AMERICAN MINING CONGRESS
FOUNDED 1897
Suite 300
1920 N Street N.W.
Washington, D.C. 20036
202/861-2800
TWX 710/822-0126
Easylink: 62756020
John A. Knebel
President

MEMORANDUM

September 12, 1988

TO: Processing Waste Work Group

FROM: Rod Dwyer, Senior Counsel

RE: September 20 Meeting

Chairman David Crouch has called a meeting of the work group for Tuesday, September 20, 1988, in Denver, Colorado, starting at 9:00 a.m. The meeting will be held at the Hyatt Regency, 1750 Welton Street, Denver, Colorado 80202. An agenda is enclosed.

Because of the D.C. Circuit's July 29 decisions in EDF & HWTC v. EPA, ordering the listing of six smelting wastes as hazardous under Resource Conservation and Recovery Act (RCRA) Subtitle C and ordering the Environmental Protection Agency (EPA) to propose by October 15 a rule distinguishing between those processing wastes that are and are not covered by the Bevill Amendment, the focus of the Processing Waste Work Group's efforts must shift from EPA's now defunct RTC II to (1) dealing with the smelter waste listing, (2) preparing for and responding to the October 15 proposed rule, and (3) preparing for EPA's July 31, 1989, Report to Congress on processing wastes. The first two issues are upon us and cannot await the September 27 Solid Waste Subcommittee meeting in Denver.

The purpose of the work group meeting is to initiate actions, particularly in the regulatory arena, dealing with the listing and the upcoming rulemaking. Towards that end, the various work group "commodity sectors" (copper, lead, zinc) formed earlier this year to evaluate EPA's draft RTC II, should now reevaluate the 1978-80 data used by EPA to support the August 31 listing of the copper, lead and zinc wastes. Copies of that data are enclosed. EPA used it in the original 1980 listing of those wastes. That data is known to be flawed. Be prepared on September 20 to demonstrate precisely where these data are flawed regarding your company's and your mineral sector's waste streams.

There are a variety of regulatory options potentially available for dealing with the listing. At the September 20 meeting, we will need your opinions on the wisdom or folly of using any one or more of these options. To assist you, we enclose a paper listing these options. The paper also contains legislative and judicial options. We welcome your input on those as well, but ask that you put your greatest thought into the regulatory phase.

Here is the status report on the processing waste situation:

Legal

The D.C. Circuit has not yet responded to AMC's request for a rehearing date of the case en banc. We expect that the court will deny this request. Beveridge & Diamond will prepare a petition for certiorari, asking the Supreme Court to review the D.C. Circuit's decision, and will request a stay of the lower court decision.

Regulatory

On August 31, EPA Administrator Lee Thomas signed a final rule listing the six smelting wastes as hazardous. While the agency is focusing on the October 15 deadline for proposing the "Bevill criteria for processing waste" rule, AMC is attempting to obtain from EPA informal assurances as to effective dates and certain other matters regarding the listing.

Legislative

Senator Max Baucus (D-MT) is expected momentarily to introduce a RCRA reauthorization bill, including provisions on mining and processing waste. We will forward copies as soon as possible. In the meantime, contacts are being made in appropriate parts of Capitol Hill to determine whether, and what kind of, relief from the court decision might be available.

Internal AMC

At a September 7 meeting, the Washington Mine Waste Group (along with some members of the Solid Waste Subcommittee, smelter management personnel and outside counsel for many AMC member processing companies) reviewed the situation. The group agreed with the protective filing of a petition for judicial review of the August 31 listing rule, and with preparation of a petition for certiorari. The group also agreed that the Processing Waste Work Group, as a part of the Solid Waste Subcommittee, was the proper focus for (1) analysis of the EPA data, and (2) efforts in the regulatory arena. The Washington Mine Waste Group recommended, in light of the interrelationship among regulatory, legislative and judicial avenues in dealing with the July 29 court order, that company legal counsel and Washington representatives attend Processing Waste Work Group meetings. Accordingly, notice of the September 20 Processing Waste Work Group meeting is being sent to those who attended the September 7 Washington Mine Waste Group meeting. Please feel free to invite personnel from your company whom you believe (a) need to be part of this effort and (b) can make a contribution to its success.

The Hyatt Regency has set aside a block of rooms for those of you who wish to spend one or two nights in Denver. The rooms are set aside for the Processing Waste Work Group and the reservation phone number is 303/295-5870.

@85 9/19

15-20 min

American Limo #5/30

CC 916 019

Please return the enclosed response form to Ms Lori Lingo by September 16, indicating whether you plan to attend the meeting of the Processing Waste Work Group.

Enclosures

AMERICAN
MINING
CONGRESS

FOUNDED 1897

Suite 300
1920 N Street N.W.
Washington, D.C. 20036
202/861-2800

TWX 710/822-0126
Easylink: 62756020

John A. Knebel
President

AGENDA

for

PROCESSING WASTE WORK GROUP

Tuesday, September 20, 1988

Hyatt Regency Hotel
1750 Welton Street
Denver, Colorado 80202

I. Call to Order

II. Processing Waste Status Report

- A. Regulatory
- B. Judicial
- C. Legislative

III. Report by Commodity Sectors on Review of EPA Data Supporting Listing

- A. Copper
- B. Lead
- C. Zinc

IV. Option and Recommendations

- A. What additional data to submit
- B. What regulatory approaches AMC shall use

V. Adjournment

OPTIONS

I. Petition for Rulemaking

A. Single petition to repeal listing of K064, K065 and K066 wastes ab initio (e.g. repeal effective from the date of initial listing)

1. Each waste stream failed to meet criteria for listing
2. Inadequate data base existed to support listing

Document #2

B. Three separate petitions to repeal listing of each waste stream ab initio

C. One or multiple petitions to narrow/define the scope of the listed waste streams

1. Exclude K064 and/or K065 and/or K066 wastes generated using "excess lime"
2. Define "thickening" for K064 wastes to exclude certain waste streams (e.g. acid plant blowdown mixed with mill tailings, then dewatered--define as not involving "thickening")
3. Exclude slag dewatered in surface impoundments from K065 waters, and exclude solids from settling of stormwaters run-on and run-off from slag storage areas
4. Exclude solids derived from non-contact cooling waters
5. Exclude solids in emergency fire water reservoirs and virgin water holding ponds

Document #2

D. One or more petitions to make Subtitle C rules inapplicable (permanently or temporarily), or modify them when applied to the listed wastes (e.g. the mixture rule, the derived from the "contained in" rule, and/or certain aspects of the land disposal ban rules)

1. Generally
2. Only at integrated facilities where "Bevilled" extraction and beneficiation wastes are mixed with the newly listed wastes
3. Where the listed waste is treated so as to remove, render non-toxic, or immobilize hazardous constituents
4. For specific facilities operations/waste streams

Document #2

E. One or more petitions to exclude materials that are recycled or returned to the process for materials reclamation from the listing(s) (Cite AMC v. EPA, 824 F.2d 1177 (D.C. Cir. 1987))

1. Generally
2. Under certain classes of circumstances or conditions
3. For specific facilities/operations/waste streams
4. One or more petitions to clarify the effective dates(s) of the listing(s) and of related rules and obligations

F. One or more petitions to define the relationship between the listed wastes and wastes remaining subject to the Bevill Amendment (i.e. to prevent listed wastes from "infecting" "Bevilled" wastes--see also D2 above)

G. Petition(s) to modify "facility" and "solid waste management unit" definitions for corrective action when applied to these newly listed wastes

1. Generally
2. For integrated facilities
3. For specified classes of facilities/operations
4. For specifically named facilities/operations

H. One or more petitions to clarify the effective date(s) of the listing(s) and of related rules and obligations

1. Relationship of listing clock and "characteristics" clock?
2. Prospective effect only of new listings
3. Federal listing date v. state listing dates in RCRA authorized states for 90-day notification?

II. Seeking Informational Guidance or Interpretations from EPA

III. Delisting Petitions for Individual Facilities

IV. Legislative Approaches

A. Vehicles

1. RCRA Amendments
2. Appropriations Bill Rider Supplemental/Continuing Resolution
3. Clean Air Act Amendments
4. Other non-germane Senate legislation

B. Content

1. Reverse court decision; restore wastes to "Be-villed" status
2. Suspend mandated listing and/or prohibit use of EPA funds to enforce Subtitle C, require EPA to initiate and complete rulemaking process as to whether to list any of these waste streams
3. Limit listings as per any of the ideas in the Petitions section above
4. Set-up non-Subtitle C regulatory scheme for these wastes as per AMC draft on other comparable approach in lieu of Subtitle C regulation
5. Other

V. Judicial Approaches

A. Seek en banc review and/or Supreme Court review of EDF v. EPA

B. File new lawsuit challenging EPA's determination (note 3) that these waste meet the listing criteria

C. [more to come]

PRIMARY COPPER SMELTING AND REFINING

.064 Acid plant blowdown slurry/sludge resulting from the thickening of blowdown slurry (T)

Summary of Basis for Listing

Acid plant blowdown slurry/sludge, resulting from the thickening of the blowdown slurry, is a waste stream from the treatment of the acid plant blowdown slurry at facilities where primary copper is smelted in a reverberatory furnace. The Administrator has determined that these sludges are solid wastes which pose a substantial present or potential hazard to human health or the environment when improperly transported, treated, stored, disposed of or otherwise managed and, therefore, should be subject to appropriate management requirements under Subtitle C of RCRA. This conclusion is based on the following considerations:

1) Acid plant blowdown slurry contains high concentrations of the toxic heavy metals lead and cadmium.*

2) A large quantity of these wastes is generated annually (approximately 286,000 MT (dry weight) was produced in 1977) and this quantity is expected to increase to 360,360 MT by 1983.

3) A solubility study has shown that lead and cadmium can be leached from these sludges by even a mild (distilled water) leaching media. Therefore, even under the mild conditions, the possibility of groundwater contami-

*For concentrations of other listed toxic heavy metals that do not warrant waste listing, see Attachment 1.

nation via leaching will exist if these waste materials are improperly disposed.

4) Current waste management practices consist of storage or disposal in unlined lagoons. These waste management practices may not be adequate to prevent a hazard to human health and the environment.

Discussion

A. Profile for the Industry

A 1977 review (1) indicated that there were 15 primary copper smelters in the United States operated by eight companies. A more recent source (2) identifies seventeen primary smelters operated by nine companies. Table 1 lists the seventeen plants and their production capacities. Almost all of the smelting capacity is concentrated in the southwestern United States, primarily Arizona and New Mexico. An average smelter can be assumed to have a capacity of 100,000 metric tons per year (1). Total national production of copper is increasing, based on a comparison of total capacities cited by References 1 and 2.

B. Manufacturing Process

Processing of copper includes mining, concentrating of ores, smelting and refining. The smelting process involves two basic steps (3). First, the copper concentrate is melted in a reverberatory furnace to yield matte, which is essentially a mixture of copper and iron sulfides. The matte is then fed to converters in which air oxidation converts the copper sulfate to impure copper and the iron sulfide to an iron

oxide/silicate slag that can be separated from the copper. The product resulting from the reverberatory furnace converter smelting is blister copper. Depending on the intended final use, the blister copper is purified by fire refining and electrolytic refining. A flow diagram for the primary copper smelting process is shown in Figure 1.

The source of the listed waste stream is also indicated in Figure 1. (Note that the reverberatory furnace slag is not included in the listing since data submitted during the comment period indicated that the contaminants in the slag tend not to migrate out of the waste.) Lead and cadmium, the metals that constitute the basis for listing, are always in the waste since they are always present in the basic raw material, namely copper ore.

C. Waste Generation and Management

As indicated in Figure 1, the listed waste addressed in this document arises from the acid plant which constitutes the principal controller for removal of sulfur dioxide from furnace and converter off-gases (3). The converter off-gases typically contain 5% or more of sulfur dioxide (3). According to the Calspan report (1), the acid plant for an average 100,000 metric ton/year smelter generates a blowdown slurry at a rate of about 2,270 cubic meters/day. After thickening, the bulk of the solid content of slurry is recycled to the

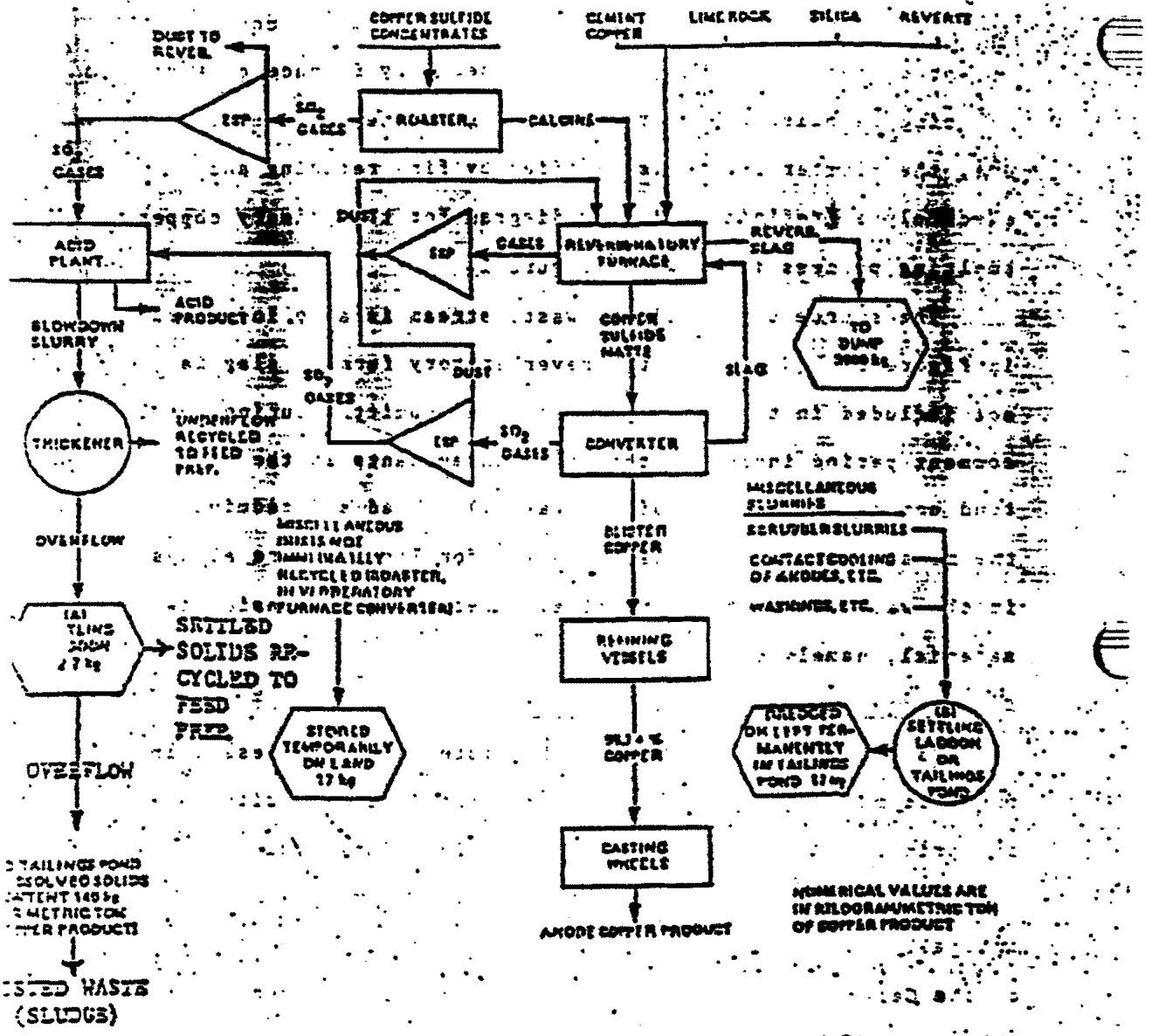

Figure 1 PRIMARY COPPER SMELTING AND FIRE REFINING

Source: Reference 1

reverberatory furnace.* The overflow from the thickener - about 2,200 cubic meters per day, containing 0.77 metric tons of suspended solids and 40 metric tons of dissolved solids - is sent to a lagoon for settling. The suspended solid content is eventually recovered and recycled to the smelter.* The 40 metric tons/day of dissolved solids remain in the aqueous lagoon effluent which is discharged to the main tailings pond.

Available documentation (1) indicates that this sludge is allowed to accumulate, along with the tailings waste, in the tailings pond. There is no evidence that this sludge/tailings mixture is dredged out for further treatment or disposal. Available documentation also indicates that these tailings ponds are unlined. These unlined tailings ponds are, therefore, the point of disposal for the 40 MT/day of material from the acid plant blowdown slurry that is not recycled. In comparison, 46 MT/day of thickener underflow solids and 0.8 MT/day of the overflow suspended

*At this time, applicable requirements of Parts 262 through 265 apply insofar as the accumulation, storage and transportation of hazardous wastes that are used, reused, recycled, or reclaimed. The Agency believes that this regulatory coverage is appropriate for the subject wastes. The slurry/sludge is hazardous insofar as they are being accumulated and stored in surface impoundments and insofar as they may be stored in piles prior to recycling. This waste may not pose a substantial hazard during the recycling and, even though listed as a hazardous waste, this aspect of their management is not now being regulated.

Table 1

GEOGRAPHICAL DISTRIBUTION AND CAPACITIES OF PRIMARY COPPER SMELTERS

Company	Location	Smelting Capacity (MT*/yr)
Anaconda	Anaconda, MT	198,000
ASARCO	Hayden, AZ	180,000
	El Paso, TX	115,000
	Tacoma, WA	100,000
Cities Service	Copper Hill, TN	22,000
Copper Range	White Pine, MI	90,000
Hecla Mining	Casa Grande, AZ	31,000**
Inspiration	Miami, AZ	150,000
Kennecott	Garfield, Utah	280,000
	Hurley, NM	80,000
	Hayden, AZ	80,000
	Mc Gill, NV	50,000
Magma	San Manuel, AZ	200,000
Phelps Dodge	Morenci, AZ	177,000
	Hidalgo, NM	140,000
	Douglas, AZ	127,000
	Ajo, AZ	70,000

* MT - metric tons

** Smelting is done by a leach process, but the plant has an acid plant associated with the roaster.

solids are eventually recycled during treatment of the acid plant blowdown slurry.

Table 2 summarizes the total quantities of acid plant blowdown slurries (and miscellaneous other small volume slurries) that are generated. A total of 286,000 metric tons (dry weight) of waste sludge from primary copper smelters was generated in 1977. It is estimated (1) that this quantity will increase by about 26% to 360,360 metric tons by 1983. The total quantity of waste sludge disposed of (not recycled) by primary copper smelters in 1977 was 128,400 metric tons (dry weight).

D. Hazards Posed by the Waste

1. Concentrations of Lead and Cadmium in the Waste Stream

The listed waste has been analyzed (1) and found to contain toxic metals. The concentrations found are summarized in Table 3.

Sludges also have been subjected to leaching tests and have been shown (1) to leach lead and cadmium in significant concentrations. The leaching tests in the Calspan Study (1) was performed on one sample by agitating one part waste with two parts distilled water (initial pH 5.5) for 72 hours. The mixture was then filtered and analyzed. Table 4 presents the concentrations found in the leachate from the sludge sample.
As shown by the test results in Table 4, cadmium appears in concentrations 17,000 times the EPA National Interim Primary Water Standard, and lead

TABLE 2

ESTIMATED TOTAL WASTE SLUDGES FROM PRIMARY COPPER SMELTERS IN 1977* (METRIC TONS - DRY WEIGHT)

State	Total Blowdown Slurry	Total Disposed
Tennessee	2,300	1,000
Michigan	17,500	7,900
Texas	14,800	6,700
New Mexico	24,800	11,200
Montana	28,500	13,000
Utah	34,300	15,000
Arizona	143,600	64,600
Nevada	6,100	2,700
Washington	14,100	6,300
Total	286,000	128,400

*A number of copper smelters which were in existence in 1974 are no longer in operation, thus, the wastes produced by these smelters are not included in this table.

Source: Reference 1, Table 7d

TABLE 3

CONCENTRATIONS OF HEAVY METALS IN WASTE SLUDGES FROM PRIMARY COPPER SMELTERS (PPM)

Metal	Sludges
Cadmium	520
Lead	8000

Source: Reference 1

appears in concentrations 150 times the National Interim Primary Standard.

The distilled water leaching procedure used in the Calspan tests (1) thus indicates that lead and cadmium will leach from the waste even when subjected to mild environmental conditions. A more aggressive leaching agent may lead to more substantial release of the toxic metals. Disposal/storage in a surface impoundment or landfill with an acidic environment will certainly enhance the solubility of lead and other metals, since their solubility is pH dependent (i.e., solubility increases as the pH decreases (4)).

The information on the solubility of the compounds coupled with the fact that solubilization can occur more readily due to the fine particulate composition of the sludges suggests that the metals present in the listed waste may be released from the acid plant blowdown under improper storage/disposal conditions.

Once released from the matrix of the waste, the toxic metals can migrate from the disposal/storage site to ground and surface waters utilized as drinking water sources. Present practices associated with impounding the waste may be inadequate to prevent such an occurance. For instance, selection of disposal sites in areas with permeable soils can permit contaminant-bearing leachate

Table 4

CONCENTRATIONS OF HEAVY METALS IN FILTERED DISTILLED WATER LEACHATE, PPM

	Sludges
Cadmium	8.4
Lead	7.8

Source: Reference 1

from the waste to migrate to groundwater. This is especially significant with respect to ponded wastes because a large quantity of liquid is available to percolate through the solids and soil beneath the fill.

In addition to difficulties caused by improper site selection, the lagoon/tailing ponds are likely to have insufficient leachate and surface run-off control practices. Therefore, there may be no leachate collection and treatment system to diminish leachate percolation through the wastes and soil underneath the site to groundwater. Further, there may be no surface run-off diversion system to prevent contaminants from being carried from the disposal site to nearby surface waters.

An overflow problem would thus be encountered if the liquid portion of the waste has been allowed to reach too high a level in the lagoon/tailings pond; a heavy rainfall could cause flooding which might reach surface waters in the vicinity.

Should lead and cadmium migrate from this waste, they would persist in the environment (in some form) virtually indefinitely and, therefore, may contaminate drinking water sources for long periods of time. Furthermore, cadmium is bioaccumulated at all tropic levels. Lead can be bioaccumulated and passed along

the food chain, but not biomagnified. The liklihood of human exposure is thus increased.

The large quantities of this waste stream generated (a total of approximately 286,000 MT (dry weight) in 1977) is an additional factor supporting the listing of this solid waste as hazardous. As previously indicated, the waste from primary copper smelting is generated in substantial quantities and contains significant concentrations (See Table 3) of cadmium and lead. Large amounts of these metals from the waste sludge are thus available for potential environmental release. The large quantities of these contaminants pose the danger of polluting large areas of ground or surface waters. Contamination could also occur for long periods of time, since large amounts of pollutants are available for environmental loading. Attenuative capacity of the environment surrounding the disposal facility could also be reduced or used up due to the large quantities of pollutants available. All of these considerations increase the possiblity or exposure to harmful constituents and, in the Agency's view, support a T listing.

2. Hazards Associated with Lead and Cadmium

As presented below, The actual toxicity of these harmful constituents is well documented.

A 1977 review (5) summarizes much of the available data on the toxicity of lead and cadmium. Capsule descriptions of adverse health and environmental effects based on Reference 6 are summarized below; more detail on the adverse effects of lead, and cadmium can be found in Appendix A.

Lead is poisonous in all forms. It is one of the most hazardous of the toxic metals because it accumulates in many organisms, and its deleterous effects are numerous and severe. Lead may enter the human system through inhalation, ingestion or skin contact. Lead is a cumulative poison in humans, one leading to damage in kidneys, liver, gonads, the nervous system and blood vessels. Lead compounds also have been reported to cause oncogenic and teratogenic effects in animals. Toxicity to aquatic organisms occurs at ppb concentrations.

Cadmium shows both acute and chronic toxic effects in humans. The LD_{50} (oral, rat) is 72 mg/kg of CdO. Cadmium and its compounds have been reported to produce oncogenic and taratogenic affects. Aquatic toxicity has been observed at sub-ppb levels.

The hazards associated with exposure to lead, and cadmium have been recognized by other regulatory programs. Lead and cadmium are listed as priority pollutants in accordance with §307(a) of the Clean Water Act of 1977. Under §6 of the Occupational Safety and Health Act of 1970, a final standard for occupational exposure to lead has been established (7,8). Also, a national ambient air quality standard for lead has

been announced by EPA pursuant to the Clean Air Act (8). In addition, final or proposed regulations of the States of California, Maine, Maryland, Massachusetts, Minnesota, Missouri, New Mexico, Oklahoma and Oregon define cadmium or lead containing compounds as hazardous wastes or components thereof (9).

Attachment 1

These wastes contain measurable concentrations of certain other constituents listed in Appendix VIII of Part 261, including arsenic, chromium, mercury and selenium. The concentrations of these constituents in both the waste and distilled water leachate samples are, however, deemed insufficient to warrent listing the wastes on basis of these additional constituents, as demonstrated by the following tables:

CONCENTRATIONS OF HEAVY METALS IN WASTE SLUDGES FROM PRIMARY COPPER SMELTERS (PPM)

Metals	Sludges
Chromium	50
Mercury	0.8
Selenium	30

Source: Reference 1.

REFERENCES

1. U.S. EPA, Office of Solid Waste. Assessment of hazardous waste practices in the metal smelting and refining industry, v.2. EPA No. SW-145c2. NTIS PB No. 276 170. April, 1977.

2. U.S. Department of the Interior, Bureau of Mines. Copper - mineral commodity profiles. September, 1979.

3. P. D. Dougall. Copper. In: M. Grayson and D. Eckoth, eds. Kirk-Othmer encyclopedia of chemical technology. 3rd ed. v.6. John Wiley and Sons, New York. 1979.

4. Pourbaix, M. Atlas of electrochemical equilibria in aqueous solutions. Pergamon Press, London. 1966.

5. The Merck Index, 8th ed. Merck and Company, Inc. Rahway, NJ. 1968.

6. Cleland and Kingsbury. Multimedia environmental goals. v.2. EPA No. 600/7-77-136B. November, 1977.

7. U.S. Department of Interior, Bureau of Mines. Mineral commodity summaries. 1979.

8. NIOSH. Registry of toxic effects of chemical substances. U.S. Department of Health, Education and Welfare, National Institute for Occupational Safety and Health. 1977.

9. U.S. EPA States Regulations Files, Hazardous Waste State Programs, WH-565. U.S. EPA, 401 M St., S.W., Washington, D.C. 20460. Contact Sam Morekas (202) 755-9145. January, 1980.

THE INDUSTRY, OUR COMPANY AND ITS PEOPLE HAVE SURVIVED RESTRUCTURING AND ARE PROBABLY STRONGER FOR IT. AND FEW WOULD DOUBT THAT EFFECTIVE COMMUNICATIONS HAD MUCH TO DO WITH THAT SURVIVAL.

LISTING BACKGROUND DOCUMENT

PRIMARY ZINC SMELTING AND REFINING

K066 Sludge from treatment of process wastewater and/or acid plant blowdown (T)

K067 Electrolytic anode slimes/sludges (T)

K068 Cadmium plant leach residue (iron oxide) (T)

Summary of Basis for Listing

The primary zinc industry is comprised of 7 plants that employ one of two major zinc manufacturing processes--electrolytic or pyrometallurgical processing. The five electrolytic and two pyrometallurgical plants recover zinc metal from ore concentrates. Cadmium and lead contaminants found in the raw materials are carried through numerous processes and are subsequently found in high concentrations in the wastewater treatment sludge generated by the treatment of process wastewater and/or acid plant blowdown, in the electrolytic anode slimes/sludges and in cadmium plant leach residue (iron oxide).

The Administrator has determined that these wastes are solid wastes which may pose a substantial present or potential hazard to human health or the environment when improperly transported, treated, stored, disposed of or otherwise managed, and therefore should be subject to appropriate management requirements under Subtitle C of RCRA. This conclusion is based on the following considerations:

1) The wastes contain significant concentrations of the toxic metals cadmium and lead.

2) Cadmium and lead have been shown to leach from samples of these wastes in significant concentrations

extraction procedure.

3) Electrolytic anode slimes/sludges and cadmium plant leach residue are generated at a rate of 2,600 tons/year, and 200/tons year, respectively. Sludge from the treatment of process wastewater and/or acid plant blowdown is generated at a rate greater than 11,000 tons/year. Such large quantities of wastes containing high concentrations of hazardous constituents increases the probability of damage to human health and the environment under improper disposal conditions.

4) These wastes are currently stockpiled on-site and/or hauled off-site to landfills in a manner that could allow the cadmium and lead in the wastes to leach to groundwater.

Industry Profile and Manufacturing Process

Five plants produce zinc by the electrolytic process, and two plants produce zinc by pyrometallurgical techniques (3). Locations of the plants, capacities and products are given in Table 1.

Electrolytic plants (not including the one new plant in Tennessee) account for approximately 9 percent of the total solid waste generated although they represent about 49 percent of the industry's production of slab zinc. The two pyrometallurgical plants account for 91 percent of the solid waste, although they represent only 51 percent of the production of zinc (3).

Electrolytic Process

At four of the electrolytic zinc plants, actual production rates range from 41,800 tons to 82,100 tons of slab zinc per year. These four plants account for approximately 268,300 tons of the total annual primary zinc production, or about 49 percent of the industry total. The fifth plant has come

LOCATIONS, CAPACITY AND PRODUCTS OF PRIMARY ZINC SMELTERS AND REFINERS (3)

Company and Location	Process Description	Capacity (tons/year)	Product
Amax, Inc. East St. Louis, Ill.	Electrolytic	82,000	Slab zinc, cadmium, zinc sulfate, and sulfuric acid
Asarco, Inc. Corpus Christi, Tex.	Electrolytic	108,000	Slab zinc, zinc alloys, zinc sulfate, cadmium, and sulfuric acid
The Bunker Hill Co. Silver King, Idaho	Electrolytic	108,000	Slab zinc, zinc alloys, cadmium, and sulfuric acid
National Zinc Co. Bartlesville, Okla	Electrolytic	55,000	Zinc dust, zinc slab, zinc alloys, cadmium, cobalt cake, copper/lead/nickel cake, and lead silver residue
New Jersey Zinc Co. Palmerton, Pa.	Pyrometallurgical	113,500	Slab zinc, zinc alloys, zinc dust and pellets, zinc oxide, ferroalloy, and sulfuric acid
St. Joe Minerals Corp. Monica, Pa.	Pyrometallurgical	250,200	Slab zinc, zinc alloys, zinc oxide, cadmium, ferrosilicon, mercury, and sulfuric acid
Jersey Miniere Co. Clarksville, Tenn.	Electrolytic	90,000	Slab zinc, cadmium, sulfuric acid

on-line recently, and production figures are not yet available (3). Electrolytic processing basically involves dissolving the zinc in a sulfate solution followed by electrolytic deposition of zinc (3). Process flow (see Figure 1) at the plants is very similar, with some variation(3).

The sources of solid waste generated by the electrolytic process are: (1) treatment of preleach residue (this operation occurs at only one plant), (2) the collection and treatment of acid plant blowdown and miscellaneous slurries, (3) the cleaning of the electrolysis cells (anode slimes/sludges), and (4) the filtration of the leach solution.

The preleach process is used by one electrolytic plant with an annual production of 62,300 tons. Preleaching removes excess magnesium from the incoming zinc concentrates. Magnesium is not electrolyzed but accumulates in the system; therefore zinc concentrates having high magnesium levels must be preleached before further processing. The preleach step involves the reaction of sulfuric acid and a bleed stream from the acid plant (i.e., acid plant blowdown--a weak acid stream) with a portion (up to 100%) of the incoming concentrates to solubilize the magnesium. The insoluble concentrate containing zinc is separated and continues through the process. The solubilized material containing magnesium and the acidic preleach solution enter a lined surface impoundment, from which it is pumped to a wastewater treatment plant (WWTP). The sludge that settles in the impoundment is periodically removed and placed in the WWTP. This sludge, together with the sludge produced from

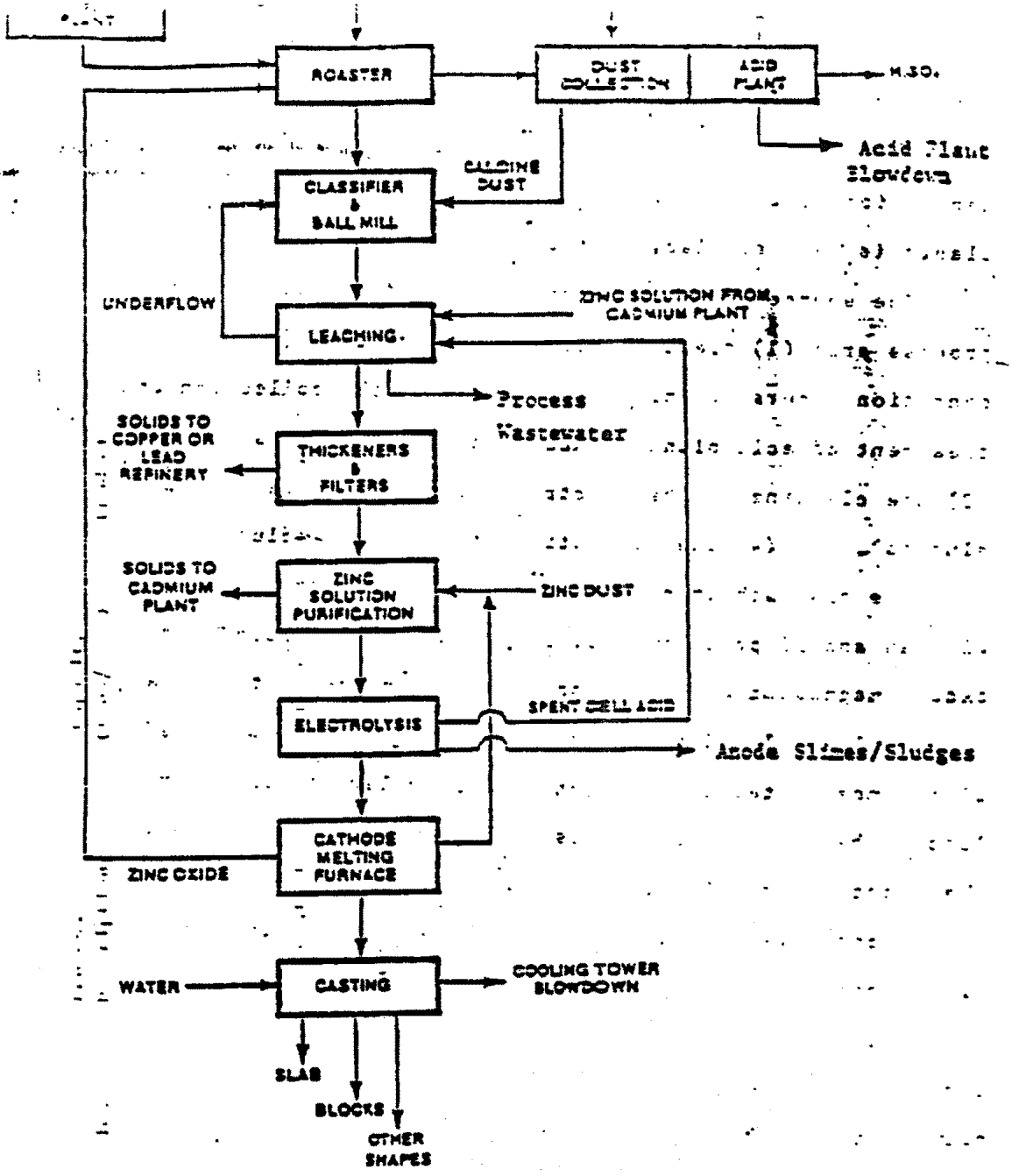

FIGURE 1. ELECTROLYTIC ZINC PRODUCTION PROCESS

is continuously removed and hauled to an off-site landfill operated by a private contractor. At the plant that uses preleaching, the WWTP sludge also contains solids from acid plant blowdown, anode slimes (electrolytic cell cleanings), and miscellaneous slurries. The available information indicates that 9,400 tons of WWTP sludge is generated annually by this plant (3).

All zinc concentrates received at zinc plants are roasted to drive off sulfur and convert the zinc sulfide in the concentrate to an impure zinc oxide called calcine (3). The conversion to calcine in the roaster produces a roaster off-gas stream containing enough sulfur dioxide to permit sulfur recovery as sulfuric acid. All electrolytic plants treat the roaster offgas in sulfuric acid plants to produce a saleable sulfuric acid. The acid production results in a weak acid waste stream from the scrubbing columns that clean the off-gas. This waste is referred to as a bleed stream or acid plant blowdown. The acid plant blowdown is neutralized and thickened, and the solids are allowed to settle in ponds (3). Whether or not the solids are being stored for recycling, the solids do constitute a solid waste as defined by §261.2*. Treatment of

*The Agency has concluded that it does have jurisdiction under Subtitle C of RCRA to regulate wastewater treatment sludges and other waste materials that are used, reused, recycled or reclaimed Furthermore, it has reasoned that such materials do not become less hazardous to human health or the environment because they are intended to be used, reused, recycled or reclaimed in lieu of being discarded. Therefore, at this time, applicable requirements of Parts 262 through 265 and 122 will apply insofar as the accumulation, storage and transportation of hazardous wastes that are used, reused, recycled or reclaimed.

the acid plant blowdown generates an estimated [illegible] tons of sludge per year, (3) which has been designated as hazardous.

All electrolytic plants also generate a waste of anode slimes or sludges from cleaning of the electrolytic cells. Anode slimes/sludges consist of gangue material that is passed through earlier process steps but is not plated out, or electrolyzed, in the electrolysis step. It is estimated that anode slimes/sludges make up 2,600 tons of the annual solid waste produced (3). This waste is also designated as hazardous.*

Pyrometallurgical Process

There are two pyrometallurigical zinc plants with a combined annual production rate of about 261,000 tons of zinc metal (3). These plants account for approximately 51 percent of the total production of zinc metal by the primary zinc industry, but 91 percent of the total solid waste produced by the industry. Although the two plants use the same basic processes (see Figure 2), they differ greatly in the quantities of solid waste generated and in the ultimate disposal or control of the waste (3).

Pyrometallurgical processing entails the following steps: sintering, retorting, refining and casting. Sintering develops the desired characteristics for pyrometallurgical smelting of the calcine by processing the calcine in a sinter machine where the

*All electrolytic plants also generate a leach residue from filtration of the leach slurry, which is not currently listed as hazardous and will not be further discussed in this background document.

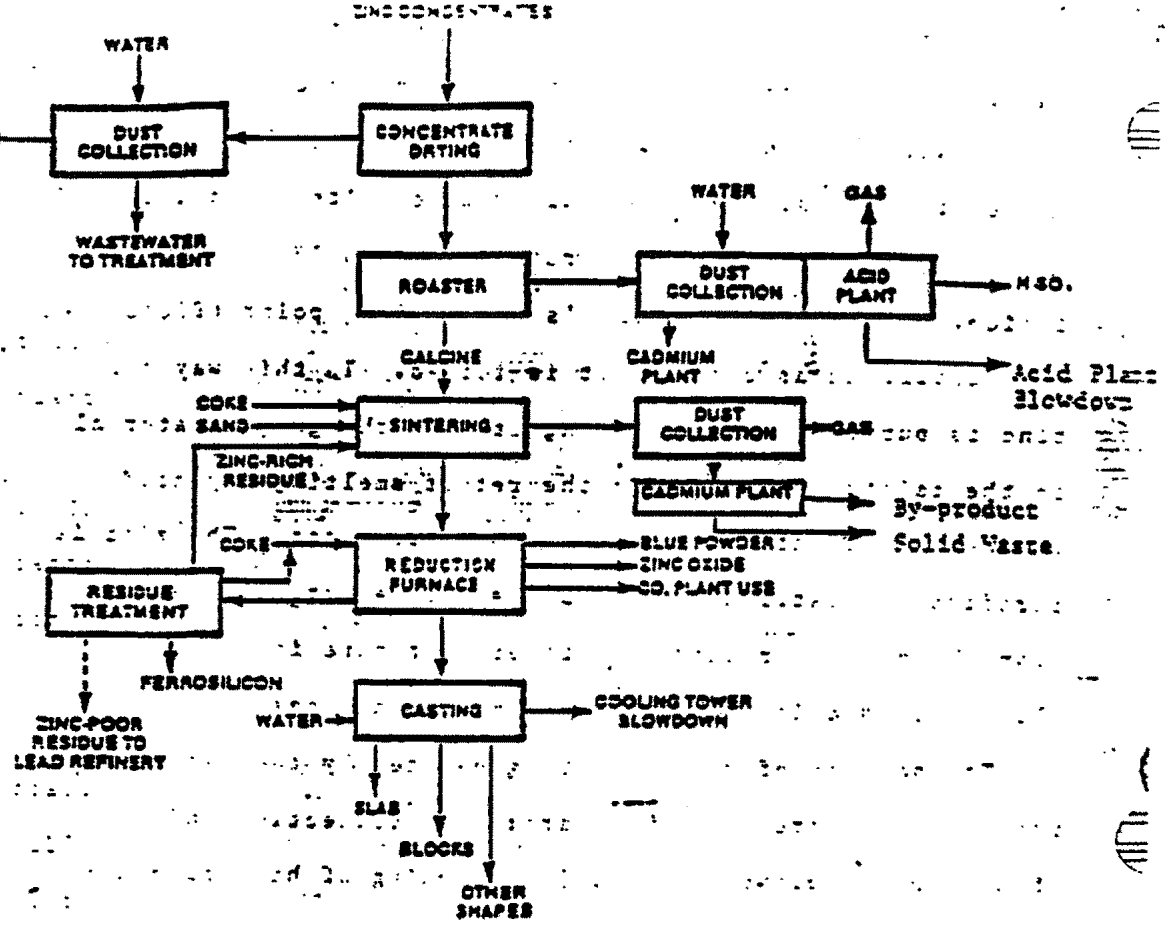

FIGURE 2. PYROMETALLURGICAL ZINC PRODUCTION PROCESS

calcine burns autothermally and is fused into hard, permeable sinter. Retorting consists of reducing the calcine in the sinter with carbon in a retort to produce zinc metal. Preheated feed of sinter and coal or coke is then fed into the top of the retort; the temperature reaches 1300°C-1400°C inside. Because of the zinc's low boiling point (906°C), it is volatilized as soon as it is formed. In this way the zinc is purified by separating it from the gangue material in the calcine. Zinc from the retort smelting may need further purification for some commercial uses. The zinc is purified by distillation in a graphic retort. Molten zinc from the graphic retort is either cast pure into bars or blocks or is alloyed with other metals and cast.

The sources of solid waste generated by the pyrometallurgical process which are hazardous are: (1) collection and treatment of acid plant blowdown, and (2) leaching of high-cadmium dusts in the cadmium plant (3).*

Both pyrometallurgical plants treat roaster off-gas in their sulfuric acid plants to control sulfur dioxide emissions. The process is the same as the one described above for electrolytic plants. The acid plants produce a saleable sulfuric acid and a bleed stream (acid plant blowdown) that must be neutralized. One plant neutralizes the blowdown with lime, which leads to the generation of an estimated 10,000 tons per year of settled

*Two other wastes generated by this process (i.e., residue from the production of zinc oxide in Waelz Kins (one plant only) and furnace residue from the operation of retort and oxidizing furnaces) are not currently listed as hazardous and will not be further discussed in this background document.

sludge, half of which is re[illegible] process. The sludge contains significant concentrations of cadmium and lead and is designated as hazardous.

The other pyrometallurgical plant uses the acid plant blowdown to cool and humidify the roaster off-gas in a humidifying scrubber. Acid plant blowdown from the scrubber is thickened and then cooled before being recycled to the [illegible] scrubber. A bleed stream from the thickener bottoms is sent to the cadmium plant for cadmium recovery. This acid plant process generates no wastes. [illegible] and must be [illegible]

Both of the pyrometallurgical plants operate cadmium plants to process dusts with high cadmium content that are collected from the sinter machine off-gas. Processing includes the cadmium precipitation to produce a cadmium sponge. The leaching steps produce two residues. One contains relatively large quantities of lead, silver, and gold, and is sold as a by-product. The other residue constitutes a solid waste that contains cadmium and lead and is generated at a rate of 200 tons per year.(3) The latter residue has been classified as hazardous.

Waste Generation and Management (3)

At both the electrolytic and pyrometallurgical facilities off-gases from the roaster are treated in sulfuric acid plants to control sulfur dioxide emissions. This process generates acid plant blowdown which may be mixed with the process wastewater prior to treatment by lime precipitation.

cadmium and is designated as hazardous.

Electrolytic refining generates a waste of anode slimes/sludges from cleaning the electrolytic cells. These slimes/sludges consist of gangue material that has passed through the earlier process steps but was not plated out in the electrolysis step. This waste also contains significant amounts of lead and cadmium and is designated is hazardous.

Pyrometallurgical plants process high cadmium dusts collected from the sinter baghouse to recover cadmium. Processing involves acid leaching which produces two residues. One contains significant amounts of lead, silver and gold; this residue is sold as a by-product. The other residue is a solid waste designated as hazardous because of its lead and cadmium content.

Current solid waste control practices are fairly uniform throughout the zinc industry. Of the total solid waste generated, about 90 percent is controlled through on-site stockpiling, 7 percent is removed by private and municipal organizations and individuals for various uses (such as winter road sand), and the remaining 3 percent is hauled and landfilled by private contractors.

Control Practices at Electrolytic Plants (3)

Electrolytic zinc plants produce solid waste consisting of anode "slimes/sludges", neutralized acid plant blowdown, surface impoundment dredgings, wastewater treatment sludge, and goethite residue.

Two of the electrolytic plants use wastewater treatment plants (WWTP) to treat plant wastewater and various process sludges. At both of these plants, the WWTP sludge is removed and hauled to off-site landfills. One of the two plants removes this sludge continuously as it is filtered (dewatered). There is no on-site storage or disposal at this plant. This particular sludge contains solids from anode sludge, neutralization of acid plant blowdown, impoundment dredgings, and sludge generated from the treatment of a process of prelech slurry. The other plant using a WWTP piles WWTP sludge on-site temporarily for drying prior to removal and transportation to an off-site landfill. This particular sludge contains solids from the neutralization of acid plant blowdown and solids precipitated from plant runoff and washdown. At this plant, anode sludge is not treated in the WWTP but is stockpiled on site. The WWTP sludge from these two plants amounts to about 31 percent of the solid waste generated at electrolytic plants. All of this sludge is hauled to off-site landfills, either immediately or after temporary on-site storage. Because the WWTP at each of these plants treats acid plant blowdown, the WWTP sludges generated containing cadmium and lead, are considered hazardous.

Two of the remaining three electrolytic plants stockpile dredgings from surface impoundments on-site. One of these plants generates two additional solid wastes that none of the other plants generate. These two wastes, goethite and a sulfur residue, are also stockpiled on-site.

through 1978 used lined surface impoundments. Two of these plants use synthetic liners; the other uses a clay liner. The fourth plant has an unlined surface impoundment. Monitoring wells are used by at least one plant.(3)*

It is assumed(3) that the fifth plant, one which has recently come on-line and will have a WWTP, will generate a sludge which will be removed to an off-site landfill. It is also assumed(3) that this plant will use a lined surface impoundment which treats the anode sludge, acid plant blowdown, impoundment dredgings, and plant wastewater in the WWTP. These assumptions, based on plant similarities indicated in the available literature(3), were necessary to estimate quantities of solid waste generation at this new facility. In order to avoid underestimation, the new plant is also assumed to generate a solid waste (such as goethite residue) that is stockpiled on-site.

Control Practices at Pyrometallurgical Plants

The two pyrometallurgical zinc plants produce acid plant blowdown, furnace (retort, oxide, and Waelz kiln) residue, scrap furnace brick, and a cadmium plant residue. One of these plants has a relatively small solid waste stockpile. The other pyrometallurgical plant has an extremely large stockpile of solid waste. This plant alone generates about 89 percent of the solid waste produced by all primary zinc

*The groundwater monitoring system at this one plant may not be sufficient to adequately monitor leaching from the surface impoundment.

plants(3). Solid waste stockpile sites are selected primarily for convenience. No site preparation is conducted other than clearing and grubbing.

Both plants have surface impoundments. The impoundment at one plant is lined with synthetic material; the impoundment at the other is not lined. At one plant, the impoundment collects acid plant blowdown and plant water. At the other plant, acid plant blowdown is not slurried to the impoundment, but is instead sent to the cadmium plant for further processing. Dredgings from both impoundments are controlled on-site. One plant recycles all dredgings to the process; the other recycles about half of the dredgings and stockpiles the remainder. One of the plants also stockpiles cadmium plant residues on-site.

These plants do not use surface water control by collection and diversion ditching to its fullest potential.(3) Neither do the plants currently use barriers to prevent seepage from solid waste stockpiles, or wells to monitor or collect any seepage or leachate(3).

Hazardous Properties of the Wastes

The Administrator has classified the process wastewater and/or acid plant blowdown treatment sludge, electrolytic anode slimes/sludges, and the cadmium plant leach residue (iron oxide) as hazardous because of the high levels of toxic cadmium and lead found in the wastes. In EPA's "Assessment of Hazardous Waste Practices in the Metal Smelting and Refining Industry," Calspan Corporation tested samples of the wastes

...performed extraction ... on the wastes using distilled water as the extraction medium (1). The results are as follows:

	Waste Analysis (ppm)		Extract Analysis (ppm)	
	Cd	Pb	Cd	Pb
Sludge from acid plant blowdown (Electrolytic Plant)	<10	98		2.1
	<10	1750		1.0
	550	18,100		
Sludge from acid plant blowdown (Pyrometallurgical Plant)	2000	4350	<0.01	1.3
	640	4280		
Anode slimes/ sludges	12	170,000	12	2.0
	1400	89,000		
Cadmium Plant Residue	280	215,000	<0.01	9.0

Calculations of sludge contents from lime-and-settle wastewater treatment also indicate that significant amounts and concentrations of lead and cadmium are present in these wastes (2).

Plant	Contaminants	Percent in Sludge
#1	Cadmium	4.0%
	Lead	2.5%
#2	Cadmium	2.6%
	Lead	1.7%

Cadmium and lead are always expected to be in the sludges after treatment because 1) the treatment processes are designed to remove such elements from the wastewater to meet

effluent standards, and 2) cadmium and lead will not be lost (e.g., volatilized) in the treatment process.

Based on the data presented above, the waste is classified as hazardous because it contains significant concentrations of cadmium and lead which are toxic and because the extraction tests performed on these wastes indicate that the cadmium and lead may be in a soluble form and could be released to the environment in harmful concentrations. The fact that water extractions of the wastes have shown that the wastes could leach potentially hazardous concentrations of toxic metals indicates that under the mildest environmental conditions (e.g., neutral pH rainfall) at a mono-disposal site, the wastes may leach contaminants to the groundwater in concentrations which would be harmful to human health and the environment. Where conditions tend to be acidic, the release of these toxic metals over the lifetime of a landfill is expected to be even higher than indicated by the water extraction data, since cadmium and lead solubilities increase with a decrease in pH (4). /

On-site stockpiling is most likely not an environmentally acceptable means of disposing of a waste which contains

/ The Agency has determined to list wastes from primary zinc smelting and refining as a "T" hazardous waste, on the basis of lead and cadmium constituents, although these constituents are also measureable by the EP toxicity characteristic. The Agency believes that there are factors in addition to metal concentrations in leachate which justify the "T" listing. Some of these factors are the high concentrations of lead and cadmium in actual wastes streams, the non-degradability of these substances and indications of lack of proper management of the wastes in actual practice.

significant concentrations of toxic metals that have been shown to migrate from the waste. Surface water can become contaminated with contaminants from these wastes via runoff from rainfall. Similar hazards exist if these wastes are disposed of in improperly managed landfills or surface impoundments; leaching, run-off, or overflow may result in contamination of surface and groundwaters.

The cadmium and lead that may migrate from the waste to the environment as a result of improper disposal practices are toxic metals that persist in the environment and therefore may contaminate drinking water sources for extremely long periods of time. Cadmium is toxic to practically all systems and functions of the human and animal organism(5). Acute poisoning may result from the inhalation of cadmium dusts and fumes (usually cadmium oxide) and from ingestion of cadmium salts(6). Lead is poisonous in all forms; it is one of the most hazardous of the toxic metals because it accumulates in many organisms and the deleterious effects are numerous and severe. Lead may enter the human system through inhalation, ingestion or skin contact. Ingestion of contaminated drinking water is a possible means of exposure to humans as a result of improper management of these wastes. Additional information on the adverse health effects of cadmium and lead can be found in Appendix A.

The hazards associated with exposure to cadmium and lead have been recognized by other regulatory programs. Lead and

§307(a) of the Clean Water Act of 1977. Under §6 of the Occupational Safety and Health Act of 1970, a final standard for occupational exposure to lead has been established (7). Also, a national ambient air quality standard for lead has been announced by EPA pursuant to the Clean Air Act (7).

In addition, final or proposed regulations of the State of California, Maine, Massachusetts, Minnesota, Missouri, New Mexico, Oklahoma and Oregon define cadmium and lead-containing compounds as hazardous wastes or components thereof (8). EPA has proposed regulations that will limit the amount of cadmium in municipal sludge which can be landspread on crop land (9). The Occupational Safety and Health Administration (OSHA) has issued an advance notice of proposed rulemaking for cadmium air exposure based on a recommendation by the National Institute for Occupational Safety and Health (NIOSH) (10). EPA has prohibited ocean dumping of cadmium and cadmium compounds except as trace contaminants (11). EPA has also promulgated pretreatment standards for electroplaters which specifically limit discharges of cadmium to Public Owned Treatment Works (12).

References

1. U.S. EPA, Office of Solid Waste. Assessment of hazardous waste practices in the metal smelting and refining industry. Vols. II and IV. EPA Nos. SW-145c2 and SW-145c4. NTIS PB Nos. 276 170 and 276 172. April, 1977.

2. U.S. EPA, Effluent Guidelines Division. Draft development document for effluent limitation guidelines and new source performance standards for the major nonferrous metals segment of the nonferrous manufacturing point source category. EPA No. 440/1-79/019. September, 1979.

3. U.S. EPA, Office of Solid Waste. Assessment of solid waste management problems and practices in nonferrous smelters. 1979.

4. Pourbaix, M. Atlas of electrochemical equilibria in aqueous solutions. Pergamon Press, London. 1966.

5. Waldbott, G.L. Health effects of environmental pollutants. C.V. Mosby Company, St. Louis. 1973.

6. Gleason, M.N., R.E. Gosselin, H.C. Hodge, B.P. Smith. Clinical toxicology of commercial products, 3rd ed. The Williams and Wilkins Co., Baltimore. 1969.

7. U.S. Department of Interior, Bureau of Mines. Mineral commodity summaries, 1980. December, 1979.

8. U.S. EPA State Regulations File, Hazardous Waste State Programs, WH-565. U.S. EPA, 401 M St., S.W., Washington, D.C. 20460. Contact Sam Morekas. (202) 755-9145.

9. 44 FR 53449.

10. 44 FR 5434.

11. 38 FR 28610.

12. 40 CFR, Part 413. Federal Register, Vol. 44, No. 175, Friday, September 7, 1979.

Comments were received from three companies pertaining to the listing of wastes from the primary zinc industry. The comments address the following general points:

1. Listed wastes are recycled and not discarded.
2. Listed wastes are being stored on-site but will eventually be recycled.

The Agency has concluded that it does have jurisdiction under Subtitle C of RCRA to regulate wastewater treatment sludges and other waste materials that are used, reused, recycled or reclaimed. Furthermore, it has reasoned that such materials do not become less hazardous to human health or the environment because they are intended to be used, reused, recycled or reclaimed in lieu of being discarded. Although the materials recycled and reclaimed may not pose a hazard, the accumulation, storage and transport of a hazardous waste prior to use, reuse, recycle or reclamation will present the same hazard as they would prior to being discarded. In addition, the act of use, reuse, recycling or reclamation, in many cases, poses a hazard equivalent to that encountered if the waste were discarded. Thus, the Agency believes it has a strong environmental rationale for regulating hazardous wastes that are used, reused, recycled or reclaimed.

For the particular wastes at issue, the Agency recognizes that these wastes for most or all of its existance prior to being recycled is deposited in a surface impoundment when the

potential for leaching of the hazardous constituents is real and significant. Consequently, the waste must be considered a hazardous waste in this environment; to avoid listing it as a hazardous waste would be unjustified. Likewise, if the waste is piled and stored on the land, prior to recycling, the potential of leaching of its hazardous constituents into the environment would still prevail and avoiding its regulation would be unjustified.

The key question, therefore, is not whether or not it is a hazardous waste and should be listed as a hazardous waste, but whether or not to what degree it should be regulated during recycling; that is should the recycling process and facility be considered a hazardous waste management operation and facility required to obtain interim status and eventually a permit and required to meet the standards set forth in Parts 264 and 265 of the regulations. At this time, the Agency has deferred regulation of such facilities because it recognizes that the full set of Subtitle C management requirements may not be necessary. As and when it concludes that regulation of these facilities is necessary, it will terminate this deferral and impose either the requirements of Parts 264 and 265 (as well as 122) or special tailored requirements under Part 266.

At this time, applicable requirements of Parts 262 through 265 and 122 will apply insofar as the accumulation, storage and transportation of hazardous wastes that are used,

reused, recycled or reclaimed. The Agency believes this regulatory coverage and the above described deferral of regulated coverage is appropriate to the subject wastes. These sludges are hazardous insofar as they are being accumulated and stored in surface inpoundments and insofar as they may be stored in piles prior to recycling. Therefore, these sludges should be listed as hazardous waste. These sludges may not pose a substantial hazard during their recycling and, even though listed as hazardous waste, this aspect of their management is not now being regulated.

LISTING BACKGROUND DOCUMENT

PRIMARY LEAD SMELTING

K065 Surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities.(T)

Summary of Basis for Listing

The smelting of primary lead produces a number of wastewaters and slurries, including acid plant blowdown, slag granulation water, and plant washwater. These wastewaters and slurries are sent to treatment and storage impoundments to settle out the solids. The solids may be left in the lagoons, or they may be periodically dredged and disposed of elsewhere.

The Administrator has determined that the solids contained in and dredged from surface impoundments used to treat or store wastewaters and slurries from primary lead smelting may pose a present or potential hazard to human health or the environment when improperly managed and therefore should be subject to appropriate management requirements under Subtitle C of RCRA. This conclusion is based on the following considerations:

1. The waste contains significant concentrations of the toxic metals, lead and cadmium.

2. Significant concentrations of lead and cadmium have been shown to leach from samples of the waste which were subjected to an extraction procedure designed to predict the release of contaminants into the environment. If the wastes are not properly managed, leachate could migrate from the waste disposal site and contaminate underlying drinking water sources. Further, lead and cadmium do not degrade, so that contamination, and the opportunity for contaminant contact with living receptors, will be long-term.

3. Estimates indicate that large quantities of the waste are generated each year (more than 49,100 tons in 1978) and that the typical waste management practices may be inadequate to prevent substantial environmental harm caused by lead and cadmium migration.

Manufacturing Process and Sources of Hazardous Wastes (1)

The primary lead facilities that generate the hazardous wastes that concern EPA are four integrated lead smelter/refineries. These facilities are located in Missouri and Idaho. Production capacity ranges from 110,000 to 225,000 tons per year. Total primary lead production (from the four integrated smelter/refineries, two smelters and one refinery) was 611,650 tons in 1977. Forecasts indicate that domestic demand will increase to 1,030,000 - 2,340,000 tons in the year 2000.

by pyrometallurgical smelting and refining processes. The major process steps are the same at all the smelters, with the exception that those that treat non-Missouri ore concentrates use auxiliary operations to recover valuable metals or remove undesirable impurities. The following is a step-by-step description of the manufacturing process as presented in Figure 1. This description includes the major process steps for all primary lead smelting and refining plants.

During the smelting process, concentrates produced by the beneficiation of various lead-bearing ores are converted to an impure lead bullion suitable for refining. The ore concentrate is the major feedstock material. Other raw materials that may be added during the process include iron, silica, limestone flux, coke, soda, ash, pyrite, zinc, caustic, and particulates and sludges collected in pollution control devices. The ore concentrate and the pollution control dusts and sludges are the primary sources of lead and cadmium found in the settled solids from the surface impoundments.

The first of the processes in smelting is sintering, an operation which agglomerates the fine particles, converts metallic sulfides to oxides, drives off volatile metals, and eliminates most of the sulphur as sulphur dioxide. Off-gases from sintering may contain sulphur dioxides in concentrations that

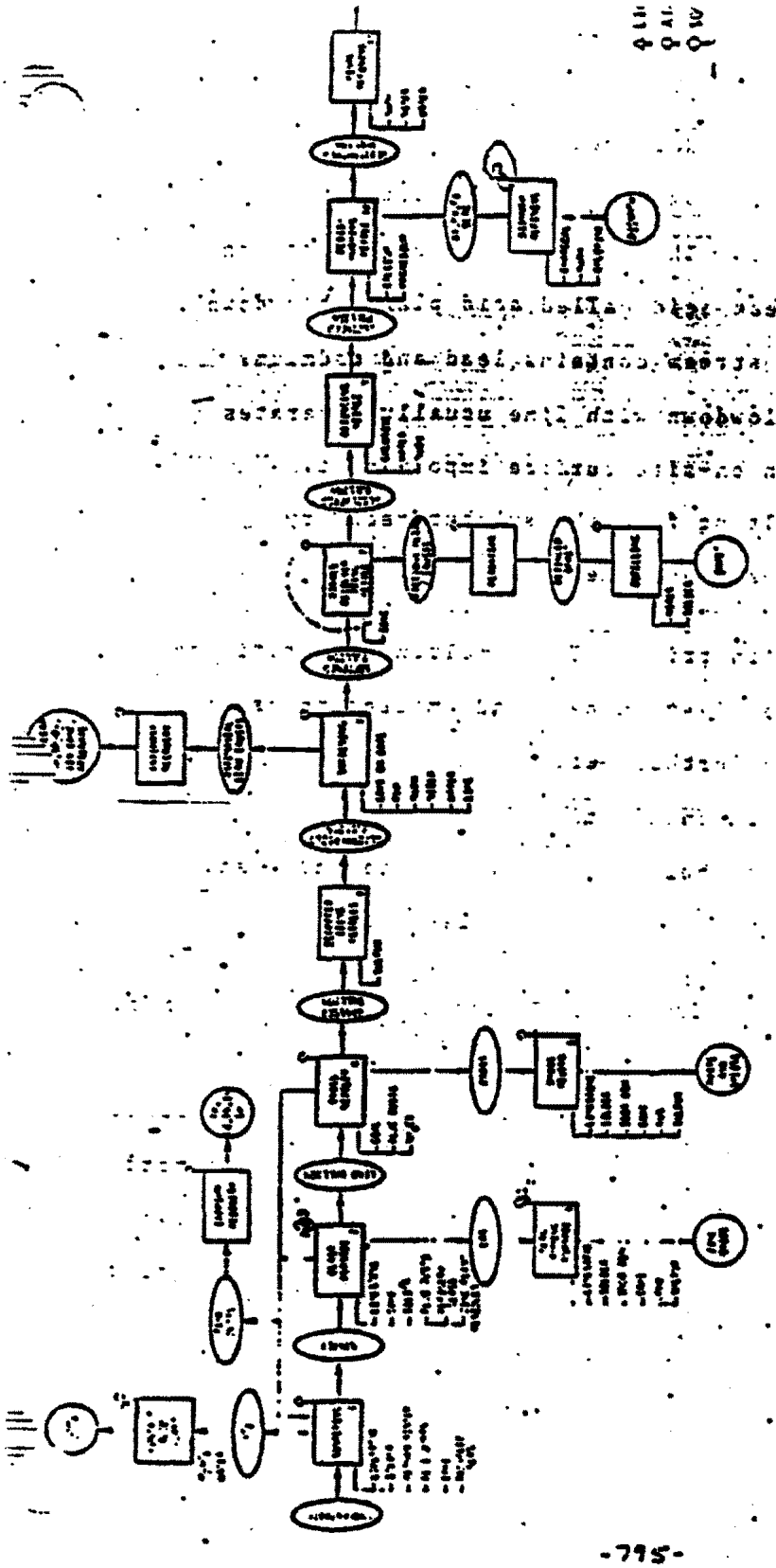

Figure 1. Flow chart depicts primary lead smelting and refining. (umbers correspond to process numbers in text and also correspond to step process in this document. The first three steps produce the hazardous miscellaneous slurries of concern.)

are practical for recovery. Of particular concern, though, are the lead and cadmium entrained in those off-gases. Four plants have sinter machines designed to produce an off-gas containing enough sulphur dioxide to permit recovery of sulphur as sulphuric acid. The sulphur recovery operation generates a stream of weak acid called acid plant "blowdown". The acid plant blowdown stream contains lead and cadmium. Neutralization of the blowdown with lime usually generates a slurry destined for an on-site surface impoundment. This waste stream, resulting from the sulphur recovery operation, requires proper management.

In the second step in primary lead smelting and refining, sinter is charged to the blast furnace and smelted to crude lead bullion that can be further refined. During this reduction process, the components of the sinter are separated into four distinct layers, bullion, speiss, matte and slag. The two layers of concern are the bullion layer and the slag layer which result from the interaction of fluxes and metal impurities. The crude lead bullion is charged to drossing (the fourth step in this process.) The blast furnace slag may be disposed of or sent to a zinc fuming furnace (an interim step) for recovery of lead and zinc, rather than opting for direct disposal. The zinc fuming process, in turn, also generates a slag. Blast furnace slag and zinc fuming slag disposal practices are similar. The waste is either

sent directly to a slag pile or granulated in a water jet before being transported to the slag pile. The granulation process cools newly generated, hot slag with a water spray. Slag granulation water is often transported to surface impoundments for settling.

The blast furnace bullion undergoes "drossing" (Step 4) to remove common metallic impurities. Dross separated from the lead bullion must be further treated in a reverberatory drossing furnace (Step 5) to recover metal values. Rough-drossed lead bullion, still containing copper, is decopperized (Step 6) before further refining. One of three usual processes is then used to remove metals that cause lead to harden. This process is called softening (Step 7). Softened lead bullion contains precious metals, gold, and silver, which are recovered for their economic value through the Parkes desilverizing process (Step 8). To remove the excess zinc added during desilverization, a dezincing process (Step 10) which removes the bismuth, which is in excess of the 0.15 percent specification for desilvered and dezinced lead bullion. Lead bullion from desincing or debismuthing is combined with flux to remove remaining impurities before casting (Step 11) and, finally, the refined lead bullion is cast into ingots for sale (Step 12).

The listed hazardous wastes generated by primary lead

smelting plants are settled solids from surface impoundments. The impoundments are used to collect solids from miscellaneous slurries, such as acid plant blowdown, slag granulation water and plant washings. Plant washing is a housekeeping process; plant washdown normally contains a substantial amount of lead and other process material.

Data indicate that in 1978 four integrated smelter/refineries that process lead ore concentrates combined to produce more than 49,100 tons of impoundment solids considered hazardous. The data also indicate that the bulk of this waste is generated and managed at three plant locations.

The waste contains high concentrations of lead and cadmium. The presence of such high concentrations of toxic metals in a waste stream in and of itself raises regulatory concerns. Furthermore, distilled water extraction test data indicate that these dangerous constituents may leach from the waste in harmful concentrations unless the wastes are properly managed.

Waste Generation and Management (1)

As previously mentioned, the miscellaneous slurries generated by primary lead smeltering plants are settled in

surface impoundments. Typically a minimal effort is expended for impoundment site selection. Site selection is based primarily on convenience. Site preparation usually consists of simply scooping out earth to form impoundments. EPA is unaware of any sealants or liners being employed beneath disposal areas. Leachate or groundwater monitoring is not adequately utilized, or not utilized at all.

Four facilities have surface impoundments. Currently, some of the impoundments are dredged of their accumulated solids on an "as needed" basis. Dredging is done with common equipment at frequencies from once per year to once every 3 years or longer. The dredged material is either dumped beside the impoundment or trucked to an on-site dump. Some of this material may be recycled to sintering if it contains enough metals.*

Hazardous Properties of the Waste (3)

EPA has sampled process wastewater before and after treatment in an effort to quantify the amounts of lead and cadmium likely to be in the waste. The settled solids are assumed to contain the pollutants removed from the process wastewater. The data are summarized as follows:

*See "Response to Comments" at the end of this document for a discussion on the coverage of those materials recycled back to the process.

Plant A

Flow = 1,300,000 gpd (gallons per day)

Metal	Influent Concentration	Effluent Concentration	Difference	lbs/day in solids
Cd	0.89 ppm	0.044 ppm	0.846 ppm	9.172
Pb	17 ppm	0.925 ppm	16.075 ppm	174.3

Plant B

Flow = 280,000 gpd

Metal	Influent Concentration	Effluent Concentration	Difference	lbs/day in solids
Cd	15 ppm	0.43 ppm	14.57 ppm	34
Pb	50 ppm	0.39 ppm	49.61 ppm	115.85

Based on continuous year round plant operation, these data show that approximately 3300 lbs/yr of cadmium accumulate in an impoundment in Plant A and approximately 12,400 lbs/yr accumulate in Plant B. Lead in the impoundment solids from Plant A accumulates at a rate of almost 64,000 lbs/yr., and at a rate of almost 42,300 lbs/yr at Plant B. Should only one percent of each metal leach from the settled solids from Plant B, the result would be 124 lbs/yr of cadmium

and 423 lbs/yr of lead potentially available to the environment from that one plant.

The above evidence indicating that significant amounts of lead and cadmium are present in the settled solids is supported by actual waste analyses which reveal that the waste does in fact contain high concentrations of these toxic metals. The Calspan Corporation tested samples of the impoundment dredgings at two plants and found the following concentrations of lead and cadmium(2)

Hazardous Constituents of Impoundment Dredgings (ppm)

	Cd	Pb
Plant I	700	115,000
Plant II	640	140,000

Calspan Corporation also subjected a sample of the waste believed to be representative of the lagoon dredgings to a water extraction to determine whether the toxic metals could leach from the waste. Approximately 50 grams of a sample was placed in a 200 milliliter jar and two parts by weight of water were added. The bottle was gently agitated on a rotary tumbler for 72 hours. The extract was then filtered through a 0.45 micron micropore filter and the filtrate was analyzed for toxic metals. This waste leached 11 ppm of

cadmium (1,125 times the amount permitted by the National Interim Primary Drinking Standard) and 4.5 ppm of lead (90 times the amount permitted by the National Interim Primary Drinking Standard). Therefore, cadmium and lead are likely to be leached from the waste in harmful concentrations even when they are placed in a monodisposal site subject to mild environmental conditions. If these wastes are placed in acidic environments such as disposal sites subject to acid rainfall or co-disposal with acids, the concentrations will probably be higher, since lead and cadmium compounds are generally more soluble in acid than in distilled water.

The hazard associated with leaching of hazardous constituents from the impoundments during the interim storage period is the migration of those constituents to ground and surface waters. The miscellaneous slurries are probably composed of particulates of various sizes, ranging from dust particles to fine slag from slag granulation water. The potential of the hazardous constituents being released from the matrix is influenced by the physical form of the waste. For instance, wastes composed of fine particles provide greater surface area on which a solubilizing medium can act and therefore the probability is increased that hazardous constituents will leach from the waste. Contaminant-bearing leachate can then migrate to ground and surface water.

Thus, improper disposal of surface impoundment solids may result in contamination of ground and surface waters by lead and cadmium. Aquatic species might be affected, and, where ground and surface waters are sources of drinking water, ingestion of the contaminants by humans could occur. For this reason, proper waste management is essential and of major concern to EPA.(2)

Present management practices appear to be inadequate to prevent contamination of ground and surface waters used as drinking water sources. Presently, if solids are allowed to settle in unlined and unsealed impoundments in areas with permeable soils, the solubilized lead and cadmium in the liquid phase could migrate from the site to an aquifer. Groundwater contamination might also occur if the dredged solids are dumped on permeable soils since no provision presently appears to be made to prevent percolation of rainfall through the waste or to collect resulting leachate. Surface waters may become contaminated if run-off from dumping sites and overflow from surface impoundments are not controlled by appropriate diversion systems.(2)

Compounding this problem, and an important consideration for the future, is the fact that should lead or cadmium escape from the disposal site, they will not degrade with

the passage of time, but will provide a potential source of longterm contamination.

Further, as indicated previously, the cadmium and particularly the lead found in the impoundments are generated in very substantial quantities. Large amounts of each of these metals are thus available for potential environmental release. The large quantities of these contaminants pose the danger of polluting large areas of ground and surface waters. Contamination could also occur for long periods of time, since large amounts of pollutants are available for environmental loading. The attenuation capacity of the environment surrounding the disposal facility could also be reduced or exhausted by such large quantities of of pollutants. All of these considerations increase the possibility of exposure to harmful constituents in the wastes, and in the Agency's view, demand recognition.

Adverse Health Effects Associated with Lead and Cadmium

Lead and cadmium are toxic metals that threaten both human health and that of other organisms. The hazards of human exposure to lead include neurological damage, renal damage and adverse reproductive effects. In addition, lead is carcinogenic to laboratory animals, and relatively toxic

to freshwater organisms. It also bioaccumulates in many species. Additional information on lead can be found in Appendix A. Cadmium (see Appendix A for more information) also can cause toxic effects in many species. It is bioaccumulated at all trophic levels and has been shown to be mutagenic and teratogenic in laboratory animals.

Hazards associated with exposure to lead and cadmium have been recognized by other regulatory programs. For example, Congress designated lead and cadmium as priority pollutants under §307(a) of the Clean Water Act. The Occupational Health and Safety Administration has a final exposure standard for lead and a draft standard has been developed for cadmium under §6 of the Occupational Safety and Health Act of 1970. The states of Maine, Vermont, New Mexico, Missouri, Massachusetts, Minnesota, Oklahoma, Oregon, and California either regulate or are considering regulation of lead and cadmium as hazardous waste. The implications of these regulations or considerations thereof are obvious: unregulated lead and cadmium management is a real and recognized hazard.

1. U.S. EPA. IERL/ORD and Office of Solid Waste. Assessment of solid waste management problems and practices in nonferrous smelters. Prepared by PEDCO Environmental Inc., Contract No. 68-03-2577. November, 1979.

2. U.S. EPA. Office of Solid Waste. Assessment of hazardous waste practices in the metal smelting and refining industry. V's 1-4. NTIS PB Nos. 276 169, 276 170, 276 171, 276 172. April, 1977.

3. U.S. EPA. Office of Water Planning and Standards, Effluent Guidelines Division. Draft development document for effluent limitations guidelines and standards for the nonferrous metals manufacturing point source category. EPA No. 440/1-79/019c. September, 1979.

1. One commenter indicated that the listed waste (surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities) was recycled at his facility and, therefore, should not be listed as a hazardous waste.

The Agency has concluded that it does have jurisdiction under Subtitle C of RCRA to regulate wastewater treatment sludges and other waste materials that are used, reused, recycled or reclaimed. Furthermore, it has reasoned that such materials do not become less hazardous to human health or the environment because they are intended to be used, reused, recycled or reclaimed in lieu of being discarded. Although the materials recycled and reclaimed may not pose a hazard, the accumulation, storage and transport of a hazardous waste prior to use, reuse, recycle or reclamation will present the same hazard as they would prior to being discarded. In addition, the act of use, reuse, recycling or reclamation, in many cases, poses a hazard equivalent to that encountered if the waste were discarded. Thus, the Agency believes it has a strong environmental rationale for regulating hazardous wastes that are used, reused, recycled or reclaimed.

nizes that it is a wastewater treatment sludge and for most or all of its existence prior to being recycled, it is deposited in a surface impoundment where the potential for leeching of the hazardous constituents is real and significant. Consequently, the waste must be considered a hazardous waste in this environment; to avoid listing it as a hazardous waste would be unjustified. Likewise, if the waste is piled and stored on the land, prior to recycling, the potential of leaching of its hazardous constituents into the environment would still prevail and avoiding its regulations would be unjustified.

The key question, therefore, is not whether or not it is a hazardous waste and should be listed as a hazardous waste, but whether or not or to what degree it should be regulated during recycling; that is, should the recycling process and facility be considered a hazardous waste management operation and facility required to obtain interim status and eventually a permit and required to meet the standards set forth in Parts 264 and 265 of the regulations. At this time, the Agency has deferred regulation of such facilities because it recognizes that the full set of Subtitle C management requirements may not be necessary. As and when it concludes that regulation of these facilities is necessary, it will terminate this

deferral and impose either the requirement of Parts 264 and 265 (as well as 122) or special tailored requirements under Part 266.

At this time, applicable requirement of Parts 262 through 265 and 122 will apply insofar as the accumulation, storage and transportation of hazardous wastes that are used, reused, recycled or reclaimed. The Agency believes this regulatory coverage and the above described deferral of regulated coverage is appropriate to the subject wastes. These sludges are hazardous insofar as they are being accumulated and stored in surface impoundments and insofar as they may be stored in piles prior to recycling. Therefore, these sludges should be listed as hazardous waste. These sludges may not pose a substantial hazard during their recycling and, even though listed as hazardous waste, this aspect of their management is not now being regulated.