Total Toxic Metals	434.9	5.9	1.4	1.0	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY(3) ($X10^{-6})					
Investment	-	26.71	13.52	15.90	67.16
Annual	-	14.91	1.69	2.00	9.98

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	1.6	1.2	0.3	0.3	0
Dissolved Iron	11,843.8	1.6	0.4	0.2	-
Oil and Grease	33.8	7.3	1.8	0.8	-
Total Suspended Solids	528.7	39.4	9.8	4.0	-
Total Toxic Metals	65.7	0.9	0.2	0.2	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($X10^{-6})					
Investment	-	2.55	0.90	1.06	4.47
Annual	-	1.59	0.11	0.13	0.66

(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Raw waste loads for the acid recovery plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
SULFURIC ACID PICKLING SUBCATEGORY
ROD/WIRE/COIL: NEUTRALIZATION AND ACID RECOVERY

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW(1)(2) WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	2.8	2.2	0.3	0.3	0
Dissolved Iron	8,419.0	2.4	0.4	0.2	-
Oil and Grease	33.1	10.6	1.6	0.7	-
Total Suspended Solids	360.8	57.3	8.8	3.6	-
Total Toxic Metals	49.9	1.3	0.2	0.1	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY(3) ($X10^{-6})					
Investment	-	17.23	2.08	2.70	26.75
Annual	-	4.08	0.26	0.34	3.73

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	2.2	1.9	0.4	0.4	0
Dissolved Iron	6,845.5	2.1	0.4	0.2	-
Oil and Grease	26.9	9.1	1.8	0.8	-
Total Suspended Solids	293.4	49.3	9.7	4.0	-
Total Toxic Metals	40.6	1.1	0.2	0.1	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY(3) ($X10^{-6})					
Investment	-	6.87	1.19	1.55	15.56
Annual	-	2.21	0.15	0.20	2.17

(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Raw waste loads for the acid recovery plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
SULFURIC ACID PICKLING SUBCATEGORY
BAR/BILLET/BLOOM: NEUTRALIZATION AND ACID RECOVERY

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW(1) WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	1.6	1.0	0.4	0.4	0
Dissolved Iron	6,854.1	1.1	0.4	0.2	-
Oil and Grease	17.6	4.8	1.8	0.8	-
Total Suspended Solids	298.8	26.2	9.5	3.9	-
Total Toxic Metals	38.6	0.6	0.2	0.1	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY(3) ($X10^{-6})					
Investment	-	9.88	3.34	3.93	24.38
Annual	-	2.93	0.42	0.50	3.45

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	0.2	0.2	0.06	0.06	0
Dissolved Iron	822.5	0.2	0.1	(2)	-
Oil and Grease	2.1	0.9	0.3	0.1	-
Total Suspended Solids	35.8	5.0	1.7	0.7	-
Total Toxic Metals	4.6	0.1	(2)	(2)	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($X10^{-6})					
Investment	-	1.71	0.46	0.54	3.35
Annual	-	0.65	0.06	0.07	0.48

(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Load is less than or equal to 0.05 ton/year.
(3) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
SULFURIC ACID PICKLING SUBCATEGORY
PIPE/TUBE/OTHER: NEUTRALIZATION AND ACID RECOVERY

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW[(1)(2)] WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	3.0	2.0	0.3	0.3	0
Dissolved Iron	7,819.2	2.2	0.4	0.2	-
Oil and Grease	39.1	9.8	1.6	0.7	-
Total Suspended Solids	358.4	52.8	8.4	3.5	-
Total Toxic Metals	47.6	1.2	0.2	0.1	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY[(3)] ($$X10^{-6}$)					
Investment	-	8.74	1.39	2.12	29.08
Annual	-	2.11	0.17	0.27	4.12

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	1.2	1.0	0.2	0.2	0
Dissolved Iron	3,083.8	1.1	0.2	0.1	-
Oil and Grease	15.4	4.8	0.8	0.3	-
Total Suspended Solids	141.3	26.1	4.1	1.7	-
Total Toxic Metals	18.8	0.6	0.1	0.1	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY[(3)] ($$X10^{-6}$)					
Investment	-	2.05	0.29	0.44	6.04
Annual	-	0.60	0.04	0.06	0.86

(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Raw waste loads for the acid recovery plants have been included in these totals.
(3) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HYDROCHLORIC ACID PICKLING SUBCATEGORY
STRIP/SHEET/PLATE: NEUTRALIZATION AND ACID REGENERATION

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	32.6	29.1	4.5	4.5	0
Dissolved Iron	161,273.1	38.8	6.0	3.0	-
Oil and Grease	479.5	170.8	26.6	12.1	-
Total Suspended Solids	2,266.5	923.9	143.7	59.2	-
Total Toxic Metals	2,027.7	23.3	3.6	2.6	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	52.46	39.22	43.45	111.88
Annual	-	19.46	4.76	5.33	17.63

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	3.8	3.4	0.5	0.5	0
Dissolved Iron	18,603.0	4.6	0.7	0.4	-
Oil and Grease	55.3	20.1	3.1	1.4	-
Total Suspended Solids	261.4	108.7	16.7	6.9	-
Total Toxic Metals	233.9	2.7	0.4	0.3	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	1.76	1.86	2.07	5.41
Annual	-	1.60	0.23	0.26	0.86

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HYDROCHLORIC ACID PICKLING SUBCATEGORY
ROD/WIRE/COIL: NEUTRALIZATION

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	1.1	0.4	0.1	0.1	0
Dissolved Iron	1,414.2	0.4	0.1	0.1	-
Oil and Grease	11.8	1.9	0.6	0.3	-
Total Suspended Solids	35.4	10.2	3.2	1.3	-
Total Toxic Metals	15.9	0.3	0.1	0.1	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($X10^{-6})					
Investment	-	3.86	0.18	0.51	10.92
Annual	-	0.78	0.02	0.06	1.55

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	0.9	0.4	0.1	0.1	0
Dissolved Iron	1,218.5	0.4	0.1	0.1	-
Oil and Grease	10.2	2.0	0.5	0.2	-
Total Suspended Solids	30.5	10.8	2.8	1.1	-
Total Toxic Metals	13.7	0.3	0.1	0.1	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY(1) ($X10^{-6})					
Investment	-	4.70	0.25	0.62	15.04
Annual	-	1.15	0.03	0.08	2.13

(1) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HYDROCHLORIC ACID PICKLING SUBCATEGORY
PIPE/TUBE: NEUTRALIZATION

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	0.4	0.2	0.05	0.05	0
Dissolved Iron	545.2	0.3	(1)	(1)	-
Oil and Grease	4.5	1.2	0.2	1.0	-
Total Suspended Solids	13.6	6.4	1.2	0.5	-
Total Toxic Metals	6.1	0.2	(1)	(1)	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY(2) ($X10^{-6})					
Investment	-	0.96	0.07	0.13	2.80
Annual	-	0.21	0.009	0.02	0.38

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	0.1	0.1	0.01	0.01	0
Dissolved Iron	146.1	0.1	(1)	(1)	-
Oil and Grease	1.2	0.5	0.1	(1)	-
Total Suspended Solids	3.6	2.9	0.3	0.1	-
Total Toxic Metals	1.6	0.1	(1)	(1)	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY ($X10^{-6})					
Investment	-	0.03	0.001	0.003	0.06
Annual	-	0.006	0.0002	0.0003	0.008

(1) Load is less than or equal to 0.05 ton/year.
(2) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COMBINATION ACID PICKLING SUBCATEGORY
BATCH STRIP/SHEET/PLATE: NEUTRALIZATION

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW(1) WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	1.9	0.8	0.2	0.2	0
Dissolved Iron	1,349.3	0.8	0.2	0.1	-
Fluoride	2,819.5	12.2	3.4	3.4	-
Oil and Grease	20.1	3.6	1.0	0.5	-
Total Suspended Solids	74.5	19.4	5.4	2.2	-
Total Toxic Metals	226.8	0.6	0.2	0.1	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY(2) ($X10^{-6})					
Investment	-	3.21	0.42	0.68	12.16
Annual	-	0.74	0.05	0.09	1.66

(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) The cost summary totals do not include confidential plants.

Note: There are no POTW dischargers in this segment.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COMBINATION ACID PICKLING SUBCATEGORY
CONTINUOUS STRIP/SHEET/PLATE: NEUTRALIZATION

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	15.1	12.9	1.7	1.7	0
Dissolved Iron	9,089.0	17.2	2.3	1.1	-
Fluoride	10,502.9	258.0	34.2	34.2	-
Oil and Grease	202.0	75.7	10.0	4.6	-
Total Suspended Solids	1,615.8	409.3	54.3	22.4	-
Total Toxic Metals	3,026.4	13.2	1.8	0.7	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	17.57	3.14	5.36	41.09
Annual	-	6.56	0.39	0.68	7.02

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	1.1	0.9	0.1	0.1	0
Dissolved Iron	657.6	1.2	0.2	0.1	-
Fluoride	759.8	18.5	2.5	2.5	-
Oil and Grease	14.6	5.4	0.7	0.3	-
Total Suspended Solids	116.9	29.3	3.9	1.6	-
Total Toxic Metals	219.0	0.9	0.1	(1)	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	0.35	0.04	0.07	0.50
Annual	-	0.12	0.005	0.008	0.09

(1) Load is less than or equal to 0.05 ton/year.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COMBINATION ACID PICKLING SUBCATEGORY
ROD/WIRE/COIL: NEUTRALIZATION

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	2.2	1.3	0.3	0.3	0
Dissolved Iron	1,775.2	1.5	0.3	0.2	-
Fluoride	2,878.7	21.9	4.5	4.5	-
Oil and Grease	24.0	6.4	1.3	0.6	-
Total Suspended Solids	117.5	34.8	7.2	3.0	-
Total Toxic Metals	421.9	1.2	0.2	0.1	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	5.84	0.99	1.44	17.09
Annual	-	1.55	0.12	0.18	3.14

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	2.1	1.2	0.3	0.3	0
Dissolved Iron	1,664.7	1.3	0.3	0.1	-
Fluoride	2,699.4	19.7	4.2	4.2	-
Oil and Grease	22.5	5.8	1.2	0.6	-
Total Suspended Solids	110.2	31.2	6.7	2.8	-
Total Toxic Metals	395.6	1.0	0.2	0.1	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	3.20	0.41	0.59	7.08
Annual	-	0.87	0.05	0.08	1.00

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COMBINATION ACID PICKLING SUBCATEGORY
BAR/BILLET/BLOOM: NEUTRALIZATION

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW(1) WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	0.2	0.06	0.03	0.03	0
Dissolved Iron	181.4	0.1	(2)	(2)	-
Fluoride	460.3	1.0	0.5	0.5	-
Oil and Grease	2.7	0.3	0.1	0.1	-
Total Suspended Solids	6.8	1.6	0.7	0.3	-
Total Toxic Metals	17.8	0.1	(2)	(2)	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY(3) ($X10^{-6})					
Investment	-	0.60	0.06	0.16	4.54
Annual	-	0.20	0.008	0.02	0.62

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	0.01	0.01	0.002	0.002	0
Dissolved Iron	10.0	(2)	(2)	(2)	-
Fluoride	25.4	0.2	(2)	(2)	-
Oil and Grease	0.1	0.1	(2)	(2)	-
Total Suspended Solids	0.4	0.4	0.1	(2)	-
Total Toxic Metals	1.0	(2)	(2)	(2)	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY ($X10^{-6})					
Investment	-	0.56	0.04	0.10	2.72
Annual	-	0.18	0.005	0.01	0.37

(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Load is less than or equal to 0.05 ton/year.
(3) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COMBINATION ACID PICKLING SUBCATEGORY
PIPE/TUBE: NEUTRALIZATION

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW[1] WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	1.1	0.6	0.1	0.1	0
Dissolved Iron	715.8	0.6	0.1	0.1	-
Fluoride	1,851.2	9.3	2.1	2.1	-
Oil and Grease	12.3	2.7	0.6	0.3	-
Total Suspended Solids	38.3	14.8	3.4	1.4	-
Total Toxic Metals	70.9	0.5	0.1	(2)	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY[3] ($X10^{-6})					
Investment	-	3.00	0.21	0.53	14.84
Annual	-	0.69	0.03	0.07	2.04

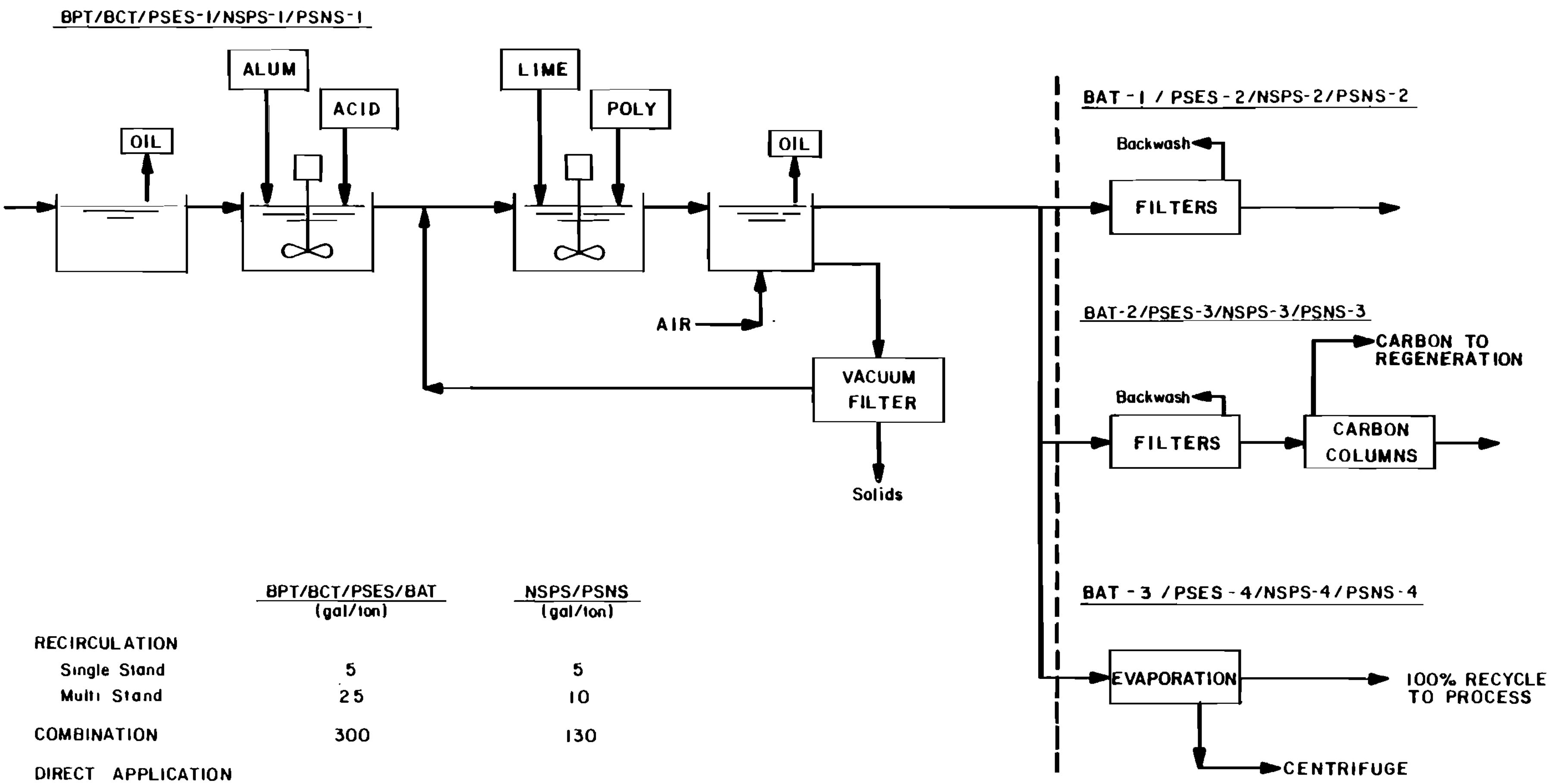
INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	1.0	0.4	0.1	0.1	0
Dissolved Iron	599.5	0.5	0.1	0.1	-
Fluoride	1,550.5	7.1	1.8	1.8	-
Oil and Grease	10.3	2.1	0.5	0.2	-
Total Suspended Solids	32.0	11.2	2.9	1.2	-
Total Toxic Metals	59.4	0.4	0.1	(2)	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY[3] ($X10^{-6})					
Investment	-	1.10	0.04	0.11	2.97
Annual	-	0.28	0.005	0.01	0.41

(1) Raw waste loads for the plants which haul all wastes have been included in these totals.
(2) Load is less than or equal to 0.05 ton/year.
(3) The cost summary totals do not include confidential plants.

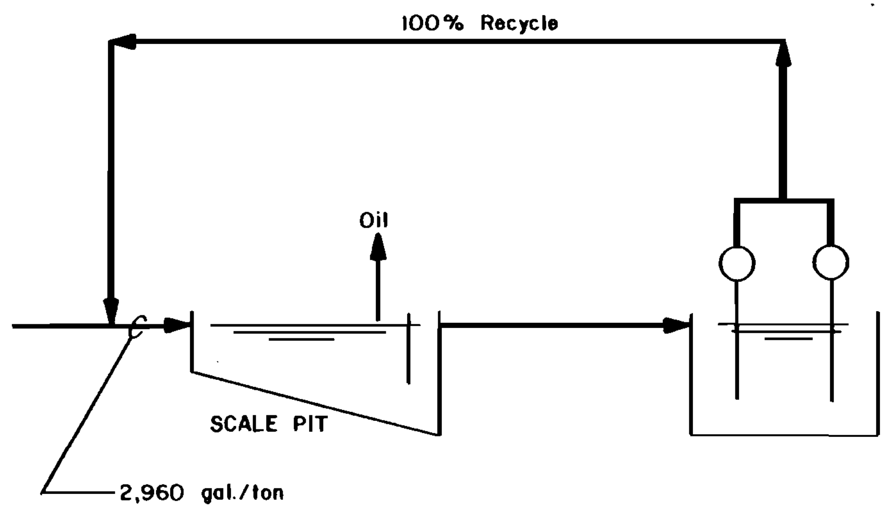
COLD FORMING: COLD ROLLING
TREATMENT MODELS SUMMARY



	BPT/BCT/PSES/BAT (gal/ton)	NSPS/PSNS (gal/ton)
RECIRCULATION		
Single Stand	5	5
Multi Stand	25	10
COMBINATION	300	130
DIRECT APPLICATION		
Single Stand	90	25
Multi Stand	400	290

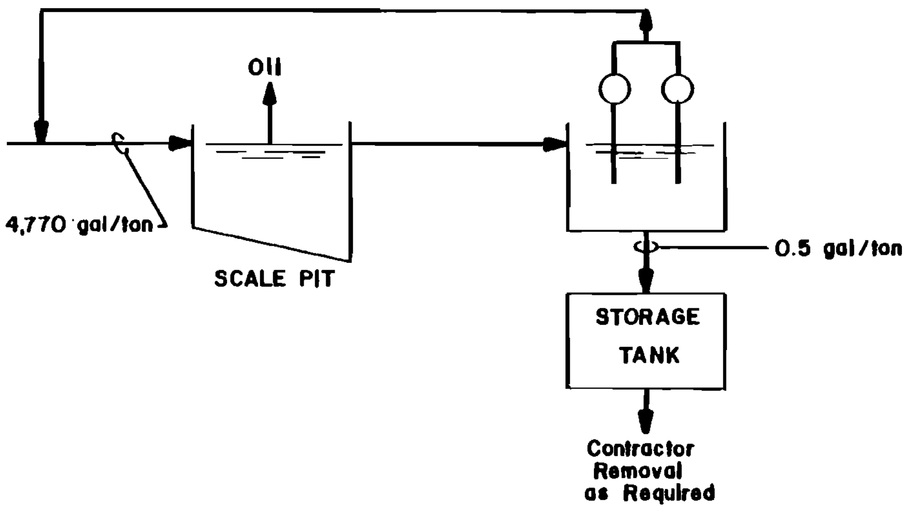
COLD FORMING
PIPE AND TUBE (WATER)
TREATMENT MODEL SUMMARY

BPT/BAT/BCT/PSES/PSNS/NSPS

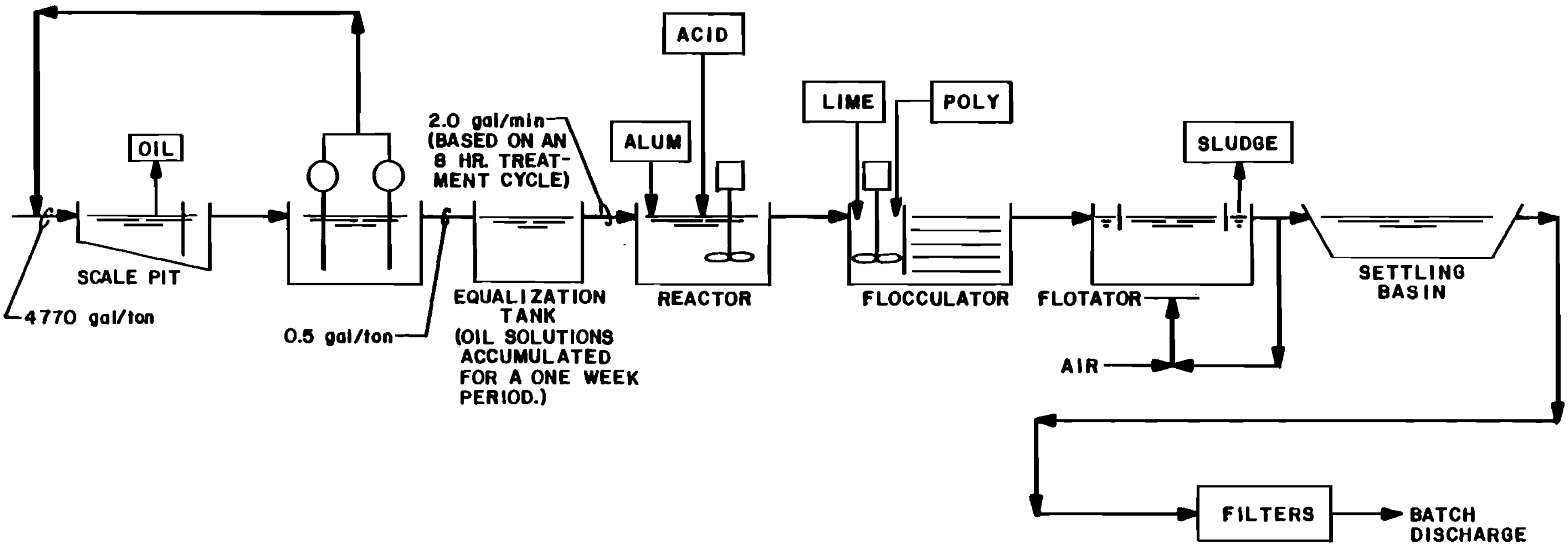


COLD FORMING
PIPE AND TUBE (SOLUBLE OIL)
TREATMENT MODELS SUMMARY

BPT/BAT/BCT/PSES/PSNS-1/NSPS-1



PSNS-2/NSPS-2



SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

		SINGLE STAND	MULTI STAND
SUBCATEGORY: Cold Forming	MODEL SIZE (TPD):	450	2400
: Cold Rolling	OPER. DAYS/YEAR :	348	348
: Recirculation	TURNS/DAY :	3	3

RAW WASTE FLOWS

Single Stand

Model Plant		0.002 MGD
13	Direct Dischargers	0.03 MGD
3	Indirect Dischargers	0.006 MGD
10	Contract Hauled	0.02 MGD
26	Active Plants	0.06 MGD

Multi Stand

Model Plant		0.06 MGD
21	Direct Dischargers	1.3 MGD
3	Indirect Dischargers	0.2 MGD
3	Contract Hauled	0.2 MGD
27	Active Plants	1.7 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment				
Single Stand	208	8.0	184	538
Multi Stand	494	49.5	1142	1946
Annual				
Single Stand	29.9	1.3	24.2	75.0
Multi Stand	55.0	6.7	147	291
$/Ton of Production				
Single Stand	0.19	0.008	0.15	0.48
Multi Stand	0.066	0.008	0.18	0.35

	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3	NSPS-4 PSNS-4
Investment				
Single Stand	208	216	392	746
Multi Stand	361	390	1,024	1,840
Annual				
Single Stand	29.9	31.2	54.1	105
Multi Stand	43.6	47.5	129	242
$/Ton of Production				
Single Stand	0.19	0.20	0.35	0.67
Multi Stand	0.052	0.057	0.15	0.29

SUBCATEGORY SUMMARY DATA
COLD FORMING-RECIRCULATION
PAGE 2

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3	BAT-3 NSPS-4 PSES-4 PSNS-4
	Flow (GPT) Single Stand	5 [5]	5 [5]	5 [5]	5 [5]	0
	Flow (GPT) Multi Stand	25 [10]	25 [10]	25 [10]	25 [10]	0
	pH (SU)	6-9	6-9	6-9	6-9	-
	Oil and Grease	14700	(10)7	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	1013	(30)16	(15)9.8	(15)9.8	-
1	Acenaphthene	0.055	0.01	0.01	0.01	-
11	1,1,1-Trichloroethane	0.063	0.063	0.063	0.063	-
13	1,1-Dichloroethane	0.011	0.011	0.011	0.011	-
23	Chloroform	0.037	0.002	0.002	0.002	-
39	Fluoranthene	0.27	0.01	0.01	0.01	-
55	Naphthalene	1.5	(0.1***)0.012	(0.1***)0.012	(0.02)0.012	-
60	4,6-Dinitro-o-cresol	0.063	0.063	0.025	0.025	-
65	Phenol	0.17	0.093	0.093	0.05	-
72	Benzo (a) Anthracene	0.16	0.005	0.005	0.005	-
76	Chrysene	0.11	0.001	0.001	0.001	-
77	Acenaphthylene	0.14	0.01	0.01	0.01	-
78	Anthracene	0.14	0.01	0.01	0.01	-
80	Fluorene	3.5	0.01	0.01	0.01	-
81	Phenanthrene	0.91	0.01	0.01	0.01	-
84	Pyrene	0.30	0.005	0.005	0.005	-
85	Tetrachloroethylene	0.036	(0.15***)0.035	(0.15***)0.035	(0.15***)0.035	-
86	Toluene	0.012	0.004	0.004	0.004	-
87	Trichlorocthylene	0.009	0.002	0.002	0.002	-
114	Antimony*	0.031	0.031	0.031	0.031	-
115	Arsenic*	0.26	0.1	0.05	0.05	-
118	Cadmium*	0.11	0.016	0.016	0.016	-
119	Chromium*	2.5	(0.4)0.28	(0.1)0.03	(0.1)0.03	-
120	Copper*	7.1	0.1	0.03	0.03	-
122	Lead*	2.9	(0.15)0.1	(0.1)0.06	(0.1)0.06	-
124	Nickel*	3.3	(0.3)0.2	(0.1)0.04	(0.1)0.04	-
128	Zinc*	3.7	(0.1)0.06	(0.1)0.06	(0.1)0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for various levels of treatment. All other values represent long term average values or predicted average performance levels.
: Values in brackets represent NSPS/PSNS flows.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
*** Maximum limit only.
PSNS/NSPS flow

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Cold Forming	MODEL SIZE (TPD):	4800
:	Cold Rolling	OPER. DAYS/YEAR :	348
:	Combination	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		1.4 MGD
10	Direct Dischargers	14.0 MGD
0	Indirect Dischargers	0.0 MGD
10	Active Plants	14.0 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment	1540	561	3988	12298
Annual	299	77.9	553	2470
$/Ton of Production	0.18	0.047	0.33	1.48
	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3	NSPS-4 PSNS-4
Investment	1182	1652	3731	6920
Annual	202	266	533	1386
$/Ton of Production	0.12	0.16	0.32	0.83

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3	BAT-3 NSPS-4 PSES-4 PSNS-4
	Flow (GPT)	300 [130]	300 [130]	300 [130]	300 [130]	0
	pH (SU)	6-9	6-9	6-9	6-9	-
	Oil and Grease	1481	(10)7	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	843	(30)16	(15)9.8	(15)9.8	-
39	Fluoranthene	0.071	0.01	0.01	0.01	-
55	Naphthalene	4	(0.1***)0.012	(0.1***)0.012	(0.1***)0.012	-
78	Anthracene	0.18	0.01	0.01	0.01	-
80	Fluorene	0.98	0.01	0.01	0.01	-
81	Phenanthrene	5.1	0.01	0.01	0.01	-
84	Pyrene	0.05	0.005	0.005	0.005	-
85	Tetrachlorothylene	0.02	(0.15***)0.02	(0.15***)0.02	(0.15***)0.02	-
115	Arsenic*	0.16	0.1	0.05	0.05	-
119	Chromium*	0.03	(0.4)0.03	(0.1)0.03	(0.1)0.03	-
120	Copper*	0.89	0.1	0.03	0.03	-
122	Lead	0.1	(0.15)0.1	(0.1)0.06	(0.1)0.06	-
124	Nickel*	0.21	(0.3)0.2	(0.1)0.04	(0.1)0.04	-
128	Zinc*	0.15	(0.1)0.06	(0.1)0.06	(0.1)0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for various levels of treatment. All other values represent long term average values or predicted average performance levels.
: Values in brackets represent NSPS/PSNS flows.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
*** Maximum limit only
NSPS/PSNS flow

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Cold Forming
: Cold Rolling
: Direct Application

	SINGLE STAND	MULTI STAND
MODEL SIZE (TPD):	2000	2700
OPER. DAYS/YEAR :	348	348
TURNS/DAY :	3	3

RAW WASTE FLOWS

Single Stand

Model Plant		0.2 MGD
9	Direct Dischargers	1.8 MGD
0	Indirect Dischargers	0 MGD
1	Contract Hauled	0.2 MGD
10	Active Plants	2.0 MGD

Multi Stand

Model Plant		1.1 MGD
10	Direct Dischargers	11.0 MGD
0	Indirect Dischargers	0.0 MGD
1	Contract Hauled	1.1 MGD
11	Active Plants	12.1 MGD

MODEL COSTS ($\$X10^{-3}$)	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment				
Single Stand	714	153	2057	2633
Multi Stand	1216	539	3367	7887
Annual				
Single Stand	102	20.1	264	461
Multi Stand	206	75.3	468	1842
$/Ton of Production				
Single Stand	0.15	0.029	0.38	0.66
Multi Stand	0.22	0.080	0.50	1.96

	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3	NSPS-4 PSNS-4
Investment				
Single Stand	432	476	1456	2014
Multi Stand	1111	1651	3983	7670
Annual				
Single Stand	62.4	68.4	194	290
Multi Stand	184	256	557	1548
$/Ton of Production				
Single Stand	0.09	0.10	0.28	0.42
Multi Stand	0.20	0.27	0.59	1.65

SUBCATEGORY SUMMARY DATA
COLD FORMING-DIRECT APPLICATION
PAGE 2

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT/BCT NSPS-1 PSES-1 PSNS-1	BAT-1 NSPS-2 PSES-2 PSNS-2	BAT-2 NSPS-3 PSES-3 PSNS-3	BAT-3 NSPS-4 PSES-4 PSNS-4
	Flow (GPT) Single Stand	90 [25]	90 [25]	90 [25]	90 [25]	0
	Flow (GPT) Multi Stand	400 [290]	400 [290]	400 [290]	400 [290]	0
	pH (SU)	6-9	6-9	6-9	6-9	-
	Oil and Grease	1215	(10)7	(5**)2.0	(5**)2.0	-
	Total Suspended Solids	135	(30)16	(15)9.8	(15)9.8	-
6	Carbon Tetrachloride	0.007	0.007	0.007	0.007	-
11	1,1,1-Trichloroethane	0.043	0.043	0.043	0.043	-
55	Napthalene	4.4	(0.1***)0.012	(0.1***)0.012	(0.1***)0.012	
78	Anthracene	0.014	0.01	0.01	0.01	-
85	Tetrachloroethylene	0.02	(0.15***)0.02	(0.15***)0.02	(0.15***)0.02	-
86	Toluene	0.69	0.004	0.004	0.004	-
115	Arsenic	0.02	0.02	0.02	0.02	-
117	Beryllium	0.01	0.006	0.006	0.006	-
119	Chromium	0.04	(0.4)0.04	(0.1)0.03	(0.1)0.03	-
120	Copper*	0.17	0.1	0.03	0.03	-
122	Lead	0.39	(0.15)0.1	(0.1)0.06	(0.1)0.06	-
124	Nickel*	0.2	(0.3)0.2	(0.1)0.04	(0.1)0.04	-
128	Zinc	0.098	(0.1)0.06	(0.1)0.06	(0.1)0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BPT and PSES-2 through PSES-4 are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the proposed limitations/standards. All other values represent long term average values or predicted average performance levels.
: Values in brackets represent NSPS/PSNS flows.

* Toxic pollutant found in all raw waste samples analyzed.
** Limit for oil and grease is based upon 10 mg/l (maximum only).
*** Maximum limit only.
NSPS/PSNS flow

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Cold Forming	MODEL SIZE (TPD):	500
:	Cold Worked Pipe and Tube	OPER. DAYS/YEAR :	260
:	Using Water	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		1.5 MGD
9	Direct Dischargers	13.3 MGD
2	Indirect Dischargers	3.0 MGD
4	Zero Dischargers	5.9 MGD
15	Active Plants	22.2 MGD

MODEL COSTS ($X10^{-3})	BPT/BCT BAT NSPS PSES PSNS
Investment	498
Annual	64.5
$/Ton of Production	0.50

WASTEWATER CHARACTERISTICS		RAW WASTE	BPT/BCT BAT NSPS PSES PSNS
	Flow (GPT)	2960	0
	pH (SU)	6-9	-
	Oil and Grease	65	-
	Total Suspended Solids	25	-
120	Copper	0.07	-
124	Nickel	0.025	-
128	Zinc	0.23	-

Note: All concentrations are in mg/l unless otherwise noted.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY:	Cold Forming	MODEL SIZE (TPD):	270
:	Cold Worked Pipe and Tube	OPER. DAYS/YEAR :	260
:	Using Oil	TURNS/DAY :	3

RAW WASTE FLOWS

Model Plant		1.3 MGD
1	Direct Discharger	1.3 MGD
0	Indirect Dischargers	0.0 MGD
15	Plants Hauling Waste Solutions	19.3 MGD
2	Zero Dischargers	2.6 MGD
1	Other Discharger	1.3 MGD
19	Active Plants	24.5 MGD

MODEL COSTS ($\$X10^{-3}$)	BPT/BCT BAT NSPS-1 PSES PSNS-1	NSPS-2 PSNS-2
Investment	424	665
Annual	55.6	87.2
$/Ton of Production	0.79	1.24

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT/BCT BAT NSPS-1 PSES PSNS-1	NSPS-2 PSNS-2
	Flow (GPT)	4770	0	0.5
	pH (SU)	6-9	-	6-9
	Oil and Grease	10%	-	2
	Total Suspended Solids	1000	-	9.8
39	Fluoranthene	0.049	-	0.01
65	Phenol	0.016	-	0.016
72	Benzo (a) Anthracene	0.018	-	0.005
78	Anthracene	0.38	-	0.1
80	Fluorene	0.04	-	0.01
84	Pyrene	0.079	-	0.005
85	Tetrachloroethylene	0.078	-	0.05
86	Toluene	0.015	-	0.015
87	Trichloroethylene	0.092	-	0.092
119	Chromium	0.42	-	0.03
120	Copper	2	-	0.03
122	Lead	0.36	-	0.06
124	Nickel	0.51	-	0.04
128	Zinc	5	-	0.10

Notes: All concentrations are in mg/l unless otherwise noted.
: All values represent long-term average values or predicted average performance levels.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COLD FORMING SUBCATEGORY

DIRECT DISCHARGERS(1)

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	73.3	28.1	28.1	28.1	0
Oil and Grease	2,742,937.8	285.8	81.7	81.7	-
Total Suspended Solids	44,570.5	653.0	400.0	400.0	-
Total Toxic Metals	320.6	21.4	9.8	9.8	-
Total Organics	356.9	4.1	4.0	3.8	-
SUBCATEGORY COST SUMMARY(2) ($X10^{-6})					
Investment	-	34.86	12.98	113.95	268.31
Annual	-	4.57	1.84	15.44	53.48

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	3.2	0.2	0.2	0.2	0
Oil and Grease	4,194.9	1.9	0.6	0.6	-
Total Suspended Solids	355.0	4.4	2.7	2.7	-
Total Toxic Metals	11.4	0.3	0.2	0.2	-
Total Organics	8.1	0.2	0.2	0.2	-
SUBCATEGORY COST SUMMARY(2) ($X10^{-6})					
Investment	-	0.15	0.09	1.99	3.89
Annual	-	0.02	0.01	0.26	0.57

(1) The raw waste load and BPT cost contributions of the zero discharge operations are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COLD FORMING SUBCATEGORY
COLD ROLLING

DIRECT DISCHARGERS[1]

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	29.6	28.1	28.1	28.1	0
Oil and Grease	86,942.3	285.8	81.7	81.7	-
Total Suspended Solids	22,502.3	653.0	400.0	400.0	-
Total Toxic Metals	93.7	21.4	9.8	9.8	-
Total Organics	336.5	4.1	4.0	3.8	-
SUBCATEGORY COST SUMMARY[2] ($\$X10^{-6}$)					
Investment	-	27.71	12.98	113.95	268.31
Annual	-	3.64	1.84	15.44	53.48

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	0.2	0.2	0.2	0.2	0
Oil and Grease	3,986.2	1.9	0.6	0.6	-
Total Suspended Solids	274.7	4.4	2.7	2.7	-
Total Toxic Metals	5.4	0.3	0.2	0.2	-
Total Organics	2.1	0.2	0.2	0.2	-
SUBCATEGORY COST SUMMARY[2] ($\$X10^{-6}$)					
Investment	-	0.06	0.09	1.99	3.89
Annual	-	0.008	0.01	0.26	0.57

(1) The raw waste load and BPT cost contributions of the zero discharge operations (contract haul) are included in the direct discharger data. As these plants have no wastewater discharges, they do not contribute to BAT costs or to the BPT and BAT effluent waste loads.

(2) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COLD FORMING SUBCATEGORY
COLD WORKED PIPE AND TUBE

	DIRECT DISCHARGERS	
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT BAT
Flow (MGD)	43.7	0
Oil and Grease	2,655,995.5	-
Total Suspended Solids	27,068.2	-
Total Toxic Metals	226.9	-
Total Organics	20.4	-
SUBCATEGORY COST SUMMARY[(1)] ($\$X10^{-6}$)		
Investment	-	7.15
Annual	-	0.93

	INDIRECT (POTW) DISCHARGERS	
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES
Flow (MGD)	3.0	0
Oil and Grease	208.7	-
Total Suspended Solids	80.3	-
Total Toxic Metals	1.0	-
Total Toxic Organics	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)		
Investment	-	0.09
Annual	-	0.01

(1) The cost summary totals do not include confidential plants.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COLD FORMING SUBCATEGORY
COLD ROLLING - RECIRCULATION, SINGLE STAND

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW[2] WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	0.05	0.03	0.03	0.03	0
Oil and Grease	1,104.6	0.3	0.1	0.1	-
Total Suspended Solids	76.1	0.7	0.4	0.4	-
Total Toxic Metals	1.5	(1)	(1)	(1)	-
Total Organics	0.6	(1)	(1)	(1)	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	1.10	0.10	2.32	6.80
Annual	-	0.16	0.02	0.31	0.95

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	0.007	0.007	0.007	0.007	0
Oil and Grease	144.1	0.1	(1)	(1)	-
Total Suspended Solids	9.9	0.2	0.1	0.1	-
Total Toxic Metals	0.2	(1)	(1)	(1)	-
Total Organics	0.1	(1)	(1)	(1)	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	0.03	0.02	0.42	1.22
Annual	-	0.005	0.003	0.06	0.17

(1) Load is less than or equal to 0.05 ton/year.
(2) Raw waste loads for contract haul plants have been included in these totals.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COLD FORMING SUBCATEGORY
COLD ROLLING - RECIRCULATION, MULTI STAND

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW(1) WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	1.4	1.3	1.3	1.3	0
Oil and Grease	30,736.6	12.8	3.7	3.7	-
Total Suspended Solids	2,118.1	29.3	17.9	17.9	-
Total Toxic Metals	41.6	1.7	0.6	0.6	-
Total Organics	15.7	0.7	0.6	0.5	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	5.83	0.97	22.32	38.04
Annual	-	0.40	0.13	2.87	5.68

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	0.2	0.2	0.2	0.2	0
Oil and Grease	3,842.1	1.8	0.5	0.5	-
Total Suspended Solids	264.8	4.2	2.6	2.6	-
Total Toxic Metals	5.2	0.2	0.1	0.1	-
Total Organics	2.0	0.1	0.1	0.1	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	0.03	0.07	1.57	2.67
Annual	-	0.003	0.009	0.20	0.40

(1) Raw waste loads for contract haul plants have been included in these totals.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COLD FORMING SUBCATEGORY
COLD ROLLING - COMBINATION

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	14.4	14.4	14.4	14.4	0
Oil and Grease	30,966.6	146.4	41.8	41.8	-
Total Suspended Solids	17,626.5	334.5	204.9	204.9	-
Total Toxic Metals	32.2	10.2	4.6	4.6	-
Total Organics	217.5	1.6	1.6	1.6	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	7.57	5.80	41.25	127.19
Annual	-	1.29	0.81	5.72	25.55

Note: There are no indirect dischargers in this segment.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COLD FORMING SUBCATEGORY
COLD ROLLING - DIRECT APPLICATION, SINGLE STAND

	DIRECT DISCHARGERS				
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW(1) WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	1.8	1.6	1.6	1.6	0
Oil and Grease	3,175.6	16.5	4.7	4.7	-
Total Suspended Solids	352.8	37.6	23.1	23.1	-
Total Toxic Metals	2.4	1.2	0.6	0.6	-
Total Organics	13.5	0.2	0.2	0.2	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	4.02	0.92	15.65	20.36
Annual	-	0.58	0.16	2.04	3.57

Note: There are no indirect dischargers in this segment.

(1) Raw waste loads for contract haul plants have been included in these totals.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COLD FORMING SUBCATEGORY
COLD ROLLING - DIRECT APPLICATION, MULTI STAND

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW(1) WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	11.9	10.8	10.8	10.8	0
Oil and Grease	20,958.9	109.8	31.4	31.4	-
Total Suspended Solids	2,328.8	250.9	153.7	153.7	-
Total Toxic Metals	16.0	8.3	3.9	3.9	-
Total Organics	89.2	1.5	1.5	1.5	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	9.19	5.19	32.41	75.92
Annual	-	1.21	0.72	4.50	17.73

Note: There are no indirect dischargers in this segment.

(1) Raw waste loads for contract haul plants have been included in these totals.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COLD FORMING SUBCATEGORY
COLD WORKED PIPE AND TUBE - USING WATER

	DIRECT DISCHARGERS	
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT BAT
Flow (MGD)	19.2	0
Oil and Grease	1,356.7	-
Total Suspended Solids	521.8	-
Total Toxic Metals	6.8	-
Total Toxic Organics	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)		
Investment	-	4.06
Annual	-	0.53

	INDIRECT (POTW) DISCHARGERS	
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES
Flow (MGD)	3.0	0
Oil and Grease	208.7	-
Total Suspended Solids	80.3	-
Total Toxic Metals	1.0	-
Total Toxic Organics	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)		
Investment	-	0.09
Annual	-	0.01

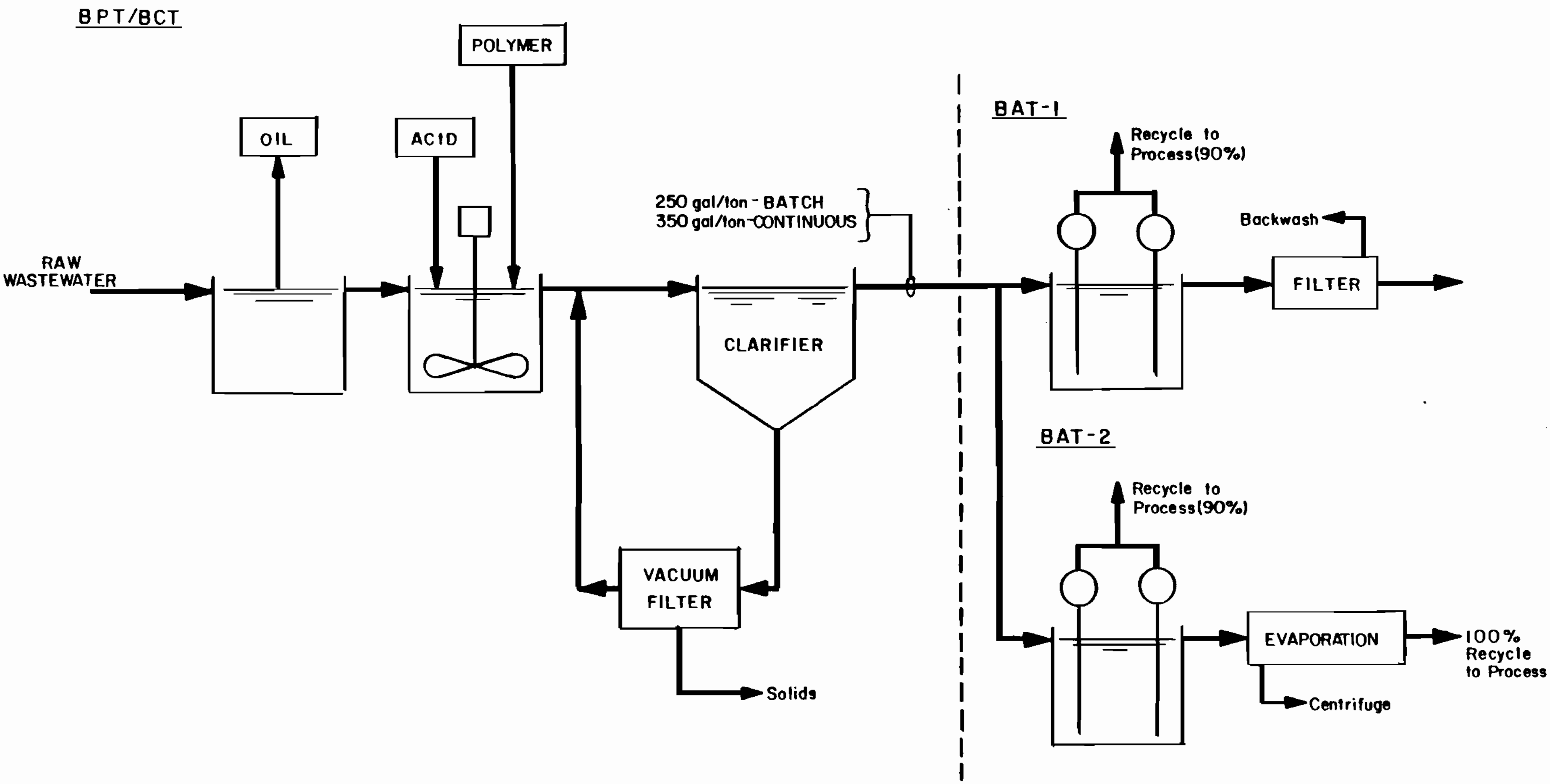
SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
COLD FORMING SUBCATEGORY
COLD WORKED PIPE AND TUBE - USING OIL

	DIRECT DISCHARGERS	
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT BAT
Flow (MGD)	24.5	0
Oil and Grease	2,654,638.8	-
Total Suspended Solids	26,546.4	-
Total Toxic Metals	220.1	-
Total Organics	20.4	-
SUBCATEGORY COST SUMMARY(1) ($X10^{-6})		
Investment	-	3.09
Annual	-	0.40

Note: There are no indirect dischargers in this subdivision.

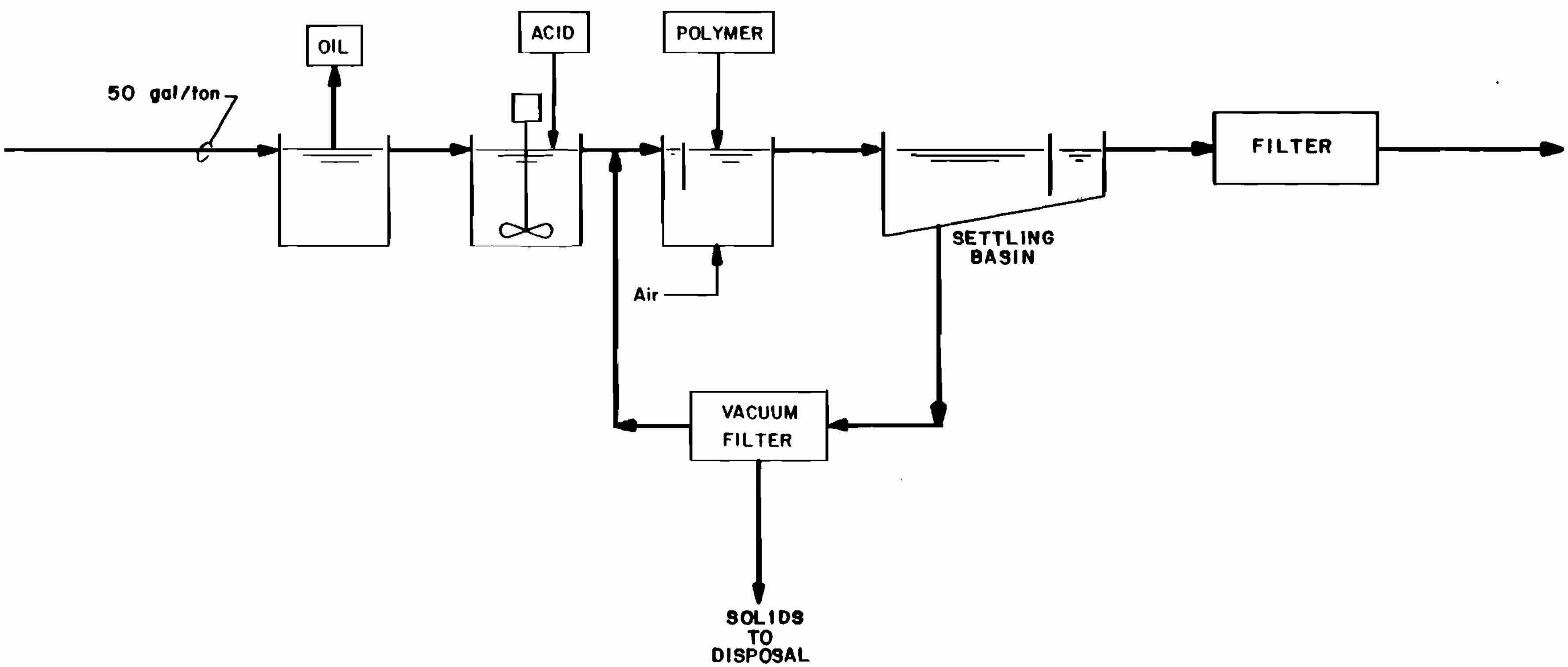
(1) The cost summary totals do not include confidential plants.

ALKALINE CLEANING
BPT/BCT/BAT
TREATMENT MODELS SUMMARY



ALKALINE CLEANING
NSPS
TREATMENT MODELS SUMMARY

NSPS



SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Alkaline Cleaning
: Batch

MODEL SIZE (TPD): 150
OPER. DAYS/YEAR : 250
TURNS/DAY : 2

RAW WASTE FLOWS

Model Plant		0.04 MGD
22	Direct Dischargers	0.8 MGD
9	Indirect Dischargers	0.3 MGD
31	Active Plants	1.1 MGD

MODEL COSTS ($X10^{-3})	BPT/ BCT	BAT-1	BAT-2
Investment	381	37.6	840
Annual	49.8	5.0	108
$/Ton of Production	1.33	0.13	2.88

	NSPS
Investment	237
Annual	30.7
$/Ton of Production	0.82

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT/ BCT	BAT-1 NSPS	BAT-2
	Flow (GPT) NSPS only	50		50	
	Flow (GPT)	250	250	25	0
	pH (SU)	7-11	6-9	6-9	-
	Dissolved Iron	0.38	0.38	0.38	-
	Oil and Grease(1)	13	(10)4.4	(5**)2	-
	Total Suspended Solids(1)	10	(30)23.8	(15)9.8	-
36	2,6-Dinitrotoluene	0.016	0.016	0.016	-
39	Fluoranthene	0.017	0.017	0.01	-
84	Pyrene	0.11	0.011	0.005	-
114	Antimony	0.048	0.048	0.048	-
119	Chromium	0.085	0.04	0.03	-
121	Cyanide	0.019	0.019	0.019	-
122	Lead	0.038	0.038	0.038	-
124	Nickel	0.013	0.013	0.013	-
125	Selenium	0.07	0.07	0.07	-
128	Zinc*	0.12	0.06	0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT costs are incremental over BPT costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

* Toxic pollutant found in all raw waste samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) The BPT and BCT total suspended solids and oil and grease limitations for alkaline cleaning operations are applicable when alkaline cleaning wastewaters are co-treated with wastewaters from other steel finishing operations.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Alkaline Cleaning
: Continuous

MODEL SIZE (TPD): 1500
OPER. DAYS/YEAR : 250
TURNS/DAY : 2

RAW WASTE FLOWS

Model Plant		0.5 MGD
22	Direct Dischargers	11.6 MGD
9	Indirect Dischargers	4.7 MGD
31	Active Plants	16.3 MGD

MODEL COSTS ($\$X10^{-3}$)	BPT/BCT	BAT-1	BAT-2
Investment	832	367	2430
Annual	115	46.1	348
$/Ton of Production	0.31	0.12	0.93

	NSPS
Investment	553
Annual	73.8
$/Ton of Production	0.20

	WASTEWATER CHARACTERISTICS	RAW WASTE	BPT/BCT	BAT-1 NSPS	BAT-2
	Flow (GPT) NSPS only	50		50	
	Flow (GPT)	350	350	35	0
	pH (SU)	7-11	6-9	6-9	-
	Dissolved Iron	0.38	0.38	0.38	-
	Oil and Grease(1)	13	(10)4.4	(5**)2	-
	Total Suspended Solids(1)	10	(30)23.8	(15)9.8	-
36	2,6-Dinitrotoluene	0.016	0.016	0.016	-
39	Fluoranthene	0.017	0.017	0.01	-
84	Pyrene	0.011	0.011	0.005	-
114	Antimony	0.048	0.048	0.048	-
119	Chromium	0.085	0.04	0.03	-
121	Cyanide	0.019	0.019	0.019	-
122	Lead	0.038	0.038	0.038	-
124	Nickel	0.013	0.013	0.013	-
125	Selenium	0.07	0.07	0.07	-
128	Zinc*	0.12	0.06	0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT costs are incremental over BPT costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term average values or predicted average performance levels.

*Toxic pollutant found in all raw waste samples.
**Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) The BPT and BCT total suspended solids and oil and grease limitations for alkaline cleaning operations are applicable when alkaline cleaning wastewaters are co-treated with wastewaters from other steel finishing operations.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
ALKALINE CLEANING SUBCATEGORY

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	12.4	12.4	1.3	0
Dissolved Iron	4.9	4.9	0.5	-
Oil and Grease	167.8	56.8	2.6	-
Total Suspended Solids	129.1	307.2	12.6	-
Total Toxic Metals	4.8	3.4	0.3	-
Total Organics (1)	0.9	0.9	0.1	-
SUBCATEGORY COST SUMMARY (2) ($X10^{-6})				
Investment	-	12.26	7.61	57.72
Annual	-	1.68	0.96	8.10

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES
Flow (MGD)	5.5	(3)
Dissolved Iron	1.9	
Oil and Grease	68.7	
Total Suspended Solids	52.8	
Total Toxic Metals	1.9	
Total Organics (1)	0.3	
SUBCATEGORY COST SUMMARY ($X10^{-6})		
Investment	-	
Annual	-	

(1) Total Organics load includes total cyanide.
(2) The cost summary totals do not include confidential plants.
(3) General Pretreatment Regulations apply, 40 CFR Part 403.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
ALKALINE CLEANING SUBCATEGORY
BATCH

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	0.8	0.8	0.08	0
Dissolved Iron	0.3	0.3	(1)	-
Oil and Grease	11.2	3.8	0.2	-
Total Suspended Solids	8.6	20.5	0.8	-
Total Toxic Metals	0.3	0.2	(1)	-
Total Organics[3]	0.1	0.1	(1)	-
SUBCATEGORY COST SUMMARY[2] ($X10^{-6})				
Investment	-	1.98	0.46	10.35
Annual	-	0.26	0.06	1.32

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES
Flow (MGD)	0.4	(4)
Dissolved Iron	0.1	
Oil and Grease	4.6	
Total Suspended Solids	3.5	
Total Toxic Metals	0.1	
Total Organics[3]	(1)	
SUBCATEGORY COST SUMMARY ($X10^{-6})		
Investment	-	
Annual	-	

(1) Load is less than or equal to 0.05 ton/year.
(2) The cost summary totals do not include confidential plants.
(3) Total Organics load includes total cyanide.
(4) General Pretreatment Regulations apply, 40 CFR part 403.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
ALKALINE CLEANING SUBCATEGORY
CONTINUOUS

DIRECT DISCHARGERS

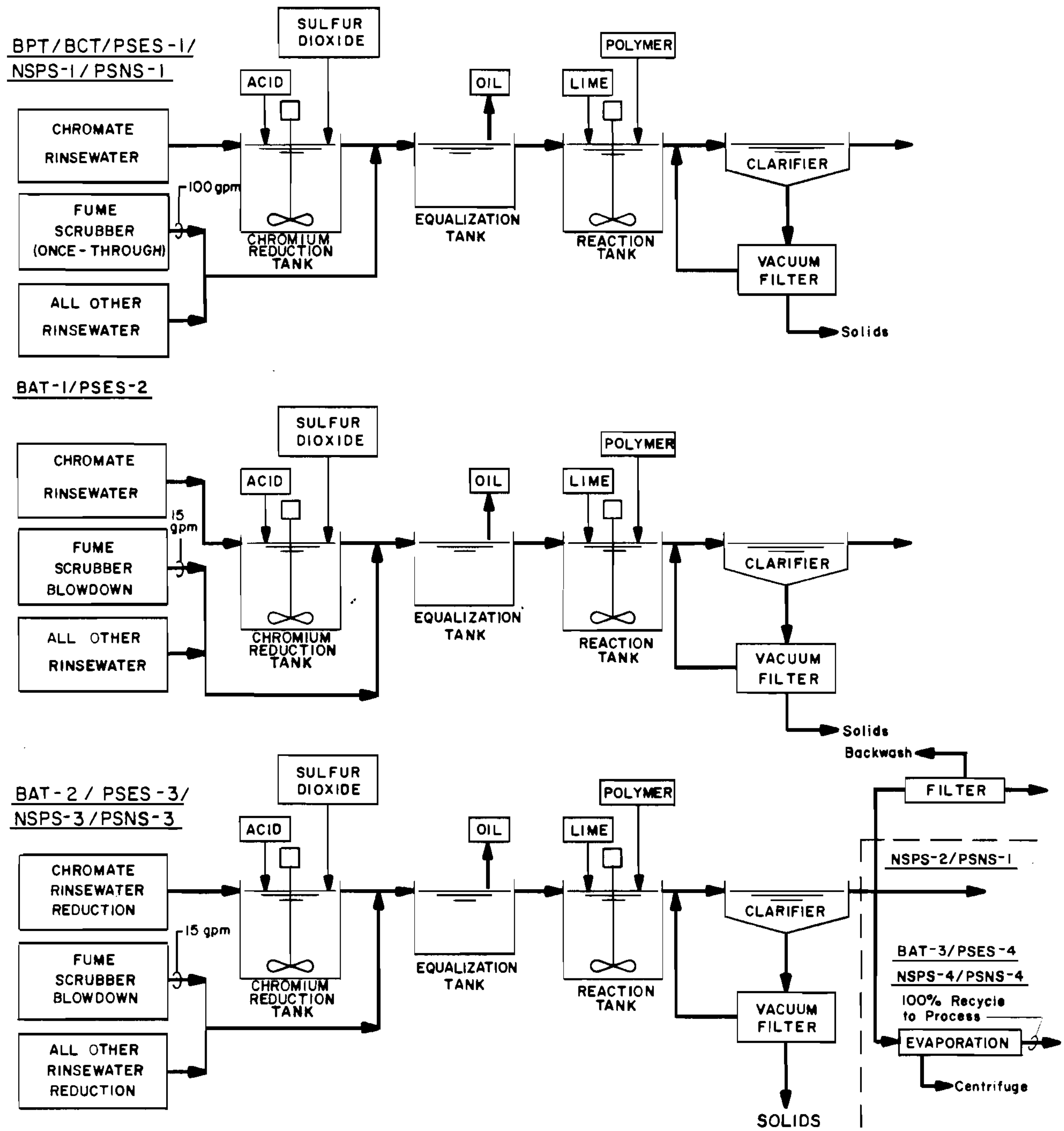
SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2
Flow (MGD)	11.6	11.6	1.2	0
Dissolved Iron	4.6	4.6	0.5	-
Oil and Grease	156.6	53.0	2.4	-
Total Suspended Solids	120.5	286.7	11.8	-
Total Toxic Metals	4.5	3.2	0.3	-
Total Organics(1)	0.8	0.8	0.1	-
SUBCATEGORY COST SUMMARY(2) ($X10^{-6})				
Investment	-	10.28	7.15	47.37
Annual	-	1.42	0.90	6.78

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES
Flow (MGD)	4.7	(3)
Dissolved Iron	1.8	
Oil and Grease	64.1	
Total Suspended Solids	49.3	
Total Toxic Metals	1.8	
Total Organics(1)	0.3	
SUBCATEGORY COST SUMMARY ($X10^{-6})		
Investment	-	
Annual	-	

(1) Total organics load includes total cyanide.
(2) The cost summary totals do not include confidential plants.
(3) General Pretreatment Regulations apply, 40 CFR part 403.

HOT COATING / GALVANIZING
TREATMENT MODELS SUMMARY

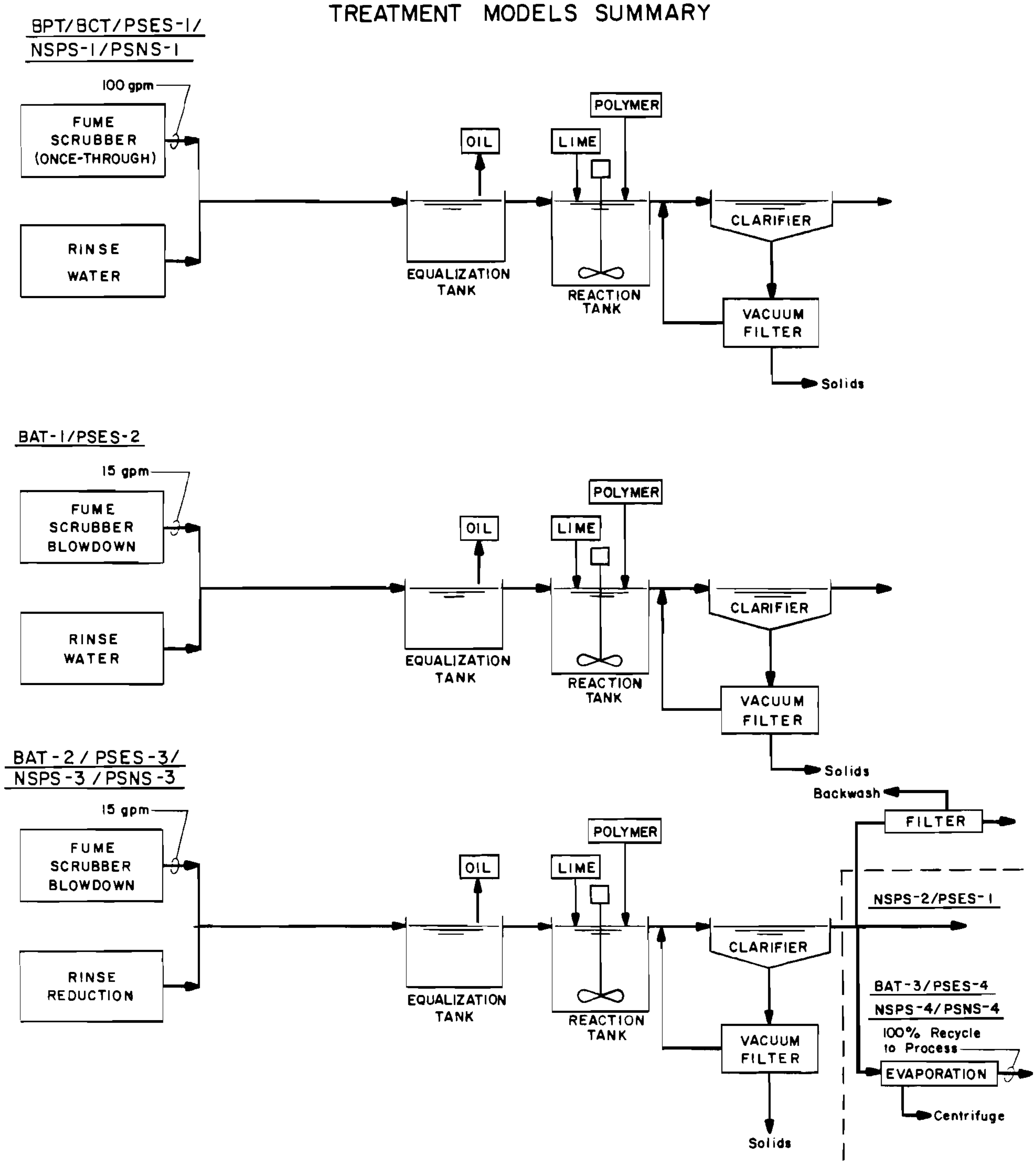


HOT COATING RINSE WATER FLOW RATES (GPT)

PRODUCT	BPT/BCT/PSES-1 & 2 BAT-1/NSPS-1/PSNS-1 (1)	ALL OTHER MODELS (2)
Strip / Sheet & Misc. Products	600	150
Wire Products & Fasteners	2400	600

(1) Fume scrubber flow at BPT/BCT/PSES-1/NSPS-1/PSNS-1: 100 gpm/scrubber
(2) Fume scrubber flow at all other models: 15 gpm/scrubber

HOT COATING/TERNE & OTHER METALS TREATMENT MODELS SUMMARY



HOT COATING RINSE WATER FLOW RATES (GPT)

PRODUCT	BAT/BCT/PSES-1&2/ BAT-1/NSPS-1/PSNS-1 (1)	ALL OTHER MODELS (2)
Strip/Sheet & Misc. Products	600	150
Wire Products & Fasteners	2400	600

(1) Fume scrubber flow at BPT/BCT/PSES-1/NSPS-1/PSNS-1: 15 gpm/scrubber
(2) Fume scrubber at all other models: 15 gpm/scrubber

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Coating - Galvanizing
: Strip, Sheet and Miscellaneous Products

MODEL SIZE (TPD): 800
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Rinses		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.5 MGD	Model Plant	0.3 MGD	
25 Direct Dischargers	12.0 MGD	11 Direct Dischargers	3.2 MGD	15.2 MGD
3 Indirect Dischargers	1.4 MGD	1 Indirect Dischargers	0.3 MGD	1.7 MGD
5 Zero Dischargers	0.1 MGD	1 Zero Dischargers	<0.03 MGD	0.1 MGD
33 Active Plants	13.5 MGD	13 Active Plants	3.5 MGD	17.0 MGD

MODEL COST ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2		BAT-2 PSES-3	BAT-3 PSES-4
Investment					
Plants Without Scrubbers	739	-		408	2593
Plants With Scrubbers	943	59.1		491	2864
Annual					
Plants Without Scrubbers	120	-		51.8	402
Plants With Scrubbers	154	8.3		63.3	452
$/Ton of Production					
Plants Without Scrubbers	0.58	-		0.25	1.93
Plants With Scrubbers	0.74	0.04		0.30	2.17
	NSPS-1 PSNS-1		**NSPS-2 PSNS-2**	**NSPS-3 PSNS-3**	**NSPS-4 PSNS-4**
Investment					
Plants Without Scrubbers	739		822	942	3127
Plants With Scrubbers	943		951	1095	3467
Annual					
Plants Without Scrubbers	120		128	143	493
Plants With Scrubbers	154		152	170	559
$/Ton of Production					
Plants Without Scrubbers	0.58		0.61	0.69	2.37
Plants With Scrubbers	0.74		0.73	0.82	2.69

WASTEWATER CHARACTERISTICS	RAW WASTE No Scrub	RAW WASTE W/Scrub	NSPS-1 PSNS-1 PSES-1 BPT/BCT	PSES-2 BAT-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3 PSES-3 BAT-2	NSPS-4 PSNS-4 PSES-4 BAT-3
Flow (GPT)	600	(1)	$600^{(1)}$	$600^{(2)}$	$150^{(2)}$	$150^{(2)}$	0
pH (SU)	2-9	2-8	6-9	6-9	6-9	6-9	-
Dissolved Iron	16	10	1	1	1	0.5	-
Hexavalent Chromium$^{(3)}$	1	0.6	(0.02)0.01	(0.02)0.01	(0.02)0.01	(0.02)0.01	-
Oil and Grease	60	45	(10)4.4	(10)4.4	(10)4.4	(5**)2	-
Total Suspended Solids	120	100	(30)23.8	(30)23.8	(30)23.8	(15)9.8	-
115 Arsenic*	0.2	0.12	0.1	0.1	0.1	0.1	-
119 Chromium	7	4	0.04	0.04	0.04	0.03	-
120 Copper*	0.8	0.5	0.04	0.04	0.04	0.03	-
122 Lead	0.6	0.4	(0.15)0.1	(0.15)0.1	(0.15)0.1	(0.1)0.06	-
124 Nickel	1	0.8	0.15	0.15	0.15	0.04	-
128 Zinc*	120	80	(0.1)0.06	(0.1)0.06	(0.1)0.06	(0.1)0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term averages or predicted average performance levels.
: PSES-1/BPT/BCT is the selected BAT for those operations without fume scrubbers.

* Toxic pollutant found in all raw wastewater samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) Additional limitations for fume scrubbers are provided, based upon 100 gpm per scrubber serving each galvanizing line.
(2) Additional limitations for fume scrubber blowdowns are provided, based upon 15 gpm per scrubber serving each galvanizing line.
(3) Limitations/standards apply only to plants discharging wastewaters from a chromate rinsing step.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Coating - Galvanizing
: Wire Products and Fasteners

MODEL SIZE (TPD): 100
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Rinses		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.24 MGD	Model Plant	0.3 MGD	
15 Direct Dischargers	3.6 MGD	6 Direct Dischargers	1.7 MGD	5.3 MGD
14 Indirect Dischargers	3.4 MGD	7 Indirect Dischargers	2.0 MGD	5.4 MGD
1 Zero Discharger	0 MGD	0 Zero Dischargers	0 MGD	0 MGD
30 Active Plants	7.0 MGD	13 Active Plants	3.7 MGD	10.7 MGD

MODEL COST ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment				
Plants Without Scrubbers	557	-	85.5	1982
Plants With Scrubbers	724	59.1	205	2363
Annual				
Plants Without Scrubbers	83.9	-	11.1	283
Plants With Scrubbers	113	8.3	27.3	357
$/Ton of Production				
Plants Without Scrubbers	3.23	-	0.43	10.88
Plants With Scrubbers	4.35	0.32	1.05	13.73

	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3	NSPS-4 PSNS-4
Investment				
Plants Without Scrubbers	557	421	471	2367
Plants With Scrubbers	724	583	694	2852
Annual				
Plants Without Scrubbers	83.9	65.0	71.5	344
Plants With Scrubbers	113	92.6	107	437
$/Ton of Production				
Plants Without Scrubbers	3.23	2.50	2.75	13.23
Plants With Scrubbers	4.35	3.56	4.12	16.81

WASTEWATER CHARACTERISTICS	RAW WASTE No Scrub	RAW WASTE W/Scrub	NSPS-1 PSNS-1 PSES-1 BPT/BCT	PSES-2 BAT-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3 PSES-3 BAT-2	NSPS-4 PSNS-4 PSES-4 BAT-3
Flow (GPT)	2400	(1)	2400(1)	2400(2)	600(2)	600(2)	0
pH (SU)	3-9	3-9	6-9	6-9	6-9	6-9	-
Dissolved Iron	10	5	1	1	1	0.5	-
Hexavalent Chromium(3)	0.2	0.1	(0.02)0.01	(0.02)0.01	(0.02)0.01	(0.02)0.01	-
Oil and Grease	25	15	(10)4.4	(10)4.4	(10)4.4	(5**)2	-
Total Suspended Solids	80	50	(30)23.8	(30)23.8	(30)23.8	(15)9.8	-
115 Arsenic	0.25	0.15	0.1	0.1	0.1	0.1	-
119 Chromium*	2	1	0.04	0.04	0.04	0.03	-
120 Copper*	0.8	0.4	0.04	0.04	0.04	0.03	-
122 Lead*	2	1	(0.15)0.1	(0.15)0.1	(0.15)0.1	(0.1)0.06	-
124 Nickel*	0.5	0.2	0.15	0.15	0.15	0.04	-
128 Zinc*	10	5	(0.1)0.06	(0.1)0.06	(0.1)0.06	(0.1)0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop limitations/standards for the various levels of treatment. All other values represent long term averages or predicted average performance levels.
: PSES-1/BPT/BCT is the selected BAT for those operations without fume scrubbers.

* Toxic pollutant found in all raw wastewater samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) Additional limitations for fume scrubbers are provided, based upon 100 gpm per scrubber serving each galvanizing line.
(2) Additional limitations for fume scrubber blowdowns are provided, based upon 15 gpm per scrubber serving each galvanizing line.
(3) Limitations/standards apply only to plants discharging wastewaters from a chromate rinsing step.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Coating - Terne
: All Products

MODEL SIZE (TPD): 365
OPER. DAYS/YEAR : 260
TURNS/DAY : 3

RAW WASTE FLOWS

Rinses		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.22 MGD	Model Plant	0.14 MGD	
4 Direct Dischargers	0.9 MGD	3 Direct Dischargers	0.4 MGD	1.3 MGD
1 Indirect Discharger	0.2 MGD	0 Indirect Dischargers	0 MGD	0.2 MGD
5 Active Plants	1.1 MGD	3 Active Plants	0.4 MGD	1.5 MGD

MODEL COST ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2		BAT-2 PSES-3	BAT-3 PSES-4
Investment					
Plants Without Scrubbers	477	-		178	2030
Plants With Scrubbers	557	53.8		242	2260
Annual					
Plants Without Scrubbers	70.1	-		22.6	286
Plants With Scrubbers	84.3	7.4		31.4	328
$/Ton of Production					
Plants Without Scrubbers	0.74	-		0.24	3.01
Plants With Scrubbers	0.89	0.088		0.33	3.46

	NSPS-1 PSNS-1		NSPS-2 PSNS-2	NSPS-3 PSNS-3	NSPS-4 PSNS-4
Investment					
Plants Without Scrubbers	477		452	499	2351
Plants With Scrubbers	557		545	602	2620
Annual					
Plants Without Scrubbers	70.1		65.1	71.2	335
Plants With Scrubbers	84.3		80.5	88.0	384
$/Ton of Production					
Plants Without Scrubbers	0.74		0.69	0.75	3.53
Plants With Scrubbers	0.89		0.85	0.93	4.05

WASTEWATER CHARACTERISTICS	RAW WASTE No Scrub	RAW WASTE W/Scrub	NSPS-1 PSNS-1 PSES-1 BPT/BCT	PSES-2 BAT-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3 PSES-3 BAT-2	NSPS-4 PSNS-4 PSES-4 BAT-3
Flow (GPT)	600	(1)	600(1)	600(2)	150(2)	150(2)	0
pH (SU)	2-8	2-8	6-9	6-9	6-9	6-9	-
Dissolved Iron	40	25	1	1	1	0.5	-
Oil and Grease	30	20	(10)4.4	(10)4.4	(10)4.4	(5**)2	-
Tin	3	2	0.5	0.5	0.5	0.1	-
Total Suspended Solids	75	50	(30)23.8	(30)23.8	(30)23.8	(15)9.8	-
115 Arsenic	0.15	0.1	0.1	0.1	0.1	0.1	-
118 Cadmium*	0.3	0.2	0.1	0.1	0.1	0.05	-
119 Chromium*	5	3	0.04	0.04	0.04	0.03	-
120 Copper	0.6	0.4	0.04	0.04	0.04	0.03	-
122 Lead*	1.2	0.8	(0.15)0.1	(0.15)0.1	(0.15)0.1	(0.1)0.06	-
124 Nickel*	1	0.6	0.15	0.15	0.15	0.04	-
128 Zinc*	1.5	1	(0.1)0.06	(0.1)0.06	(0.1)0.06	(0.1)0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop limitations/standards for the various levels of treatment. All other values represent long term averages or predicted average performance levels.
: PSES-1/BPT/BCT is the selected BAT for those operations without fume scrubbers.

* Toxic pollutant found in all raw wastewater samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) Additional limitations for fume scrubbers are provided, based on 100 gpm per scrubber serving each coating line.
(2) Additional limitations for fume scrubber blowdowns are provided, based upon 15 gpm per scrubber serving each coating line.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Coating - Other Metallic Coatings
: Strip, Sheet and Miscellaneous Products

MODEL SIZE (TPD): 500
OPER. DAYS/YEAR : 260
TURNS/DAY : 2

RAW WASTE FLOWS

Rinses		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.3 MGD	Model Plant	0.1 MGD	
3 Direct Dischargers	0.9 MGD	0 Direct Dischargers	0 MGD	0.9 MGD
0 Indirect Dischargers	0 MGD	0 Indirect Dischargers	0 MGD	0 MGD
1 Zero Discharger	<0.01 MGD	0 Zero Dischargers	0 MGD	<0.01 MGD
4 Active Plants	0.9 MGD	0 Active Plants	0 MGD	0.9 MGD

MODEL COST ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2	BAT-2 PSES-3	BAT-3 PSES-4
Investment				
Plants Without Scrubbers	571	-	236	2232
Plants With Scrubbers	660	53.8	339	2605
Annual				
Plants Without Scrubbers	89.5	-	30.1	323
Plants With Scrubbers	106	7.4	43.6	383
$/Ton of Production				
Plants Without Scrubbers	0.69	-	0.23	2.48
Plants With Scrubbers	0.82	0.06	0.34	2.95

MODEL COST ($X10^{-3})	NSPS-1 PSNS-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3	NSPS-4 PSNS-4
Investment				
Plants Without Scrubbers	571	568	624	2620
Plants With Scrubbers	660	684	790	3055
Annual				
Plants Without Scrubbers	89.5	86.8	94.3	387
Plants With Scrubbers	106	107	120	460
$/Ton of Production				
Plants Without Scrubbers	0.69	0.67	0.73	2.98
Plants With Scrubbers	0.82	0.82	0.92	3.54

WASTEWATER CHARACTERISTICS	RAW WASTE No Scrub	RAW WASTE W/Scrub	NSPS-1 PSNS-1 PSES-1 BPT/BCT	PSES-2 BAT-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3 PSES-3 BAT-2	NSPS-4 PSNS-4 PSES-4 BAT-3
Flow (GPT)	600	(1)	600(1)	600(2)	150(2)	150(2)	0
pH (SU)	2-9	3-9	6-9	6-9	6-9	6-9	-
Aluminum	30	20	1	1	1	0.1	-
Dissolved Iron	30	20	1	1	1	0.1	-
Oil and Grease	60	40	(10)4.4	(10)4.4	(10)4.4	(5**)2	-
Tin	8	5	0.5	0.5	0.5	0.1	-
Total Suspended Solids	400	250	(30)23.8	(30)23.8	(30)23.8	(15)9.8	-
115 Arsenic*	0.2	0.1	0.1	0.1	0.1	0.1	-
118 Cadmium	0.4	0.3	0.04	0.04	0.04	0.03	-
119 Chromium*	0.4	0.3	0.04	0.04	0.04	0.03	-
120 Copper*	0.4	0.3	0.04	0.04	0.04	0.03	-
122 Lead*	2	1.5	(0.15)0.1	(0.15)0.1	(0.15)0.1	(0.1)0.06	-
124 Nickel*	1	0.6	0.15	0.15	0.15	0.04	-
128 Zinc*	5	3	(0.1)0.06	(0.1)0.06	(0.1)0.06	(0.1)0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term averages or predicted average performance levels.
: PSES-1/BPT/BCT is the selected BAT for those operations without fume scrubbers.

* Toxic pollutant found in all raw wastewater samples analyzed.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) Additional limitations for fume scrubbers are provided, based upon 100 gpm per scrubber serving each coating line.
(2) Additional limitations for fume scrubber blowdowns are provided, based upon 15 gpm per scrubber serving each coating line.

SUBCATEGORY SUMMARY DATA
BASIS 7/1/78 DOLLARS

SUBCATEGORY: Hot Coating - Other Metallic Coatings
: Wire Products and Fasteners

MODEL SIZE (TPD): 15
OPER. DAYS/YEAR : 260
TURNS/DAY : 2

RAW WASTE FLOWS

Rinses		Fume Scrubbers (Additional Flow)		Total Flow
Model Plant	0.04 MGD	Model Plant	0.14 MGD	
2 Direct Dischargers	0.07 MGD	0 Direct Dischargers	0 MGD	0.07 MGD
4 Indirect Dischargers	0.14 MGD	0 Indirect Dischargers	0 MGD	0.14 MGD
6 Active Plants	0.21 MGD	0 Active Plants	0 MGD	0.21 MGD

MODEL COST ($X10^{-3})	BPT/BCT PSES-1	BAT-1 PSES-2		BAT-2 PSES-3	BAT-3 PSES-4
Investment					
Plants Without Scrubbers	225	-		20.8	1045
Plants With Scrubbers	404	53.8		91.8	1538
Annual					
Plants Without Scrubbers	31.4	-		2.9	137
Plants With Scrubbers	57.9	7.4		12.4	205
$/Ton of Production					
Plants Without Scrubbers	8.05	-		0.74	35.13
Plants With Scrubbers	14.85	1.90		3.18	52.56
	NSPS-1 PSNS-1		NSPS-2 PSNS-2	NSPS-3 PSNS-3	NSPS-4 PSNS-4
Investment					
Plants Without Scrubbers	225		161	176	1200
Plants With Scrubbers	404		335	368	1814
Annual					
Plants Without Scrubbers	31.4		22.8	24.9	159
Plants With Scrubbers	57.9		48.6	52.8	245
$/Ton of Production					
Plants Without Scrubbers	8.05		5.85	6.38	40.77
Plants With Scrubbers	14.85		12.46	13.54	62.82

WASTEWATER CHARACTERISTICS	RAW WASTE No Scrub	RAW WASTE W/Scrub	NSPS-1 PSNS-1 PSES-1 BPT/BCT	PSES-2 BAT-1	NSPS-2 PSNS-2	NSPS-3 PSNS-3 PSES-3 BAT-2	NSPS-4 PSNS-4 PSES-4 BAT-3
Flow (GPT)	2400	(1)	2400(1)	2400(2)	600(2)	600(2)	0
pH (SU)	3-9	3-9	6-9	6-9	6-9	6-9	-
Aluminum	20	5	1	1	1	0.1	-
Dissolved Iron	30	8	1	1	1	0.5	-
Oil and Grease	30	15	(10)4.4	(10)4.4	(10)4.4	(5**)2	-
Tin	2	1	0.5	0.5	0.5	0.1	-
Total Suspended Solids	250	75	(30)23.8	(30)23.8	(30)23.8	(15)9.8	-
115 Arsenic	0.2	0.1	0.1	0.1	0.1	0.1	-
118 Cadmium	0.2	0.1	0.04	0.04	0.04	0.03	-
119 Chromium*	0.2	0.1	0.04	0.04	0.04	0.03	-
120 Copper*	0.3	0.1	0.04	0.04	0.04	0.03	-
122 Lead*	0.6	0.2	(0.15)0.1	(0.15)0.1	(0.15)0.1	(0.1)0.06	-
124 Nickel*	0.4	0.2	0.15	0.15	0.15	0.04	-
128 Zinc*	1	0.5	(0.1)0.06	(0.1)0.06	(0.1)0.06	(0.1)0.06	-

Notes: All concentrations are in mg/l unless otherwise noted.
: BAT and PSES-2 through PSES-4 costs are incremental over BPT/PSES-1 costs.
: Values in parentheses represent the concentrations used to develop the limitations/standards for the various levels of treatment. All other values represent long term averages or predicted average performance levels.
: PSES-1/BPT/BCT is the selected BAT for those operations without fume scrubbers.

* Toxic pollutant found in all raw wastewater samples.
** Limit for oil and grease is based upon 10 mg/l (maximum only).

(1) Additional limitations for fume scrubbers are provided, based upon 100 gpm per scrubber serving each coating line.
(2) Additional limitations for fume scrubber blowdowns are provided, based upon 15 gpm per scrubber serving each coating line.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT COATING-ALL SUBDIVISIONS
ALL PRODUCTS

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	22.9	22.8	18.3	5.23	0
Aluminum	31.2	1.1	1.1	(2)	-
Dissolved Iron	321.8	24.8	19.8	2.7	-
Hexavalent Chromium	13.7	0.2	0.2	0.1	-
Oil and Grease	1,059.9	108.7	87.0	11.2	-
Tin	11.1	1.2	1.0	0.1	-
Total Suspended Solids	2,657.8	588.1	471.1	54.8	-
Total Toxic Metals	1,829.3	12.2	9.8	1.8	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY ($X10^{-6})(1)					
Investment	-	33.68	0.87	12.8	119.8
Annual	-	5.07	0.12	1.64	18.7

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	7.5	7.5	5.6	1.6	0
Aluminum	3.1	0.2	0.2	(2)	-
Dissolved Iron	77.5	8.1	6.0	0.9	-
Hexavalent Chromium	2.3	0.1	0.1	(2)	-
Oil and Grease	217.1	35.7	26.3	3.6	-
Tin	1.0	0.2	0.2	(2)	-
Total Suspended Solids	611.5	192.8	142.3	17.4	-
Total Toxic Metals	268.8	4.0	3.0	0.6	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY ($X10^{-6})(1)					
Investment	-	4.97	0.08	1.58	23.0
Annual	-	0.73	0.01	0.21	3.35

(1) The cost summary totals do not include confidential plants.
(2) Load is less than or equal to 0.05 ton/year.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT COATING-GALVANIZING
STRIP, SHEET AND MISCELLANEOUS PRODUCTS

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	15.3	15.2	12.5	3.5	0
Dissolved Iron	210.3	16.5	13.5	1.9	-
Hexavalent Chromium	12.9	0.2	0.1	(2)	-
Oil and Grease	857.5	72.4	59.5	7.5	-
Total Suspended Solids	1,807.2	391.6	322.1	36.9	-
Total Toxic Metals	1,747.2	8.1	6.6	1.2	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)(1)					
Investment	-	21.58	0.63	9.92	73.8
Annual	-	3.36	0.09	1.27	12.11

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	1.7	1.7	1.5	0.4	0
Dissolved Iron	25.0	1.9	1.6	0.2	-
Hexavalent Chromium	1.5	(2)	(2)	(2)	-
Oil and Grease	100.0	8.2	7.1	0.9	-
Total Suspended Solids	208.3	44.6	38.3	4.3	-
Total Toxic Metals	206.5	0.9	0.8	0.1	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	1.16	0.012	0.61	4.03
Annual	-	0.17	0.002	0.078	0.61

(1) The cost summary totals do not include confidential plants.
(2) Load is less than or equal to 0.05 ton/year.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT COATING-GALVANIZING
WIRE PRODUCTS AND FASTENERS

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	5.3	5.3	3.9	1.2	0
Dissolved Iron	40.6	5.8	4.2	0.6	-
Hexavalent Chromium	0.8	0.1	(2)	(2)	-
Oil and Grease	110.1	25.4	18.4	2.5	-
Total Suspended Solids	359.3	137.6	99.6	12.3	-
Total Toxic Metals	63.1	2.8	2.0	0.4	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)(1)					
Investment	-	7.86	0.08	1.42	28.2
Annual	-	1.07	0.011	0.19	4.09

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	5.4	5.4	3.7	1.1	0
Dissolved Iron	38.3	5.8	4.0	0.6	-
Hexavalent Chromium	0.8	0.1	(2)	(2)	-
Oil and Grease	105.3	25.7	17.5	2.5	-
Total Suspended Solids	346.3	138.8	94.6	12.1	-
Total Toxic Metals	59.4	2.9	2.0	0.4	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)(1)					
Investment	-	3.23	0.07	0.90	16.21
Annual	-	0.48	0.010	0.12	2.38

(1) The cost summary totals do not include confidential plants.
(2) Load is less than or equal to 0.05 ton/year.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT COATING-TERNE
ALL PRODUCTS

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	1.3	1.3	0.94	0.28	0
Dissolved Iron	39.0	1.4	1.0	0.2	-
Oil and Grease	30.8	6.2	4.5	0.6	-
Tin	3.1	0.7	0.5	(1)	-
Total Suspended Solids	76.9	33.8	24.3	3.0	-
Total Toxic Metals	9.5	0.8	0.5	0.1	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	2.21	0.16	0.95	9.34
Annual	-	0.33	0.02	0.12	1.34

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	0.22	0.22	0.22	0.055	0
Dissolved Iron	9.5	0.2	0.2	(1)	-
Oil and Grease	7.1	1.0	1.0	0.1	-
Tin	0.7	0.1	0.1	(1)	-
Total Suspended Solids	17.8	5.6	5.6	0.6	-
Total Toxic Metals	2.3	0.1	0.1	(1)	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	0.07	-	0.03	0.29
Annual	-	0.01	-	0.003	0.04

(1) Load is less than or equal to 0.05 ton/year.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT COATING-OTHER METALLIC COATINGS
STRIP, SHEET AND MISCELLANEOUS PRODUCTS

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	0.9	0.9	0.9	0.23	0
Aluminum	29.6	1.0	1.0	(1)	-
Dissolved Iron	29.6	1.0	1.0	(1)	-
Oil and Grease	59.2	4.3	4.3	0.5	-
Tin	7.9	0.5	0.5	(1)	-
Total Suspended Solids	394.9	23.2	23.2	2.4	-
Total Toxic Metals	9.3	0.5	0.5	0.1	-
Total Organics	-	-	-	-	-
SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	1.72	-	0.50	6.50
Annual	-	0.27	-	0.06	0.94

Note: There are no indirect dischargers in this segment. Also, since none of the plants have fume scrubbers, the BAT-1 discharge loads are identical with the BPT/BCT loads.

(1) Load is less than or equal to 0.05 ton/year.

SUMMARY OF EFFLUENT LOADINGS AND TREATMENT COSTS
HOT COATING-OTHER METALLIC COATINGS
WIRE PRODUCTS AND FASTENERS

DIRECT DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	BPT/BCT	BAT-1	BAT-2	BAT-3
Flow (MGD)	0.07	0.07	0.07	0.02	0
Aluminum	1.6	0.1	0.1	(1)	-
Dissolved Iron	2.3	0.1	0.1	(1)	-
Oil and Grease	2.3	0.3	0.3	(1)	-
Tin	0.2	(1)	(1)	(1)	-
Total Suspended Solids	19.5	1.9	1.9	0.2	-
Total Toxic Metals	0.2	(1)	(1)	(1)	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)(1)					
Investment	-	0.31	-	0.04	1.93
Annual	-	0.04	-	0.005	0.25

INDIRECT (POTW) DISCHARGERS

SUBCATEGORY LOAD SUMMARY (TONS/YEAR)	RAW WASTE	PSES-1	PSES-2	PSES-3	PSES-4
Flow (MGD)	0.14	0.14	0.14	0.04	0
Aluminum	3.1	0.2	0.2	(1)	-
Dissolved Iron	4.7	0.2	0.2	(1)	-
Oil and Grease	4.7	0.7	0.7	0.1	-
Tin	0.3	0.1	0.1	(1)	-
Total Suspended Solids	39.1	3.7	3.7	0.4	-
Total Toxic Metals	0.4	0.1	0.1	(1)	-
Total Organics	-	-	-	-	-

SUBCATEGORY COST SUMMARY ($\$X10^{-6}$)					
Investment	-	0.51	-	0.04	2.44
Annual	-	0.07	-	0.006	0.32

(1) Load is less than or equal to 0.05 ton/year.

VOLUME I

APPENDIX D

STEEL INDUSTRY WASTEWATER POLLUTANTS

Acrylonitrile (3). Acrylonitrile (CH_2=CHCN) is an explosive flammable liquid having a normal boiling point of 77°C and a vapor pressure of 80 mmHg at 20°C. It is miscible with most organic solvents. It is manufactured by the reaction of propylene with ammonia and oxygen in the presence of a catalyst. Annual U.S. production is eight hundred thousand tons.

The major use of acrylonitrile is in the manufacture of copolymers for the production of acrylic and modacrylic fibers. It is also used in the plastics, surface coatings, and adhesives industries.

The acute toxicity of acrylonitrile is well known. The compound appears to exert part of its toxic effect through the release of inorganic cyanide. Inhalation has been reported to be the major route of exposure in lethal cases of acrylonitrile poisoning. Toxic manifestations of acrylonitrile inhalation include disorders of the central nervous system and chronic upper respiratory tract irritation. The next most likely route of exposure is dermal. Dermatologic conditions include contact allergic dermatitis, occupational eczema and toxodermia. The least likely route of exposure of acrylonitrile is through ingestion. Ingestion usually occurs through exposure to water or aquatic life containing acrylonitrile or exposure to food products packaged in materials which leach acrylonitrile to the food.

There is suggestive evidence that acrylonitrile is carcinogenic to humans and animals. NIOSH 1978 states, "...acrylonitrile must be handled in the workplace as a suspect human carcinogen." Laboratory rats which had acrylonitrile administered to them through inhalation and drinking water developed central nervous system tumors and zymbal gland carcinomas not evident in the control animals. Numerous reports have been made of the embryotoxicity, mutagenicity, and teratogenicity of acrylonitrile in laboratory animals.

For the maximum protection of human health from the potential carcinogenic effects of exposure to acrylonitrile through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of acrylonitrile estimated to result in additional lifetime cancer risk at levels of 10^{-7}, 10^{-6} and 10^{-5} are 5.79×10^{-6} mg/l, 5.79×10^{-5} mg/l and 5.79×10^{-4} mg/l, resepctively. If contaminated aquatic organisms alone are consumed excluding the consumption of water, the water concentration should be less than 6.52×10^{-3} mg/l to keep the lifetime cancer risk below 10^{-5}. Limited acute and chronic toxicity data for fresh water aquatic life show that adverse effects occur at concentrations higher than those cited for human health risks.

Some studies have been reported regarding the behavior of acrylonitrile in POTW. Biochemical oxidation of acrylonitrile under laboratory conditions at concentrations of 86-162 mg/l, produced 0, 2, and 56 percent degradation in 5, 10, and 20 days, respectively, using unacclimated seed cultures. Degradation of 72 percent was produced in 10 days using acclimated seed cultures. Based on these data and general conclusions relating molecular structure to biochemical oxidation, it is expected that acrylonitrile will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. Other reports suggest that acrylonitrile entering an activated sludge process in concentrations of 50 ppm or greater, may inhibit certain bacterial processes such as nitrification.

Benzene (4). Benzene (C_6H_6) is a clear, colorless, liquid obtained mainly from petroleum feedstocks by several different processes. Some is recovered from light oil obtained from coal carbonization gases. It boils at 80°C and has a vapor pressure of 100 mm Hg at 26°C. It is slightly soluble in water (1.8 g/l at 25°C) and it disolves in hydrocarbon solvents. Annual U.S. production is three to four million tons.

Most of the benzene used in the U.S. goes into chemical manufacture. About half of that is converted to ethylbenzene which is used to make styrene. Some benzene is used in motor fuels.

Benzene is harmful to human health according to numerous published studies. Most studies relate effects of inhaled benzene vapors. These effects include nausea, loss of muscle coordination, and excitement, followed by depression and coma. Death is usually the result of respiratory or cardiac failure. Two specific blood disorders are related to benzene exposure. One of these, acute myelogenous leukemia, represents a carcinogenic effect of benzene. However, most human exposure data are based on exposure in occupationed settings and benzene carcinogenisis is not considered to be firmly established.

Oral administration of benzene to laboratory animals produced leukopenia, a reduction in number of leukocytes in the blood. Subcutaneous injection of benzene-oil solutions has produced suggestive, but not conclusive, evidence of benzene carcinogenisis.

Benzene demonstrated teratogenic effects in laboratory animals, and mutagenic effects in humans and other animals.

For maximum protection of human health from the potential carcinogenic effects of exposure to benzene through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of benzene estimated to result in additional lifetime cancer risk at levels of 10^{-7}, 10^{-6}, and 10^{-5} are 8×10^{-5} mg/l, 8×10^{-4} mg/l, and 8×10^{-3} mg/l, respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 0.478 mg/l to keep the lifetime cancer risk below 10^{-5}. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

Some studies have been reported regarding the behavior of benzene in POTW. Biochemical oxidation of benzene under laboratory conditions, at concentrations of 3 to 10 mg/l, produced 24, 27, 24, and 29 percent degradation in 5, 10, 15, and 20 days, respectively, using unacclimated seed cultures in fresh water. Degradation of 58, 67, 76, and 80 percent was produced in the same time periods using acclimated seed cultures. Other studies produced similar results. Based on these data and general conclusions relating molecular structure to biochemical oxidation, it is expected that benzene will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. Other reports indicate that most benzene entering a POTW is removed to the sludge and that influent concentrations of 1 g/l inhibit sludge digestion. An EPA study of the fate of toxic pollutants in POTW reveals removal efficiencies of 70 to 98 percent for three POTW where influent benzene levels were 5×10^{-3} to 143×10^{-3} mg/l. Four other POTW samples had influent benzene concentrations of 1 or 2×10^{-3} mg/l and removals appeared indeterminate because of the limits of quantification for analyses. There is no information about possible effects of benzene on crops grown in soils amended with sludge containing benzene.

<u>Hexachlorobenzene (9)</u>. Hexachlorobenzene (C_6Cl_6) is a nonflammable crystalline substance which is virtually insoluble in water. However, it is soluble in benzene, chloroform, and ether. Hexachlorobenzene (HCB) has a density of 2.044 g/ml. It melts at 231°C and boils at 323-326°C. Commercial production of HCB in the U.S. was discontinued in 1976, though it is still generated as a by-product of other chemical operations. In 1972, an estimated 2425 tons of HCB were produced in this way.

Hexachlorobenzene is used as a fungicide to control fungal diseases in cereal grains. The main agricultural use of HCB is on wheat seed intended soley for planting. HCB has been used as an impurity in other pesticides. It is used in industry as a plasticizer for polyvinyl chloride as well as a flame retardant. HCB is also used as a starting material for the production of pentachlorophenol which is marketed as a wood preservative.

Hexachlorobenzene can be harmful to human health as was seen in Turkey from 1955-1959. Wheat that had been treated with HCB in preparation for planting was consumed as food. Those people affected by HCB developed cutanea tarda porphyria, the symptoms of which included blistering and epidermolysis of the exposed parts of the body, particularly the face and the hands. These symptoms disappeared after consumption of HCB contaminated bread was discontinued. However, the HCB which was stored in body fat contaminated maternal milk. As a result of this, at least 95 percent of the infants feeding on this milk died. The fact that HCB remains stored in body fat after exposure has ended presents an additional problem. Weight loss may result in a dramatic redistribution of HCB contained in fatty tissue. If the stored levels of HCB are high, adverse effects might ensue.

Limited testing suggests that hexachlorobenzene is not teratogenic or mutagenic. However, two animal studies have been conducted which indicate that HCB is a carcinogen. HCB appears to have multipotential carcinogenic activity; the incidence of hepatomas, haemangioendotheliomas and thyroid adenomas was significantly increased in animals exposed to HCB by comparison to control animals.

For maximum protection of human health from the potential carcinogenic effects of exposure to hexachlorobenzene through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of HCB estimated to result in additional lifetime cancer risk at levels of 10^{-7}, 10^{-6}, and 10^{-5} are 7.2 x 10^{-8} mg/l, 7.2 x 10^{-6}mg/l, and 7.2 x 10^{-6} mg/l, respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 7.4 x 10^{-6} mg/l keep the increased lifetime cancer risk below 10^{-5}. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

No detailed study of hexachlorobenzene behavior in POTW is available. However, general observations relating molecular structure to ease of degradation have been developed for all of the organic toxic pollutants. The conclusion reached by study of the limited data is that biological treatment produces little or no degradation of hexachlorobenzene. No evidence is available for drawing conclusions regarding its possible toxic or inhibitory effect on POTW operations.

<u>1,1,1-Trichloroethane(11)</u>. 1,1,1-Trichloroethane is one of the two possible trichlorethanes. It is manufactured by hydrochlorinating vinyl chloride to 1,1-dichloroethane which is then chlorinated to the desired product. 1,1,1-Trichloroethane is a liquid at room temperature with a vapor pressure of 96 mm Hg at 20°C and a boiling point of 74°C. Its formula is CCl_3CH_3. It is slightly soluble in water (0.48 g/l) and is very soluble in organic solvents. U.S. annual production is greater than one-third of a million tons.

1,1,1-Trichloroethane is used as an industrial solvent and degreasing agent.

Most human toxicity data for 1,1,1-trichloroethane relates to inhalation and dermal exposure routes. Limited data are available for determining toxicity of ingested 1,1,1-trichloroethane, and those data are all for the compound itself not solutions in water. No data are available regarding its toxicity to fish and aquatic organisms. For the protection of human health from the toxic properties of 1,1,1-trichloroethane ingested through the consumption of water and fish, the ambient water criterion is 18.4 mg/l. If aquatic organisms alone are consumed, the water concentration should be less than 1030 mg/l. Available data show that adverse effects in aquatic species can occur at 18 mg/l.

No detailed study of 1,1,1-trichloroethane behavior in POTW is available. However, it has been demonstrated that none of the organic priority pollutants of this type can be broken down by biological treatment processes as readily as fatty acids, carbohydrates, or proteins.

Biochemical oxidation of many of the organic priority pollutants has been investigated, at least in laboratory scale studies, at concentrations higher than commonly expected in municipal wastewater. General observations relating molecular structure to ease of degradation have been developed for all of these pollutants. From study of the limited data, it is expected that 1,1,1-trichloroethane will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. No evidence is available for drawing conclusions about its possible toxic or inhibitory effect on POTW operation. However, for degradation to occur a fairly constant input of the compound would be necessary.

Its water solubility would allow 1,1,1-trichloroethane, present in the influent and not biodegradable, to pass through a POTW into the effluent. One factor which has received some attention, but no detailed study, is the volatilization of the lower molecular weight organics from POTW. If 1,1,1-trichloroethane is not biodegraded, it will volatilize during aeration processes in the POTW.

<u>2,4,6-Trichlorophenol(21)</u>. 2,4,6-Trichlorophenol ($Cl_3C_6H_2OH$, abbreviated here to 2,4,6 TCP) is a colorless crystalline solid at room temperature. It is prepared by the direct chlorination of phenol. 2,4,6-TCP melts at 68°C and is slightly soluble in water (0.8 gm/l at 25°C). This phenol does not produce a color with 4-aminoantipyrene, therefore does not contribute to the nonconventional pollutant parameter "Total Phenols." No data were found on production volumes.

2,4,6-TCP is used as a fungicide, bactericide, glue and wood preservative, and for antimildew treatment. It is also used for the manufacture of 2,3,4,6-tetrachlorophenol and pentachlorophenol.

No data were found on human toxicity effects of 2,4,6-TCP. Reports of studies with laboratory animals indicate that 2,4,6-TCP produced convulsions when injected interperitoneally. Body temperature was also elevated. The compound also produced inhibition of ATP production in isolated rat liver mitochondria, increased mutation rate in one strain of bacteria, and produced a genetic change in rats. No studies on teratogenicity were found.

For the maximum protection of human health from the potential carcinogenic effects of exposure to 2,4,6-trichlorophenol through ingestion of water and contaminated aquatic organisms, the ambient water concentration should be zero. The estimated levels which would result in increased lifetime cancer risks of 10^{-7}, 10^{-6}, and 10^{-5} are 1.18×10^{-5} mg/l, 1.18×10^{-4} mg/l, and 1.18×10^{-3} mg/l, respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 3.6×10^{-3} mg/l to keep the increased lifetime cancer risk below 10^{-5}. Available data show that adverse effects in aquatic species can occur at 9.7×10^{-4} mg/l.

Although no data were found regarding the behavior of 2,4,6-TCP in POTW, studies of the biochemical oxidation of the compound have been made in a laboratory scale at concentrations higher than those normally expected in municipal wastewaters. Biochemical oxidation of 2,4,6-TCP at 100 mg/l produced 23 percent degradation using a phenol-adapted acclimated seed culture. Based on these results, it is expected that 2,4,6-TCP will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. Another study indicates that 2,4,6-TCP may be produced in POTW by chlorination of phenol during normal chlorination treatment.

Para-chloro-meta-cresol(22). Para-chloro-meta-cresol (ClC_7H_6OH) is thought to be 4-chloro-3-methyl-phenol (4-chloro-meta-cresol, or 2 chloro-5-hydroxy-toluene), but is also used by some authorities to refer to 6-chloro-3-methyl-phenol (6-chloro-meta-cresol, or 4-chloro-3-hydroxy-toluene), depending on whether the chlorine is considered to be para to the methyl or to the hydroxy group. It is assumed for the purposes of this document that the subject compound is 2-chloro-5-hydroxy-toluene. This compound is a colorless crystalline solid melting at 66-68°C. It is slightly soluble in water (3.8 gm/l) and soluble in organic solvents. This phenol reacts with 4-aminoantipyrene to give a colored product and therefore contributes to the nonconventional pollutant parameter designated "Total Phenols." No information on manufacturing methods or volumes produced was found.

Para-chloro-meta cresol (abbreviated here as PCMC) is marketed as a microbicide, and was proposed as an antiseptic and disinfectant, more than forty years ago. It is used in glues, gums, paints, inks, textiles, and leather goods. PCMC was found in raw wastewaters from the die casting quench operation from one subcategory of foundry operations.

Although no human toxicity data are available for PCMC, studies on laboratory animals have demonstrated that this compound is toxic when administered subcutaneously and intravenously. Death was preceeded by severe muscle tremors. At high dosages kidney damage occurred. On the other hand, an unspecified isomer of chlorocresol, presumed to be PCMC, is used at a concentration of 0.15 percent to preserve mucous heparin, a natural product administered intervenously as an anticoagulant. The report does not indicate the total amount of PCMC typically received. No information was found regarding possible teratogenicity, or carcinogenicity of PCMC. Based on available organoleptic data, for controlling undesirable taste and odor quality of ambient water, the estimated level is 3 mg/l. Available data show that adverse effects on aquatic life occur at concentrations as low as 0.03 mg/l.

Two reports indicate that PCMC undergoes degradation in biochemical oxidation treatments carried out at concentrations higher than are expected to be encountered in POTW influents. One study showed 59 percent degradation in 3.5 hours when a phenol-adapted acclimated seed culture was used with a solution of 60 mg/l PCMC. The other study showed 100 percent degradation of a 20 mg/l solution of PCMC in two weeks in an aerobic activated sludge test system. No degradation of PCMC occurred under anaerobic conditions. From a review of limited data, it is expected that PCMC will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTWs.

Chloroform(23). Chloroform is a colorless liquid manufactured commercially by chlorination of methane. Careful control of conditions maximizes chloroform production, but other products must be separated. Chloroform boils at 61°C and has a vapor pressure of 200 mm Hg at 25°C. It is slightly soluble in water (8.22 g/l at 20°C) and readily soluble in organic solvents.

Chloroform is used as a solvent and to manufacture refrigerents, pharmaceuticals, plastics, and anesthetics. It is seldom used as an anesthetic.

Toxic effects of chloroform on humans include central nervous system depression, gastrointestinal irritation, liver and kidney damage and possible cardiac sensitization to adrenalin. Carcinogenicity has been demonstrated for chloroform on laboratory animals.

For the maximum protection of human health from the potential carcinogenic effects of exposure to chloroform through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of chloroform estimated to result in additional lifetime cancer risks at the levels of 10^{-7}, 10^{-6}, and 10^{-5} were 1.89×10^{-5} mg/l, 1.89×10^{-4} mg/l, and 1.89×10^{-3} mg/l, respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 0.157 mg/l to keep the increased lifetime cancer risk below 10^{-5}. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

Few data are available regarding the behavior of chloroform in a POTW. However, the biochemical oxidation of this compound was studied in one laboratory scale study at concentrations higher than those expected to be contained by most municipal wastewaters. After 5, 10, and 20 days no degradation of chloroform was observed. The conclusion reached is that biological treatment produces little or no removal by degradation of chloroform in POTW. An EPA study of the fate of toxic pollutants in POTW reveals removal efficiencies of 0 to 80 percent for influent concentrations ranging from 5 to 46×10^{-3} mg/l at seven POTW.

The high vapor pressure of chloroform is expected to result in volatilization of the compound from aerobic treatment steps in POTW. Remaining chloroform is expected to pass through into the POTW effluent.

2-Chlorophenol(24). 2-Chlorophenol (ClC_6H_4OH), also called ortho-chlorophenol, is a colorless liquid at room temperature, manufactured by direct chlorination of phenol followed by distillation to separate it from the other principal product, 4-chlorophenol. 2-Chlorophenol solidifies below 7°C and boils at 176°C. It is soluble in water (28.5 gm/l at 20°C) and soluble in several types of organic solvents. This phenol gives a strong color with 4-aninoantipyrene and therefore contributes to the nonconventional pollutant parameter "Total Phenols." Production statistics could not be found. 2-Chlorophenol is used almost exclusively as a chemical intermediate in the production of pesticdes and dyes. Production of some phenolic resins uses 2-chlorophenol.

Very few data are available on which to determine the toxic effects of 2-chlorophenol on humans. The compound is more toxic to laboratory mammals when administered orally than when administered subcataneously or intravenously. This affect is attributed to the fact that the compound is almost completely in the un-ionized state at the low pH of the stomach and hence is more readily absorbed into the body. Initial symptoms are restlessness and increased respiration rate, followed by motor weakness and convulsions induced by noise or touch. Coma follows. Following lethal doses, kidney, liver, and intestinal damage were observed. No studies were found which addressed the teratogenicity or mutagenicity of 2-chlorophenol. Studies of 2-chlorophenol as a promoter of carcinogenic activity of other carcinogens were conducted by dermal application. Results do not bear a determinable relationship to results of oral administration studies.

For controlling undesirable taste and odor quality of ambient water due to the organoleptic properties of 2-chlorophenol in water, the estimated level is 1×10^{-4} mg/l. Available data show that adverse effects on aquatic life occur at concentrations higher than that cited for organaleptic effects.

Data on the behavior of 2-chlorophenol in POTW are not available. However, laboratory scale studies have been conducted at concentrations higher than those expected to be found in municipal wastewaters. At 1 mg/l of 2-chlorophenol, an acclimated culture produced 100 percent degradation by biochemical oxidation after 15 days. Another study showed 45, 70, and 79 percent degradation by biochemical oxidation after 5, 10, and 20 days, respectively. From study of these limited data, and general observations on all organic priority pollutants relating molecular structure to ease of biochemical oxidation, it is expected that 2-chlorophenol will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. Undegraded 2-chlorophenol is expected to pass through POTW into the effluent because of the water solubility. Some 2-chlorophenol is also expected to be generated by chlorination treatments of POTW effluents containing phenol.

2,4-Dimethylphenol(34). 2,4-Dimethylphenol (2,4-DMP), also called 2,4-xylenol, is a colorless, crystalline solid at room temperature (25°C), but melts at 27 to 28°C. 2,4-DMP is slightly soluble in water and, as a weak acid, is soluble in alkaline solutions. Its vapor pressure is less than 1 mm Hg at room temperature.

2,4-DMP is a natural product, occurring in coal and petroleum sources. It is used commercially as a intermediate for manufacture of pesticides, dystuffs, plastics and resins, and surfactants. It is found in the water runoff from asphalt surfaces. It can find its way into the wastewater of a manufacfuring plant from any of several adventitious sources.

Analytical procedures specific to this compound are used for its identification and quantification in wastewaters. This compound does not contribute to "Total Phenol" determined by the 4-aminoantipyrene method.

Three methylphenol isomers (cresols) and six dimethylphenol isomers (xylenols) generally occur together in natural products, industrial processes, commercial products, and phenolic wastes. Therefore, data are not available for human exposure to 2,4-DMP alone. In addition to this, most mammalian tests for toxicity of individual dimethylphenol isomers have been conducted with isomers other than 2,4-DMP.

In general, the mixtures of phenol, methylphenols, and dimethylphenols contain compounds which produced acute poisoning in laboratory animals. Symptoms were difficult breathing, rapid muscular spasms, disturbance of motor coordination, and assymetrical body position. In a 1977 National Academy of Science publication the conclusion was reached that, "In view of the relative paucity of data on the mutagenicity, carcinogenicity, teratogenicity, and long term oral toxicity of 2,4 dimethylphenol, estimates of the effects of chronic oral exposure at low levels cannot be made with any confidence." No ambient water quality criterion can be set at this time. In order to protect public health, exposure to this compound should be minimized as soon as possible.

Toxicity data for fish and freshwater aquatic life are limited. Acute toxicity to freshwater aquatic life occurs at 2,4-dimethylphenol concentrations of 2.12 mg/l. For controlling undesirable taste and odor quality of ambient water due to the organoleptic effects of 2,4-dimethylphenol in water the estimated level is 0.4 mg/l.

The behavior of 2,4-DMP in POTW has not been studied. As a weak acid its behavior may be somewhat dependent on the pH of the influent to the POTW. However, over the normal limited range of POTW pH, little effect of pH would be expected.

Biological degradability of 2,4-DMP as determined in one study, showed 94.5 percent biochemical oxidation after 110 hours using an adapted culture. Thus, it is expected that 2,4-DMP will be biochemically oxidized to about the same extent as domestic sewage by biological treatment in POTW. Another study determined that persistance of 2,4-DMP in the environment is low, thus any of the compound which remained in the sludge or passed through the POTW into the effluent would be degraded within moderate length of time (estimated as 2 months in the report).

2,4-Dinitrotoluene(35). 2,4-Dinitrotoluene [$(NO_2)_2C_6H_3CH_3$], a yellow crystalline compound, is manufactured as a coproduct with the 2,6 isomer by nitration of nitrotoluene. It melts at 71°C. 2,4-Dinitrotoluene is insoluble in water (0.27 g/l at 22°C) and soluble in a number of organic solvents. Production data for the 2,4-isomer alone are not available. The 2,4-and 2,6-isomers are manufactured in an 80:20 or 65:35 ratio, depending on the process used. Annual U.S. commercial production is about 150 thousand tons of the two isomers. Unspecified amounts are produced by the U.S. government and further nitrated to trinitrotoluene (TNT) for military use.

The major use of the dinitrotoluene mixture is for production of toluene diisocyanate used to make polyurethanes. Another use is in production of dyestuffs.

The toxic effect of 2,4-dinitrotoluene in humans is primarily methemoglobinemia (a blood condition hindering oxygen transport by the blood). Symptoms depend on severity of the disease, but include cyanosis, dizziness, pain in joints, headache, and loss of appetite in workers inhaling the compound. Laboratory animals fed oral doses of 2,4-dinitrotoluene exhibited many of the same symptoms. Aside from the effects in red blood cells, effects are observed in the nervous system and testes.

Chronic exposure to 2,4-dinitrotoluene may produce liver damage and reversible anemia. No data were found on teratogenicity of this compound. Mutagenic data are limited and are regarded as confusing. Data resulting from studies of carcinogenicity of 2,4-dinitrotoluene point to a need for further testing for this property.

For the maximum protection of human health from the potential carcinogenic effects of exposure to 2,4-dinitrotoluene through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of 2,4-dinitrotoluene estimated to result in additional lifetime cancer risk at risk levels of 10^{-7}, 10^{-6}, and 10^{-5} are 1.11×10^{-5} mg/l, 1.11×10^{-4} mg/l, and 1.11×10^{-3} mg/l, respectively. If aquatic organisms alone are consumed, the water concentration should be less than 0.091 mg/l to keep the increased lifetime cancer risk below 10^{-5}. Available data show that adverse effects in aquatic life occur at concentrations higher than those cited for human health risks.

Data on the behavior of 2,4-dinitrotoluene in POTW are not available. However, biochemical oxidation of 2,4-dinitrotoluene was investigated on a laboratory scale. At 100 mg/l of 2,4-dinitrotoluene, a concentration considerably higher than that expected in municipal wastewaters, biochemical oxidation by an acclimated, phenol-adapted seed culture produced 52 percent degradation in three hours. Based on this limited information and general observations relating molecular structure to ease of degradation for all the organic toxic pollutants, it is expected that 2,4-dinitrotoluene will be biochemically oxidized to about the same extent as domestic sewage by biological treatment in POTW. No information is available regarding possible interference by 2,4-dinitrotoluene in POTW treatment processes, or on the possible detrimental effect on sludge used to amend soils in which food crops are grown.

2,6-Dinitrotoluene(36). 2,6-Dinitrotoluene $[(NO_2)_2C_6H_3CH_3]$ is a crystalline solid produced as a coproduct with 2,4-dinitrotoluene by nitration of nitrotoluene. It melts at 66C. No solubility or vapor pressure data are given in the literature, but this compound is expected to be insoluble just as the 2,4-dinitrotoluene isomer is (0.27 g/l at 22C). Production data for the 2,6-isomer are not available. The 2,4- and 2,6- isomers are manufactured in an 80:20 or 65:35 ratio depending on the process used. Annual U.S. commercial production is about 150 thousand tons of the two isomers. Unspecified amounts are produced by the U.S. government and further nitrated to trinitrotoluene (TNT) for military use.

The major use of the dinitrotoluene mixture is for production of toluene diisocyanate used to make polyurethanes. Another use is in production of dyestuffs.

No toxicity data are available in the literature for 2,6-dinitrotoluene. The 2,4-isomer is toxic and is classed as a potential carcinogen on the basis of tumerogenic effects and other considerations. No ambient water criterion has been established for 2,6-dinitrotoluene.

Data on the behavior of 2,6-dinitrotoluene in POTW are not available. Biochemical oxidation of many of the organic priority pollutants have been investigated, at least in laboratory scale studies, at concentrations higher than those expected to be contained by most municipal wastewaters. General observations have been developed relating molecular structure to ease of degradation for all the organic toxic pollutants. Based upon study of the limited data, it is expected that 2,6-dinitrotoluene will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. No information is available regarding possible interferance by 2,6-dinitrotoluene in POTW processes, or the possible detrimental effect on sludge used to amend soils in which crops are grown.

Ethylbenzene(38). Ethylbenzene is a colorless, flammable liquid manufactured commercially from benzene and ethylene. Approximately half of the benzene used in the U.S. goes into the manufacture of more than three million tons of ethylbenzene annually. Ethylbenzene boils at 136°C and has a vapor pressure of 7 mm Hg at 20°C. It is slightly soluble in water (0.14 g/l at 15°C) and is very soluble in organic solvents.

About 98 percent of the ethylbenzene produced in the U.S. goes into the production of styrene, much of which is used in the plastics and synthetic rubber industries. Ethylbenzene is a constituent of xylene mixtures used as diluents in the paint industry, agricultural insecticide sprays, and gasoline blends.

Although humans are exposed to ethylbenzene from a variety of sources in the environment, little information on effects of ethylbenzene in man or animals is available. Inhalation can irritate eyes, affect the respiratory tract, or cause vertigo. In laboratory animals ethylbenzene exhibited low toxicity. There are no data available on teratogenicity, mutagenicity, or carcinogenicity of ethylbenzene.

Criteria are based on data derived from inhalation exposure limits. For the protection of human health from the toxic properties of ethylbenzene ingested through water and contaminated aquatic organisms, the ambient water criterion is 1.4 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is 3.28 mg/l. Available data show that at concentrations of 0.43 mg/l, adverse effects on aquatic life occur.

The behavior of ethylbenzene in POTW has not been studied in detail. Laboratory scale studies of the biochemical oxidation of ethylbenzene at concentrations greater than would normally be found in municipal wastewaters have demonstrated varying degrees of degradation. In one study with phenol-acclimated seed cultures 27 percent degradation was observed in a half day at 250 mg/l ethyl- bezene. Another study at unspecified conditions showed 32, 38, and 45 percent degradation after 5, 10, and 20 days, respectively. Based on these results and general observations relating molecular structure to ease of degradation, it is expected that ethylbenzene will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW.

An EPA study of seven POTW showed removals of 77 to 100 percent in five POTW having influent ethylbenzene concentrations of 10 to 44 x 10^{-3} mg/l. The other two POTW had influent concentrations of 2 x 10^{-3} mg/l or less. Other studies suggest that most of the ethylbenzene entering a POTW is removed from the aqueous stream to the sludge. The ethylbenzene contained in the sludge removed from the POTW may volatilize.

Fluoranthene(39). Fluoranthene (1,2-benzacenaphthene) is one of the compounds called polynuclear aromatic hydrocarbons (PAH). A pale yellow solid at room temperature, it melts at 111°C and has a negligible vapor pressure at 25°C. Water solubility is low (0.2 mg/l). Its molecular formula is $C_{16}H_{10}$.

Fluoranthene, along with many other PAH's, is found throughout the environment. It is produced by pyrolytic processing of organic raw materials, such as coal and petroleum, at high temperature (coking processes). It occurs naturally as a product of plant biosyntheses. Cigarette smoke contains fluoranthene. Although it is not used as the pure compound in industry, it has been found at relatively higher concentrations (0.002 mg/l) than most other PAH's in at least one industrial effluent. Furthermore, in a 1977 EPA survey to determine levels of PAH in U.S. drinking water supplies, none of the 110 samples analyzed showed any PAH other than fluoranthene.

Experiments with laboratory animals indicate that fluoranthene presents a relatively low degree of toxic potential from acute exposure, including oral administration. Where death occured, no information was reported concerning target organs or specific cause of death.

There is no epidemiological evidence to prove that PAH in general, and fluoranthene, in particular, present in drinking water are related to the development of cancer. The only studies directed toward determining carcinogenicity of fluoranthene have been skin tests on laboratory animals. Results of these tests show that fluoranthene has no activity as a complete carcinogen (i.e., an agent which produces cancer when applied by itself, but exhibits significant cocarcinogenicity (i.e., in combination with a carcinogen, it increases the carcinogenic activity).

Based on the limited animal study data, and following an establishing procedure, the ambient water criterion for fluoranthene through water and contaminated aquatic organisms is determined to be 0.042 mg/l for the protection of human health from its toxic properties. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is 0.054 mg/l. Available data show that adverse effects on aquatic life occur at concentrations of 0.016 mg/l.

Results of studies of the behavior of fluoranthene in conventional sewage treatment processes found in POTW have been published. Removal of fluoranthene during primary sedimentation was found to be 62 to 66 percent (from an initial value of 0.00323 to 0.0435 mg/l to a final value of 0.00122 to 0.0146 mg/l), and the removal was 91 to 99 percent (final values of 0.00028 to 0.00026 mg/l) after biological purification with activated sludge processes.

A review was made of data on biochemical oxidation of many of the organic priority pollutants investigated in laboratory scale studies at concentrations higher than would normally be expected in municipal wastewater. General observations relating molecular structure to ease of degradation have been developed for all of these pollutants. The conclusion reached by study of the limited data is that biological treatment produces little or no degradation of fluoranthene. The same study however concludes that fluoranthene would be readily removed by filtration and oil water separation and other methods which rely on water insolubility, or adsorption on other particulate surfaces. This latter conclusion is supported by the previously cited study showing significant removal by primary sedimentation.

No studies were found to give data on either the possible interference of fluoranthene with POTW operation, or the persistance of fluoranthene in sludges on POTW effluent waters. Several studies have documented the ubiquity of fluoranthene in the environment and it cannot be readily determined if this results from persistance of anthropogenic fluoranthene or the replacement of degraded fluoranthene by natural processes such as biosynthesis in plants.

Isophorone(54). Isophorone is an industrial chemical produced at a level of tens of millions of pounds annually in the U.S. The chemical name for isophorone is 3,5,5-trimethyl-2-cyclohexen-1-one and it is also known as trimethyl cyclohexanone and isoacetophorone. The formula is $C_6H_5(CH_3)_3O$. Normally, it is produced as the gamma isomer; technical grades contain about 3 percent of the beta isomer (3,5-5-trimethyl-3-cyclohexen-1-one). The pure gamma isomer is a water-white liquid, with vapor pressure less than 1 mm Hg at room temperature, and a boiling point of 215.2°C. It has a camphor- or peppermint-like odor and yellows upon standing. It is slightly soluble (12 mg/l) in water and dissolves in fats and oils.

Isophorone is synthesized from acetone and is used commercially as a solvent or cosolvent for finishes, lacquers, polyvinyl and nitrocellulose resins, pesticides, herbicides, fats, oils, and gums. It is also used as a chemical feedstock.

Because isophorone is an industrially used solvent, most toxicity data are for inhalation exposure. Oral administration to laboratory animals in two different studies revealed no acute or chronic effects during 90 days, and no hematological or pathological abnormalities were reported. Apparently, no studies have been completed on the carcinogenicity of isophorone.

Isophorone does undergo bioconcentration in the lipids of aquatic organisms and fish.

The ambient water criterion for isophorone ingested through consumption of water and fish is determined to be 5.2 mg/l for the protection of human health from its toxic properties. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criteria is 520 mg/l. Available data show that adverse effects in aquatic life occur at concentrations as low as 12.9 mg/l.

The behavior of isophorone in POTW has not been studied. However, the biochemical oxidation of many of the organic priority pollutants has been investigated in laboratory-scale studies at concentrations higher than would normally be expected in municipal wastewater. General observations relating molecular structure to ease of degradation have been developed for all of these pollutants. Based on the study of the limited data, it is expected that isophorone will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. This conclusion is consistant with the findings of an experimental study of microbiological degradation of isophorone which showed about 45 percent biooxidation in 15 to 20 days in domestic wastewater, but only 9 percent in salt water. No data were found on the persistance of isophorone in sewage sludge.

Naphthalene(55). Naphthalene is an aromatic hydrocarbon with two orthocondensed benzene rings and a molecular formula of $C_{10}H_8$. As such it is properly classed as a polynuclear aromatic hydrocarbon (PAH). Pure naphthalene is a white crystalline solid melting at 80°C. For a solid, it has a relatively high vapor pressure (0.05 mm Hg at 20°C), and moderate water solubility (19 mg/l at 20°C). Naphthalene is the most abundant single component of coal tar. Production is more than a third of a million tons annually in the U.S. About three fourths of the production is used as feedstock for phthalic anhydride manufacture. Most of the remaining production goes into manufacture of insecticide, dystuffs, pigments, and pharmaceuticals. Chlorinated and partially hydrogenated naphthalenes are used in some solvent mixtures. Naphthalene is also used as a moth repellent.

Naphthalene, ingested by humans, has reportedly caused vision loss (cataracts), hemolytic anemia, and occasionally, renal disease. These effects of naphthalene ingestion are confirmed by studies on laboratory animals. No carcinogenicity studies are available which can be used to demonstrate carcinogenic activity for naphthalene. Naphthalene does bioconcentrate in aquatic organisms.

The available data base is insufficient to establish an ambient water criterion for the protection of human health from the toxic properties of naphthalene. Available data show that adverse effects on aquatic life occur at concentrations as low as 0.62 mg/l.

Only a limited number of studies have been conducted to determine the effects of naphthalene on aquatic organisms. The data from those studies show only moderate toxicity.

Naphthalene has been detected in sewage plant effluents at concentrations up to 22 μg/l in studies carried out by the U.S. EPA. Influent levels were not reported. The behavior of naphthalene in POTW has not been studied. However, recent studies have determined that naphthalene will accumulate in sediments at 100 times the concentration in overlying water. These results suggest that naphthalene will be readily removed by primary and secondary settling in POTW, if it is not biologically degraded.

Biochemical oxidation of many of the organic priority pollutants has been investigated in laboratory-scale studies at concentrations higher than would normally be expected in municipal wastewater. General observations relating molecular structure to ease of degradation have been developed for all of these pollutants. Based on the study of the limited data, it is expected that naphthalene will be biochemically oxidized to about the same extent as domestic sewage by biological treatment in POTW. One recent study has shown that microorganisms can degrade naphthalene, first to a dihydro compound, and ultimately to carbon dioxide and water.

2-Nitrophenol(57). 2-Nitrophenol ($NO_2C_6H_4OH$), also called ortho-nitrophenol, is a light yellow crystalline solid, manufactured commercially by hydrolysis of 2-chloro-nitrobenzene with aqueous sodium hydroxide. 2-Nitrophenol melts at 45°C and has a vapor pressure of 1 mm Hg at 49°C. 2-Nitrophenol is slightly soluble in water (2.1 g/l at 20°C) and soluble in organic solvents. This phenol does not react to give a color with 4-aminoantipyrene, and therefore does not contribute to the nonconventional pollutant parameter "Total Phenols. U.S. annual production is five thousand to eight thousand tons.

The principal use of ortho-nitrophenol is to synthesize ortho-aminophenol, ortho-nitroanisole, and other dyestuff intermediates.

The toxic effects of 2-nitrophenol on humans have not been extensively studied. Data from experiments with laboratory animals indicate that exposure to this compound causes kidney and liver damage. Other studies indicate that the compound acts directly on cell membranes, and inhibits certain enzyme systems in vitro. No information regarding potential teratogencity was found. Available data indicate that this compound does not pose a mutagenic hazard to humans. Very limited data for 2-nitrophenol do not reveal potential carcinogenic effects.

The available data base is insufficient to establish an ambient water criterion for protection of human health from exposure to 2-nitrophenol. No data are available on which to evaluate the adverse effects of 2-nitrophenol on aquatic life.

Data on the behavior of 2-nitrophenol in POTW were not available. However, laboratory-scale studies have been conducted at concentrations higher than those expected to be found in municipal wastewater. Biochemical oxidation using adapted cultures from various sources produced 95 percent degradation in three to six days in one study. Similar results were reported for other studies. Based on these data, and general observations relating molecular structure to ease of biological oxidation, it is expected that 2-nitrophenol will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTWs.

4,6-dinitro-o-cresol(60). 4,6-dinitro-o-cresol (DNOC) is a yellow crystalline solid derived from o-cresol. DNOC melts at 85.8°C and has a vapor pressure of 0.000052 mm Hg at 20°C. DNOC is sparingly soluble in water (100 mg/l at 20°C), while it is readily soluble in alkaline aqueous solutions, ether, acetone, and alcohol. DNOC is produced by sulfonation of o-cresol followed by treatment with nitric acid.

DNOC is used primarily as a blossom thinning agent on fruit trees and as a fungicide, insecticide and miticide on fruit trees during the dormant season. It is highly toxic to plants in the growing stage. DNOC is not manufactured in the U.S. as an agricultural chemical. Imports of DNOC have been decreasing recently with only 30,000 lbs being imported in 1976.

While DNOC is highly toxic to plants, it is also very toxic to humans and is considered to be one of the more dangerous agricultural pesticides. The available literature concerning humans indicates that DNOC may be absorbed in acutely toxic amounts through the respiratory and gastrointestinal tracts and through the skin, and that it accumulates in the blood. Symptoms of poisoning inlude profuse sweating, thirst, loss of weight, headache, malaise, and yellow staining to the skn, hair, sclera, and conjunctiva.

There is no evidence to suggest that DNOC is teratogenic, mutagenic, or carcinogenic. The effects of DNOC in the human due to chronic exposure are basically the same as those effects resulting from acute exposure. Although DNOC is considered a cumulative poison in humans, cataract formation is the only chronic effect noted in any human or experimental animal study. It is believed that DNOC accumulates in the human body and that toxic symptoms may develop when blood levels exceed 20 mg/kg.

For the protection of human health from the toxic properties of dinitro-o-cresol ingested through water and contaminanted aquatic organisms, the ambient water criterion is determined to be 0.0134 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is determined to be 0.765 mg/l. No data are available on which to evaluate the adverse effects of 4,6-dinitro-o-cresol on aquatic life.

Some studies have been reported regarding the behavior of DNOC in POTW. Biochemical oxidation of DNOC under laboratory conditions at a concentration of 100 mg/l produced 22 percent degradation in 3.5 hours, using acclimated phenol adapted seed cultures. In addition, the nitro group in the number 4 (para) position seems to impart a destabilizing effect on the molecule. Based on these data and general conclusions relating molecular structure to biochemical oxidation, it is expected that 4,6-dinitro-o-cresol will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW.

Pentachlorophenol(64). Pentachlorophenol (C_6Cl_5OH) is a white crystalline solid produced commercially by chlorination of phenol or polychlorophenols. U.S. annual production is in excess of 20,000 tons. Pentachlorophenol melts at 190°C and is slightly soluble in water (14 mg/l). Pentachlorophenol is not detected by the 4-amino antipyrene method.

Pentachlorophenol is a bactericide and fungacide and is used for preservation of wood and wood products. It is competative with creosote in that application. It is also used as a preservative in glues, starches, and photographic papers. It is an effective algicide and herbicide.

Although data are available on the human toxicity effects of pentachlorophenol, interpretation of data is frequently uncertain. Occupational exposure observations must be examined carefully because exposure to pentachlorophenol is frequently accompained by exposure to other wood preservatives. Additionally, experimental results and occupational exposure observations must be examined carefully to make sure that observed effects are produced by the pentachlorophenol itself and not by the by-products which usually contaminate pentachlorophenol.

Acute and chronic toxic effects of pentachlorophenol in humans are similar; muscle weakness, headache, loss of appetite, abdominal pain, weight loss, and irritation of skin, eyes, and respiratory tract. Available literature indicates that pentachlorophenol does not accumulate in body tissues to any significant extent. Studies on laboratory animals of distribution of the compound in body tissues showed the highest levels of pentachlorophenol in liver, kidney, and intestine, while the lowest levels were in brain, fat, muscle, and bone.

Toxic effects of pentachlorophenol in aquatic organisms are much greater at pH of 6 where this weak acid is predominantly in the undissociated form than at pH of 9 where the ionic form predominates. Similar results were observed in mammals where oral lethal doses of pentachlorophenol were lower when the compound was administered in hydrocarbon solvents (un-ionized form) than when it was administered as the sodium salt (ionized form) in water.

There appear to be no significant teratogenic, mutagenic, or carcinogenic effects of pentachlorophenol.

For the protection of human health from the toxic properties of pentachlorophenol ingested through water and through contaminated aquatic organisms, the ambient water quality criterion is determined to be 1.01 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is determined to be 29.4 mg/l. Available data show that adverse effects on aquatic life occur at concentration as low as 0.0032 mg/l.

Only limited data are available for reaching conclusions about the behavior of pentachlorophenol in POTW. Pentachlorophenol has been found in the influent to POTW. In a study of one POTW the mean removal was 59 percent over a 7 day period. Trickling filters removed 44 percent of the influent pentachlorophenol suggesting that biological degradation occurs. The same report compared removal of pentachlorophenol of the same plant and two additional POTW on a later date and obtained values of 4.4, 19.5 and 28.6 percent removal, the last value being for the plant which was 59 percent removal in the original study. Influent concentrations of pentachloropehnol ranged from 0.0014 to 0.0046 mg/l. Other studies, including the general review of data relating molecular structure to biological oxidation, indicate that pentachlorophenol is not biochemically oxidized by biological treatment processes in POTW. Anaerobic digestion processes are inhibited by 0.4 mg/l pentachlorophenol.

The low water solubility and low volatility of pentachloro- phenol lead to the expectation that most of the compound will remain in the sludge in a POTW. The effect on plants grown on land treated with sludge containing pentachlorophenol is unpredicatable. Laboratory studies show that this compound affects crop germination at 5.4 mg/l. However, photodecomposition of pentachlorophenol occurs in sunlight. The effects of the various breakdown products which may remain in the soil was not found in the literature.

Phenol(65). Phenol, also called hydroxybenzene and carbolic acid, is a clear, colorless, hygroscopic, deliquescent, crystalline solid at room temperature. Its melting point is 43°C and its vapor pressure at room temperature is 0.35 mm Hg. It is very soluble in water (67 gm/l at 16°C) and can be dissolved in benzene, oils, and petroleum solids. Its formula is C_6H_5OH.

Although a small percent of the annual production of phenol is derived from coal tar as a naturally occuring product, most of the phenol is synthesized. Two of the methods are fusion of benzene sulfonate with sodium hydroxide, and oxidation of cumene followed by clevage with a catalyst. Annual production in the U.S. is in excess of one million tons. Phenol is generated during distillation of wood and the microbiological decomposition of organic matter in the mammalian intestinal tract.

Phenol is used as a disinfectant, in the manufacture of resins, dyestuffs, and pharmaceuticals, and in the photo processing industry. Phenol was detected on only one day in one coil coating raw waste stream out of 14 days of sampling and analysis at 11 coil coating plants. In this discussion, phenol is the specific compound which is separated by methylene chloride extraction of an acidified sample and identified and quantified by GC/MS. Phenol also contributes to the "Total Phenols", discussed elsewhere which are determined by the 4-AAP colorimetric method.

Phenol exhibits acute and sub-acute toxicity in humans and laboratory animals. Acute oral doses of phenol in humans cause sudden collapse and un- consciousness by its action on the central nervous system. Death occurs by respiratory arrest. Sub-acute oral doses in mammals are rapidly absorbed then quickly distributed to various organs, then cleared from the body by urinary excretion and metabolism. Long term exposure by drinking phenol contaminated water has resulted in statistically significant increase in reported cases of diarrhea, mouth sores, and burning of the mouth. In laboratory animals long term oral administration at low levels produced slight liver and kidney damage. No reports were found regarding carcinogenicity of phenol administered orally - all carcinogenicity studies were skin tests.

For the protection of human health from phenol ingested through water and through contaminated aquatic organisms the ambient water criterion is determined to be 3.5 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is 769 mg/l. Available data show that adverse effects in aquatic life occur at concentrations as low as 2.56 mg/l.

Data have been developed on the behavior of phenol in POTW. Phenol is biodegradable by biota present in POTW. The ability of a POTW to treat phenol-bearing influents depends upon acclimation of the biota and the constancy of the phenol concentration. It appears that an induction period is required to build up the population of organisms which can degrade phenol. Too large a concentration will result in upset or pass through in the POTW, but the specific level causing upset depends on the immediate past history of phenol concentrations in the influent. Phenol levels as high as 200 mg/l have been treated with 95 percent removal in POTW, but more or less continuous presence of phenol is necessary to maintain the population of microorganisms that degrade phenol. An EPA study of seven POTWs revealed that only three POTW showed a decrease in phenol concentration between influent (14, 1, and 1×10^{-3} mg/l) and effluent (1×10^{-3} mg/l, and 0, respectively).

Phenol which is not degraded is expected to pass through the POTW because of its very high water solubility. However, in POTW where chlorination is practiced for disinfection of the POTW effluent, chlorination of phenol may occur. The products of that reaction may be priority pollutants.

The EPA has developed data on influent and effluent concentrations of total phenols in a study of 103 POTW. However, the analytical procedure was the 4-AAP method mentioned earlier and not the GC/MS method specifically for phenol. Discussion of the study, which of course includes phenol, is presented under the pollutant heading "Total Phenols."

Phthalate Esters (66-71). Phthalic acid, or 1,2-benzenedicarboxylic acid, is one of three isomeric benzenedicarboxylic acids produced by the chemical industry. The other two isomeric forms are called isophthalic and terephathalic acids. The formula for all three acids is $C_6H_4(COOH)_2$. Some esters of phthalic acid are designated as toxic pollutants. They will be discussed as a group here, and specific properties of individual phthalate esters will be discussed afterwards.

Phthalic acid esters are manufactured in the U.S. at an annual rate in excess of 1 billion pounds. They are used as plasticizers - primarily in the production of polyvinyl chloride (PVC) resins. The most widely used phthalate plasticizer is bis (2-ethylhexyl) phthalate (66) which accounts for nearly one third of the phthalate esters produced. This particular ester is commonly referred to as dioctyl phthalate (DOP) and should not be confused with one of the less used esters, di-n-octyl phthalate (69), which is also used as a plastcizer. In addition to these two isomeric dioctyl phthalates, four other esters, also used primarily as plasticizers, are designated as priority pollutants. They are: butyl benzyl phthalate (67), di-n-butyl phthalate (68), diethyl phthalate (70), and dimethyl phthalate (71).

Industrially, phthalate esters are prepared from phthalic anhydride and the specific alcohol to form the ester. Some evidence is available suggesting that phthalic acid esters also may be synthesized by certain plant and animal tissues. The extent to which this occurs in nature is not known.

Phthalate esters used as plasticizers can be present in concentrations up to 60 percent of the total weight of the PVC plastic. The plasticizer is not linked by primary chemical bonds to the PVC resin. Rather, it is locked into the structure of intermeshing polymer molecules and held by van der Waals forces. The result is that the plasticizer is easily extracted. Plasticizers are responsible for the odor associated with new plastic toys or flexible sheet that has been contained in a sealed package.

Although the phthalate esters are not soluble or are only very slightly soluble in water, they do migrate into aqueous solutions placed in contact with the plastic. Thus industrial facilities with tank linings, wire and cable coverings, tubing, and sheet flooring of PVC are expected to discharge some phthalate esters in their raw waste. In addition to their use as plasticizers, phthalate esters are used in lubricating oils and pesticide carriers. These also can contribute to industrial discharge of phthalate esters.

From the accumulated data on acute toxicity in animals, phthalate esters may be considered as having a rather low order of toxicity. Human toxicity data are limited. It is thought that the toxic effects of the esters is most likely due to one of the metabolic products, in particular the monoester. Oral acute toxicity in animals is greater for the lower molecular weight esters than for the higher molecular weight esters.

Orally administered phthalate esters generally produced enlarging of liver and kidney, and atrophy of testes in laboratory animals. Specific esters produced enlargement of heart and brain, spleenitis, and degeneration of central nervous system tissue.

Subacute doses administered orally to laboratory animals produced some decrease in growth and degeneration of the testes. Chronic studies in animals showed similar effects to those found in acute and subacute studies, but to a much lower degree. The same organs were enlarged, but pathological changes were not usually detected.

A recent study of several phthalic esters produced suggestive but not conclusive evidence that dimethyl and diethyl phthalates have a cancer liability. Only four of the six priority pollutant esters were included in the study. Phthalate esters do biconcentrate in fish. The factors, weighted for relative consumption of various aquatic and marine food groups, are used to calculate ambient water quality criteria for four phthalate esters. The values are included in the discussion of the specific esters.

Studies of toxicity of phthalate esters in freshwater and salt water organisms are scarce. Available data show that adverse effects on aquatic life occur at phthalate ester concentrations as low as 0.003 mg/l.

The behavior of phthalate esters in POTW has not been studied. However, the biochemical oxidation of many of the organic priority pollutants has been investigated in laboratory-scale studies at concentrations higher than would normally be expected in municipal wastewater. Three of the phthalate esters were studied. Bis(2-ethylhexyl) phthalate was found to be degraded slightly or not at all and its removal by biological treatment in a POTW is expected to be slight or zero. Di-n-butyl phthalate and diethyl phthalate were degraded to a moderate degree and it is expected that they will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. Based on these data and other observations relating molecular structure to ease of biochemical degradation of other organic pollutants, it is expected that butyl benzyl phthalate and dimethyl phthalate will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. On the same basis, it is expected that di-n-octyl phthalate will not be biochemically oxidized to a significant extent by biological treatment in POTW. An EPA study of seven POTW revealed that for all but di-n-octyl phthalate, which was not studied, removals ranged from 62 to 87 percent.

No information was found on possible interference with POTW operation or the possible effects on sludge by the phthalate esters. The water insoluble phthalate esters - butylbenzyl and di-n-octyl phthalate - would tend to remain in sludge, whereas the other four toxic pollutant phthalate esters with water solubilities ranging from 50 mg/l to 4.5 mg/l would probably pass through into the POTW effluent.

Bis (2-ethylhexyl) phthalate(66). In addition to the general remarks and discussion on phthalate esters, specific information on bis(2-ethylhexyl) phthalate is provided. Little information is available about the physical properties of bis(2-ethylhexyl) phthalate. It is a liquid boiling at 387°C at 5mm Hg and is insoluble in water. Its formula is $C_6H_4(COOC_8H_{17})_2$. This priority pollutant constitutes about one third of the phthalate ester production in the U.S. It is commonly referred to as dioctyl phthalate, or DOP, in the plastics industry where it is the most extensively used compound for the plasticization of polyvinyl chloride (PVC). Bis(2-ethylhexyl) phthalate has been approved by the FDA for use in plastics in contact with food. Therefore, it may be found in wastewaters coming in contact with discarded plastic food wrappers as well as the PVC films and shapes normally found in industrial plants. This priority pollutant is also a commonly used organic diffusion pump oil where its low vapor pressure is an advantage.

For the protection of human health from the toxic properties of bis(2-ethylhexyl) phthalate ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 15 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criteria is determined to be 50 mg/l.

Although the behavior of bis(2-ethylhexyl) phthalate in POTW has not been studied, biochemical oxidation of this priority pollutant has been studied on a laboratory scale at concentrations higher than would normally be expected in municipal wastewater. In fresh water with a nonacclimated seed culture no biochemical oxidation was observed after 5, 10, and 20 days. However, with an acclimated seed culture, biological oxidation occurred to the extents of 13, 0, 6, and 23 of theoretical after 5, 10, 15 and 20 days, respectively. Bis(2-ethylhexyl) phthalate concentrations were 3 to 10 mg/l. Little or no removal of bis(2-ethylhexyl) phthalate by biological treatment in POTW is expected.

Butyl benzyl phthalate(67). In addition to the general remarks and discussion on phthalate esters, specific information on butyl benzyl phthalate is provided. No information was found on the physical properties of this compound.

Butyl benzyl phthalate is used as a plasticizer for PVC. Two special applications differentiate it from other phthalate esters. It is approved by the U.S. FDA for food contact in wrappers and containers; and it is the industry standard for plasticization of vinyl flooring because it provides stain resistance.

No ambient water criterion is proposed for butyl benzyl phthalate.

Butyl benzyl phthalate removal in POTWs is discussed in the general discussion of phthalate esters.

Di-n-butyl phthalate (68). In addition to the general remarks and discussion on phthalate esters, specific information on di-n-butyl phthalate (DBP) is provided. DBP is a colorless, oily liquid, boiling at 340°C. Its water solubility at room temperature is reported to be 0.4 g/l and 4.5g/l in two different chemistry handbooks. The formula for DBP, $C_6H_4(COOC_4H_9)_2$ is the same as for its isomer, di-isobutyl phthalate. DCP production is one to two percent of total U.S. phthalate ester production.

Dibutyl phthalate is used to a limited extent as a plasticizer for polyvinylchloride (PVC). It is not approved for contact with food. It is used in liquid lipsticks and as a diluent for polysulfide dental impression materials. DBP is used as a plasticizer for nitrocellulose in making gun powder, and as a fuel in solid propellants for rockets.

Further uses are insecticides, safety glass manufacture, textile lubricating agents, printing inks, adhesives, paper coatings and resin solvents.

For protection of human health from the toxic properties of dibutyl phthalate ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 34 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is 154 mg/l.

Although the behavior of di-n-butyl phthalate in POTW has not been studied, biochemical oxidation of this toxic pollutant has been studied on a laboratory scale at concentrations higher than would normally be expected in municipal wastewater. Biochemical oxidation of 35, 43, and 45 percent of theoretical oxidation were obtained after 5, 10, and 20 days, respectively, using sewage microorganisms as an unacclimated seed culture. Based on these data, it is expected that di-n-butyl phthalate will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTWs.

Biological treatment in POTW is expected to remove di-n-butyl phthalate to a moderate degree.

Di-n-octyl phthalate(69). In addition to the general remarks and discussion on phthalate esters, specific information on di-n-octyl phthalate is provided. Di-n-octyl phthalate is not to be confused with the isomeric bis(2-ethylhexyl) phthalate which is commonly referred to in the plastics industry as DOP. Di-n-octyl phthalate is a liquid which boils at 220°C at 5 mm Hg. It is insoluble in water. Its molecular formula is $C_6H_4(COOC_8H_{17})_2$. Its production constitutes about one percent of all phthalate ester production in the U.S.

Industrially, di-n-octyl phthalate is used to plasticize polyvinyl chloride (PVC) resins.

No ambient water criterion is proposed for di-n-octyl phthalate.

Biological treatment in POTW is expected to lead to little or no removal of di-n-octyl phthalate.

Diethyl phthalate (70). In addition to the general remarks and discussion on phthalate esters, specific information on diethyl phthalate is provided. Diethyl phthalate, or DEP, is a colorless liquid boiling at 296°C, and is insoluble in water. Its molecular formula is $C_6H_4(COOC_2H_5)_2$. Production of diethyl phthalate constitutes about 1.5 percent of phthalate ester production in the U.S.

Diethyl phthalate is approved for use in plastic food containers by the U.S. FDA. In addition to its use as a polyvinylchloride (PVC) plasticizer, DEP is used to plasticize cellulose nitrate for gun powder, to dilute polysulfide dental impression materials, and as an accelerator for dying triacetate fibers. An additional use which would contribute to its wide distribution in the environment is as an approved special denaturant for ethyl alcohol. The alcohol-containing products for which DEP is an approved denaturant include a wide range of personal care items such as bath preparations, bay rum, colognes, hair preparations, face and hand creams, perfumes and toilet soaps. Additionally, this denaturant is approved for use in biocides, cleaning solutions, disinfectants, insecticides, fungicides, and room deodorants which have ethyl alcohol as part of the formulation. It is expected, therefore, that people and buildings would have some surface loading of this priority pollutant which would find its way into raw wastewaters.

For the protection of human health from the toxic properties of diethyl phthalate ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 350 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is 1800 mg/l.

Although the behavior of diethylphthalate in POTW has not been studied, biochemical oxidation of this toxic pollutant has been studied on a laboratory scale at concentrations higher than would normally be expected in municipal wastewater. Biochemical oxidation of 79, 84, and 89 percent of theoretical was observed after 5, 5, and 20 days, respectively. Based on these data it is expected that diethyl phthalate will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTWs.

Dimethyl phthalate (71). In addition to the general remarks and discussion on phthalate esters, specific information on dimethyl phthalate (DMP) is provided. DMP has the lowest molecular weight of the phthalate esters - M.W. = 194 compared to M.W. of 391 for bis(2-ethylhexyl)phthalate. DMP has a boiling point of 282°C. It is a colorless liquid, soluble in water to the extent of 5 mg/l. Its molecular formula is $C_6H_4(COOCH_3)_2$.

Dimethyl phthalate production in the U.S. is just under one percent of total phthalate ester production. DMP is used to some extent as a plasticizer in cellulosics. However, its principle specific use is for dispersion of polyvinylidene fluoride (PVDF). PVDF is resistant to most chemicals and finds use as electrical insulation, chemical process equipment (particularly pipe), and as a base for long-life finishes for exterior metal siding. Coil coating techniques are used to apply PVDF dispersions to aluminum or galvanized steel siding.

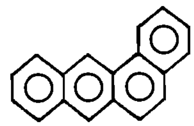
For the protection of human health from the toxic properties of dimethyl phthalate ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 313 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is 2800 mg/l.

Based on limited data and observations relating molecular structure to ease of biochemical degradation of other organic pollutants, it is expected that dimethyl phthalate will be biochemically oxidized to a lesser extent than domestic sewage of biological treatment in POTWs.

Polynuclear Aromatic Hydrocarbons(72-84). The polynuclear aromatic hydrocarbons (PAH) selected as toxic pollutants are a group of 13 compounds consisting of substituted and unsubstituted polycyclic aromatic rings. The general class of PAH includes hetrocyclics, but none of those were selected as toxic pollutants. PAH are formed as the result of incomplete combustion when organic compounds are burned with insufficient oxygen. PAH are found in coke oven emissions, vehicular emissions, and volatile products of oil and gas burning. The compounds chosen as priority pollutants are listed with the structural formula and melting point (m.p.) for each. All are insoluble in water.

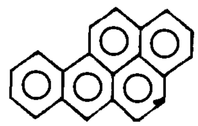
72 Benzo(a)anthrancene (1,2-benzanthracene)

m.p. 162°C



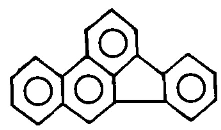
73 Benzo(a)pyrene (3,4-benzopyrene)

m.p. 176°C



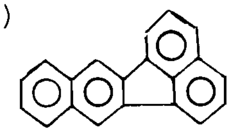
74 3,4-Benzofluoranthene

m.p. 168°C



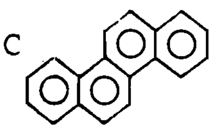
75 Benzo(k)fluoranthene (11,12-benzofluoranthene)

m.p. 217°C



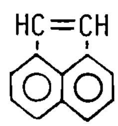
76 Chrysene (1,2-benzphenanthrene)

m.p. 255°C



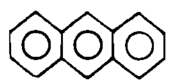
77 Acenaphthylene
HC=CH

m.p. 92°C



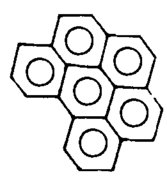
78 Anthracene

m.p. 216°C



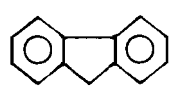
79 Benzo(ghi)perylene (1,12-benzoperylene)

m.p. not reported



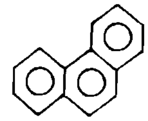
80 Fluorene (alpha-diphenylenemethane)

m.p. 116°C



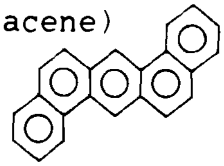
81 Phenanthrene

m.p. 101°C



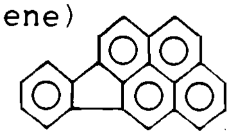
82 Dibenzo(a,h)anthracene (1,2,5,6-dibenzoanthracene)

m.p. 269°C



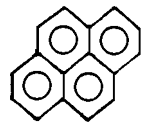
83 Indeno(1,2,3-cd)pyrene (2,3-o-phenyleneperylene)

m.p. not available



84 Pyrene

m.p. 156°C



Some of these priority pollutants have commercial or industrial uses. Benzo(a)anthracene, benzo(a)pyrene, chrysene, anthracene, dibenzo(a,h)anthracene, and pyrene are all used as antioxidants. Chrysene, acenaphthylene, anthracene, fluorene, phenanthrene, and pyrene are all used for synthesis of dyestuffs or other organic chemicals. 3,4-Benzofluoranthrene, benzo(k)fluoranthene, benzo(ghi)perylene, and indeno (1,2,3-cd)pyrene have no known industrial uses, according to the results of a recent literature search.

Several of the PAH toxic pollutants are found in smoked meats, in smoke flavoring mixtures, in vegetable oils, and in coffee. They are found in soils and sediments in river beds. Consequently, they are also found in many drinking water supplies. The wide distribution of these pollutants in complex mixtures with the many other PAHs which have not been designated as toxic pollutants results in exposures by humans that cannot be associated with specific individual compounds.

The screening and verification analysis procedures used for the organic toxic pollutants are based on gas chromatography (GC). Three pairs of the PAH have identical elution times on the column specified in the protocol, which means that the pollutants of the pair are not differentiated. For these three pairs [anthracene (78) - phenanthrene (81); 3,4-benzofluoranthene (74) - benzo(k)fluoranthene (75); and benzo(a)anthracene (72) - chrysene (76)] results are obtained and reported as "either-or." Either both are present in the combined concentration reported, or one is present in the concentration reported. When detections below reportable limits are recorded no further analysis is required. For samples where the concentrations of coeluting pairs have a significant value, additional analyses are conducted, using different procedures that resolve the particular pair.

There are no studies to document the possible carcinogenic risks to humans by direct ingestion. Air pollution studies indicate an excess of lung cancer mortality among workers exposed to large amounts of PAH containing materials such as coal gas, tars, and coke-oven emissions. However, no definite proof exists that the PAH present in these materials are responsible for the cancers observed.

Animal studies have demonstrated the toxicity of PAH by oral and dermal administration. The carcinogenicity of PAH has been traced to formation of PAH metabolites which, in turn, lead to tumor formation. Because the levels of PAH which induce cancer are very low, little work has been done on other health hazards resulting from exposure. It has been established in animal studies that tissue damage and systemic toxicity can result from exposure to noncarcinogenic PAH compounds.

Because there were no studies available regarding chronic oral exposures to PAH mixtures, proposed water quality criteria were derived using data on exposure to a single compound. Two studies were selected, one involving benzo(a)pyrene ingestion and one involving dibenzo(a,h)anthracene ingestion. Both are known animal carcinogens.

For the maximum protection of human health from the potential carcinogenic effects of exposure to polynuclear aromatic hydro- carbons (PAH) through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of PAH estimated to result in additional lifetime cancer risk of 10^{-7}, 10^{-6}, and 10^{-5} are 2.8 x 10^{-7} mg/l, 2.8 x a0^{-6} mg/l and 2.8 x 10^{-5} mg/l, respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 3.11 x 10^{-4} mg/l to keep the increased lifetime cancer risk below 10^{-5}. Available data show the adverse effects on aquatic life occur at concentrations higher than those cited for human health risk.

The behavior of PAH in POTW has received only a limited amount of study. It is reported that up to 90 percent of PAH entering a POTW will be retained in the sludge generated by conventional sewage treatment processes. Some of the PAH can inhibit bacterial growth when they are present at concentrations as low as 0.018 mg/l. Biological treatment in activated sludge units has been shown to reduce the concentration of phenanthrene and anthracene to some extent. However, a study of biochemcial oxidation of fluorene on a laboratory scale showed no degradation after 5, 10, and 20 days. On the basis of that study and studies of other organic priority pollutants, some general observations were made relating molecular structure to ease of degradation. Those observations lead to the conclusion that the 13 PAH selected to represent that group as toxic pollutants will be removed only slightly or not at all by biological treatment methods in POTW. Based on their water insolubility and tendency to attach to sediment particles very little pass through of PAH to POTW effluent is expected.

No data are available at this time to support any conclusions about contamination of land by PAH on which sewage sludge containing PAH is spread.

Tetrachloroethylene(85). Tetrachloroethylene (CCl_2CCl_2), also called perchloroethylene and PCE, is a colorless nonflammable liquid produced mainly by two methods - chlorination and pyrolysis of ethane and propane, and oxychlorination of dichloroethane. U.S. annual production exceeds 300,000 tons. PCE boils at 121°C and has a vapor pressure of 19 mm Hg at 20°C. It is insoluble in water but soluble in organic solvents.

Approximately two-thirds of the U.S. production of PCE is used for dry cleaning. Textile processing and metal degreasing, in equal amounts consume about one-quarter of the U.S. production.

The principal toxic effect of PCE on humans is central nervous system depression when the compound is inhaled. Headache, fatigue, sleepiness, dizziness and sensations of intoxication are reported. Severity of effects increases with vapor concentration. High integrated exposure (concentration times duration) produces kidney and liver damage. Very limited data on PCE ingested by laboratory animals indicate liver damage occurs when PCE is administered by that route. PCE tends to distribute to fat in mammalian bodies.

One report found in the literature suggests, but does not conclude, that PCE is teratogenic. PCE has been demonstrated to be a liver carcinogen in B6C3-F1 mice.

For the maximum protection of human health from the potential carcinogenic effects of exposure to tetrachloroethylene through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of tetrachloroethylene estimated to result in additional lifetime cancer risk levels of 10^{-7}, 10^{-6}, and 10^{-5} are 8×10^{-5} mg/l, 8×10^{-4} mg/l, and 8×10^{-3} mg/l respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 0.088 mg/l to keep the increased lifetime cancer risk below 10^{-5}. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

Few data were found regarding the behavior of PCE in POTW. Many of the organic toxic pollutants have been investigated, at least in laboratory scale studies, at concentrations higher than those expected to be contained by most municipal wastewaters. General observations have been developed relating molecular structure to ease of degradation for all of the organic toxic pollutants. Based on study of the limited data, it is expected that PCE will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. An EPA study of seven POTW revealed removals of 40 to 100 percent. Sludge concentrations of tetrachloroethylene ranged from 1×10^{-3} to 1.6 mg/l. Some PCE is expected to be volatilized in aerobic treatment processes and little, if any, is expected to pass through into the effluent from the POTW.

Toluene(86). Toluene is a clear, colorless liquid with a benzene like odor. It is a naturally occuring compound derived primarily from petroleum or petrochemical processes. Some toluene is obtained from the manufacture of metallurgical coke. Toluene is also referred to as totuol, methylbenzene, methacide, and phenymethane. It is an aromatic hydrocarbon with the formula $C_6H_5CH_3$. It boils at 111°C and has a vapor pressure of 30 mm Hg at room temperature. The water solubility of toluene is 535 mg/l, and it is miscible with a variety of organic solvents. Annual production of toluene in the U.S. is greater than 2 million metric tons. Approximately two-thirds of the toluene is converted to benzene and the remaining 30 percent is divided approximately equally into chemical manufacture, and use as a paint solvent and aviation gasoline additive. An estimated 5,000 metric tons is discharged to the environment annually as a constituent in wastewater.

Most data on the effects of toluene in human and other mammals have been based on inhalation exposure or dermal contact studies. There appear to be no reports of oral administration of toluene to human subjects. A long term toxicity study on female rats revealed no adverse effects on growth, mortality, appearance and behavior, organ to body weight ratios, blood-urea nitrogen levels, bone marrow counts, peripheral blood counts, or morphology of major organs. The effects of inhaled toluene on the central nervous system, both at high and low concentrations, have been studied in humans and animals. However, ingested toluene is expected to be handled differently by the body because it is absorbed more slowly and must first pass through the liver before reaching the nervous system. Toluene is extensively and rapidly metabolized in the liver. One of the principal metabolic products of toluene is benzoic acid, which itself seems to have little potential to produce tissue injury.

Toluene does not appear to be teratogenic in laboratory animals or man. Nor is there any conclusive evidence that toluene is mutagenic. Toluene has not been demonstrated to be positive in any *in vitro* mutagenicity or carcinogenicity bioassay system, nor to be carcinogenic in animals or man.

Toluene has been found in fish caught in harbor waters in the vicinity of petroleum and petrochemical plants. Bioconcentration studies have not been conducted, but bioconcentration factors have been calculated on the basis of the octanol-water partition coefficient.

For the protection of human health from the toxic properties of toluene ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 14.3 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water quality criterion is 424 mg/l. Available data show that adverse effects on aquatic life occur at concentrations as low as 5 mg/l.

Acute toxicity tests have been conducted with toluene and a variety of freshwater fish and Daphnia magna. The latter appears to be significantly more resistant than fish. No test results have been reported for the chronic effects of toluene on freshwater fish or invertebrate species.

Only one study of toluene behavior in POTW is available. However, the biochemical oxidation of many of the toxic pollutants has been investigated in laboratory scale studies at con- centrations greater than those expected to be contained by most municipal wastewaters. At toluene concentrations ranging from 3 to 250 mg/l biochemical oxidation proceeded to fifty percent of theroetical or greater. The time period varied from a few hours to 20 days depending on whether or not the seed culture was acclimated. Phenol adapted acclimated seed cultures gave the most rapid and extensive biochemical oxidation. Based on study of the limited data, it is expected that toluene will be biochemically oxidized to a lesser extent than domestic sewage by biological treatment in POTW. The volatility and relatively low water solubility of toluene lead to the expectation that aeration processes will remove significant quantities of toluene from the POTW. The EPA studied toluene removal in seven POTW. The removals ranged from 40 to 100 percent. Sludge concentrations of toluene ranged from 54×10^{-3} to 1.85 mg/l.

Antimony(114). Antimony (chemical name - stibium, symbol Sb) classified as a nonmetal or metalloid, is a silvery white , brittle, crystalline solid. Antimony is found in small ore bodies throughout the world. Principal ores are oxides of mixed antimony valences, and an oxysulfide ore. Complex ores with metals are important because the antimony is recovered as a by-product. Antimony melts at 631°C, and is a poor conductor of electricity and heat.

Annual U.S. consumption of primary antimony ranges from 10,000 to 20,000 tons. About half is consumed in metal products - mostly antimonial lead for lead acid storage batteries, and about half in non - metal products. A principal compound is antimony trioxide which is used as a flame retardant in fabrics, and as an opacifier in glass, ceramincs, and enamels. Several antimony compounds are used as catalysts in organic chemicals synthesis, as fluorinating agents (the antimony fluoride), as pigments, and in fireworks. Semiconductor applications are economically significant.

Essentially no information on antimony - induced human health effects has been derived from community epidemiolocy studies. The available data are in literature relating effects observed with therapeutic or medicinal uses of antimony compounds and industrial exposure studies. Large therapeutic doses of antimonial compounds, usually used to treat schistisomiasis, have caused severe nausea, vomiting, convulsions, irregular heart action, liver damage, and skin rashes. Studies of acute industrial antimony poisoning have revealed loss of appetite, diarrhea, headache, and dizziness in addition to the symptoms found in studies of therapeutic doses of antimony.

For the protection of human health from the toxic properties of antimony ingested through water and through contaminated aquatic organisms the ambient water criterion is determined to be 0.146 mg/l. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the ambient water criterion is determined to be 45 mg/l. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

Very little information is available regarding the behavior of antimony in POTW. The limited solubility of most antimony compounds expected in POTW, i.e. the oxides and sulfides, suggests that at least part of the antimony entering a POTW will be precipitated and incorporated into the sludge. However, some antimony is expected to remain dissolved and pass through the POTW into the effluent. Antimony compounds remaining in the sludge under anaerobic conditions may be connected to stibine (SbH_3), a very soluble and very toxic compound. There are no data to show antimony inhibits any POTW processes. Antimony is not known to be essential to the growth of plants, and has been reported to be moderately toxic. Therefore, sludge containing large amounts of antimony could be detrimental to plants if it is applied in large amounts to cropland.

Arsenic(115). Arsenic (chemical symbol As), is classified as a nonmetal or metalloid. Elemental arsenic normally exists in the alpha-crystalline metallic form which is steel gray and brittle, and in the beta form which is dark gray and amorphous. Arsenic sublimes at 615°C. Arsenic is widely distributed throughout the world in a large number of minerals. The most important commercial source of arsenic is as a by-product from treatment of copper, lead, cobalt, and gold ores. Arsenic is usually marketed as the trioxide (As_2O_3). Annual U.S. production of the trioxide approaches 40,000 tons.

The principal use of arsenic is in agricultural chemicals (herbicides) for controlling weeds in cotton fields. Arsenicals have various applications in medicinal and veterinary use, as wood preservatives, and in semiconductors.

The effects of arsenic in humans were known by the ancient Greeks and Romans. The principal toxic effects are gastrointestinal disturbances. Breakdown of red blood cells occurs. Symptoms of acute poisoning include vomiting, diarrhea, abdominal pain, lassitude, dizziness, and headache. Longer exposure produced dry, falling hair, brittle, loose nails, eczema; and exfoliation. Arsenicals also exhibit teratogenic and mutagenic effects in humans. Oral administration of arsenic compounds has been associated clinically with skin cancer for nearly a hundred years. Since 1888 numerous studies have linked occupational exposure to, and therapeutic administration of arsenic compounds to increased incidence of respiratory and skin cancer.

For the maximum protection of human health from the potential carcinogenic effects of exposure to arsenic through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. Concentrations of arsenic estimated to result in additional lifetime cancer risk levels of 10^{-7}, 10^{-6}, and 10^{-5} are 2.2×10^{-7} mg/l, 2.2×10^{-6} mg/l, and 2.2×10^{-5} mg/l, respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 2.7×10^{-4} mg/l to keep the increased lifetime cancer risk below 10^{-5}. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

A few studies have been made regarding the behavior of arsenic in POTW. One EPA survey of 9 POTW reported influent concentrations ranging from 0.0005 to 0.693 mg/l; effluents from 3 POTW having biological treatment contained 0.0004 - 0.01 mg/l; 2 POTW showed arsenic removal efficiencies of 50 and 71 percent in biological treatment. Inhibition of treatment processes by sodium arsenate is reported to occur at 0.1 mg/l in activated sludge, and 1.6 mg/l in anaerobic digestion processes. In another study based on data from 60 POTW, arsenic in sludge ranged from 1.6 to 65.6 mg/kg and the median value was 7.8 mg/kg. Arsenic in sludge spread on cropland may be taken up by plants grown on that land. Edible palnts can take up arsenic, but normally their growth is inhibited before the palnts are ready for harvest.

Cadmium(118). Cadmium is a relatively rare metallic element that is seldom found in sufficient quantities in a pure state to warrant mining or extraction from the earth's surface. It is found in trace amounts of about 1 ppm throughout the earth's crust. Cadmium is, however, a valuable by-product of zinc production.

Cadmium is used primarily as an electroplated metal, and is found as an impurity in the secondary refining of zinc, lead, and copper.

Cadmium is an extremely dangerous cumulative toxicant, causing progressive chronic poisoning in mammals, fish, and probably other organisms. The metal is not excreted.

Toxic effects of cadmium on man have been reported from throughout the world. Cadmium may be a factor in the development of such human pathological conditions as kidney disease, testicular tumors, hypertension, arteriosclerosis, growth inhibition, chronic disease of old age, and cancer. Cadmium is normally ingested by humans through food and water as well as by breathing air contaminated by cadmium dust. Cadmium is cumulative in the liver, kidney, pancreas, and thyroid of humans and other animals. A severe bone and kidney syndrome known as itai-itai disease has been documented in Japan as caused by cadmium ingestion via drinking water and contaminated irrigation water. Ingestion of as little as 0.6 mg/day has produced the disease. Cadmium acts synergistically with other metals. Copper and zinc substantially increase its toxicity.

Cadmium is concentrated by marine organisms, particularly mollusks, which accumulate cadmium in calcareous tissues and in the viscera. A concentration factor of 1000 for cadmium in fish muscle has been reported, as have concentration factors of 3000 in marine plants and up to 29,600 in certain marine animals. The eggs and larvae of fish are apparently more sensitive than adult fish to poisoning by cadmium, and crustaceans appear to be more sensitive than fish eggs and larvae.

For the protection of human health from the toxic properties of cadmium ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 0.010 mg/l. Available data show that adverse effects on aquatic life occur at concentrations in the same range as those cited for human health, and they are highly dependent on water hardness.

Cadmium is not destroyed when it is introduced into a POTW, and will either pass through to the POTW effluent or be incorporated into the POTW sludge. In addition, it can interfere with the POTW treatment process.

In a study of 189 POTW, 75 percent of the primary plants, 57 percent of the trickling filter plants, 66 percent of the activated sludge plants and 62 percent of the biological plants allowed over 90 percent of the influent cadmium to pass thorugh to the POTW effluent. Only 2 of the 189 POTW allowed less than 20 percent pass-through, and none less than 10 percent pass-through. POTW effluent concentrations ranged from 0.001 to 1.97 mg/l (mean 0.028 mg/l, standard deviation 0.167 mg/l).

Cadmium not passed through the POTW will be retained in the sludge where it is likely to build up in concentration. Cadmium contamination of sewage sludge limits its use on land since it increases the level of cadmium in the soil. Data show that cadmium can be incorporated into crops, including vegetables and grains, from contaminated soils. Since the crops themselves show no adverse effects from soils with levels up to 100 mg/kg cadmium, these contaminated crops could have a significant impact on human health. Two Federal agencies have already recognized the potential adverse human health effects posed by the use of sludge on cropland. The FDA recommends that sludge containing over 30 mg/kg of cadmium should not be used on agricultural land. Sewage sludge contains 3 to 300 mg/kg (dry basis) of cadmium mean = 10 mg/kg; median = 16 mg/kg. The USDA also recommends placing limits on the total cadmium from sludge that may be applied to land.

<u>Chromium(119)</u>. Chromium is an elemental metal usually found as a chromite ($FeO \bullet Cr_2O_3$). The metal is normally produced by reducing the oxide with aluminum. A significant proportion of the chromium used is in the form of compounds such as sodium dichromate (Na_2CrO_4), and chromic acid (CrO_3) - both are hexavalent chromium compounds.

Chromium is found as an alloying component of many steels and its compounds are used in electroplating baths, and as corrosion inhibitors for closed water circulation systems.

The two chromium forms most frequently found in industry wastewaters are hexavalent and trivalent chromium. Hexavalaent chromium is the form used for metal treatments. Some of it is reduced to trivalent chromium as part of the process reaction. The raw wastewater containing both valence states is usually treated first to reduce remaining hexavalent to trivalent chromium, and second to precipitate the trivalent form as the hydroxide. The hexavalent form is not removed by lime treatment.

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. Hexavalent chromium is a known human carcinogen. Levels of chromate ions that show no effect in 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 the effect of water hardness. Studies have shown that trivalent chromium is more toxic to fish of some types than is hexavalent chromium. Hexavalent chromium retards growth of one fish species at 0.0002 mg/l. Fish food organisms and other lower forms of aquatic life are extremely sensitive to chromium. Therefore, both hexavalent and trivalent chromium must be considered harmful to particular fish or organisms.

For the protection of human health from the toxic properties of chromium (except hexavalent chromium) ingested through water and contaminated aquatic organisms, the ambient water criterion is 0.050 mg/l. For the maximum protection of human health from the potential carcinogenic effects of exposure to hexavalent chromium through ingestion of water and contaminated aquatic organisms, the ambient water concentration is zero. The estimated levels which would result in increased lifetime cancer risks of 10^{-7}, 10^{-6}, and 10^{-5} are 7.4×10^{-8} mg/l, 7.4×10^{-7} mg/l, and 7.4×10^{-6} mg/l respectively. If contaminated aquatic organisms alone are consumed, excluding the consumption of water, the water concentration should be less than 1.5×10^{-5} mg/l to keet the increased lifetime cancer risk below 10^{-5}.

Chromium is not destroyed when treated by POTW (although the oxidation state may change), and will either pass through to the POTW effluent or be incorporated into the POTW sludge. Both oxidation states can cause POTW treatment inhibition and can also limit the usefuleness of municipal sludge.

Influent concentrations of chromium to POTW facilities have been observed by EPA to range from 0.005 to 14.0 mg/l, with a median concentration of 0.1 mg/l. The efficiencies for removal of chromium by the activated sludge process can vary greatly, depending on chromium concentration in the influent, and other operating conditions at the POTW. Chelation of chromium by organic matter and dissolution due to the presence of carbonates can cause deviations from the predicted behavior in treatment systems.

The systematic presence of chromium compounds will halt nitrification in a POTW for short periods, and most of the chromium will be retained in the sludge solids. Hexavalent chromium has been reported to severely affect the nitrification process, but trivalent chromium has litte or no toxicity to activated sludge, except at high concentrations. The presence of iron, copper, and low pH will increase the toxicity of chromium in a POTW by releasing the chromium into solution to be ingested by microorganisms in the POTW.

The amount of chromium which passes through to the POTW effluent depends on the type of treatment processes used by the POTW. In a study of 240 POTWs 56 percent of the primary plants allowed more than 80 percent pass through to POTW effluent. More advanced treatment results in less pass-through. POTW effluent concentrations ranged from 0.003 to 3.2 mg/l total chromium (mean = 0.197, standard deviation = 0.48), and from 0.002 to 0.1 mg/l hexavalent chromium (mean = 0.017, standard deviation = 0.020).

Chromium not passed through the POTW will be retained in the sludge, where it is likely to build up in concentration. Sludge concentrations of total chromium of over 20,000 mg/kg (dry basis) have been observed. Disposal of sludges containing very high concentrations of trivalent chromium can potentially cause problems in uncontrollable landfills. Incineration, or similar destructive oxidation processes can produce hexavalent chromium from lower valance states. Hexavalent chromium is potentially more toxic than trivalent chromium. In cases where high rates of chrome sludge application on land are used, distinct growth inhibition and plant tissue uptake have been noted.

Pretreatment of discharges substantially reduces the concentration of chromium in sludge. In Buffalo, New York, pretreatment of electroplating waste resulted in a decrease in chromium concentrations in POTW sludge from 2,510 to 1,040 mg/kg. A similar reduction occurred in in Grand Rapids, Michigan POTW where the chromium concentration in sludge decreased from 11,000 to 2,700 mg/kg when pretreatment was made a requirement.

Copper(120). Copper is a metallic element that sometimes is found free, as the native metal, and is also found in minerals such as cuprite (Cu_2O), malechite [$CuCO_3 \bullet Cu(OH)_2$], azurite [$2CuCO_3 \bullet Cu(OH)_2$], chalcopyrite ($CuFeS_2$), and bornite (Cu_5FeS_4). Copper is obtained from these ores by smelting, leaching, and electrolysis. It is used in the plating, electrical, plumbing, and heating equipment industries, as well as in insecticides and fungicides.

Traces of copper are found in all forms of plant and animal life, and the metal is an essential trace element for nutrition. Copper is not considered to be a cumulative systemic poison for humans as it is readily excreted by the body, but it can cause symptoms of gastroenteritis, with nausea and intestinal irritations, at relatively low dosages. The limiting factor in domestic water supplies is taste. To prevent this adverse organoleptic effect of copper in water, a criterion of 1 mg/l has been established.

The toxicity of copper to aquatic organisms varies significantly, not only with the species, but also with the physical and chemical characteristics of the water, including temperature, hardness, turbidity, and carbon dioxide content. In hard water, the toxicity of copper salts may be reduced by the precipitation of copper carbonate or other insoluble compounds. The sulfates of copper and zinc, and of copper and calcium are synergistic in their toxic effect on fish.

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. Concentrations of 0.02 to 0.031 mg/l have proven fatal to some common fish species. In general the salmonoids are very sensitive and the sunfishes are less sensitive to copper.

The recommended criterion to protect saltwater aquatic life is 0.00097 mg/l as a 24-hour average, and 0.018 mg/l maximum concentration.

Copper salts cause undesirable color reactions in the food industry and cause pitting when deposited on some other metals such as aluminum and galvanized steel. To control undesirable taste and odor quality of ambient water due to the organoleptic properties of copper, the estimated level is 1.0 mg/l. For total recoverable copper the criterion to protect freshwater aquatic life is 5.6×10^{-3} mg/l as a 24 hour average.

Irrigation water containing more than minute quantities of copper can be detrimental to certain crops. 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. Copper is essential to the life of plants, and the normal range of concentration 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 mg/kg, respectively, under conditions of severe copper toxicity. Even under conditions of copper toxicity, most of the excess copper accumulates in the roots; very little is moved to the aerial part of the plant.

Copper is not destroyed when treated by a POTW, and will either pass through to the POTW effluent or be retained in the POTW sludge. It can interfere with the POTW treatment processes and can limit the usefulness of municipal sludge.

The influent concentration of copper to POTW facilities has been observed by the EPA to range from 0.01 to 1.97 mg/l, with a median concentration of 0.12 mg/l. The copper that is removed from the influent stream of a POTW is adsorbed on the sludge or appears in the sludge as the hydroxide of the metal. Bench scale pilot studies have shown that from about 25 percent to 75 percent of the copper passing through the activated sludge process remains in solution in the final effluent. Four-hour slug dosages of copper sulfate in concentrations exceeding 50 mg/l were reported to have severe effects on the removal efficiency of an unacclimated system, with the system returning to normal in about 100 hours. Slug dosages of copper in the form of copper cyanide were observed to have much more severe effects on the activated sludge system, but the total system returned to normal in 24 hours.

In a recent study of 268 POTW, the median pass-through was over 80 percent for primary plants and 40 to 50 percent for trickling filter, activated sludge, and biological treatment plants. POTW effluent concentrations of copper ranged from 0.003 to 1.8 mg/l (mean 0.126, standard deviation 0.242).

Copper which does not pass through the POTW will be retained in the sludge where it will build up in concentration. The presence of excessive levels of copper in sludge may limit its use on cropland. Sewage sludge contains up to 16,000 mg/kg of copper, with 730 mg/kg as the mean value. These concentrations are significantly greater than those normally found in soil, which usually range from 18 to 80 mg/kg. Experimental data indicate that when dried sludge is spread over tillable land, the copper tends to remain in place down to the depth of tillage, except for copper which is taken up by plants grown in the soil. Recent investigation has shown that the extractable copper content of sludge-treated soil decreased with time, which suggests a reversion of copper to less soluble forms was occurring.

Cyanide(121). Cyanides are among the most toxic of pollutants commonly observed in industrial wastewaters. Introduction of cyanide into industrial processes is usually by dissolution of potassium cyanide (KCN) or sodium cyanide (NaCN) in process waters. However, hydrogen cyanide (HCN) formed when the above salts are dissolved in water, is probably the most acutely lethal compound.

The relationship of pH to hydrogen cyanide formation is very important. As pH is lowered to below 7, more than 99 percent of the cyanide is present as HCN and less than 1 percent as cyanide ions. Thus, at neutral pH, that of most living organisms, the more toxic form of cyanide prevails.

Cyanide ions combine with numerous heavy metal ions to form complexes. The complexes are in equilibrium with HCN. Thus, the stability of the metal-cyanide complex and the pH determine the concentration of HCN. Stability of the metal-cyanide anion complexes is extremely variable. Those formed with zinc, copper, and cadmium are not stable - they rapidly dissociate, with production of HCN, in near neutral or acid waters. Some of the complexes are extremely stable. Cobaltocyanide is very resistant to acid distillation in the laboratory. Iron cyanide complexes are also stable, but undergo photodecomposition to give HCN upon exposure to sunlight. Synergistic effects have been demonstrated for the metal cyanide complexes making zinc, copper, and cadmiun, cyanides more toxic than an equal concentration of sodium cyanide.

The toxic mechanism of cyanide is essentially an inhibition of oxygen metabolism, i.e., rendering the tissues incapable of exchanging oxygen. The cyanogen compounds are true noncummulative protoplasmic poisons. They arrest the activity of all forms of animal life. Cyanide shows a very specific type of toxic action. It inhibits the cytochrome oxidase system. This system is the one which facilitates electron transfer from reduced metabolites to molecular oxygen. The human body can convert cyanide to a nontoxic thiocyanate and elminiate it. However, if the quantity of cyanide ingested is too great at one time, the inhibition of oxygen utilization proves fatal before the detoxifying reaction reduces the cyanide con- centration to a safe level.

Cyanides are more toxic to fish than to lower forms of aquatic organisms such as midge larvae, crustaceans, and mussels. Toxicity to fish is a function of chemical form and concentration, and is influenced by the rate of metabolism (temperature), the level of dissolved oxygen, and pH. In laboratory studies free cyanide concentrations ranging from 0.05 to 0.15 mg/l have been proven to be fatal to sensitive fish species including trout, bluegill, and fathead minnows. Levels above 0.2 mg/l are rapidly fatal to most fish species. Long term sublethal concentrations of cyanide as low as 0.01 mg/l have been shown to affect the ability of fish to function normally, e.g., reproduce, grow, and swim.

For the protection of human health from the toxic properties of cyanide ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 0.200 mg/l. Available data show taht adverse effects on aquatic life occur at concentrations as low as 3.5×10^{-3} mg/l.

Persistance of cyanide in water is highly variable and depends upon the chemical form of cyanide in the water, the concentration of cyanide, and the nature of other constituents. Cyanide may be destroyed by strong oxidizing agents such as permanganate and chlorine. Chlorine is commonly used to oxidize strong cyanide solutions. Carbon dioxide and nitrogen are the products of complete oxidation. But if the reaction is not complete, the very toxic compound, cyanogen chloride, may remain in the treatment system and subsequently be released to the environment. Partial chlorination may occur as part of a POTW treatment, or during the disinfection treatment of surface water for drinking water preparation.

Cyanides can interfere with treatment processes in POTW, or pass through to ambient waters. At low concentrations and with acclimated microflora, cyanide may be decomposed by microorganisms in anaerobic and aerobic environments or waste treatment systems. However, data indicate that much of the cyanide introduced passes through to the POTW effluent. The mean pass-through of 14 biological plants was 71 percent. In a recent study of 41 POTW the effluent concentrations ranged from 0.002 to 100 mg/l (mean = 2.518, standard deviation = 15.6). Cyanide also enhances the toxicity of metals commonly found in POTW effluents, including the toxic pollutants cadmium, zinc, and copper.

Data for Grand Rapids, Michigan, showed a significant decline in cyanide concentrations downstream from the POTW after pretreat- ment regulations were put in force. Concentrations fell from 0.66 mg/l before, to 0.01 mg/l after pretreatment was required.

Lead (122). Lead is a soft, malleable, ductible, blueish-gray, metallic element, usually obtained from the mineral galena (lead sulfide, PbS), anglesite (lead sulfate, $PbSO_4$), or cerussite (lead carbonate, $PbCO_3$). Because it is usually associated with minerals of zinc, silver, copper, gold, cadmium, antimony, and arsenic, special purification methods are frequently used before and after extraction of the metal from the ore concentrate by smelting.

Lead is widely used for its corrosion resistance, sound and vibration absorption, low melting point (solders), and relatively high imperviousness to various forms of radiation. Small amounts of copper, antimony and other metals can be alloyed with lead to achieve greater hardness, stiffness, or corrosion resistance than is afforded by the pure metal. Lead compounds are used in glazes and paints. About one third of U.S. lead consumption goes into storage batteries. About half of U.S. lead consumption is from secondary lead recovery. U.S. consumption of lead is in the range of one million tons annually.

Lead ingested by humans produces a variety of toxic effects including impaired reproductive ability, disturbances in blood chemistry, neurological disorders, kidney damage, and adverse cardiovascular effects. Exposure to lead in the diet results in permanent increase in lead levels in the body. Most of the lead entering the body eventually becomes localized in the bones where it accumulates. Lead is a carcinogen or cocarcinogen in some species of experimental animals. Lead is terratogenic in experimental animals. Mutangenicity data are not available for lead.

For the protection of human health from the toxic properties of lead ingested through water and through contaminated aquatic organisms, the ambient water criterion is 0.050 mg/l. Available data show that adverse effects on aquatic life occur at concentrations as low as 7.5×10^{-4} mg/l.

Lead is not destroyed in POTW, but is passed through to the effluent or retained in the POTW sludge; it can interfere with POTW treatment processes and can limit the usefulness of POTW sludge for application to agricultural croplands. Threshold concentration for inhibition of the activated sludge process is 0.1 mg/l, and for the nitrification process is 0.5 mg/l. In a study of 214 POTW, median pass through values were over 80 percent for primary plants and over 60 percent for trickling filter, activated sludge, and biological process plants. Lead concentration in POTW effluents ranged from 0.003 to 1.8 mg/l (means = 0.106 mg/l, standard deviation = 0.222).

Application of lead-containing sludge to cropland should not affect the uptake by crops under most conditions because normally lead is strongly bound by soil. However, under the unusual conditions of low pH (less than 5.5) and low concentrations of labile phosphorus, lead solubility is increased and plants can accumulate lead.

Nickel(124). Nickel is seldom found in nature as the pure elemental metal. It is a reltively plentiful element and is widely distributed throughout the earth's crust. It occurs in marine organisms and is found in the oceans. The chief commercial ores for nickel are pentlandite [$(Fe,Ni)_9S_8$], and a lateritic ore consisting of hydrated nickel-iron-magnesium silicate.

Nickel has many and varied uses. It is used in alloys and as the pure metal. Nickel salts are used for electroplating baths.

The toxicity of nickel to man is thought to be very low, and systemic poisoning of human beings by nickel or nickel salts is almost unknown. 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.

Nickel salts can kill fish at very low concentrations. However, nickel has been found to be less toxic to some fish than copper, zinc, and iron. Nickel is present in coastal and open ocean water at concentrations in the range of 0.0001 to 0.006 mg/l although the most common values are 0.002 - 0.003 mg/l. Marine animals contain up to 0.4 mg/l and marine plants contain up to 3 mg/l. Higher nickel concentrations have been reported to cause reduction in photosynthetic activity of the giant kelp. A low concentration was found to kill oyster eggs.

For the protection of human health based on the toxic properties of nickel ingested through water and through contaminated aquatic organisms, the ambient water criterion is determined to be 0.134 mg/l. If contaminated aquatic organisms are consumed, excluding consumption of water, the ambient water criterion is determined to be 1.01 mg/l. Available data show that adverse effects on aquatic life occur for total recoverable nickel concentrations as low as 0.032 mg/l.

Nickel is not destroyed when treated in a POTW, but will either pass through to the POTW effluent or be retained in the POTW sludge. It can interfere with POTW treatment processes and can also limit the usefulness of municipal sludge.

Nickel salts have caused inhibition of the biochemical oxidation of sewage in a POTW. In a pilot plant, slug doses of nickel significantly reduced normal treatment efficiencies for a few hours, but the plant acclimated itself somewhat to the slug dosage and appeared to achieve normal treatment efficiencies within 40 hours. It has been reported that the anaerobic digestion process is inhibited only by high concentrations of nickel, while a low concentration of nickel inhibits the nitrification process.

The influent concentration of nickel to POTW facilities has been observed by the EPA to range from 0.01 to 3.19 mg/l, with a median of 0.33 mg/l. In a study of 190 POTW, nickel pass-through was greater than 90 percent for 82 percent of the primary plants. Median pass-through for trickling filter, activated sludge, and biological process plants was greater than 80 percent. POTW effuent concentrations ranged from 0.002 to 40 mg/l (mean = 0.410, standard deviation = 3.279).

Nickel not passed through the POTW will be incorporated into the sludge. In a recent two-year study of eight cities, four of the cities had median nickel concentrations of over 350 mg/kg, and two were over 1,000 mg/kg. The maximum nickel concentration observed was 4,010 mg/kg.

Nickel is found in nearly all soils, plants, and waters. Nickel has no known essential function in plants. In soils, nickel typically is found in the range from 10 to 100 mg/kg. Various environmental exposures to nickel appear to correlate with increased incidence of tumors in man. For example, cancer in the maxillary antrum of snuff users may result from using plant material grown on soil high in nickel.

Nickel toxicity may develop in plants from application of sewage sludge on acid soils. Nickel has caused reduction of yields for a variety of crops including oats, mustard, turnips, and cabbage. In one study nickel decreased the yields of oats significantly at 100 mg/kg.

Whether nickel exerts a toxic effect on plants depends on several soil factors, the amount of nickel applied, and the contents of other metals in the sludge. Unlike copper and zinc, which are more available from inorganic sources than from sludge, nickel uptake by plants seems to be promoted by the presence of the organic matter in sludge. Soil treatments, such as liming reduce the solubility of nickel. Toxicity of nickel to plants is enhanced in acidic soils.

Selenium(125). Selenium (chemical symbol Se) is a nonmetallic element existing in several allotropic forms. Gray selenium, which has a metallic appearance, is the stable form at ordinary temperatures and melts at 220°C. Selenium is a major component of 38 minerals and a minor component of 37 others found in various parts of the world. Most selenium is obtained as a by-product of precious metals recovery from electrolytic copper refinery slimes. U.S. annual production at one time reached one million pounds.

Principal uses of selenium are in semi-conductors, pigments, decoloring of glass, zerography, and metallurgy. It also is used to produce ruby glass used in signal lights. Several selenium compounds are important oxidizing agents in the synthesis of organic chemicals and drug products.

While results of some studies suggest that selenium may be an essential element in human nutrition, the toxic effects of selenium in humans are well established. Lassitude, loss of hair, discoloration and loss of fingernails are symptoms of selenium poisoning. In a fatal case of ingestion of a larger dose of selenium acid, peripheral vascular collapse, pulumonary edema, and coma occurred. Selenium produces mutagenic and teratogenic effects, but it has not been established as exhibiting carcinogenic activity.

For the protection of human health from the toxic properties of selenium ingested through water and through contaminated aquatic organisms, the ambient water criterion is determind to be 0.010 mg/l. Available data show that adverse effects on aquatic life occur at concentrations higher than that cited for human toxicity.

Very few data are available regarding the behavior of selenium in POTW. One EPA survey of 103 POTW revealed one POTW using biological treatment and having selenium in the influent. Influent concentration was 0.0025 mg/l, effluent concentration was 0.0016 mg/l giving a removal of 37 percent. It is not known to be inhibitory to POTW processes. In another study, sludge from POTW in 16 cities was found to contain from 1.8 to 8.7 mg/kg selenium, compared to 0.01 to 2 mg/kg in untreated soil. These concentrations of selenium in sludge present a potential hazard for humans or other mammuals eating crops grown on soil treated with selenium containing sludge.

Silver(126). Silver is a soft, lustrous, white metal that is insoluble in water and alkali. In nature, silver is found in the elemental state (native silver) and combined in ores such as argentite (Ag_2S), horn silver ($AgCl$), proustite (Ag_3AsS_3), and pyrargyrite (Ag_3SbS_3). Silver is used extensively in several industries, among them electroplating.

Metallic silver is not considered to be toxic, but most of its salts are toxic to a large number of organisms. Upon ingestion by humans, many silver salts are absorbed in the circulatory system and deposited in various body tissues, resulting in generalized or sometimes localized gray pigmentation of the skin and mucous membranes know as argyria. There is no known method for removing silver from the tissues once it is deposited, and the effect is cumulative.

Silver is recognized as a bactericide and doses from 1×10^{-6} to 5×10^{-4} mg/l have been reported as sufficient to sterilize water. The ambient water criterion to protect human health from the toxic properties of silver ingested through water and through contaminated aquatic organisms is 0.05 mg/l. Available data show that adverse effects on aquatic life occur at total recoverable silver concentrations as low as 1.2×10^{-3} mg/l.

The chronic toxic effects of silver on the aquatic environment have not been given as much attention as many other heavy metals. Data from existing literature support the fact that silver is very toxic to aquatic organisms. Despite the fact that silver is nearly the most toxic of the heavy metals, there are insufficient data to adequately evaluate even the effects of hardness on silver toxicity. There are no data available on the toxicity of different forms of silver.

There is no available literature on the incidental removal of silver by POTW. An incidental removal of about 50 percent is assumed as being representative. This is the highest average incidental removal of any metal for which data are available. (Copper has been indicated to have a median incidental removal rate of 49 percent).

Bioaccumulation and concentration of silver from sewage sludge has not been studied to any great degree. There is some indication that silver could be bioaccumulated in mushrooms to the extent that there could be adverse physiological effects on humans if they consumed large quantites of mushrooms grown in silver enriched soil. The effect, however, would tend to be unpleasnat rather than fatal.

There is little summary data available on the quantity of silver discharged to POTW. Presumably there would be a tendency to limit its discharge from a manufacturing facility because of its high intrinsic value.

Thallium (127). Thallium (Tl) is a soft, silver-white, dense, malleable metal. Five major minerals contain 15 to 85 percent thallium, but they are not of commerical importance because the metal is produced in sufficient quantity as a by-product of lead-zinc smelting of sulfide ores. Thallium melts at 304°C. U.S. annual production of thallium and its compounds is estimated to be 1500 lb.

Industrial uses of thallium include the manufacture of alloys, electronic devices and special glass. Thallium catalysts are used for industrial organic syntheses.

Acute thallium poisoning in humans has been widely described. Gastrointestinal pains and diarrhea are followed by abnormal sensation in the legs and arms, dizziness, and, later, loss of hair. The central nervous system is also affected. Somnolence, delerium or coma may occur. Studies on the teratogenicity of thallium appear inconclusive; no studies on mutagenicity were found; and no published reports on carcinogenicity of thallium were found.

For the protection of human health from the toxic properties of thallium ingested through water and contaminated aquatic organisms, the ambient water criterion is 1.34×10^{-2} mg/l. If contaminated aquatic organisms alone are consumed, excluding consumption of water, the ambient water criterion is determined to be 48 mg/l. Available data show that adverse effects on aquatic life occur at concentrations higher than those cited for human health risks.

No reports were found regarding the behavior of thallium in POTW. It will not be degraded, therefore it must pass through to the effluent or be removed with the sludge. However since the sulfide (TlS) is very insoluble, if appreciable sulfide is present dissolved thallium in the influent to POTW may be precipitated into the sludge. Subsequent use of sludge bearing thallium compounds as a soil amendment to crop bearing soils may result in uptake of this element by food plants. Several leafy garden crops (cabbage, lettuce, leek, and endive) exhibit relatively higher concentrations of thallium than other foods such as meat.

Zinc(128). Zinc occurs abundantly in the earth's crust, concentrated in ores. It is readily refined into the pure, stable, silvery-white metal. In addition to its use in alloys, zinc is used as a protective coating on steel. It is applied by hot dipping (i.e. dipping the steel in molten zinc) or by electroplating.

Zinc can have an adverse effect on man and animals at high concentrations. Zinc at concentrations in excess of 5 mg/l causes an undesirable taste and odor which persists through conventional treatment. For the prevention of adverse effects due to these organoleptic properties of zinc, concentrations in ambient water should not exceed 5 mg/l. Available data show that adverse effects on aquatic life occur at concentrations as low as 0.047 mg/l.

Toxic concentrations of zinc compounds cause adverse changes in the morphology and physiology of fish. Lethal concentrations in the range of 0.1 mg/l have been reported. Acutely toxic concentrations induce cellular breakdown of the gills, and possibly the clogging of the gills with mucous. Chronically toxic concentrations of zinc compounds cause general enfeeblement and widespread histological changes to many organs, but not to gills. Abnormal swimming behavior has been reported at 0.04 mg/l. Growth and maturation are retarded by zinc. It has been observed that the effects of zinc poisoning may not become apparent immediately, so that fish removed from zinc-contaminated water may die as long as 48 hours after removal.

In general, salmonoids are most sensitive to elemental zinc in soft water; the rainbow trout is the most sensitive in hard waters. A complex relationship exists between zinc concentration, dissolved zinc concentration, pH, temperature, and calcium and magnesium concentration. Prediction of harmful effects has been less than reliable and controlled studies have not been extensively documented.

The major concern with zinc compounds in marine waters is not with acute lethal effects, but rather with the long-term sublethal effects of the metallic compounds and complexes. Zinc accumulates in some marine species, and marine animals contain zinc in the range of 6 to 1500 mg/kg. From the point of view of acute lethal effects, invertebrate marine animals seem to be the most sensitive organism tested.

Toxicities of zinc in nutrient solutions have been demonstrated for a number of plants. A variety of fresh water plants tested manifested harmful symptoms at concentrations of 10 mg/l. Zinc sulfate has also been found to be lethal to many plants and it could impair agricultural uses of the water.

Zinc is not destroyed when treated by POTW, but will either pass through to the POTW effluent or be retained in the POTW sludge. It can interfere with treatment processes in the POTW and can also limit the usefuleness of municipal sludge.

In slug doses, and particularly in the presence of copper, dissolved zinc can interfere with or seriously disrupt the operation of POTW biological processes by reducing overall removal efficiencies, largely as a result of the toxicity of the metal to biological organisms. However, zinc solids in the form of hydroxides or sulfides do not appear to interfere with biological treatment processes, on the basis of available data. Such solids accumulate in the sludge.

The influent concentrations of zinc to POTW facilities have been observed by the EPA to range from 0.017 to 3.91 mg/l, with a median concentration of 0.33 mg/l. Primary treatment is not efficient in removing zinc; however, the microbial floc of secondary treatment readily adsorbs zinc.

In a study of 258 POTW, the median pass-through values were 70 to 88 percent for primary plants, 50 to 60 percent for trickling filter and biological process plants, and 30-40 percent for activated process plants. POTW effluent concentrations of zinc ranged from 0.003 to 3.6 mg/l (mean = 0.330, standard deviation = 0.464).

The zinc which does not pass through the POTW is retained in the sludge. The presence of zinc in sludge may limit its use on cropland. Sewage sludge contains 72 to over 30,000 mg/kg of zinc, with 3,366 mg/kg as the mean value. These concentrations are significantly greater than those normally found in soil, which range from 0 to 195 mg/kg, with 94 mg/kg being a common level. Therefore, application of sewage sludge to soil will generally increase the concentration of zinc in the soil. Zinc can be toxic to plants, depending upon soil pH. Lettuce, tomatoes, turnips, mustard, kale, and beets are especially sensitive to zinc contamination.

<u>Xylene (130)</u>. Xylene ($C_6H_4(CH_3)_2$) is a colorless flammable liquid with a density of 0.86 g/ml. The boiling point ranges from 137 to 140°C, and the flash point is 29°C. Xylene is practically insoluble in water, but it is miscible with alcohol, ether, and many other organic liquids. Xylene is commonly a mixture of three isomers, ortho, meta, and para-xylene, with m-xylene predominating. Xylene is manufactured from pseudocumene, or by catalytic isomerization of a hydrocarbon fraction.

Xylene is predominately used as a solvent, for the manufacture of dyes and other organics, and as a raw material for production of benzoic acid, phthalic anhydride and other acids and esters used in the manufacture of polyester fibers.

Xylene has been shown to have a narcotic effect on humans exposed to high concentrations. The chronic toxicity of xylene has not been defined, however, it is less toxic than benzene.

Data on the behavior of xylene in POTW are not available. However, the methyl groups in xylene tend to transfer electrons to the benzene ring and make it more susceptible to biochemical oxidation. This observation in addition to the low water solubility of xylene, leads to the expectation that aeration processes will remove some xylene from the POTW.

Aluminum. Aluminum is a nonconventional pollutant. It is a silvery white metal, very abundant in the earths crust (8.1%), but never found free in nature. Its principal ore is bauxite. Alumina (Al_2O_3) is extracted from the bauxite and dissolved in molten cryolite. Aluminum is produced by electrolysis of this melt.

Aluminum is light, malleable, ductile, possesses high thermal and electrical conductivity, and is non-magnetic. It can be formed, machined or cast. Although aluminum is very reactive, it forms a protective oxide film on the surface which prevents corrosion under many conditions. In contact with other metals in presence of moisture the protective film is destroyed and voluminous white corrosion products form. Strong acids and strong alkali also break down the protective film. Aluminum is one of the principal basis metals used in the coil coating industry.

Aluminum is nontoxic and its salts are used as coagulants in water treatment. Although some aluminum salts are soluble, alkaline conditions cause precipitation of the aluminum as a hydroxide.

Aluminum is commonly used in cooking utensils. There are no reported adverse physiological effects on man from low concentrations of aluminum in drinking water.

Aluminum does not have any adverse effects on POTW operation at any concentrations normally encountered.

Ammonia. Ammonia (chemical formula NH_3) is a non-conventional pollutant. It is a colorless gas with a very pungent odor, detectable at concentrations of 20 ppm in air by the nose, and is very soluble in water (570 gm/l at 25°C). Ammonia is produced industrially in very large quantities (nearly 20 millions tons annually in the U.S.). It is converted to ammonium compounds or shipped in the liquid form (it liquifies at -33°C). Ammonia also results from natural processes. Bacterial action on nitrates or nitrites, as well as dead plant and animal tissue and animal wastes produces ammonia. Typical domestic wastewaters contain 12 to 50 mg/l ammonia.

The principal use of ammonia and its compounds is as fertilizer. High amounts are introduced into soils and the water runoff from agricultural land by this use. Smaller quantities of ammonia are used as a refrigerant. Aqueous ammonia (2 to 5 percent solution) is widely used as a household cleaner. Ammonium compounds find a variety of uses in various industries.

Ammonia is toxic to humans by inhalation of the gas or ingestion of aqueous solutions. The ionized form (NH_4^+) is less toxic than the un-ionized form. Ingestion of as little as one ounce of household ammonia has been reported as a fatal dose. Whether inhaled or ingested, ammonia acts distructively on mucous membrane with resulting loss of function. Aside from breaks in liquid ammonia refrigeration equipment, industrial hazard from ammonia exists where solutions of ammonium compounds may be accidently treated with a strong alkali, releasing ammonia gas. As little as 150 ppm ammonia in air is reported to cause laryngeal spasm, and inhalation of 5000 ppm in air is considered sufficient to result in death.

Freshwater ambient water criteria for total ammonia are pH and temperature dependent; un-ionized ammonia criteria is 0.02 mg/l. The reported odor threshold for ammonia in water is 0.037 mg/l. Un-ionized ammonia is acutely or chronically toxic to many important freshwater and marine aquatic organisms at ambient water concentrations below 4.2 mg/l. Salmonoid fishes are especially sensitive to the toxic effects of un-ionized ammonia at concentrations as low as 0.025 mg/l during prolonged exposure. Because the proportion of un-ionized ammonia varies with environmental conditions and cannot be directly controlled in the ambient water, total ammonia is the pollutant which must be controlled.

The behavior of ammonia in POTW is well documented because it is a natural component of domestic wastewaters. Only very high concentrations of ammonia compounds could overload POTWs. One study has shown that concentrations of un-ionized ammonia greater than 90 mg/l reduce gasification in anaerobic digesters and concentrations of 140 mg/l stop digestion competely. Corrosion of copper piping and excessive consumption of chlorine also result from high ammonia concentrations. Interference with aerobic nitrification processes can occur when large concentrations of ammonia suppress dissolved oxygen. Nitrites are then produced instead of nitrates. Elevated nitrite concentrations in drinking water are known to cause infant methemoglobinemia.

Fluoride. Fluoride ion (F^-) is a nonconventional pollutant. Fluorine is an extremely reactive, pale yellow, gas which is never found free in nature. Compounds of fluorine - fluorides - are found widely distributed in nature. The principal minerals containing fluorine are fluorspar (CaF_2) and cryolite (Na_3AlF_6). Although fluorine is produced commercially in small quantities by electrolysis of potassium bifluoride in anhydrous hydrogen fluoride, the elemental form bears little relation to the combined ion. Total production of fluoride chemicals in the U.S. is difficult to estimate because of the varied uses. Large volume usage compounds are: Calcium fluoride (est. 1,500,000 tons in U.S.) and sodium fluoroaluminate (est. 100,000 tons in U.S.). Some fluoride compounds and their uses are: sodium fluoroaluminate - aluminum production; calcium fluoride - steelmaking, hydrofluoric acid production, enamel, iron foundry; boron trifluoride - organic synthesis; antimony pentafluoride - fluorocarbon production; fluoboric acid and fluoborates - electroplating; perchloryl fluoride (ClO_3F) - rocket fuel oxidizer; hydrogen fluoride - organic fluoride manufacture, pickling acid in stainless steelmaking, manufacture of alumium fluoride; sulfur hexafluoride - insulator in high voltage transformers; polytetrafluoroethylene - inert plastic. Sodium fluoride is used at a concentration of about 1 ppm in many public drinking water supplies to prevent tooth decay in children.

The toxic effects of fluoride on humans include severe gastroenteritis, vomiting diarrhea, spasms, weakness, thirst, failing pulse and delayed blood coagulation. Most observations of toxic effects are made on individuals who intentionally or accidentally ingest sodium fluoride intended for use as rat poison or insecticide. Lethal doses for adults are estimated to be as low as 2.5 g. At 1.5 ppm in drinking water, mottling of tooth enamel is reported, and 14 ppm, consumed over a period of years, may lead to deposition of calcium fluoride in bone and tendons.

Very few data are available on the behavior of fluoride in POTW. Under usual operating conditions in POTW, fluorides pass through into the effluent. Very little of the fluoride entering conventional primary and secondary treatment processes is removed. In one study of POTW influents conducted by the U.S. EPA, nine POTW reported concentrations of fluoride ranging from 0.7 mg/l to 1.2 mg/l, which is the range of concentrations used for fluoridated drinking water.

Iron. Iron is a nonconventional polluant. It is an abundant metal found at many places in the earth's crust. The most common iron ore is hematite (Fe_2O_3) from which iron is obtained by reduction with carbon. Other forms of commercial ores are magnetite (Fe_3O_4) and taconite (FeSiO). Pure iron is not often found in commercial use, but it is usually alloyed with other metals and minerals. The most common of these is carbon.

Iron is the basic element in the production of steel. Iron with carbon is used for casting of major parts of machines and it can be machined, cast, formed, and welded. Ferrous iron is used in paints, while powdered iron can be sintered and used in powder metallurgy. Iron compounds are also used to precipitate other metals and undesirable minerals from industrial wastewater streams.

Corrosion products of iron in water cause staining of porcelain fixtures, and ferric iron combines with tannin to produce a dark violet color. The presence of excessive iron in water discourages cows from drinking and thus reduces milk production. High concentrations of ferric and ferrous ions in water kill most fish introduced to the solution within a few hours. The killing action is attributed to coatings of iron hydroxide precipitates on the gills. Iron oxidizing bacteria are dependent on iron in water for growth. These bacteria form slimes that can affect the aesthetic values of bodies of water and cause stoppage of flows in pipes.

Iron is an essential nutrient and micro-nutrient for all forms of growth. Drinking water standards in the U.S. set a limit of 0.3 mg/l of iron in domestic water supplies based on aesthetic and organoleptic properties of iron in water.

High concentrations of iron do not pass through a POTW into the effluent. In some POTW iron salts are added to coagulate precipitates and suspended sediments into a sludge. In an EPA study of POTW the concentration of iron in the effluent of 22 biological POTW meeting secondary treatment performance levels ranged from 0.048 to 0.569 mg/l with a median value of 0.25 mg/l. This represented removals of 76 to 97 percent with a median of 87 percent removal.

Iron in sewage sludge spread on land used for agricultural purposes is not expected to have a detrimental effect on crops grown on the land.

Phenols(Total). "Total Phenols" is a nonconventional pollutant parameter. Total phenols is the result of analysis using the 4-AAP (4-aminoantipyrene) method. This analytical procedure measures the color development of reaction products between 4-AAP and some phenols. The results are reported as phenol. Thus "total phenol" is not total phenols because many phenols (notably nitrophenols) do not react. Also, since each reacting phenol contributes to the color development to a different degree, and each phenol has a molecular weight different from others and from phenol itself, analyses of several mixtures containing the same total concentration in mg/l of several phenols will give different numbers depending on the proportions in the particular mixture.

Despite these limitations of the analytical method, total phenols is a useful analysis when the mix of phenols is relatively constant and an inexpensive monitoring method is desired. In any given plant or even in an industry subcategory, monitoring of "total phenols" provides an indication of the concentration of this group of toxic pollutants as well as those phenols not selected as toxic pollutants. A further advantage is that the method is widely used in water quality determinations.

In an EPA survey of 103 POTW the concentration of "total phenols" ranged grom 0.0001 mg/l to 0.176 mg/l in the influent, with a median concentration of 0.016 mg/l. Analysis of effluents from 22 of these same POTW which had biological treatment meeting secondary treatment performance levels showed "total phenols" concentrations ranging from 0 mg/l to 0.203 mg/l with a median of 0.007. Removals were 64 to 100 percent with a median of 78 percent.

It must be recognized, however, that six of the eleven toxic pollutant phenols could be present in high concentrations and not be detected.

Conversely, it is possible, but not probable, to have a high "total phenol" concentration without any phenol itself or any of the ten other toxic pollutant phenols present. A characterization of the phenol mixture to be monitored to establish constancy of composition will allow "total phenols" to be used with confidence.

Oil and Grease. Oil and grease are taken together as one pollutant parameter. This is a conventional polluant and some of its components are:

1. Light Hydrocarbons - These include light fuels such as gasoline, kerosene, and jet fuel, and miscellaneous sol- vents used for industrial processing, degreasing, or cleaning purposes. The presence of these light hydro- carbons may make the removal of other heavier oil wastes more difficult.

2. Heavy Hydrocarbons, Fuels, and Tars - These include the crude oils, diesel oils, #6 fuel oil, residual oils, slop oils, and in some cases, asphalt and road tar.

3. Lubricants and Cutting Fluids - These generally fall in- to two classes: nonemulsifiable oils such as lubrica- ting oils and greases and emulsifiable oils such as water soluble oils, rolling oils, cutting oils, and draw- ing compounds. Emulsifiable oils may contain fat soap or various other additives.

4. Vegetable and Animal Fats and Oils - These originate primarily from processing of foods and natural products.

These compounds can settle or float and may exist as solids or liquids depending upon factors such as method of use, production process, and temperature of wastewater.

Oil and grease even in small quantities cause troublesome taste and odor problems. Scum lines from these agents are produced on water treatment basin walls and other containers. Fish and water fowl are adversely affected by oils in their habitat. Oil emulsions may adhere to the gills of fish causing suffocation, and the flesh of fish is tainted when microorganisms that were exposed to waste oil are eaten. Deposition of oil in the bottom sediments of water can serve to inhibit normal benthic growth. Oil and grease exhibit an oxygen demand.

Many of the organic priority pollutants will be found distributed between the oily phase and the aqueous phase in industrial wastewaters. The presence of phenols, PCBs, PAHs, and almost any other organic pollutant in the oil and grease make characterization of this parameter almost impossible. However, all of these other organics add to the objectionable nature of the oil and grease.

Levels of oil and grease which are toxic to aquatic organisms vary greatly, depending on the type and the species susceptibility. However, it has been reported that crude oil in concentrations as low as 0.3 mg/l is extremely toxic to fresh-water fish. It has been recommended that public water supply sources be essentially free from oil and grease.

Oil and grease in quantities of 100 l/sq km show up as a sheen on the surface of a body of water. The presence of oil slicks decreases the aesthetic value of a waterway.

Oil and grease is compatible with a POTW activated sludge process in limited quantity. However, slug loadings or high concentrations of oil and grease interfere with biological treatment processes. The oils coat surfaces and solid particles, preventing access of oxygen, and sealing in some microorganisms. Land spreading of POTW sludge containing oil and grease uncontaminated by toxic pollutants is not expected to affect crops grown on the treated land, or animals eating those crops.

pH. Although not a specific pollutant, pH is related to the acidity or alkalinity of a wastewater stream. It is not, however, a measure of either. The term pH is used to describe the hydrogen ion concentration (or activity) present in a given solution. Values for pH range from 0 to 14, and these numbers are the negative logarithms of the hydrogen ion concentrations. A pH of 7 indicates neutrality. Solutions with a pH above 7 are alkaline, while those solutions with a pH below 7 are acidic. The relationship of pH and acidity and alkalinity is not necessarily linear or direct. Knowledge of the water pH is useful in determining necessary measures for corroison control, sanitation, and disinfection. Its value is also necessary in the treatment of industrial wastewaters to determine amounts of chemcials required to remove pollutants and to measure their effectiveness. Removal of pollutants, especially dissolved solids is affected by the pH of the wastewater.

Waters with a pH below 6.0 are corrosive to water works structures, distribution lines, and household plumbing fixtures and can thus add constituents to drinking water such as iron, copper, zinc, cadmium, and lead. The hydrogen ion concentration can affect the taste of the water and at a low pH, water tastes sour. The bactericidal effect of chlorine is weakened as the pH increases, and it is advantageous to keep the pH close to 7.0. This is significant for providng safe drinking water.

Extremes of pH or rapid pH changes can exert stress conditions or kill aquatic life outright. Even moderate changes from acceptable criteria limits of pH are deleterious to some species. The relative toxicity to aquatic life of many materials is increased by changes in the water pH. For example, metallocyanide complexes can increase a thousand-fold in toxicity with a drop of 1.5 pH units.

Because of the universal nature of pH and its effect on water quality and treatment, it is selected as a pollutant parameter for many industry categories. A neutral pH range (approximately 6-9) is generally desired because either extreme beyond this range has a deleterious effect on receiving waters or the pollutant nature of other wastewater constituents.

Pretreatment for regulation of pH is covered by the "General Pretreatment Regulations for Exisiting and New Sources of Pollution," 40 CFR 403.5. This section prohibits the discharge to a POTW of "pollutants which will cause corrosive structural damage to the POTW but in no case discharges with pH lower than 5.0 unless the works is specially designed to accommodate such discharges."

Sulfides. Sulfides are constituents of many industrial wastes such as those from tanners, paper mills, chemical plants, and gas works; but they are also generated in sewage and some natural waters by the anerobic decomposition of organic matter. When added to water, soluble sulfide salts such as Na_2S dissociate into sulfide ions which in turn react with the hydrogen ions in the water to form HS- or H_2S, the proportion of each depending upon the resulting pH value.

Due to the unpleasant taste and odor which exist when sulfides are present in water, it is unlikely that any person or animal would consume a harmful dose. The threshold level of taste and smell are reported to be 0.2 mg/l of sulfides in pump-mill wastes. For industrial uses, however, even small traces of sulfides are often detrimental.

The toxicity of sulfide solutions toward fish increases as the pH value is lowered, i.e., the H_2S or HS- appears to be the principle toxic agent. Experiments with trout substantiate this statement. However, inorganic sulfides have also proved fatal to trout at concentrations between 0.5 and 1.0 mg/l as sulfide, even in neutral and somewhat alkaline solutions.

Tin. Tin is a silver-white, lustrous and malleable metal with a density of 7.31 g/ml. The melting point of tin is 231.9°C while the boiling point is 2507°C.

Tin is used chiefly for tin-plating, soldering alloys and babbitt type metals.

Tin is not present in natural waters but it may occur in industrial wastes. Tin salts therefore, may reach surface waters or groundwater; but because many of the salts are insoluble in water, it is unlikely that much of the tin will remain in solution or suspension. No reports have been uncovered to indicate that tin can be detrimental in domestic water supplies.

Rats have tolerated 25 mg or more of sodium stannuous tartrate in the diet over a period of 4-12 months without ill effects. Similar tests with other animals had similar results - no ill effects. On the basis of these feeding experiments, it is unlikely that any concentration of tin that could occur in water would be detrimental to livestock.

It is apparent that trace concentrations of tin are beneficial to fish. However, higher levels have proved fatal to eels which were tested.

Total Suspended Solids(TSS). Suspended solids include both organic and inorganic materials. The inorganic compounds include sand, silt, and clay. The organic fraction includes such materials as grease, oil, tar, and animal and vegetable waste products. 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. These solids discharged with man's wastes may be inert, slowly biodegradable materials, or rapidly decomposable substances. While in suspension, suspended solids increase the turbidity of the water, reduce light penetration, and impair the photosynthetic activity of aquatic plants.

Supended solids in water interfere with many industrial processes and cause foaming in boilers and incrustastions on equipment exposed to such water, especially as the temperature rises. They are undesirable in process water used in the manufacture of steel, in the textile industry, in laundries, in dyeing, and in cooling systems.

Solids in suspension are aesthetically displeasing. When they settle to form sludge deposits on the stream or lake bed, they are often damaging to the life in the water. Solids, when transformed to sludge deposit, may do a variety of damaging things, including blanketing the stream or lake bed and thereby destroying the living spaces for those benthic organisms that would otherwise occupy the habitat. When of an organic nature, solids use a portion or all of the dissolved oxygen available in the area. Organic materials also serve as a food source for sludgeworms and associated organisms.

Disregarding any toxic effect attributable to substances leached out by water, suspended solids may kill fish and shellfish by causing abrasive injuries and by clogging the gills and respiratory passages of various aquatic fauna. Indirectly, suspended solids are inimical to aquatic life because they screen out light, and they promote and maintain the development of noxious conditions through oxygen depletion. This results in the killing of fish and fish food organisms. Suspended solids also reduce the recreational value of the water.

Total suspended solids is a traditional pollutant which is compatible with a well-run POTW. This pollutant with the exception of those components which are described elsewhere in this section, e.g., heavy metal components, does not interfere with the operation of a POTW. However, since a considerable portion of the innocuous TSS may be inseparably bound to the constituents which do interfere with POTW operation, or produce unusable sludge, or subsequently dissolve to produce unacceptable POTW effluent, TSS may be considered a toxic waste hazard.

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