# BARIUM CARBONATE LISTING BACKGROUND DOCUMENT FOR THE INORGANIC CHEMICAL LISTING DETERMINATION

**This Document Does Not Contain Confidential Business Information**

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

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# 1. BARIUM CARBONATE SECTOR OVERVIEW

## 1.1 SECTOR DEFINITION, FACILITY NAMES AND LOCATIONS

The scope of the listing determination for the inorganic chemical industry includes those facilities in the United States which manufacture one of the fourteen chemicals specified in the Environmental Protection Agency's (EPA) consent decree with the Environmental Defense Fund ("consent decree"). Those facilities which solely distribute one of the fourteen chemicals without taking part in their manufacture are not within the scope of this listing determination and have not been assessed during this effort.

Barium carbonate is currently manufactured in the United States in significant amounts by two facilities. **Table 1.1** gives the name and location of the two producers.[1] **Figure 1.1** shows the geographical location of the facilities.

**Table 1.1 Barium Carbonate Producers**

| Facility Name | Facility Address |
|---|---|
| 1. Chemical Products Corporation (CPC) | 102 Old Mill Road<br>P.O. Box 2470<br>Cartersville, Georgia 30120 |
| 2. OSRAM SYLVANIA Products Inc. (OSRAM) | Hawes Street<br>Towanda, Pennsylvania 18848 |

CPC produces barium carbonate for the commercial market.[2] OSRAM does not sell its barium carbonate and produces the chemical solely for use as a feedstock in various internal manufacturing processes at the OSRAM Towanda facility. The EPA assessed both facilities in detail during this listing determination.

Cerac, Inc. reported in their response to the EPA's1998 RCRA §3007 Survey of the Inorganic Chemicals Industry ("1998 RCRA §3007 survey") that they manufactured a small quantity of barium carbonate in 1998 (10.017 kilograms) and generated similarly small quantities of waste (0.956 kg) . This facility is a manufacturer of relatively small quantities of many types of specialty chemicals for research and other purposes.[3] We did not specifically assess this facility during the listing determination because of the small quantities of product and waste the facility produces. However, wastes from

[1] Unless noted otherwise, the sources for specific information in this technical background document are the respective barium carbonate facilities' responses to the Environmental Protection Agency's 1998 RCRA §3007 Survey of the Inorganic Chemicals Industry.

[2] http://www.ceramics.com/cpc/products.html and http://www.ceramics.com/cpc/cpc.html

[3] http://www.cerac.com/profile/profile.htm

barium carbonate production at this facility remain subject to all applicable RCRA Subtitle C regulations.

Barium & Chemicals, Inc. of Steubenville, Ohio also received the 1998 RCRA §3007 survey. The company responded to the survey by stating that they are solely distributors, not manufacturers, of barium carbonate. The only barium carbonate produced on-site is that which is produced as a by-product of other manufacturing processes at the facility. This material is used on-site in other chemical manufacturing processes and is not sold. This facility, therefore, falls outside the scope of this listing determination and was not assessed during this listing effort.

## 1.2 PRODUCT NATURE, USAGE, AND MARKETS

The chemical formula for barium carbonate is $BaCO_3$. It is a white crystalline solid at room temperature, has a molecular weight of 197.37 gram/mol, melts at 1740 degrees Celsius (°C) and decomposes at 1300°C. It is a very dense material which is nearly insoluble in water and is only slightly soluble in carbonated water.[4]

Barium carbonate is second only to barite as the most commercially important barium chemical and has a wide range of uses. In 1989, 30% of barium carbonate was used in the glass industry, 30% in brick and clay products, 20% in barium chemicals manufacture, 5% in barium ferrite manufacture, 5% in photographic paper, and 10% in various other uses.[5]

Coarser grades of barium carbonate are used by the glass industry and fine, highly reactive grades are used by the chemical industry. Barium carbonate, acting as a flux for silica, is added to textile fiber glass, crown and flint optical glass, laboratory glassware, decorative glass, and frits for ceramics. Barium oxide, manufactured from barium carbonate, is integrated into the silicate structure of glass and increases its durability, weight, density, and refractive index. Additionally, the barium oxide enables glass to absorb X- rays, making it useful in television screen glass manufacturing.[6]

Barium carbonate is also used in the manufacturing of brick, tile, masonry cement, terra cotta, and sewer pipe. The chemical prevents scum formation in sewer pipes by precipitating calcium and magnesium as insoluble carbonates and by also precipitating sulfates and other ions.[7]

Barium carbonate is an additive in oil-well drilling muds. The barite suspensions used in the oil-well drilling industry can destabilize when soluble materials such as gypsum are present in the mud. The presence of gypsum leads to coagulation and a loss of consistency in the drilling muds. When added to the muds, barium carbonate precipitates the gypsum and prevents destabilization of the barite

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[4] Kirk Othmer Encyclopedia of Chemical Technology. Volume 3. Fourth Ed. 1992. p. 913.

[5] Kirk-Othmer Encyclopedia of Chemical Technology. Volume 3, 4th edition, 1992, p. 919.

[6] Ibid.

[7] Ibid.

suspension.[8]

When barium carbonate reacts with iron oxide in the presence of heat, barium ferrites form. Magnetically aligned barium ferrite can be pressed and sintered into a magnet for use in small motors or incorporated into plastic strips for use in appliances as a closure mechanism.[9]

Barium carbonate also reacts with titanium to form barium titanate, a ferroelectric material with a high dielectric constant. Barium titanate is most commonly used in transducers for ultrasonic technical devices used to emulsify liquids, mix powders or paint, and homogenize milk. It is also used in sonar equipment. In addition, barium carbonate is used in photographic paper manufacturing. The chemical is used to produce the barium sulfate which gives the photographic paper its flat white appearance. Lastly, barium carbonate has been used as a brine purification chemical in the chlor-alkali industry[10] and as an ingredient in rat poisons, enamels, rubber and paper.[11]

[8] Kirk-Othmer Encyclopedia of Chemical Technology. Volume 3, 4th edition, 1992, p. 919.

[9] Ibid.

[10] Ibid.

[11] http://www.bariumchemicals.com/barium.htm

**Figure 1.1 Geographical Distribution of Barium Carbonate Producers**[1]

[1] See **Table 1.1** for facility names and addresses.
Numbers on map correspond to facility numbers in table.

## 1.3 PRODUCTION QUANTITY

The 1998 production capacities for the two barium carbonate manufacturing facilities manufacturing large quantities of barium carbonate, Chemical Products Corporation and OSRAM SYLVANIA Products, Inc., are listed in **Table 1.2.** These quantities were reported by the facilities in their 1998 RCRA §3007 Survey responses.

**Table 1.2 Barium Carbonate Production Capacity**

| Facility Name | Facility Location | 1998 Production Quantity (MT) |
|---|---|---|
| Chemical Products Corporation | Cartersville, Georgia | Confidential Business Information |
| OSRAM SYLVANIA Products Inc. | Towanda, Pennsylvania | 34 |

## 1.4 PRODUCTION, PRODUCT, AND PROCESS TRENDS

Between 1975 and 1985, the barium carbonate manufacturing industry experienced a significant decline. Four plants reported manufacturing barium carbonate in 1975, but only two plants reported manufacturing significant quantities of the chemical in 1998. One reason for the decreased demand is the use of new technologies at chlor-alkali plants which have reduced the use of barium carbonate for sulfate removal in brine purification.[12]

# 2. OSRAM SYLVANIA PRODUCTS INC.—High Purity Barium Chloride Feedstock Process

OSRAM SYLVANIA Products Inc. uses commercially purchased high-purity barium chloride as their primary feedstock.[13] The facility dissolves the barium chloride solid in water, heats, and filters the resulting solution and precipitates barium carbonate by reacting the barium chloride solution with ammonium bicarbonate. The resulting barium carbonate precipitate is washed, filtered, dried, and sized before the facility utilizes it as a feedstock in other manufacturing processes at its facility. A simplified process flow diagram for barium carbonate production from high purity barium chloride solid is represented by **Figure 2.1**.

The facility also manufactures the following products: molybdenum and tungsten chemicals, rod, wire and fabricated parts, phosphors, and powders. The Towanda facility is also the site of a

[12] Engineering Analysis: Wastes in the Inorganic Chemicals Industry. Draft Report. Prepared by Versar Inc. and Jacobs Engineering Group for USEPA, Office of Solid Waste. December 12, 1985. p. 2-4 to 2-5.

[13] July 28, 1999 Phone Log, Ashley Allen, et al. (EPA) to William Schmieg (OSRAM SYLVANIA)

high-temperature metallurgy and inorganic chemistry laboratory.[14]

## 2.1 DESCRIPTION OF MANUFACTURING PROCESS

At the OSRAM facility, high-purity barium chloride salt[15] is dissolved in deionized water. The solution is heated and specific gravity and pH levels are adjusted to predetermined levels. The solution is filtered to remove suspended residual solids and the resulting filtration sludge discarded. Ammonium bicarbonate ($NH_4HCO_3$) solution is then pumped into the barium chloride solution to precipitate barium carbonate. Ammonium bicarbonate is fairly soluble in water, yielding bicarbonate ion. Bicarbonate ion dissociates slightly in solution and moves towards equilibrium with carbonate and hydrogen ions.

$$NH_4HCO_3 + H_2O \rightarrow H_3O^+ + CO_3^{-2} + NH_4^+$$

The barium ion reacts with the carbonate ion and precipitates as nearly insoluble barium carbonate, shifting the reaction equilibrium in the direction of barium carbonate.

$$CO_3^{-2} + Ba^{+2} \rightarrow BaCO_3$$

The overall reaction for the production of barium carbonate is:

$$BaCl_2 + NH_4HCO_3 \rightarrow BaCO_3 + NH_4Cl$$

Ammonia vapor from the addition of ammonium bicarbonate to barium chloride is vented to a scrubber. The scrubber's wastewater is piped directly to the OSRAM facility's on-site wastewater treatment plant.

The barium carbonate precipitate is allowed to settle out of solution and the ammoniated spent process solutions from the precipitation step, containing 50,000 ppm ammonia, are separated from the precipitate and sent to a covered storage tank with secondary containment.[16] This tank stores ammoniated spent process solutions from several different onsite manufacturing processes prior to their processing in the onsite ammonia reclamation unit (referred to by the facility as the ammonia stripper).[17] Accumulated solids from the ammoniated spent process solution storage tank are removed and discarded on an annual basis. The commingled ammoniated spent process solutions are piped directly to the ammonia reclamation unit where they are processed with lime to recover the ammonia they contain in the form of 28% ammonium hydroxide ($NH_4OH$) solution. Reclaimed ammonium hydroxide is reused in various processes within the OSRAM facility as a raw material or reactant, including the

[14] http://www.sylvania.com/aboutus/whereweare/pmc.htm#PMTP

[15] July 28, 1999 Phone Log, Ashley Allen, et al. (EPA) to William Schmieg (OSRAM SYLVANIA)

[16] July 28, 1999 Phone Log, Ashley Allen, et al. (EPA) to William Schmieg (OSRAM SYLVANIA)

[17] March 24, 2000 E-mail from OSRAM (Carmen Venezia) to EPA (Ashley L. Allen)

production of ammonium bicarbonate for use as a reagent in the barium carbonate production process.[18] The ammonium hydroxide is stored in a tank until it is used. Wastewater from the ammonia stripper is piped directly to the facility's wastewater treatment plant for treatment and disposal.

The barium carbonate precipitate is washed with deionized water and the resulting wash water is sent directly to the facility's wastewater treatment plant. The barium carbonate product is filtered, dried, and sized. Water vapor is vented to the atmosphere from the drying and sizing unit. Dust generated during the sizing step is captured by a dust collector and ultimately discarded. The final barium carbonate product is used internally within the OSRAM facility as a raw material for the production of OSRAM products.

The sludge from the facility's wastewater treatment plant is removed periodically for disposal. Wastewaters sent to the wastewater treatment plant are processed via elementary neutralization and filtration. The treated wastewater is discharged to the Susquehanna River under a National Pollutant Discharge Elimination System (NPDES) permit.

## 2.2 PRODUCTION TRENDS, CHANGES, AND IMPROVEMENTS

According to the OSRAM SYLVANIA facility, no changes in current production practices are anticipated for the near future.

[18] March 24, 2000 E-mail from OSRAM (Carmen Venezia) to EPA (Ashley L. Allen)

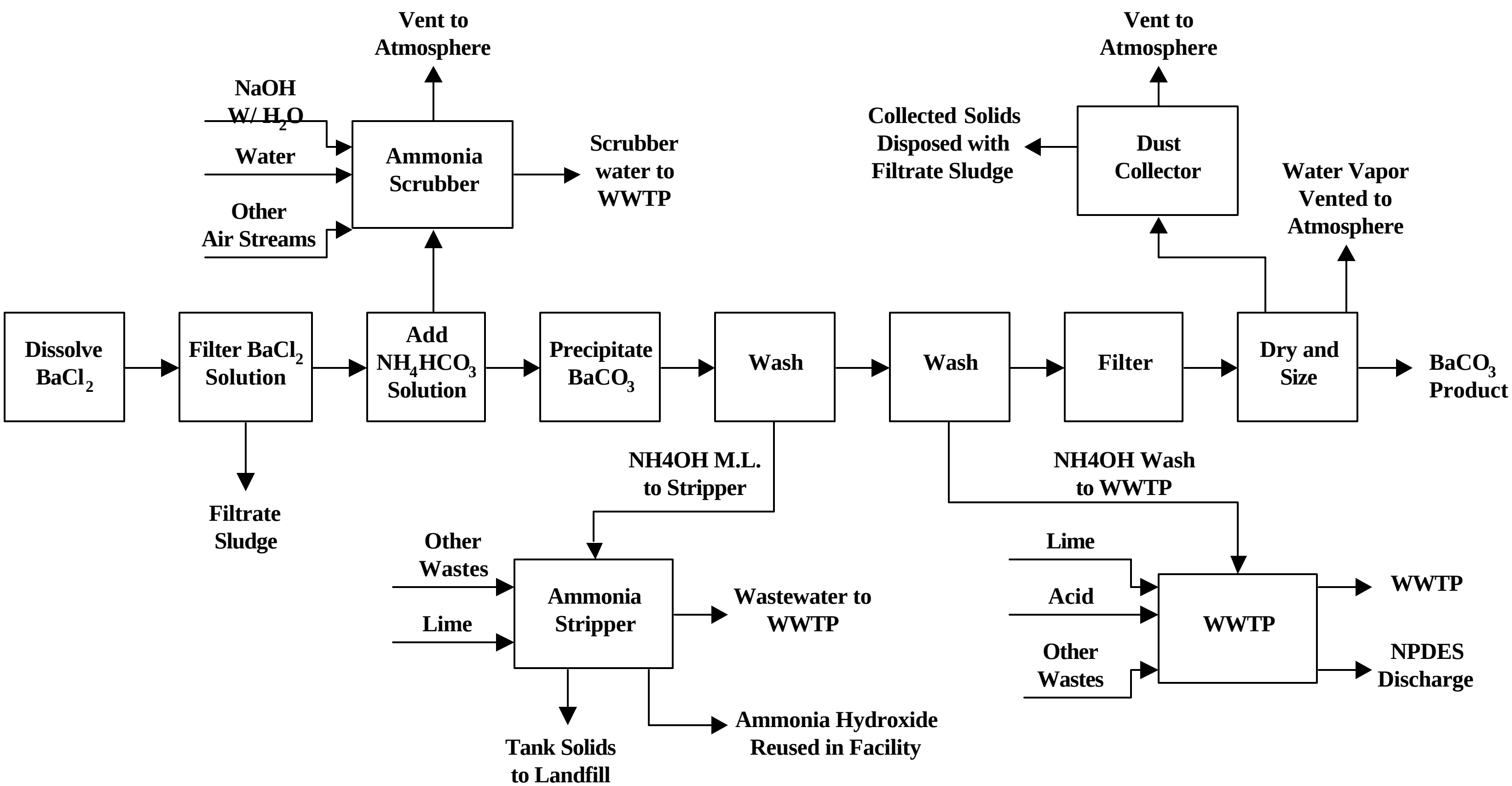


**Figure 2.1 Process Flow Diagram for the Production of Barium Carbonate from High Purity Barium Chloride Feedstock**

## 2.3 RESIDUAL GENERATION, CHARACTERIZATION, AND MANAGEMENT: High Purity Barium Chloride Feedstock Process

This section details the generation, characterization, and management of residuals from the production of barium carbonate from high purity barium chloride feedstock. **Appendix A** contains a summary table of the residuals within the scope of the listing determination generated by OSRAM, the amounts of the residuals generated in metric tons per year, and the final management step for the residuals.

### 2.3.1 Sludge and Spent Filter Media from Filtration of Barium Chloride Solution and Barium Carbonate Drying and Sizing Unit Dusts

<u>Waste Generation</u>

The high-purity barium chloride salt feedstock[19] is dissolved in deionized water, heated, and adjusted to predetermined levels of specific gravity and pH. This solution is filtered to remove suspended residual solids, producing a filter press sludge and spent filter media. The facility reported generating 0.23 MT of this residual in 1998. The residual is generated every 1-7 days.

Barium carbonate drying and sizing unit dusts are produced at the end of the barium carbonate production process when the finished barium carbonate product is dried and sized to meet internal facility specifications. The dusts from the drying and sizing process are captured by a dust collector. The facility reported generating less than 1 MT of this residual in 1998. This residual is generated every 32 days to 6 months.

<u>Waste Management</u>

The sludge and spent filter materials from filtration of barium chloride solution and the barium carbonate drying and sizing dusts are placed in closed, 55 gallon steel drums on-site before being sent off-site for treatment (stabilization for the sludge and filter materials) and disposal at a Subtitle C hazardous waste treatment facility and landfill operated by Michigan Disposal in Belleville, Michigan.

<u>Waste Characterization</u>

Both of these residuals carry the hazardous waste code, D005 (exceeds the TC for barium). The facility reported that the filter press sludge is 90% solids, has a pH of 7, and contains 2300 mg/L barium according to the TCLP. The barium dust collector solids also have a pH of 7 and are 100% barium carbonate.

### 2.3.2 Ammonia Vapor Scrubber Wastewaters, Spent Ammoniated Process Solution, and Ammonia Reclamation Unit Wastewaters

#### 2.3.2.a <u>Ammonia Vapor Scrubber Wastewaters</u>

[19] July 28, 1999 Phone Log, Ashley Allen, et al. (EPA) to William Schmieg (OSRAM SYLVANIA)

Waste Generation

Ammonia vapor from the addition of ammonium bicarbonate solution to barium chloride solution during the manufacturing process is vented to a scrubber. This scrubber is also used to control emissions from other facility manufacturing processes. Water, sodium hydroxide, and the emissions from other manufacturing processes in the facility mix with the ammonia vapor in the scrubber to produce a scrubber wastewater. The facility did not report a generation amount for this wastestream, nor did the facility indicate the percentage of material entering the scrubber which derives specifically from the barium carbonate production process. This residual is generated every 1-7 days.

Waste Management

This wastewater is sent directly via pipe to the on-site, tank-based, WWTP for elementary neutralization, filtration, and disposal. See Sections 2.3.5 and 2.3.6 for discussions of the treated wastewaters and the treatment sludge from the wastewater treatment plant.

Waste Characterization

The facility reported the RCRA hazardous waste code of D002 (corrosivity) for this wastewater and a pH of 10-12.

#### 2.3.2.b Spent Ammoniated Process Solution and Ammonia Reclamation Unit Wastewaters

Waste Generation

Ammonium hydroxide solution is recovered from 152,000-159,000 metric tons per year of ammoniated spent process solutions sent to the ammonia reclamation unit from several manufacturing processes at the OSRAM facility. Wastewaters from the barium carbonate manufacturing process (ammoniated mother liquors from the precipitation of barium carbonate) comprise approximately 1%, or 1600 metric tons per year, of the total amount of wastewaters entering the reclamation unit.[20] These wastewaters (spent ammoniated process solution) are piped to a tank and then piped to the ammonia reclamation unit with no significant potential for release prior to entering the reclamation unit. The facility did not report the volume of wastewaters exiting the ammonia reclamation unit. However, the facility reported generating 2725 metric tons of ammonium hydroxide in 1998, suggesting that the majority of the wastewaters entering the unit exit as ammonia reclamation unit wastewaters. The ammonia reclamation unit wastewater is generated every 1-7 days.

Waste Management

The spent ammoniated process solution is piped to a tank prior to being piped to the ammonia reclamation unit with no significant potential for release prior to entering the reclamation unit. The reclamation unit wastewater is piped directly to the on-site, tank-based

[20] March 24, 2000 E-mail from Carmen Venezia (OSRAM SYLVANIA) to Ashley L. Allen (EPA)

wastewater treatment facility where it is treated via elementary neutralization and then filtered before disposal. See Sections 2.3.5 and 2.3.6 for a discussion of the treatment sludge and the treated wastewaters from the wastewater treatment plant.

Waste Characterization

The facility reported the RCRA hazardous waste code of D002 (corrosivity) for this wastewater and a pH of 12.

### 2.3.3 Ammoniated Spent Process Solution Storage Tank Solids

Waste Generation

Spent ammoniated process solution from the precipitation of barium carbonate is sent to a storage tank before entering an ammonia reclamation unit which recovers ammonia in the form of ammonium hydroxide. The barium carbonate production process contributes approximately 1%, or 1600 metric tons per year, of the total ammoniated spent process solutions, 152,000-159,000 metric tons per year, entering and commingling in the tank.[21] The other wastewaters derive from other manufacturing processes not within the scope of this listing effort. Tank solids accumulate on the bottom of the spent ammoniated process solution storage tanks. The facility reported generating 1 MT of this residual in 1998.

Waste Management

The facility disposes of the solids from the bottom of the spent ammoniated process solution storage tank in a local Subtitle D municipal solid waste landfill on a yearly basis. The landfill is the Northern Tier Solid Waste Authority, Bradford County Landfill Operation in Burlington, Pennsylvania. It is a double-lined facility.[22]

Waste Characterization

This wastestream has a pH of 4 and does not exceed the TC level for any constituent.[23] Data on the chemical components of the waste are presented in **Table 2.1**. The facility states that the nickel, vanadium, and antimony found in the tank solids derive from manufacturing processes other than the barium carbonate manufacturing process. These manufacturing processes are beyond the scope of this listing determination. According to the facility, the most likely source of the antimony in the solids is the facility's lamp phosphor manufacturing process for which antimony trioxide is an additive in calcium halophosphate phoshors. The vanadium most likely derives from a process in which it is used to produce the specialty phosphor yttrium vanadate. Nickel is present in several of the facility's chemical and metallurgical processes, though the most likely source of that found in the tank solids is the tungsten

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[21] March 24, 2000 E-mail from Carmen Venezia (OSRAM SYLVANIA) to Ashley L. Allen (EPA)

[22] http://www.ntswa.org/bclandfill.htm

[23] February 15, 2000 fax from Carmen Venezia (OSRAM SYLVANIA) to Ashley L. Allen (EPA)

ore and scrap reclamation processes in which nickel is an impurity.[24] These manufacturing processes are beyond the scope of this listing determination.

Data in **Table 2.1** represent the range and average of concentrations found in five different samples. Samples were taken on 9/22/99, 9/21/99, 10/20/99, 10/20/99, and 12/13/99. For those constituents for which some samples fell below the detection limit, average concentrations were calculated by using one half the detection limit for samples falling below the detection limit.

**Table 2.1 Chemical Characterization of Ammoniated Spent Process Solution Storage Tank Solids**[25]

| Chemical Component | Concentration Range in TCLP Leachate (mg/L) | Average Concentration in TCLP Leachate (mg/L) |
|---|---|---|
| Ag | all <0.3 | <0.3 |
| As | all <1 | <1 |
| Ba | all <5 | <5 |
| Cd | all <0.2 | <0.2 |
| Cr | all <0.9 | <0.9 |
| Cu | all <1[a] | <1 |
| Hg | <0.008 [a] | <0.008 |
| Ni | <1-1.4 | 1 |
| Pb | all <0.4 | <0.4 |
| Sb | 3.7-30 | 16 |
| Se | all <0.16 | <0.16 |
| Ti | <0.08-<0.12 | <0.12 |
| V | 0.68, 0.40, <0.23 | 0.29 |
| Zn | all <1 | <1 |
| pH @ 10% | 8-8.8 [b] | 8.5 |
| Ammonia | 0.858%[c] | --- |

[a] Based on analysis of four samples.
[b] Based on analysis of three samples.
[c] Based on analysis of one sample.

[24] March 24, 2000 E-mail from Carmen Venezia (OSRAM SYLVANIA) to Ashley L. Allen (EPA)

[25] February 15, 2000 fax from Carmen Venezia (OSRAM SYLVANIA) to Ashley L. Allen (EPA)

### 2.3.4 Barium carbonate precipitate washwater

Waste Generation

The barium carbonate precipitate formed from the addition of ammonium bicarbonate to barium chloride is washed with deionized water to remove any residual process solutions. The washwater is discarded. The facility reported generating 1600 MT of this residual in 1998. This residual is generated every 1-7 days.

Waste Management

The washwater is sent to the on-site, tank-based, wastewater treatment facility where it is processed via elementary neutralization and then filtered before disposal. See Section 2.3.5 and 2.3.6 for discussions of the treated wastewaters and the treatment sludge from the wastewater treatment plant.

Waste Characterization

This wastewater has a pH of 9 and contains 3000 ppm ammonia. The wastestream does not exceed the TC level for any constituent.

### 2.3.5 WWTP Sludge

Waste Generation

The facility commingles and treats 1.1 million gallons per day of wastewaters from several different manufacturing processes in the on-site, tank-based wastewater treatment plant. Wastewaters from the barium carbonate manufacturing process contribute less than 1% of the total volume of wastewater flowing through the treatment facility. Treatment of the commingled wastewaters consists of neutralization with lime and acid followed by filtration, generating a sludge. The facility reported generating 8200 MT of this sludge in 1998. The residual is generated every 1-7 days.

Waste Management

The WWTP sludge is placed in a roll-off bin onsite before being disposed of in an off-site, local municipal Subtitle D landfill. The landfill is the Northern Tier Solid Waste Authority, Bradford County Landfill Operation in Burlington, Pennsylvania. It is a double-lined facility.[26]

Waste Characterization

According to the facility, the sludge does not exceed the TC level for any constituent. Chemical characterization data for the wastestream are presented in **Table 2.2.** Ammonia, nickel, antimony, and vanadium are all present in the WWTP sludge. According to the facility, nickel, antimony, and vanadium do not derive from the barium carbonate manufacturing process. The facility reports that antimony is used in the facility's lamp phosphor manufacturing process for which antimony trioxide is an additive in calcium halophosphate phosphors. Vanadium is used to produce the specialty phosphor

[26] http://www.ntswa.org/bclandfill.htm

yttrium vanadate. Nickel is present in several chemical and metallurgical processes including the tungsten ore and scrap reclamation processes in which nickel is an impurity.[27] The sludge is reported to have a pH of 8.5.

**Table 2.2 Chemical Characterization of Wastewater Treatment Plant Sludge from OSRAM Sylvania**

| Chemical Constituent | Total Concentration (mg/kg) | TCLP Concentration (mg/L) |
|---|---|---|
| Ammonia | 4000 | --- |
| Antimony | --- | 12 |
| Vanadium | --- | 0.5 |
| Nickel | --- | 1 |

### 2.3.6 Treated Wastewaters

Waste Generation

OSRAM commingles and treats wastewaters from many of the facility's manufacturing processes in an on-site, tank-based wastewater treatment plant (WWTP) consisting of a series of tanks, clarifiers and filters. The facility processes 1.1 million gallons per day of wastewater. Wastewaters from the barium carbonate production process are piped directly to the WWTP or are first routed through the facility's tank-based ammonia reclamation unit. Wastewaters from the barium carbonate production process comprise less than 1% of the total WWTP flow-through; the remainder of the wastewaters entering the WWTP are from manufacturing processes not within the scope of this listing determination. Wastewaters are treated through elementary neutralization (treatment with lime and acid) followed by filtration. The facility generated 1,200,000 MT of this residual in 1998. It is continuously produced.

Waste Management

OSRAM discharges the treated wastewaters from the WWTP to the Susquehanna River under a NPDES permit #PA0009024.

Waste Characterization

The facility reported that the treated wastewaters have a pH of 8.5.

## 3.0 CHEMICAL PRODUCTS CORPORATION—Barite Ore Feedstock Process

Chemical Products Corporation, Cartersville, Georgia uses locally mined barite ore containing

[27] March 24, 2000 E-mail from Carmen Venezia (OSRAM SYLVANIA) to Ashley L. Allen (EPA)

barium in the form of barium sulfate as their primary feedstock. The ore is crushed and milled, thermally reduced in a roasting kiln, and leached with water to solubilize the barium. The resulting barium sulfide solution is filtered and reacted with carbon dioxide gas to produce a barium carbonate precipitate. This precipitate is then washed, dried, and sized for sale. The generic process flow diagram for barium carbonate production from barite ore feedstock is represented by **Figure 3.1**.

The facility has produced barium compounds at its current location south of the city limits of Cartersville in Bartow County, Georgia since 1942.[28] The facility also produces barium chloride, barium sulfide (black ash), sodium sulfide, sodium hydrosulfide, ammonium sulfide, elemental sulfur, sodium silicate glass and solutions, sodium metasilicate pentahydrate, strontium carbonate, and strontium nitrate for commercial sale.[29]

## 3.1 DESCRIPTION OF MANUFACTURING PROCESS[30]

At Chemical Products Corporation (CPC) in Cartersville, Georgia, the primary feedstock for the manufacture of barium carbonate is barite ore, either naturally occurring or beneficiated "chemical grade." The plant uses barite ore from New Riverside Ochre Company, a local mine affiliated with CPC[31] and located approximately one mile from the CPC manufacturing facility.

Barite ore is crushed, milled, mixed with petroleum coke,[32] and fed into one of two countercurrent, direct-fired rotary kilns[33] operating at a temperature of approximately 1100-1200°C (~2000-2200 °F) where it reacts with the coke (elemental carbon) in a ratio of 5:4 ($BaSO_4$ : C) to produce water-soluble barium sulfide (BaS).[34]

$$BaSO_4 + 4\ CO\ \ 6\ BaS + 4CO_2$$

A small portion of the barium sulfate remains unreacted. Airborne residues from the ore crusher/grinder

[28] RCRA Facility Assessment of Chemical Products Corporation, EPA I.D. No. GAD003275468, August 1995. Submitted by Jane Hendricks, Georgia Department of Natural Resources, to Kent Williams, USEPA, Region IV.

[29] http://www.ceramics.com/cpc/cpc.html

[30] This process description is taken, except as noted, from the Engineering Site Visit and Analytical Data Report for Familiarization Sampling, Chemical Products Corporation, Cartersville, Georgia 30120, EPA ID: GAD003275468, Final Report, June 12, 2000, U.S. Environmental Protection Agency. This document has been placed in the same docket as this technical background document.

[31] February 17, 2000 fax from Jerry Cook (CPC) to Ashley Allen (EPA)

[32] CPC's Response to EPA's 1998 RCRA §3007 Survey of the Inorganic Chemicals Industry. April 23, 1999.

[33] CPC's 1998 Hazardous Waste Reduction Plan, Form II: Description of Processes that Generate Hazardous Waste and Corresponding Process Flow Diagrams. February 26, 1998.

[34] Kirk Othmer Encyclopedia of Chemical Technology. Volume 3. Fourth Ed. 1992. p. 913-914.

unit are captured with a baghouse dust collector and recycled back to the ore crusher/grinder unit.[35]

The kiln is lined with refractory brick which deteriorates over time and must be replaced on an occasional basis. The deteriorated brick remnants are removed from the kiln, washed with water, washed with sodium sulfate solution, and mixed with gypsum (calcium sulfate) before disposal.[36]

Solids from the washing of the brick are managed as one of the wastes from cleaning and maintenance of the barium carbonate production area.[37] Washwaters from the treatment of kiln brick are routed back to the barium carbonate production area for reuse.[38] A dust collector on the kiln collects airborne particulates which are then returned to the kiln for further processing. Gases from the dust collector are vented to the atmosphere.[39]

The resulting impure barium sulfide is called "black ash" and is more soluble than the barium sulfate from which it derives. The "black ash" is leached with hot water in tanks in a countercurrent extraction procedure to dissolve the barium sulfide.[40] The leaching is a batch process. The barium sulfide solution is agitated. The resulting solution, "strong" barium sulfide solution, is decanted to separate the barium sulfide product stream from the majority of the residual solids. The barium sulfide solution is sent through a second filter, a polishing filter, to further remove solids and the filtration sludge is treated and disposed.

The solids from which "strong" barium sulfide solution is decanted are leached a second time with water over a period of days[41]. The remaining leached solids, consisting of various impurities and unreacted barium compounds, are then separated, washed[42] and dewatered on a vacuum rotary filter to approximately 50% moisture content. Strontium remains with the product stream, but iron and other elements are removed with the solid impurities. These solids are a RCRA characteristic hazardous waste carrying the hazardous waste code D005 (barium). The decantate, washwaters, and filtrate water from the second leaching and residue filtration steps are utilized in the initial leaching stage where they are mixed with the "black ash." The solids are pumped directly from the vacuum rotary filter to the

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[35] May 9, 2000 Phone Log, Ashley L. Allen (EPA) and Jerry Cook and Timothy McCown (CPC)

[36] CPC's response to EPA's 1998 RCRA §3007 Survey of the Inorganic Chemicals Industry. April 23, 1999.

[37] CPC's response to EPA's 1998 RCRA §3007 Survey of the Inorganic Chemicals Industry. April 23, 1999.

[38] May 10, 2000 fax from Jerry Cook (CPC) to Ashley Allen (EPA)

[39] CPC's response to EPA's 1998 RCRA §3007 Survey of the Inorganic Chemicals Industry. April 23, 1999.

[40] RCRA Facility Assessment of Chemical Products Corporation, EPA I.D. No. GAD003275468, August 1995. Submitted by Jane Hendricks, Georgia Department of Natural Resources, to Kent Williams, USEPA, Region IV.

[41] CPC's 1998 Hazardous Waste Reduction Plan, Form II: Description of Processes that Generate Hazardous Waste and Corresponding Process Flow Diagrams. February 26, 1998.

[42] CPC's 1998 Hazardous Waste Reduction Plan, Form II: Description of Processes that Generate Hazardous Waste and Corresponding Process Flow Diagrams. February 26, 1998.

RCRA-permitted hazardous waste treatment unit for batch treatment.[43]

Some of the barium sulfide solution is used to make barium chloride products.[44] For the production of barium carbonate, the barium sulfide is pumped to barium carbonate generation towers in which food grade carbon dioxide is bubbled through the barium sulfide solution to precipitate insoluble barium carbonate.[45]

$$BaS + CO_2 + H_2O \rightarrow BaCO_3 + H_2S$$

The hydrogen sulfide gas produced during the reaction is absorbed in caustic solution to produce sodium hydrosulfide solution (NaHS), which the facility sells,[46] or it is converted into elemental sulfur in a Claus sulfur recovery unit to be sold as molten elemental sulfur. The facility sells all of the molten elemental sulfur and sodium hydrosulfide solution it produces.[47]

The barium carbonate crystals suspended in water are dewatered on a rotary vacuum filter. The barium carbonate filter cake is dried and granulated as necessary to meet customer specifications, while the filtrate goes directly[48] to CPC's wastewater treatment plant (WWTP) for treatment. Four types of driers are used, including a rotary, flash, and spray drier and a barium carbonate calciner.[49]

Polypropylene and nylon fabric used as the filter media on the filter employed to dewater the barium carbonate crystals deteriorates over time and must be replaced. The spent fabric is washed with water and soaked in a solution of soluble sulfate. The washwaters return to the barium carbonate production area for reuse[50] and the solids are managed as part of the wastestream, wastes from cleaning and maintenance of the barium carbonate production area.[51]

Dust collectors on the drying and on the granulation and sizing units collect airborne particulates and return these residuals to the production process. Gases from the dust collector vent to the

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[43] RCRA Facility Assessment of Chemical Products Corporation, EPA I.D. No. GAD003275468, August 1995. Submitted by Jane Hendricks, Georgia Department of Natural Resources, to Kent Williams, USEPA, Region IV.

[44] RCRA Facility Assessment of Chemical Products Corporation, EPA I.D. No. GAD003275468, August 1995. Submitted by Jane Hendricks, Georgia Department of Natural Resources, to Kent Williams, USEPA, Region IV.

[45] CPC's 1998 Hazardous Waste Reduction Plan, Form II: Description of Processes that Generate Hazardous Waste and Corresponding Process Flow Diagrams. February 26, 1998.

[46] CPC's response to EPA's 1998 RCRA §3007 Survey of the Inorganic Chemicals Industry. April 23, 1999.

[47] CPC's response to EPA's 1998 RCRA §3007 Survey of the Inorganic Chemicals Industry. April 23, 1999.

[48] May 10, 2000 fax from Jerry Cook (CPC) to Ashley Allen (EPA)

[49] CPC's 1998 Hazardous Waste Reduction Plan, Form II: Description of Processes that Generate Hazardous Waste and Corresponding Process Flow Diagrams. February 26, 1998.

[50] May 10, 2000 fax from Jerry Cook (CPC) to Ashley Allen (EPA)

[51] CPC's response to EPA's 1998 RCRA §3007 Survey of the Inorganic Chemicals Industry. April 23, 1999.

atmosphere.[52]

The bags from baghouse dust collectors deteriorate over time and must be replaced periodically. These spent bags are washed with water and then soaked in a solution of soluble sulfate. The washwaters return to the barium carbonate production area for reuse.[53] The solids are managed as part of the wastestream from cleaning and maintenance of the barium carbonate production area.[54]

In addition to the solid wastes generated by CPCs continuous manufacturing processes, a small amount of potentially hazardous waste is accumulated from the cleaning of tanks and ditches and sweeping of floors. This waste is assumed by the facility to be D005 waste and is stored in RCRA Subtitle C containers which are kept in a designated area[55] until treatment in the facility's RCRA Subtitle C hazardous waste treatment unit. Miscellaneous washwaters from the barium carbonate production area are reused within the barium carbonate production area.[56]

## 3.2 PRODUCTION TRENDS AND CHANGES AND IMPROVEMENTS

According to CPC, no changes in current production practices are anticipated in the near future.

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[52] CPC's response to EPA's 1998 RCRA §3007 Survey of the Inorganic Chemicals Industry. April 23, 1999.

[53] May 10, 2000 fax from Jerry Cook (CPC) to Ashley Allen (EPA)

[54] CPC's response to EPA's 1998 RCRA §3007 Survey of the Inorganic Chemicals Industry. April 23, 1999.

[55] CPC's 1998 Hazardous Waste Reduction Plan, Form II: Description of Processes that Generate Hazardous Waste and Corresponding Process Flow Diagrams. February 26, 1998.

[56] May 10, 2000 fax from Jerry Cook (CPC) to Ashley Allen (EPA)

**Figure 3.1 Process Flow Diagram for the Production of Barium Carbonate -Barite ore starting material**

## 3.3 RESIDUAL GENERATION, CHARACTERIZATION, AND MANAGEMENT: BARITE ORE FEEDSTOCK PROCESS

This section details the generation, characterization and management of residuals from the production of barium carbonate by the barite ore feedstock production process. Only wastes within the scope of the consent decree governing the inorganic chemicals industry listing are described below.[57] For a more detailed discussion of the scope of the consent decree, please refer to the relevant preamble section of the inorganic chemical industry listing proposal.

**Appendix A** presents a complete summary of the wastestreams generated by Chemical Products Corporation., volume of the wastestreams generated in metric tons per year, and the associated final management step.

### 3.3.1 Treated barium wastes (consists of treatment residues of barite ore leaching waste, barium sulfide filtration sludge, and barium carbonate production area cleaning and maintenance wastes)

Waste Generation

This wastestream is the treatment residue from the commingling and treatment of several barium wastes in an on-site hazardous waste treatment unit. The commingled wastes, which are consistently characteristically hazardous for barium (D005) or are consistently assumed by the facility to be D005 wastes, include:

- barite ore leaching wastes
- barium sulfide filtration sludge
- wastes from cleaning and maintenance of the barium carbonate production area

D005 wastes are defined at 40 CFR 262 as containing 100 mg/L ore more of barium by the Toxicity Characteristic Leaching Procedure.

Barite ore leaching waste is residual solids left after the roasting and double-leaching of barite ore and filtration of the liquid product stream from the barite ore roasting and leaching units. The wastestream is produced continuously. The solids are dewatered, washed with hot water, and dewatered again to approximately 50% moisture content on a rotary vacuum filter.[58] The wash and filtrate waters are recycled back to the leaching portion of the manufacturing process.[59] From the dewatering filter, the solids are pumped directly to the facility's RCRA-permitted Hazardous Waste Treatment Unit (a cement mixer truck standing on concrete pavement and containing gypsum). The

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[57] Residuals from barite ore feedstock barium carbonate production falling outside the scope of the inorganic chemical industry consent decree include: spent kiln brick, hydrogen sulfide gas produced at the CPC facility, and wastes from the production of molten elemental sulfur and sodium hydrosulfide solution.

[58] CPC RCRA Permit Application, January 12, 1996. Revision No. 6, Section C.

[59] CPC RCRA Permit Application, January 12, 1996. Revision No. 6, Section C.

waste consists primarily of unconverted ore (BaSO4), unreacted coke, and various compounds of iron and silica from naturally occuring impurities in the barite ore. It also contains small amounts of barium sulfites, thiosulfates, and silicates.[60] Some of the barium compounds in the residue are soluble. CPC produced 18,000 MT of this residue in 1998. It is produced continuously.

Barium sulfide sludge is from polishing filtration of liquid barium sulfide. Impure barium sulfide solution from the leaching of roasted barite ore is sent through a second polishing filter. The resulting barium sulfide filtration sludge is cleaned out every three to seven days. The facility generated 40 MT of this wastestream in 1998.[61] The wastestream is produced every 1-7 days.

Cleanup and maintenance wastes include wastes from routine cleaning of process vessels, paving, and the open, concrete lined ditches that comprise the plant's chemical sewer system.[62] This waste varies widely in physical nature from a dry powder from the cleanup of spilled product to wet solids from the cleanout of a ditch or process vessel.[63] This waste stream also includes solids from the washing of deteriorated kiln brick remnants, spent polypropylene and nylon filter fabric, and deteriorated baghouse bags with water and sulfate solutions. This waste is always handled as a hazardous waste. The facility generated 260 MT of this waste in 1998.[64]

Waste Management

The facility states that all barium-containing residuals from the barium carbonate production process are treated and tested to ensure that they are non-hazardous before final disposal. RCRA Hazardous Waste Facility Permit Number HW-026(T) authorizes the on-site treatment process for these barium wastes.[65] Barite ore leaching waste is sent directly to the treatment unit for batch treatment.[66] Barium sulfide filtration sludge and wastes from cleanup and maintenance in the barium carbonate production area are placed in 1 cubic yard tote bins at their point of generation and are then transferred to the miscellaneous waste treatment area. The bins are closed containers. A forklift is used to load the wastes into the feeder system for the concrete mixer treatment unit. Accumulation and

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[60] CPC RCRA Permit Application, January 12, 1996. Revision No. 6, Section C.

[61] February 22, 2000 fax from Jerry Cook (CPC) to Ashley Allen (EPA)

[62] RCRA Facility Assessment of Chemical Products Corporation, EPA I.D. No. GAD003275468, August 1995. Submitted by Jane Hendricks, Georgia Department of Natural Resources, to Kent Williams, USEPA, Region IV.

[63] CPC RCRA Permit Application, January 12, 1996. Revision No. 6, Section C.

[64] February 22, 2000 fax from Jerry Cook (CPC) to Ashley Allen (EPA)

[65] RCRA Facility Assessment of Chemical Products Corporation, EPA I.D. No. GAD003275468, August 1995. Submitted by Jane Hendricks, Georgia Department of Natural Resources, to Kent Williams, USEPA, Region IV.

[66] RCRA Facility Investigation Workplan. Prepared for Chemical Products Corporation, Cartersville, Georgia. May 16, 1996. Revision 3.0.

loading of the tote bins takes place on a concrete pad.[67]

The treatment process is a stabilization process for barium using gypsum (primarily $CaSO_4$) and water to precipitate soluble barium as less soluble barium sulfate. The gypsum derives from the manufacture of titanium dioxide and has been tested, according to the facility, for hazardous constituents. Besides acting as a treatment reagent, the gypsum aids in the solidification of the waste in the landfill.[68] The concrete mixer trucks provide a means of mixing gypsum with the barium wastes. The treatment unit consists of a 9 cubic yard concrete mixer-type truck standing on concrete pavement during waste loading and treatment. CPC places gypsum in the truck prior to loading the truck with waste.[69] The treatment reaction is:[70]

$$Ba^{2+} + CaSO_4 \cdot H_2O \rightarrow BaSO_4 + Ca^{2+} + 2H_2O$$

According to RCRA Subtitle C regulations, the treated barium waste must meet the Land Disposal Restriction Universal Treatment Standards (LDR UTS). Once treated, the same trucks in which the residuals were treated transport the treated barium wastes to the facility's captive Subtitle D landfill for disposal, located approximately 2 miles from the production facility on a non-contiguous 250 acre piece[71] of facility-owned property.

According to the facility, the TCLP is too time-consuming a testing method for daily management of their waste.[72] Therefore, the facility uses two tests for the presence of barium to aid in the daily management of their D005 wastes. These tests are conducted in addition to the TCLP to ensure effective treatment of the D005 wastes in the facility's hazardous waste treatment unit.[73] Every batch is tested. Additional gypsum is mixed into any batch which has been insufficiently treated. The TCLP is performed at least monthly on daily composite samples of the three barium wastes.[74] Protocals for these tests, which are not standard EPA tests, have been placed in the docket for this

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[67] RCRA Facility Assessment of Chemical Products Corporation, EPA I.D. No. GAD003275468, August 1995. Submitted by Jane Hendricks, Georgia Department of Natural Resources, to Kent Williams, USEPA, Region IV.

[68] CPC RCRA Permit Application, January 12, 1996. Revision No. 6, Section C.

[69] RCRA Facility Assessment of Chemical Products Corporation, EPA I.D. No. GAD003275468, August 1995. Submitted by Jane Hendricks, Georgia Department of Natural Resources, to Kent Williams, USEPA, Region IV.

[70] CPC RCRA Permit Application, January 12, 1996. Revision No. 6, Section C.

[71] Engineering Site Visit and Analytical Data Report for Familiarization Sampling, Chemical Products Corporation, Cartersville, Georgia 30120, EPA ID: GAD003275468, Final Report, June 12, 2000, U.S. Environmental Protection Agency.

[72] CPC RCRA Permit Application, January 12, 1996. Revision No. 6, Section C.

[73] Letter from ATEC Associates, Inc. to Harold Gillespie (Georgia Department of Natural Resources, Environmental Protection Division). "Re: CPC Landfill, Permit Number 008-007D(L), Waste Characterization Assessment, ATEC Project Number: 24-01-95-00242." September 25, 1995.

[74] CPC RCRA Permit Application, January 12, 1996. Revision No. 6, Section C.

rulemaking.[75] The facility makes an effort to add excess gypsum to the treatment unit to both ensure the full treatment of the barium wastes and to provide an extra reservoir of reactant in the landfill.[76]

The landfill has been in operation since 1969[77] and is a former barite ore mining cut.[78] CPC holds Private Industry Solid Waste Disposal Facility Permit Number 008-007D(L) for the disposal of inert solids process wastes in the landfill. Only wastes from CPC are disposed of in the landfill.[79] Besides treated barium waste, CPC also disposes of gypsum-treated wastewater treatment plant sludge in the landfill. Mining overburden, bricks and sodium silicate (glass) are also disposed of in the landfill.[80]

CPC claims that the wastes placed in the landfill are non-hazardous, inorganic, and inert. The facility also claims that the wastes are not biodegradable and not volatile.[81]

The waste has a relatively high moisture content when placed in the landfill. The wastes are disposed of in the landfill in a liquid form poured from the concrete mixer trucks treatment units.[82] The wastes are in liquid form to aid mixing of the wastes with the gypsum.[83] The wastes dewater in the landfill by evaporation and percolation and are reported to harden over time[84] to a hard, dark blue

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[75] May 12, 2000 fax from Timothy McCown (CPC) to Ashley Allen (EPA)

[76] Letter from ATEC Associates, Inc. to Harold Gillespie (Georgia Department of Natural Resources, Environmental Protection Division). "Re: CPC Landfill, Permit Number 008-007D(L), Waste Characterization Assessment, ATEC Project Number: 24-01-95-00242." September 25, 1995.

[77] Letter from ATEC Associates, Inc. to Harold Gillespie (Georgia Department of Natural Resources, Environmental Protection Division). "Re: CPC Landfill, Permit Number 008-007D(L), Waste Characterization Assessment, ATEC Project Number: 24-01-95-00242." September 25, 1995.

[78] RCRA Facility Assessment of Chemical Products Corporation, EPA I.D. No. GAD003275468, August 1995. Submitted by Jane Hendricks, Georgia Department of Natural Resources, to Kent Williams, USEPA, Region IV.

[79] RCRA Facility Investigation Workplan. Prepared for Chemical Products Corporation, Cartersville, Georgia. May 16, 1996. Revision 3.0.

[80] Letter from ATEC Associates, Inc. to Harold Gillespie (Georgia Department of Natural Resources, Environmental Protection Division). "Re: CPC Landfill, Permit Number 008-007D(L), Waste Characterization Assessment, ATEC Project Number: 24-01-95-00242." September 25, 1995.

[81] January 6, 1995 letter from L. Ballard Mauldin (CPC) to Harold C. Gillespie (Georgia Department of Natural Resources)

[82] Letter from ATEC Associates, Inc. to Harold Gillespie (Georgia Department of Natural Resources, Environmental Protection Division). "Re: CPC Landfill, Permit Number 008-007D(L), Waste Characterization Assessment, ATEC Project Number: 24-01-95-00242." September 25, 1995.

[83] Letter from ATEC Associates, Inc. to Harold Gillespie (Georgia Department of Natural Resources, Environmental Protection Division). "Re: CPC Landfill, Permit Number 008-007D(L), Waste Characterization Assessment, ATEC Project Number: 24-01-95-00242." September 25, 1995.

[84] January 6, 1995 letter from L. Ballard Mauldin (CPC) to Harold C. Gillespie (Georgia Department of Natural Resources)

cake. A study prepared at the request of the facility claims that no visible windblown emissions were observed coming from the landfill during the course of the study[85] and the facility states that no dust supression is needed. The facility has a variance from the state for daily or monthly cover requirements[86] and cover is instead applied as needed.

The multiple wastes co-mingled and disposed of in the landfill over time have an overall moisture content of 30-40%.[87] Approximately 35% (dry basis) of the total wastes in the landfill consist of barium sulfate. Other common constituents include strontium sulfate (30%), petroleum coke (5%), calcium compounds (10%), iron compounds (10%), and silica and silicates (10%).[88]

The wastes have been managed in this manner for over 15 years. The landfill has a remaining life of nearly 20 years. The landfill does not have a liner or leachate collection system. The leachate figure provided by CPC in their survey response is actually an estimate of the liquid flowing through the landfill on a yearly basis.[89] The facility reports in their RCRA §3007 survey response that the state of Georgia issued a variance for the landfill's liner requirements because of the nature of the waste, described as inert, earthen-derived, monofill shown to be unlikely to produce leachate of environmental concern, placed in the landfill. The facility states in their RCRA §3007 survey response that the landfill is situated on natural low-permeability clay.

Runoff from the landfill is regulated under a stormwater permit and is controlled through a system designed to handle a 25-year storm event. Runoff is routed to a 25 acre, clay-lined sedimentation pond from which it is discharged under NPDES permit #GA002982. Discharge from this pond is monitored for flow, total suspended solids, turbidity, and barium content. The clay-lined pond is used primarily in association with local mining operations. The landfill is reported to lie outside the 500 year flood plain. Distance to the nearest water body, the Etowah River, is 1700 feet. In recent years, the Etowah River in the vicinity of the landfill has had a flow rate varying between 9.9 and 230 m3 per second on a daily basis.[90]

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[85] Letter from ATEC Associates, Inc. to Harold Gillespie (Georgia Department of Natural Resources, Environmental Protection Division). "Re: CPC Landfill, Permit Number 008-007D(L), Waste Characterization Assessment, ATEC Project Number: 24-01-95-00242." September 25, 1995.

[86] June 8, 1995 letter from James W. Dunbar (Georgia Department of Natural Resources) to L. Ballard Mauldin (Chemical Products Corporation)

[87] Letter from ATEC Associates, Inc. to Harold Gillespie (Georgia Department of Natural Resources, Environmental Protection Division). "Re: CPC Landfill, Permit Number 008-007D(L), Waste Characterization Assessment, ATEC Project Number: 24-01-95-00242." September 25, 1995.

[88] Letter from ATEC Associates, Inc. to Harold Gillespie (Georgia Department of Natural Resources, Environmental Protection Division). "Re: CPC Landfill, Permit Number 008-007D(L), Waste Characterization Assessment, ATEC Project Number: 24-01-95-00242." September 25, 1995.

[89] September 16, 1999 phone log, Ashley L. Allen (EPA) to Jerry Cook (CPC)

[90] Historical Steamflow Daily Values Graph for Etowah River at Allatoona Dam Ab [sic] Cartersville, GA (02394000), http://waterdata.usgs.gov

The facility is also exempt from groundwater monitoring requirements.[91] However, analyses of groundwater are available from several sampling events at four monitoring wells surrounding the landfill.[92]

An aerial photograph of the landfill facility and the adjacent 25 acre sedimentation pond used to manage stormwater run-off from the facility is available for viewing the docket for this rulemaking in the facility's survey response. Further information on the landfill is provided in CPC's response to the RCRA §3007 survey.

Waste Characterization

Before treatment, the barium wastes are D005 (exceed the TC level for barium).[93] Information from both the state of Georgia and the facility indicate that once treated, the barium wastes no longer exceed the TC level for barium (100 mg/L from TCLP analysis) and typically leach less than 1 mg/L barium according to both SPLP and TCLP analyses.[94] In addition, according to 1998-1999 data the facility submitted to the Agency from recent sampling events, treated barium waste does not exceed any

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[91] November 26, 1996 letter from Harold C. Gillespie (Georgia Department of Natural Resources) to Tim McCown (CPC)

[92] CPC monitoring wells #1 and #2 are downgradient of the landfill and monitoring wells #3 and #4 are upgradient according to a July 29, 1999 fax from Jerry Cook (CPC) to Shen-yi Yang (EPA). Wells NRO #1 and NRO #2 are located at a neighboring mine site according to the August 28, 1988 Georgia Department of Natural Resources (GADNR) Trip Report, Chemical Products Corporation (CPC). Also see this report for more information on the locations of the monitoring wells and their geology.

The following sources, placed in the docket for this listing effort, contain information on the groundwater sampled from the CPC landfill monitoring wells:

August 25, 1988 letter from R.E. Kotteman (CPC) to Ramona J. Klein (GADNR)---averages of analyses of multiple constituents in groundwater sampled between October 1979 and October 1985; February 28 1995 letter from L. Ballard Mauldin (CPC) to James W. Dunbar (Georgia Environmental Protection Division (GAEPD))---analyses of barium levels in multiple samples taken between October 1984 and August 1994; October 21, 1987 letter from R.E. Kottemann, Jr. (CPC) to Ramona J. Klein (GADNR)—samples taken September 29, 1987; December 7, 1987 GADNR memo from Ramona J. Klein to Renee Hudson Goodley—samples taken September 29, 1987; September 12, 1988 letter from R.E. Kottemann, Jr. (CPC) to Ramona J. Klein (GADNR) ---samples taken August 8, 1988; October 24, 1988 letter from Ramona J. Klein (GADNR) to R.E. Kottemann, Jr. (CPC)---samples taken August 9, 1988 (see September 16, 1999 fax from Jerry Cook (CPC) to Ashley Allen (EPA) commenting on some of the data in this document); March 22, 1989 GADNR memo from Renee Hudson Goodley to Randolph D. Williams---analyses in CPC work plan submitted to GADNR; July 29,1999 fax from Jerry Cook (CPC) to Shen-yi Yang (EPA)---samples taken June 8, 1999; GADNR June 8, 1999 CPC sampling event data.

[93] RCRA Facility Assessment of Chemical Products Corporation, EPA I.D. No. GAD003275468, August 1995. Submitted by Jane Hendricks, Georgia Department of Natural Resources, to Kent Williams, USEPA, Region IV.

[94] See February 28, 1995 letter from CPC (L. Ballard Mauldin) to Georgia Environmental Protection Division (James W Dunbar) for analyses of barium TCLP levels in daily composite samples taken between March 27, /1990 and October 14, 1994. See CPC's RCRA Permit Application, March 1,1995, Revision No. 0, Section C for additional information on treated barium leaching wastes (daily composites taken on September 26, 1994 and October 14, 1994). See May 4 1999 fax from Jerry Cook (CPC) to Shen-yi Yang (EPA) for additional information on the treated and untreated wastes from barium sulfide filtration and cleaning and maintenance of the production area.

TC level and meets the LDR UTS for all regulated constituents.[95] The waste is dewatered to approximately 50% moisture content before disposal. The facility report a pH of 10 for the waste.

According to quarterly TCLP analyses for barium content between 1985 and 1995, the average barium concentration in the treated wastes according to the TCLP was 1.2 mg/L (37 sampling events) and the highest detected level was 3.6 mg/L.[96] A study prepared at the request of the facility found that treatment with gypsum reduced the concentration of leachable barium in the barium wastes from 2,000 mg/L to 1.2 mg/L.[97]

The wastes do not contain volatile constituents of concern.[98] Regulatory standards (Human Health benchmarks and Ambient Water Quality Criteria) are listed in Appendix B for comparison with the data presented in the tables below. Data on chemical constituents found in the untreated barium wastes are presented in **Table 3.1**, data on chemical constituents found in the treated barium wastes are presented in **Table 3.2**, and data on chemical constituents found in free liquids from treated barium wastes are presented in **Table 3.3.**

**Table 3.1 Untreated Barium Wastes**

| Chemical Constituent | Composite sample: 10-10-94 to 10-16-94[99] | Grab Sample: 6/8/99[100] | | | Grab Sample: 6/8/99[101] | | |
|---|---|---|---|---|---|---|---|
| | TCLP (mg/L) | Total (mg/kg) | SPLP (mg/L) | TCLP (mg/L) | SPLP–Preserved [a] (mg/L) | SPLP–Not Preserved (mg/L) | TCLP (mg/L) |
| Arsenic | --- | 14 | <0.08 | 0.1 | <0.01 | <0.01 | 0.07 |
| Barium | 880 | 3100 | 270 | 140 | 394 | 284 | 1.840 |
| Cadmium | 0.01 | <1 | <0.01 | <0.01 | <0.02 | <0.02 | 0.04 |

[95] See a discussion of the constituent chromium in the February 22, 2000 fax from Jerry Cook (CPC) to Ashley Allen (EPA).

[96] Letter from ATEC Associates, Inc. to Harold Gillespie (Georgia Department of Natural Resources, Environmental Protection Division). "Re: CPC Landfill, Permit Number 008-007D(L), Waste Characterization Assessment, ATEC Project Number: 24-01-95-00242." September 25, 1995.

[97] Letter from ATEC Associates, Inc. to Harold Gillespie (Georgia Department of Natural Resources, Environmental Protection Division). "Re: CPC Landfill, Permit Number 008-007D(L), Waste Characterization Assessment, ATEC Project Number: 24-01-95-00242." September 25, 1995.

[98] CPC RCRA Permit Application, January 12, 1996. Revision No. 6, Section C.

[99] CPC's RCRA permit application, Revision No. 0, Section C, March 1, 1995,

[100] GADNR June 8, 1999 CPC sampling event data

[101] July 29, 1999 fax from Jerry Cook (CPC) to Shen-yi Yang (EPA)

| | TCLP (mg/L) | Total (mg/kg) | SPLP (mg/L) | TCLP (mg/L) | SPLP–Preserved [a] (mg/L) | SPLP–Not Preserved (mg/L) | TCLP (mg/L) |
|---|---|---|---|---|---|---|---|
| Calcium | --- | 9700 | 21 | 500 | --- | --- | --- |
| Chromium | 0.49 | 11 | <0.02 | 0.27 | <0.05 | <0.05 | 0.21 |
| Copper | --- | 27 | --- | --- | --- | --- | --- |
| Iron | --- | 14,000 | <0.02 | 85 | <0.05 | <0.05 | 372 |
| Lead | 0.2 | 53 | <0.09 | <0.09 | <0.1 | <0.1 | <0.1 |
| Mercury | --- | <0.001 | --- | --- | <0.0005 | <0.0005 | <0.0005 |
| Nickel | --- | 150 | <0.02 | 0.035 | 0.02 | <0.01 | --- |
| Selenium | --- | <19 | <0.19 | 0.19 | 0.02 | 0.03 | 0.04 |
| Silver | 0.13 | <1 | <0.01 | <0.01 | <0.05 | <0.05 | <0.05 |
| pH | 11.4 | --- | --- | --- | --- | --- | --- |

## Table 3.2 Chemical Constituents in Treated Barium Waste

| Chemical Constituent | RCRA 3007 Survey Data | | Grab Sample---6/8/99[102] | | Grab Sample—6/8/99[103] | | | Composite: 4/16/99[104] | Composite: 4/17/99[105] |
|---|---|---|---|---|---|---|---|---|---|
| | Total (mg/kg) | TCLP (mg/L) | Total (mg/kg) | SPLP (mg/L) | SPLP–Preserved[a] (mg/L) | SPLP–Not Preserved (mg/L) | TCLP (mg/L) | TCLP (mg/L) | TCLP (mg/L) |
| Arsenic | 5 | 0.020 | 11 | <0.08 | <0.01 | <0.01 | <0.01 | <0.5 | <0.5 |
| Barium | 150,000[b] 100,000[c] | 1 | 470 | 0.092 | <0.2 | <0.2 | <0.2 | <10 | <10 |
| Cadmium | 1 | 0.05 | <1 | <0.01 | <0.02 | <0.02 | 0.05 | <0.1 | <0.1 |
| Calcium | --- | --- | 34,000 | 570 | --- | --- | --- | --- | --- |
| Chromium (total) | 40 | 1.3[d] | 65 | <0.02 | <0.05 | <0.05 | 0.43 | <0.5 | <0.5 |
| Iron | --- | --- | 17,000 | 0.031 | <0.05 | 0.26 | 434 | --- | --- |
| Copper | --- | --- | 23 | — | --- | --- | --- | --- | --- |
| Lead | 30 | 0.3 | 31 | <0.09 | <0.1 | <0.1 | <0.1 | <0.5 | <0.5 |
| Mercury | <0.4 | <0.020 | <0.001 | --- | <0.0005 | <0.0005 | <0.0005 | <0.02 | <0.02 |
| Nickel | --- | --- | --- | --- | <0.01 | 0.04 | 0.08 | --- | --- |
| Selenium | 0.02 | 0.001 | <19 | <0.19 | 0.04 | 0.06 | 0.02 | <0.1 | <0.01 |
| Silver | 1 | 0.05 | <1 | <0.01 | <0.05 | <0.05 | <0.05 | <0.5 | <0.5 |

[102] GADNR June 8, 1999 CPC sampling event data

[103] July 29, 1999 fax from Jerry Cook (CPC) to Shen-yi Yang (EPA)

[104] May 4, 1999 fax from Jerry Cook (CPC) to Shen-yi Yang (EPA)

[105] May 4, 1999 fax from Jerry Cook (CPC) to Shen-yi Yang (EPA)

| | Total (mg/kg) | TCLP (mg/L) | Total (mg/kg) | SPLP (mg/L) | SPLP–Preserved[a] (mg/L) | SPLP–Not Preserved (mg/L) | TCLP (mg/L) | TCLP (mg/L) | TCLP (mg/L) |
|---|---|---|---|---|---|---|---|---|---|
| Sulfides (total) | 100[b]<br>0[c] | --- | --- | --- | --- | --- | --- | --- | --- |
| pH | 10 | --- | | | --- | --- | --- | --- | --- |

a: SPLP extract was acidified for preservation before analysis
b: content of barite ore leaching residue
c: content of wastes from cleaning and maintenance of the barium carbonate production area and barium sulfide solution filtration.
d: see 2/21/00 fax from CPC (Jerry Cook) to EPA (Ashley Allen) for a discussion of this data point

**Table 3.3 Chemical Constituents in Free Liquids from Treated Barium Waste (Sampled 12/22/94)** [106]

| Chemical Constituent | Concentration (mg/L) |
|---|---|
| Ba | 0.96 |
| Cd | <0.0057 |
| Cr (total) | <0.0066 |
| Ag | <0.0050 |
| Hg | <0.00015 |
| As | <0.0029 |
| Pb | <0.0040 |
| Se | <0.0031 |

### 3.3.2 Wastewater from Barium Carbonate Precipitate Dewatering

Waste Generation

CPC generates wastewater from dewatering newly precipitated barium carbonate crystals on a rotary vacuum filter. The facility reported generating 313,000 MT of this residual in 1998. This wastestream is continuously produced.

Waste Management

Wastewater from the washing and dewatering of barium carbonate precipitate travels directly to the onsite wastewater treatment plant (WWTP). Wastewaters for the whole plant are managed in the facility. Total throughput in 1998 was 1,818,000 MT. Wastewater from barium carbonate production comprise approximately 17% of the total WWTP flow-through.

Wastewaters are treated through an oxidation process. The treatment process takes place in uncovered tanks with secondary containment (concrete containment basins lined with chemically resistant tile[107] in close proximity to the tanks). The treated water is discharged to the Etowah River under NPDES permit #GA0000281. The treatment process also generates a sludge, discussed Section 3.3.3 below.

According to the facility, no wastewater from the barium carbonate production process enters the wastewater basins associated with the facility's WWTP. All wastewaters from barium carbonate production are either returned to the barium carbonate production area for reuse or are routed directly to the treatment tank portion of the wastewater treatment plant. The basins associated with the

[106] February 28, 1995 letter from L. Ballard Mauldin (CPC) to James W. Dunbar (Georgia Environmental Protection Division)

[107] RCRA Facility Assessment of Chemical Products Corporation, EPA I.D. No. GAD003275468, August 1995. Submitted by Jane Hendricks, Georgia Department of Natural Resources, to Kent Williams, USEPA, Region IV.

wastewater treatment plant act as diversion basins for the purposes of managing flow of wastewaters from other manufacturing processes onsite through the treatment tanks. In addition, they serve as secondary containment for the treatment tanks.[108]

The facility does not plan any changes in the management of this wastewater. The wastewater treatment plant has been in use since September 1973.

Waste Characterization

Data provided by CPC on the chemical composition of their barium carbonate precipitate dewatering wastewaters is presented in **Table 3.4** below.

**Table 3.4 Chemical Characterization of Wastewater from Barium Carbonate Precipitate Dewatering**

| Chemical Constituent | Total Concentration (mg/kg) |
|---|---|
| Sodium | 600 |
| Barium | 10 |
| Total Sulfur | 300 |
| Carbonate | 400 |
| Total Sulfide | 200 |
| pH | 11 |

### 3.3.3 Wastewater Treatment Plant Sludge

Waste Generation

The facility's WWTP generates a treatment sludge from the commingling and treatment of wastewaters from the entire facility. Wastewaters from the barium carbonate production process comprise approximately 17% of the total mass of wastewater flowing through the facility. Other wastewaters treated in the WWTP include filtrate water from the strontium carbonate production process, sodium silicate production wastewater, cooling water and clean water.[109] The treatment process consists of oxidation, converting sulfides in the wastewaters for thiosulfate.[110] The sludge

[108] May 10, 2000 fax from Jerry Cook (CPC) to Ashley Allen (EPA)

[109] Engineering Site Visit and Analytical Data Report for Familiarization Sampling, Chemical Products Corporation, Cartersville, Georgia 30120, EPA ID: GAD003275468, Final Report, June 12, 2000, U.S. Environmental Protection Agency.

[110] Engineering Site Visit and Analytical Data Report for Familiarization Sampling, Chemical Products Corporation, Cartersville, Georgia 30120, EPA ID: GAD003275468, Final Report, June 12, 2000, U.S. Environmental Protection Agency.

resulting from the commingled wastewaters consists primarily of inorganic oxidation catalyst.[111] The facility reported generating 11,000 MT of this residual in 1998.

Waste Management

The wastewater treatment plant sludge is collected in a clarifier and then pumped directly from the bottom of the clarifier to an elevated holding tank. The facility dewaters the sludge to a thick slurry with a 25% solids content through decantation. The overflow is recycled to the wastewater treatment clarifier. The sludge is held for a maximum of three days.[112] The sludge then flows by gravity from the holding tank to the facility's Subtitle C hazardous waste treatment unit, a concrete mixer truck already containing gypsum (primarily $CaSO_4$). The truck mixes the sludge with the gypsum and then transports the treated sludge to the facility's captive Subtitle D landfill for disposal, located approximately 2 miles from the facility. The treatment process converts soluble barium in the waste to a less soluble form of barium. The facility states that treatment with gypsum ensures that water associated with the WWTP sludge falls below the drinking water standard for barium. The waste has a relatively high moisture content when placed in the landfill and is reported to harden over time. The wastes have been managed in this manner for over 15 years.[113]

See Section 3.3.1 for additional information on the characteristics of the landfill used for the disposal of the wastewater treatment plant sludge.

Waste Characterization

Characterization data from the state of Georgia shows that the treatment process reduced leachable barium in the sludge, according to the SPLP, from 53 mg/L to 0.03 mg/L. State data also shows no potential constituents of concern in treated WWTP sludge at concentrations above HBLs, AWQCs, or TC levels. Regulatory standards (Human Health Benchmarks and Ambient Water Quality Criteria) are listed in Appendix B for comparison with the data presented in **Tables 3.5** and **3.6.** **Table 3.5** presents data on chemical constituents found in untreated wastewater treatment plant sludge and **Table 3.6** presents data on chemical constituents found in treated wastewater treatment plant sludge. The waste has a high moisture content (consists of 75% moisture) and does not contain any volatile constituents of concern. The sludge contains barium and strontium in the form of sulfates precipitated during wastewater treatment as well as inorganic material from the chemical used as a catalyst in the oxidation process.[114]

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[111] Engineering Site Visit and Analytical Data Report for Familiarization Sampling, Chemical Products Corporation, Cartersville, Georgia 30120, EPA ID: GAD003275468, Final Report, June 12, 2000, U.S. Environmental Protection Agency.

[112] CPC RCRA Permit Application, January 12, 1996. Revision No. 6, Section C

[113] May 11, 2000 fax from Jerry Cook (CPC) to Ashley Allen (EPA)

[114] CPC RCRA Permit Application, January 12, 1996. Revision No. 6, Section C

**Table 3.5 Chemical Characterization of Untreated Wastewater Treatment Plant Sludge[115]**

| Chemical Constituent | Concentration in 1/10/94-1/14/94 Composite | Concentration in 1/27/94-1/31/94 Composite | Concentration in 2/7/94-2/11/94 Composite | 2/17/00 Grab[116] | | |
|---|---|---|---|---|---|---|
| | TCLP (mg/L) | TCLP (mg/L) | TCLP (mg/L) | Total (mg/kg) | TCLP (mg/L) | SPLP (mg/L) |
| Arsenic | 0.56 | <0.5 | <0.5 | <80 | <0.08 | <0.08 |
| Barium | 4.3 | 9.5 | 1.9 | 1100 | 53 | 0.39 |
| Cadmium | <0.1 | <0.1 | <0.1 | 27 | <0.01 | <0.01 |
| Calcium | --- | --- | --- | 15,000 | --- | |
| Chromium | <0.5 | <0.5 | <0.5 | 95 | <0.02 | <0.02 |
| Copper | --- | --- | --- | 25 | --- | --- |
| Iron | --- | --- | --- | 170,000 | --- | --- |
| Lead | <0.5 | <0.5 | <0.5 | 46 | <0.09 | <0.09 |
| Mercury | --- | --- | --- | <0.1 | --- | --- |
| Nickel | --- | --- | --- | 190 | 0.48 | <0.02 |
| Selenium | <0.005 | <0.005 | <0.005 | <760 | <0.19 | <0.19 |
| Silver | <0.5 | <0.5 | <0.5 | <2 | <0.01 | <0.03 |

115 Chemical Product Corporation's RCRA Permit Application, March 1, 1995, Revision No. 0, Section C. Additional information on barium levels in composite untreated samples is available in the May 4, 1999 fax from Jerry Cook (CPC) to Shen-yi Yang (EPA).

116 GADNR February 17, 2000 CPC sampling event data

**Table 3.6 Chemical Characterization of Treated Wastewater Treatment Plant Sludge, 2/17/00**[117]

| Chemical Constituent | Total Concentration (mg/kg) | TCLP Concentration (mg/L) | SPLP Concentration (mg/L) |
|---|---|---|---|
| Arsenic | 4.7 | <0.08 | <0.08 |
| Barium | 170 | 0.038 | 0.03 |
| Cadmium | 5.2 | <0.01 | <0.01 |
| Calcium | 47,000 | --- | --- |
| Chromium | 100 | <0.02 | 0.02 |
| Copper | 12 | --- | --- |
| Iron | 33,000 | --- | --- |
| Lead | 21 | <0.09 | <0.09 |
| Mercury | <0.1 | --- | --- |
| Nickel | 24 | 0.44 | 0.02 |
| Selenium | <10 | <0.19 | <0.19 |
| Silver | <1 | <0.01 | <0.03 |

### 3.3.4 Treated Wastewaters

Waste Generation

1,818,000 MT of wastewater was treated in CPC's WWTP in 1998. Approximately 17% (~313,000 MT) of this wastewater derives from the barium carbonate production process. The wastewaters are treated through an oxidation process and the sludge is separated from the treated wastewaters in a clarifier.[118]

Waste Management

Treated wastewaters are discharged to the Etowah River under NPDES permit #GA0000281.

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[117] GADNR February 17, 2000 CPC sampling event data

[118] CPC RCRA Permit Application, January 12, 1996. Revision No. 6, Section C

Waste Characterization

CPC did not provide characterization data for this residual.

### 3.3.5 Spent Polypropylene and Nylon Filter Media and Baghouse Dust Collector Bags

Waste Generation

This wastestream is generated at CPC at several points in the barium carbonate production process. The baghouse bags are part of the air pollution control equipment attached to the reactor kiln, barium carbonate drying units and barium carbonate granulation and packaging units. The polypropylene and nylon fabric filter media are used in the rotary vacuum filter for the dewatering of barium carbonate crystals suspended in water. When the filter cloth becomes inoperable, it is removed from the filter, pressure washed, and reused whenever possible.[119] Residuals collected in the baghouse bags are returned to the manufacturing process.[120] Baghouse dust collector bags and polypropylene and nylon fabric filters deteriorate over time and must be replaced. The facility reported generating approximately 3 MT of filters[121] and approximately 1.5 MT of baghouse bags in 1998.[122]

Waste Management

The facility washes the baghouse bags and filter fabrics with water and soaks them in sulfate solution to stabilize any remaining barium. The facility then disposes of the bags and filter fabric in a local municipal Subtitle D landfill (Bartow County Municipal Landfill), a lined landfill. Washwaters from the washing of the filters and bags are sent back to the barium carbonate production area for reuse.[123] Solids from the washing are managed as part of the wastes from cleaning and maintenance in the barium carbonate production area (see Section 3.3.1)

Waste Characterization

This wastestream was not characterized in the RCRA §3007 questionnaire. Neither the bags nor the filters exceed the TC level for any constituent according to the facility. In addition, the facility treats the materials to stabilize any remaining barium before disposing of them in a Subtitle D municipal solid waste landfill.

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[119] May 4, 1999 fax from Jerry Cook (CPC) to Shen-yi Yang (EPA)

[120] RCRA Facility Assessment of Chemical Products Corporation, EPA I.D. No. GAD003275468, August 1995. Submitted by Jane Hendricks, Georgia Department of Natural Resources, to Kent Williams, USEPA, Region IV.

[121] May 4, 1999 fax from Jerry Cook (CPC) to Shen-yi Yang (EPA)

[122] May 12, 2000 fax from Timothy McCown (CPC) to Ashley Allen (EPA)

[123] May 10, 2000 fax from Jerry Cook (CPC) to Ashley Allen (EPA)

# APPENDIX A

## Summary of Waste Generation and Management

## Osram Sylvania Products Inc.

| Wastestreams | RIN/RCRA Hazardous Waste Code | Waste Volume (MT/yr) | Final Waste Management Step |
|---|---|---|---|
| Sludge and spent filter materials from filtration of barium chloride solution and barium carbonate drying and sizing unit dusts | 1<br>Filter press sludge<br>D005 | .23 | Off-site Subtitle C landfill |
| | 10<br>Dust Collector Solids<br>D005 | <1 | |
| Barium carbonate precipitate washwater | 3<br>Washwater | 1600 | Discharge to and treatment in on-site wastewater treatment facility |
| Ammonia vapor scrubber and ammonia stripper wastewaters | 4<br>Peabody Scrubber solution<br>D002 | NR | Discharge to and treatment in on-site tank-based wastewater treatment plant |
| | 5<br>Ammonia Stripper Wastewater<br>D002 | NR | |
| Spent ammoniated process solution storage tank solids | 7<br>Stripper storage tank sludge | 1 | Off-site municipal Subtitle D landfill |
| WWTP sludge | 8<br>Wastewater Treatment Plant Sludge | 8200 | Off-site municipal Subtitle D landfill |

NR = not reported in RCRA §3007 questionnaire

## Chemical Products Corporation

| Wastestreams | RIN/RCRA Hazardous Waste Code | Waste Volume (MT/yr) | Final Waste Management Step |
|---|---|---|---|
| Treated barium wastes (including barite ore leaching waste, barium sulfide sludge, and cleanup and maintenance wastes) | 1<br>Barium Leaching Waste<br>D005 | 18,000 | Disposal in local, captive, industrial Subtitle D landfill (after treatment of D005 wastes on-site) |
| | 2<br>Miscellaneous Barium Waste<br>D005 | 40 | |
| | 4<br>Miscellaneous waste resulting from clean-up and maintenance operations | 260 | |
| Wastewater treatment plant sludge | NR | 11,000 | Disposal in local, captive, industrial Subtitle D landfill |
| Wastewater from BaCO3 precipitate washing and dewatering | 3<br>Yellow water | 313,000 | Discharge to and treatment in on-site wastewater treatment facility |
| Spent polypropylene and nylon filters and baghouse bags | NR | 3 and 1.5 | Off-site municipal Subtitle D landfill |

NR = not reported in RCRA §3007 questionnaire

### Wastes Beyond the Scope of the Consent Decree

| Wastestreams | RIN/RCRA Hazardous Waste Code | Waste Volume (MT/yr) | Waste Management Steps |
|---|---|---|---|
| Kiln Brick | 5 | 1.6 | Washed with water, treated with gypsum, disposed of in local, captive, industrial, Subtitle D landfill |

## Appendix B

## Human Health Benchmarks and Ambient Water Quality Criteria Screening Levels

**Human Health Benchmarks and Ambient Water Quality Criteria (AWQC) Screening Levels**[124]

| Substance | Health Based Limit: Drinking Water Ingestion (mg/L) | AWQC: CCC-Fresh Water (mg/L) | AWQC: Human Health (mg/L) |
|---|---|---|---|
| Aluminum | 16 | 0.087 | NA |
| Antimony | 0.0063 | NA | 0.014 |
| Arsenic | 0.00074 | 0.15 | 0.000018 |
| Barium | 1.1 | NA | 1 |
| Beryllium | 0.031 | NA | NA |
| Boron | 1.4 | NA | NA |
| Cadmium | 0.0078 | 0.0022 | NA |
| Chromium (VI) | 0.047 | 0.011 | NA |
| Chromium (III) | 23 | 0.74 | NA |
| Cobalt | 0.94 | NA | NA |
| Copper | NA | 0.0090 | 1.3 |
| Iron | 5 | 1 | 0.3 |
| Lead | NA | 0.0025 | NA |
| Manganese | 0.73 | NA | 0.05 |
| Mercury (II) | 0.0047 | 0.00077 | 0.000050 |
| Nickel | 0.31 | 0.052 | 0.61 |
| Selenium | 0.078 | 0.0050 | 0.17 |
| Silver | 0.078 | 0.0034 | NA |
| Thallium | 0.0013 | NA | 0.0017 |
| Vanadium | 0.14 | NA | NA |
| Zinc | 4.7 | 0.12 | 9.1 |

[124] See the risk assessment background document for today=s proposal, ARisk Assessment for the Listing Determinations for Inorganic Chemical Manufacturing Wastes@ (August 2000)