INORGANIC HYDROGEN CYANIDE
LISTING BACKGROUND DOCUMENT
FOR THE
INORGANIC CHEMICAL LISTING DETERMINATION

August 2000

U.S. ENVIRONMENTAL PROTECTION AGENCY
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1. SECTOR OVERVIEW

1.1 Sector Definition, Facility Names and Locations

Hydrogen cyanide (HCN) is produced in the United States by 10 manufacturers through the Inorganic (Andrussow and Blausaure-Methan-Ammoniak (BMA)) process. **Table 1.1** presents the names and locations of the HCN producers[1]. **Figure 1.1** shows the geographical location of the facilities on a U.S. map. The numbers on the map correspond to the facility numbers in Table 1.1.

Table 1.1 Hydrogen Cyanide Producers

Facility Number	Facility Name	Facility Location	Production Process
1	Cyanco	9000 West Jungo Road 5505 Cyanco Drive (Mailing) Winnemucca, NV 89554	Inorganic (Andrussow) process
2	DeGussa-Huls Corp. (DeGussa-Huls)	4201 DeGussa Road PO Box 606 Theodore, AL 36590	Inorganic (BMA) process
3	Dow Chemical Co., Versene Facility (Dow)	2301 North Brazosport Boulevard Freeport, TX 77541-3257	Inorganic (Andrussow) process
4	E.I. DuPont de Nemours & Company, Inc. Memphis Plant (DuPont Memphis)	2571 Fite Road Memphis, TN 38127	Inorganic (Andrussow) process
5	E.I. DuPont de Nemours & Company, Inc. Sabine River (DuPont Sabine)	Farm Road 1006 PO Box 1089 Orange, TX 77630	Inorganic (Andrussow) process
6	E.I. DuPont de Nemours & Company, Inc. Victoria Plant (DuPont Victoria)	Old Bloomington Road PO Box 2626 Victoria, TX 77902-2626	Inorganic (Andrussow) process
7	FMC Corp., Green River (FMC)	580 Westvaco Road PO Box 872 Green River, WY	Inorganic (Andrussow) process
8	Novartis Crop Protection, Inc. (Novartis)	3905 Highway 75 PO Box 11 St. Gabriel, LA 70776	Inorganic (Andrussow) process

[1] Environmental Protection Agency, RCRA 3007, Survey of Inorganic Chemicals Industry

Table 1.1 Hydrogen Cyanide Producers (continued)

Facility Number	Facility Name	Facility Location	Production Process
9	Rhone-Poulenc Rhodimet Unit (Rhone-Poulenc)	Route 25 PO Box 2831 Charleston, WV 25330	Inorganic (Andrussow) process
10	Rohm and Haas Texas, Inc. (Rohm and Haas)	600 La Porte Freeway PO Box 672 Deer Park, TX 77536	Inorganic (Andrussow) process

This listing determination is for the inorganic HCN manufacturing process. HCN production as a byproduct of acrylonitrile manufacturing (also referred to as the Sohio process) will not be addressed, since this type of production is directly linked to organic chemicals manufacturing and has already been subjected to a listing determination (K011 - Bottom stream from the wastewater stripper in the production of acrylonitrile; K013 - Bottom stream from the acetonitrile column in the production of acrylonitrile; and K014 - Bottoms from the acetonitrile purification column in the production of acrylonitrile). The facilities that produce HCN utilizing the Sohio process were sent RCRA §3007 questionnaires to confirm that they manufacture HCN utilizing an organic process.

1.2 Products, Product Usage and Markets

Hydrogen cyanide is a highly volatile liquid which produces poisonous vapors at room temperature, has a molecular formula of HCN, and has a molecular weight of 27.03 grams/mol (g/mol). Hydrogen cyanide melts at -13.2 degrees Celsius (^{o} C) and boils at just above 25 ^{o} C.

HCN is also known as: hydrocyanic acid, prussic acid, and formonitrile. It is a colorless, poisonous, low viscosity liquid having an odor characteristic of almonds. The production of HCN has the following uses: adiponitrile (for nylon 6/6), 41%; acetone cyanohydrin (for methyl methacrylate), 32%; sodium cyanide, 14%; methionine, 4%; chelating agents, 3%; miscellaneous, including cyanuric chloride and nitrilotriacetic acid and salts, 6%.[2]

[2] ChemExpo Home Page, www.chemexpo.com/news/PROFILE981123.cfm

Figure 1.1 Geographical Distribution of Inorganic Hydrogen Cyanide Producers [1]

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

The historical market for HCN has shown a growth of approximately 3 percent per year in the period spanning the years 1988-1997. Future growth of the market from the present time until the year 2002 is expected to continue at the rate of approximately 2 percent per year. Market demand for this product was approximately 1.44 billion pounds in 1998. [3]

1.3 Production Capacity

As of November 1998, the production capacity of Hydrogen Cyanide via the Andrussow and BMA processes in the United States was approximately 1.42 billion pounds per year.[4] **Table 1.2** shows how this production capacity is split among the 10 production facilities.

Table 1.2 Hydrogen Cyanide Production Capacity

Facility Name	Facility Location	Capacity (10^6 lbs/yr)[1]
Cyanco	Winnemucca, NV	48
DeGussa-Huls	Theodore, AL	76
Dow, Versene Facility	Freeport, TX	20
DuPont Memphis	Memphis, TN	220
DuPont Sabine	Orange, TX	320
DuPont Victoria	Victoria, TX	400
FMC Green River	Green River, WY	33
Novartis	St. Gabriel, LA	90
Rhone-Poulenc Rhodimet Unit	Charleston, WV	15
Rohm and Haas	Deer Park, TX	200

1.4 Production, Product and Process Trends

Recent U.S. expansions in methyl methacrylate have been based on the acetone cyanohydrin route, which requires HCN as a feedstock. Growth in sodium cyanide has been driven by new mines using more NaCN and older ones using cyanide heap leaching to extract gold from lower-grade ores. Methionine, although a small part of HCN's overall end-use pattern, has grown rapidly and the U.S. has become a net exporter. Alternate routes to some of HCN's derivatives subtract from growth. Only

[3] Ibid

[4] Ibid

one of the two U.S. adiponitrile producers uses HCN in its process.

Overall demand for HCN should continue to grow depending on performance of nylon 6/6 and methyl methacrylate going into consumer end products. Strong exports of adiponitrile and sodium cyanide have been key growth factors for HCN in recent years.

2. DESCRIPTION OF MANUFACTURING PROCESS

The Andrussow process flow diagram is presented in **Figure 2.1**. The inorganic manufacturing of HCN is via the Andrussow process also known as the direct process, and is described in **Section 2.1**. There are variations on the Andrussow process that are determined by HCN use and ammonia management. These variations are discussed in **Section 2.2**.

2.1 Andrussow Process

HCN Conversion

The first step in the Andrussow Process is the conversion of air, ammonia and natural gas into HCN. Filtered ammonia, natural gas and air are fed into a reactor and heated in the presence of a platinum and rhodium catalyst to 2,200 ^{o} C. The reaction is:

$$2NH_3 + 2CH_4 + 3O_2 = 2HCN + 6H_2O$$

The reactor off-gas containing HCN and un-reacted ammonia are quenched in a waste heat boiler to approximately 350 ^{o} C. The HCN conversion process generates used feed gas and process air filters. Additionally, the catalyst is replaced approximately every 18-24 months.

Ammonia Absorption

The cooled reactor off-gas is sent through an ammonia absorption process to remove un-reacted ammonia. This is accomplished by the addition of either ammonium phosphate solution, phosphoric acid or sulfuric acid to remove the ammonia, which is then sent to an ammonia recovery system (see ammonia recovery and purification). In general, this step does not generate any wastes.

HCN Absorption

From the ammonia absorber the product off-gas is sent through the HCN absorber where cold water is added to entrain the HCN. The excess un-reacted gases are sent to flare. In general, this step does not generate any wastes.

HCN Purification

The HCN-water mixture is then sent to a cyanide stripper where excess waste is removed from the liquid. In addition, the HCN-water mixture may also be sent through a fractionator to concentrate the HCN before the product is stored in tanks or directly used as a feedstock. This HCN purification step produces wastewaters that are sent to wastewater treatment or are recycled back to the HCN absorption step. HCN product storage in tanks may also generate sediments or sludges.

Ammonia Recovery and Purification

The ammonia recovery and purification system receives wastewater from the ammonia absorber which is stripped to remove ammonia. The system consists of a steam stripper and a fractionator. From the stripper, the overhead containing water and ammonia is condensed and sent to a fractionator where additional water is removed. This wastewater is sent to wastewater treatment and the ammonia is recycled back to the reactor feed. The stripper bottoms may be recycled to the ammonia absorber. Some facilities produce a byproduct from their ammonia recovery system instead of recovering the ammonia and recycling it back to the reactor. Two byproducts are generated by different facilities: ammonia sulfate and ammonia phosphate, both used as fertilizers.

Wastewater Treatment

The wastewater treatment at the 8 facilities that treat HCN purification wastewaters, ammonia purification wastewaters, in addition to other miscellaneous wastewaters generated during the process includes neutralization, biological treatment, alkaline-chlorination, and ozone treatment. The biological treatment process can produce biological treatment solids.

2.2 Variations to the Andrussow Process

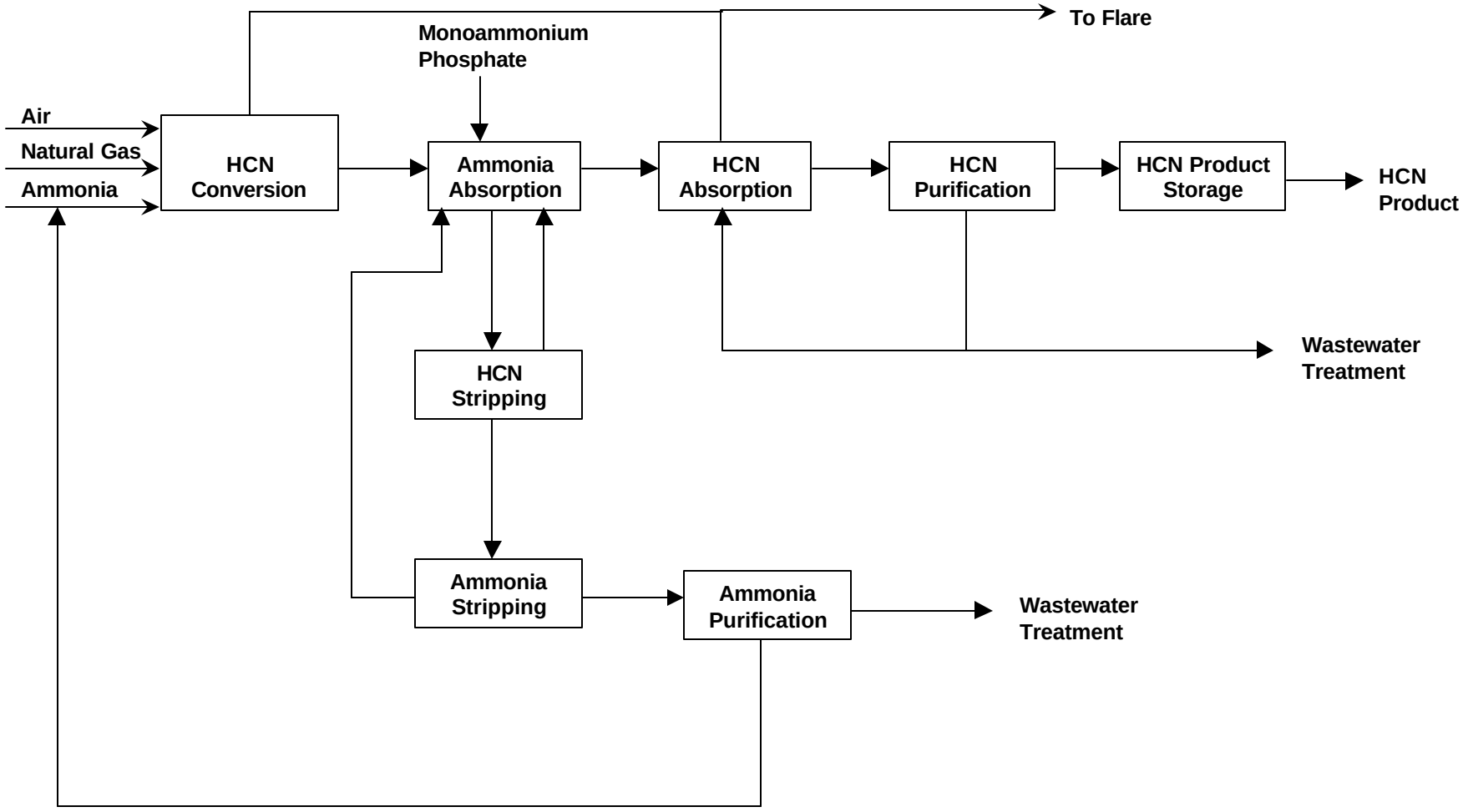
Sodium Cyanide (NaCN) Production

The production of NaCN follows the Andrussow process through the HCN conversion step using the same three feedstocks i.e., ammonia, natural gas and air, sent through a platinum/rhodium catalyst to produce HCN. However, the liquid product is immediately reacted with NaOH to produce NaCN, which is then used as a feedstock. Therefore, there are no process wastewaters generated and no ammonia recovery system or byproducts generated.

Blausaure-Methan-Ammoniak (BMA) Process

The BMA process was developed by DeGussa-Huls and involves the reaction of ammonia with methane without air. The reaction is carried out in tubes that are heated externally. After removal of the un-reacted ammonia and recovery of HCN, the waste gas is essentially pure hydrogen suitable for other uses.

Figure 2.1 Process Flow Diagram for Inorganic Hydrogen Cyanide



* The BMA process does not use air.

3. WASTE GENERATION AND MANAGEMENT

Section 3.1 presents a detailed discussion of the production steps that generate the wastes, the management steps for the wastes, a characterization of the physical and chemical properties of the wastes, and results of initial screening analysis. **Section 3.2** describes several waste categories that are outside the scope of the consent decree. **Appendix A** presents a complete summary of the wastes generated at each of the facilities and their management.

3.1. Summary of Waste Generation Processes

Wastes generated from the production of hydrogen cyanide consist of various types of wastewater, various types of spent filter media, spent catalyst, biological solids from wastewater treatment, and ammonium salts. **Table 3.1** presents a summary of the waste categories generated by facility.

Table 3.1 Wastes Generated From the Production of Inorganic Hydrogen Cyanide [1]

Facility	Commingled Wastewaters	Ammonia Recycle Cartridge and Spent Carbon Filters	Biological Wastewater Treatment Solids	Feed Gas Cartridge and Spent Carbon Filters	Process Air Cartridge Filters	Acid Spray Cartridge Filters	Spent Catalyst	Ammonia Sulfate and Ammonium Phosphate
Cyanco				x	x		x	
DeGussa-Huls	x		x	x			x	x
Dow	x			x	x		x	
DuPont Memphis	x	x		x	x		x	
DuPont Sabine	x	x			x		x	
DuPont Victoria	x	x		x		x	x	x
FMC				x	x		x	
Novartis	x	x	x		x		x	
Rhone-Poulenc	x		x		x		x	x
Rohm and Haas	x	x	x	x	x		x	

x - Facility generates this waste

1 - A facility may generate more than one waste per category

Facility	Miscellaneous Wastewaters	HCN Polymer and Sump Waste	Sludge from Wastewater Collection Tank	HCN Storage Tank Solids	Wastewater Filters	Ammonium Sulfate Filters	Spent Ammonium Phosphate	Organic Layer from Wastewater Collection Tank
Cyanco								
DeGussa-Huls	x	x				x		
Dow								
DuPont Memphis	x			x				
DuPont Sabine								
DuPont Victoria			x		x			
FMC								
Novartis	x						x	
Rhone-Poulenc								
Rohm and Haas	x		x					x

x - Facility generates this waste

1 - A facility may generate more than one waste per category.

3.2.1 Commingled Wastewaters

Waste Generation

The commingled wastewaters consist of HCN purification wastewaters and ammonia purification wastewaters. These wastewaters are commingled along with other miscellaneous waste (discussed separately, see Section 3.2.9) In addition, at all facilities that generate wastewaters, the HCN process wastewaters are commingled and managed with non-HCN process wastewaters.

HCN Purification Wastewaters

HCN purification wastewaters are generated when the HCN-water mixture from the reactor is sent through a stripper to remove excess water. Some facilities generate this wastewater as a discrete waste and others pipe this wastewater back to the HCN absorber for reuse.

Ammonia Purification Wastewaters

Ammonia purification wastewaters are generated when the reactor off-gases are mixed with either ammonium phosphate, phosphoric acid or sulfuric acid to remove the un-reacted ammonia which is then stripped of ammonia. The resultant wastewater from the stripper is the ammonia purification wastewater.

Waste Management

The commingled wastewaters are all treated in on-site wastewater treatment processes before being discharged under a National Pollutant Discharge Elimination System (NPDES) permit, to a Publically-Owned Treatment Works (POTW), or via deep-well injection. The wastewaters are treated using one or more of the following operations:

- steam stripping to remove cyanide and ammonia, with off-gases vented to flares, scrubbers or incinerators;
- pH adjustment;
- aerated or non-aerated biological treatment in tanks or lined/unlined surface impoundments;
- ozone treatment;
- oxychlorination; and
- settling in surface impoundments.

Table 3.2 presents a summary of the management practices used by the facilities for commingled wastewaters and reported waste volumes.

Table 3.2 Waste Management Summary for Commingled Wastewaters

Facility	Waste (RIN #)	Management	Total Volume (MT/yr)
DeGussa-Huls	801 Emergency Tank (RIN 17)	pH adjustment, aerated biological treatment in lined concrete tank and double lined surface impoundment with leak detection and leachate collection system, NPDES discharge	43,800
	810 Wastewater Tank (RIN 18)		131,400
	811 Wastewater Tank (RIN 19)		13,000
	HCN Wastewater Pit (RIN 21)		22,000
	501 Blowdown (RIN 22)		26,000
	Centrifuge Purge (RIN 23)		8,760
	Amsul Plant Sump (RIN 501)		15,700
Dow	Wastewater to Centralized WWTP (RIN 1)	pH adjustment, steam stripping, biological treatment in tanks, NPDES discharge	115,000
DuPont Memphis	HCN Refining Stripper Bottoms (RIN 2)	pH adjustment, oxychlorination, settling in unlined surface impoundments, discharge to POTW	3,718,722 (1997)
	Ammonia Recovery Rectifier Bottoms (RIN 4)		172,265 (1997)
DuPont Sabine River	HCN Stripper Tails Purge (RIN 1)	Filtered, deep-well injection in Class I well with approved RCRA no-migration petition	350,000
	Ammonia Enricher Tails (RIN 2)		180,000
DuPont Victoria	Ammonia Enricher Tails (RIN 1)	Filtered, deep-well injection in Class I well with approved RCRA no-migration petition	303,000
Novartis	APS Purge (RIN 10)	pH adjustment and oxychlorination in tanks, NPDES discharge	65,000
	Ammonia Enricher Blowdown (RIN 12)		8,200
Rhone-Poulenc	Rhodimet Wastewater (RIN 1)	pH adjustment and ozone treatment in tanks, NPDES discharge	33,409
Rohm and Haas	HCN Purification Wastewater (RIN 1)	Steam stripping, pH adjustment, aerated biological treatment in an unlined surface impoundment, NPDES discharge	298,300
	Ammonia Purification Wastewater (RIN 2)		89,500
		Total	5,594,056

Table 3.3 Wastewater Record Samples

Facility	HCN Purification Wastewater	Ammonia Purification Wastewater	Commingled HCN Process Wastewaters	Commingled HCN Process Wastewaters Inlet to Surface Impoundment	Commingled HCN Process Wastewaters Outlet from Surface Impoundment	Wastewater to Wastewater Stripper	Wastewater from Wastewater Stripper	Effluent from Wastewater Treatment Plant
DeGussa-Huls	DG-1-HC-03	DG-1-HC-04	DG-1-HC-07					DG-1-HC-11
DuPont Memphis	DM-1-HC-01	DM-1-HC-03		DM-1-HC-07 DM-2-HC-07	DM-1-HC-08 DM-2-HC-08			
Rohm and Haas	RH-1-HC-01	RH-1-HC-06		RH-1-HC-04		RH-1-HC-02	RH-1-HC-03	

Waste Characterization

Three record samples of HCN purification wastewaters and ammonia purification wastewaters were collected. In addition, nine record samples of commingled wastewaters were collected. **Table 3.3** describes the wastewater samples collected and their corresponding sample numbers. The complete record sampling analytical results for each sample can be found in the sampling and analytical data reports listed below and included in the docket as separate documents. These reports contain all pertinent data validations and quality control information.

Sampling and Analytical Data Report for Record Sampling and Characterization of Wastes from the Inorganic Hydrogen Cyanide Manufacturing Sector; E.I. DuPont de Nemours & Co., Inc., Memphis, TN; August 12, 1999

Sampling and Analytical Data Report for Record Sampling and Characterization of Wastes from the Inorganic Hydrogen Cyanide Manufacturing Sector; E.I. DuPont de Nemours & Co., Inc., Memphis, TN; October 26, 1999

Sampling and Analytical Data Report for Record Sampling and Characterization of Wastes from the Inorganic Hydrogen Cyanide Manufacturing Sector; Rohm & Haas Texas, Deer Park, TX; July 28, 1999

Sampling and Analytical Data Report for Record Sampling and Characterization of Wastes from the Inorganic Hydrogen Cyanide Manufacturing Sector; Rohm & Haas Texas, Deer Park, TX; November 16, 1999

Sampling and Analytical Data Report for Record Sampling and Characterization of Wastes from the Inorganic Hydrogen Cyanide Manufacturing Sector; Degussa-Huls, Theodore, AL; August 26, 1999

Appendix A presents a comparison of EPA sample and facility-provided split sample data results.

Because HCN purification and ammonia purification wastewaters are commingled with other non-HCN wastewaters prior to treatment and management in on-site surface impoundments at each of the three facilities that were investigated, the samples that were assessed in the initial screening were the samples that represent the commingled wastewaters in these surface impoundments. These samples are numbered as follows: DM-1-HC-08, RH-1-HC-04, and DG-1-HC-07. **Table 3.4** presents the applicable analytical data used for initial screening. Only detected constituents are shown. A second round of analysis was conducted at DuPont Memphis resulting in additional analytical results, also included in **Table 3.4** (DM-2-HC-08).

The MCL is 0.2 for free cyanide. The HBL for free cyanide is 0.3. We are assuming the analytical results for amenable cyanide represent mainly free cyanide (although some metal cyanide complexes may be also be amenable to chlorination). We are assuming the appropriate risk assessment input

would be our amenable cyanide results and that these results adequately reflect free cyanide concentrations.

Results of Screening Analyses

The three facilities that use surface impoundments were assessed individually, as described further below. **Table 3.4** compares the analytical results for detected constituents with the corresponding HBLs.

Rohm and Haas

Summary

An initial screening analysis of the Rohm and Haas commingled wastewaters managed in the on-site surface impoundment was conducted by comparing the analytical results for sample RH-1-HC-04 to the health-based levels (HBLs) for detected constituents. This initial screening showed that all constituents detected in Rohm and Haas' wastewater are either below the HBLs or are derived from non-HCN wastewaters commingled with the targeted wastes (e.g., acetone). Therefore, the Rohm and Haas unlined surface impoundment scenario did not warrant further assessment.

Detailed Analysis

Acetone was detected in the commingled wastewater entering the surface impoundment at levels exceeding the HBL and it was also detected in one of the upstream process wastewaters. However, EPA believes this constituent is derived from non-HCN wastewaters from two separate sources of other on-site organic chemical processes that are commingled with the HCN wastewaters. The HCN wastewaters, which consist of HCN Purification Wastewater (RIN 1) and Ammonia Purification Wastewater (RIN 2), showed low levels of acetone prior to commingling with non-HCN wastewaters of 4 mg/L and 0.005 mg/L, respectively. After the first commingling with non-HCN wastewater, the acetone concentration increases to 240 mg/L (Wastewater to Stripper, RH-1-HC-02) and then drops to 0.1 mg/L after processing in the stripper (Wastewater from Stripper, RH-1-HC-03), which is designed to remove cyanide and ammonia. After the second commingling with non-HCN wastewaters, the acetone level increases from 0.1 mg/L to 50 mg/L prior to the surface impoundment. Therefore, EPA is assuming that the bulk of the acetone loading in the commingled wastewater cannot be attributed to HCN manufacture.

A number of other toxicant constituents shown in Table 3.4 (arsenic, benzene, lead, 4-methyl-2-pentanone, and methacrylonitrile) were detected in R&H's wastewater inlet at levels close to or exceeding HBLs. However, these constituents were not detected in any of the upstream HCN process wastewaters that we sampled (RH-1-HC-01 and RH-1-HC-06), except for low levels of 4-methyl-pentanone in sample RH-1-HC-06. However, the level of this chemical in sample RH-1-HC-06 (0.01 mg/L) was an order of magnitude lower than the level measured in RH-1-HC-04 (and also below the HBLs), which indicates no significant levels of this constituent are derived from the HCN process. Therefore, these constituents of concern are not associated with the HCN process.

DuPont Memphis

Summary

The facility and its surface impoundments are sited on the banks of the Loosahatchie River. The surface impoundments are located approximately 800 feet from the river. Based on information available in the Remedial Facility Investigation (RFI),[5] the direction of the groundwater flow is documented to be south towards the Loosahatchie River. The possibility of a public water supply well or private well being located down gradient of the Tennessee surface impoundments is unlikely because the facility boundary extends to the river to the south. Hence, based on the geologic setting of the facility as detailed above, we believe it is highly unlikely that these impoundments could impact drinking water wells via migration of a contaminated groundwater plume. Based on these facts we did not assess the groundwater-to-drinking water well pathway further at this site.

We did, however, conduct a screening analysis of potential releases of groundwater to surface water and subsequent exposure via ingestion because of the proximity of the unit to the river. We calculated the concentrations in the river that would result from discharge of contaminated groundwater by estimating the infiltration rate for the unlined impoundment and diluting the resulting leachate volume into the river under various flow conditions. The results of this screening level analysis demonstrate that concentrations of the constituents of concern in the river would be well below the aquatic life AWQC and HBLs for drinking water. The methodology and detailed results of the screening analysis are presented in *Risk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes* (August 2000) in the docket for today's proposal.

Detailed Analysis

Some of the analytical results in the first round of sampling at DuPont Memphis on August 12, 1999 are qualified due to holding time exceedences.[6] We re-sampled this waste category at DuPont[7] on October 26, 1999 (sample DM-2-HC-08).

In discussions with DuPont regarding differences in our split results for cyanide, DuPont noted that their samples were preserved and analyzed differently than ours, with the purpose of their method being to halt the oxychlorination destruction of CN (the treatment technology they employ in the WWT system). Their split-sample results for total cyanide are consistently higher than ours, as expected, because they represent a snapshot of the waste in the impoundment at the time of sampling, and the oxychlorination

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[5] U.S. EPA Phase II RFI Workplan, Potentiometric Surface Plan, March 3 & 4, 1999.

[6] The results reported on 10/18 for amenable cyanide were qualified as K, "estimated results with high bias". The determination of the "non-amenable" portion of this analysis was made outside the holding time, resulting in a possible underestimate of the amount of "non-amenable" cyanide. Because this value is then subtracted from the total cyanide results to calculate "amenable cyanide", the overall amenable value is estimated high.

[7] These samples were re-analyzed for total and amenable CN, as well as volatiles, pH, and % solids, and were collected at the inlet and outlet of the 8-hr basins.

process may have continued in our samples. This pattern does not hold, however, for the amenable results. It is unclear whether this difference is due to the holding time problems with our amenable analysis or DuPont's preservatives.

In our second round of sampling at the DuPont, Memphis facility, we collected two sample volumes of the wastewaters, one of which was preserved using our standard SW-846 preservatives, and the other which was preserved using $Na_2S_2O_3$ (DuPont's standard method). Using the DuPont technique provided us with (1) a split sample that is directly comparable to DuPont's, and (2) worst case results that may not be as sensitive to holding times.

The DuPont Memphis commingled wastewater analytical results (DM-1-HC-08 and DM-1-HC-08) were compared directly to the drinking water HBLs and Ambient Water Quality Criteria (AWQC) as a first level screening analysis (see Table 3.4). The following constituents exceeded the HBLs or AWQC in one or both of these samples: acetonitrile, acrylonitrile, carbon tetrachloride, chloroform, cyanide, dibromochloromethane, methylene chloride, vinyl chloride, iron, nitrite, copper and lead.

Acetonitrile was detected at 50 mg/L in DM-1-HC-08, but qualified as estimated by the laboratory due to interferences. DuPont's split-sample results were about half our detected levels. Our detected levels are consistent in our three related DuPont samples, and we also found it in the DeGussa sample. Thus, we used the detected concentration, despite its qualification, because (1) DuPont's split is within the same order of magnitude, (2) other samples of comparable wastes also contain acetonitrile, (3) samples of the upstream HCN wastewaters at DuPont, Rohm&Haas and Degussa also contained acetonitrile at comparable or higher levels.
Low levels of acetonitrile were detected in the DuPont trip blank (1 ppm). We do not believe these levels are significant given the much higher levels detected in the wastes themselves.

We evaluated exit concentrations for DuPont's surface impoundment as the most representative concentration to model in groundwater. However, the difference between inlet and exit concentrations are not dramatic, and would not significantly affect the screening results.

DuPont has submitted information regarding the lack of groundwater receptors. However, we conducted a second level screening analysis for possible releases to surface water for those constituents that did not screen out in the first level HBL/AWQC screen. We reviewed this information, as well as the RFI/RFA[8] documents, to determine the most appropriate hydrogeologic parameters to model. From the existing documents, we assumed that any plume from the impoundments intercepts the adjacent river via the shallow aquifer.

This analyses is based on the subsurface migration of wastewaters from the 8-hour surface impoundment at DuPont-Memphis discharging directly into the Loosahatchie River. Thus, the estimated seepage rate under the impoundment was diluted directly into the river water. Seepage rates were calculated for two soil types: silt clay loam and silt loam. Although the subsurface soils are

[8]U.S. EPA Phase II RFI Workplan, Potentiometric Surface Plan, March 3 & 4, 1999

described in the RFI as clayey silt and silty clay, a soil permeability (saturated hydraulic conductivity) corresponding to a silt clay loam was used to account for the expected natural heterogeneity of alluvial soils. The higher soil permeability corresponding to silt loam is considered a bounding condition.

The results of this screening level analysis suggest that concentrations of the constituents of concern in the river would be well below the aquatic life AWQC and HBLs for drinking water. The details of the screening analysis are presented in *"Risk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes"* in the docket.

DeGussa-Huls

Summary

An initial screening analysis of the Degussa-Huls commingled wastewaters was conducted by comparing the analytical results for sample DG-1-HC-07 to the HBLs for detected constituents (see **Table 3.4**). This initial screening identified two constituents of concern: acetonitrile and cyanide. DeGussa-Huls reported in a letter to EPA[9] that the volume associated with the sample point is 20,800 MT/yr, and that the total waste volume managed in the equalization basin is 748,300 MT/yr, resulting in a dilution ratio of 36. Sample DG-1-HC-07 was collected directly from the equalization tank for the commingled HCN process wastewater. After the HCN process wastewater leaves the neutralization tank, it is commingled with process wastewater from other on-site non-HCN process wastewaters prior to the point in the wastewater treatment system where the combined HCN and non-HCN wastewater is placed in the equalization basin. Levels of all constituents of concern (including cyanide) are below HBLs in the combined HCN/non-HCN wastewater, except for acetonitrile. The equalization basin is double-lined with a leachate collection system. A study of existing wells near the facility indicates the presence of private water wells within a one-mile radius of the property boundary. See Appendix B in *Risk-Based Corrective Action Plan for the Sodium Cyanide Production Unit at Degussa Corporation; Theodore, Alabama; March 19, 1998.* This surface impoundment scenario warranted further assessment of acetonitrile. For details and the results of this assessment see *Risk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes (August 2000)* available in the docket for this proposal.

Detailed Analysis

The DeGussa facility manages wastewater in a series of surface impoundments and tanks that provide equalization, oxidation, maturation, rock-reed filtration, and mixing. In addition, the facility has an emergency holding basin which has also been used for HCN process wastewaters. The surface impoundments are equipped with double synthetic liners with leachate detection and collection systems. The oxidation basin is a concrete-lined structure with an additional synthetic liner. Our analytical data indicates that concentrations at the inlet to the impoundments would exceed the HBLs for one

[9]April 21, 2000 letter from DeGussa-Huls to M. Diaz (EPA); RE: Response to EPA Letter Requesting Additional Information dated April 18, 2000

constituent of concern (acetonitrile). A study of existing wells near the facility indicates the presence of private water wells within a one-mile radius of the property boundary. We therefore assessed these units further for potential releases to groundwater.

The DeGussa's surface impoundments are located in the center of an industrial park on the west side of Mobile Bay. The wastewater treatment impoundments are located near the eastern property boundary of the facility and approximately 4,000 feet south of the State of Alabama barge canal. We chose to assess surface water risks at the Tennessee facility, which is closer to a surface water body. However, given the use of groundwater in the area around the Alabama facility, we assessed the possible impact on drinking water wells. We selected the equalization basin as the unit for quantitative modeling. This is the first surface impoundment in the series and is likely to hold the highest level of constituents of concern. We elected not to assess the emergency holding pond, which is used primarily during high stormwater events. Due to the intermittent use of the holding pond, we expect the potential for significant groundwater releases to be greater for the equalization pond. In addition, the equalization pond is covered with a floating synthetic membrane, while the holding pond is not.[10] Our modeling of the covered equalization pond did not assume any loss of the volatile constituents of concern, thus allowing more of the constituents to infiltrate to the groundwater rather than volatilize to the air.

We did not model the biological treatment unit because we believe the equalization unit would pose more risk. The concentrations in the equalization pond will be higher than in this unit, as evidenced by the sampling and analysis data downstream of the biological treatment unit (which screened out). Thus the concentrations in the equalization impoundment are likely to be much greater than in the biological treatment unit. Also, the equalization pond is bigger than the biounit (1,700 m^2 vs 1,200 m^2), and the biological treatment unit is concrete-lined, making any release to groundwater less likely.

Based on information available in a corrective action plan related to a product spill on-site (*Risk-Based Corrective Action Plan for the Sodium Cyanide Production Unit at DeGussa Corporation Alabama Facility, Theodore, Alabama*; March 19, 1998), the most likely direction of groundwater flow is to the low-lying areas to the north-northeast of the surface impoundments. We found there are drinking water wells located due east of the equalization surface impoundment. Although the wells are located east of the surface impoundment instead of the estimated north-northeast groundwater flow direction, they are at somewhat lower ground elevation than the surface impoundment. Given the uncertainty in the direction of the groundwater flow, we assumed that contaminated groundwater from the surface impoundment could migrate to the east and reach these wells. Based on the available land use and groundwater use information for this area, we performed risk modeling for potential releases to drinking water wells located between 3,100 and 5,280 feet east of the surface impoundment. The minimum distance of 3,100 feet is based on the distance from the impoundment to the eastern boundary of the industrial area controlled by the facility. The maximum distance of 5,280 is the distance east from

[10] The facility reported that the cover on the equalization unit was installed to ensure compliance with expected new regulations to control volatile organic carbon emissions from wastewater sources for the Synthetic Organic Chemical Manufacturing Industry (SOCMI) (proposal, 59 FR 46780, September 9, 1994).

the impoundment to the closest known well. This drinking water well appears to be located just inside the eastern boundary of the State property, which lies to the east of the industrial park where the facility is located. We also assumed that a future well may be placed in the same State property directly east of the facility's undeveloped tract at approximately 3,100 feet from the surface impoundment. The details of this assessment are presented in the *"Risk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes"* in the docket.

A map provided by the County of Mobile shows that the land between the plant boundary and the residential area is owned by commercial entities or the State. However, we know of no zoning restrictions on the land owned by the state and thus we are not certain that this land might not be developed for residences at some time in the future.

Waste Data

The only constituent of concern is acetonitrile. Cyanide levels will be below the HBLs once dilution with non-HCN wastewaters is accounted for. We have reviewed the usefulness of our analytical results for acetonitrile, which are qualified as estimated, and concluded that these results are usable.

We sampled the wastewater at the Alabama facility in August, 1999. The analytical data for the commingled HCN wastewaters (DG-1-HC-07, Table 3.4) represent waste concentrations prior to commingling with other non-HCN wastewaters. Our results for a key chemical, acetonitrile, are qualified as "estimated" for this sample as a result of problems during sampling and analyses at this site as described further in *Waste Characterization Report, DeGussa-Huls; February 25, 2000*, available in the docket for today's proposal. Despite the estimated nature of the results for acetonitrile in this waste sample, the data clearly indicate that acetonitrile is likely to be present in the waste. Acetonitrile, also commonly referred to as methyl cyanide, is a likely by-product from the main reaction between methane and ammonia to form hydrogen cyanide. In addition, samples we collected at the Tennessee facility show that significant levels of acetonitrile are present in the wastewater, albeit at somewhat lower levels than we found at the Alabama site.

We obtained the facility's split-sample analysis. The facility reported estimated concentrations in the wastes that are somewhat higher than our results, but noted that "The instrument was <u>not</u> calibrated for this compound on September 1, 1999 when the sample was analyzed." The facility's split samples were more problematic, because the analytical instruments were not calibrated for key constituents being analyzed; thus, the split sample results appear even more uncertain. Additional information from the facility indicates that acetonitrile is present in the reactor gas stream at 0.1% by volume.

The relevant sample represents the HCN wastes prior to commingling with other non-HCN wastewaters. Degussa reports (April 21, 2000 letter from DeGussa to M. Diaz, EPA) that the volume associated with our sample point is 20,800 MT/yr, and that the total waste volume managed in the equalization basin is 748,300 MT/yr, resulting in a dilution ratio of 36. Therefore, the expected concentration in the equalization impoundment, after commingling was estimated to be 5.3 mg/L. The groundwater modeling effort used this concentration of acetonitrile. For the results of this assessment see the proposed rule and the *Risk Assessment for the Listing Determinations for Inorganic*

Chemical Manufacturing Wastes (August 2000*)* available in the docket for this proposal.

Table 3.4 Waste Characterization for Commingled Wastewaters [1]

EPA Sample Number	DM-1-HC-08		DM-2-HC-08		RH-1-HC-04		DG-1-HC-07		HBLs[2]		AWQC[2] (mg/L)
Date Sampled	08/12/1999		10/26/1999		07/28/1999		08/26/1999		Drinking water (mg/L)	Shower (mg/L)	
Sample Description	Exit from 8-hour pond		Exit from 8-hour pond		Wastewater from secondary API separator		Waste neutralization pit				
Result Type	Total		Total		Total		Total				
Units	mg/L		mg/L		mg/L		mg/L				
Target Analyte	Result	DQ	Result	DQ	Result	DQ	Result	DQ			
Arsenic	<0.005	U	No Analysis		0.0046		<0.005	U	0.0074		
Barium	0.104		No Analysis		<2.0	U	0.0649		1.1		
Boron	<0.050	U	No Analysis		0.38		0.403	K	1.4		
Calcium	23		No Analysis		35.2		19.9				
Chromium	0.0151		No Analysis		0.11		0.166		23		
Cobalt	<0.005	U	No Analysis		0.0049		<0.005	U	0.94		
Copper	0.0063		No Analysis		1.1	K	0.0056		1.3		
Iron	2.720		No Analysis		8.0		1.65		5		0.3 (HH) 1 (CCC)
Lead	0.0088	B	No Analysis		0.086		0.0039		0.015		0.015 (HH) 0.0025 (CCC)
Mercury	<0.0002		No Analysis		<0.0005		<0.0002		0.0047	0.00003	0.000050 (HH) 0.00077 (CCC)
Nickel	0.0106		No Analysis		0.29		0.0461		0.31		
Nitrite as N	11.5		No Analysis		0.056	L	<2.5	U	2		1
Potassium	1.7		No Analysis		8.6		5.9				
Silver	<0.001	U	No Analysis		<0.0049	U	0.0028		0.078		
Sodium	463		No Analysis		2410		2320				
Titanium	<0.005	U	No Analysis		0.023	B	0.0108				
Vanadium	<0.005	U	No Analysis		0.016		<0.005	U	0.14		
Zinc	0.0589		No Analysis		0.20	B	0.862		4.7		
Ammonia	50.2		No Analysis		93		9.2				
Amenable CN	0.638	K	<0.010	U	<0.020	U	0.509		0.3 (HBL)[5] 0.2 (MCL)	0.0006	0.2 (HH) 0.0052 (CCC)

EPA Sample Number	DM-1-HC-08		DM-2-HC-08		RH-1-HC-04		DG-1-HC-07		HBLs[2]		AWQC[2] (mg/L)
Date Sampled	08/12/1999		10/26/1999		07/28/1999		08/26/1999		Drinking water (mg/L)	Shower (mg/L)	
Sample Description	Exit from 8-hour pond		Exit from 8-hour pond		Wastewater from secondary API separator		Waste neutralization pit				
Result Type	Total		Total		Total		Total				
Units	mg/L		mg/L		mg/L		mg/L				
Target Analyte	Result	DQ	Result	DQ	Result	DQ	Result	DQ			
Total CN	0.638		<0.010	U	0.099	L	0.604				
2-Butanone	<0.005	U	<0.005	U	0.02	L	<0.005	U	9.4	2.2	
4-Methyl-2-pentanone	<0.005	U	<0.005	U	0.1	L	<0.005	U	1.3	0.02	
Acetone	0.0041	B	0.015	B	50	L	0.0078	B	1.6	25	
Acetonitrile	50	K	28		<0.005		190	K		0.045	
Acrylonitrile	0.013		<0.0005	U	N/A		<0.0005	U	0.002	0.03	0.000059
Benzene	<0.001	U	<0.001	U	0.02	L	<0.001	U	0.4	0.02	
Bromodichloromethane	<0.001	U	<0.001	U	<0.005		0.0019		0.02	0.01	
Bromoform	0.0018		<0.001	U	<0.005		<0.001	U	0.1	0.3	
Carbon tetrachloride	<0.001		0.0015		<0.002		<0.001		0.008	0.01	0.00025
Chloroform	0.00098	J	0.0083	B	<0.005		0.011		0.2	0.03	0.0057
Dibromochloromethane	0.0013		<0.001	U	<0.005		<0.001	U	0.01	0.03	0.00041
Methacrylonitrile	<0.002	U	<0.005	U	0.02	L	<0.002	U	0.002	0.01	
Methylene chloride	<0.005		0.010		<0.005		<0.005		0.1	0.4	0.0047
Vinyl Chloride	0.029		0.0066	J	<0.005		<0.001	U	0.0009	0.1	0.0020

[1] Because samples contained less than 0.5% solids, no TCLP or SPLP extractions were conducted.

[2] See "*Risk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes* (August 2000) in the docket for sources of HBLs and AWQC (HH = human health criteria, CCC = continuous concentration for aquatic life).

J - Analyte present, reported value may not be accurate or precise.

U - Not detected.

L - Analyte present, reported value may be biased low, actual value is expected to be higher.

K - Analyte present, reported value may be biased high, actual value is expected to be lower.

3.2.2 Ammonia Recycle Cartridge and Spent Carbon Filters

Waste Generation

Facilities that recover ammonia from their wastewaters and reuse it as feedstock, filter the ammonia prior to reuse to remove organonitrile polymers.

Waste Management

The filters are disposed at on-site Subtitle C landfills, off-site Subtitle D landfills or incinerated on-site at a Subtitle C facility. **Table 3.5** presents a summary of the management practices used by the facilities for this waste.

Table 3.5 Waste Management Summary for Ammonia Recycle Cartridge and Spent Carbon Filters

Facility	Waste (RIN #)	Final Management	Total Volume (MT/yr)
DuPont Memphis	Ammonia Recovery Filter Cartridges (RIN 5)	Off-site municipal Subtitle D landfill	23 (1997)
	Ammonia Recovery Spent Carbon (RIN 6)		1 (1997)
DuPont Sabine	Ammonia Stripper Filter Cartridges (RIN 3)	On-site hazardous waste incineration	10
	Ammonia Stripper Carbon (RIN 4)		1
DuPont Victoria	Ammonia Stripper Filter Cartridge (RIN 2)	On-site Subtitle C landfill	1.5
	Ammonia Stripper Carbon (RIN 3)		6.5
Novartis	Ammonia Filters (RIN 20)	On-site non-hazardous waste incineration	9
Rohm and Haas*	Ammonia Recycle Filters (RIN 8)	Off-site industrial Subtitle D landfill	21.5
		Total	73.5

* Volume is from a follow-up phone conversation with the facility.

Waste Characterization

Four record samples of this waste were collected. **Table 3.6** provides the ammonia recycle cartridge samples collected and their corresponding sample number. The DM-2 and RH-2 samples were collected during a second sampling trip. The initial samples were not analyzed for (1) amenable cyanide at Rohm & Haas, (2) total or amenable cyanide at DuPont Memphis, and (3) amenable cyanide SPLP at DuPont Memphis. Additionally, the arsenic results were qualified in the initial samples. Therefore a second round of sampling was required.

Due to schedule constraints, we initiated the risk analyses using the first round of samples. The risk analysis and second round of sampling and analysis were conducted in parallel. **Table 3.7** presents the applicable analytical data for the constituents that were detected. The detailed analytical results can be found in sampling and analyses reports identified **Section 3.2.1.** The corresponding HBLs are also shown in Table 3.7.

After reviewing all the analytical data, we believe the modeled data set appropriately characterizes the risks of all constituents included in the first sampling round, and that re-running the model with the second round of analytical data would not increase the predicted risk. The only additional constituent of concern found in the second analysis was cadmium; we did re-run the modeling for this constituent using the same two scenarios and found no significant risk.

Table 3.6 Ammonia Recycle Cartridge Samples

Facility	**Sample Number**
DuPont Memphis	DM-1-HC-04; DM-2-HC-04
Rohm and Haas	RH-1-HC-05; RH-2-HC-05

DuPont Memphis and Rohm and Haas provided split-sample data for this waste. **Appendix A** presents a comparison of these data results with EPA data results.

Results of Screening Analysis

Disposal in the on-site Subtitle C landfill and incineration practices did not warrant further analysis. These management practices are already regulated by RCRA.

An initial screening analysis of the Subtitle D landfill scenarios was conducted by comparing the TCLP and SPLP analytical results to the drinking water HBLs for detected constituents. The critical samples are RH-1-HC-05 and DM-1-HC-04. Table 3.7 compares the analytical results for detected constituents with the corresponding HBLs. This initial screening identified four constituents of concern:

- antimony
- arsenic
- cyanide
- nickel

The TCLP Boron result also exceed the HBL, however, because it exceeds the HBL by a factor of less than two, it was screened out; a dilution and attenuation factor of two would bring this constituent below the HBL.

We assessed the groundwater ingestion pathway for the off-site landfill scenarios, reflecting the types of management reported for this waste. Our model inputs included different hydrogeologic settings reflecting the two regions where the wastes are reported to be managed. We used the TCLP results for the municipal landfill scenario and the SPLP for the industrial landfill scenario.
Landfill characteristics were selected from the national municipal landfill database rather than using the reported landfills because of the potential for the wastes to be managed at a variety of landfills other than those reported. The landfills were be assumed to be unlined, although the landfill operators indicate that they are lined with leachate collection systems and groundwater monitoring under the Subtitle D program.

For details and the results of this assessment, see *"Risk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes"* (August 2000) available in the docket.

No significant volatile constituents were detected in this waste (only non-volatile metals were detected), thus volatilization from landfills to the air was not a pathway of concern. It is also highly unlikely that wind blown particulates from landfills would be significant due to the common usage of daily and longer-term cover at landfills. In any case, the levels of all constituents in the waste itself (i.e., total concentrations shown in Table 3.7) are below or only marginally above soil screening levels based on the direct ingestion of the waste (see table 3-3 of the risk document cited above). In one sample, antimony exceeded the ingestion level by a factor of 2.5 and arsenic by a factor of 1.2. Given these levels and the small volumes of waste at issue (22 and 23 MT), the likelihood of any release of particulates presenting a significant risk is remote.

Table 3.7 Waste Characterization for Ammonia Recycle Cartridge and Spent Carbon Filters

EPA Sample Number	RH-1-HC-05						RH-2-HC-05						HBL[1], mg/L
Date Sampled	07/28/1999						11/16/1999						
Result Type	Total		TCLP		SPLP		Total		TCLP		SPLP		
Units	mg/kg		mg/L		mg/L		mg/kg		mg/L		mg/L		
Target Analyte	Result	DQ	Result	DQ	Result	DQ	Result	DQ	Result	DQ	Result	DQ	
Antimony	81.5		0.55	J	0.59		24.5	L	<0.5	U	0.237		0.0063
Arsenic	5.8		0.045	L	0.039		0.5		<0.5	U	0.0137		0.0074
Barium	2.1		<2.0	U	<2.0	U	0.5		<2	U	0.371	B	1.1
Beryllium	0.089		<0.0040	U	<0.0040	U	<0.2	U	<0.02	U	<0.002	U	0.031
Boron	<0.38	U	0.20	K	0.019	B	<5	U	<2	U	0.894	K	1.4
Cadmium	<0.23	U	<0.0050	U	<0.0050	U	7.4	J	<0.05	U	0.0168		0.0078
Chromium	204		0.78		1.0		22.2		0.3		0.281		23
Cobalt	0.92		<0.0047	U	0.0053		<0.5	U	<0.05	U	<0.005	U	0.94
Copper	19.1		<1.3	U	<1.3	U	7.3		<0.25	U	0.0118		1.3
Iron	225	K	1.1	J	<0.30	U	86.3	J	<1	U	0.177		14
Nickel	1460		0.50	J	0.61		195	L	<0.2	U	0.303		0.31
Vanadium	4.0		<0.0050	U	<0.0050	U	0.6		<0.05	U	<0.005	U	
Zinc	44.1		0.31	J	0.091		<5	U	2.8	B	1.05	K	4.7
Total CN[2]	4.0	L	N/A		2.4	L	68.4		0.260	L	0.243	L	0.2
Acetone	N/A		<0.005	U	N/A		N/A		N/A		N/A		1.6

Table 3.7 Waste Characterization for Ammonia Recycle Cartridge and Spent Carbon Filters (continued)

EPA Sample Number	DM-1-HC-04						DM-2-HC-04						
Date Sampled	08/12/1999						10/26/1999						
Result Type	Total		TCLP		SPLP		Total		TCLP		SPLP		
Units	mg/kg		mg/L		mg/L		mg/kg		mg/L		mg/L		
Target Analyte	Result	DQ	Result	DQ	Result	DQ	Result	DQ	Result	DQ	Result	DQ	HBL[1], mg/L
Antimony	2.7	J	<0.5	U	<0.05	U	8.8	J	0.8		1.08		0.006
Arsenic	<1	U	<0.5	U	<0.05	U	0.5		<0.5	U	0.0112		0.007
Barium	32.5		<2	U	0.141	K	5.5		<2	U	0.190	B	1.1
Beryllium	<2	U	<0.02	U	<0.02	U	<0.2	U	<0.02	U	<0.002	U	0.03
Boron	<50	U	<2	U	<0.5	U	7.6		2.2		0.558	K	1.4
Cadmium	<5	U	<0.05	U	<0.05	U	2.1		0.087		0.0065		0.0078
Chromium	209		1.1		0.991		18.9	J	0.1		0.254		23
Copper	37.6	K	<0.25	U	<0.05	U	8.2		<0.25	U	0.0061		1.3
Iron	838		1.2		2.39		155	J	<1	U	0.710		14
Nickel	406		<0.2	U	0.0654		263		<0.2	U	0.0178		0.31
Zinc	56.3	L	<2	U	<0.5	U	<5	U	<2	U	0.753	B	4.7
Total CN[2]	N/A		0.218		0.187	L	95.7		0.0650	J	0.303		0.2
Acetone	N/A		0.012	B	<0.005	U	N/A		N/A		N/A		1.6

1- See "*Risk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes* (August 2000) in the docket for sources of HBLs.

2 - TCLP/SPLP extraction was conducted using deionized water at 20:1 ratio (deionized water sample), therefore, the laboratory reported the result as SPLP leachate.

J - Analyte present, reported value may not be accurate or precise.

U - Not detected.

L - Analyte present, reported value may be biased low, actual value is expected to be higher.

K - Analyte present, reported value may be biased high, actual value is expected to be lower.

B - Blank contamination

3.2.3 Biological Wastewater Treatment Solids

Waste Generation

Facilities that treat their wastewaters using biological treatment generate solids as a result of treatment.

Waste Management

This waste is sent off-site to an industrial Subtitle D landfill, disposed in an on-site Subtitle C landfill or used as an agricultural liming agent. **Table 3.8** presents a summary of the management practices used by the facilities for this waste.

Table 3.8 Waste Management Summary for Biological Wastewater Treatment Solids

Facility	Waste (RIN #)	Final Management	Total Volume (MT/yr)
Degussa-Huls	Bio Filter Cake (RIN 28)	Off-site Industrial Subtitle D Landfill	2,270
Novartis	Not Reported	Agricultural Liming Agent	not reported
Rhone-Poulenc	Filter Cake (RIN 3)	On-site Subtitle C Landfill	5,127
Rohm and Haas	Not Reported	Off-site Municipal Subtitle D Landfill	38,000*
		Total	45,397

* Not reported in facility's RCRA §3007 questionnaire. Information provided in follow-up phone conversation.

Waste Characterization

Two record samples of this waste were collected at Degussa-Huls (DG-1-HC-02) and Rohm and Haas (RH-1-HC-08). The validated record sampling analytical results can be found in *Sampling and Analytical Data Report for Record Sampling and Characterization of Wastes from the Inorganic Hydrogen Cyanide Manufacturing Sector*; Rohm & Haas Texas, Deer Park, TX; July 28, 1999 and *Sampling and Analytical Data Report for Record Sampling and Characterization of Wastes from the Inorganic Hydrogen Cyanide Manufacturing Sector*; Rohm & Haas Texas, Deer Park, TX; November 16, 1999. **Table 3.9** presents the applicable analytical data. In addition, Rohm and Haas provided split sample results; **Appendix A** presents a comparison of these results with EPA's record sampling results.

Results of Initial Screening Analysis

An initial screening analysis of the samples was conducted by comparing the analytical results to the drinking water HBLs and soil screening levels (SSLs) for detected constituents.[11] **Table 3.9** compares the analytical results for detected constituents with the corresponding HBLs and SSLs. We assessed the industrial landfill scenario using our SPLP results from the Rohm and Haas sample, and a municipal landfill scenario using the TCLP results from the DeGussa sample. The waste passed both screening analyses.[12] We did not have a sample from the residual that was used as a liming agent, however, the for the two samples we have the total levels were below background and direct ingestion levels. Therefore, the Subtitle D landfill scenarios and the agricultural liming use do not warrant further analysis. The on-site Subtitle C landfill scenario does not warrant further assessment. The waste is currently identified as a listed hazardous waste, F039 due to non-HCN process wastewaters.

[11] For further explanation of these levels see *"Risk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes"* (August 2000) in the docket.

[12] The TCLP results for boron in sample RH-1-HC-08 showed an elevated level, however the TCLP value is not possible given the nondetect level in the total analysis (< 10 mg/kg). The TCLP method should have yielded a leaching level of no more than ~0.5 mg/L based on this total value, which is well below the HBL. Furthermore, boron is not expected to be in wastes from the HCN process..

Table 3.9 Waste Characterization for Biological Wastewater Treatment Solids

EPA Sample Number	RH-1-HC-08						DG-1-HC-02						HBL (mg/L)	SSL[1] (mg/kg)
Sample Description	Wastewater treatment plant sludge						Wastewater treatment bio sludge							
Result Type	Total (mg/kg)		TCLP (mg/L)		SPLP (mg/L)		Total (mg/kg)		TCLP (mg/L)		SPLP (mg/L)			
Target Analyte	Result	DQ	Result	DQ	Result	DQ	Result	DQ	Result	DQ	Result	DQ		
Arsenic	0.58		<0.0020	UL	<0.0020	U	<0.5	U	<0.5	U	<0.005	U	0.00074	4.7[2]
Barium	13.7		<2.0	U	<2.0	U	5.7		<2	U	0.159	K	1.1	440
Beryllium	0.066		<0.0040	U	<0.0040	U	<0.2	U	<0.02	U	<0.002	U	0.031	0.6
Boron	1.1		0.17	K	0.030	B	<10	U	11.8		<0.12	UJ	1.4	26
Chromium	24.7		<0.10	U	<0.10	U	22.1		<0.05	U	<0.005	U	23	37
Cobalt	3.3		0.0055		<0.0047	U	<0.5	U	<0.05	U	<0.005	U	0.94	6.7
Copper	154		<1.3	U	<1.3	U	5.6		<0.25	U	0.112		1.3	NA
Iron	1090	K	3.2	L	0.67		3290		<1	U	<0.05	U	5	430,000[2]
Lead	10.9		<0.015	U	<0.015	U	1.2		<0.5	U	<0.005	U	0.015	400[2]
Nickel	30.8		0.10		<0.10	U	9.0		<0.2	U	0.0801		0.31	1,600[2]
Selenium	13.5		<0.050	U	<0.050	U	<0.5	U	<0.5	U	<0.005	U	0.078	400[2]
Silver	<0.47	U	<0.0049	U	<0.0049	U	0.2		<0.1	U	<0.001	U	0.078	0.1
Titanium	6.6		<0.0050	U	<0.0050	U	50.1		<0.05	U	<0.005	U		
Vanadium	3.0		<0.0050	U	<0.0050	U	0.8		<0.05	U	<0.005	U	0.14	58
Zinc	33.1		0.16		<0.020	U	78.1		<3	U	<0.1	U	4.7	48
Amenable CN	N/A		N/A		N/A		<0.5	U	N/A		N/A		0.3	1,600[2]
Total CN	2.9		N/A[3]		0.024[3]	L	<0.5	U	<10	U	<10	U		
Acetone	N/A		0.6	L	N/A		0.240	J	0.038	B	0.014	J	1.6	8,100[2]

[1] Soil screening levels (SSLs) are based on soil background, except where ingestion levels are otherwise noted; in all cases the ingestion levels are above the background levels. See "*Risk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes* (August 2000) in the docket for details.

[2] Soil ingestion HBL.

[3] TCLP/SPLP extraction was conducted using deionized water at 20:1 ratio (deionized water sample); results reported as SPLP leachate.

U - Not detected.

K - Analyte present, reported value may be biased high, actual value is expected to be lower.

B - Detected at greater than the reporting limit but not substantially above the level reported in lab or field blanks.

L - Analyte present, reported value may be biased low, actual value is expected to be higher.

J - Analyte present, reported value may not be accurate or precise.

3.2.4 Feed Gas Cartridge and Spent Carbon Filters

Waste Generation

Natural gas and ammonia feedstocks are typically filtered prior to entering the reactor. The filter media are typically made of cotton, polypropylene, or a blend wrapped around a stainless steel core.

Waste Management

These filters are disposed at Subtitle C or Subtitle D landfills or returned to the manufacturer for refurbishment and reused. **Table 3.10** presents a summary of the management practices used by the facilities for this waste.

Table 3.10 Waste Management Summary for Feed Gas Cartridge and Spent Carbon Filters

Facility	Waste (RIN #)	Final Management	Volume (MT/yr)
Cyanco	Liquid anhydrous ammonia filters (RIN 1)	Off-site industrial Subtitle D landfill	0.004
	Natural gas filter (RIN 2)		0
	Mixed gas filtrate (RIN 4)		0.05
Degussa-Huls	Ammonia filters (RIN 2)	Off-site industrial Subtitle D landfill	0.09
Dow	Ammonia filters (RIN 3)	Returned to manufacturer, refurbished and reused	0.023 (1999)
	Methane filters (RIN 4)		0.02 (1999)
DuPont Memphis	Natural gas feed filters (RIN 10)	Off-site municipal Subtitle D landfill	0.2
	Ammonia feed filters (RIN 11)		0.2
DuPont Victoria	Natural gas sock filters (RIN 8)	On-site Subtitle C landfill	0.09
	Natural gas carbon bed (RIN 9)		1.90
FMC*	Gas mixer inlet filters (RIN 1)	On-site industrial Subtitle D landfill	0.04
	Gas mixer outlet filter (RIN 2)		0.28
Rohm and Haas**	Feed gas filters (RIN 6)	Off-site industrial Subtitle D landfill	6.8
		Total	9.697

* Combined natural gas, process air and ammonia filter.
** Volume derived based on E-mail message from J. McTague (Dynamac) to Max Diaz (EPA), April 3, 2000. The feed gas filters (RIN 6) and Process air filters (RIN 5) volumes were originally included in the Ammonia recycle filters (RIN 8) volume of 35 MT/yr; the RIN 5 and RIN 6 volumes were assumed to each be half of the difference between 35 MT/yr and the revised RIN 8 volume of 21.5 MT/yr.
Note: Novartis and DuPont Sabine River reported generating this waste in their written follow-up response. However, they did not provide the volume generated or management information.

Waste Characterization

One sample of a combined natural gas and ammonia feed gas filter was collected at Rohm and Haas (RH-1-HC-10). The validated record sampling analytical results can be found in *Sampling and Analytical Data Report for Record Sampling and Characterization of Wastes from the Inorganic Hydrogen Cyanide Manufacturing Sector*; Rohm & Haas Texas, Deer Park, TX; July 28, 1999. **Table 3.11** present the applicable analytical data. Rohm and Haas provided split-sample results; **Appendix A** presents a comparison of these data results with EPA data results.

Results of Initial Screening Analysis

An initial screening analysis of the samples was conducted by comparing the analytical results to the drinking water HBLs for detected constituents. **Table 3.11** compares the analytical results for detected constituents with the corresponding HBLs and SSLs. The SPLP levels were below the drinking water HBLs. However, the TCLP results showed levels that exceeded the HBLs for the following constituents:

- barium
- boron
- lead
- nickel
- zinc

The industrial Subtitle D landfill scenario did not warrant further assessment because all the SPLP results were below the HBLs. The Subtitle C landfill scenario did not warrant further assessment because it was assumed that a hazardous waste landfill would reduce risks far below the levels of concern. The municipal Subtitle D landfill warranted further assessment. For details and the results of this assessment see *Risk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes (August 2000)* available in the docket for this proposal.

No significant volatile constituents were detected in this waste (only non-volatile metals were detected), thus volatilization from landfills to the air was not a pathway of concern. It is also highly unlikely that wind blown particulates from landfills would be significant due to the common usage of daily and longer-term cover at landfills. In any case, the levels of all constituents in the waste itself (i.e., total concentrations shown in Table 3.7) are below or only marginally above soil screening levels based on the direct ingestion of the waste (see table 3-3 of the risk document cited above). Boron exceeded the ingestion level by a factor of 2.5. Given this levels and the small volumes of waste at issue (largest volume was 6.8 MT), the likelihood of any release of particulates presenting a significant risk is remote.

Table 3.11 Waste Characterization for Feed Gas Cartridge and Spent Carbon Filters

Sample Number	RH-1-HC-10						HBL[1] (mg/L)
Date Sampled	08/02/1999						
Sample Description	Feed gas filter						
Result Type	Total		TCLP		SPLP		
Units	mg/kg		mg/L		mg/L		
Target Analyte	Result	DQ	Result	DQ	Result	DQ	
Barium	168		<2	U	0.0690	K	1.1
Boron	17900		7.4		<0.5	U	1.4
Chromium	229		0.100		<0.05	U	23
Chromium $^{6+}$	3.6	L	N/A [2]		0.02 [2]	L	0.047
Cobalt	6.3		<0.05	U	<0.05	U	0.94
Copper	46.8		<0.25	U	<0.05	U	1.3
Total CN	<0.5	UL	N/A		N/A		
Iron	9960		<1	U	<0.5	U	5
Lead	18.5		<0.5	U	<0.03	U	0.015
Nickel	91.0		0.4		<0.05	U	0.31
Titanium	1600		0.053		<0.05	U	
Vanadium	55.6		<0.05	U	<0.05	U	0.14
Zinc	1060		13.0		<0.5	U	4.7

1 - See "*Risk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes* (August 2000) in the docket for sources of HBLs.
2 - TCLP/SPLP extraction was conducted using deionized water at a 20:1 ratio (de-ionized water sample); therefore, the laboratory reported the result as SPLP leachate.
U - Not detected.
K - Analyte present, reported value may be biased high, actual value is expected to be lower.
L - Analyte present, reported value may be biased low, actual value is expected to be higher.
UL - Not detected, reporting limit is probably higher.

3.1.5 Process Air Cartridge Filters

Waste Generation

The air entering the reactor is filtered prior to entering the reactor to remove dust, rust and other particulates.

Waste Management

These filters are disposed at Subtitle D landfills or returned to the manufacturer, refurbished and reused. **Table 3.15** presents a summary of the management practices used by the facilities for this waste.

Table 3.12 Waste Management Summary for Process Air Cartridge Filters

Facility	Waste (RIN #)	Final Management	Volume (MT/yr)
Cyanco	Process Air Filters (RIN 3)	Off-site industrial Subtitle D landfill	0.004
Dow	Air Filters (RIN 2)	Returned to manufacturer, refurbished and reused	0.136 (1999)
DuPont Memphis	Air Feed Filters (RIN 9)	Off-site municipal Subtitle D landfill	0.2
FMC*	Gas Mixer Inlet Filters (RIN 1)	On-site industrial Subtitle D landfill	0.043
	Gas Mixer Outlet Filter (RIN2)		0.283
Rohm and Haas**	Process Air Filters (RIN 5)	Off-site industrial Subtitle D landfill	6.8
		Total	7.466

* Combined natural gas, process air and ammonia filter.

**Volume derived based on E-mail message from J. McTague (Dynamac) to Max Diaz (EPA), April 3, 2000. The feed gas filters (RIN 6) and Process air filters (RIN 5) volumes were originally included in the Ammonia recycle filters (RIN 8) volume of 35 MT/yr; the RIN 5 and RIN 6 volumes were assumed to each be half of the difference between 35 MT/yr and the revised RIN 8 volume of 21.5 MT/yr.

Note: Novartis, Rhone-Poulenc and DuPont Sabine River reported generating this waste in their written follow-up response. However, they did not provide the volume generated or management information.

Waste Characterization

This waste was not available for sampling under the sampling schedule. However, the level of toxicants is expected to be low because the filters are used to remove airborne solids from the ambient air used in the process.

Results of Initial Screening Analysis

This waste did not warrant further assessment. The level of any toxicants in the waste are not expected to exceed levels of concern that would pose a risk to groundwater based on a Subtitle D landfill scenario.

3.1.6 Acid Spray Cartridge Filters

Waste Generation

During HCN purification, the HCN-water mixture is filtered to remove particulates and rust that may clog HCN lines. The cartridge-type filter elements are used to prevent clogging of spray nozzles used

to inject HCN intermediate product into the HCN stripper.

Waste Management

Before removal the filters are flushed in place (the washwater is commingled with other wastewaters and sent to the on-site wastewater treatment plant). The filters are disposed at an on-site Subtitle C landfill as a matter of convenience. **Table 3.13** presents the management practice used by DuPont Victoria for this waste.

Table 3.13 Waste Management for Acid Spray Cartridge Filters

Facility	Waste (RIN #)	Final Management	Total Volume (MT/yr)
DuPont Victoria	Acid Spray Filter Elements (RIN4)	On-site Subtitle C landfill	1.1

Waste Characterization

This waste was not available for sampling under the sampling schedule. The filters are not a RCRA hazardous waste. They are classified in Texas as a non-hazardous "Class 1" waste. The filters are used to remove inert impurities such as pipe scale. The facility washes the filters prior to removal of the filters from the process. We expect that any hydrogen cyanide contamination is removed during this washing. The facility reported in its RCRA Section 3007 Survey that the waste contains a total concentration of cyanide of 1 ppm.

Results of Initial Screening Analysis

This waste did not warrant further assessment. The level of any toxicants of concern is expected to be below the levels of concern. The filters are used to remove inert impurities and any HCN contamination is removed when the filters are washed prior to removal. In addition, the waste quantity is small. While we do not have any leaching test data, we can conservatively estimate that any leachable level of cyanide would be at least 20-fold less than the 1 ppm total level reported, i.e, less than 0.05 mg/L. This is based on the TCLP or SPLP leaching procedure (see SW-846 method 1311 and 1312). This is well below the HBL for amenable cyanide (0.3 mg/L). Furthermore, this small volume waste is already managed in a Subtitle C landfill.

3.1.7 Spent Catalyst

Waste Generation

A platinum/rhodium catalyst is used in the reactor to convert the ammonia, air and natural gas into HCN. All ten facilities use a catalyst and all recycle or reuse their catalysts. The spent material is an impermeable metal gauze that undergoes thorough cleaning and decontamination to eliminate cyanide concentrations prior to removal from the reactor.

Waste Management

The catalyst is a high value item due to the precious metals content that generators maintain close control over and is always returned to the manufacturer for recycling or to a reclaimer for precious metals reclamation. **Table 3.14** presents a summary of the management practices used by the facilities for this waste.

Table 3.14 Waste Management Summary for Spent Catalyst

Facility	Waste (RIN #)	Final Management	Total Volume (MT/yr)
Cyanco	Platinum/ Rhodium Catalyst Gauze (RIN 5)	Off-site metals reclamation/regeneration	0.07
DeGussa-Huls	Platinum Catalyst (RIN 11)	Off-site metals reclamation/regeneration	3
Dow	Spent Catalyst (RIN 5)	Off-site metals reclamation/regeneration	0.02 (1999)
DuPont Memphis	Used Platinum/ Rhodium Catalyst (RIN 1)	Off-site metals reclamation/regeneration	0.4 (1997)
DuPont Sabine River	Used Catalyst Pack (RIN 6)	Off-site metals reclamation/regeneration	0.004
DuPont Victoria	Used Catalyst Pack (RIN 6)	Off-site metals reclamation/regeneration	0.4
FMC	Catalyst Gauze (RIN 3)	Off-site metals reclamation/regeneration	0.07
Novartis	Spent Catalyst (RIN 21)	Off-site metals reclamation/regeneration	0.05
Rhone-Poulenc	Platinum Catalyst (RIN 2)	Off-site metals reclamation/regeneration	0.05
Rohm and Haas	HCN Converter Catalyst (RIN 7)	Off-site metals reclamation/regeneration	CBI
		Total	4.064 (excluding CBI volume)

Waste Characterization

The catalyst used at all the facilities is composed of various concentrations of platinum and rhodium.

Results of Initial Screening Analysis

This waste did not warrant further assessment. Generators clean and decontaminate the catalyst prior to removal. The catalyst is maintained in containers with limited potential for significant releases prior to being shipped off-site for precious metals recovery.

3.1.8 Ammonium Sulfate and Ammonium Phosphate

Waste Generation

An ammonia byproduct is generated at three facilities. Ammonium sulfate is generated by combining the reactor off-gases with sulfuric acid. Ammonium phosphate is generated by combining the reactor off-gases with phosphoric acid.

Waste Management

All three facilities sell this byproduct as a fertilizer. **Table 3.15** presents a summary of the management practices used by the facilities for this waste.

Table 3.15 Waste Management Summary for Ammonium Sulfate and Ammonium Phosphate

Facility	Waste (RIN #)	Final Management	Total Volume (MT/yr)
DeGussa- Huls	AMSUL (RIN 505)	Sold as fertilizer	12,000
DuPont Victoria	NR	Sold as fertilizer	NR
Rhone-Poulenc	NR	Sold as fertilizer	15,425
		Total	27,425

NR - not reported

Waste Characterization

One record sample was collected at DeGussa-Huls (DG-1-HC-01). The validated record sampling analytical results can be found in *Sampling and Analytical Data Report for Record Sampling and Characterization of Wastes from the Inorganic Hydrogen Cyanide Manufacturing Sector, DeGussa-Huls, February 25, 2000.* **Table 3.16** presents the applicable analytical data. DeGussa has provided split sample results; **Appendix A** presents a comparison of these data results to EPA's record sampling results

Results of Initial Screening Analysis

Because the material is land applied it remains a solid waste under Subtitle C regulations and thus requires assessment. An initial screening analysis of the samples was conducted by comparing the analytical results to soil screening levels. **Table 3.16** compares the analytical results for detected constituents with the soil screening levels. This initial screening showed that all detected constituents are below the soil screening levels. In addition, we compared the SPLP leaching results to the HBLs as a screen of potential groundwater exposure. Note that the SPLP/HBL groundwater screen for this scenario is likely to be a worst-case screening, because the fertilizer application scenario is not analogous to a landfill scenario, particularly with respect to application rates. Therefore, this waste did not warrant further assessment.

Table 3.16 Waste Characterization for Ammonium Sulfate

Sample Number: DG-1-HC-01							SSL[1] (mg/kg)	HBLs[1] (mg/L)
Date Sampled: 8/26/1999								
Sample Description: Ammonium sulfate								
Result Type	Total		TCLP		SPLP			
Units	mg/kg		mg/L		mg/L			
Target Analyte	Result	DQ	Result	DQ	Result	DQ		
Boron	<10	U	<2	U	0.198	J	26	1.4
Chromium	1.2		0.050		0.0466		37	23
Copper	<0.5	U	<0.25	U	0.0039		17	-
Iron	7.3		1.4		0.0867		430,000[2]	5
Nickel	0.7		<0.2	U	0.0273		13	0.31
Zinc	<5	U	<2	U	0.332		48	4.7
2-Butanone	0.017	K	<0.005	U	<0.005	U	48,000[2]	2.2
Acetone	0.160	K	0.013	B	0.0028	J	8,100[2]	1.6
Chloromethane	0.0058	K	<0.005	U	<0.005	U	540[2]	-

[1] Soil screening levels (SSLs) are based on soil background, except where ingestion levels are otherwise noted; in all cases the ingestion levels are above the background levels. See "*Risk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes* (August 2000) in the docket for details and sources of the HBLs and SSLs.

[2] Soil ingestion level.

U - not detected.

J - analyte present., reported value may not be accurate or precise.

K - analyte present, reported value may be biased high, actual value is expected to be lower.

B - detected at greater than the reporting limit but not substantially above the level reported in lab or field blanks.

3.1.9 Miscellaneous Wastewaters

Waste Generation

There are various miscellaneous wastewaters that are generated on an intermittent, continuous or periodic basis. For example, DuPont Memphis reported scrubber water from the tank storage of HCN. This waste is generated only when the process is shutdown or if the tank farm flare is not operating. Rohm and Haas reported the washwater that is used to clean equipment prior to opening during plant shutdowns. These miscellaneous wastewaters are commingled with the commingled wastewaters discussed in Section 3.1.1. In addition, at all facilities that generate wastewaters, the HCN process wastewaters are commingled and managed with non-HCN process wastewaters.

Waste Management

The miscellaneous wastewaters are all treated in on-site wastewater treatment processes before being discharged under an NPDES permit, to a POTW, or via deep-well injection. The wastewaters are treated using one or more of the following operations:

- steam stripping to remove cyanide and ammonia, with off-gases vented to flares, scrubbers or incinerators;
- pH adjustment;
- aerated or non-aerated biological treatment in tanks or lined/unlined surface impoundments;
- oxychlorination; and
- settling in surface impoundments

Table 3.17 presents a summary of the management practices used by the facilities for miscellaneous wastewaters.

Table 3.17 Waste Management Summary for Miscellaneous Wastewaters

Facility	Waste (RIN #)	Management	Volume (MT/yr)
DeGussa-Huls	H3PO4 Drum Storage (RIN 1)	pH adjustment, aerated biological treatment in lined concrete tank and double lined surface impoundment with leak detection and leachate collection system, NPDES discharge	100
	H2SO4 Unloading (RIN 4)		35
	NH3 Storage (RIN 5)		745
	H2SO4 Storage Tank (RIN 6)		300
	HCN Lab Sump (RIN 9)		8,760
	NH3 Vaporization (RIN 10)		210
	Diesel Storage (RIN 12)		21.6
	HCN Outside Process (RIN 13)		2,730

Facility	Waste (RIN #)	Management	Volume (MT/yr)
	Furnace Hall (RIN 14)		100
	Stormwater Ditch (RIN 16)		600
	Wastewater Dike (RIN 20)		225
	Decon Dike (RIN 24)		1,800
	Amsul Loading (RIN 502)		1,750
	Amsul Storage (RIN 503)		133
DuPont Memphis	Tank Farm Scrubber (RIN 3)	pH adjustment, oxychlorination, settling in unlined surface impoundments, discharge to POTW	3,921 (1997)
	Miscellaneous Wastewaters (RIN 8)		170,000 (1997)
Novartis	HCN Area Sump (RIN 11)	pH adjustment and oxychlorination in tanks, NPDES discharge	1,000
	Ammonia Area Sump (RIN 13)		1,000
	Lab Drain (RIN 14)		60
	Ammonia Vaporizer Blowdown (RIN 15)		0.3
	Ammonia exchanger cleaning (RIN 16)		60
Rohm and Haas	Washdown Wastewater (RIN 11)	steam stripping, pH adjustment, aerated biological treatment in unlined surface impoundment, NPDES discharge	15,270
		Total	208,830.9

Waste Characterization

No record samples of these miscellaneous wastewaters were collected because they were commingled with the major process wastewaters that were characterized and assess in **Section 3.1.1.** However, the facilities reported data in the surveys which are shown in **Table 3.18**.

Table 3.18 Characterization of Miscellaneous Wastewaters

Facility	Waste (RIN #)	Constituent Concentrations, mg/kg
DuPont Memphis	Tank Farm Scrubber (RIN 3)	Total & amenable CN = 20,000
Rohm & Haas	Washdown wastewater (RIN 11)	Typical CN = <2 Max. CN = 10,000
DeGussa-Huls	H3PO4 drum storage (RIN 1)	acrylic acid = 0.08 formaldehyde = 0.02
	H2SO4 unloading	H2SO4 = 10
	NH3 storage (RIN 5)	NH3 = 10
	H2SO4 storage (RIN 6)	H2SO4 = 10
	HCN lab sump (RIN 9)	(NH4)2SO4 = 10 H2SO4 = 10 H3PO4 = 10
	NH3 vaporization (RIN 10)	glycol = 10
	Diesel storage (RIN 12)	diesel = 10
	HCN outside process sump (RIN 13)	CN = 10 H3PO4 = 10 H2SO4 = 10
	Furnace hall (RIN 14)	corrosion inhibitors = 10
	Stormwater ditch (RIN 16)	CN = 5 NH3 = 10
	Wastewater dike (RIN 20)	CN = 10 (NH4)2SO4 = 10 H2SO4 = 10 H3PO4 = 10 NH3 = 10
	Decon dike (RIN 24)	CN = 10 HCN polymer = 20,000
	Amsul loading (RIN 502)	ammonium sulfate = 5,000
	Amsul storage (RIN 503)	(NH4)2SO4 = 10
Novartis	NH3 area sump (RIN 13)	CN = 0 - 50 pH = 6 - 9
	HCN area sump (RIN 11)	CN = 1 - 50

Facility	Waste (RIN #)	Constituent Concentrations, mg/kg
	NH3 exchanger cleaning (RIN 16)	CN = 10 - 20,000 HCN polymers = 20,000 pH < 12

Results of Initial Screening Analysis

Groundwater Pathway

This waste did not warrant further assessment. There is no direct exposure pathway from these individual wastes because they are commingled with all the other wastewaters at the facility. Any HCN in this wastewater is also easy to treat and the treatment takes place soon after the wastewaters are generated so any risk is minimized. In addition, these small volume wastewaters are mixed with other larger volume wastewaters diluting the HCN concentrations of the individual wastewaters.

For example, the waste with the highest reported cyanide level is the tank farm scrubber from DuPont, Memphis. This is treated using oxychlorination prior to reaching the settling impoundment, which should rapidly destroy any cyanide. Furthermore, the relatively small volume of the tank farm scrubber (3,900 MT/yr.) compared to the overall wastewater flow (3,900,000/yr) further reduces any residual cyanide in the treated waste.

Air Pathway

The air exposure pathway for these miscellaneous wastewaters did not warrant further assessment. As noted above, wastewaters with high cyanide levels are effectively treated early in the process. Furthermore, any releases are currently controlled under a variety of state and federal air quality control programs and may be addressed by the MACT standards on a facility-wide basis.

3.1.10 HCN Polymer and Sump Waste

Waste Generation

Polymers (heavy organonitrile compounds) settle out in the wastewater collection system sump generating this waste.

Waste Management

This waste is stored on-site in containers and disposed off-site at an industrial Subtitle D landfill. **Table 3.19** presents a summary of the management practices used by DeGussa-Huls for this waste.

Table 3.19 Waste Management for HCN Polymer and Sump Wastes

Facility	Waste (RIN #)	Management	Volume (MT/yr)
DeGussa-Huls	HCN Sump waste (RIN 25)	Off-site industrial Subtitle D landfill	0.4
	HCN Waste Polymer (RIN 26)		0.3

Waste Characterization

This waste was not available for sampling under the sampling schedule. In the RCRA Section §3007 Survey, the one generator reported that total levels of cyanide were 50 mg/kg for the HCN polymer and 5 mg/kg for the sump wastes.

Results of Initial Screening Analysis

These very small volume wastes are unlikely to pose significant risk. In support of this, we note that if a TCLP or SPLP leaching test results were performed on these wastes, the leaching levels would be at least 20-fold less than the total levels. This would mean any leaching from sump waste would be below the HBL for cyanide. While this 20-fold factor would leave the HCN polymer somewhat above the HBL at 2.5 ppm cyanide, this is highly unlikely to pose a significant threat, based on the modeling results for cyanide for the ammonia recycle filters, which show that similar levels of cyanide in a larger waste volume presents very low levels of risk in a landfill scenario.

3.1.11 Sludge from Wastewater Collection Tank

Waste Generation

At two facilities, wastewater is sent to a wastewater collection tank prior to wastewater treatment or final management via deepwell injection. A sludge layer accumulates in the bottom of the tanks and is removed periodically.

Waste Management

Table 3.20 presents the management practices used for this waste. Rohm and Haas reported a volume of 2.1 MT over a seven year period, or approximately 0.3 MT/year. They reported their waste as a characteristically hazardous ignitable waste (D001), stabilized it on-site, and disposed of in an off-site Subtitle C landfill. The waste is generated approximately every ten years; the volume reported was for 1993 with no generation of that waste since that date. HCN wastewaters managed in this tank only account for ten percent of throughput; the sediment thus is only marginally associated with HCN production. The other facility reported generating 1.8 MT of this waste, and also codes it as characteristically hazardous waste (in this case as D018 for benzene). This second facility sends the waste off-site to a Subtitle C incinerator; the facility reported that the benzene was derived from other on-site processes.

Table 3.20 Waste Management for Sludge from Wastewater Collection Tank

Facility	Waste (RIN #)	Final Management	Volume (MT/yr)
Rohm and Haas	Sludge from Wastewater Collection Tank (RIN 10)	On-site stabilization, off-site Subtitle C landfill	2.1 (1993)
DuPont Victoria	Tank Clean-out (RIN 11)	Off-site Subtitle C incineration	1.8

Waste Characterization

These wastes were not available for sampling under the sampling schedule. Rhom and Haas codes the waste as ignitable (D001), and DuPont Victoria reported this waste as characteristically for benzene (D018).

Results of Initial Screening Analysis

This wastes did not warrant further assessment, because they are very small volume wastes that are already managed as characteristically hazardous wastes in compliance with the Subtitle C regulations. In addition, the wastes are generated from the treatment of predominantly non-HCN wastewater from unrelated petrochemical processes at the facilities.

3.1.12 HCN Storage Tank Solids

Waste Generation

One facility reported generating sludge from the HCN storage tanks. These solids are left in the tank after a thorough tank washing, prior to personnel entry.

Waste Management

This waste is stored on-site in roll-on/roll-off bins and disposed off-site at a municipal Subtitle D landfill. **Table 3.21** presents a summary of the management practice used by DuPont Memphis for this waste.

Table 3.21 Waste Management for HCN Storage Tank Solids

Facility	Waste (RIN #)	Final Management	Total Volume (MT/yr)
DuPont Memphis	HCN Storage Tank Solids (RIN 12)	Off-site municipal Subtitle D landfill	0.3

Waste Characterization

This waste was not available for sampling under the sampling schedule. DuPont Memphis reported that the solids are composed of HCN polymer and possible tank scale of inert complexed ferrocyanide, similar in composition to the ammonia recycle cartridge and spent carbon filters discussed in Section 3.1.2.

Results of Initial Screening Analysis

Because this waste is similar in composition to the ammonia recycle cartridge and spent carbon filters, and it is much smaller volume, it did not warrant further assessment for the reasons discussed in Section 3.1.2.

3.1.13 Wastewater Filters

Waste Generation

One facility reported generating this waste. DuPont Victoria filters its wastewaters prior to deepwell injection.

Waste Management

The filters are stored on-site in containers and then sent off-site for incineration at a captive Subtitle C facility. **Table 3.22** presents a summary of the management practice used by DuPont Victoria for this waste.

Table 3.22 Waste Management for Wastewater Filters

Facility	Waste (RIN #)	Final Management	Total Volume (MT/yr)
DuPont Victoria	311 Filters (RIN 10)	Off-site hazardous waste incineration	450

Waste Characterization

DuPont Victoria reported this waste as characteristically hazardous for benzene (D018). They also reported the total concentration for benzene as 2 mg/kg and the total oil concentration as 1000 mg/kg. DuPont Victoria reported that the source of the benzene is from other non-HCN process wastewater.

Results of Initial Screening Analysis

This waste did not warrant further assessment. It is characteristically hazardous and currently managed and incinerated as a hazardous waste.

3.1.14 Ammonia Sulfate Filters

Waste Generation

One facility reported generating this waste. Ammonium sulfate is filtered prior to loading into tanker trucks.

Waste Management

The filters are stored on-site in containers and then sent off-site for disposal at an industrial Subtitle D landfill. **Table 3.23** presents a summary of the management practice used by DeGussa-Huls for this waste.

Table 3.23 Waste Management for Ammonia Sulfate Filters

Facility	Waste (RIN #)	Final Management	Total Volume (MT/yr)
DeGussa-Huls	Amsul Filters (RIN 504)	Off-site industrial Subtitle D landfill	1.1

Waste Characterization

This waste was not available for sampling under the sampling schedule. DeGussa-Huls reported concentrations of cyanide (1 mg/kg) and ammonium sulfate (5,000 mg/kg).

Results of Initial Screening Analysis

This waste did not warrant further assessment. The level of toxicants in the waste are not expected to exceed levels of concern that would pose a risk to groundwater based on a Subtitle D landfill scenario. The reported concentration of cyanide is low and is not expected to be of concern. In addition, we collected a sample of the ammonium sulfate by-product (i.e., the material being filtered to generate this waste) and did not find any constituents of concern.

3.1.15 Spent Ammonium Phosphate

Waste Generation

One facility reported generating this waste. Ammonium phosphate solution is used to scrub the off-gas stream from the reactor to assist in ammonia recovery.

Waste Management

The spent ammonium phosphate is stored in a tank, and either used as a nutrient source in the on-site biological treatment unit or it may be incinerated in the on-site non-hazardous incinerator. This waste is generated in batches and only requires treatment once or twice a year. If the operating conditions of the biological treatment unit preclude the spent ammonium phosphate from being sent there then they

are incinerated. **Table 3.24** presents a summary of the management practice used by Novartis for this waste.

Table 3.24 Waste Management for Spent Ammonium Phosphate

Facility	Waste (RIN #)	Final Management	Total Volume (MT/yr)
Novartis	Spent Ammonium Phosphate (RIN 17)	On-site Biological Treatment in Tanks or On-site Non hazardous Waste Incineration	230

Waste Characterization

This waste was not available for sampling under the sampling schedule. Novartis reported the following total concentration: ammonium phosphate (10,000 - 350,000 mg/kg), ammonia as nitrogen (5,000 - 50,000 mg/kg), ammonium formate (1,000 - 60,000 mg/kg), cyanide (1 - 20 mg/kg) and acetonitrile (0 - 10,000 mg/kg).

Results of Initial Screening Analysis

This waste did not warrant further assessment because it is managed in the on-site wastewater treatment system that does not use land-based management units or in an on-site non-hazardous incinerator that is regulated under local air permits. The preferred management method is to reuse the waste as a nutrient source in the biotreatment system, with incineration only when this is not possible due to the solution becoming spent or when the concentrations of phosphate and ammonia are incompatible with the wastewater treatment system. We believe the levels of organonitrile compounds do not pose a risk under either management scenario. The wastewater treatment scenario results in the destruction of the compounds via biodegradation and the incineration scenario would also result in destruction of the volatile organonitriles. Additionally, emissions from the on-site incinerator would be regulated, if necessary, under the planned Hydrogen Cyanide MACT standards.

3.1.16 Organic Layer from Wastewater Collection Tank

Waste Generation

At one facility, wastewater is sent to a wastewater collection tank prior to treatment. An organic layer accumulates on top of the liquid surface and is removed periodically.

Waste Management

This waste sent for treatment at a Subtitle C incinerator. **Table 3.25** presents the management practice used by Rohm and Haas for this waste.

Table 3.25 Waste Management for Organic Layer from Wastewater Collection Tank

Facility	Waste (RIN #)	Final Management	Total Volume (MT/yr)
Rohm and Haas	Organic Layer from Wastewater Collection (RIN 9)	Off-site Subtitle C incineration	43.3 (1993)

Waste Characterization

This waste was not available for sampling under the sampling schedule. However, Rohm and Haas identified the waste as a characteristically ignitable hazardous waste (D001).

Results of Initial Screening Analysis

This waste is managed as characteristically hazardous in accordance with applicable Subtitle C standards. Further, the waste is generated from the treatment of predominantly non-HCN wastewater from other unrelated petrochemical processes at the facility. Only ten percent of the wastewater throughput in the tank generating this waste is associated with HCN production; the percentage contribution from the HCN process to this oily layer is likely to be much lower, because other petrochemical processes on-site are the likely sources of the organic material.
This waste did not warrant further assessment.

3.2 Wastes Outside the Scope of the Consent Decree

Some facilities reported refractory brick, absorber and pipe scale, debris, and used gaskets that are outside the scope of the consent decree. These residuals are structural components of the plant where production takes place rather than a waste from the "production" of hydrogen cyanide.

APPENDIX A

Comparison of Facility Split-Sample Analytical Results with EPA's Record Sampling Results

COMPARISON OF RESULTS REPORTED BY DUPONT-MEMPHIS (FACILITY) WITH RESULTS REPORTED BY APPL, INC. (LABORATORY)

Sample	Ammonia Rectifier Bottoms, Sample #DM-1-HC-03		
Target Analyte	**Facility Results, mg/L**	**Laboratory Results, mg/L**	**Relative Percent Difference, % [1]**
Cyanide, Free	9.64	<0.01 [2]	200.0% [3]
Cyanide, Total	8.69	4.68	60.0% [4]
Ammonia	75.3	67.8	10.5%
Arsenic	<0.005	<0.005	
Barium	<0.200	<0.005	
Cadmium	<0.002	<0.005	
Chromium	0.009	0.0181	-67.2% [5]
Lead	<0.003	0.0035	200.0% [5]
Silver	<0.005	<0.001	
Mercury	<0.0002	<0.0002	
Hexavalent Chromium	<0.02	<0.02	

Sample	**HCN Stripper Bottoms, Sample #DM-1-HC-01**		
Target Analyte	**Facility Results, mg/L**	**Laboratory Results, mg/L**	**Relative Percent Difference, %**
Cyanide, Free	23.0	0.403 [2]	193.1% [3]
Cyanide, Total	21.2	19.4	8.9%
Ammonia	76.4	66.0	14.6%
Arsenic	<0.005	<0.005	
Barium	<0.200	0.0899	200.0% [6]
Cadmium	<0.002	<0.005	
Chromium	0.012	0.0156	-26.1%
Lead	<0.003	<0.003	
Silver	<0.005	<0.001	
Mercury	<0.0002	0.0002	200.0% [5]
Acetonitrile	45.7	96 [7]	-71.0%
Acrylonitrile	<0.02	<0.002	

Sample	**Ammonia Recovery Filter, Sample #DM-1-HC-04**		
Target Analyte	**Facility Results, mg/kg**	**Laboratory Results, mg/kg**	**Relative Percent Difference, %**
Cyanide, Free	4.18	140 [2]	-188.4% [4]

Target Analyte	Facility Results, mg/kg	Laboratory Results, mg/kg	Relative Percent Difference, %
Cyanide, Total	186	N/A	
Ammonia	25,200	N/A	
Arsenic	9.5	<5	200.0% [5]
Barium	<2	32.5	200.0% [4]
Cadmium	<0.2	<5	
Chromium	18.4	209	-167.6% [4]
Lead	0.6	<5	200.0% [6]
Silver	<0.5	<1	
Mercury	<0.10	<0.1	
% Moisture	0.05	5.7	-196.5% [4]

Sample	8 Hr. Pond Inlet, Sample #DM-1-HC-07		
Target Analyte	**Facility Results, mg/L**	**Laboratory Results, mg/L**	**Relative Percent Difference, %**
Cyanide, Free	0.29	<0.010 [2]	200.0% [8]
Cyanide, Total	2.95	2.27	26.1%
Ammonia	70.5	39.6	56.1% [4]
Arsenic	<0.005	<0.005	
Barium	<0.200	0.0517	200.0% [6]
Cadmium	<0.002	<0.005	
Chromium	0.039	<0.005	200.0% [4]
Lead	<0.003	<0.003	
Silver	<0.005	<0.001	
Acetonitrile	25.1	51 [7]	-68.1%
Acrylonitrile	<0.02	0.020	200.0% [5]

Sample	8 Hr. Pond Outlet, Sample #DM-1-HC-08		
Target Analyte	**Facility Results, mg/L**	**Laboratory Results, mg/L**	**Relative Percent Difference, %**
Cyanide, Free	0.11	<0.010 [2]	200.0% [8]
Cyanide, Total	0.90	0.638	34.1%
Ammonia	62.8	49.7	23.3%
Arsenic	<0.005	<0.005	
Barium	<0.200	0.104	200.0% [6]
Cadmium	<0.002	<0.005	
Chromium	0.073	0.0151	200.0% [4]
Lead	<0.003	0.0088	200.0% [5]
Silver	<0.005	<0.001	
Acetonitrile	24.0	50 [7]	-70.3%

Acrylonitrile	<0.02	0.013	200.0% [6]

1. The QC limit of 50% relative percent difference that was established for field duplication was used to evaluate these results. In calculating relative percent difference, zero was used for a non-detect result.

2. Holding time for this analysis was exceeded; results should be considered biased low.

3. Although the result reported by the laboratory for amenable cyanide should be considered biased low because of holding time exceedance.

4. Upon discussion with the facility, it was determined that the method they were using for determining total and free or amenable cyanide was significantly different than the method the laboratory was using, which can explain the difference in the sample results.

5. Because sample results were close to the reporting limit (<5x the reporting limit), a relative percent difference greater than 50% is not considered significant.

6. Because of differences in reporting limits, these results can be considered to agree: the detectable result reported by the laboratory is less than the reporting limit used by the facility, or the detectable result reported by the facility is less than the reporting limit used by the laboratory.

7. In reporting this result, the laboratory applied an "E" qualifier and stated that the result is estimated due to interference.

8. The difference in sample results may be explained by the fact that the results reported by the laboratory should be considered to be biased low due to holding time exceedance.

Rohm and Haas - Comparison of EPA Sample Results and Rohm and Haas Sample Results [1]

Laboratory Sample Number	9H0P003008				9H0P004001				9H0P004008			
EPA Sample Number	RH-1-HC-01 [2]		RH-1-HC-01-S		RH-1-HC-02 [2]		RH-1-HC-02-S		RH-1-HC-03 [2]		RH-1-HC-03-S	
Date Sampled	07/28/1999		07/28/1999		07/28/1999		07/28/1999		07/28/1999		07/28/1999	
Sample Description	HCN purification wastewater		HCN purification wastewater		Wastewater to wastewater stripper		Wastewater to wastewater stripper		Wastewater from wastewater stripper		Wastewater from wastewater stripper	
Result Type	Total		Total		Total		Total		Total		Total	
Units	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Target Analyte	**Result**	**DQ [3]**	**Result**	**RPD [4]**	**Result**	**DQ**	**Result**	**RPD**	**Result**	**DQ**	**Result**	**RPD**
Inorganics												
Antimony	<0.0060	U	<0.020		<0.0060	U	<0.020		<0.0060	U	<0.020	
Arsenic	<0.0020	U	<0.010		<0.0020	U	<0.010		<0.0020	U	<0.010	
Barium	<2.0	UL	<0.005		<2.0	UL	0.023		<2.0	UL	0.018	
Boron	<0.0038	U	<0.010		<0.0038	U	0.012		<0.0038	U	0.011	
Chromium	<0.10	U	0.055		<0.10	U	0.059		<0.10	U	0.048	
Chromium $^{6+}$	<0.10	R	<0.01		0.040	R	<0.01		<0.10	R	<0.01	
Cobalt	<0.0047	U	<0.005		<0.0047	U	<0.005		<0.0047	U	<0.005	
Copper	5.4	K	4.86	10.5%	3.5	K	3.08	12.8%	4.1	K	3.68	10.8%
Lead	<0.015	U	<0.010		<0.015	U	<0.010		<0.015	U	<0.010	
Nickel	0.17		0.094	57.6%	<0.10	U	0.073		<0.10	U	0.067	
Selenium	<0.050	U	<0.02		<0.050	U	<0.02		<0.050	U	<0.02	
Silver	<0.0049	U	<0.001		<0.0049	U	0.001		<0.0049	U	0.001	
Thallium	<0.0050	U	<0.003		<0.0050	U	<0.003		<0.0050	U	<0.003	
Titanium	0.0081	B	<1.2		<0.0050	U	<1.2		<0.0050	U	<1.2	
Vanadium	<0.0050	U	<0.005		<0.0050	U	<0.005		<0.0050	U	<0.005	
Zinc	0.61	B	0.019	187.9%	0.073	B	0.116	45.5%	0.11	B	0.094	15.7%
Ammonia Nitrogen	1430		570	86.0%	1360		573	81.4%	173		139	21.8%
Nitrite Nitrogen	<0.050	UL	<0.01		<0.050	UL	<0.01		<0.05	UL	<0.01	
Nitrate Nitrogen	<0.050	UL	0.40		0.12	B	2.35	180.6%	0.33	B	1.50	127.9%
Amenable CN	11.7	K	4.63	86.6%	N/A [5]		421		5.2	K	3.31	44.4%
Total CN	11.7	L	4.97	80.7%	N/A [5]		432		5.2	L	3.38	42.4%
TOC	970		1085	11.2%	950		939	1.2%	340		297	13.5%
Volatiles												

Rohm and Haas - Comparison of EPA Sample Results and Rohm and Haas Sample Results [1]

Laboratory Sample Number	9H0P003008				9H0P004001				9H0P004008			
EPA Sample Number	RH-1-HC-01 [2]		RH-1-HC-01-S		RH-1-HC-02 [2]		RH-1-HC-02-S		RH-1-HC-03 [2]		RH-1-HC-03-S	
Date Sampled	07/28/1999		07/28/1999		07/28/1999		07/28/1999		07/28/1999		07/28/1999	
Sample Description	HCN purification wastewater		HCN purification wastewater		Wastewater to wastewater stripper		Wastewater to wastewater stripper		Wastewater from wastewater stripper		Wastewater from wastewater stripper	
Result Type	Total		Total		Total		Total		Total		Total	
Units	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Target Analyte	**Result**	**DQ [3]**	**Result**	**RPD [4]**	**Result**	**DQ**	**Result**	**RPD**	**Result**	**DQ**	**Result**	**RPD**
Acetone	4	L	<0.1		240		544	77.6%	0.1		<0.1	
2-Butanone	0.05	L	N/R		<0.5	U	N/R		<0.5	U	N/R	
Benzene	<0.005	R	<0.005		<0.05	U	0.007		<0.05	U	<0.005	
4-Methyl-2-pentanone	0.01	L	<0.05		<0.5	U	<0.05		<0.5	U	<0.05	
2-Hexanone	0.01	L	N/R		<0.5	U	N/R		<0.5	U	N/R	
Methacrylonitrile	<0.002	R	<0.002		<0.05	U	0.037		<0.05	UL	<0.002	
Acetonitrile	55	L	<0.005		33		297	160.0%	<0.5	U	<0.005	
Acrylonitrile	0.006	L	<0.006		N/A		2.55		N/A		0.017	
Physical Properties												
pH, pH units	1.5		1.55	3.3%	9.1		8.84	2.9%	6.2		6.48	4.4%
Specific gravity (unitless)	1.0		1.005	0.5%	1.0		1.000	0.0%	1.0		1.001	0.1%
TSS, mg/L	22.0		52	81.1%	23.0		28	19.6%	23.0		56	83.5%

Rohm and Haas - Comparison of EPA Sample Results and Rohm and Haas Sample Results [1]

Laboratory Sample Number	9H0P003001				9H0P002001				9H0P002008			
EPA Sample Number	RH-1-HC-04 [2]		RH-1-HC-04-S		RH-1-HC-06 [2]		RH-1-HC-06-S		RH-1-HC-07 [2]		RH-1-HC-07-S	
Date Sampled	07/28/1999		07/28/1999		07/28/1999		07/28/1999		07/28/1999		07/28/1999	
Sample Description	Wastewater from secondary API separator		Wastewater from secondary API separator		Ammonia purification wastewater		Ammonia purification wastewater		Ammonia purification wastewater (field duplicate)		Ammonia purification wastewater (field duplicate)	
Result Type	Total		Total		Total		Total		Total		Total	
Units	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Target Analyte	**Result**	**DQ**	**Result**	**RPD**	**Result**	**DQ**	**Result**	**RPD**	**Result**	**DQ**	**Result**	**RPD**
Inorganics												
Antimony	<0.0060	U	<0.020		<0.0060	U	<0.020		<0.0060	U	<0.020	
Arsenic	0.0046		<0.010		<0.0020	U	<0.010		<0.0020	U	<0.010	
Barium	<2.0	UL	0.093		<2.0	UL	<0.005		<2.0	UL	<0.005	
Boron	0.38		0.321	16.8%	<0.0038	U	<0.010		<0.0038	U	<0.010	
Chromium	0.11		0.091	18.9%	<0.10	U	<0.005		<0.10	U	<0.005	
Chromium $^{6+}$	<0.10	R	<0.01		<0.10	R	<0.01		<0.10	R	<0.01	
Cobalt	0.0049		<0.005		<0.0047	U	<0.005		<0.0047	U	<0.005	
Copper	1.1	K	0.986	10.9%	<1.3	U	0.053		<1.3	U	<0.010	
Lead	0.086		0.089	3.4%	<0.015	U	<0.010		<0.015	U	<0.010	
Nickel	0.29		0.237	20.1%	<0.10	U	0.007		<0.10	U	0.006	
Selenium	<0.050	U	<0.02		<0.050	U	<0.02		<0.050	U	<0.02	
Silver	<0.0049	U	<0.001		<0.0049	U	0.002		<0.0049	U	0.002	
Thallium	<0.0050	U	<0.003		<0.0050	U	<0.003		<0.0050	U	<0.003	
Titanium	0.023	B	<1.2		<0.0050	U	<1.2		0.0091	B	<1.2	
Vanadium	0.016		<0.020		<0.0050	U	<0.005		<0.0050	U	<0.005	
Zinc	0.20	B	0.147	30.5%	<0.020	UL	0.106		0.027	B	0.095	111.5%
Ammonia Nitrogen	93.0		89	4.4%	60.0		48	22.2%	56.0		59	5.2%
Nitrite Nitrogen	0.056	L	<0.01		<0.050	UL	0.32		<0.050	UL	0.49	
Nitrate Nitrogen	1.1	L	2.77	86.3%	<0.050	UL			<0.050	UL		
Amenable CN	<0.020	U	0.03		340	K	333	2.1%	350	K	173	67.7%
Total CN	0.099	L	0.08	21.2%	2380	J	337	150.4%	302	L	178	51.7%
TOC	320		312	2.5%	830		615	29.8%	930		608	41.9%

Rohm and Haas - Comparison of EPA Sample Results and Rohm and Haas Sample Results [1]

Laboratory Sample Number	9H0P003001				9H0P002001				9H0P002008			
EPA Sample Number	RH-1-HC-04 [2]		RH-1-HC-04-S		RH-1-HC-06 [2]		RH-1-HC-06-S		RH-1-HC-07 [2]		RH-1-HC-07-S	
Date Sampled	07/28/1999		07/28/1999		07/28/1999		07/28/1999		07/28/1999		07/28/1999	
Sample Description	Wastewater from secondary API separator		Wastewater from secondary API separator		Ammonia purification wastewater		Ammonia purification wastewater		Ammonia purification wastewater (field duplicate)		Ammonia purification wastewater (field duplicate)	
Result Type	Total		Total		Total		Total		Total		Total	
Units	mg/L		mg/L		mg/L		mg/L		mg/L		mg/L	
Target Analyte	**Result**	**DQ**	**Result**	**RPD**	**Result**	**DQ**	**Result**	**RPD**	**Result**	**DQ**	**Result**	**RPD**
Volatiles												
Acetone	50	L	135	91.9%	<0.005	R	<0.1		<0.005	R	<0.1	
2-Butanone	0.02	L	N/R		<0.005	R	N/R		<0.005	R	N/R	
Benzene	0.02	L	0.016	22.2%	<0.005	R	<0.005		<0.005	R	<0.005	
4-Methyl-2-pentanone	0.1	L	0.178	56.1%	<0.005	R	<0.05		<0.005	R	<0.05	
2-Hexanone	<0.005	R	N/R		<0.02	R	N/R		<0.005	R	N/R	
Methacrylonitrile	0.02	L	<0.002		<0.002	R	<0.002		<0.002	R	<0.002	
Acetonitrile	<0.005	R	<0.005		<0.005	R	<0.005		<0.005	R	<0.005	
Acrylonitrile	N/A		<0.006		0.08	L	0.065	20.7%	0.03	L	0.028	6.9%
Physical Properties												
pH, pH units	6.9		6.92	0.3%	10.9		10.94	0.4%	10.9		11.05	1.4%
Specific gravity (unitless)	1.0		1.005	0.5%	1.0		1.002	0.2%	1.0		1.003	0.3%
TSS, mg/L	58.0		76	26.9%	15.0		44	98.3%	25.0		40	46.2%

Rohm and Haas - Comparison of EPA Sample Results and Rohm and Haas Sample Results [1]

Laboratory Sample Number	9H0P004016											
EPA Sample Number	RH-1-HC-05						RH-1-HC-05-S					
Date Sampled	07/28/1999						07/28/1999					
Sample Description	Ammonia recycle filters						Ammonia recycle filters					
Result Type	Total		TCLP		SPLP		Total		TCLP		SPLP	
Units	mg/kg		mg/L		mg/L		mg/kg		mg/L		mg/L	
Target Analyte	**Result**	**DQ**	**Result**	**DQ**	**Result**	**DQ**	**Result**	**RPD**	**Result**	**RPD**	**Result**	**RPD**
Inorganics												
Antimony	81.5		0.55	J	0.59		5.93	172.9%	0.346	45.5%	0.447	27.6%
Arsenic	5.8		0.045	L	0.039		<0.05		0.02	76.9%	0.033	16.7%
Barium	2.1		<2.0	U	<2.0	U	<0.250		0.252		0.454	
Boron	<0.38	U	0.20	K	0.019	B	2.81		0.103	64.0%	0.273	174.0%
Chromium	204		0.78		1.0		<1.00		0.860	9.8%	0.827	18.9%
Chromium $^{6+}$	<1.0	U	N/A		N/A		<0.05		N/R		N/R	
Cobalt	0.92		<0.0047	U	0.0053		<0.250		0.005		<0.005	
Copper	19.1		<1.3	U	<1.3	U	10.3	59.9%	<0.010		0.018	
Lead	<2.8	U	<0.015	U	<0.015	U	<1.00		<0.010		<0.010	
Nickel	1460		0.50	J	0.61		156	161.4%	0.548	9.2%	0.559	8.7%
Selenium	<5.0	UL	<0.050	U	<0.050	U	<1.00		<0.020		<0.020	
Silver	<0.47	U	<0.0049	U	<0.0049	U	<0.50		<0.015		<0.015	
Thallium	<2.7	U	<0.0050	UL	<0.0050	U	<1.0		<0.003		0.003	
Titanium	8.7		<0.0050	U	<0.0050	U	347	190.2%	<1.2		<1.2	
Vanadium	4.0		<0.0050	U	<0.0050	U	<1.0		<0.020		<0.05	
Zinc	44.1		0.31	J	0.091		1.47	187.1%	0.181	52.5%	0.350	117.5%
Ammonia Nitrogen	N/A		N/A		N/A		20600		N/R		N/R	
Nitrite Nitrogen (soluble)	<0.80	UL	N/A		N/A		<5.00		N/R		N/R	
Nitrate Nitrogen (soluble)	1.1	B	N/A		N/A		<10.0		N/R		N/R	
Amenable CN	N/A		N/A		N/A		351		N/R		N/R	
Total CN	4.0	L	N/A [6]		2.4 [6]	L	464	196.6%	N/R		N/R	
TOC	760,000		N/A		N/A		6.72% [7]		N/R		N/R	
Volatiles												
Acetone	N/A		<0.005	U	N/A		N/A		N/R		N/R	

Rohm and Haas - Comparison of EPA Sample Results and Rohm and Haas Sample Results [1]

Laboratory Sample Number	9H0P004016											
EPA Sample Number	RH-1-HC-05						RH-1-HC-05-S					
Date Sampled	07/28/1999						07/28/1999					
Sample Description	Ammonia recycle filters						Ammonia recycle filters					
Result Type	Total		TCLP		SPLP		Total		TCLP		SPLP	
Units	mg/kg		mg/L		mg/L		mg/kg		mg/L		mg/L	
Target Analyte	**Result**	**DQ**	**Result**	**DQ**	**Result**	**DQ**	**Result**	**RPD**	**Result**	**RPD**	**Result**	**RPD**
2-Butanone	N/A		<0.005	U	N/A		N/R		N/R		N/R	
Benzene	N/A		<0.005	U	N/A		N/A		N/R		N/R	
4-Methyl-2-pentanone	N/A		<0.005	U	N/A		N/A		N/R		N/R	
2-Hexanone	N/A		<0.005	U	N/A		N/R		N/R		N/R	
Methacrylonitrile	N/A		<0.002	U	N/A		N/A		N/R		N/R	
Acetonitrile	N/A		<0.005	U	N/A		N/A		N/R		N/R	
Acrylonitrile	N/A		<0.005	U	N/A		N/A		N/R		N/R	
Physical Properties												
pH, pH units	6.7		N/A		N/A		6.52	2.7%	N/R		N/R	
Moisture content, %	37.0		N/A		N/A		66.3	56.7%	N/A		N/A	

Rohm and Haas - Comparison of EPA Sample Results and Rohm and Haas Sample Results [1]

Laboratory Sample Number	9H0P001004											
EPA Sample Number	RH-1-HC-08						RH-1-HC-08-S					
Date Sampled	07/28/1999						07/28/1999					
Sample Description	Wastewater treatment plant sludge						Wastewater treatment plant sludge					
Result Type	Total		TCLP		SPLP		Total		TCLP		SPLP	
Units	mg/kg		mg/L		mg/L		mg/kg		mg/L		mg/L	
Target Analyte	**Result**	**DQ**	**Result**	**DQ**	**Result**	**DQ**	**Result**	**RPD**	**Result**	**RPD**	**Result**	**RPD**
Inorganics												
Antimony	<2.1	U	<0.0060	U	<0.0060	U	<1.0		<0.020		<0.020	
Arsenic	0.58		<0.0020	UL	<0.0020	U	<0.50		<0.01		<0.020	
Barium	13.7		<2.0	U	<2.0	U	14.6	6.4%	0.138		0.110	
Boron	1.1		0.17	K	0.030	B	<0.7		0.096	55.6%	0.157	135.8%
Chromium	24.7		<0.10	U	<0.10	U	<1.00		0.009		<0.005	
Chromium 6+	<1.0	U	N/A		N/A		<0.05		N/R		N/R	
Cobalt	3.3		0.0055		<0.0047	U	3.76	13.0%	0.008	37.0%	<0.005	
Copper	154		<1.3	U	<1.3	U	190	20.9%	0.043		0.022	
Lead	10.9		<0.015	U	<0.015	U	13.6	22.0%	<0.010		<0.010	
Nickel	30.8		0.10		<0.10	U	37.1	18.6%	0.197	65.3%	0.011	
Selenium	13.5		<0.050	U	<0.050	U	<1.00		<0.020		<1.2	
Silver	<0.47	UL	<0.0049	U	<0.0049	U	<0.50		0.001		0.001	
Thallium	<2.7	U	<0.0050	UL	<0.0050	U	<1.0		<0.003		<0.003	
Titanium	6.6		<0.0050	U	<0.0050	U	<0.5		<1.2		<1.2	
Vanadium	3.0		<0.0050	U	<0.0050	U	2.67	11.6%	<0.005		<0.05	
Zinc	33.1		0.16		<0.020	U	41.0	21.3%	0.190	17.1%	0.198	
Ammonia Nitrogen	N/A		N/A		N/A		706		N/R		N/R	
Nitrite Nitrogen (soluble)	<1.0	UL	N/A		N/A		0.02		N/R		N/R	
Nitrate Nitrogen (soluble)	<1.0	UL	N/A		N/A		0.49		N/R		N/R	
Amenable CN	N/A		N/A		N/A		1.9		N/R		N/R	
Total CN	2.9		N/A [6]		0.024 [6]	L	3.8	26.9%	N/R		N/R	
TOC	580,000		N/A		N/A		3.30%		N/R		N/R	
Volatiles												
Acetone	N/A		0.6	L	N/A		N/A		N/R		N/R	

Rohm and Haas - Comparison of EPA Sample Results and Rohm and Haas Sample Results [1]

Laboratory Sample Number	9H0P001004											
EPA Sample Number	RH-1-HC-08						RH-1-HC-08-S					
Date Sampled	07/28/1999						07/28/1999					
Sample Description	Wastewater treatment plant sludge						Wastewater treatment plant sludge					
Result Type	Total		TCLP		SPLP		Total		TCLP		SPLP	
Units	mg/kg		mg/L		mg/L		mg/kg		mg/L		mg/L	
Target Analyte	**Result**	**DQ**	**Result**	**DQ**	**Result**	**DQ**	**Result**	**RPD**	**Result**	**RPD**	**Result**	**RPD**
2-Butanone	N/A		<0.005	R	N/A		N/R		N/R		N/R	
Benzene	N/A		<0.005	R	N/A		N/A		N/R		N/R	
4-Methyl-2-pentanone	N/A		<0.005	R	N/A		N/A		N/R		N/R	
2-Hexanone	N/A		<0.005	R	N/A		N/R		N/R		N/R	
Methacrylonitrile	N/A		<0.002	R	N/A		N/A		N/R		N/R	
Acetonitrile	N/A		<0.005	R	N/A		N/A		N/R		N/R	
Acrylonitrile	N/A		<0.005	R	N/A		N/A		N/R		N/R	
Physical Properties												
pH, pH units	6.6		N/A		N/A		6.16	6.9%	N/R		N/R	
Moisture content, %	83.5		N/A		N/A		83.8	0.4%	N/A		N/A	

Rohm and Haas - Comparison of EPA Sample Results and Rohm and Haas Sample Results [1]

Laboratory Sample Number	AP82588											
EPA Sample Number	RH-1-HC-10						RH-1-HC-10-S					
Date Sampled	08/02/1999						08/02/1999					
Sample Description	Feed gas filter						Feed gas filter					
Result Type	Total		TCLP		SPLP		Total		TCLP		SPLP	
Units	mg/kg		mg/L		mg/L		mg/kg		mg/L		mg/L	
Target Analyte	**Result**	**DQ**	**Result**	**DQ**	**Result**		**Result**	**DQ**	**Result**	**DQ**	**Result**	**DQ**
Inorganics												
Antimony	<5	U	<0.5	U	<0.05		<1.0		0.005		<0.003	
Arsenic	<5	U	<0.5	U	<0.05		0.50		<0.01		<0.020	
Barium	168		<2	U	0.0690		120	33.3%	0.420		0.136	65.4%
Boron	17900		7.4		<0.5		14400	21.7%	0.958	154.2%	0.609	
Chromium	229		0.100		<0.05		146	44.3%	0.283	95.6%	0.024	
Chromium $^{6+}$	3.6	L	N/A [6]		0.02 [6]		<0.05		N/R		N/R	
Cobalt	6.3		<0.05	U	<0.05		3.30	62.5%	0.020		<0.005	
Copper	46.8		<0.25	U	<0.05		107	78.3%	0.024		<0.010	
Lead	18.5		<0.5	U	<0.03		2.85	146.6%	<0.010		<0.010	
Nickel	91.0		0.4		<0.05		93.8	3.0%	0.655	48.3%	0.014	
Selenium	<5	U	<0.5	U	<0.05		<1.00		<0.020		<0.020	
Silver	<1	U	<0.1	U	<0.01		1.06		<0.005		<0.001	
Thallium	<20	U	<2	U	<0.05		<2.7		<0.005		<0.003	
Titanium	1600		0.053		<0.05		10.9	197.3%	0.010	136.5%	0.010	
Vanadium	55.6		<0.05	U	<0.05		10.6	136.0%	<0.005		<0.005	
Zinc	1060		13.0		<0.5		523	67.8%	16.4	23.1%	0.145	
Ammonia Nitrogen	N/A		N/A		N/A		N/A		N/A		N/A	
Nitrite Nitrogen	<2	UL	N/A		N/A		0.02		N/R		N/R	
Nitrate Nitrogen	6.3	L	N/A		N/A		0.32	180.7%	N/R		N/R	
Amenable CN	N/A		N/A		N/A		<1.0		N/R		N/R	
Total CN	<0.5	UL	N/A		N/A		<1.0		0.021		<0.020	
TOC, mg/kg	1100	L	N/A		N/A		<0.05%		N/R		N/R	
Volatiles												
Acetone	N/A		N/A		N/A		<0.1		N/R		N/R	

Rohm and Haas - Comparison of EPA Sample Results and Rohm and Haas Sample Results [1]

Laboratory Sample Number	AP82588											
EPA Sample Number	RH-1-HC-10						RH-1-HC-10-S					
Date Sampled	08/02/1999						08/02/1999					
Sample Description	Feed gas filter						Feed gas filter					
Result Type	Total		TCLP		SPLP		Total		TCLP		SPLP	
Units	mg/kg		mg/L		mg/L		mg/kg		mg/L		mg/L	
Target Analyte	**Result**	**DQ**	**Result**	**DQ**	**Result**		**Result**	**DQ**	**Result**	**DQ**	**Result**	**DQ**
2-Butanone	N/A		N/A		N/A		N/R		<0.05		N/R	
Benzene	N/A		N/A		N/A		<0.005		<0.005		N/R	
4-Methyl-2-pentanone	N/A		N/A		N/A		<0.05		N/R		N/R	
2-Hexanone	N/A		N/A		N/A		<0.005		N/R		N/R	
Methacrylonitrile	N/A		N/A		N/A		N/A		<2		<2	
Acetonitrile	N/A		N/A		N/A		N/A		<20		<20	
Acrylonitrile	N/A		N/A		N/A		N/A		<20		<20	
Physical Properties												
pH, pH units	7.2		N/A		N/A		8.80		N/A		N/A	
Specific gravity (unitless)	1.6		N/A		N/A		N/A		N/A		N/A	
Moisture content, %	<2	U	N/A		N/A		0.1%		N/A		N/A	

Rohm and Haas - Comparison of EPA Sample Results and Rohm and Haas Sample Results [1]

Laboratory Sample Number	9H0P001001				9H0P001002			
EPA Sample Number	RH-1-HC-FB		RH-1-HC-FB-S		RH-1-HC-EB		RH-1-HC-EB-S	
Date Sampled	07/28/1999		07/28/1999		07/28/1999		07/28/1999	
Sample Description	Field blank		Field blank		Equipment blank		Equipment blank	
Result Type	Total		Total		Total		Total	
Units	mg/L		mg/L		mg/L		mg/L	
Target Analyte	**Result**	**DQ**	**Result**	**RPD**	**Result**	**DQ**	**Result**	**RPD**
Inorganics								
Antimony	<0.0060	U	N/A		<0.0060	U	<0.020	
Arsenic	<0.0020	U	N/A		<0.0020	U	<0.010	
Barium	<2.0	U	N/A		<2.0	U	<0.005	
Boron	<0.0038	U	N/A		<0.0038	U	<0.010	
Chromium	<0.10	U	N/A		<0.10	U	<0.005	
Chromium $^{6+}$	<0.10	R	N/A		<0.10	R	<0.01	
Cobalt	<0.0047	U	N/A		<0.0047	U	<0.005	
Copper	0.051		N/A		0.051		0.047	8.2%
Lead	<0.015	U	N/A		<0.015	U	<0.010	
Nickel	<0.10	U	N/A		<0.10	U	0.005	
Selenium	<0.050	U	N/A		<0.050	U	<0.02	
Silver	<0.0049	U	N/A		<0.0049	U	<0.001	
Thallium	<0.0050	U	N/A		<0.0050	U	<0.003	
Titanium	<0.0050	U	N/A		0.16		<1.2	
Vanadium	<0.0050	U	N/A		<0.0050	U	<0.005	
Zinc	<0.020	U	N/A		0.23		0.023	163.6%
Ammonia Nitrogen	<1.0	U	N/A		<1.0	U	1	
Nitrite Nitrogen	<0.050	U	N/A		<0.050	U	0.29	
Nitrate Nitrogen	0.097		N/A		0.085			
Amenable CN	<0.020	U	N/A		<0.020	U	0.01	
Total CN	<0.020	U	N/A		<0.020	U	0.12	
TOC	<1.0	U	N/A		<1.0	U	3	
Volatiles								

Rohm and Haas - Comparison of EPA Sample Results and Rohm and Haas Sample Results [1]

Laboratory Sample Number	9H0P001001				9H0P001002			
EPA Sample Number	RH-1-HC-FB		RH-1-HC-FB-S		RH-1-HC-EB		RH-1-HC-EB-S	
Date Sampled	07/28/1999		07/28/1999		07/28/1999		07/28/1999	
Sample Description	Field blank		Field blank		Equipment blank		Equipment blank	
Result Type	Total		Total		Total		Total	
Units	mg/L		mg/L		mg/L		mg/L	
Target Analyte	**Result**	**DQ**	**Result**	**RPD**	**Result**	**DQ**	**Result**	**RPD**
Acetone	0.007		<0.1		0.008		<0.1	
2-Butanone	<0.005	U	N/R		<0.005	U	N/R	
Benzene	<0.005	U	<0.005		<0.005	U	<0.005	
4-Methyl-2-pentanone	<0.005	U	<0.05		<0.005	U	<0.05	
2-Hexanone	<0.005	U	N/R		<0.005	U	N/R	
Methacrylonitrile	<0.002	U	<0.002		<0.002	U	<0.002	
Acetonitrile	<0.005	U	545		<0.005	U	<0.005	
Acrylonitrile	<0.005	U	<0.006		<0.005	U	<0.006	
Physical Properties								
pH, pH units	5.1		N/A		5.1		10.94	72.8%
Specific gravity (unitless)	1.0		N/A		0.99		0.998	0.8%
TSS, mg/L	<5.0		N/A		<5.0		16	

[1] Sample numbers ending in "-S" were analyzed by Rohm and Haas. < = Less than the reporting limit specified. N/A = Not analyzed. N/R = Not reported.

[2] The laboratory stated that insufficient sample volume was available for TCLP and SPLP extractions. Based on the moisture content of these samples, it is likely that they contained less than 0.5% solids.

[3] DQ = Data Qualifier.

[4] RPD = Relative percent difference between EPA result and Rohm and Haas result. Only reported when analyte was detected in both samples.

[5] Not analyzed. Sample was lost during shipping (jar lid came off).

[6] TCLP/SPLP extraction was conducted using deionized water at a 20:1 ratio (deionized water: sample); therefore, the laboratory reported the result as SPLP leachate.

[7] Rohm and Haas reported these results as in units of ppm. However, based on the method used, it is assumed that these results are in units of percent.

APPENDIX B

PHONE LOGS, MAPS AND OTHER SUPPORTING MATERIALS