PHOSPHORUS TRICHLORIDE LISTING BACKGROUND DOCUMENT FOR THE INORGANIC CHEMICAL LISTING DETERMINATION

This Document Contains No Confidential Business Information

August 2000

U.S. ENVIRONMENTAL PROTECTION AGENCY
ARIEL RIOS BUILDING
1200 PENNSYLVANIA AVENUE, N.W.
WASHINGTON, D.C. 20460

TABLE OF CONTENTS

LIST OF APPENDICES

LIST OF TABLES

LIST OF FIGURES

1. SECTOR OVERVIEW

1.1 SECTOR DEFINITION, FACILITY NAMES AND LOCATIONS

Phosphorus trichloride is produced in the United States by six manufacturers. **Table 1.1** presents the name and location of the manufacturers.[1] **Figure 1.1** shows the geographical locations of the six facilities presented in Table 1.1.

Table 1.1 Phosphorus Trichloride Producers

Facility Name	Facility Location
1. Akzo Nobel Chemicals Inc.[1]	State Route 2, P.O. Box 1721 Gallipolis Ferry, WV 25515
2. Albright & Wilson Inc.	2151 King Street Charleston, SC 29405
3. Great Lakes Chemical Corp. (formerly FMC Nitro Corp.)[2]	200 Pickens Road Nitro, WV 25143
4. Monsanto Luling Facility	12501 South River Road Luling, LA 70070
5. Rhodia Inc.- Morrisville Plant[3]	2300 South Pennsylvania Avenue Morrisville, PA 19067
6. Zeneca AG Products- Cold Creek Plant	U.S. Highway 43 North Bucks, AL 36512

Notes:
[1] This facility produced phosphorus trichloride in 1997, but not in 1998.
[2] Nitro Plant was sold by FMC Corp. and has been bought by The Great Lakes Chemical Corporation.
[3] This facility discontinued production as of November 1999 and has no future plans of resuming production of phosphorus trichloride.

[1] EPA, RCRA §3007, Survey of Inorganic Chemicals Industry

Figure 1.1 - Geographical Distribution of Phosphorus Trichloride Producers[1]

[1] See Table 1.1 for facility name and location.

1.2 PRODUCTS, PRODUCT USAGE AND MARKETS

Phosphorus trichloride, which has a molecular formula of PCl_3, is a harsh smelling volatile liquid with a molecular weight of 137.33 gram (g)/mol. Phosphorus trichloride has a melting point of -112 degrees Celsius (C) and a boiling point of 75 degrees C.

Its primary use is as pesticide intermediates, most importantly in the production of a glyphosate intermediate, which is a nonselective herbicide. Other uses include: phosphorus acid (primarily for water treatment chemicals), plastics and elastomer additives (including flame retardants and phosphite antioxidants and stabilizers) and lube oil and paint additives.[2]

Phosphorus trichloride is also used as a chlorinating agent for producing various acyl and alkyl chlorides, as follows:

$$PCl_3 + 3\,RCOOH \div H_3PO_3 + 3\,RCOCl$$

Phosphorus trichloride reacts with oxygen, sulfur, chlorine, and water. It is used as an intermediate in the production of phosphorus oxychloride, phosphorus sulfochloride, phosphorus pentachloride, and phosphoric acids. Phosphorus trichloride is also used as the raw material for the manufacture of dialkyl phosphonates, triarylphosphites, and dialkyl alkylphosphonates.

Pesticide intermediates uses, primarily serving glyphosate requirements, are driving the phosphorus trichloride market.

1.3 PRODUCTION CAPACITY

As of 1999, the current maximum production capacity in the United States is approximately 359,000 short tons per year. This production capacity is split among the six current manufacturers as follows.[2] **(Table 1.2)**

[2] ChemExpo Home Page, http://www.chemexpo.com/news/profile990927.cfm

Table 1.2 Phosphorus Trichloride Production Capacity

Facility	Location	Capacity (short tons/yr)
Akzo Nobel Chemicals, Inc.	State Route 2, P.O. Box 1721 Gallipolis Ferry, WV 25515	22,000
Albright & Wilson, Inc.	2151 King Street Charleston, SC 29405	55,000
Great Lakes Chemical Corp. (formerly FMC Nitro Corp.)	200 Pickens Road Nitro, WV 25143	30,000
Monsanto Luling Facility	12501 South River Road Luling, LA 70070	220,000
Rhodia, Inc.	2300 South Pennsylvania Avenue Morrisville, PA 19067	17,000
Zeneca, Inc.	U.S. Highway 43 North Bucks, AL 36512	15,000
Total		359,000

1.4 PRODUCTION, PRODUCT AND PROCESS TRENDS

Phosphorus trichloride consumption is increasing at rates in excess of demand for other phosphorus chemicals, driven primarily by sustained double-digit growth for glyphosate herbicide products. Volume sales of Monsanto Company's Roundup (glyphosate), the largest single use, have expanded by about 20 percent per year for most of the decade. Phosphorus trichloride use in the production of surfactants and sequestrants is projected to grow at an average annual rate of about 2 or 3 percent, with phosphoric acid for organophosphonates making up the bulk of this market segment.[3] However, rising chlorine costs are a concern to producers of phosphorus trichloride. None of them have captive chlorine supplies, and they have historically had difficulty passing these added costs on to their customers.

Domestic demand for phosphorus trichloride in the production of glyphosate and other pesticides is expected to grow at an annual rate of 5 to 7 percent over the next few years. Demand for uses in plastics and elastomer additives is showing modest growth after market share losses earlier in the decade to chlorinated phosphate flame retardants. The domestic demand for phosphorus trichloride grew from 210,000 tons in 1998 to 225,000 tons in 1999. Demand is projected to be 255,000 tons in the year 2001, and 290,000 tons in the year 2003.[4]

Historically (1983-1998), phosphorus trichloride sales have grown 7 percent per year. In the future,

[3] Id.

[4] Id.

five percent annual growth through the year 2003 is projected.

2. DESCRIPTION OF MANUFACTURING PROCESSES

2.1 PRODUCTION PROCESS DESCRIPTION

The following is a general description of the production process and does not account for specific variations reported by manufacturers of phosphorus trichloride. The production of phosphorus trichloride begins as liquid phosphorus is sprayed into a reactor simultaneously fed with chlorine gas. The reaction is exothermic and the heat of reaction is utilized to vaporize PCl_3, driving the vapors through a structured packing column up to air condensers, which then cool the vapors back to liquid PCl_3. The reacted phosphorus trichloride is purified by distillation and then sent to a product storage tank. Residual gases from distillation and from various storage tanks are scrubbed with water to produce a wastewater of weak hydrochloric acid and phosphorus acid (H_3PO_3). These acidic waters are neutralized and sent to off-site wastewater treatment system.

Periodically, about once or twice a year, the reactor must be cleaned to facilitate the production of high quality product. The accumulated residual material, which is highly reactive and contains arsenic, is pumped from the reactor into drums for transport and off-site incineration. The emptied reactor is washed with water which is disposed of in an off-site wastewater treatment system.

Additionally, the treatment of wastewaters generates a sludge which is periodically removed from the system.

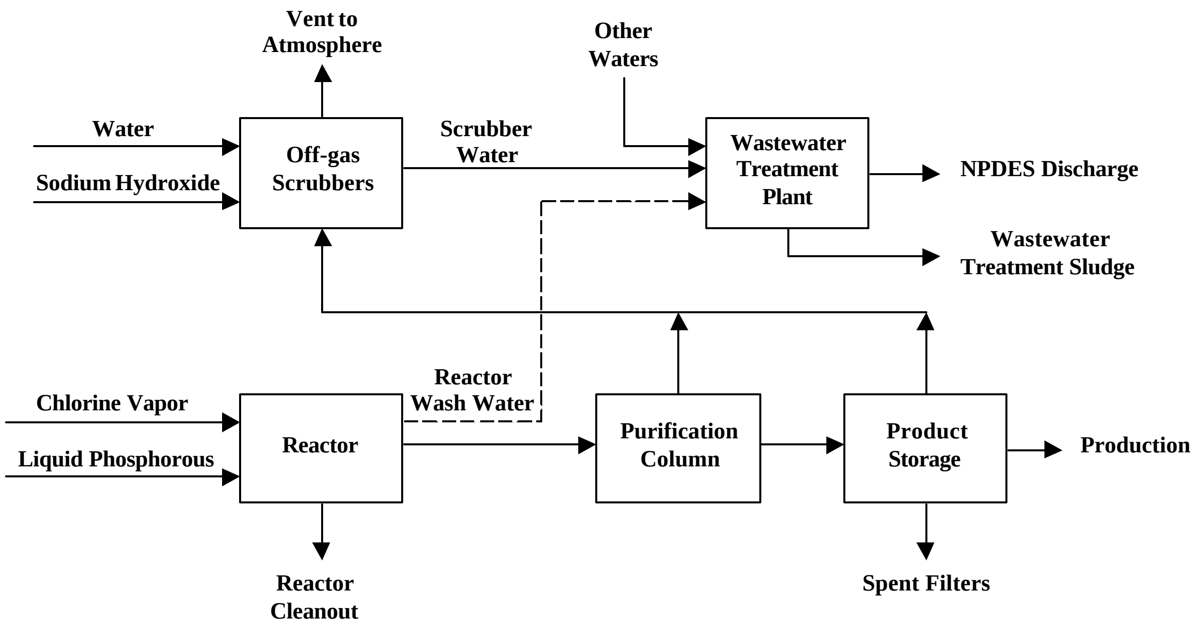
2.2 PRODUCTION TRENDS, CHANGES AND IMPROVEMENTS

Rhodia Inc. has discontinued production as of November 1999 and has no future plans of resuming production of phosphorus trichloride.

2.3 PROCESS FLOW DIAGRAM

Figure 2.1 is a general process flow diagram and does not account for specific process particulars of any of the listed manufacturers of phosphorus trichloride.

Figure 2.1 - Process Flow Diagram for the Production of Phosphorus Trichloride



3. WASTE GENERATION AND MANAGEMENT

Appendix A presents a complete summary of the wastestreams generated at each of the facilities in the phosphorus trichloride sector, the volume of the wastestreams generated in MT/yr, and the associated final management step. **Section 3.1** discusses wastes that are outside the scope of the consent decree. **Section 3.2** presents a discussion of each wastestream and identifies where in the process the waste is generated and the subsequent management steps employed at each facility. It also presents a characterization of the wastestream, the generated volume, and a results of initial risk screening analysis.

3.1 WASTES OUTSIDE THE SCOPE OF THE CONSENT DECREE

EPA does not consider some kinds of debris and plant component materials to fall within the scope of the consent decree. The Monsanto Luling Facility reported the generation of 4.0 MT of phosphorus contaminated material in 1998. Phosphorus contaminated material is a solid waste periodically generated due to routine plant maintenance activities. This residual includes personal protective equipment and plant debris (e.g., miscellaneous construction materials, insulation, reactor bed material, and piping). This wastestream is outside the scope of the consent decree. Furthermore, this waste is coded as characteristically hazardous (D001), stored in containers, and disposed of at off-site hazardous waste incineration facilities.

3.2 SUMMARY OF WASTE GENERATION PROCESSES

Wastes generated from the production of phosphorus trichloride generally consist of sludges, wastewaters and spent filters. The sludges are generated as part of reactor and wastewater treatment system cleanout. Spent filters are generated as part of product filtration during product storage and loading. Wastewaters are generated throughout the production of phosphorus trichloride.

Together, the different manufacturing process units produced fourteen types of different wastestreams. The units (waste source) and wastestreams are as follows:

Phosphorus Storage:

- Phosphorus Tank Sediment
- Phosphorus Water

Reactor:

- Reactor Cleanout Sludge
- Initial Washout Water from Reactor
- Final Washout Water from Reactor

Scrubber:

- Caustic Scrubber Water
- Process Scrubber Water

Product Storage and Loading:

- Spent Filters for Product
- Spent Filters Wash Water for Product
- Phosphorus Contaminated Material
- Process Area Wash Water
- Product Storage Tank Cleanout with Nonreactive Rinse
- Product Storage Tank Cleanout with Water

Wastewater Treatment System:

- Wastewater Treatment Sludge

Table 3.1 presents a summary of wastestreams generated by facilities.

Table 3.1 Wastes Generated from the Production of Phosphorus Trichloride

Facility	Reactor Cleanout Sludge	Initial Reactor Washout Water	Final Reactor Washout Water	Caustic Scrubber Water	Process Scrubber Water	Spent Product Filters
Akzo Nobel Chemicals, Gallipolis Ferry, WV	x	x		x	x	
Albright & Wilson Americas Inc. Charleston, SC	x		x	x	x	
Great Lakes Chemical Corp. (formerly FMC Nitro Corp.)	x	x			x	x
Rhodia, Inc. Morrisville, PA	x	x		x		x
Monsanto Luling Facility, Luling, LA		x		x	x	
Zeneca Inc., Bucks, AL	x	x		x		

Table 3.1 Wastes Generated from the Production of Phosphorus Trichloride (continued)

Facility	Spent Product Filters Wash Water	Phosphorus Contaminated Material	Process Area Wash Water	Storage Tank Cleanout w/ Nonreactive Phosphate Ester Rinse	Storage Tank Cleanout with Water	Wastewater Treatment Sludge	Phosphorus Tank Sediment	Phosphorus Water
Akzo Nobel Chemicals, Gallipolis Ferry, WV						x	x	x
Albright & Wilson Americas Inc. Charleston, SC						x		
Great Lakes Chemical Corp. (formerly FMC Nitro Corp.)	x		x	x	x	x		
Rhodia, Inc. Morrisville, PA	x							
Monsanto Luling Facility, Luling, LA		x						
Zeneca Inc., Bucks, AL						x		

3.2.1 Reactor Cleanout Sludge

Waste Generation

As phosphorus trichloride is produced, high boiling point impurities and solids accumulate in the reactor. Once or twice a year these accumulated impurities begin to interfere with the operation and must be removed generating reactor cleanout sludge. Five facilities reported generating this wastestream.

Waste Management

This residual is pumped from the reactor into drums for off-site incineration at Subtitle C facilities. It is always handled and incinerated off-site as a hazardous waste. **Table 3.2** presents the generated volume and the final management step used by the facilities for this wastestream in 1998.

Table 3.2 Waste Management Summary for Reactor Cleanout Sludge

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
Off-site Hazardous Waste Incineration	3	2*	22.4

*Akzo Nobel Inc. generated 0.36 MT in 1997 and Zeneca Inc. generated 44.0 MT in 1996.

Waste Characterization

Four facilities identify this wastestream as characteristically hazardous waste. This wastestream is highly reactive and carries the following hazardous waste codes: D001 (ignitability), D002 (corrosivity), D003 (reactivity), D004 (arsenic), D006 (cadmium), D007 (chromium), D008 (lead), D009 (mercury), D010 (selenium) and D011 (silver).

Results of Initial Risk Screening Analysis

This waste was not sampled and **did not warrant a risk assessment for the following reasons:**

1. **The waste exhibits one or more hazardous waste characteristics.**
2. **The waste is currently managed as hazardous from the point of generation through disposal because it is characteristically hazardous. This includes meeting applicable LDR standards.**

3.2.2 Initial Reactor Washout Water

Waste Generation

Periodically (once or twice a year) the reactor is shut down for cleaning and the accumulated phosphorus trichloride residue is removed. The emptied reactor is rinsed with water and/or steam to remove residual from the reactor walls generating reactor washout wastewater.

Waste Management

Three facilities reported that the water/sludge stream is transferred to a wastewater treatment system for neutralization and biological treatment before it is discharged under an NPDES permit. One facility reported the use of a surface impoundment in their wastewater treatment system but phosphorus trichloride wastewaters are a small portion of the total amount of wastewater treated in the surface impoundment. One facility incinerates this waste at Subtitle C facilities. **Table 3.3** presents the generated volume and the final management step used by the facilities for this wastestream in 1998.

Table 3.3 Waste Management Summary for Initial Reactor Washout Water

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
Off-site Hazardous Waste Incineration	0	1*	*
NPDES or POTW discharge	2	2**	445.0

* Rhodia Inc. generated 76,620 MT in 1997, but ceased production in 1999.
**Akzo Nobel Inc. generated 1.5 MT in 1997 and Zeneca Inc. generated 23.0 MT in 1996.

Waste Characterization

This wastestream is reactive and carries the following hazardous waste codes: D002 (corrosivity), D004 (arsenic), D006 (cadmium), D007 (chromium), and D008 (lead).

Results of Initial Risk Screening Analysis

This waste was not sampled and did not warrant a risk assessment for the following reasons:

1. The waste exhibits one or more hazardous waste characteristics.
2. One waste (23 MT generated in 1996) reportedly managed in a surface impoundment was a relatively small wastewater volume and occurred after treatment in tanks.
3. Discharges to surface water under NPDES are exempt from RCRA regulation and regulated

extensively under the Clean Water Act.

3.2.3 Final Reactor Washout Water

Waste Generation

This waste is generated by Albright & Wilson Inc. during additional reactor washing after reactor cleanout sludge removal.

Waste Management

The final reactor washout water is commingled with other wastewaters prior to wastewater pretreatment. The facility reported that it is transferred to a wastewater treatment system for neutralization before it is discharged to a POTW. The facility did not report a waste generation volume. **Table 3.4** presents the final management step used by the facility for this wastestream in 1998.

Table 3.4 Waste Management Summary for Final Reactor Washout Water

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
POTW discharge	0	1	

Waste Characterization

The facility reported this wastestream as non-hazardous.

Results of Initial Risk Screening Analysis

This waste was not sampled and did not warrant a risk assessment for the following reasons:

1. The wastewater is managed in enclosed systems. Therefore, no exposure pathway exists.
2. Discharges to POTWs are regulated extensively under the Clean Water Act and are exempt from RCRA regulations.
3. The primary constituents of concern, phosphoric acid and phosphorus acid are readily controlled via neutralization.

3.2.4 Caustic Scrubber Water

Waste Generation

Residual gases from the reactor system, storage tanks, scrubber system, etc., are scrubbed with a caustic solution to produce chlorine scrubber water. The discharge from the caustic scrubber is listed as caustic scrubber wastewater. Five facilities reported generation of caustic scrubber discharge.

Waste Management

The caustic scrubber water is sent, along with other wastewaters, to the facility's centralized wastewater pretreatment system for neutralization in tanks and then discharged to either a POTW or under an NPDES permit. One facility recycles this wastestream. **Table 3.5** presents the generated volume and the final management step used by the facilities for this wastestream in 1998.

Table 3.5 Waste Management Summary for Caustic Scrubber Water

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
POTW or NPDES discharge	3	2*	8,875

*Akzo Nobel Inc. generated 0.1 MT in 1997 and Zeneca Inc. generated 11.0 MT in 1996.

Waste Characterization

This wastestream has a pH ranging from 6 to14. The caustic scrubber water contains small amounts of the sodium hydrochloride, sodium carbonate, and residual caustic. A total concentration of arsenic, less than 1.0 ppm, may also present.

Results of Initial Risk Screening Analysis

This waste was not sampled and did not warrant a risk assessment for the following reasons:

1. The wastewater is managed in enclosed systems. Therefore, no exposure pathway exists.
2. Discharges to surface water under an NPDES permit or to POTW are exempt from RCRA regulation. Point source discharges are regulated extensively under the Clean Water Act.
3. The primary constituents of concern, phosphoric acid and phosphorous acid are readily controlled via neutralization.
4. The air pathway is not a concern because phosphorus trichloride is rapidly hydrolyzed and neither volatile contaminants nor airborne particulates are expected to be present in these wastes.

3.2.5 Process Scrubber Water

Waste Generation

Four facilities reported the generation of this wastestream. The scrubbers are designed to clean hazardous materials from vapors before release to the atmosphere. The scrubber collects phosphorus trichloride vapors from the reaction, distillation, and storage steps of the production processes, and hydrolyzes the vapors to hydrochloric acid and phosphorous acid (which may subsequently be oxidized to phosphoric acid). The quantity of phosphorus trichloride collected is dependent on the efficiency of the upstream condensers, since phosphorus trichloride is highly volatile.

Waste Management

The process scrubber water is sent for neutralization in tanks in on-site wastewater treatment systems and discharged under an NPDES permit or to a POTW. **Table 3.6** presents the generated volume and the final management step used by the facilities for this wastestream in 1998.

Table 3.6 Waste Management Summary for Process Scrubber Water

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
POTW or NPDES discharge	3	1*	10,258

*Akzo Nobel Inc. generated 2,270 MT in 1997.

Waste Characterization

This wastestream ranges in pH from 2.0 to 10.0. Only one facility, Great Lakes Chemical Corp. (formerly FMC Nitro Corp.) reported that it carries waste code D002 (corrosivity). The total concentration of arsenic is less than 0.1 ppm.

Results of Initial Risk Screening Analysis

This waste was not sampled and did not warrant a risk assessment for the following reasons:

1. The wastewater is managed in enclosed systems. Therefore, no exposure pathway exists.
2. Discharges to surface water via NPDES or to POTW are exempt from RCRA regulation. Point source discharges are regulated extensively under the Clean Water Act.
3. The primary constituents of concern, phosphoric acid and phosphorous acid are readily controlled via neutralization.
4. The air pathway is not a concern because phosphorus trichloride is rapidly hydrolyzed and neither volatile contaminants nor airborne particulates are expected to be present in these wastes.

3.2.6 Spent Filters for Product

Waste Generation

Phosphorus trichloride product is filtered before shipment to ensure there is no dirt or pipe scale in the final product and to remove PCl_4 and PCl_5. These compounds produce a slime on the product and are more viscous than the product (knowledge gained through phone conversation with facility personnel). The filters are replaced periodically (monthly). The spent filter cartridges are rinsed and allowed to dry before disposal.

Waste Management

Spent filter cartridges are washed with water and disposed of in off-site Subtitle D landfills as a nonhazardous waste. **Table 3.7** presents the generated volume and the final management step used by the facilities for this wastestream.

Table 3.7 Waste Management Summary for Spent Filters for Product

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
Off-site Subtitle D landfill	2	0	0.15

Waste Characterization

No characterization data is available.

Results of Initial Risk Screening Analysis

This waste was not sampled and did not warrant a risk assessment for the following engineering judgement reasons:

1. A very small volume is generated.
2. No contamination is expected because contaminants are easily washed with water due to their solubility.

3.2.7 Spent Filters Wash Water for Product

Waste Generation

Phosphorus trichloride product is filtered before shipment to ensure there is no dirt or pipe scale in the final product. The spent filter cartridges are rinsed with water before disposal generating spent product filter wash water.

Waste Management

The spent filter wash water is sent to the wastewater treatment system for neutralization and then to a POTW or discharged under an NPDES permit discharge. **Table 3.8** presents the generated volume and the final management step used by the facilities for this wastestream.

Table 3.8 Waste Management Summary for Spent Filter Wash Water

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
POTW or NPDES discharge	1	1*	15.0

* Rhodia Inc. did not report a volume.

Waste Characterization

One facility reported the waste as corrosive (D002). The reported total concentration of hydrochloric acid is 6,000 ppm and phosphorous acid is 4,000 ppm.

Results of Initial Risk Screening Analysis

This waste was not sampled and did not warrant a risk assessment for the following reasons:

1. The wastewater is managed in enclosed systems. Therefore, no exposure pathway exists.
5. Discharges to surface water via NPDES discharge or to POTW are exempt from RCRA regulation.
   Point source discharges are regulated extensively under the Clean Water Act.
3. The primary constituents of concern, hydrochloric acid and a phosphorous acid, are readily controlled via neutralization.

3.2.8 Process Area Wash Water

Waste Generation

Any spilled material, pad washdown and rain water are collected in the containment area generating this wastewater at Great Lakes Chemical Corp. (formerly FMC Nitro Corp.)

Waste Management

This process area wash water is sent to an on-site wastewater treatment system for neutralization and then discharged under an NPDES permit. **Table 3.9** presents the generated volume and the final management step used by the facility for this wastestream.

Table 3.9 Waste Management Summary for Process Area Wash Water

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
NPDES discharge	1	0	1,400.0

Waste Characterization

This wastestream carries hazardous waste code D002 (corrosivity). The total concentration of hydrochloric acid is 3,000 ppm and phosphorous acid is 2,000 ppm.

Results of Initial Risk Screening Analysis

This waste was not sampled and did not warrant a risk assessment for the following reasons:

1. The wastewater is managed in enclosed systems. Therefore, no exposure pathway exists.
2. Discharges to surface water via NPDES discharge are exempt from RCRA regulation. Point source discharges are regulated extensively under the Clean Water Act.
3. The primary constituents of concern, hydrochloric acid and phosphorous acid, are readily controlled via neutralization.

3.2.9 Product Storage Tank Cleanout with Nonreactive Phosphate Ester Rinse

Waste Generation

This waste is generated monthly by Great Lakes Chemical Corp. (formerly FMC Nitro Corp.) when product storage tanks or equipment are cleaned with phosphate ester. The tank or equipment is usually rinsed with a non-reactive phosphate ester creating this wastestream. Waste generated from these activities was higher than normal in 1998 due to increased tank and equipment inspections conducted under the Maintenance Integrity Program.

Waste Management

The waste is drummed for off-site incineration as a hazardous waste and sent to a Subtitle C facility. **Table 3.10** presents the generated volume and the final management step used by the facility for this wastestream.

Table 3.10 Waste Management Summary for Product Storage Tank Cleanout W/Nonreactive Rinse (phosphate ester)

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
Off-site Hazardous Waste Incineration	1	0	10.0

Waste Characterization

This wastestream carries hazardous waste codes D002 (corrosivity) and D003 (reactivity). The total concentration of phosphorus trichloride is 50,000 ppm.

Results of Initial Risk Screening Analysis

This waste was not sampled and did not warrant a risk assessment for the following reasons:

1. The waste exhibits hazardous waste characteristics.
2. The waste is currently managed as hazardous from the point of generation through disposal because it is characteristically hazardous. This includes meeting applicable LDR standards.

3.2.10 Product Storage Tank Cleanout with Water

Waste Generation

City water and/or steam are also used by Great Lakes Chemical Corp. (formerly FMC Nitro Corp.) to rinse tanks or equipment further generating wastewater. The volume of this waste in 1998 was higher than normal for the same reason as discussed in section 3.2.10.

Waste Management

This potentially acidic rinse water is sent to the wastewater treatment system for neutralization in tanks and discharged under an NPDES permit. **Table 3.11** presents the generated volume and the final management step used by the facility for this wastestream.

Table 3.11 Waste Management Summary for Product Storage Tank Cleanout with Water

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
NPDES discharge	1	0	15.0

Waste Characterization

This wastestream carries the hazardous waste code D002 (corrosivity). The total concentration of phosphorous acid is 4,000 ppm and hydrochloric acid is 4,000 ppm.

Results of Initial Risk Screening Analysis

This waste was not sampled and did not warrant a risk assessment for the following reasons:

1. The wastewater is managed in enclosed systems. Therefore, no exposure pathway exists.
2. Discharges to surface water under an NPDES permit are exempt from RCRA regulation. Point source discharges are regulated extensively under the Clean Water Act.
3. The primary constituents of concern, hydrochloric acid and phosphorous acid, are readily controlled via neutralization.

3.2.11 Wastewater Treatment Sludge

Waste Generation

The treatment of wastewaters in the wastewater treatment system generates a sludge which is periodically (~annually) removed from the system. Four facilities reported generation of this wastestream. In all cases, the phosphorus trichloride wastewater is only a small portion of the overall wastewater volume. The wastewaters generated from the PCl_3 process discharged to the WWTP make up about 1.6% at Albright and Wilson, and the RINs were reported to contain no appreciable solids. Similarly, the contribution at FMC was estimated to be 0.4%, and a minute amount at the Zeneca facility. The PCl_3 wastewater volume at Akzo Nobel was very small for wastewater (20 MT), and is also expected to have no significant impact on the total wastewater.

Waste Management

The waste is stored in containers and disposed off-site in a Subtitle C or Subtitle D landfill. **Table 3.12** presents the generated volume and the final management step used by the facility for this wastestream.

Table 3.12 Waste Management Summary for Wastewater Treatment Sludge

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
Off-site Subtitle C landfill	1	2*	520.0
Off-site Subtitle D landfill	1	0	560.0

*Akzo Nobel Inc. generated 20.0 MT in 1997 ; Albright & Wilson, Inc did not report a volume, but reported that the sludge is occasionally characteristically hazardous for D028 (dichloroethane), and the waste is then sent to a Subtitle C landfill. The dichloroethane is used in a process unrelated to the phosphorus trichloride process.

<u>Waste Characterization</u>

This waste has a pH ranging from 6.0 to 9.0 and percent solids ranging from 25.0 to 60.0. One facility reported low concentration of the following metals: barium, chromium, lead, copper, nickel, zinc and vanadium. As noted above, one facility codes the waste as characteristically hazardous sometimes due to other on-site processes.

<u>Results of Initial Risk Screening Analysis</u>

This waste was not sampled and did not warrant a risk assessment for the following reason:

1. The wastewater contribution from phosphorus trichloride process is insignificant. Therefore any constituents that are present in the sludge would not be indicative of the PCl_3 process.
2. Many wastes are managed as hazardous already.

3.2.12 Phosphorus Tank Sediment

<u>Waste Generation</u>

Akzo Nobel Chemicals, Gallipolis Ferry, WV reported the generation of this wastestream in 1997. This waste is the inert sediment and contaminants from the raw material.

<u>Waste Management</u>

This waste is accumulated on a storage pad and shipped to off-site recovery. **Table 3.13** presents the generated volume and the final management step used by the facility for this wastestream.

Table 3.13 Waste Management Summary for Phosphorus Tank Sediment

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
Off-site Recovery	0	1	0.93 (1997)

<u>Waste Characterization</u>

This wastestream carries hazardous waste codes D001 (ignitability), D002 (corrosivity) and D004 (arsenic).

<u>Results of Initial Risk Screening Analysis</u>

This small volume waste was not sampled and did not warrant a risk assessment because it is recycled and there is no potential for release to the environment. These wastes are also currently coded as hazardous, if disposed.

3.2.13 Phosphorus Water

<u>Waste Generation</u>

Akzo Nobel Chemicals, Gallipolis Ferry, WV reported the generation of this wastestream in1997. Phosphorus water is a recycled water layer under which the elemental phosphorus raw material is transported and transferred to and from storage vessels.

Waste Management

Phosphorus transfer water is returned to the supplier by railcar for material recovery. **Table 3.14** presents the generated volume and the final management step used by the facility for this wastestream.

Table 3.14 Waste Management Summary for Phosphorus Water

Final Management	# of Wastestreams with Reported Volumes	# of Wastestreams with Unreported Volumes	Total Volume (MT/yr)
Off-site Recovery	0	1	0.36 (1997)

Waste Characterization

No characterization data is available.

Results of Initial Risk Screening Analysis

This small volume waste was not sampled and did not warrant a risk assessment because it is returned to the raw material producer for recovery and there is no significant potential for release to the environment.

APPENDIX A

Summary of Waste Generation and Management

Wastestreams	Facility	Waste Volume (MT/yr)	Hazardous Waste #	Final Management Step
Reactor Cleanout Sludge	Albright & Wilson, Inc.	8.0	D002, D003, D004, D006, D007, D008, D010, D011	Off-site Hazardous Waste Incineration
	FMC Corp.	14.0	D001, D002, D003, D004, D006, D007	
	Rhodia, Inc.	0.4	D002, D004, D006, D007, D008, D009, D011	
	Zeneca, Inc.	44.0 (1996)	D001, D002, D003, D004	
	Akzo Nobel, Inc	0.36 (1997)	NR	
Initial Reactor Washout Water	Akzo Nobel, Inc.	9.7 (1997)	NR	NPDES discharge
	FMC Corp.	52.0	D002, D004, D006, D007	NPDES discharge
	Rhodia, Inc.	76,620 (1997)	D002, D004, D006, D007, D008	Off-site Hazardous Waste Incineration
	Monsanto Luling, Inc.	393.0	D004, D007	NPDES discharge
	Zeneca, Inc.	23.0 (1996)	D002, D004	NPDES discharge
Final Reactor Washout Water	Albright & Wilson, Inc.	NR	NR	POTW discharge
Caustic Scrubber Water	Akzo Nobel, Inc.	0.1 (1997)	NR	Recycling
	Albright & Wilson, Inc.	2,352	NR	POTW discharge
	Monsanto Luling, Inc.	1,873	NR	NPDES discharge
	Rhodia, Inc.	4,650	NR	POTW discharge
	Zeneca, Inc.	11 (1996)	NR	NPDES discharge

Wastestreams	Facility	Waste Volume (MT/yr)	Hazardous Waste #	Final Management Step
Process Scrubber Water	Akzo Nobel, Inc.	2,270 (1997)	NR	NPDES discharge
	Albright & Wilson, Inc.	3,985	NR	POTW discharge
	FMC Corp.	300.0	D002	NPDES discharge
	Monsanto Luling, Inc.	5,973	NR	NPDES discharge
Spent Product Filters	FMC Corp.	0.1	NR	Disposal off-site Subtitle D landfill
	Rhodia, Inc.	30 bags	NR	
Spent Product Filter Wash Water	FMC Corp.	15.0	D002	NPDES discharge
	Rhodia, Inc.	NR	NR	POTW discharge
Phosphorus Contaminated Material	Monsanto Luling, Inc.	4.0	D001	Off-site Hazardous Waste Incineration
Process Area Wash Water	FMC Corp.	1,400	D002	NPDES discharge
Product Storage Tank Cleanout with Nonreactive Phosphate Ester	FMC Corp.	10.0	D002, D003	Off-site Hazardous Waste Incineration
Product Storage Tank Cleanout with Water	FMC Corp.	15.0	D002	NPDES discharge
Wastewater Treatment Sludge	Akzo Nobel, Inc.	20.0 (1997)	NR	Disposal off-site Subtitle C landfill
	FMC Corp	560.0	None	Disposal off-site Subtitle D landfill
	Zeneca, Inc.	520.0	None	Disposal off-site Subtitle C landfill
	Albright &Wilson, Inc.*	NR	NR	Disposal off-site Subtitle C landfill
Phosphorus Tank Sediment	Akzo Nobel, Inc.	0.93 (1997)	D001, D002, D004	Off-site Recovery
Phosphorus Water	Akzo Nobel, Inc.	0.36 (1997)	NR	Off-site Recovery

*Reported that the sludge is occasionally characteristically hazardous for D028 (dichloroethane), and the waste is then sent to a Subtitle C landfill. The dichloroethane is used in a process unrelated to the phosphorus trichloride process.