This report is one in a series of volumes published by the U.S. Environmental Protection Agency (EPA) to provide information of general interest regarding environmental issues associated with specific industrial sectors. The documents were developed under contract by Abt Associates (Cambridge, MA), and Booz-Allen & Hamilton, Inc. (McLean, VA). This publication may be **purchased** from the Superintendent of Documents, U.S. Government Printing Office. A listing of available Sector Notebooks and document numbers is included on the following page.

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Electronic versions of all Sector Notebooks are available free of charge at the following web address: **www.epa.gov/oeca/sector**. Direct technical questions to the "Feedback" button at the bottom of the web page.

Cover photograph courtesy of Reynolds Aluminum Recycling Company, Richmond, Virginia. Special thanks to Terry Olbrysh for providing photographs.

EPA/310-R-95-010

EPA Office of Compliance Sector Notebook Project

Profile of the Nonferrous Metals Industry

September 1995

Office of Compliance
Office of Enforcement and Compliance Assurance
U.S. Environmental Protection Agency
401 M St., SW (MC 2221-A)
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EPA/310-R-95-003.	Wood Furniture and Fixtures Industry	Bob Marshall	564-7021
EPA/310-R-95-004.	Inorganic Chemical Industry*	Walter DeRieux	564-7067
EPA/310-R-95-005.	Iron and Steel Industry	Maria Malave	564-7027
EPA/310-R-95-006.	Lumber and Wood Products Industry	Seth Heminway	564-7017
EPA/310-R-95-007.	Fabricated Metal Products Industry*	Scott Throwe	564-7013
EPA/310-R-95-008.	Metal Mining Industry	Jane Engert	564-5021
EPA/310-R-95-009.	Motor Vehicle Assembly Industry	Anthony Raia	564-6045
EPA/310-R-95-010.	Nonferrous Metals Industry	Jane Engert	564-5021
EPA/310-R-95-011.	Non-Fuel, Non-Metal Mining Industry	Rob Lischinsky	564-2628
EPA/310-R-95-012.	Organic Chemical Industry*	Walter DeRieux	564-7067
EPA/310-R-95-013.	Petroleum Refining Industry	Tom Ripp	564-7003
EPA/310-R-95-014.	Printing Industry	Ginger Gotliffe	564-7072
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EPA/310-R-95-016.	Rubber and Plastic Industry	Maria Malave	564-7027
EPA/310-R-95-017.	Stone, Clay, Glass, and Concrete Industry	Scott Throwe	564-7013
EPA/310-R-95-018.	Transportation Equipment Cleaning Ind.	Virginia Lathrop	564-7057
EPA/310-R-97-001.	Air Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-002.	Ground Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-003.	Water Transportation Industry	Virginia Lathrop	564-7057
EPA/310-R-97-004.	Metal Casting Industry	Jane Engert	564-5021
EPA/310-R-97-005.	Pharmaceuticals Industry	Emily Chow	564-7071
EPA/310-R-97-006.	Plastic Resin and Man-made Fiber Ind.	Sally Sasnett	564-7074
EPA/310-R-97-007.	Fossil Fuel Electric Power Generation Ind.	Rafael Sanchez	564-7028
EPA/310-R-97-008.	Shipbuilding and Repair Industry	Anthony Raia	564-6045
EPA/310-R-97-009.	Textile Industry	Belinda Breidenbach	564-7022
EPA/310-R-97-010.	Sector Notebook Data Refresh-1997	Seth Heminway	564-7017
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EPA/310-R-98-004.	Agricultural Livestock Production Ind.	Ginah Mortensen	(913)551-7864
EPA/310-R-98-005.	Oil and Gas Exploration and Production Industry	Dan Chadwick	564-7054
EPA/310-R-98-008.	Local Government Operations	John Dombrowski	564-7036

*Spanish translations available.

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NONFERROUS METALS INDUSTRY
(SIC 333-334)
LIST OF ACRONYMS

AFS -	AIRS Facility Subsystem (CAA database)
AIRS -	Aerometric Information Retrieval System (CAA database)
BIFs -	Boilers and Industrial Furnaces (RCRA)
BOD -	Biochemical Oxygen Demand
CAA -	Clean Air Act
CAAA -	Clean Air Act Amendments of 1990
CERCLA -	Comprehensive Environmental Response, Compensation and Liability Act
CERCLIS -	CERCLA Information System
CFCs -	Chlorofluorocarbons
CO -	Carbon Monoxide
COD -	Chemical Oxygen Demand
CSI -	Common Sense Initiative
CWA -	Clean Water Act
D&B -	Dun and Bradstreet Marketing Index
ELP -	Environmental Leadership Program
EPA -	United States Environmental Protection Agency
EPCRA -	Emergency Planning and Community Right-to-Know Act
FIFRA -	Federal Insecticide, Fungicide, and Rodenticide Act
FINDS -	Facility Indexing System
HAPs -	Hazardous Air Pollutants (CAA)
HSDB -	Hazardous Substances Data Bank
IDEA -	Integrated Data for Enforcement Analysis
LDR -	Land Disposal Restrictions (RCRA)
LEPCs -	Local Emergency Planning Committees
MACT -	Maximum Achievable Control Technology (CAA)
MCLGs -	Maximum Contaminant Level Goals
MCLs -	Maximum Contaminant Levels
MEK -	Methyl Ethyl Ketone
MSDSs -	Material Safety Data Sheets
NAAQS -	National Ambient Air Quality Standards (CAA)
NAFTA -	North American Free Trade Agreement
NCDB -	National Compliance Database (for TSCA, FIFRA, EPCRA)
NCP -	National Oil and Hazardous Substances Pollution Contingency Plan
NEIC -	National Enforcement Investigation Center
NESHAP -	National Emission Standards for Hazardous Air Pollutants
NO_2 -	Nitrogen Dioxide
NOV -	Notice of Violation
NO_X -	Nitrogen Oxide
NPDES -	National Pollution Discharge Elimination System (CWA)

NONFERROUS METALS INDUSTRY
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LIST OF ACRONYMS (CONT'D)

NPL - National Priorities List
NRC - National Response Center
NSPS - New Source Performance Standards (CAA)
OAR - Office of Air and Radiation
OECA - Office of Enforcement and Compliance Assurance
OPA - Oil Pollution Act
OPPTS - Office of Prevention, Pesticides, and Toxic Substances
OSHA - Occupational Safety and Health Administration
OSW - Office of Solid Waste
OSWER - Office of Solid Waste and Emergency Response
OW - Office of Water
P2 - Pollution Prevention
PCS - Permit Compliance System (CWA Database)
POTW - Publicly Owned Treatments Works
RCRA - Resource Conservation and Recovery Act
RCRIS - RCRA Information System
SARA - Superfund Amendments and Reauthorization Act
SDWA - Safe Drinking Water Act
SPL - Spent Potliner
SEPs - Supplementary Environmental Projects
SERCs - State Emergency Response Commissions
SIC - Standard Industrial Classification
SO_2 - Sulfur Dioxide
TOC - Total Organic Carbon
TRI - Toxic Release Inventory
TRIS - Toxic Release Inventory System
TCRIS - Toxic Chemical Release Inventory System
TSCA - Toxic Substances Control Act
TSS - Total Suspended Solids
UIC - Underground Injection Control (SDWA)
UST - Underground Storage Tanks (RCRA)
VOCs - Volatile Organic Compounds

NONFERROUS METALS INDUSTRY
(SIC 333-334)

I. INTRODUCTION TO THE SECTOR NOTEBOOK PROJECT

I.A. Summary of the Sector Notebook Project

Environmental policies based upon comprehensive analysis of air, water, and land pollution are an inevitable and logical supplement to traditional single-media approaches to environmental protection. Environmental regulatory agencies are beginning to embrace comprehensive, multi-statute solutions to facility permitting, enforcement and compliance assurance, education/outreach, research, and regulatory development issues. The central concepts driving the new policy direction are that pollutant releases to each environmental medium (air, water, and land) affect each other, and that environmental strategies must actively identify and address these inter-relationships by designing policies for the "whole" facility. One way to achieve a whole facility focus is to design environmental policies for similar industrial facilities. By doing so, environmental concerns that are common to the manufacturing of similar products can be addressed in a comprehensive manner. Recognition of the need to develop the industrial "sector-based” approach within the EPA Office of Compliance led to the creation of this document.

The Sector Notebook Project was initiated by the Office of Compliance within the Office of Enforcement and Compliance Assurance (OECA) to provide its staff and managers with summary information for eighteen specific industrial sectors. As other EPA offices, States, the regulated community, environmental groups, and the public became interested in this project, the scope of the original project was expanded. The ability to design comprehensive, common sense environmental protection measures for specific industries is dependent on knowledge of several inter-related topics. For the purposes of this project, the key elements chosen for inclusion are: general industry information (economic and geographic); a description of industrial processes; pollution outputs; pollution prevention opportunities; Federal statutory and regulatory framework; compliance history; and a description of partnerships that have been formed between regulatory agencies, the regulated community, and the public.

For any given industry, each topic listed above could alone be the subject of a lengthy volume. However, in order to produce a manageable document, this project focuses on providing summary information for each topic. This format provides the reader with a synopsis of each issue, and references where more in-depth information is available. Text within each profile was researched from a variety of sources, and was usually condensed from more detailed sources pertaining to specific topics. This approach allows for a wide coverage of activities that can be further explored based upon the citations and references listed at the end of this profile. As a check on the information included, each notebook went through an external review process. The Office of Compliance appreciates the efforts of all those that participated in this process and enabled us to develop more complete, accurate, and up-to-date summaries. Many of those who reviewed this notebook are listed as contacts in Section IX and may be sources of additional information. The individuals and groups on this list do not necessarily concur with all statements within this notebook.

I.B. Additional Information

Providing Comments

OECA's Office of Compliance plans to periodically review and update the notebooks and will make these updates available both in hard copy and electronically. If you have any comments on the existing notebook, or if you would like to provide additional information, please send a hard copy and computer disk to the EPA Office of Compliance, Sector Notebook Project, 401 M St., SW (2223-A), Washington, DC 20460. Comments can also be uploaded to the Enviroene Bulletin Board or the Enviroene World Wide Web for general access to all users of the system. Follow instructions in Appendix A for accessing these data systems. Once you have logged in, procedures for uploading text are available from the on-line Enviroene Help System.

Adapting Notebooks to Particular Needs

The scope of the existing notebooks reflect an approximation of the relative national occurrence of facility types that occur within each sector. In many instances, industries within specific geographic regions or States may have unique characteristics that are not fully captured in these profiles. For this reason, the Office of Compliance encourages State and local environmental agencies and other groups to supplement or re-package the information included in this notebook to include more specific industrial and regulatory information that may be available. Additionally, interested States may want to supplement the "Summary of Applicable Federal Statutes and Regulations" section with State and local requirements. Compliance or technical assistance providers may also want to develop the "Pollution Prevention" section in more detail. Please contact the appropriate specialist listed on the opening page of this notebook if your office is interested in assisting us in the further development of the information or policies addressed within this volume.

If you are interested in assisting in the development of new notebooks for sectors not covered in the original eighteen, please contact the Office of Compliance at 202-564-2395.

II. INTRODUCTION TO THE NONFERROUS METALS INDUSTRY

This section provides background information on the Nonferrous Metals Industry and the organization of this sector's notebook.

II.A. Introduction and Background of the Notebook

The Standard Industrial Classification (SIC) code 33 is composed of establishments that engage in: the primary and secondary smelting and refining of ferrous and nonferrous metal from ore or scrap; rolling, drawing, and alloying; and the manufacturing and casting of basic metal products such as nails, spikes, wire, and cable. Primary smelting and refining produces metals directly from ores, while secondary refining and smelting produces metals from scrap and process waste. Scrap is bits and pieces of metal parts, bars, turnings, sheets, and wire that are off-specification or worn-out but are capable of being recycled.

Two metal recovery technologies are generally used to produce refined metals. Pyrometallurgical technologies are processes that use heat to separate desired metals from other less or undesirable materials. These processes capitalize on the differences between constituent oxidation potential, melting point, vapor pressure, density, and/or miscibility when melted. Examples of pyrometallurgical processes include drying, calcining, roasting, sintering, retorting, and smelting. Hydrometallurgical technologies differ from pyrometallurgical processes in that the desired metals are separated from undesirables using techniques that capitalize on differences between constituent solubilities and/or electrochemical properties while in aqueous solutions. Examples of hydrometallurgical processes include leaching, chemical precipitation, electrolytic recovery, membrane separation, ion exchange, and solvent extraction.

During pyrometallic processing, an ore, after being concentrated by beneficiation (crushing, washing, and drying) is sintered, or combined by heat, with other materials such as baghouse dust and flux. The concentrate is then smelted, or melted, in a blast furnace in order to fuse the desired metals into an impure molten bullion. This bullion then undergoes a third pyrometallic process to refine the metal to the desired level of purity. Each time the ore or bullion is heated, waste materials are created. Air emissions such as dust may be captured in a baghouse and are either disposed of or returned to the process depending upon the residual metal content. Sulfur is also captured, and when concentrations are above four percent it can be turned into sulfuric acid, a component of fertilizers. Depending upon the origin of the ore and its residual metals content, various metals such as gold and silver may also be produced as by-products.

Production operations under this SIC code are subject to a number of regulations, including those imposed by the Resource Conservation and Recovery Act (RCRA), the Clean Water Act (CWA), and the Clean Air Act (CAA). A number of RCRA-listed hazardous wastes are produced during primary refining operations which require the heating of ores to remove impurities. Specific pretreatment standards under the CWA apply to the processes associated with copper and aluminum. Lastly, large amounts of sulfur are released during copper, lead, and zinc smelting operations which are regulated under the CAA.

The Department of Commerce classification codes divide this industry by production process. The two-digit SIC code is broken down as follows:

SIC 331 - Steel Works, Blast Furnaces, and Rolling and Finishing Mills (covered in a separate profile)
SIC 332 - Iron and Steel Foundries (covered in a separate profile)
SIC 333 - Primary Smelting and Refining of Nonferrous Metals
SIC 334 - Secondary Smelting and Refining of Nonferrous Metals
SIC 335 - Rolling, Drawing, and Extruding of Nonferrous Metals (not covered in this profile)
SIC 336 - Nonferrous Foundries (castings) (not covered in this profile)
SIC 339 - Miscellaneous Primary Metal Products (not covered in this profile).

II.B. Organization of the Nonferrous Metals Notebook

SIC 33 is a diverse industrial area which is comprised of many different manufacturing processes. It is because of this diversity of processes and related pollutant issues that this notebook focuses only on SIC 333 and 334; Primary and Secondary Nonferrous Metals Processing. The metals aluminum, copper, lead, and zinc were chosen for inclusion in this profile because they are the four most widely used nonferrous metals in the United States. Where possible, information for the four metals is discussed separately. However, due to the SIC groupings, in many instances data for all four metals and other processes are intermingled. Every effort will be made to highlight where separate information is available and where information concerning more than one of the metals has been intermingled.

The notebook begins with a discussion of the primary and secondary aluminum industries. This discussion is comprised of economic and geographic characterizations of the industries and detailed discussions of the industrial processes involved, including production line raw material inputs and pollution outputs. The following three sections provide the same information for copper, lead, and zinc, respectively. The notebook continues with EPA Toxics Release Inventory data for the nonferrous metals industry. Much of this information is intermingled, but where possible has been separated. The notebook concludes with sections discussing pollution prevention opportunities, pending and proposed regulatory requirements, compliance and enforcement information, and compliance activities and initiatives.

III. PRIMARY AND SECONDARY ALUMINUM PROCESSING INDUSTRY

III.A. Characterization of Industry - Aluminum

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the Primary and Secondary Aluminum Industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes.

III.A.1. Industry Size and Geographic Distribution - Aluminum

The following discussion is based upon the following materials: "Aluminum Know the Facts, July 1994," the Aluminum Association; "Industry & Trade Summary - Aluminum," the U.S. Trade Commission; and "U.S. Industrial Outlook 1994 - Metals," U.S. Department of Commerce.

Variation in facility counts occur across data sources due to many factors, including reporting and definitional differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

In 1993, the majority of primary aluminum producers (SIC 3334) in the U.S. were located either in the Northwest (39.1 percent of U.S. capacity) or the Ohio River Valley (31.1 percent of U.S. capacity), while most secondary aluminum smelters were located in Southern California and the Great Lakes Region. The reason for the difference in plant locations is due to the energy intensive nature of the primary aluminum smelting process and the cost of fuels. Primary smelters are located in the Northwest and Ohio River Valley to take advantage of the abundant supplies of hydroelectric and coal-based energy, while secondary smelters locate themselves near major industrial and consumer centers to take advantage of the large amounts of scrap generated. Secondary smelting uses 95 percent less energy to produce the same product than primary reduction. On the average, a third of primary production costs are attributable to the cost of energy.

The domestic primary aluminum smelting industry consists of 23 smelting facilities operated by 13 firms which employ approximately 20,000. Of the thirteen firms, four integrated producers, Alcoa, Alumax, Reynolds, and Kaiser, accounted for 63 percent of 1993's capacity. The secondary smelting industry operates an estimated 68 plants employing

3,600. These figures have remained stable since 1988 and reflect an industry that emerged strong and competitive following the contractions and restructuring of the early 1980's that were caused by worldwide price swings and supply/demand disequilibrium.

About 40 percent of the domestic supply of aluminum is recovered by secondary refiners (SIC 334) from both purchased new and old aluminum scrap. New scrap is material generated during the fabrication of aluminum products. Old scrap includes products such as aluminum pistons and other aluminum engine or body parts from junked cars, used aluminum beverage cans, doors and siding, and used aluminum foil. In 1993, 2.3 million metric tons (Mmt) of metal, valued at an estimated $3.5 billion, were recovered from both new and old aluminum scrap. Of this total, approximately 55 percent was recovered from old scrap. Recycling rates for aluminum beverage containers reached 63 percent (60 billion cans) in 1993, keeping more than two billion pounds of material out of landfills.

III.A.2. Product Characterization - Aluminum

The primary and secondary aluminum industry produces ingots of pure (greater than 99 percent) aluminum that serve as feedstock for other materials and processes. Within the U.S., the leading end-users of aluminum come from three industries; containers and packaging, transportation, and building and construction. In 1993, demand from the three industries accounted for an estimated 60 percent of the eight Mmt of aluminum ingot and semifabricated products produced, with containers and packaging alone accounting for more than 25 percent of total shipments. Examples of materials produced with aluminum are: sheet metal; aluminum plate and foil; rod, bar, and wire; beverage cans, automobiles, aircraft components, and window/door frames.

III.A.3. Economic Trends - Aluminum

The amount of aluminum a plant could produce if working at engineered (full) capacity held steady in 1993. This was due to two factors: reduced hydroelectric supplies in the Northwest and falling aluminum prices. Hydroelectric supplies were reduced in the Northwest due to drought. Prices for primary aluminum fell to record-lows in 1993 despite a slight global increase in demand, due in large part to a flood of exports from the former Soviet republics.

U.S. aluminum shipments increased 12 percent in 1994, based on increased demands in the beverage can stock and transportation sectors.

At present, the automotive sector is the largest end-user. The next largest end-user is the beverage can stock.

Automotive use of aluminum is expected to sky-rocket as the sector increases its use of aluminum to increase fuel efficiency. Chrysler Corporation may begin building an aluminum-intensive car in 1996, employing 600-700 pounds of aluminum per car. The reduction in weight for a midsize vehicle would cut gasoline consumption by one gallon for each 100 miles driven.

III.B. Industrial Process Description - Aluminum

This section describes the major industrial processes within the Primary and Secondary Aluminum industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section XII for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provides a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

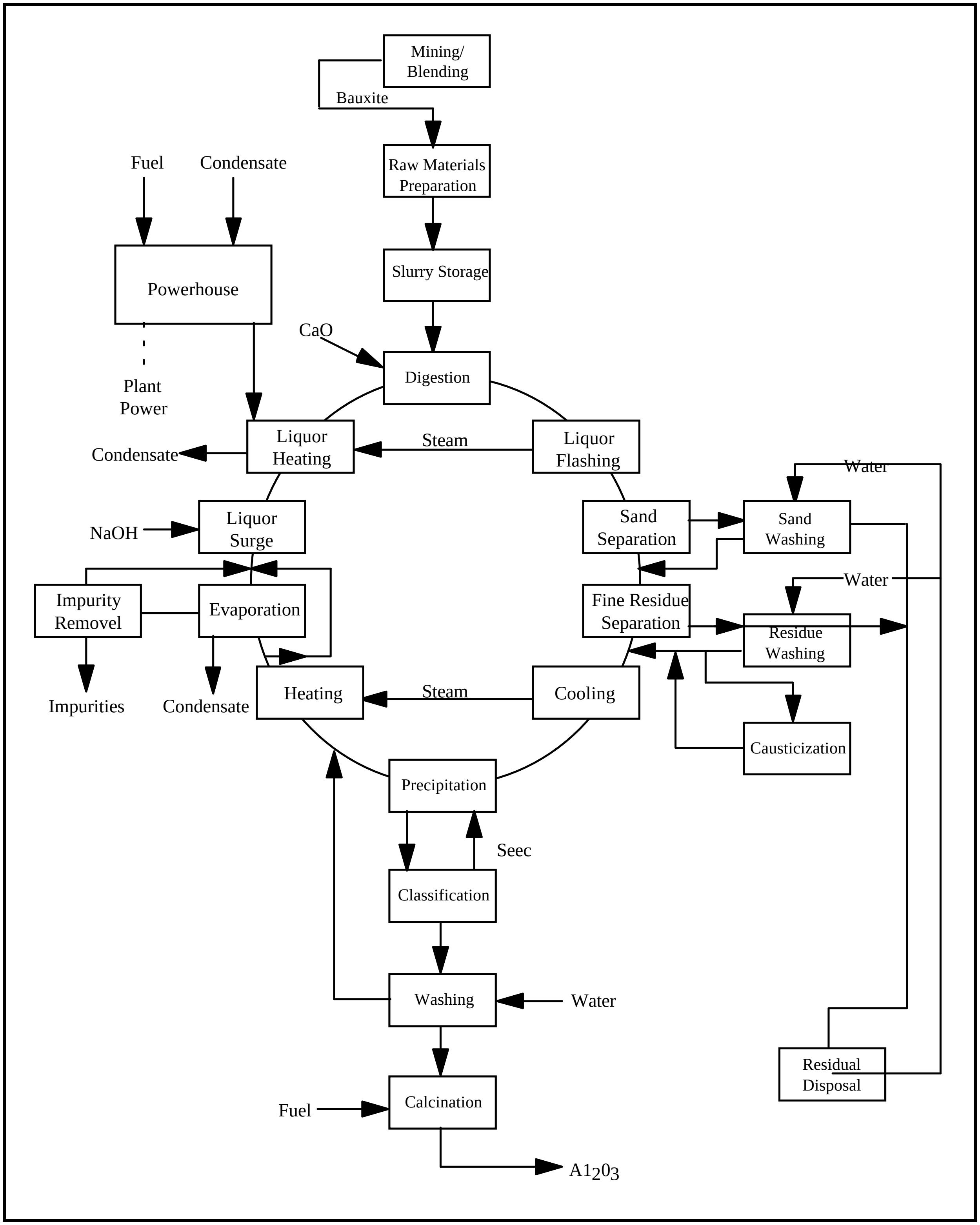
III.B.1. Industrial Processes in the Primary and Secondary Aluminum Industry

The following discussion is based in part upon the following documents: "Background Listing Document for K088," and AP42 from the U.S. Environmental Protection Agency, and materials provided by The Aluminum Association, Incorporated.

Primary Aluminum Processing

Primary aluminum producers generally employ a three step process to produce aluminum alloy ingots. First, alumina is extracted from bauxite ore using the Bayer process (See Exhibit 1). In the Bayer process, finely crushed bauxite is mixed with an aqueous sodium hydroxide (caustic soda) solution to form a slurry. The slurry is then reacted at a high temperature under steam pressure in a vessel known as a digester, and creates a mixture of dissolved aluminum oxides and bauxite residues. During the reaction a majority of the impurities such as silicon, iron, titanium, and calcium oxides drop to the bottom of the digester and form a sludge. The remaining sodium aluminate slurry is then flash cooled by evaporation and sent for clarification. During clarification, agents such as starch are added to help any fine impurities that remain in the slurry, such as sand, to drop out, further purifying the sodium aluminate solution. The solution is then fed into a precipitation tank to be crystallized. In the precipitator the solution is allowed to cool with the addition of a small amount of aluminum hydroxide "seed." The seed stimulates the precipitation of solid crystals of aluminum hydroxide and sodium hydroxide.

Exhibit 1 - Bayer Process (Alumina Refining)

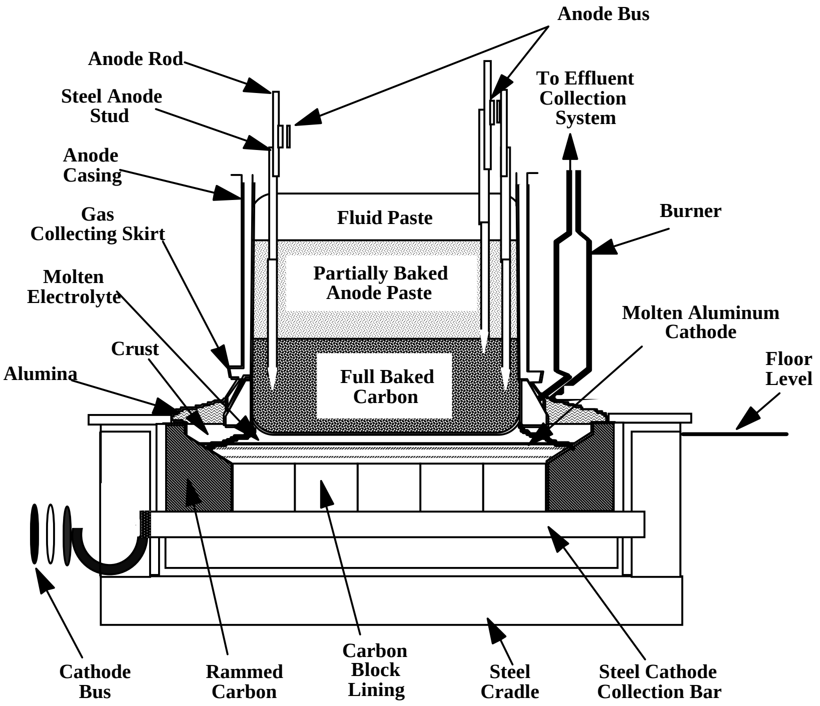


Source: <u>Air Pollution Engineering Manual</u>, Anthony J. Buonicore and Wayne T. Davis, ed., Air & Waste Management Association, Van Norstrand Reinhold.

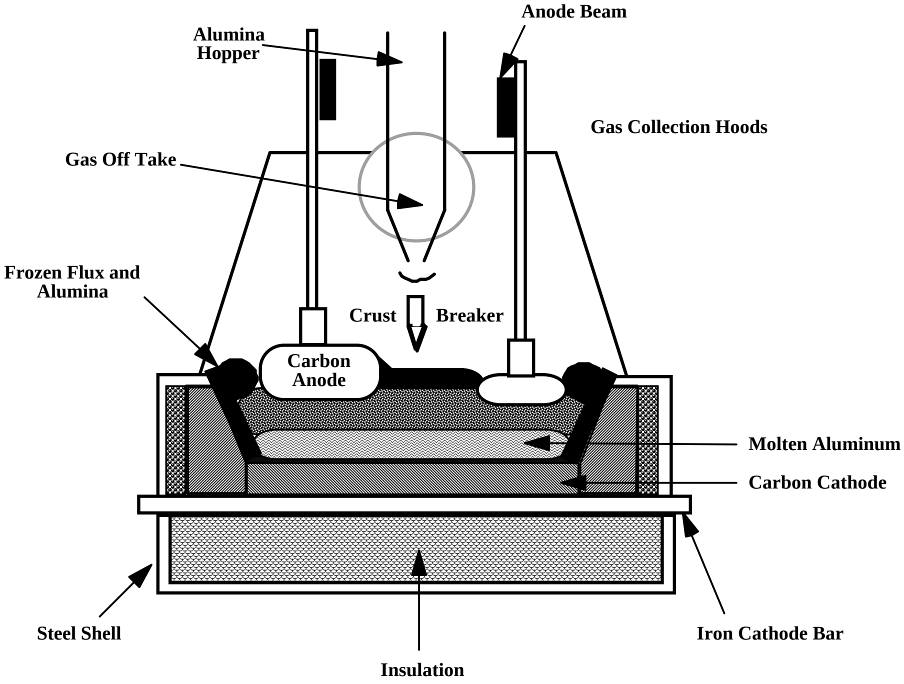
The aluminum hydroxide crystals settle to the tank bottom, and are removed. The crystals are then washed to remove any caustic soda residues, vacuum dewatered, and sent on for calcination. In the calciners (a type of rotating kiln) the aluminum hydroxide is roasted for further dewatering.

In the second step, the aluminum oxide (alumina) produced during the Bayer process is reduced to make pure molten aluminum. Alumina is a fine white powder, and consists of about equal weights of aluminum and oxygen. The strong chemical bond that exists between the aluminum and oxygen makes separating them difficult — pyrometallurgical separation requires a temperature of about 3600 degrees F. However, in 1866 it was discovered that alumina will dissolve when placed in the molten metal cryolite at around only 1742 degrees F. Once dissolved, the aluminum oxide is readily separated into aluminum and oxygen by electric current. The Hall-Heroult process, as this type of electrolytic reduction is known, begins with the placement of the alumina into electrolytic cells, or "pots," filled with molten cryolite (See Exhibit 2). Though the process requires large amounts of electricity (six or seven kilowatts of electricity per pound of aluminum produced), only a low voltage is needed. This allows the pots to be laid out in a series along one long electrical circuit to form what is known as a "potline." Within each pot a positive electric current is passed through the cryolite by means of a carbon anode submerged in the liquid cryolite. The oxygen atoms, separated from aluminum oxide, carry a negative electrical charge and are attracted to the carbon anodes. The carbon and the oxygen combine immediately to form carbon dioxide and carbon monoxide. These gases bubble free of the melt. The aluminum (which is more than 99 percent pure) collects at the bottom of the pot, is siphoned off, placed into crucibles, and then transferred to melting/holding furnaces.

Exhibit 2 - Aluminum Anodes



Vertical Stud Soderberg Cell



Center-Worked Prebake Cell

Source: The Aluminum Association.

The third step consists of either mixing the molten aluminum with other metals to form alloys of specific characteristics, or casting the aluminum into ingots for transport to fabricating shops. Casting involves pouring molten aluminum into molds and cooling it with water. At some plants, the molten aluminum may be batch treated in furnaces to remove oxide, gaseous impurities and active metals such as sodium and magnesium before casting. Some plants add a flux of chloride and fluoride salts and then bubble chlorine gas, usually mixed with an inert gas, through the molten mixture. Chloride reacts with the impurities to form HCL, Al_2O_3, and metal chloride emissions. A dross forms to float on the molten aluminum and is removed before casting.

Two types of anodes may be used during the reduction process; either an anode paste or a pre-baked anode. Because the carbon is consumed during the refining process (about one-half pound of carbon is consumed for every pound of aluminum produced), if anode paste (Soderberg anode) is used, it needs to be continuously fed through an opening in the steel shell of the pot. The drawback to pre-baked anodes is that they require that a pre-baked anode fabricating plant be located nearby or on-site. Most aluminum reduction plants include their own facilities to manufacture anode paste and/or pre-baked anode blocks. These pre-baked blocks, each of which may weigh 600 or 700 pounds, must be replaced after 14 to 20 days of service.

One waste material produced during the primary production of aluminum are fluoride compounds. Fluoride compounds are principally produced during the reduction process. One reason that pre-baked anodes are favored is that the closure of the pots during smelting facilitates the capture of fluoride emissions, though many modern smelters employ other methods to capture and recycle fluorides and other emissions.

The pots used to hold the aluminum during smelting range in size from 30 to 50 feet long, 9 to 12 feet wide, and 3 to 4 feet high, and are lined with refractory brick and carbon. Eventually the carbon linings crack and must be removed and replaced. However, during the aluminum reduction process iron cyanide complexes form in the carbon portion of the liners. When the linings are removed they are "spent," and are considered to be RCRA listed hazardous waste K088.

Secondary Aluminum Processing

In the secondary production of aluminum, scrap is usually melted in gas- or oil-fired reverberatory furnaces of 30,000 to over 100,000 pounds capacity. The furnaces have one or two charging wells separated from the main bath by a refractory wall that permits only molten metal into the main bath. The principal processing of aluminum-base scrap involves the removal of magnesium by treating the molten bath with chlorine or with various fluxes such as aluminum chloride, aluminum fluoride, or mixtures of sodium and potassium chlorides and fluorides. To facilitate handling, a significant proportion of the old aluminum scrap, and in some cases new scrap, is simply melted to form sweated pig that must be processed further to make specification-grade ingot.

Another method of secondary aluminum recovery uses aluminum drosses as the charge instead of scrap. Traditionally, the term dross was defined as a thick liquid or solid phase that forms at the surface of molten aluminum, and is a by-product of melting operations. It is formed with or without fluxing and the free aluminum content of this by-product can vary considerably. Most people in the industry have generally referred to dross as being lower in aluminum content, while the material with a higher aluminum content is referred to as "skim," or "rich" or "white dross." If a salt flux is used in the melting process, the by-product is usually called a "black dross" or "salt cake." Drosses containing about 30 percent metallics are usually crushed and screened to bring the metallic content up to about 60 to 70 percent. They are then melted in a rotary furnace, where the molten aluminum metal collects on the bottom of the furnace and is tapped off. Salt slags containing less than 30 percent metallics may be leached with water to separate the metallics. In addition to this classic dross-recycling process, a new dross treatment process using a water-cooled plasma gas arc heater (plasma torch) installed in a specially-designed rotary furnace was patented recently. The new process eliminates the use of salt flux in the conventional dross treatment process, and reports recovery efficiencies of 85 to 95 percent.

III.B.2. Raw Material Inputs and Pollution Outputs

The material inputs and pollution outputs resulting from primary and secondary aluminum processing are presented by media in Exhibit 3.

Exhibit 3
Process Materials Inputs/Pollution Outputs - Aluminum

Process	Material Input	Air Emissions	Process Wastes	Other Wastes
Bauxite Refining	Bauxite, sodium hydroxide	Particulates		Residue containing silicon, iron, titanium, calcium oxides, and caustic
Alumina Clarification and Precipitation	Alumina slurry, starch, water		Wastewater containing starch, sand, and caustic	
Alumina Calcination	Aluminum hydrate	Particulates and water vapor		
Primary Electrolytic Aluminum Smelting	Alumina, carbon anodes, electrolytic cells, cryolite	Fluoride, both gaseous and particulates, carbon dioxide, sulfur dioxide, carbon monoxide, C_2F_6, CF_4, and perflourinated carbons (PFC)		Spent potliners, K088
Secondary Scrap Aluminum Smelting	Aluminum scrap, oil or gas, chlorine or other fluxes (aluminum chloride, aluminum fluoride, sodium and potassium chlorides, and fluorides)	Particulates and HCL / Cl_2		Slag containing magnesium and chlorides
Secondary Aluminum Dross Recycling	Aluminum dross, water	Particulates	Wastewater, salts	

Primary Aluminum Processing

Primary aluminum processing activities result in air emissions, proccess wastes, and other solid-phase wastes. Large amounts of particulates are generated during the calcining of hydrated aluminum oxide, but the economic value of this dust for reuse in the process is such that extensive controls are used to reduce emissions to relatively small quantities. Small amounts of particulates are emitted from the bauxite grinding and materials handling processes. Emissions from aluminum reduction processes are primarily gaseous hydrogen fluoride and particulate fluorides, alumina, carbon monoxide, volatile organics, and sulfur dioxide from the reduction cells; and fluorides, vaporized organics and sulfur dioxide from the anode baking furnaces. A variety of control devices such as wet scrubbers are used to abate emissions from reduction cells and anode baking furnaces.

Wastewaters generated from primary aluminum processing are produced during clarification and precipitation though much of this water is fed back into the process to be reused.

Solid-phase wastes are generated at two stages in the primary aluminum process; red mud produced during bauxite refining, and spent potliners from the reduction process. Red mud normally contains significant amounts of iron, aluminum, silicon, calcium, and sodium. The types and concentrations of minerals present in the mud depends on the composition of the ore and the operating conditions in the digesters. Red mud is managed on site in surface impoundments, and has not been found to exhibit any of the characteristics of hazardous waste (1990 Report to Congress on Special Wastes from Mineral Processing). The process does however, generate hazardous waste. The carbon potliners used to hold the alumina/cryolite solution during electrolytic aluminum reduction process eventually crack and need to be removed and replaced. When the liners are removed they are "spent," and are considered to be RCRA listed hazardous waste K088.

Secondary Aluminum Processing

Secondary aluminum processing also results in air emissions, wastewaters, and solid wastes. Atmospheric emissions from reverberatory (chlorine) smelting/refining represent a significant fraction of the total particulate and gaseous effluents generated in the secondary aluminum industry. Typical furnace effluent gases contain combustion products, chlorine, hydrogen chloride and metal chlorides of zinc, magnesium, and aluminum, aluminum oxide and various metals and metal compounds, depending on the quality of scrap charges. Emissions from reverberatory (fluorine) smelting/refining are similar to those from reverberatory (chlorine) smelting/refining. The use of AlF_3 rather than chlorine in the demagging step reduces demagging emissions. Fluorides are emitted as gaseous fluorides or as dusts. Baghouse scrubbers are usually used for fluoride emission control.

Solid-phase wastes are also generated during secondary scrap aluminum smelting. The slag generated during smelting contains chlorides resulting from the use of fluxes and magnesium. Waste waters are also generated during secondary aluminum processing when water is added to the smelting slags to aid in the separation of metallics. The waste waters are also likely to be contaminated with salt from the various fluxes used.

IV. PRIMARY AND SECONDARY COPPER PROCESSING INDUSTRY

IV.A. Characterization of the Industry - Copper

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the Primary and Secondary Copper Industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes.

IV.A.1. Industry Size and Geographic Distribution - Copper

The following discussion is based in part upon the following documents: "U.S. Industrial Outlook 1994 - Metals," U.S. Department of Commerce, and information provided by the U.S. Department of the Interior, Bureau of Mines.

Variation in facility counts occur across data sources due to many factors, including reporting and definitional differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

Copper ore is mined in both the Northern and Southern Hemispheres but is primarily processed and consumed by countries in the Northern Hemisphere. The U.S., is both a major producer (second only to Chile) and consumer of copper.

The domestic primary unwrought, or unworked, integrated copper industry consists of mines, concentrators, smelters, refineries, and electrowinning plants (SIC 3331 encompasses facilities engaging in primary smelting and refining, but not mining). The number of operating mines producing copper has decreased from 68 mines in 1989 to 65 mines in 1992. Of the 65 mines actively producing copper in the U.S., 33 list copper as the primary product. The remaining 32 mines produce copper either as a byproduct or co-product of gold, lead, zinc, or silver (U.S. DOI, Bureau of Mines). Nineteen of the 33 active mines that primarily produce copper are located in Arizona, which accounts for 65 percent of domestically mined copper ore. The remaining mines are located throughout New Mexico and Utah, which together account for 28 percent of domestic production, and Michigan, Montana, and Missouri account for the remainder (U.S. DOI, Bureau of Mines). Five integrated producers, Phelps Dodge Corp., Magma Copper Co., ASARCO Incorporated, Kennecott Corp., and Cyprus-AMAX Minerals Co., produce over 90 percent of domestic primary copper.

In 1988, there were 17 copper mines in the U.S. using leaching methods, with total production of approximately 227,000 metric tons of electrowon copper (U.S. EPA; U.S. DOI, Bureau of Mines). According to the U.S. Bureau of Mines, in 1991 441,000 metric tons of copper (an increase of 94 percent in three years) were recovered by leaching/electrowinning methods (U.S. DOI, Bureau of Mines). While solution operations are conducted throughout the Southwestern U.S., almost 75 percent of the facilities (14) are located in Arizona. There are two facilities in New Mexico, one in Utah, and one in Nevada.

In 1991, the consumption of refined copper in the U.S. decreased by four percent from 1990 levels. In 1992, refined copper was consumed at approximately 20 wire-rod mills, 41 brass mills, and 750 foundries, chemical plants, and other manufacturers. According to the Bureau of Mines, in 1992 U.S. consumption of copper was about 2.2 million tons. Consumption in 1993 and 1994 rose sharply to almost 2.7 million tons.

Fifty-six percent of recycled, or secondary copper, is derived from new scrap, while 44 percent comes from old scrap. Domestically, the secondary copper smelting industry is led by four producers: Franklin, Southwire Co., Chemetco., and Cerro Copper Co. Like the secondary aluminum industry, these producers buy the scrap they recycle on the open market, in addition to using scrap generated in their own downstream productions. The secondary copper industry is concentrated in Georgia, South Carolina, Illinois, and Missouri.

IV.A.2. Product Characterization - Copper

Because of its superior electrical conductivity, the leading domestic consumer of refined copper is wire mills, accounting for 75 percent of refined copper consumption. Brass mills producing copper and copper alloy semi-fabricated shapes are the other dominant domestic consumers at 23 percent. The dominant end-users of copper and copper alloy are the construction and electronic products industries, accounting for 65 percent of copper end-usage. Transportation equipment such as radiators also account for a fair amount of copper end-usage at 11.6 percent. Copper and copper alloys powders are used for brake linings and bands, bushings, instruments, and filters in the automotive and aerospace industries, for electrical and electronic applications, for anti-fouling paints and coatings, and for various chemical and medical purposes. Copper chemicals, principally copper sulfate and the cupric and cuprous oxides, are widely used as algaecides, fungicides, wood preservatives, copper plating, pigments, electronic applications, and numerous special applications.

IV.A.3. Economic Trends - Copper

Conditions in the U.S. copper industry continued to improve during 1993, and refined copper production increased approximately seven percent by mid-year as compared to the first half of 1992. U.S. copper consumption is estimated to grow by approximately 1.5 to 7 percent through 2000, while global consumption is expected to increase approximately two percent through the same period. The foreign market, particularly the Asian Pacific region, is expected to be a growing market because of its strong automobile, air conditioning, and consumer electronics industries. China is expected to see the largest increase in demand if economic reforms continue.

IV.B. Industrial Process Description - Copper

This section describes the major industrial processes within the Primary and Secondary Copper Processing industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

IV.B.1. Industrial Processes in the Primary and Secondary Copper Processing Industry

The following discussion is based upon materials provided by the International Copper Association, Ltd., and the following documents:

"Copper Technology and Competitiveness," Congress of the United States, Office of Technology Assessment and "Compilation of Air Pollutant Emission Factors (AP42)," the U.S. Environmental Protection Agency.

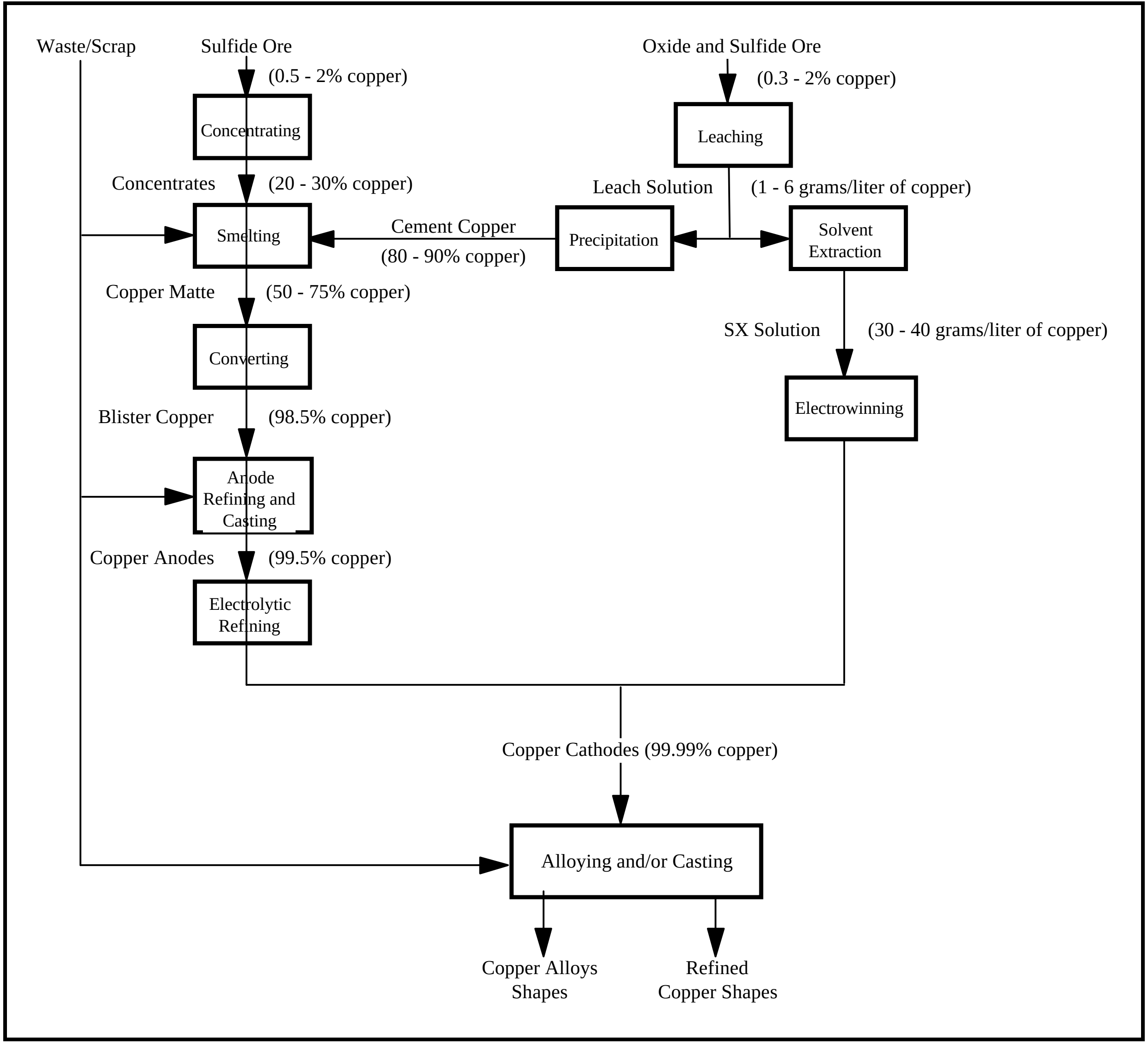
Primary Copper Processing

Copper is mined in both open pits and underground mines, depending upon the ore grade and the nature of the ore deposit. Copper ore typically contains less that one percent copper and is in the form of sulfide minerals. Once the ore is delivered above the ground, it is crushed and ground to a powdery fineness, after which it is concentrated for further processing. In the concentration process, ground ore is slurried with water, chemical reagents are added, and air is blown through the slurry. The air bubbles attach themselves to the copper minerals and are then skimmed off of the top of the flotation cells. The concentrate contains between 20 and 30 percent copper. The “tailings,” or gangue minerals, from the ore fall to the bottom of the cells and are removed, dewatered by “thickeners,” and transported as a slurry to a tailings pond for disposal. All water used in this operation, from dewatering thickeners and the tailings pond, is recovered and recycled back into the process.

Copper can be produced either pyrometallurgically or hydrometallurgically depending upon the ore-type used as a charge. The ore concentrates, which contain copper sulfide and iron sulfide minerals, are treated by pyrometallurgical processes to yield high purity copper products. Oxide ores, that contain copper oxide minerals which may occur in other parts of the mine, together with other oxidized waste materials, are treated by hydrometallurgical processes to yield high purity copper products. Both processes are illustrated in Exhibit 4.

Copper conversion is accomplished by a pyrometallurgical process known as “smelting.” During smelting the concentrates are dried and fed into one of several different types of furnaces. There the sulfide minerals are partially oxidized and melted to yield a layer of “matte,” a mixed copper-iron sulfide, and “slag,” an upper layer of waste.

Exhibit 4 - Copper Production Process

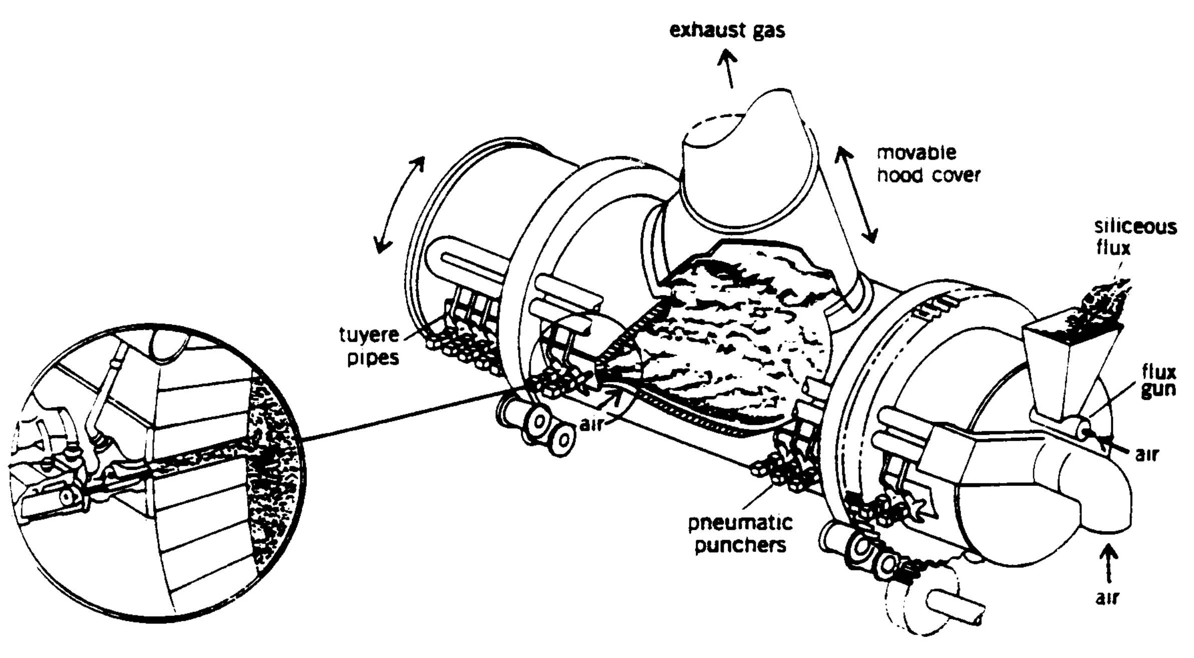


Source: Office of Technology Assessment.

The matte is further processed by a process known as "converting." The slag is tapped from the furnace and stored or discarded in slag piles on site. A small amount of slag is sold for railroad ballast and for sand blasting grit. A third product of the smelting process is sulfur dioxide, a gas which is collected, purified, and made into sulfuric acid for sale or for use in hydrometallurgical leaching operations.

Following smelting, the copper matte is fed into a converter. During this process the copper matte is poured into a horizontal cylindrical vessel (approximately 30 x 13 feet) fitted with a row of pipes (See Exhibit 5). The pipes, known as "tuyeres," project into the cylinder and are used to introduce air into the converter. Lime and silica are added to the copper matte to react with the iron oxide produced in the process to form slag. Scrap copper may also be added to the converter. The furnace is rotated so that the tuyeres are submerged, and air is blown into the molten matte causing the remainder of the iron sulfide to react with oxygen to form iron oxide and sulfur dioxide. Following the "blow," the converter is rotated to pour off the iron silicate slag.

Exhibit 5
Cutaway View of a Pierce-Smith Converter for Producing Blister Copper from Matte



Source: <u>Extractive Metallurgy of Copper</u>, A. K. Biswas and W. D. Davenport, Pergamon Press.

Once all of the iron is removed, the converter is rotated back and given a second blow during which the remainder of the sulfur is oxidized and removed from the copper sulfide. The converter is then rotated to pour off the molten copper, which at this point is called “blister” copper (so named because if allowed to solidify at this point, it will have a bumpy surface due to the presence of gaseous oxygen and sulfur). Sulfur dioxide from the converters is collected and fed into the gas purification system together with that from the smelting furnace and made into sulfuric acid. Due to its residual copper content, slag is recycled back to the smelting furnace.

Blister copper, containing a minimum of 98.5 percent copper, is refined to high purity copper in two steps. The first step is “fire refining,” in which the molten blister copper is poured into a cylindrical furnace, similar in appearance to a converter, where first air and then natural gas or propane are blown through the melt to remove the last of the sulfur and any residual oxygen from the copper. The molten copper is then poured into a casting wheel to form anodes pure enough for “electrorefining.”

In electrorefining, the copper anodes are loaded into electrolytic cells and interspaced with copper “starting sheets,” or cathodes, in a bath of copper sulfate solution. When a DC current is passed through the cell the copper is dissolved from the anode, transported through the electrolyte, and re-deposited on the cathode starting sheets. When the cathodes have built-up to sufficient thickness they are removed from the electrolytic cell and a new set of starting sheets is put in their place. Solid impurities in the anodes fall to the bottom of the cell as a sludge where they are ultimately collected and processed for the recovery of precious metals such as gold and silver. This material is known as “anode slime.”

The cathodes removed from the electrolytic cell are the primary product of the copper producer and contain 99.99+ percent copper. These may be sold to wire-rod mills as cathodes or processed further to a product called “rod.” In manufacturing rod, cathodes are melted in a shaft furnace and the molten copper is poured onto a casting wheel to form a bar suitable for rolling into a 3/8-inch diameter continuous rod. This rod product is shipped to wire mills where it is extruded into various sizes of copper wire.

In the hydrometallurgical process, the oxidized ores and waste materials are leached with sulfuric acid from the smelting process. Leaching is performed *in situ*, or in specially prepared piles by distributing acid across the top and allowing it to percolate down through the material where it is collected. The ground under the leach pads is lined with an acid proof, impermeable plastic material to prevent leach liquor from contaminating groundwater. Once the copper-rich solutions are collected they can be processed by either of two processes - the “cementation” process or the “solvent extraction/electrowinning” process (SXEW). In the cementation process (which is rarely used today), the copper in the acidic solution is deposited on the surface of scrap iron in exchange for the iron. When sufficient copper has been “cemented out” the copper-rich iron is put into the smelter together with the ore concentrates, for copper recovery via the pyrometallurgical route.

In the SXEW process, the pregnant leach solution (PLS) is concentrated by solvent extraction. In solvent extraction, an organic chemical that extracts copper but not impurity metals (iron and other impurities) is mixed with the PLS. The copper-laden organic solution is then separated from the leachate in a settling tank. Sulfuric acid is added to the pregnant organic mixture, which strips the copper into an electrolytic solution. The stripped leachate, containing the iron and other impurities, is returned to the leaching operation where its acid is used for further leaching. The copper-rich strip solution is passed into an electrolytic cell known as an “electrowinning” cell. An electrowinning cell differs from an electrorefining cell in that it uses a permanent, insoluble anode. The copper in solution is then plated onto a starting sheet cathode in much the same manner as it is on the cathode in an electrorefining cell. The copper-depleted electrolyte is returned to the solvent extraction process where it is used to strip more copper from the organic. The cathodes produced from the electrowinning process are then sold or made into rod in the same manner as those produced from the electrorefining process.

Electrowinning cells are used also for the preparation of starting sheets for both the electrorefining and electrowinning processes. Here copper is plated onto either stainless steel or titanium cathodes. When sufficient thickness has built-up, the cathodes are removed and the copper plating on both sides of the stainless steel or titanium is stripped off. After straightening and flattening, these copper sheets are fabricated into starting sheet cathodes by mechanically attaching copper strips to be used as hangers when they are in the electrolytic cell. Both the starting sheet and the strips become part of the final product. The same care in achieving and maintaining purity must be maintained with these materials as is practiced for the electrodeposited copper.

An activity that is carried out concurrently with the primary copper production is sulfur fixation. As mentioned above, in the pyrometallurgical process most of the sulfur in the ore is transformed into sulfur dioxide (though a portion is discarded in the slag). The copper smelting and converting processes typically generate over half a ton of sulfur dioxide per ton of copper concentrate. In order to meet CAA emission standards, sulfur dioxide releases must be controlled. This is accomplished by elaborate gas collection and filtration systems after which the sulfur dioxide contained in the off-gases is made into sulfuric acid. In general, if the sulfur dioxide concentration exceeds four percent it will be converted into sulfuric acid, an ingredient in fertilizer. Fugitive gases containing less than four percent sulfuric acid are either released to the atmosphere or scrubbed to remove the sulfur dioxide. The sulfur recovery process requires the emissions to flow through a filtering material in the air emissions scrubber to capture the sulfur. A blowdown slurry is formed from the mixture of the filtering material and sulfur emissions. This slurry contains not only sulfur, but cadmium and lead, metals that are present in copper ore. The acid plant blowdown slurry/sludge that results from thickening of blowdown slurry at primary copper facilities is regulated by RCRA as hazardous waste K064.

Secondary Copper Processing

The primary processes involved in secondary copper recovery are scrap metal pretreatment and smelting. Pretreatment includes cleaning and concentration to prepare the material for the smelting furnace. Pretreatment of the feed material can be accomplished using several different procedures, either separately or in combination. Feed scrap is concentrated by manual and mechanical methods such as sorting, stripping, shredding, and magnetic separation. Feed scrap is sometimes briquetted in a hydraulic press. Pyrometallurgical pretreatment may include sweating, burning of insulation (especially from scrap wire), and drying (burning off oil and volatiles) in rotary kilns. Hydrometallurgical methods include flotation and leaching with chemical recovery.

After pretreatment the scrap is ready for smelting. Though the type and quality of the feed material determines the processes the smelter will use, the general fire-refining process is essentially the same as for the primary copper smelting industry.

IV.B.2. Raw Material Inputs and Pollution Outputs

The material inputs and pollution outputs resulting from primary and secondary copper processing are presented by media in Exhibit 6.

Exhibit 6
Process Materials Inputs/Pollution Outputs - Copper

Process	Material Input	Air Emissions	Process Wastes	Other Wastes
Copper Concentration	Copper ore, water, chemical reagents, thickeners		Flotation wastewaters	Tailings containing waste minerals such as limestone, and quartz
Copper Leaching	Copper concentrate, sulfuric acid		Uncontrolled leachate	Heap leach waste
Copper Smelting	Copper concentrate, siliceous flux,	Sulfur dioxide, particulate matter containing arsenic, antimony, cadmium, lead, mercury, and zinc		Acid plant blowdown slurry/sludge (K064), slag containing iron sulfides, silica
Copper Conversion	Copper matte, scrap copper, siliceous flux	Sulfur dioxide, particulate matter containing arsenic, antimony, cadmium, lead, mercury, and zinc		Acid plant blowdown slurry/sludge (K064), slag containing iron sulfides, silica
Electrolytic Copper Refining	Blister copper		Process wastewater	Slimes containing impurities such as gold, silver, antimony, arsenic, bismuth, iron, lead, nickel, selenium, sulfur, and zinc
Secondary Copper Processing		Particulates	Slag granulation waste	Slag

Primary Copper Processing

Primary copper processing results in air emissions, process wastes, and other solid-phase wastes. Particulate matter and sulfur dioxide are the principal air contaminants emitted by primary copper smelters. Copper and iron oxides are the primary constituents of the particulate matter, but other oxides, such as arsenic, antimony, cadmium, lead, mercury and zinc, may also be present, with metallic sulfates and sulfuric acid mist. Single stage electrostatic precipitators are widely used in the primary copper industry to control these particulate emissions. Sulfur oxides contained in the off-gases are collected, filtered, and made into sulfuric acid.

Large amounts of water are used in the copper concentration process though disposal of liquid wastes is rarely a problem because the vast majority of the water is recycled back into the process. Once the wastewater exits the flotation process it is sent to a sediment control pond where it is held long enough for most of the sediment to settle.

The seepage and leaking of sulfuric acid solutions used in leaching can also produce liquid wastes, however this potential is off-set by the copper producer's interest to collect as much of the copper-bearing leachate as possible. Older operations generally do not have protective liners under the piles, and experience some loss of leachate. New leaching operations use impermeable membranes to confine leach solutions and channel them to collection ponds.

Electrolytic refining does produce wastewaters that must be treated and discharged, reused, or disposed in some manner. Many facilities use a wastewater treatment operation to treat these wastes.

Primary copper processing primarily generates two solid-phase wastes; slag and blowdown slurry/sludge. Slag is generated during the smelting, converting, fire refining, and electrolytic refining stages. Slag from smelting furnaces is higher in copper content than the original ores taken from the mines. These slags therefore, may be sent to a concentrator and the concentrate returned to the smelter. This slag processing operation results in slag tailings. Slag resulting from converting and fire refining also is normally returned to the process to capture any remaining mineral values. Blowdown slurry/sludge that results from the sulfur recovery process is regulated by RCRA as hazardous waste K064.

Secondary Copper Processing

Secondary copper processing produces the same types of wastes as primary pyrometallurgical copper processing. One type of secondary processing pollutant that differs from primary processing is the air emissions. Air pollutants are generated during the drying of chips and borings to remove excess oils and cuttings fluids and causes discharges of large amounts of dense smoke containing soot and unburned hydrocarbons. These emissions can be controlled by baghouses and/or direct-flame afterburners.

V. PRIMARY AND SECONDARY LEAD PROCESSING INDUSTRY

V.A. Characterization of the Industry - Lead

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the Primary and Secondary Lead Industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes.

V.A.1. Industry Size and Geographic Distribution - Lead

The following discussion is based upon "U.S. Industrial Outlook 1994 - Metals," U.S. Department of Commerce, and information provided by the U.S. Department of the Interior, Bureau of Mines.

Variation in facility counts occur across data sources due to many factors, including reporting and definitional differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

The U.S. is the world's third largest primary lead producer with 1/7 of all production reserves. Over 80 percent of the lead ore mined domestically comes from Missouri. The mines with the largest ore capacity are owned by Asarco Inc., The Doe Run Co., and Cominco American Inc., the first two of which are also integrated producers of refined lead materials. The majority of lead ores mined in the U.S. are smelted in conventional blast furnaces and are refined using pyrometallurgical methods.

In 1993, the lead industry employed 600 workers at primary smelters and refineries, and 1,700 at secondary smelters and refineries. Primary and secondary smelter and refinery employment was not expected to change in 1994 (U.S. DOI, Bureau of Mines, 1995).

The U.S. is the world's largest recycler of lead scrap and is able to meet about 72 percent of its total refined lead production needs from scrap recycling. At the end of 1991, the secondary lead industry consisted of 16 companies that operated 23 battery breakers-smelters with capacities of between 10,000 and 120,000 metric tons a year (mt/y); five smaller operations with capacities between 6,000 and 10,000 mt/y; and 15 smaller plants that produced mainly specialty alloys for solders, brass and bronze ingots, and miscellaneous uses. Sanders Lead Co., East Penn Mfg. Co., and Schuylkill Metals Corp. are some of the larger secondary lead producers in the United States.

V.A.2. Product Characterization - Lead

Within the U.S., the power storage battery industry is the largest end-user of lead, accounting for 83 percent of the estimated 1.357 Mmt domestically consumed in 1993. Demand for lead by the lead-acid battery industry rose 12 percent to 1.12 Mmt in 1993 due to a significant increase in consumer need for batteries. Industrial demand for batteries rose as well, due both to the growth in demand for stationary batteries used in telecommunications and back-up power systems for computers, lighting, and security systems, as well as an increased need for mobile batteries used in fork lifts and other battery-powered vehicles. Additional lead end-uses and users of consequence are ammunition, consumers of lead oxides used in television glass and computers, construction (including radiation shielding) and protective coatings, and miscellaneous uses such as ballasts, ceramics, and crystal glass.

V.A.3. Economic Trends - Lead

In 1994, domestic consumption of lead is expected to increase seven percent to 1.5 Mmt. This increase is based in part on expected increased demand from the automobile sector for both original and replacement equipment batteries. This increased consumption should continue to be met by the secondary lead industry, which is expected to continue to supply approximately 72 percent of total domestic production. Through 1998, production of unwrought lead is expected to grow 1.4 percent to 1.3 Mmt, while U.S. consumption is estimated to increase 1.4 percent to 1.6 Mmt.

Power storage batteries, both industrial and automotive, will continue to be the largest end-users. Demand for power storage batteries may be greater than initially expected due to several factors. California and nine Northeastern States have recently passed laws requiring the production, but not the consumer use of, electric vehicles. Other innovative uses of lead include lead-acid batteries for load-leveling of electricity. Using batteries for load-leveling reduces the total installed generating capacity needed by charging the battery at times of low demand for electricity, then discharging it to level the power supply at times of peak demand. A pilot facility in Chino, CA has already come on line with a battery which uses 2,000 pounds of lead and has a capacity of 40 megawatt hours. Another potential use for refined lead is the containment of high-level radioactive waste. Argentina and Sweden already employ it for this purpose and this use is being considered elsewhere, including the United States. A final innovative application being tested for lead is its use as a road paving stabilizer. Tests have shown that certain lead compounds can double the life of asphalt while only adding four to five percent to production costs.

V.B. Industrial Process Description - Lead

This section describes the major industrial processes within the Primary and Secondary Lead Processing industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

V.B.1. Industrial Processes in the Primary and Secondary Lead Processing Industry

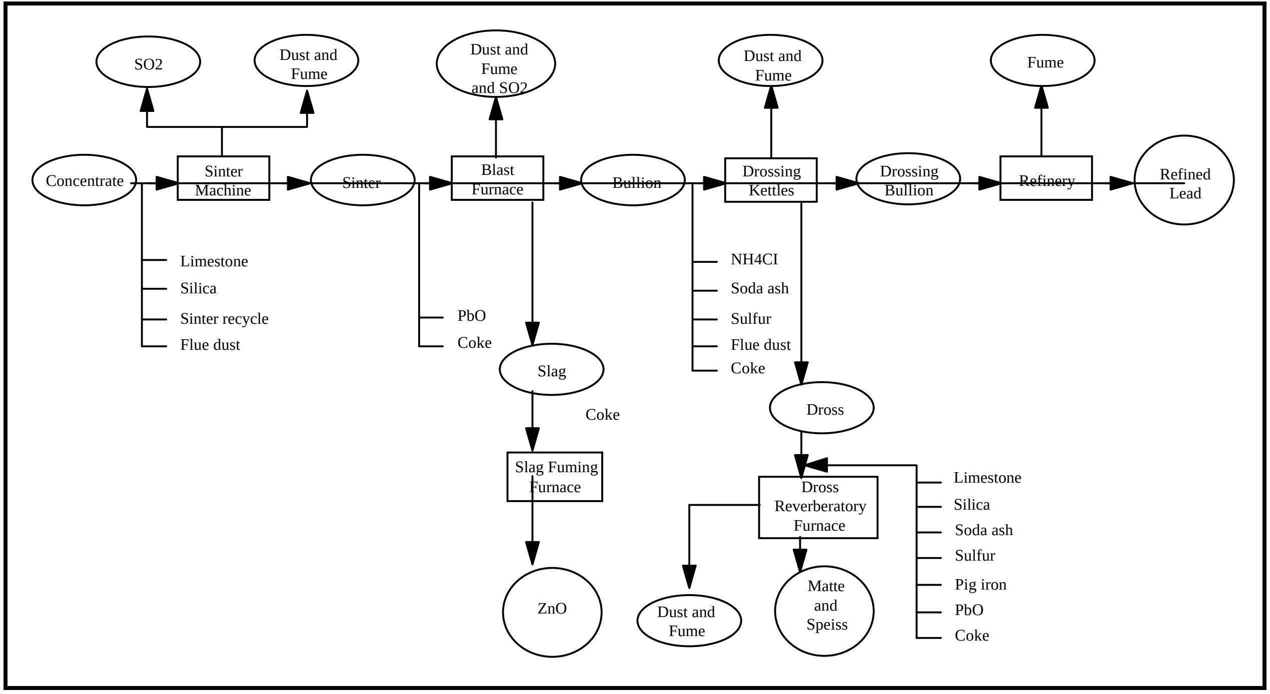
The following discussion is based upon the following documents: "Compilation of Air Pollutant Emission Factors (AP42)," "Background Listing Document for K065," "1990 Report to Congress on Special Wastes From Mineral Processing," published by the U.S. Environmental Protection Agency, and "Recycled Metals in The United States, A Sustainable Resource," published by U.S. Department of the Interior, Bureau of Mines.

Primary Lead Processing

The primary lead production process consists of four steps: sintering, smelting, drossing, and pyrometallurgical refining (See Exhibit 7). To begin, a feedstock comprised mainly of lead concentrate is fed into a sintering machine. Other raw materials may be added including iron, silica, limestone flux, coke, soda, ash, pyrite, zinc, caustic, and particulates gathered from pollution control devices. In the sintering machine the lead feedstock is subjected to blasts of hot air which burn off the sulfur, creating sulfur dioxide. The lead material existing after this process contains about nine percent of its weight in carbon. The sinter is then fed along with coke, various recycled and cleanup materials, limestone, and other fluxing agents into a blast furnace for reducing, where the carbon acts as a fuel and smelts or melts the lead material. The molten lead flows to the bottom of the furnace where four layers form: "speiss" (the lightest material, basically arsenic and antimony); "matte" (copper sulfide and other metal sulfides); blast furnace slag (primarily silicates); and lead bullion (98 weight percent lead). All layers are then drained off. The speiss and matte are sold to copper smelters for recovery of copper and precious metals. The blast furnace slag which contains zinc, iron, silica, and lime is stored in piles and partially recycled. Sulfur oxide emissions are generated in blast furnaces from small quantities of residual lead sulfide and lead sulfates in the sinter feed.

Rough lead bullion from the blast furnace usually requires preliminary treatment in kettles before undergoing refining operations. During drossing the bullion is agitated in a drossing kettle and cooled to just above its freezing point (700 to 800 degrees F). A dross, which is composed of lead oxide, along with copper, antimony, and other elements, floats to the top and solidifies above the molten lead.

Exhibit 7 - Primary Lead Production Process



Source: Air Pollution Engineering Manual, Anthony J. Buonicore and Wayne T. Davis, ed., Air & Waste Management Association, Van Norstrand Reinhold.

The dross is removed and fed into a dross furnace for recovery of the non-lead mineral values. To enhance copper recovery, drossed lead bullion is treated by adding sulfur bearing materials, zinc, and/or aluminum, lowering the copper content to approximately 0.01 percent.

During the fourth step the lead bullion is refined using pyrometallurgical methods to remove any remaining non-lead saleable materials (e.g., gold, silver, bismuth, zinc, and metal oxides such as antimony, arsenic, tin, and copper oxide). The lead is refined in a cast iron kettle during five stages. Antimony, tin, and arsenic are removed first. Then gold and silver are removed by adding zinc. Next, the lead is refined by vacuum removal of zinc. Refining continues with the addition of calcium and magnesium. These two materials combine with bismuth to form an insoluble compound that is skimmed from the kettle. In the final step caustic soda and/or nitrates may be added to the lead to remove any remaining traces of metal impurities. The refined lead will have a purity of 99.90 to 99.99 percent, and may be mixed with other metals to form alloys or it may directly be cast into shapes.

The processes used in the primary production of lead produce several waste streams of concern under different regulatory scenarios. The listed RCRA hazardous wastes include smelting plant wastes that are sent to surface impoundments to settle. The impoundments are used to collect solids from miscellaneous slurries, such as acid plant blowdown, slag granulation water, and plant washings. Acid plant blowdown is generated during the production of lead the same way it is produced at a copper plant; during the recovery of sulfur dioxide emissions. Slag granulation water is produced when hot slag from the process is sprayed with water to be cooled and granulated before transport to a slag pile. Plant washing is a housekeeping process and the washdown normally contains a substantial amount of lead and other process materials. When these materials accumulate in a surface impoundment or are dredged from the surface impoundment they are regulated as hazardous waste K065.

Secondary Lead Processing

The secondary production of lead begins with the recovery of old scrap from worn-out, damaged, or obsolete products and new scrap that is made of product wastes and smelter-refinery drosses, residues, and slags. The chief source of old scrap in the U.S. is lead-acid batteries, though cable coverings, pipe, sheet, and terne bearing metals also serve as a source of scrap. Solder, a tin-based alloy, may also be recovered from the processing of circuit boards for use as lead charge.

While some secondary lead is recovered directly for specialty products like babbitt metal, solder, re-melt, and copper-base alloys, about 97 percent of secondary lead is recovered at secondary lead smelters and refineries as either soft (unalloyed) or antimonial lead, most of which is recycled directly back into the manufacture of new batteries. Unlike copper and zinc, where scrap processing varies tremendously by scrap type and ultimate use, the dominance of lead battery scrap allows for a more standard secondary recovery process. Prior to smelting, batteries must be broken by one of several techniques, and classified into their constituent products. The modern battery breaking process classifies the lead into metallics, oxides and sulfate fragments, and organics into separate casing and plate separator fractions. Cleaned polypropylene case fragments are recycled back into battery cases or other products. The dilute sulfuric acid is either neutralized for disposal, or recycled into the local acid market. One of three main smelting processes is then used to reduce the lead fractions to produce lead bullion.

The majority of domestic battery scrap is processed in blast furnaces or rotary reverberatory furnaces. Used to produce a semisoft lead, a reverberatory furnace is more suitable for processing fine particles and may be operated in conjunction with a blast furnace. The reverberatory furnace is a rectangular shell lined with refractory brick, and is fired directly with oil or gas to a temperature of 2300 degrees F. The material is heated by direct contact with combustion gases. The average furnace can process about 50 tons per day. About 47 percent of the charge is recovered as lead product and is periodically tapped into mold or holding pots. Forty-six percent of the charge is removed as slag and later processed in blast furnaces. The remaining seven percent of the furnace charge escapes as dust or fume. Short (batch) or long (continuous) rotary furnaces may be used. Slags from reverberatory furnaces are processed through the blast furnace for recovery of alloying elements.

Blast furnaces produce hard lead from charges containing siliceous slag from previous runs (about 4.5 percent of the charge), scrap iron (about 4.5 percent), limestone (about 3 percent), and coke (about 5.5 percent). The remaining 82.5 percent of the charge is comprised of oxides, pot furnace refining drosses, and reverberatory slag. The proportions of rerun slags, limestone, and coke, respectively vary to as high as eight percent, ten percent, and eight percent of the charge. Processing capacity of the blast furnace ranges from 20 to 80 tons per day. Similar to iron cupolas, the blast furnace is a vertical steel cylinder lined with refractory brick. Combustion air at 0.5 to 0.75 pounds per square inch is introduced through tuyeres (pipes) at the bottom of the furnace. Some of the coke combusts to melt the charge, while the remainder reduces lead oxides to elemental lead.

As the lead charge melts, limestone and iron float to the top of the molten bath and form a flux that retards oxidation of the product lead. The molten lead flows from the furnace into a holding pot at a nearly continuous rate. The product lead constitutes roughly 70 percent of the charge. From the holding pot, the lead is usually cast into large ingots, called pigs or sows. About 18 percent of the charge is recovered as slag, with about 60 percent of this being matte. Roughly five percent of the charge is retained for reuse, and the remaining seven percent of the charge escapes as dust or fume.

Refining/casting is the use of kettle type furnaces for re-melting, alloying, refining, and oxidizing processes. Materials charged for re-melting are usually lead alloy ingots that require no further processing before casting. Alloying furnaces simply melt and mix ingots of lead and alloy materials. Antimony, tin, arsenic, copper, and nickel are the most common alloying materials. Refining furnaces, as in primary lead production, are used either to remove copper and antimony to produce soft lead, or to remove arsenic, copper, and nickel for hard lead production.

Newer secondary recovery plants use lead paste desulfurization to reduce sulfur dioxide emissions and waste sludge generation during smelting. At the Doe Run Resource Recycling Facility, battery paste containing lead sulfate and lead oxide is desulfurized with soda ash to produce market grade sodium sulfate solution. The desulfurized paste is processed in a reverberatory furnace. The lead carbonate product may then be treated in a short rotary furnace. The battery grids and posts are processed separately in a rotary smelter.

V.B.2. Raw Material Inputs and Pollution Outputs

The material inputs and pollution outputs resulting from primary and secondary lead processing are presented by media in Exhibit 8.

Exhibit 8
Process Materials Inputs/Pollution Outputs - Lead

Process	Material Input	Air Emissions	Process Wastes	Other Wastes
Lead Sintering	Lead ore, iron, silica, limestone flux, coke, soda, ash, pyrite, zinc, caustic, and baghouse dust	Sulfur dioxide, particulate matter containing cadmium and lead		
Lead Smelting	Lead sinter, coke	Sulfur dioxide, particulate matter containing cadmium and lead	Plant washdown wastewater, slag granulation water	Slag containing impurities such as zinc, iron, silica, and lime, surface impoundment solids (K065)
Lead Drossing	Lead bullion, soda ash, sulfur, baghouse dust, coke			Slag containing such impurities as copper, surface impoundment solids (K065)
Lead Refining	Lead drossing bullion			
Lead-acid Battery Breaking	Lead-acid batteries			Polypropylene case fragments, dilute sulfuric acid
Secondary Lead Smelting	Battery scrap, rerun slag, drosses, oxides, iron, limestone, and coke	Sulfur dioxide, particulate matter containing cadmium and lead		Slag, emission control dust (K069)

<u>Primary Lead Processing</u>

Primary lead processing activities usually result in air emissions, process wastes, and other solid-phase wastes. The primary air emissions from lead processing are substantial quantities of SO_2 and/or particulates. Nearly 85 percent of the sulfur present in the lead ore concentrate is eliminated in the sintering operation. The offgas containing a strong stream of SO_2 (five to seven percent SO_2) is sent to a sulfuric acid plant, while the weak stream (less than 0.5 percent SO_2) is vented to the atmosphere after removal of particulates. Particulate emissions from sinter machines range from five to 20 percent of the concentrated ore feed. Approximately 15 percent of the sulfur in the ore concentrate fed to the sinter machine is eliminated in the blast furnace. However, only half of this amount, about seven percent of the total sulfur in the ore, is emitted as SO_2. Particulate emissions from blast furnaces contain many different kinds of material, including a range of lead oxides, quartz, limestone, iron pyrites, iron-limestone-silicate slag, arsenic, and other metallic compounds associated with lead ores. The emission controls most commonly employed are fabric filters and electrostatic precipitators.

As mentioned above, approximately seven percent of the total sulfur present in lead ore is emitted as SO_2. The remainder is captured by the blast furnace slag. The blast furnace slag is composed primarily of iron and silicon oxides, as well as aluminum and calcium oxides. Other metals may also be present in smaller amounts including antimony, arsenic, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, mercury, molybdenum, silver, and zinc. This blast furnace slag is either recycled back into the process or disposed of in piles on site. About 50-60 percent of the recovery furnace output is slag and residual lead that are both returned to the blast furnace. The remainder of this dross furnace output is sold to copper smelters for recovery of the copper and other precious metals.

Slag from the primary processing of lead that is not recycled was retained within the Bevill exemption and addressed in the 1990 Report to Congress. In the subsequent regulatory determination (56 FR 27300), EPA determined that regulation of this waste under Subtitle C was not warranted.

The smelting of primary lead produces a number of wastewaters and slurries, including acid plant blowdown, slag granulation water, and plant washdown water. Slag granulation water is generated when slag is disposed. It can either be 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. Plant washdown water results from plant housekeeping and normally contains a substantial amount of lead and other process materials. Acid plant blowdown results from the conversion of SO_2 to sulfuric acid. All of these materials are included in the definition of hazardous waste K065.

Secondary Lead Processing

Secondary lead processing results in the generation of air emissions and solid-phase wastes. As with primary lead processing, reverberatory and blast furnaces used in smelting account for the vast majority of the total lead emissions. Other emissions from secondary smelting include oxides of sulfur and nitrogen, antimony, arsenic, copper, and tin. Smelting emissions are generally controlled with a settling and cooling chamber, followed by a baghouse. Other air emissions are generated during battery breaking. Emissions from battery breaking are mainly sulfuric acid and dusts containing dirt, battery case material, and lead compounds. Emissions from crushing are also mainly dusts.

The solid-phase wastes generated by secondary processing are emission control dust and slag. Slag is generated from smelting, and the emission control dust, when captured and disposed of, is considered to be hazardous waste K069.

VI. PRIMARY AND SECONDARY ZINC PROCESSING

VI.A. Characterization of the Industry - Zinc

This section provides background information on the size, geographic distribution, employment, production, sales, and economic condition of the Primary and Secondary Zinc Industry. The type of facilities described within the document are also described in terms of their Standard Industrial Classification (SIC) codes.

VI.A.1. Industry Size and Geographic Distribution - Zinc

The following discussion is based upon "U.S. Industrial Outlook 1994 - Metals," U.S. Department of Commerce, and information provided by the U.S. Department of the Interior, Bureau of Mines.

Variation in facility counts occur across data sources due to many factors, including reporting and definitional differences. This document does not attempt to reconcile these differences, but rather reports the data as they are maintained by each source.

Zinc is the fourth most widely used metal after iron, aluminum, and copper (lead is fifth). In abundant supply world-wide, zinc is mined and produced mainly in Canada, the former Soviet Union, Australia, Peru, Mexico, and the United States. Historically, in the U.S. recoverable zinc has been mined in 19 States: Alaska, Arizona, Colorado, Idaho, Illinois, Kansas, Missouri, Montana, Nevada, New Jersey, New Mexico, New York, Oklahoma, Pennsylvania, Tennessee, Utah, Virginia, Washington, and Wisconsin. In 1993, nearly 50 percent of all domestic zinc was produced in Alaska. Except for Missouri (eight percent) other exact state production figures were withheld to protect company proprietary data. Other top producing states in order of output were Tennessee, New York, and Missouri.

In 1993, the zinc industry employed 22,250 workers at mines and mills and 1,400 at primary smelters. For 1994, mine and mill employment was expected to stay at 2,200 and employment at zinc smelters was expected to decrease to 1,100 (U.S. DOI, Bureau of Mines, 1995). Employment decreases for primary smelters was attributed to the indefinite closures of a smelter in Oklahoma in later 1993. The four primary zinc smelters in the U.S., are located in Illinois, Oklahoma, Tennessee and Pennsylvania. There are currently 10 secondary zinc recovery plants in the U.S. (U.S. EPA, AP42, 1993).

VI.A.2. Product Characterization - Zinc

The U.S. accounts for almost one-quarter of worldwide slab zinc consumption and is the world's single largest market. About 80 percent of zinc is used in metal form while the rest is used in compound form. Ninety percent of zinc metal is used for galvanizing steel (a form of corrosion protection) and for alloys, and is used in a wide variety of materials in the automotive, construction, electrical, and machinery sectors of the economy. Zinc compound use also varies widely, but is mainly found in the agricultural, chemical, paint, pharmaceutical, and rubber sectors of the economy.

VI.A.3. Economic Trends - Zinc

In 1993, both domestic mine and slab zinc production were down, with slab zinc production down 4.75 percent to .381 Mmt. This production slump was off-set by domestic consumption which increased significantly in 1993, up eight percent, to 1.15 Mmt due to a surge in galvanized steel shipments. Strong growth in automobile demand and continued improvement in the construction industry led to increased consumption along with increased zinc die casting consumption. Consumption of zinc compounds also increased, especially of zinc oxide which increased over 27 percent. More than half of domestic zinc oxide production went to the rubber industry, primarily for use in producing tires (zinc is used in the compounding of rubber before it is cured).

In 1994, domestic refined zinc production is expected to continue its downward trend and drop 3.5 percent from .381 to .370 Mmt. However, domestic demand for zinc is expected to grow 4.2 percent in 1994 to 1.22 Mmt due to increases in all end uses except for nonresidential construction. This increased domestic demand should be met in large part by imports from Canada and Mexico. Imports of slab zinc mainly from these two countries in 1993 made up for almost 65 percent of domestic consumption. Zinc alloy was given preferential status in the Generalized System of Preferences 1990, which allows Mexico and member countries to export zinc alloys to the U.S. duty free. Tariffs on zinc from Canada will be phased out by 1998 due to the U.S.-Canada Free Trade Agreement. Zinc from the former Soviet Union is not expected to be used for U.S. consumption though its production is expected to negatively affect the U.S. market. This situation is similar to that for other metals in that over-production by former eastern bloc countries causes world prices to drop as London Metal Exchange warehouse supplies increase.

Domestically, the long-term demand for zinc is expected to increase, with consumption rising about 2.2 percent a year to reach 1.27 Mmt by 1998. Galvanization using zinc is expected to continue as the largest end-user of zinc, and it is predicted that by 1995 virtually all automobiles sold in the U.S. will be made from two-sided steel, enabling these vehicles to last at least ten years without any perforation damage. Zinc die-casting is also expected to increase in use as new applications are put into use.

VI.B. Industrial Process Description

This section describes the major industrial processes within the Primary and Secondary Zinc Processing industry, including the materials and equipment used, and the processes employed. The section is designed for those interested in gaining a general understanding of the industry, and for those interested in the inter-relationship between the industrial process and the topics described in subsequent sections of this profile -- pollutant outputs, pollution prevention opportunities, and Federal regulations. This section does not attempt to replicate published engineering information that is available for this industry. Refer to Section IX for a list of reference documents that are available.

This section specifically contains a description of commonly used production processes, associated raw materials, the byproducts produced or released, and the materials either recycled or transferred off-site. This discussion, coupled with schematic drawings of the identified processes, provide a concise description of where wastes may be produced in the process. This section also describes the potential fate (air, water, land) of these waste products.

VI.B.1. Industrial Processes in the Primary and Secondary Zinc Processing Industry

The following discussion is based upon the following documents: "Compilation of Air Pollutant Emission Factors(AP42), " "Background Listing Document for K065," "1990 Report to Congress on Special Wastes from Mineral Processing," published by the U.S. Environmental Protection Agency, and "Recycled Metals in the United States, A Sustainable Resource," published by U.S. Department of the Interior, Bureau of Mines.

Primary Zinc Processing

The primary production of zinc begins with the reduction of zinc concentrates to metal (the zinc concentration process consists of separating the ore, which may be as little as two percent zinc, from waste rock by crushing and flotation, a process normally performed at the mining site and discussed in more detail in the Metal Mining Profile). Zinc reduction is accomplished in one of two ways: either pyrometallurgically by distillation (retorting in a furnace) or hydrometallurgically by electrowinning. Because hydrometallurgical refining accounts for approximately 80 percent of total zinc refining, pyrometallurgical zinc refining will not be discussed in detail in this profile.

Four processing stages are generally used in hydrometallurgic zinc refining: calcining, leaching, purification, and electrowinning. Calcining, or roasting, is common to both pyrometallic and electrolytic (a form of hydrometallurgy) zinc refining, and is performed to eliminate sulfur and form leachable zinc oxide. Roasting is a high-temperature process that converts zinc sulfide concentrate to an impure zinc oxide called calcine. Roaster types include multiple-hearth, suspension, or fluidized-bed. In general, calcining begins with the mixing of zinc-containing materials with coal. This mixture is then heated, or roasted, to vaporize the zinc oxide which is then moved out of the reaction chamber with the resulting gas stream. The gas stream is directed to the bag-house (filter) area where the zinc oxide is captured in bag-house dust.

In a multiple-hearth roaster, the concentrate drops through a series of nine or more hearths stacked inside a brick-lined cylindrical column. As the feed concentrate drops through the furnace, it is first dried by the hot gases passing through the hearths and then oxidized to produce calcine. Multiple hearth roasters are unpressurized and operate at approximately 1,300 degrees F.

In a suspension roaster, the concentrates are blown into a combustion chamber. The roaster consists of a refractory-lined cylindrical shell, with a large combustion space at the top and two to four hearths in the lower portion. Additional grinding, beyond that required for a multiple hearth furnace, is normally required to assure that heat transfer to the material is sufficiently rapid for desulfurization and oxidation reaction to occur in the furnace chamber. Suspension roasters are also unpressurized and operate at about 1,800 degrees F.

Fluidized bed roasters require that the sulfide concentrates be finely ground. The concentrates are then suspended and oxidized on a feedstock bed supported on an air column. As in the suspension bed roaster, the reduction rates for desulfurization are more rapid than in the older multiple-hearth processes. Fluidized-bed roasters operate under a pressure slightly lower than atmospheric and at temperatures averaging 1,800 degrees F. In the fluidized-bed process, no additional fuel is required after ignition has been achieved. The major advantages of this roaster are greater throughput capacities and greater sulfur removal capabilities. All of the above calcining processes generate sulfur dioxide, which is controlled and converted to sulfuric acid as a marketable process by-product.

Electrolytic processing of desulfurized calcine consists of three basic steps; leaching, purification, and electrolysis. Leaching refers to the dissolving of the captured calcine in a solution of sulfuric acid to form a zinc sulfate solution. The calcine may be leached once or twice. In the double-leach method, the calcine is dissolved in a slightly acidic solution to remove the sulfates. The calcine is then leached a second time in a stronger solution which dissolves the zinc. This second leaching step is actually the beginning of the third step of purification because many of the iron impurities (such as goethite and hematite) drop out of the solution as well as the zinc.

After leaching, the solution is purified in two or more stages by adding zinc dust. The solution is purified as the dust forces deleterious elements to precipitate so that they can be filtered out. Purification is usually conducted in large agitation tanks. The process takes place at temperatures ranging from 104 to 185 degrees F, and pressures ranging from atmospheric to 2.4 atmospheres. The elements recovered during purification include copper as a cake and cadmium as a metal. After purification the solution is ready for the final step; electrowinning.

Zinc electrowinning takes place in an electrolytic cell and involves running an electric current from a lead-silver alloy anode through the aqueous zinc solution. This process charges the suspended zinc and forces it to deposit onto an aluminum cathode (a plate with an opposite charge) which is immersed in the solution. Every 24 to 48 hours, each cell is shut down, the zinc-coated cathodes removed and rinsed, and the zinc mechanically stripped from the aluminum plates. The zinc concentrate is then melted and cast into ingots, and is often as high as 99.995 percent pure.

Electrolytic zinc smelters contain as many as several hundred cells. A portion of the electrical energy is converted into heat, which increases the temperature of the electrolyte. Electrolytic cells operate at temperature ranges from 86 to 95 degrees F at atmospheric temperature. During electrowinning a portion of the electrolyte passes through cooling towers to decrease its temperature and to evaporate the water it collects during the process.

Sulfur dioxide is generated in large quantities during the primary zinc refining process and sulfur fixation is carried out concurrently with the primary production process in order to meet CAA emission standards. Concentrations of sulfur dioxide in the off-gas vary with the type of roaster operation. Typical concentrations for multiple hearth, suspension, and fluidized bed roasters are 4.5 to 6.5 percent, 10 to 13 percent, and 7 to 12 percent respectively. This sulfur dioxide is then converted into sulfuric acid.

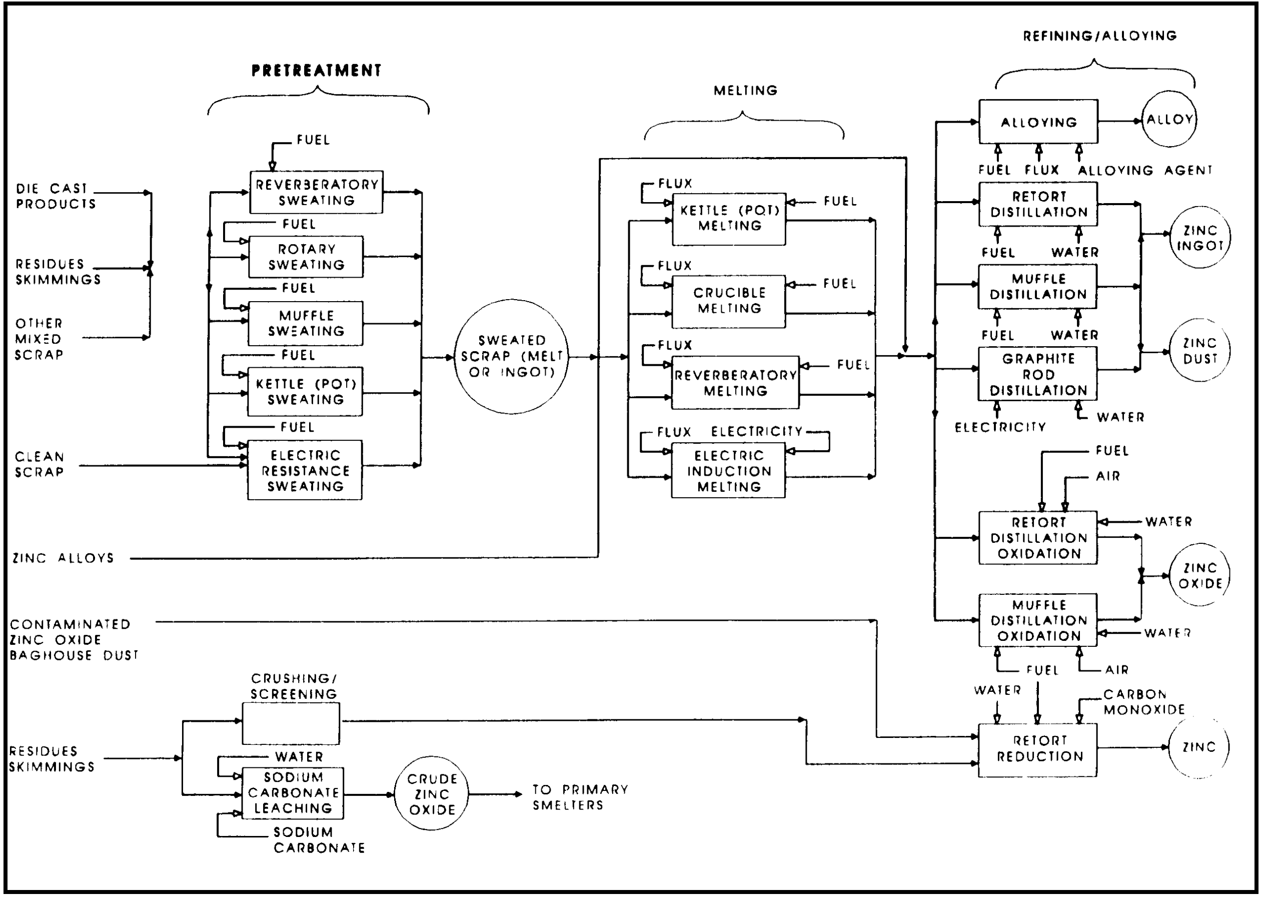
The sulfur recovery process requires that the emissions from the zinc calcining, or roasting process, where over 90 percent of potential sulfur dioxide is generated during primary zinc refining, flow through a filtering material in the air emissions scrubber to capture the sulfur. A blowdown slurry is formed from the mixture of the filtering material and sulfur emissions. This slurry contains not only sulfur, but cadmium and lead, materials that are always present in zinc ore. The acid plant blowdown slurry/sludge that results from thickening of blowdown slurry at primary zinc facilities is regulated by RCRA as hazardous waste K066.

During the electrolytic refining of zinc, solid materials in the electrolytic solution that are not captured previously during purification may precipitate out in the electrolytic cell. When the cells undergo their periodic shutdown to recover zinc, this precipitated waste (known as anode slimes/sludges) is collected during cell cleaning. Once collected it is sent to a waste water treatment plant and the resulting sludges are also regulated by RCRA as hazardous waste K066.

Secondary Zinc Processing

The secondary zinc industry processes scrap metals for the recovery of zinc in the form of zinc slabs, zinc oxide, or zinc dust. Zinc recovery involves three general operations; pretreatment, melting, and refining (see Exhibit 9). Secondary recovery begins with the separation of zinc-containing metals from other materials, usually by magnetics, sink-float, or hand sorting. In situations where nonferrous metals have been mixed in shredder scrap, zinc can be separated from higher-melting metals such as copper and aluminum, by selective melting in a sweating furnace. A sweating furnace (rotary, reverberatory, or muffle furnace) slowly heats the scrap containing zinc and other metals to approximately 787 degrees F. This temperature is sufficient to melt zinc but is still below the melting point of the remaining metals.

Exhibit 9 Secondary Zinc Processing



Source: *Compilation of Air Pollutant Emission Fasctors, (AP42), U.S. EPA.*

Molten zinc collects at the bottom of the sweat furnace and is subsequently recovered. The remaining scrap is cooled and removed to be sold to other secondary processors. In the case of zinc-galvanized steel, the zinc will be recovered largely in furnace dust after the scrap is charged into a steel making furnace and melted. Almost all of the zinc in electric arc furnace (EAF) dust is first recovered in an upgraded, impure zinc oxide product and is then shipped to primary pyrometallurgical zinc smelter for refinement to metal.

Clean new scrap, mainly brass and rolled zinc clippings and reject diecastings, generally require only re-melting before reuse. During melting, the zinc-containing material is heated in kettle, crucible, reverberatory, and electric induction furnaces. Flux is used to trap impurities from the molten zinc. Facilitated by agitation, flux and impurities float to the surface of the melt as dross, and is skimmed from the surface. The remaining molten zinc may be poured into molds or transferred to the refining operation in a molten state. Drosses, fragmentized diecastings, and mixed high-grade scrap are typically re-melted, followed by zinc distillation with recovery as metal, dust, or oxide. Sometimes, high-purity drosses are simply melted and reacted with various fluxes to release the metallic content; often the recovered metal can be used directly as a galvanizing brightener or master alloy. Zinc alloys are produced from pretreated scrap during sweating and melting processes. The alloys may contain small amounts of copper, aluminum, magnesium, iron, lead, cadmium, and tin. Alloys containing 0.65 to 1.25 percent copper are significantly stronger than unalloyed zinc.

Medium and low-grade skims, oxidic dust, ash, and residues generally undergo an intermediate reduction-distillation pyrometallurgical step to upgrade the zinc product before further treatment; or, they are leached with acid, alkaline, or ammoniacal solutions to extract zinc. For leaching, the zinc containing material is crushed and washed with water, separating contaminants from zinc-containing material. The contaminated aqueous stream is treated with sodium carbonate to convert zinc chloride into sodium chloride and insoluble zinc hydroxide. The sodium chloride is separated from the insoluble residues by filtration and settling. The precipitate zinc hydroxide is dried and calcined (dehydrated into a powder at high temperature) to convert it into crude zinc oxide. The zinc oxide product is usually refined to zinc at primary zinc smelters. The washed zinc-containing metal portion becomes the raw material for the melting process.

Distillation retorts and furnaces are used either to reclaim zinc from alloys or to refine crude zinc. Bottle retort furnaces consist of a pear-shaped ceramic retort (a long-necked vessel used for distillation). Bottle retorts are filled with zinc alloys and heated until most of the zinc is vaporized, sometimes as long as 24 hours. Distillation involves vaporization of zinc at temperatures from 1800 to 2280 degrees F, and condensation as zinc dust or liquid zinc. Zinc dust is produced by vaporization and rapid cooling, and liquid zinc results when the vaporous product is condensed slowly at moderate temperatures.

A muffle furnace is a continuously charged retort furnace which can operate for several days at a time. Molten zinc is charged through a feed well that also acts as an airlock. Muffle furnaces generally have a much greater vaporization capacity than bottle retort furnaces.

Air pollution control can be an area of concern when pyrometallurgical processes are employed in the secondary recovery of zinc. When the recovery process used is simply an iron pot re-melt operation to produce zinc metal, fumes will not normally be generated. If slab zinc is needed and a rotary furnace is used, any air emissions are captured directly from the venting system (a rotating furnace sweats, or melts, the zinc separating it from drosses with different melting points, which allows it to be poured off separately). Air emissions become more of a concern when more complicated processes are used to produce zinc powder. Retort and muffle furnaces used to produce zinc powder heat the zinc and other charges to such a high temperature that the zinc vaporizes and is captured in the pollution control equipment. It is this zinc oxide dust that is the process' marketable product. Hoods are employed around the furnace openings used to add additional charge. The fumes collected from the hoods are not normally of high quality and will be used for products like fertilizer and animal feed.

For the most part, the zinc materials recovered from secondary materials such as slab zinc, alloys, dusts, and compounds are comparable in quality to primary products. Zinc in brass is the principal form of secondary recovery, although secondary slab zinc has risen substantially over the last few years because it has been the principal zinc product of EAF dust recycling. Impure zinc oxide products and zinc-bearing slags are sometimes used as trace element additives in fertilizers and animal feeds. Currently about 10 percent of the domestic requirement for zinc is satisfied by old scrap.

Due to environmental concerns, both domestic and world-wide secondary recovery of zinc (versus disposal) is expected to increase. However, the prospect for gains higher than 35 to 40 percent of zinc consumption is relatively poor because of the dissipative nature of zinc vapor.

VI.B.2. Raw Material Inputs and Pollution Outputs

The material inputs and pollution outputs resulting from primary and secondary zinc processing are presented by media in Exhibit 10.

Exhibit 10
Process Materials Inputs/Pollution Outputs - Zinc

Process	Material Input	Air Emissions	Process Wastes	Other Wastes
Zinc Calcining	Zinc ore, coke	Sulfur dioxide, particulate matter containing zinc and lead		Acid plant blowdown slurry (K066)
Zinc Leaching	Zinc calcine, sulfuric acid, limestone, spent electrolyte		Wastewaters containing sulfuric acid	
Zinc Purification	Zinc-acid solution, zinc dust		Wastewaters containing sulfuric acid, iron	Copper cake, cadmium
Zinc Electrowinning	Zinc in a sulfuric acid / aqueous solution, lead-silver alloy anodes, aluminum cathodes, barium carbonate, or strontium, colloidal additives		Dilute sulfuric acid	Electrolytic cell slimes / sludges (K066)
Secondary Zinc Smelting	Zinc scrap, electric arc furnace dust, drosses, diecastings, fluxes	Particulates		Slags containing copper, aluminum, iron, lead, and other impurities
Secondary Zinc Reduction Distillation	Medium-grade zinc drosses, oxidic dust, acids, alkalines, or ammoniacal solutions	Zinc oxide fumes		Slags containing copper, aluminum, iron, lead, and other impurities

Primary Zinc Processing

Primary zinc processing activities generate air emissions, process wastes, and other solid-phase wastes. Air emissions are generated during roasting, which is responsible for more than 90 percent of the potential SO_2 emissions. Approximately 93 to 97 percent of the sulfur in the feed is emitted as sulfur oxides. Sulfur dioxide emissions from the roasting process at all four primary zinc processing facilities are recovered at on-site sulfuric acid plants. Much of the particulate matter emitted from primary zinc facilities is also attributable to roasters. Though the amount and composition of particulate varies with operating parameters, the particulate is likely to contain zinc and lead.

Wastewaters may be generated during the leaching, purification, and electrowinning stages of primary zinc processing when electrolyte and acid solutions become too contaminated to be reused again. This wastewater needs to be treated before discharge.

Solid wastes, some of which are hazardous, are generated at various stages in primary zinc processing. Slurry generated during the operation of sulfuric acid plants is regulated as hazardous waste K066 as is the sludge removed from the bottom of electrolytic cells. The solid copper cake generated during purification is generally sent off-site to recover the copper.

Secondary Zinc Processing

Secondary zinc processing generates air emissions and solid-phase wastes. Air emissions result from sweating and melting and consist of particulate, zinc fumes, other volatile metals, flux fumes, and smoke generated by the incomplete combustion of grease, rubber, and plastics in zinc scrap. Zinc fumes are negligible at low furnace temperatures. Substantial emissions may arise from incomplete combustion of carbonaceous material in the zinc scrap. These contaminants are usually controlled by afterburners, and particulate emissions are most commonly recovered by fabric filters. Emissions from refining operations are mainly metallic fumes. Distillation/oxidations operations emit their entire zinc oxide product in the exhaust dust. Zinc oxide is usually recovered in fabric filters with collection efficiencies of 9 to 99 percent.

The secondary zinc recovery process generates slags that contain metals such as copper, aluminum, iron, and lead. Though slag generated during primary pyrometallurgical processes is exempt from regulation as a hazardous waste under RCRA, slag resulting from secondary processing is not automatically exempt. Therefore if secondary processing slag exhibits a characteristic (e.g., toxicity for lead), it would need to be managed as a hazardous waste.

VII. MANAGEMENT OF CHEMICALS IN WASTESTREAM

The Pollution Prevention Act of 1990 (EPA) requires facilities to report information about the management of TRI chemicals in waste and efforts made to eliminate or reduce those quantities. These data have been collected annually in Section 8 of the TRI reporting Form R beginning with the 1991 reporting year. The data summarized below cover the years 1992-1995 and is meant to provide a basic understanding of the quantities of waste handled by the industry, the methods typically used to manage this waste, and recent trends in these methods. TRI waste management data can be used to assess trends in source reduction within individual industries and facilities, and for specific TRI chemicals. This information could then be used as a tool in identifying opportunities for pollution prevention compliance assistance activities.

While the quantities reported for 1992 and 1993 are estimates of quantities already managed, the quantities reported for 1994 and 1995 are projections only. The EPA requires these projections to encourage facilities to consider future waste generation and source reduction of those quantities as well as movement up the waste management hierarchy. Future-year estimates are not commitments that facilities reporting under TRI are required to meet.

Exhibit 11 shows that the primary and secondary metals industry managed about 1.9 billion pounds of production-related waste (total quantity of TRI chemicals in the waste from routine production operations) in 1993 (column B). Column C reveals that of this production-related waste, 35 percent was either transferred off-site or released to the environment. Column C is calculated by dividing the total TRI transfers and releases by the total quantity of production-related waste. In other words, about 70 percent of the industry's TRI wastes were managed on-site through recycling, energy recovery, or treatment as shown in columns D, E and F, respectively. The majority of waste that is released or transferred off-site can be divided into portions that are recycled off-site, recovered for energy off-site, or treated off-site as shown in columns G, H, and I, respectively. The remaining portion of the production-related wastes (12.8 percent), shown in column J, is either released to the environment through direct discharges to air, land, water, and underground injection, or it is disposed off-site.

From the yearly data presented below it is apparent that the portion of TRI wastes reported as recycled on-site has increased and the portions treated or managed through energy recovery on-site have remained steady, but are projected to decrease, between 1992 and 1995.

Exhibit 11
Source Reduction and Recycling Activity for SIC 333-334

A	B	C	D	E	F	G	H	I	J
Year	**Production Related Waste Volume (10^6lbs.)***	% Reported as Released and Transferred	**On-Site**			**Off-Site**			**Remaining Releases and Disposal**
			% Recycled	% Energy Recovery	% Treated	% Recycled	% Energy Recovery	% Treated	
1992	1,875	28%	42.98%	1.05%	23.93%	17.38%	0.15%	0.89%	12.68%
1993	1,991	35%	44.77%	0.99%	23.75%	17.17%	0.16%	0.33%	12.85%
1994	2,014	—	46.79%	0.88%	23.12%	16.60%	0.14%	0.35%	12.11%
1995	2,023	—	48.42%	1.01%	21.16%	16.39%	0.18%	0.39%	12.45%

VIII. CHEMICAL RELEASE AND TRANSFER PROFILE

This section is designed to provide background information on the pollutant releases that are reported by this industry. The best source of comparative pollutant release information is the Toxic Release Inventory System (TRI). Pursuant to the Emergency Planning and Community Right-to-Know Act, TRI includes self-reported facility release and transfer data for over 600 toxic chemicals. Facilities within SIC Codes 20-39 (manufacturing industries) that have more than 10 employees, and that are above weight-based reporting thresholds are required to report TRI on-site releases and off-site transfers. The information presented within the sector notebooks is derived from the most recently available (1993) TRI reporting year (which then included 316 chemicals), and focuses primarily on the on-site releases reported by each sector. Because TRI requires consistent reporting regardless of sector, it is an excellent tool for drawing comparisons across industries.

Although this sector notebook does not present historical information regarding TRI chemical releases over time, please note that in general, toxic chemical releases have been declining. In fact, according to the 1993 Toxic Release Inventory Data Book, reported releases dropped by 42.7% between 1988 and 1993. Although on-site releases have decreased, the total amount of reported toxic waste has not declined because the amount of toxic chemicals transferred off-site has increased. Transfers have increased from 3.7 billion pounds in 1991 to 4.7 billion pounds in 1993. Better management practices have led to increases in off-site transfers of toxic chemicals for recycling. More detailed information can be obtained from EPA's annual Toxics Release Inventory Public Data Release book (which is available through the EPCRA Hotline at 1-800-535-0202), or directly from the Toxic Release Inventory System database (for user support call 202-260-1531).

Wherever possible, the sector notebooks present TRI data as the primary indicator of chemical release within each industrial category. TRI data provide the type, amount, and media receptor of each chemical released or transferred. When other sources of pollutant release data have been obtained, these data have been included to augment the TRI information.

TRI Data Limitations

The reader should keep in mind the following limitations regarding TRI data. Within some sectors, the majority of facilities are not subject to TRI reporting because they are not considered manufacturing industries, or because they are below TRI reporting thresholds. Examples are the mining, dry cleaning, printing, and transportation equipment cleaning sectors. For these sectors, release information from other sources has been included.

The reader should also be aware that TRI "pounds released" data presented within the notebooks is not equivalent to a "risk" ranking for each industry. Weighting each pound of release equally does not factor in the relative toxicity of each chemical that is released. The Agency is in the process of developing an approach to assign toxicological weightings to each chemical released so that one can differentiate between pollutants with significant differences in toxicity. As a preliminary indicator of the environmental impact of the industry's most commonly released chemicals, the notebook briefly summarizes the toxicological properties of the top five chemicals (by weight) reported by each industry.

Definitions Associated With Section IV Data Tables

General Definitions

SIC Code -- the Standard Industrial Classification (SIC) is a statistical classification standard used for all establishment-based Federal economic statistics. The SIC codes facilitate comparisons between facility and industry data.

TRI Facilities -- are manufacturing facilities that have 10 or more full-time employees and are above established chemical throughput thresholds. Manufacturing facilities are defined as facilities in Standard Industrial Classification primary codes 20-39. Facilities must submit estimates for all chemicals that are on the EPA's defined list and are above throughput thresholds.

Data Table Column Heading Definitions

The following definitions are based upon standard definitions developed by EPA’s Toxic Release Inventory Program. The categories below represent the possible pollutant destinations that can be reported.

RELEASES -- are an on-site discharge of a toxic chemical to the environment. This includes emissions to the air, discharges to bodies of water, releases at the facility to land, as well as contained disposal into underground injection wells.

Releases to Air (Point and Fugitive Air Emissions) -- Include all air emissions from industry activity. Point emissions occur through confined air streams as found in stacks, ducts, or pipes. Fugitive emissions include losses from equipment leaks, or evaporative losses from impoundments, spills, or leaks.

Releases to Water (Surface Water Discharges) - encompass any releases going directly to streams, rivers, lakes, oceans, or other bodies of water. Any estimates for stormwater runoff and non-point losses must also be included.

Releases to Land -- includes disposal of waste to on-site landfills, waste that is land treated or incorporated into soil, surface impoundments, spills, leaks, or waste piles. These activities must occur within the facility's boundaries for inclusion in this category.

Underground Injection -- is a contained release of a fluid into a subsurface well for the purpose of waste disposal.

TRANSFERS -- is a transfer of toxic chemicals in wastes to a facility that is geographically or physically separate from the facility reporting under TRI. The quantities reported represent a movement of the chemical away from the reporting facility. Except for off-site transfers for disposal, these quantities do not necessarily represent entry of the chemical into the environment.

Transfers to POTWs -- are wastewaters transferred through pipes or sewers to a publicly owned treatments works (POTW). Treatment and chemical removal depend on the chemical's nature and treatment methods used. Chemicals not treated or destroyed by the POTW are generally released to surface waters or landfilled within the sludge.

Transfers to Recycling -- are sent off-site for the purposes of regenerating or recovering still valuable materials. Once these chemicals have been recycled, they may be returned to the originating facility or sold commercially.

Transfers to Energy Recovery -- are wastes combusted off-site in industrial furnaces for energy recovery. Treatment of a chemical by incineration is not considered to be energy recovery.

Transfers to Treatment -- are wastes moved off-site for either neutralization, incineration, biological destruction, or physical separation.

In some cases, the chemicals are not destroyed but prepared for further waste management.

Transfers to Disposal -- are wastes taken to another facility for disposal generally as a release to land or as an injection underground.

VIII.A. EPA Toxics Release Inventory for the Nonferrous Metals Industry

TRI release amounts listed below are not associated with non-compliance with environmental laws. These facilities appear based on self-reported data submitted to the Toxics Release Inventory program.

Exhibits 11-16 illustrate TRI releases and transfers for the primary nonferrous metals smelting and refining industry (SIC 333). For SIC 333 as a whole, chlorine comprises the largest number of TRI releases. This is reflected in the fact that chlorine is a by-product of the magnesium industry and the largest reporter for SIC 333 is a magnesium facility. The other top SIC 333 releases are copper compounds, zinc compounds, lead compounds, and sulfuric acid, all of which are by-products of the processes discussed previously.

The TRI database contains a detailed compilation of self-reported, facility-specific chemical releases. The top reporting facilities for this sector are listed below. Facilities that have reported only the SIC codes covered under this notebook appear on the first list. The second list contains additional facilities that have reported the SIC code covered within this report, and one or more SIC codes that are not within the scope of this notebook. Therefore, the second list includes facilities that conduct multiple operations — some that are under the scope of this notebook, and some that are not. Currently, the facility-level data do not allow pollutant releases to be broken apart by industrial process.

Exhibit 12
Top 10 TRI Releasing Primary Metal Industries Facilities (SIC 333)

SIC Codes	Total TRI Releases in Pounds	Facility Name	City	State
3339	73,300,250	Magnesium Corp. of America, Rowley Plant	Rowley	UT
3339	42,728,498	Asarco, Inc., E. Helena Plant	East Helena	MT
3331	14,773,759	Phelps Dodge Mining Co., Hidalgo Smelter	Playas	NM
3331	11,717,315	Kennecott Utah Copper	Magna	UT
3339	8,194,328	DOE Run Co., Herculaneum Smelter	Herculaneum	MO
3331	8,142,539	Chino Mines Co., Hurley Smelter	Hurley	NM
3339	7,085,302	Asarco, Inc., Glover Plant	Annapolis	MD
1021, 3331, 3351	6,223,505	Cyprus Miami Mining Corp.	Claypool	AZ
3331	5,970,420	Asarco, Inc., Amarillo Copper Refinery	Amarillo	TX
3321, 3365	4,496,188	GMC Powertrain Group, Saginaw Grey Iron	Saginaw	MI

Source: US EPA, Toxics Release Inventory Database, 1993.

Exhibit 13
Top 10 TRI Releasing Primary Smelting and Refining Facilities

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	73,300,250	Magnesium Corp. of America, Rowley Plant	Rowley	UT
2	42,728,498	Asarco Inc., E. Helena Plant	East Helena	MT
3	14,773,759	Phelps Dodge Mining Co., Hidalgo Smelter	Playas	NM
4	1,1717,315	Kennecott Utah Copper	Magna	UT
5	8,194,328	Doe Run Co., Herculaneum Smelter	Herculaneum	MO
6	8,142,539	Chino Mines Co., Hurley Smelter	Hurley	NM
7	7,085,302	Asarco, Inc., Glover Plant	Annapolis	MD
8	5,970,420	Asarco, Inc., Amarillo Copper Refinery	Amarillo	TX
9	1,123,708	Glenbrook Nickel Co.	Riddle	OR
10	780,927	Alcoa Rockdale Works	Rockdale	TX

Source: U.S. EPA, Toxics Release Inventory Database, 1993..

Note: Being included on these lists does not mean that the release is associated with non-compliance with environmental laws.

Exhibit 14
TRI Reporting Primary Smelting and Refining Facilities (SIC 333) by State

State	Number of Facilities	State	Number of Facilities
AZ	1	NM	2
CO	1	NY	2
CT	1	OH	3
IN	1	OR	3
KY	1	PA	2
MD	1	SC	1
MO	3	TX	5
MT	3	UT	3
NC	2	VA	1
NE	1	WA	7
NJ	1		

Source: U.S. EPA, Toxics Release Inventory Database, 1993..

Exhibit 15
Releases for Primary Smelting and Refining (SIC 333) in TRI, by Number of Facilities (releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Copper	20	9412	248340	508	0	500254	758514	37926
Chlorine	19	153751	67037082	2803	0	11	67193647	3536508
Sulfuric Acid	15	24527	1013009	0	5700000	100920	6838456	455897
Hydrogen Fluoride	14	1565588	1520212	5	0	0	3085805	220415
Manganese	11	15	5130	0	0	5	5150	468
Zinc Compounds	10	47545	102940	8505	5	42345637	42504632	4250463
Chromium	8	10	398	5	0	0	413	52
Copper Compounds	8	559987	408015	1502	65000	27574267	28608771	3576096
Hydrochloric Acid	8	3853	6155294	0	5	5	6159157	769895
Lead Compounds	8	68834	274504	7263	730	7713452	8064783	1008098
Arsenic Compounds	7	7147	30181	3005	52000	2190652	2282985	326141
Antimony Compounds	6	6319	4398	3143	2100	661740	677700	112950
Cadmium Compounds	6	1286	18912	311	0	39734	60243	10041
Nickel Compounds	6	1323	8956	225	4200	1149028	1163732	193955
Nitric Acid	6	15	23670	0	5	15	23705	3951
Aluminum (Fume Or Dust)	5	5760	32472	44	0	5	38281	7656
Lead	5	138589	96836	18	0	2352628	2588071	517614
Nickel	5	345	781	4	0	29052	30182	6036
Silver Compounds	5	848	2210	270	100	19633	23061	4612
Barium Compounds	4	5	1850	0	890	456308	459053	114763
Arsenic	3	270	28264	9	0	7114	35657	11886
Cadmium	3	981	6181	11	0	4824	11997	3999
Chromium Compounds	3	250	592	250	0	190005	191097	63699
Manganese Compounds	3	620	823	0	0	2400643	2402086	800695
Selenium Compounds	3	1350	38000	250	2300	120265	162165	54055
Zinc (Fume Or Dust)	3	10190	25682	46	0	4010295	4046213	1348738
1,1,1-Trichloroethane	3	75031	0	0	0	0	75031	25010
Anthracene	2	250	25487	0	0	0	25737	12869
Antimony	2	500	10915	5	0	0	11420	5710
Cobalt	2	250	5	0	0	0	255	128
Cobalt Compounds	2	669	262	255	0	5	1191	596
Cyanide Compounds	2	0	0	500	0	0	500	250
Ethylene Glycol	2	0	0	0	0	0	0	0
Phosphoric Acid	2	0	0	0	0	0	0	0
Thiourea	2	60	0	0	5300	255	5615	2808
Ammonia	1	250	0	0	0	0	250	250
Beryllium Compounds	1	0	0	0	0	0	0	0
Cresol (Mixed Isomers)	1	250	0	250	0	750	1250	1250
Decabromodiphenyl Oxide	1	0	250	0	0	0	250	250
Dichlorodifluoromethane	1	18000	0	0	0	0	18000	18000
M-Xylene	1	14000	0	0	0	0	14000	14000
Naphthalene	1	0	467	0	0	0	467	467
Phenol	1	0	0	1	0	0	1	1
Styrene	1	1900	0	0	0	5	1905	1905
Thallium	1	5	250	0	0	755	1010	1010
Titanium Tetrachloride	1	250	250	0	0	0	500	500
1,2,4-Trimethylbenzene	1	18000	0	0	0	0	18000	18000
Total	---	2,738,235	77,122,618	29,188	5,832,635	91,868,262	177,590,938	---

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 16 Transfers for Primary Smelting and Refining (SIC 333) in TRI, by Number of Facilities (Transfers reported in pounds/year)

	# Facilities	POTW				Energy	Total	Average
Copper	20	5	17596	124723	0	0	142324	7116
Chlorine	19	0		9991	0	0	9991	526
Sulfuric Acid	15	1	600	6454346	0	0	6454947	430330
Hydrogen Fluoride	14	0	0	0	0	0	0	0
Manganese	11	0	14	46752	0	0	46766	4251
Zinc Compounds	10	760	2692570	750680	833231	0	4277241	427724
Chromium	8	0	0	2361	0	0	2361	295
Copper Compounds	8	459	2900850	3882069	93989	0	6877367	859671
Hydrochloric Acid	8	0	0	0	0	0	0	0
Lead Compounds	8	2401	2253086	2289461	11239	0	4556187	569523
Arsenic Compounds	7	386	1649205	174013	634487	0	2458091	351156
Antimony Compounds	6	1749	345100	29836	15262	0	391947	65325
Cadmium Compounds	6	346	26097	420187	62987	0	509617	84936
Nickel Compounds	6	260	5	237910	3931	0	242106	40351
Nitric Acid	6	0	5	0	11000	0	11005	1834
Aluminum	5	0	317650	3826700	0	0	4144350	828870
Lead	5	5	5	640899	0	0	640909	128182
Nickel	5	5		633	0	0	638	128
Silver Compounds	5	174	5765	8756	255	0	14950	2990
Barium Compounds	4	0	0	0	0	0	0	0
Arsenic	3	5	250	55713	0	0	55968	18656
Cadmium	3	5		212387	0	0	212392	70797
Chromium Compounds	3	0	1200	15000	0	0	16200	5400
Manganese Compounds	3	41	0	5639	0	0	5680	1893
Selenium Compounds	3	0	19005	0	0	0	19005	6335
Zinc (Fume Or Dust)	3	250	0	412568	0	0	412818	137606
1,1,1-Trichloroethane	3	0	0	0	250	0	250	83
Anthracene	2	0	14032	0	0	0	14032	7016
Antimony	2	0	4110	1911550	0	0	1915660	957830
Cobalt	2	0	0	0	0	0	0	0
Cobalt Compounds	2	250	0	77640	0	0	77890	38945
Cyanide Compounds	2	0	53213	0	1813	0	55026	27513
Ethylene Glycol	2	0	0	0	8673	0	8673	4337
Phosphoric Acid	2	0	0	0	160	0	160	80
Thiourea	2	0	0	0	0	0	0	0
Ammonia	1	0	0	0	0	0	0	0
Beryllium Compounds	1	0	0	0	0	0	0	0
Cresol (Mixed Isomers)	1	0	0	0	0	0	0	0
Decabromodiphenyl Oxide	1	0	4374	0	0	0	4374	4374
Dichlorodifluoromethane	1	0	0	0	0	0	0	0
M-Xylene	1	0	0	0	0	0	0	0
Naphthalene	1	0	0	0	0	0	0	0
Phenol	1	0	0	0	0	0	0	0
Styrene	1	0	0	0	0	0	0	0
Thallium	1	5	0	750	0	0	755	755
Titanium Tetrachloride	1	0	0	0	0	0	0	0
4-Trimethylbenzene	1	0	0	0	0	0	0	0
Total	225	7,107	10,304,732	21,590,56	1,677,277	0	33,579,680	108187.82

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibits 17-20 illustrate the TRI releases and transfers for the secondary nonferrous metals smelting and refining industry (SIC 334). For the industry as a whole, the largest releases were the various metals: aluminum (fume or dust), zinc compounds, lead compounds, copper and zinc (fume or dust).

Exhibit 17
Top 10 TRI Releasing Secondary Smelting and Refining (SIC 334)

Rank	Total TRI Releases in Pounds	Facility Name	City	State
1	881,970	Gulf Chemical & Metallurgical Corp.	Freeport	TX
2	854,630	Imco Recycling Inc.	Morgantown	KY
3	758,089	Alabama Reclamation Plant	Sheffield	AL
4	329,250	Imco Recycling Inc.	Sapulpa	OK
5	288,070	Alcan Recycling Div.	Berea	KY
6	184,460	Wabash Alloys	Wabash	IN
7	147,455	Chemetco Inc.	Hartford	IL
8	146,852	Schuylkill Metals Corp.	Baton Rouge	LA
9	140,000	Southern Reclamation Co.	Sheffield	AL
10	131,899	North Chicago Refiners & Smelters	North Chicago	IL

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Note: Being included on these lists does not mean that the release is associated with non-compliance with environmental laws.

Exhibit 18
TRI Reporting Secondary Smelting and Refining Facilities (SIC 334) by State

State	Number of Facilities
AL	10
AR	3
AZ	1
CA	12
CT	2
FL	1
GA	2
IL	17
IN	13
KS	2
KY	5
LA	1
MA	5
MD	1
MI	7
MN	4
MO	4
MS	1
NC	1
NJ	5
NM	1
NY	8
OH	12
OK	3
PA	13
RI	3
SC	2
TN	9
TX	6
UT	1
VA	1
WI	4
WV	3

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 19
Releases for Secondary Smelting and Refining (SIC 334) in TRI, by Number of Facilities (Releases reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	Fugitive Air	Point Air	Water Discharges	Under-ground Injection	Land Disposal	Total Releases	Average Releases per Facility
Copper	74	17235	56198	2720	0	221287	297440	4019
Nickel	38	5646	5873	262	0	12934	24715	650
Chlorine	32	5103	6304	0	0	0	11407	356
Lead	30	13964	29230	571	0	750	44515	1484
Copper Compounds	29	11921	35205	358	0	1500	48984	1689
Lead Compounds	25	11211	115573	404	0	147930	275118	11005
Manganese	25	7848	3547	10	0	74536	85941	3438
Aluminum (Fume Or Dust)	24	34297	196604	922	11	641760	873594	36400
Zinc Compounds	24	41195	263420	3049	0	0	307664	12819
Sulfuric Acid	21	6917	1730	0	0	0	8647	412
Chromium	19	1465	1937	255	0	2005	5662	298
Zinc (Fume Or Dust)	19	57759	79392	331	0	0	137482	7236
Hydrochloric Acid	14	17116	604670	0	0	0	621786	44413
Nickel Compounds	13	1113	1492	297	0	0	2902	223
Chromium Compounds	10	276	617	0	0	0	893	89
Ammonia	9	1343335	168094	53229	57053	353800	1975511	219501
Antimony	9	364	373	586	0	5	1328	148
Antimony Compounds	9	115	1294	44	0	67760	69213	7690
Silver	9	21	517	251	0	0	789	88
Silver Compounds	9	1033	823	5	0	0	1861	207
Manganese Compounds	8	1074	3426	570	0	0	5070	634
Nitric Acid	8	1008	2628	0	0	0	3636	455
Arsenic	7	310	308	36	0	5	659	94
Arsenic Compounds	7	10	573	16	0	27104	27703	3958
Barium Compounds	6	298	2011	0	0	0	2309	385
Cadmium Compounds	6	545	5409	20	0	0	5974	996
Cobalt	6	905	680	5	0	20	1610	268
Cadmium	3	250	874	281	0	0	1405	468
Hexachloroethane	3	0	11536	0	0	0	11536	3845
Aluminum Oxide (Fibrous Form)	2	0	53	0	0	0	53	27
Barium	2	20	45	0	0	0	65	33
Beryllium	2	0	5	0	0	0	5	3
Methanol	2	1000	0	0	0	0	1000	500
Molybdenum Trioxide	2	500	4205	18750	0	0	23455	11728
Ammonium Sulfate (Solution)	1	250	0	0	0	0	250	250
Cobalt Compounds	1	0	0	0	0	0	0	0
Mercury Compounds	1	250	5	5	0	5	265	265
Phosphoric Acid	1	0	0	0	0	0	0	0
Phosphorus (Yellow Or White)	1	0	0	0	0	0	0	0
Polychlorinated Biphenyls	1	0	0	0	0	0	0	0
Selenium	1	0	1	0	0	0	1	1
Xylene (Mixed Isomers)	1	250	0	0	0	0	250	250
1,1,1-Trichloroethane	1	250	0	0	0	0	250	250
Totals	---	**1,584,854**	**1,604,652**	**82,977**	**57,064**	**1,551,401**	**4,880,948**	----

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

Exhibit 20
Transfers for Secondary Smelting and Refining (SIC 334) in TRI, by Number of Facilities (Transfers reported in pounds/year)

Chemical Name	# Facilities Reporting Chemical	POTW Discharge	Disposal	Recycling	Treatment	Energy Recovery	Total Transfers	Total per Facility
Copper	74	7024	139130	20126255	20233	0	20292642	274225
Nickel	38	282	9366	78143	3984	0	91775	2415
Chlorine	32	2545	0	0	0	0	2545	80
Lead	30	1106	675459	1749221	16055	0	2441841	81395
Copper Compounds	29	82	658756	806437	537038	0	2002313	69045
Lead Compounds	25	810	5543943	11216399	1020276	0	17781428	711257
Manganese	25	501	108806	67048	1236	0	177591	7104
Aluminum (Fume Or Dust)	24	500	966226	15417	0	0	982143	40923
Zinc Compounds	24	1661	129752	5571000	229930	0	5932343	247181
Sulfuric Acid	21	5	0	7332842	0	0	7332847	349183
Chromium	19	51	11812	43378	83	0	55324	2912
Zinc (Fume Or Dust)	19	5	164242	1048567	8180	0	1220994	64263
Hydrochloric Acid	14	0	750	56965	27557	0	85272	6091
Nickel Compounds	13	23	34996	1531600	4777	0	1571396	120877
Chromium Compounds	10	251	165015	214000	4664	0	383930	38393
Ammonia	9	0	621718	0	0	0	621718	69080
Antimony	9	927	127443	8180	880	0	137430	15270
Antimony Compounds	9	614	935418	641800	10710	0	1588542	176505
Silver	9	755	0	8680	0	0	9435	1048
Silver Compounds	9	20	835	485550	186	0	486591	54066
Manganese Compounds	8	75	29005	128500	0	0	157580	19698
Nitric Acid	8	5	1500	11299	750	0	13554	1694
Arsenic	7	67	51353	0	1784	0	53204	7601
Arsenic Compounds	7	110	196876	55734	0	0	252720	36103
Barium Compounds	6	4448	115647	82700	31094	0	233889	38982
Cadmium Compounds	6	257	0	393000	0	0	393257	65543
Cobalt	6	5	905	35045	15	0	35970	5995
Cadmium	3	0	12930	23795	900	0	37625	12542
Hexachloroethane	3	0	0	0	0	0	0	0
Aluminum Oxide (Fibrous Form)	2	0	0	0	0	0	0	0
Barium	2	5	62710	0	250	0	62965	31483
Beryllium	2	0	0	7930		0	7930	3965
Methanol	2	0	0	0	0	0	0	0
Molybdenum Trioxide	2	0		165100	17150	0	182250	91125
Ammonium Sulfate (Solution)	1	0	0	0	0	0	0	0
Cobalt Compounds	1	0	0	0	0	0	0	0
Mercury Compounds	1	0	33200	0	10	0	33210	33210
Phosphoric Acid	1	0	0	0	0	0	0	0
Phosphorus (Yellow Or White)	1	250	0	0	0	0	250	250
Polychlorinated Biphenyls	1	0	255	0	0	0	255	255
Selenium	1	0	2673	0	510	0	3183	3183
Xylene (Mixed Isomers)	1	0	0	0	0	0	0	0
1,1,1-Trichloroethane	1	0	0	0	0	0	0	0
Totals	----	22,384	10,800,721	51,904,585	1,938,252	0	64,665,942	-----

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

VIII.B. Summary of the Selected Pollutants Released

The following is a synopsis of current scientific toxicity and fate information for the top chemicals (by weight) that facilities within this sector self-reported as released to the environment based upon 1993 TRI data. Because this section is based upon self-reported release data, it does not attempt to provide information on management practices employed by the sector to reduce the release of these chemicals. Information regarding pollutant release reductions over time may be available from EPA's TRI and 33/50 programs, or directly from the industrial trade associations that are listed in Section IX of this document. Since these descriptions are cursory, please consult the sources referenced below for a more detailed description of both the chemicals described in this section, and the chemicals that appear on the full list of TRI chemicals appearing in Section IV.A.

The brief descriptions provided below were taken from the *1993 Toxics Release Inventory Public Data Release* (EPA, 1994), the Hazardous Substances Data Bank (HSDB), and the Integrated Risk Information System (IRIS), both accessed via TOXNET[1]. The information contained below is based upon exposure assumptions that have been conducted using standard scientific procedures. The effects listed below must be taken in context of these exposure assumptions that are more fully explained within the full chemical profiles in HSDB.

Chlorine

Toxicity. Breathing small amounts of chlorine for short periods of time can affect the respiratory tract in humans, causing symptoms such as coughing and chest pain. It is irritating to the skin, eyes, and respiratory

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[1] TOXNET is a computer system run by the National Library of Medicine that includes a number of toxicological databases managed by EPA, National Cancer Institute, and the National Institute for Occupational Safety and Health. For more information on TOXNET, contact the TOXNET help line at 1-800-231-3766. Databases included in TOXNET are: CCRIS (Chemical Carcinogenesis Research Information System), DART (Developmental and Reproductive Toxicity Database), DBIR (Directory of Biotechnology Information Resources), EMICBACK (Environmental Mutagen Information Center Backfile), GENE-TOX (Genetic Toxicology), HSDB (Hazardous Substances Data Bank), IRIS (Integrated Risk Information System), RTECS (Registry of Toxic Effects of Chemical Substances), and TRI (Toxic Chemical Release Inventory). HSDB contains chemical-specific information on manufacturing and use, chemical and physical properties, safety and handling, toxicity and biomedical effects, pharmacology, environmental fate and exposure potential, exposure standards and regulations, monitoring and analysis methods, and additional references.

tract. Repeated long-term exposure to chlorine can cause adverse effects on the blood and respiratory systems.

Ecologically, chlorine is highly toxic to aquatic organisms at low doses.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Most of the chlorine released to the environment will quickly evaporate.

Physical Properties. Chlorine is a highly reactive gas.

Copper

Toxicity. Metallic copper probably has little or no toxicity, although copper salts are more toxic. Inhalation of copper oxide fumes and dust has been shown to cause metal fume fever: irritation of the upper respiratory tract, nausea, sneezing, coughing, chills, aching muscles, gastric pain, and diarrhea. However, the respiratory symptoms may be due to a non-specific reaction to the inhaled dust as a foreign body in the lung, and the gastrointestinal symptoms may be attributed to the conversion of copper to copper salts in the body.

It is unclear whether long-term copper poisoning exists in humans. Some have related certain central nervous system disorders, such as giddiness, loss of appetite, excessive perspiration, and drowsiness to copper poisoning. Long-term exposure to copper may also cause hair, skin, and teeth discoloration, apparently without other adverse effects.

People at special risk from exposure to copper include those with impaired pulmonary function, especially those with obstructive airway diseases, since the breathing of copper fumes might cause exacerbation of pre-existing symptoms due to its irritant properties.

Ecologically, copper is a trace element essential to many plants and animals. However, high levels of copper in soil can be directly toxic to certain soil microorganisms and can disrupt important microbial processes in soil, such as nitrogen and phosphorus cycling.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Copper is typically found in the environment as a solid metal in soils and soil sediment in surface water. There is no evidence that biotransformation processes have a significant bearing on the fate and transport of copper in water.

Hydrochloric Acid

Toxicity. Hydrochloric acid is primarily a concern in its aerosol form. Acid aerosols have been implicated in causing and exacerbating a variety of respiratory ailments. Dermal exposure and ingestion of highly concentrated hydrochloric acid can result in corrosivity.

Ecologically, accidental releases of solution forms of hydrochloric acid may adversely affect aquatic life by including a transient lowering of the pH (i.e., increasing the acidity) of surface waters.

Carcinogenicity. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Releases of hydrochloric acid to surface waters and soils will be neutralized to an extent due to the buffering capacities of both systems. The extent of these reactions will depend on the characteristics of the specific environment.

Physical Properties. Concentrated hydrochloric acid is highly corrosive.

Lead

Toxicity. Short-term lead poisoning is relatively infrequent and occurs from ingestion of acid soluble lead compounds or inhalation of lead vapors. Symptoms include nausea, severe abdominal pain, vomiting, diarrhea or constipation, shock, tingling, pain, and muscle weakness, and kidney damage. Death may occur in one to two days. If the patient survives the acute episode, characteristic signs and symptoms of chronic lead poisoning are likely to appear. Chronic lead poisoning affects the gastrointestinal, neuromuscular, blood, kidney, and central nervous systems. Individuals with chronic lead poisoning appear ashen, with an appearance of "premature aging," with stooped posture, poor muscle tone, and emaciation. Neuromuscular syndrome (muscle weakness, easy fatigue, localized paralysis) and central nervous system syndrome (progressive mental deterioration, decreased intelligence, loss of motor skills and speech, hyperkinetic and aggressive behavior disorders, poorly controlled convulsive disorder, severe learning impairment) usually result from intense exposure, while the abdominal syndrome (anorexia, muscle discomfort, malaise, headache, constipation, severe abdominal pain, persistent metallic taste) is a more common manifestation of a very slowly and insidiously developing intoxication.

In the U.S., the central nervous system syndrome is usually more common among children, while the gastrointestinal syndrome is more prevalent in adults. Exposure to lead is also linked to decreased fertility in men. Lead is a probable human carcinogen, based on sufficient animal evidence and inadequate human evidence. Populations at increased risk of toxicity from exposure to lead include developing fetuses and young children, individuals with decreased kidney function, and children with sickle-cell anemia.

<u>Environmental Fate.</u> If released or deposited on soil, lead will be retained in the upper two to five centimeters of soil. Leaching is not important under normal conditions, nor generally is the uptake of lead from soil into plants. Lead enters water from atmospheric fallout, runoff or wastewater; it is effectively removed from the water column to the sediment predominantly by adsorption to organic matter and clay minerals. Some lead reenters the water column through methylation by microorganisms. Volatilization is negligible. Lead does not appear to bioconcentrate significantly in fish but does in some shellfish such as mussels. When released to the atmosphere, lead will generally be in dust or adsorbed to particulate matter and subject to gravitational settling.

Zinc and Zinc Compounds

<u>Toxicity</u>. Zinc is a nutritional trace element; toxicity from ingestion is low. Severe exposure to zinc might give rise to gastritis with vomiting due to swallowing of zinc dusts. Short-term exposure to very high levels of zinc is linked to lethargy, dizziness, nausea, fever, diarrhea, and reversible pancreatic and neurological damage. Long-term zinc poisoning causes irritability, muscular stiffness and pain, loss of appetite, and nausea.

Zinc chloride fumes cause injury to mucous membranes and to the skin. Ingestion of soluble zinc salts may cause nausea, vomiting, and purging.

<u>Carcinogenicity</u>. There is currently no evidence to suggest that this chemical is carcinogenic.

Environmental Fate. Significant zinc contamination of soil is only seen in the vicinity of industrial point sources. Zinc is a relatively stable soft metal, though burns in air. Zinc bioconcentrates in aquatic organisms.

VIII.C. Other Data Sources

The Aerometric Information Retrieval System (AIRS) contains a wide range of information related to stationary sources of air pollution, including the emissions of a number of air pollutants which may be of concern within a particular industry. With the exception of volatile organic compounds (VOCs), there is little overlap with the TRI chemicals reported above. Exhibit 21 summarizes annual releases of carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter of 10 microns or less (PM10), total particulates (PT), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

Exhibit 21
Pollutant Releases (Short Tons/Year)

Industry	CO	NO_2	PM_{10}	PT	SO_2	VOC
U.S. Total	97,208,000	23,402,000	45,489,000	7,836,000	21,888,000	23,312,000
Metal Mining	5,391	28,583	39,359	140,052	84,222	1,283
Nonmetal Mining	4,525	28,804	59,305	167,948	24,129	1,736
Lumber and Wood Products	123,756	42,658	14,135	63,761	9,149	41,423
Wood Furniture and Fixtures	2,069	2,981	2,165	3,178	1,606	59,426
Pulp and Paper	624,291	394,448	35,579	113,571	341,002	96,875
Printing	8,463	4,915	399	1,031	1,728	101,537
Inorganic Chemicals	166,147	108,575	4,107	39,082	182,189	52,091
Organic Chemicals	146,947	236,826	26,493	44,860	132,459	201,888
Petroleum Refining	419,311	380,641	18,787	36,877	648,153	309,058
Rubber and Misc. Plastic Products	2,090	11,914	2,407	5,355	29,364	140,741
Stone, Clay, Glass, and Concrete	58,043	338,482	74,623	171,853	339,216	30,262
Iron and Steel	1,518,642	138,985	42,368	83,017	238,268	82,292
Nonferrous Metals	**448,758**	**55,658**	**20,074**	**22,490**	**373,007**	**27,375**
Fabricated Metals	3,851	16,424	1,185	3,136	4,019	102,186
Electronics	367	1,129	207	293	453	4,854
Motor Vehicles, Bodies, Parts, and Accessories	35,303	23,725	2,406	12,853	25,462	101,275
Dry Cleaning	101	179	3	28	152	7,310

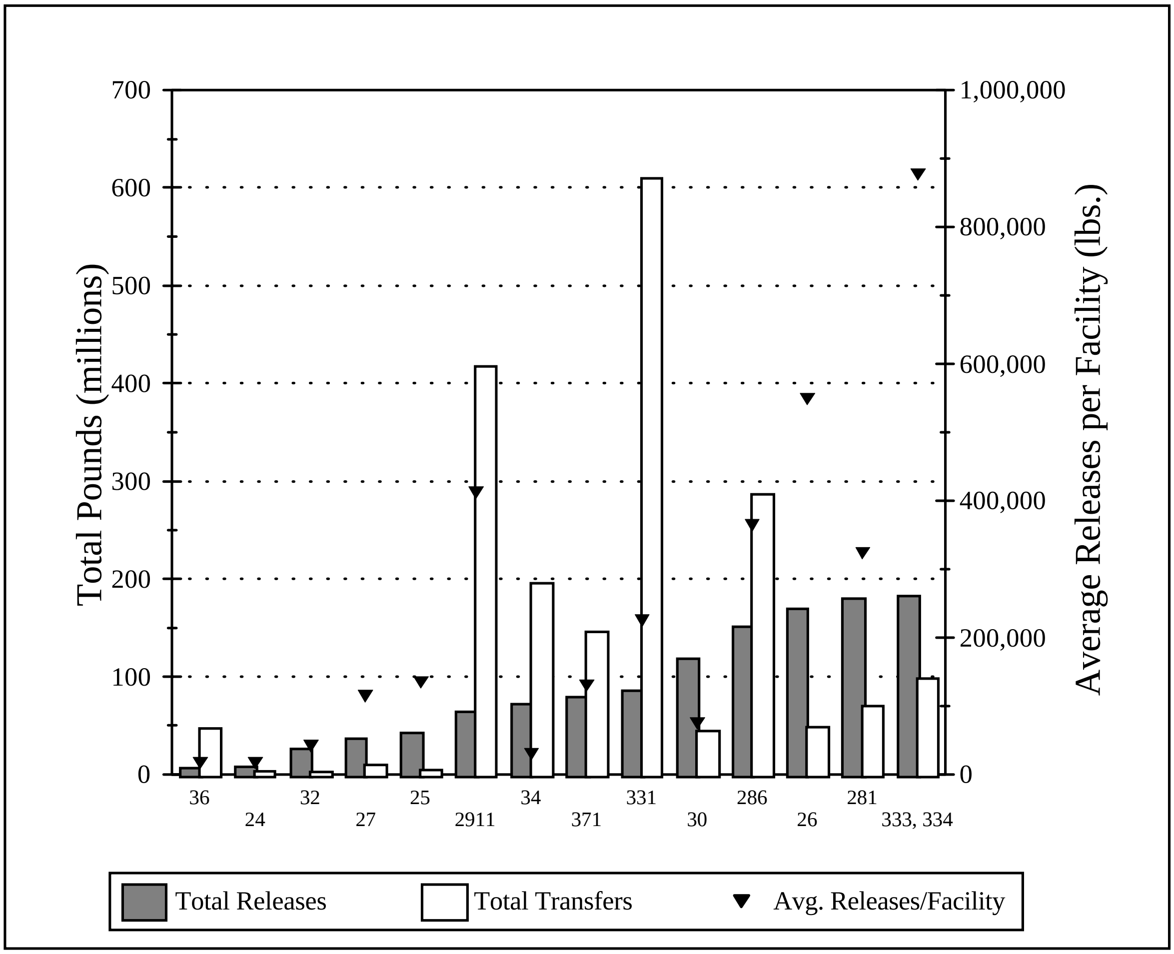
Source U.S. EPA Office of Air and Radiation, AIRS Database, May 1995.

VIII.D. Comparison of Toxic Release Inventory Between Selected Industries

The following information is presented as a comparison of pollutant release and transfer data across industrial categories. It is provided to give a general sense as to the relative scale of releases and transfers within each sector profiled under this project. Please note that the following table does not contain releases and transfers for industrial categories that are not included in this project, and thus cannot be used to draw conclusions regarding the total release and transfer amounts that are reported to TRI. Similar information is available within the annual TRI Public Data Release book.

Exhibit 22 is a graphical representation of a summary of the 1993 TRI data for the nonferrous metals industry and the other sectors profiled in separate notebooks. The bar graph presents the total TRI releases and total transfers on the left axis and the triangle points show the average releases per facility on the right axis. Industry sectors are presented in the order of increasing total TRI releases. The graph is based on the data shown in Exhibit 23 and is meant to facilitate comparisons between the relative amounts of releases, transfers, and releases per facility both within and between these sectors. The reader should note, however, that differences in the proportion of facilities captured by TRI exist between industry sectors. This can be a factor of poor SIC matching and relative differences in the number of facilities reporting to TRI from the various sectors. In the case of nonferrous metals industry, the 1993 TRI data presented here covers 208 facilities. These facilities listed SIC 333-334 nonferrous metals industry as a primary SIC code.

Exhibit 22
Summary of 1993 TRI Data: Releases and Transfers by Industry



SIC Range	Industry Sector	SIC Range	Industry Sector	SIC Range	Industry Sector
36	Electronic Equipment and Components	2911	Petroleum Refining	286	Organic Chemical Mfg.
24	Lumber and Wood Products	34	Fabricated Metals	26	Pulp and Paper
32	Stone, Clay, and Concrete	371	Motor Vehicles, Bodies, Parts, and Accessories	281	Inorganic Chemical Mfg.
27	Printing	331	Iron and Steel	333,334	Nonferrous Metals
25	Wood Furniture and Fixtures	30	Rubber and Misc. Plastics		

Exhibit 23
Toxic Release Inventory Data for Selected Industries

Industry Sector	SIC Range	# TRI Facilities	Releases		Transfers		Total Releases + Transfers (10^6 pounds)	Average Release+ Transfers per Facility (pounds)
			Total Releases (10^6 pounds)	**Average Releases per Facility (pounds)**	**1993 Total (10^6 pounds)**	**Average Transfers per Facility (pounds)**		
Stone, Clay, and Concrete	32	634	26.6	41,895	2.2	3,500	28.2	46,000
Lumber and Wood Products	24	491	8.4	17,036	3.5	7,228	11.9	24,000
Furniture and Fixtures	25	313	42.2	134,883	4.2	13,455	46.4	148,000
Printing	2711-2789	318	36.5	115,000	10.2	732,000	46.7	147,000
Electronics/Computers	36	406	6.7	16,520	47.1	115,917	53.7	133,000
Rubber and Misc. Plastics	30	1,579	118.4	74,986	45.0	28,537	163.4	104,000
Motor Vehicle, Bodies, Parts and Accessories	371	609	79.3	130,158	145.5	238,938	224.8	369,000
Pulp and paper	2611-2631	309	169.7	549,000	48.4	157,080	218.1	706,000
Inorganic Chem. Mfg.	2812-2819	555	179.6	324,000	70.0	126,000	249.7	450,000
Petroleum Refining	2911	156	64.3	412,000	417.5	2,676,000	481.9	3,088,000
Fabricated Metals	34	2,363	72.0	30,476	195.7	82,802	267.7	123,000
Iron and Steel	3312-3313 3321-3325	381	85.8	225,000	609.5	1,600,000	695.3	1,825,000
Nonferrous Metals	**333, 334**	**208**	**182.5**	**877,269**	**98.2**	**472,335**	**280.7**	**1,349,000**
Organic Chemical Mfg.	2861-2869	417	151.6	364,000	286.7	688,000	438.4	1,052,000
Metal Mining	10	Industry sector not subject to TRI reporting						
Nonmetal Mining	14	Industry sector not subject to TRI reporting						
Dry Cleaning	7215, 7216, 7218	Industry sector not subject to TRI reporting						

Source: U.S. EPA, Toxics Release Inventory Database, 1993.

IX. POLLUTION PREVENTION OPPORTUNITIES

The best way to reduce pollution is to prevent it in the first place. Some companies have creatively implemented pollution prevention techniques that improve efficiency and increase profits while at the same time minimizing environmental impacts. This can be done in many ways such as reducing material inputs, re-engineering processes to reuse by-products, improving management practices, and employing substitution of toxic chemicals. Some smaller facilities are able to actually get below regulatory thresholds just by reducing pollutant releases through aggressive pollution prevention policies.

In order to encourage these approaches, this section provides both general and company-specific descriptions of some pollution prevention advances that have been implemented within the Nonferrous Metals Industry. While the list is not exhaustive, it does provide core information that can be used as the starting point for facilities interested in beginning their own pollution prevention projects. When possible, this section provides information from real activities that can, or are being implemented by this sector -- including a discussion of associated costs, time frames, and expected rates of return. This section provides summary information from activities that may be, or are being implemented by this sector. When possible, information is provided that gives the context in which the techniques can be effectively used. Please note that the activities described in this section do not necessarily apply to all facilities that fall within this sector. Facility-specific conditions must be carefully considered when pollution prevention options are evaluated, and the full impacts of the change must examine how each option affects, air, land, and water pollutant releases.

IX.A. Identification of Pollution Prevention Activities in Use

Pollution prevention, whether through source material reduction/reuse, or waste recycling, is practiced in various sectors of the nonferrous metals industry. Pollution prevention techniques and processes currently used by the nonferrous metals industry can be grouped into the following general categories:

- Process equipment modification,
- Raw materials substitution or elimination,
- Solvent recycling, and
- Precious metals recovery.

It is interesting to note that while the stated rationale for the use of many of these techniques or processes is applicable environmental regulations, their use is both fairly universal and profitable.

Process equipment modification is used to reduce the amount of waste generated. Many copper, lead, and zinc refiners have modified their production processes by installing sulfur fixation equipment. This equipment not only captures the sulfur before it enters the atmosphere (helping the refining plant meet CAA sulfur standards), but processes it so that a marketable sulfuric acid is produced. Another example is the use of pre-baked anodes in primary aluminum refining. When a pre-baked anode is used, the electrolytic cell, or pot, can be closed, thereby increasing the efficiency of the collection of fluoride emissions. In addition, new carbon liners have been developed which significantly increase the life of the aluminum reduction cell. This has resulted in large reductions in the amount of spent potliner material (hazardous waste K088) generated by the aluminum industry.

Raw material substitution or elimination is the replacement of raw materials with other materials that produce less waste, or a non-toxic waste. Material substitution is inherent in the secondary nonferrous metals industry primarily by substituting scrap metal, slag, and baghouse dust for ore feedstock. All of these materials, whether in the form of aluminum beverage cans, copper scrap, or lead-acid batteries, are commonly added to other feedstock or charges (usually slag containing residual metals) to produce marketable grades of metal. Primary nonferrous metals refining also uses previously refined metals as feedstock, especially zinc-containing electric arc furnace dust (a by-product of the iron and steel industry).

Precious metals recovery is the modification of a refining process to allow the capture of marketable precious metals such as gold and silver. Like sulfur fixation, precious metals recovery is a common waste minimization practice. During primary copper smelting, appreciable amounts of silver and gold present in copper ore will be concentrated into the anode copper and can be recovered as a by-product in the electrorefining process (as the copper anode is electrochemically dissolved and the copper attaches itself to the cathode, silver and gold drop out and are captured in the slime at the bottom of the tank). In the lead refining process the copper often present in lead ore is removed during the initial lead bullion smelting process as a constituent of dross. Silver and gold are removed from the lead bullion later in the process by adding certain fluxes which cause them to form an impure alloy. The alloy is then refined electrolytically and separated into gold and silver. Precious metals recovery also takes place during zinc refining to separate out copper, a frequent impurity in zinc ore. Copper is removed from the zinc ore during the zinc purification process (after zinc undergoes leaching, zinc dust is added which forces many of the deleterious elements to drop out; copper is recovered in a cake form and sent for refining).

IX.B. Important Pollution Prevention Case Studies

Various pollution prevention case histories have been documented for nonferrous metals refining industries. In particular, the actions of the AMPCO Metal Manufacturing Company, Inc. typify industry efforts to simultaneously lessen the impact of the industrial process on the environment, reduce energy consumption, and lower production costs.

AMPCO Metal Manufacturing Company, Inc., in Ohio is participating in the development of pollution prevention technologies. The project, sponsored by the U.S. DOE and EPA, consists of researching and developing the use of electric induction to replace fossil fuel combustion currently used to heat tundishes. Tundishes are used to contain the heated reservoir of molten alloy in the barstock casting process. The fossil fuel combustion process currently used requires huge amounts of energy and produces tremendous amounts of waste gases, including combustion bases and lead and nickel emissions. According to new OSHA regulations, lead emissions from foundries must be reduced by 80 percent by 1998.

Heating the tundish by electric induction instead of fossil fuel combustion will substantially improve the current process, saving energy and reducing pollution. Energy efficiency will jump to an estimated 98 percent, saving 28.9 billion Btu/yr/unit. Industry-wide energy savings in 2010 are estimated to be 206 billion Btu/yr, assuming a 70 percent adoption at U.S. foundries.

In addition to the energy savings, the new process also has substantial environmental benefits. Along with the elimination of lead and nickel gases, carbon dioxide, carbon monoxide, and nitrogen oxide emissions from combustion will decrease. The consumption of refractory (a heat-resisting ceramic material) will decline by 80 percent, resulting in a similar reduction of refractory waste disposal. In all, prevention of various forms of pollution is estimated to be 147 million lb (66.7 million kg)/yr by 2010.

Economically, the elimination of lead and nickel emissions will result in an improved product because exposure of the metal to combustion gases in the current process results in porosity and entrainment of hydrogen gas in the metal. Overall, AMPCO estimates an annual savings in operations and maintenance expenses of $1.2 million with the use of this technology. Assuming the same 70 percent industry adoption, economic savings by 2010 could reach $5.8 million. Without the new electric induction heating process, the capital costs required for compliance could be $3 million.

X. SUMMARY OF FEDERAL STATUTES AND REGULATIONS

This section discusses the Federal statutes and regulations that may apply to this sector. The purpose of this section is to highlight, and briefly describe the applicable Federal requirements, and to provide citations for more detailed information. The three following sections are included.

- Section X.A contains a general overview of major statutes
- Section X.B contains a list of regulations specific to this industry
- Section X.C contains a list of pending and proposed regulations

The descriptions within Section X are intended solely for general information. Depending upon the nature or scope of the activities at a particular facility, these summaries may or may not necessarily describe all applicable environmental requirements. Moreover, they do not constitute formal interpretations or clarifications of the statutes and regulations. For further information, readers should consult the Code of Federal Regulations and other state or local regulatory agencies. EPA Hotline contacts are also provided for each major statute.

X.A. General Description of Major Statutes

Resource Conservation And Recovery Act

The Resource Conservation And Recovery Act (RCRA) of 1976 which amended the Solid Waste Disposal Act, addresses solid (Subtitle D) and hazardous (Subtitle C) waste management activities. The Hazardous and Solid Waste Amendments (HSWA) of 1984 strengthened RCRA's waste management provisions and added Subtitle I, which governs underground storage tanks (USTs).

Regulations promulgated pursuant to Subtitle C of RCRA (40 CFR Parts 260-299) establish a “cradle-to-grave” system governing hazardous waste from the point of generation to disposal. RCRA hazardous wastes include the specific materials listed in the regulations (commercial chemical products, designated with the code "P" or "U"; hazardous wastes from specific industries/sources, designated with the code "K"; or hazardous wastes from non-specific sources, designated with the code "F") or materials which exhibit a hazardous waste characteristic (ignitibility, corrosivity, reactivity, or toxicity and designated with the code "D").

Regulated entities that generate hazardous waste are subject to waste accumulation, manifesting, and recordkeeping standards. Facilities that treat, store, or dispose of hazardous waste must obtain a permit, either from EPA or from a State agency which EPA has authorized to implement the permitting program. Subtitle C permits contain general facility standards such as contingency plans, emergency procedures, recordkeeping and reporting requirements, financial assurance mechanisms, and unit-specific standards. RCRA also contains provisions (40 CFR Part 264 Subpart S and §264.10) for conducting corrective actions which govern the cleanup of releases of hazardous waste or constituents from solid waste management units at RCRA-regulated facilities.

Although RCRA is a Federal statute, many States implement the RCRA program. Currently, EPA has delegated its authority to implement various provisions of RCRA to 46 of the 50 States.

Most RCRA requirements are not industry specific but apply to any company that transports, treats, stores, or disposes of hazardous waste. Here are some important RCRA regulatory requirements:

- **Identification of Solid and Hazardous Wastes** (40 CFR Part 261) lays out the procedure every generator should follow to determine whether the material created is considered a hazardous waste, solid waste, or is exempted from regulation.
- **Standards for Generators of Hazardous Waste** (40 CFR Part 262) establishes the responsibilities of hazardous waste generators including obtaining an ID number, preparing a manifest, ensuring proper packaging and labeling, meeting standards for waste accumulation units, and recordkeeping and reporting requirements. Generators can accumulate hazardous waste for up to 90 days (or 180 days depending on the amount of waste generated) without obtaining a permit.
- **Land Disposal Restrictions** (LDRs) are regulations prohibiting the disposal of hazardous waste on land without prior treatment. Under the LDRs (40 CFR 268), materials must meet land disposal restriction (LDR) treatment standards prior to placement in a RCRA land disposal unit (landfill, land treatment unit, waste pile, or surface impoundment). Wastes subject to the LDRs include solvents, electroplating wastes, heavy metals, and acids. Generators of waste subject to the LDRs must provide notification of such to the designated TSD facility to ensure proper treatment prior to disposal.
- **Used Oil Management Standards** (40 CFR Part 279) impose management requirements affecting the storage, transportation,

burning, processing, and re-refining of the used oil. For parties that merely generate used oil, regulations establish storage standards. For a party considered a used oil marketer (one who generates and sells off-specification used oil directly to a used oil burner), additional tracking and paperwork requirements must be satisfied.

- **Tanks and Containers** used to store hazardous waste with a high volatile organic concentration must meet emission standards under RCRA. Regulations (40 CFR Part 264-265, Subpart CC) require generators to test the waste to determine the concentration of the waste, to satisfy tank and container emissions standards, and to inspect and monitor regulated units. These regulations apply to all facilities who store such waste, including generators operating under the 90-day accumulation rule.

- **Underground Storage Tanks** (USTs) containing petroleum and hazardous substance are regulated under Subtitle I of RCRA. Subtitle I regulations (40 CFR Part 280) contain tank design and release detection requirements, as well as financial responsibility and corrective action standards for USTs. The UST program also establishes increasingly stringent standards, including upgrade requirements for existing tanks, that must be met by 1998.

- **Boilers and Industrial Furnaces** (BIFs) that use or burn fuel containing hazardous waste must comply with strict design and operating standards. BIF regulations (40 CFR Part 266, Subpart H) address unit design, provide performance standards, require emissions monitoring, and restrict the type of waste that may be burned.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, responds to questions and distributes guidance regarding all RCRA regulations. The RCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Comprehensive Environmental Response, Compensation, And Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a 1980 law commonly known as Superfund, authorizes EPA to respond to releases, or threatened releases, of hazardous substances that may endanger public health, welfare, or the environment. CERCLA also enables EPA to force parties responsible for environmental contamination to clean it up or to reimburse the Superfund for response costs incurred by EPA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 revised various sections of CERCLA, extended the taxing authority for the Superfund, and created a free-standing law, SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

The CERCLA **hazardous substance release reporting regulations** (40 CFR Part 302) direct the person in charge of a facility to report to the National Response Center (NRC) any environmental release of a hazardous substance which exceeds a reportable quantity. Reportable quantities are defined and listed in 40 CFR § 302.4. A release report may trigger a response by EPA, or by one or more Federal or State emergency response authorities.

EPA implements **hazardous substance responses** according to procedures outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR Part 300). The NCP includes provisions for permanent cleanups, known as remedial actions, and other cleanups referred to as "removals." EPA generally takes remedial actions only at sites on the National Priorities List (NPL), which currently includes approximately 1300 sites. Both EPA and states can act at other sites; however, EPA provides responsible parties the opportunity to conduct removal and remedial actions and encourages community involvement throughout the Superfund response process.

EPA's RCRA/Superfund/UST Hotline, at (800) 424-9346, answers questions and references guidance pertaining to the Superfund program. The CERCLA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Emergency Planning And Community Right-To-Know Act

The Superfund Amendments and Reauthorization Act (SARA) of 1986 created the Emergency Planning and Community Right-to-Know Act (EPCRA, also known as SARA Title III), a statute designed to improve community access to information about chemical hazards and to facilitate the development of chemical emergency response plans by State and local governments. EPCRA required the establishment of State emergency response commissions (SERCs), responsible for coordinating certain emergency response activities and for appointing local emergency planning committees (LEPCs).

EPCRA and the EPCRA regulations (40 CFR Parts 350-372) establish four types of reporting obligations for facilities which store or manage specified chemicals:

- **EPCRA §302** requires facilities to notify the SERC and LEPC of the presence of any "extremely hazardous substance" (the list of such substances is in 40 CFR Part 355, Appendices A and B) if it has such substance in excess of the substance's threshold planning quantity, and directs the facility to appoint an emergency response coordinator.

- **EPCRA §304** requires the facility to notify the SERC and the LEPC in the event of a release exceeding the reportable quantity of a CERCLA hazardous substance or an EPCRA extremely hazardous substance.

- **EPCRA §§311 and 312** require a facility at which a hazardous chemical, as defined by the Occupational Safety and Health Act, is present in an amount exceeding a specified threshold to submit to the SERC, LEPC, and local fire department material safety data sheets (MSDSs) or lists of MSDSs and hazardous chemical inventory forms (also known as Tier I and II forms). This information helps the local government respond in the event of a spill or release of the chemical.

- **EPCRA §313** requires manufacturing facilities included in SIC codes 20 through 39, which have ten or more employees, and which manufacture, process, or use specified chemicals in amounts greater than threshold quantities, to submit an annual toxic chemical release report. This report, commonly known as the Form R, covers releases and transfers of toxic chemicals to various facilities and environmental media, and allows EPA to compile the national Toxic Release Inventory (TRI) database.

All information submitted pursuant to EPCRA regulations is publicly accessible, unless protected by a trade secret claim.

EPA's EPCRA Hotline, at (800) 535-0202, answers questions and distributes guidance regarding the emergency planning and community right-to-know regulations. The EPCRA Hotline operates weekdays from 8:30 a.m. to 7:30 p.m., EST, excluding Federal holidays.

Clean Water Act

The primary objective of the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act (CWA), is to restore and maintain the chemical, physical, and biological integrity of the nation's surface waters. Pollutants regulated under the CWA include "priority" pollutants, including various toxic pollutants; "conventional" pollutants, such as biochemical oxygen demand (BOD), total suspended solids (TSS), fecal coliform, oil and grease, and pH; and "non-conventional" pollutants, including any pollutant not identified as either conventional or priority.

The CWA regulates both direct and indirect discharges. The **National Pollutant Discharge Elimination System (NPDES)** program (CWA §402) controls direct discharges into navigable waters. Direct discharges or "point source" discharges are from sources such as pipes and sewers. NPDES permits, issued by either EPA or an authorized State (EPA has presently authorized forty States to administer the NPDES program), contain industry-specific, technology-based and/or water quality-based limits, and establish pollutant monitoring and reporting requirements. A facility that intends to discharge into the nation's waters must obtain a permit prior to initiating its discharge. A permit applicant must provide quantitative analytical data identifying the types of pollutants present in the facility's effluent. The permit will then set forth the conditions and effluent limitations under which a facility may make a discharge.

A NPDES permit may also include discharge limits based on Federal or State water quality criteria or standards, that were designed to protect designated uses of surface waters, such as supporting aquatic life or recreation. These standards, unlike the technological standards, generally do not take into account technological feasibility or costs. Water quality criteria and standards vary from State to State, and site to site, depending on the use classification of the receiving body of water. Most States follow EPA guidelines which propose aquatic life and human health criteria for many of the 126 priority pollutants.

Storm Water Discharges

In 1987 the CWA was amended to require EPA to establish a program to address **storm water discharges**. In response, EPA promulgated the NPDES storm water permit application regulations. Storm water discharge associated with industrial activity means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing or raw materials storage areas at an industrial plant (40 CFR 122.26(b)(14)).

These regulations require that facilities with the following storm water discharges apply for a NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

The term "storm water discharge associated with industrial activity" means a storm water discharge from one of 11 categories of industrial activity defined at 40 CFR 122.26. Six of the categories are defined by SIC codes while the other five are identified through narrative descriptions of the regulated industrial activity. If the primary SIC code of the facility is one of those identified in the regulations, the facility is subject to the storm water permit application requirements. If any activity at a facility is covered by one of the five narrative categories, storm water discharges from those areas where the activities occur are subject to storm water discharge permit application requirements.

Those facilities/activities that are subject to storm water discharge permit application requirements are identified below. To determine whether a particular facility falls within one of these categories, the regulation should be consulted.

Category i: Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

Category ii: Facilities classified as SIC 24-lumber and wood products (except wood kitchen cabinets); SIC 26-paper and allied products (except paperboard containers and products); SIC 28-chemicals and allied products (except drugs and paints); SIC 29-petroleum refining; and SIC 311-leather tanning and finishing.

Category iii: Facilities classified as SIC 10-metal mining; SIC 12-coal mining; SIC 13-oil and gas extraction; and SIC 14-nonmetallic mineral mining.

Category iv: Hazardous waste treatment, storage, or disposal facilities.

Category v: Landfills, land application sites, and open dumps that receive or have received industrial wastes.

Category vi: Facilities classified as SIC 5015-used motor vehicle parts; and SIC 5093-automotive scrap and waste material recycling facilities.

Category vii: Steam electric power generating facilities.

Category viii: Facilities classified as SIC 40-railroad transportation; SIC 41-local passenger transportation; SIC 42-trucking and warehousing (except public warehousing and storage); SIC 43-U.S. Postal Service; SIC 44-water transportation; SIC 45-transportation by air; and SIC 5171-petroleum bulk storage stations and terminals.

Category ix: Sewage treatment works.

Category x: Construction activities except operations that result in the disturbance of less than five acres of total land area.

Category xi: Facilities classified as SIC 20-food and kindred products; SIC 21-tobacco products; SIC 22-textile mill products; SIC 23-apparel related products; SIC 2434-wood kitchen cabinets manufacturing; SIC 25-furniture and fixtures; SIC 265-paperboard containers and boxes; SIC 267-converted paper and paperboard products; SIC 27-printing, publishing, and allied industries; SIC 283-drugs; SIC 285-paints, varnishes, lacquer, enamels, and allied products; SIC 30-rubber and plastics; SIC 31-leather and leather products (except leather and tanning and finishing); SIC 323-glass products; SIC 34-fabricated metal products (except fabricated structural metal); SIC 35-industrial and commercial machinery and computer equipment; SIC 36-electronic and other electrical equipment and components; SIC 37-transportation equipment (except ship and boat building and repairing); SIC 38-measuring, analyzing, and controlling instruments; SIC 39-miscellaneous manufacturing industries; and SIC 4221-4225-public warehousing and storage.

Pretreatment Program

Another type of discharge that is regulated by the CWA is one that goes to a publicly-owned treatment works (POTWs). The national **pretreatment program** (CWA §307(b)) controls the indirect discharge of pollutants to POTWs by "industrial users." Facilities regulated under §307(b) must meet certain pretreatment standards. The goal of the pretreatment program is to protect municipal wastewater treatment plants from damage that may occur when hazardous, toxic, or other wastes are discharged into a sewer system and to protect the quality of sludge generated by these plants. Discharges to a POTW are regulated primarily by the POTW itself, rather than the State or EPA.

EPA has developed technology-based standards for industrial users of POTWs. Different standards apply to existing and new sources within each category. "Categorical" pretreatment standards applicable to an industry on a nationwide basis are developed by EPA. In addition, another kind of pretreatment standard, "local limits," are developed by the POTW in order to assist the POTW in achieving the effluent limitations in its NPDES permit.

Regardless of whether a State is authorized to implement either the NPDES or the pretreatment program, if it develops its own program, it may enforce requirements more stringent than Federal standards.

EPA's Office of Water, at (202) 260-5700, will direct callers with questions about the CWA to the appropriate EPA office. EPA also maintains a bibliographic database of Office of Water publications which can be accessed through the Ground Water and Drinking Water resource center, at (202) 260-7786.

Safe Drinking Water Act

The Safe Drinking Water Act (SDWA) mandates that EPA establish regulations to protect human health from contaminants in drinking water. The law authorizes EPA to develop national drinking water standards and to create a joint Federal-State system to ensure compliance with these standards. The SDWA also directs EPA to protect underground sources of drinking water through the control of underground injection of liquid wastes.

EPA has developed primary and secondary drinking water standards under its SDWA authority. EPA and authorized States enforce the primary drinking water standards, which are, contaminant-specific concentration limits that apply to certain public drinking water supplies. Primary drinking water standards consist of maximum contaminant level goals (MCLGs), which are non-enforceable health-based goals, and maximum contaminant levels (MCLs), which are enforceable limits set as close to MCLGs as possible, considering cost and feasibility of attainment.

The SDWA **Underground Injection Control (UIC)** program (40 CFR Parts 144-148) is a permit program which protects underground sources of drinking water by regulating five classes of injection wells. UIC permits include design, operating, inspection, and monitoring requirements. Wells used to inject hazardous wastes must also comply with RCRA corrective action standards in order to be granted a RCRA permit, and must meet applicable RCRA land disposal restrictions standards. The UIC permit program is primarily State-enforced, since EPA has authorized all but a few States to administer the program.

The SDWA also provides for a Federally-implemented Sole Source Aquifer program, which prohibits Federal funds from being expended on projects that may contaminate the sole or principal source of drinking water for a given area, and for a State-implemented Wellhead Protection program, designed to protect drinking water wells and drinking water recharge areas.

EPA's Safe Drinking Water Hotline, at (800) 426-4791, answers questions and distributes guidance pertaining to SDWA standards. The Hotline operates from 9:00 a.m. through 5:30 p.m., EST, excluding Federal holidays.

Toxic Substances Control Act

The Toxic Substances Control Act (TSCA) granted EPA authority to create a regulatory framework to collect data on chemicals in order to evaluate, assess, mitigate, and control risks which may be posed by their manufacture, processing, and use. TSCA provides a variety of control methods to prevent chemicals from posing unreasonable risk.

TSCA standards may apply at any point during a chemical's life cycle. Under TSCA §5, EPA has established an inventory of chemical substances. If a chemical is not already on the inventory, and has not been excluded by TSCA, a premanufacture notice (PMN) must be submitted to EPA prior to manufacture or import. The PMN must identify the chemical and provide available information on health and environmental effects. If available data are not sufficient to evaluate the chemical's effects, EPA can impose restrictions pending the development of information on its health and environmental effects. EPA can also restrict significant new uses of chemicals based upon factors such as the projected volume and use of the chemical.

Under TSCA §6, EPA can ban the manufacture or distribution in commerce, limit the use, require labeling, or place other restrictions on chemicals that pose unreasonable risks. Among the chemicals EPA regulates under §6 authority are asbestos, chlorofluorocarbons (CFCs), and polychlorinated biphenyls (PCBs).

EPA's TSCA Assistance Information Service, at (202) 554-1404, answers questions and distributes guidance pertaining to Toxic Substances Control Act standards. The Service operates from 8:30 a.m. through 4:30 p.m., EST, excluding Federal holidays.

Clean Air Act

The Clean Air Act (CAA) and its amendments, including the Clean Air Act Amendments (CAAA) of 1990, are designed to “protect and enhance the nation's air resources so as to promote the public health and welfare and the productive capacity of the population.” The CAA consists of six sections, known as Titles, which direct EPA to establish national standards for ambient air quality and for EPA and the States to implement, maintain, and enforce these standards through a variety of mechanisms. Under the CAAA, many facilities will be required to obtain permits for the first time. State and local governments oversee, manage, and enforce many of the requirements of the CAAA. CAA regulations appear at 40 CFR Parts 50-99.

Pursuant to Title I of the CAA, EPA has established national ambient air quality standards (NAAQSs) to limit levels of "criteria pollutants," including carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Geographic areas that meet NAAQSs for a given pollutant are classified as attainment areas; those that do not meet NAAQSs are classified as non-attainment areas. Under §110 of the CAA, each State must develop a State Implementation Plan (SIP) to identify sources of air pollution and to determine what reductions are required to meet Federal air quality standards.

Title I also authorizes EPA to establish New Source Performance Standards (NSPSs), which are nationally uniform emission standards for new stationary sources falling within particular industrial categories. NSPSs are based on the pollution control technology available to that category of industrial source but allow the affected industries the flexibility to devise a cost-effective means of reducing emissions.

Under Title I, EPA establishes and enforces National Emission Standards for Hazardous Air Pollutants (NESHAPs), nationally uniform standards oriented towards controlling particular hazardous air pollutants (HAPs). Title III of the CAAA further directed EPA to develop a list of sources that emit any of 189 HAPs, and to develop regulations for these categories of sources. To date EPA has listed 174 categories and developed a schedule for the establishment of emission standards. The emission standards will be developed for both new and existing sources based on "maximum achievable control technology" (MACT). The MACT is defined as the control technology achieving the maximum degree of reduction in the emission of the HAPs, taking into account cost and other factors.

Title II of the CAA pertains to mobile sources, such as cars, trucks, buses, and planes. Reformulated gasoline, automobile pollution control devices, and vapor recovery nozzles on gas pumps are a few of the mechanisms EPA uses to regulate mobile air emission sources.

Title IV establishes a sulfur dioxide emissions program designed to reduce the formation of acid rain. Reduction of sulfur dioxide releases will be obtained by granting to certain sources limited emissions allowances, which, beginning in 1995, will be set below previous levels of sulfur dioxide releases.

Title V of the CAAA of 1990 created a permit program for all "major sources" (and certain other sources) regulated under the CAA. One purpose of the operating permit is to include in a single document all air emissions requirements that apply to a given facility. States are developing the permit programs in accordance with guidance and regulations from EPA. Once a State program is approved by EPA, permits will be issued and monitored by that State.

Title VI is intended to protect stratospheric ozone by phasing out the manufacture of ozone-depleting chemicals and restrict their use and distribution. Production of Class I substances, including 15 kinds of chlorofluorocarbons (CFCs), will be phased out entirely by the year 2000, while certain hydrochlorofluorocarbons (HCFCs) will be phased out by 2030.

EPA's Control Technology Center, at (919) 541-0800, provides general assistance and information on CAA standards. The Stratospheric Ozone Information Hotline, at (800) 296-1996, provides general information about regulations promulgated under Title VI of the CAA, and EPA's EPCRA Hotline, at (800) 535-0202, answers questions about accidental release prevention under CAA §112(r). In addition, the Technology Transfer Network Bulletin Board System (modem access (919) 541-5742)) includes recent CAA rules, EPA guidance documents, and updates of EPA activities.

X.B. Industry-Specific Requirements

Clean Water Act (CWA)

The Clean Water Act regulates the amount of chemicals/toxins released by industries via direct and indirect wastewater/effluent discharges. Regulations developed to implement this Act establish effluent guidelines and standards for different industries. These standards usually set concentration-based limits on the discharge of a given chemical by any one facility. If a facility is discharging directly into a body of water, it must obtain a National Pollution Discharge Elimination System (NPDES) permit. If a facility is discharging to a publicly owned treatment works (POTW), it must adhere to specified pretreatment standards. The following regulations are applicable to the nonferrous metals industry.

The Metal Molding and Casting Point Source Category (40 CFR Part 464) is applicable to wastewater from these operations:

- Aluminum Casting
- Copper Casting
- Zinc Casting.

The Aluminum Forming Point Source Category (40 CFR Part 467) is applicable to wastewater from these operations:

- Rolling with Neat Oils
- Rolling with Emulsions
- Extrusion
- Forging
- Drawing with Neat Oils
- Drawing with Emulsions.

The Copper Forming Point Source Category (40 CFR Part 468) is applicable to wastewater from these operations:

- Copper Forming
- Beryllium Copper Forming.

The Nonferrous Metals Forming and Metal Powders Point Source Category (40 CFR Part 471) is applicable to wastewater from these operations:

- Lead-Tin-Bismuth Forming
- Magnesium Forming
- Nickel-Cobalt Forming
- Precious Metals Forming
- Refractory Metals Forming
- Titanium Forming
- Uranium Copper Forming
- Zinc Forming
- Zirconium-Hafnium Forming
- Metals Powders.

Clean Air Act (CAA)

The primary regulatory mechanism used to implement source emission requirements under the CAA is State Implementation Plans (SIPs). SIPs provide the States with the authority and discretion to establish a strategy to attain primary NAAQS levels. These requirements can be uniform for all sources or specifically tailored for individual sources. States are not allowed to adopt less stringent standards than NAAQS. Of particular concern to primary and secondary smelters is the fact that SIPs must include steps to reduce SO_2 source emission levels in nonattainment areas. SIPs must demonstrate that nonattainment areas, designated prior to the 1990 CAA Amendments, will achieve compliance with NAAQS as soon as possible and no later than November 1995. For nonattainment areas designated after the 1990 Amendments, compliance is also required five years after the nonattainment designation. Sections 172(c)(5) or 191 and 192 require the imposition of a construction moratorium on new or modified sources of SO_2 in nonattainment areas without a fully approved SIP until the SIP includes appropriate permit requirements.

- NAAQS for sulfur dioxide, nitrogen dioxide, and hydrocarbons that frequently affect the smelting process are found in 40 CFR Part 50.

Also important to primary and secondary smelters is the list of 189 hazardous air pollutants (HAPs) established in the CAA, as amended in 1990. Under the CAA Amendments, Congress required EPA to identify major and area source categories associated with the emission of one or more listed HAPs. To date, EPA has identified 174 categories of sources. Congress also required EPA to promulgate emission standards for listed source categories within 10 years of the enactment of the CAA Amendments (by November 15, 2000). These standards are known as National Emission Standards for Hazardous Air Pollutants (NESHAPs).

In addition to general CAA requirements, specific standards apply to primary and secondary lead smelters, primary copper smelters, primary zinc smelters, and primary aluminum reduction plants.

The Standards of Performance for Secondary Lead Smelters (40 CFR Part 60, Subpart L) are applicable to pot furnaces of more than 250 kg charging capacity, blast furnaces, and reverberatory furnaces that commence construction after June 11, 1973.

These standards require secondary lead smelters to control discharge to the point that:

- Particulate matter emissions do not exceed 50 mg/dscm, and
- Visible emissions do not exhibit 20 percent opacity or greater.

In addition, these standards require that no owner or operator discharge any gases exhibiting 10 percent opacity or greater from any pot furnace on and after the date of performance testing.

The Standards of Performance for Primary Copper Smelters (40 CFR Part 60, Subpart P) are applicable to dryers, roasters, smelting furnaces, and copper converters that commence construction or modification after October 16, 1974.

These standards require that dryers control discharge to the point that particulate matter emissions do not exceed 50 mg/dscm. With respect to roasters, smelting furnaces, and copper converters, no gases containing sulfur dioxide in excess of 0.065 percent by volume are to be emitted. An exception is made in the case of reverberatory smelting furnaces, which are exempt during periods when the total smelter charge at the primary copper smelter contains a high volume of volatile impurities (more than 0.2 weight percent arsenic, 0.1 weight percent antimony, 4.5 weight percent lead, or 5.5 weight percent zinc, on a dry basis).

In addition, these standards require the owner or operator of a dryer of an affected facility using a sulfuric acid plant to control discharges to the point that visible emissions do not exhibit greater than 20 percent opacity on and after the date of performance testing.

The Standards of Performance for Primary Zinc Smelters (40 CFR Part 60, Subpart Q) are applicable to roaster and sintering machine facilities in primary zinc smelters that commence construction or modification after October 16, 1974.

These standards require sintering machines to control discharges to the point that on and after the date of performance testing:

- No gases containing particulate matter in excess of 50 mg/dscm are emitted, and
- Emissions do not exhibit an opacity of greater than 20 percent.

In addition, no roaster may emit gases containing sulfur dioxide in excess of 0.065 percent by volume. The provision also stipulates that any sintering machine that eliminates more than 10 percent of the sulfur initially contained in the zinc sulfide ore concentrates will be considered a roaster. For affected primary zinc smelting facilities that use a sulfuric acid plant, no emissions greater than 20 percent opacity are allowed on and after the date of performance testing. In addition,

- No gases containing more than 50 mg/dscm may be emitted, and
- Visible emissions may not exhibit greater than 20 percent opacity.

In addition, sintering machines, electric smelting furnaces, and converters must control discharges to the point that no gases containing greater than 0.065 percent sulfur dioxide are emitted on and after the date of performance testing.

For affected primary lead smelting facilities that use a sulfuric acid plant, no visible emissions greater than 20 percent opacity are allowed on and after the date of performance testing.

The Standards of Performance for Primary Aluminum Reduction Plants (40 CFR Part 60, Subpart S) are applicable to potroom groups and anode bake plants that commence construction after October 23, 1974.

The standards require that on and after the date of performance testing affected facilities control discharges to the point that no gases containing total fluorides are emitted on and after the date of performance testing in excess of:

- 1.0 kg/Mg of aluminum produced for potroom groups at Soderberg plants
- 0.95 kg/Mg of aluminum produced for potroom groups at prebake plants
- 0.05 kg/Mg of aluminum equivalent for anode bake plants.

Emissions slightly above these levels from Soderberg and prebake plants may be considered to be in compliance if the owner/operator demonstrates that exemplary operation and maintenance procedures are used.

In addition, on and after the date of performance testing, facilities must control discharges to the point that no emissions are discharged exhibiting greater than:

- 10 percent opacity from any potlines
- 20 percent opacity from any anode bake plant.

All of the above standards (Subparts L, P, Q, R, S) require monitoring and testing methods and procedures specific to the affected facilities.

The National Emission Standards for Hazardous Air Pollutants from Secondary Lead Smelting (40 CFR Part 63, Subpart X) are applicable to secondary lead smelters that use blast, reverberatory, rotary, or electric smelting furnaces to recover lead metal from scrap lead, primarily used lead-acid automotive batteries. These standards limit HAP emissions (lead compounds and total hydrocarbons from secondary lead smelting furnaces, refining kettles, agglomerating furnaces, dryers and fugitive dust sources, but do not affect emissions from lead smelters, lead refiners, or lead remelters.

These standards require secondary lead smelters to control:

- Process Emission sources by limiting lead compounds (metal HAP) and total hydrocarbons (organic HAP) to certain levels depending upon furnace type;

- Process Fugitive Emission Sources by requiring the use of enclosure-type hoods or containment buildings which are ventilated to control devices; and

- Fugitive Dust Sources by requiring the development of facility specific standard operating procedures.

In addition to these standards certain compliance testing, monitoring, and recordkeeping requirements also apply to these facilities. New or reconstructed sources (construction commenced after June 9, 1994) must meet these standards by June 23, 1995 or upon start up of operations. Existing secondary lead smelters have until June 23, 1997 to meet them.

Resource Conservation and Recovery Act (RCRA)

RCRA was passed in 1976, as an amendment to the Solid Waste Disposal Act, to ensure that solid wastes are managed in an environmentally sound manner. A material is classified under RCRA as a hazardous waste if the material meets the definition of solid waste (40 CFR 261.2), and that solid waste material exhibits one of the characteristics of a hazardous waste (40 CFR 261.20-24) or is specifically listed as a hazardous waste (40 CFR 261.31-33). A material defined as a hazardous waste may then be subject to Subtitle C generator (40 CFR 262), transporter (40 CFR 263), and treatment, storage, and disposal facility (40 CFR 254 and 265) requirements. The nonferrous metals industry must be concerned with the regulations addressing all these.

The greatest quantities of RCRA listed waste and characteristically hazardous waste that are generated by nonferrous metal industries are identified in Exhibit 24. For more information on identifying RCRA hazardous waste, refer to 40 CFR Part 261.

Exhibit 24
Hazardous Wastes Relevant to the Nonferrous Metal Industry

EPA Hazardous Waste No.	Hazardous Waste
D004 (arsenic) D005 (barium) D006 (cadmium) D007 (chromium) D008 (lead) D009 (mercury) D010 (selenium) D011 (silver) D035 (methyl ethyl ketone) D039 (tetra-chloroethylene) D040 (trichloro-ethylene)	Wastes which are hazardous due to the characteristic of toxicity for each of the constituents.
F001	Halogenated solvents used in degreasing: tetrachloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; all spent solvent mixtures/blends used in degreasing containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F002	Spent halogenated solvents; tetrachloroethylene, methylene chloride, trichlorethylene, 1,1,1-trichloroethane chlorobenzene, 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, trichlorofluoromethane, and 1,1,2-trichloroethane; all spent solvent mixtures/blends containing, before use, one or more of the above halogenated solvents or those listed in F001, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.

F003	Spent non-halogenated solvents: xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexanone, and methanol; all spent solvent mixtures/blends containing, before use, only the above spent non-halogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above non-halogenated solvents, and, a total of 10% or more (by volume) of one of those solvents listed in F001, F002, F004, F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F004	Spent non-halogenated solvents: cresols and cresylic acid, and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of 10% or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F005	Spent non-halogenated solvents: toluene, methy ethyl ketone, carbon disulfide, isobutanol, pyridine, benzene, 2-ethoxyethanol, and 2-nitropropane; all spent solvent mixtures/blends containing, before use, a total of 10% or more (by volume) of one or more of the above non-halogenated solvents or those solvents listed in F001, F002, or F004; and still bottoms from the recovery of these spent solvents and spent solvents mixtures.

Exhibit 24
Hazardous Wastes Relevant to the Nonferrous Metal Industry

EPA Hazardous Waste No.	Hazardous Waste
K064	Acid plant blowdown slurry/sludge resulting from the thickening of blowdown slurry from primary copper production.
K065	Surface impoundment solids contained in and dredged from surface impoundments at primary lead smelting facilities.
K066	Sludge from treatment of process wastewater and/or acid plant blowdown from primary zinc production.
K088	Spent potliners from primary aluminum reduction.
K069	Emission control dust/sludge from secondary lead smelting. (Note: this listing is stayed administratively for sludge generated from secondary acid scrubber systems. The stay will remain in effect until further administrative action is taken. If EPA takes further action effecting this stay, EPA will publish a notice of the action in the *Federal Register.*)
K100	Waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting.

One set of RCRA standards that is of particular relevance to nonferrous metals industries that recycle metals and metal-containing materials is 40 CFR Part 266, Subpart H which lays out the requirements for boilers or industrial furnaces that burn hazardous waste for energy recovery or destruction, or processing for materials recovery or as an ingredient in general.

X.C. Pending and Proposed Regulatory Requirements

Clean Air Act (CAA)

In addition to the CAA requirements discussed above, EPA is currently working on several regulations that will directly affect the nonferrous metals industry. Many proposed standards will limit the air emissions from various industries by proposing Maximum Achievable Control Technology (MACT) based performance standards that will set limits on emissions based upon concentrations in the waste stream. Various potential standards are described below.

Primary Lead Smelting

Primary lead smelters are a major source of hazardous air pollutants (HAPs). Potential emissions include compounds of lead and other metallic HAPs as well as organic HAPs.

The proposed regulation will be a MACT-based performance standard that will set limits on certain emissions based upon concentrations in the waste stream . The legal deadline is November 15, 1997.

When promulgated, these standards will regulate an industry comprised of two companies which operate three facilities in two states.

Primary Copper Smelting

Primary copper smelters are known to emit a number of HAPs listed in Section 112 of the Clean Air Act Amendments of 1990 (CAAA). While most smelters have extensive control systems for oxides of sulfur and HAPs, fugitive emissions may cause smelters to exceed major source standards.

EPA is required to promulgate 50 percent of the source categories listed in Section 112(e) CAAA by November 15, 1997. EPA plans to promulgate emissions standards for several HAPs effecting the primary copper industry by August 30, 1995

Primary Aluminum

Primary aluminum processors may be a major source of one or more HAPs. As a consequence, a MACT-based regulatory program is being developed by EPA.

The MACT based performance standards are expected to be proposed in October 1995 and to be promulgated by November 15, 1997.

Secondary Aluminum

EPA has determined that the secondary aluminum industry may reasonably be anticipated to emit several of the 189 HAPs listed in Section 112(b) of the CAA. As a result, the industry is included on the initial list of HAP emitting categories and will be on the list of categories schedule for the development of a regulatory program.

The standards will be MACT-based performance standards and are expected to be proposed in April 1996. The legal deadline for the promulgation of final standards is November 15, 1997.

Resource Conservation and Recovery Act (RCRA)

As part of EPA's groundwater protection strategy, RCRA prohibits the land disposal of most hazardous wastes until they meet a waste-specific treatment standard. While most hazardous wastes have already been assigned treatment standards, EPA must still promulgate two additional rule makings to address newly listed wastes and to make changes to the land disposal restrictions (LDR) program.

When finalized, the Phase III LDR rulemaking will establish treatment standards for some newly listed wastes and will mandate RCRA equivalent treatment be performed upon certain characteristically hazardous wastes that are injected into UIC wells under the Safe Drinking Water Act (SDWA) or managed in Subtitle D surface impoundments prior to discharge pursuant to the Clean Water Act (CWA). By consent decree, EPA must promulgate the final rule for Phase III by January 1996.

Of particular significance to the nonferrous metals industries, Phase III will restrict the land disposal of spent aluminum potliners, K088. Once the prohibition for these wastes becomes effective, the spent potliners would need to meet numeric treatment levels for at least 27 particular hazardous constituents commonly found in K088.

Phase IV will similarly restrict other newly listed or identified wastes from land disposal and create influent treatment standards to mitigate the impact of sludges, leaks, and air emissions from surface impoundments that have managed decharacterized wastes. Among those wastes that will become subject to prohibitions are characteristically hazardous mining wastes that were once excluded from regulation by the Bevill exemptions of §261.4(b)(10). In addition, Phase IV will also change the treatment standards applicable to those wastes that are prohibited from land disposal because they exhibit the characteristic of toxicity for a metal constituent.

XI. COMPLIANCE AND ENFORCEMENT PROFILE

Background

To date, EPA has focused much of its attention on measuring compliance with specific environmental statutes. This approach allows the Agency to track compliance with the Clean Air Act, the Resource Conservation and Recovery Act, the Clean Water Act, and other environmental statutes. Within the last several years, the Agency has begun to supplement single-media compliance indicators with facility-specific, multimedia indicators of compliance. In doing so, EPA is in a better position to track compliance with all statutes at the facility level, and within specific industrial sectors.

A major step in building the capacity to compile multimedia data for industrial sectors was the creation of EPA's Integrated Data for Enforcement Analysis (IDEA) system. IDEA has the capacity to "read into" the Agency's single-media databases, extract compliance records, and match the records to individual facilities. The IDEA system can match Air, Water, Waste, Toxics/Pesticides/EPCRA, TRI, and Enforcement Docket records for a given facility, and generate a list of historical permit, inspection, and enforcement activity. IDEA also has the capability to analyze data by geographic area and corporate holder. As the capacity to generate multimedia compliance data improves, EPA will make available more in-depth compliance and enforcement information. Additionally, sector-specific measures of success for compliance assistance efforts are under development.

Compliance and Enforcement Profile Description

Using inspection, violation, and enforcement data from the IDEA system, this section provides information regarding the historical compliance and enforcement activity of this sector. In order to mirror the facility universe reported in the Toxic Chemical Profile, the data reported within this section consists of records only from the TRI reporting universe. With this decision, the selection criteria are consistent across sectors with certain exceptions. For the sectors that do not normally report to the TRI program, data have been provided from EPA's Facility Indexing System (FINDS) which tracks facilities in all media databases. Please note, in this section, EPA does not attempt to define the actual number of facilities that fall within each sector. Instead, the section portrays the records of a subset of facilities within the sector that are well defined within EPA databases.

As a check on the relative size of the full sector universe, most notebooks contain an estimated number of facilities within the sector according to the Bureau of Census (See Section II). With sectors dominated by small businesses, such as metal finishers and printers, the reporting universe within the EPA databases may be small in comparison to Census data. However, the group selected for inclusion in this data analysis section should be consistent with this sector's general make-up.

Following this introduction is a list defining each data column presented within this section. These values represent a retrospective summary of inspections and enforcement actions, and solely reflect EPA, State, and local compliance assurance activities that have been entered into EPA databases. To identify any changes in trends, the EPA ran two data queries, one for the past five calendar years (August 10, 1990 to August 9, 1995) and the other for the most recent twelve-month period (August 10, 1994 to August 9, 1995). The five-year analysis gives an average level of activity for that period for comparison to the more recent activity.

Because most inspections focus on single-media requirements, the data queries presented in this section are taken from single media databases. These databases do not provide data on whether inspections are State/local or EPA-led. However, the table breaking down the universe of violations does give the reader a crude measurement of the EPA's and States' efforts within each media program. The presented data illustrate the variations across regions for certain sectors.[2] This variation may be attributable to State/local data entry variations, specific geographic concentrations, proximity to population centers, sensitive ecosystems, highly toxic chemicals used in production, or historical noncompliance. Hence, the exhibited data do not rank regional performance or necessarily reflect which regions may have the most compliance problems.

Compliance and Enforcement Data Definitions

General Definitions

Facility Indexing System (FINDS) -- this system assigns a common facility number to EPA single-media permit records. The FINDS identification number allows EPA to compile and review all permit,

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[2] EPA Regions include the following States: I (CT, MA, ME, RI, NH, VT); II (NJ, NY, PR, VI); III (DC, DE, MD, PA, VA, WV); IV (AL, FL, GA, KY, MS, NC, SC, TN); V (IL, IN, MI, MN, OH, WI); VI (AR, LA, NM, OK, TX); VII (IX KS, MO, NE); VIII (CO, MT, ND, SD, UT, WY); IX (AZ, CA, HI, NV, Pacific Trust Territories); 10 (AK, ID, OR, WA).

compliance, enforcement, and pollutant release data for any given regulated facility.

Integrated Data for Enforcement Analysis (IDEA) -- is a data integration system that can retrieve information from the major EPA program office databases. IDEA uses the FINDS identification number to "glue together" separate data records from EPA's databases. This is done to create a "master list" of data records for any given facility. Some of the data systems accessible through IDEA are: AIRS (Air Facility Indexing and Retrieval System, Office of Air and Radiation), PCS (Permit Compliance System, Office of Water), RCRIS (Resource Conservation and Recovery Information System, Office of Solid Waste), NCDB (National Compliance Data Base, Office of Prevention, Pesticides, and Toxic Substances), CERCLIS (Comprehensive Environmental and Liability Information System, Superfund), and TRIS (Toxic Release Inventory System). IDEA also contains information from outside sources such as Dun and Bradstreet and the Occupational Safety and Health Administration (OSHA). Most data queries displayed in notebook Sections IV and VII were conducted using IDEA.

Data Table Column Heading Definitions

Facilities in Search -- are based on the universe of TRI reporters within the listed SIC code range. For industries not covered under TRI reporting requirements, the notebook uses the FINDS universe for executing data queries. The SIC code range selected for each search is defined by each notebook's selected SIC code coverage described in Section II.

Facilities Inspected --- indicates the level of EPA and State agency facility inspections for the facilities in this data search. These values show what percentage of the facility universe is inspected in a 12 or 60 month period. This column does not count non-inspectional compliance activities such as the review of facility-reported discharge reports.

Number of Inspections -- measures the total number of inspections conducted in this sector. An inspection event is counted each time it is entered into a single media database.

Average Time Between Inspections -- provides an average length of time, expressed in months, that a compliance inspection occurs at a facility within the defined universe.

Facilities with One or More Enforcement Actions -- expresses the number of facilities that were party to at least one enforcement action within the defined time period. This category is broken down further into Federal and State actions. Data are obtained for administrative, civil/judicial, and criminal enforcement actions. Administrative actions include Notices of Violation (NOVs). A facility with multiple enforcement actions is only counted once in this column (facility with 3 enforcement actions counts as 1). All percentages that appear are referenced to the number of facilities inspected.

Total Enforcement Actions -- describes the total number of enforcement actions identified for an industrial sector across all environmental statutes. A facility with multiple enforcement actions is counted multiple times (a facility with 3 enforcement actions counts as 3).

State Lead Actions -- shows what percentage of the total enforcement actions are taken by State and local environmental agencies. Varying levels of use by States of EPA data systems may limit the volume of actions accorded State enforcement activity. Some States extensively report enforcement activities into EPA data systems, while other States may use their own data systems.

Federal Lead Actions -- shows what percentage of the total enforcement actions are taken by the U.S. EPA. This value includes referrals from State agencies. Many of these actions result from coordinated or joint State/Federal efforts.

Enforcement to Inspection Rate -- expresses how often enforcement actions result from inspections. This value is a ratio of enforcement actions to inspections, and is presented for comparative purposes only. This measure is a rough indicator of the relationship between inspections and enforcement. This measure simply indicates historically how many enforcement actions can be attributed to inspection activity. Related inspections and enforcement actions under the Clean Water Act (PCS), the Clean Air Act (AFS) and the Resource Conservation and Recovery Act (RCRA) are included in this ratio. Inspections and actions from the TSCA/FIFRA/EPCRA database are not factored into this ratio because most of the actions taken under these programs are not the result of facility inspections. This ratio does not account for enforcement actions arising from non-inspection compliance monitoring activities (e.g., self-reported water discharges) that can result in enforcement action within the CAA, CWA and RCRA.

Facilities with One or More Violations Identified -- indicates the number and percentage of inspected facilities having a violation identified in one of the following data categories: In Violation or

Significant Violation Status (CAA); Reportable Noncompliance, Current Year Noncompliance, Significant Noncompliance (CWA); Noncompliance and Significant Noncompliance (FIFRA, TSCA, and EPCRA); Unresolved Violation and Unresolved High Priority Violation (RCRA). The values presented for this column reflect the extent of noncompliance within the measured time frame, but do not distinguish between the severity of the noncompliance. Percentages within this column can exceed 100 percent because facilities can be in violation status without being inspected. Violation status may be a precursor to an enforcement action, but does not necessarily indicate that an enforcement action will occur.

Media Breakdown of Enforcement Actions and Inspections -- four columns identify the proportion of total inspections and enforcement actions within EPA Air, Water, Waste, and TSCA/FIFRA/EPCRA databases. Each column is a percentage of either the "Total Inspections," or the "Total Actions" column.

XI.A. Nonferrous Metals Industry Compliance History

Exhibit 25 presents enforcement and compliance information specific to SIC 33, the nonferrous metals industry (information was not available beyond the two-digit SIC level). As indicated in this exhibit, Region 4 conducted the largest number of inspections in this industry, and nearly all of Regions 4's enforcement actions are also state-lead. The numbers in this exhibit do not necessarily represent the geographic location of the industry's primary and secondary processors. This is because the number facilities and inspections represents all SIC 33 facilities and not just SIC 333 and 334 facilities.

Exhibit 25

Five Year Enforcement and Compliance Summary for the Nonferrous Metals Industry

A	B	C	D	E	F	G	H	I	J
Nonferrous Metals SIC 33	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/one or more Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Region I	67	35	144	28	13	21	38%	62%	0.15
Region II	71	54	362	12	25	89	83%	17%	0.25
Region III	77	54	447	10	20	69	80%	20%	0.15
Region IV	136	92	870	9	22	65	86%	14%	0.08
Region V	270	126	632	26	24	66	77%	23%	0.10
Region VI	72	40	205	21	13	40	52%	48%	0.20
Region VII	43	23	156	17	8	17	59%	41%	0.11
Region VIII	17	10	56	18	4	15	67%	33%	0.27
Region IX	71	24	69	62	7	16	81%	19%	0.23
Region X	20	16	156	8	9	72	85%	15%	0.46
Total/Average	844	474	3,097	16	145	470	76%	24%	0.15

XI.B. Comparison of Enforcement Activity Between Selected Industries

Exhibits 26-29 provide enforcement and compliance information for selected industries. The nonferrous metals industry (all of SIC 33) compromises the 4th largest number of facilities tracked by EPA across the selected industries, and the 5th largest number of facilities inspected. However it has the 3rd largest number of inspections and 2nd largest number of enforcement actions. For this industry, RCRA inspections comprise over 39 percent of all inspections conducted, while CWA inspections account for 23 percent and CAA inspections account for 34 percent. The fairly high CWA inspection rate and low CAA inspection rate seem to be in conflict with the importance of air emissions in the primary and secondary nonferrous metals processing industry; however this may be due to the fact that numbers represent the entire SIC 33 and not the more specific three-digit SIC 333 and 334 level.

Exhibit 26
Five Year Enforcement and Compliance Summary for Selected Industries

A	B	C	D	E	F	G	H	I	J
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Average Number of Months Between Inspections	Facilities w/One or More Enforcement Actions	Total Enforcement Actions	State Lead Actions	Federal Lead Actions	Enforcement to Inspection Rate
Metal Mining	873	339	1,519	34	67	155	47%	53%	0.10
Non-metallic Mineral Mining	1,143	631	3,422	20	84	192	76%	24%	0.06
Lumber and Wood	464	301	1,891	15	78	232	79%	21%	0.12
Furniture	293	213	1,534	11	34	91	91%	9%	0.06
Rubber and Plastic	1,665	739	3,386	30	146	391	78%	22%	0.12
Stone, Clay, and Glass	468	268	2,475	11	73	301	70%	30%	0.12
Nonferrous Metals	844	474	3,097	16	145	470	76%	24%	0.15
Fabricated Metal	2,346	1,340	5,509	26	280	840	80%	20%	0.15
Electronics/Computers	405	222	777	31	68	212	79%	21%	0.27
Motor Vehicle Assembly	598	390	2,216	16	81	240	80%	20%	0.11
Pulp and Paper	306	265	3,766	5	115	502	78%	22%	0.13
Printing	4,106	1,035	4,723	52	176	514	85%	15%	0.11
Inorganic Chemicals	548	298	3,034	11	99	402	76%	24%	0.13
Organic Chemicals	412	316	3,864	6	152	726	66%	34%	0.19
Petroleum Refining	156	145	3,257	3	110	797	66%	34%	0.25
Iron and Steel	374	275	3,555	6	115	499	72%	28%	0.14
Dry Cleaning	933	245	633	88	29	103	99%	1%	0.16

Exhibit 27
One Year Enforcement and Compliance Summary for Selected Industries

A	**B**	**C**	**D**	**E**		**F**		**G**	**H**
Industry Sector	Facilities in Search	Facilities Inspected	Number of Inspections	Facilities w/One or More Violations		Facilities w/One or More Enforcement Actions		Total Enforcement Actions	Enforcement to Inspection Rate
				Number	Percent*	Number	Percent*		
Metal Mining	873	114	194	82	72%	16	14%	24	0.13
Non-metallic Mineral Mining	1,143	253	425	75	30%	28	11%	54	0.13
Lumber and Wood	464	142	268	109	77%	18	13%	42	0.15
Furniture	293	160	113	66	41%	3	2%	5	0.04
Rubber and Plastic	1,665	271	435	289	107%	19	7%	59	0.14
Stone, Clay, and Glass	468	146	330	116	79%	20	14%	66	0.20
Nonferrous Metals	844	202	402	282	140%	22	11%	72	0.18
Fabricated Metal	2,346	477	746	525	110%	46	10%	114	0.15
Electronics/Computers	405	60	87	80	133%	8	13%	21	0.24
Motor Vehicle Assembly	598	169	284	162	96%	14	8%	28	0.10
Pulp and Paper	306	189	576	162	86%	28	15%	88	0.15
Printing	4,106	397	676	251	63%	25	6%	72	0.11
Inorganic Chemicals	548	158	427	167	106%	19	12%	49	0.12
Organic Chemicals	412	195	545	197	101%	39	20%	118	0.22
Petroleum Refining	156	109	437	109	100%	39	36%	114	0.26
Iron and Steel	374	167	488	165	99%	20	12%	46	0.09
Dry Cleaning	933	80	111	21	26%	5	6%	11	0.10

*Percentages in Columns E and F are based on the number of facilities inspected (Column C). Percentages can exceed 100% because violations and actions can occur without a facility inspection.

Exhibit 28
Five Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other*	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	339	1,519	155	35%	17%	57%	60%	6%	14%	1%	9%
Non-metallic Mineral Mining	631	3,422	192	65%	46%	31%	24%	3%	27%	<1%	4%
Lumber and Wood	301	1,891	232	31%	21%	8%	7%	59%	67%	2%	5%
Furniture	293	1,534	91	52%	27%	1%	1%	45%	64%	1%	8%
Rubber and Plastic	739	3,386	391	39%	15%	13%	7%	44%	68%	3%	10%
Stone, Clay and Glass	268	2,475	301	45%	39%	15%	5%	39%	51%	2%	5%
Nonferrous Metals	474	3,097	470	36%	22%	22%	13%	38%	54%	4%	10%
Fabricated Metal	1,340	5,509	840	25%	11%	15%	6%	56%	76%	4%	7%
Electronics/ Computers	222	777	212	16%	2%	14%	3%	66%	90%	3%	5%
Motor Vehicle Assembly	390	2,216	240	35%	15%	9%	4%	54%	75%	2%	6%
Pulp and Paper	265	3,766	502	51%	48%	38%	30%	9%	18%	2%	3%
Printing	1,035	4,723	514	49%	31%	6%	3%	43%	62%	2%	4%
Inorganic Chemicals	302	3,034	402	29%	26%	29%	17%	39%	53%	3%	4%
Organic Chemicals	316	3,864	726	33%	30%	16%	21%	46%	44%	5%	5%
Petroleum Refining	145	3,237	797	44%	32%	19%	12%	35%	52%	2%	5%
Iron and Steel	275	3,555	499	32%	20%	30%	18%	37%	58%	2%	5%
Dry Cleaning	245	633	103	15%	1%	3%	4%	83%	93%	<1%	1%

* Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substances and Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.

Exhibit 29
One Year Inspection and Enforcement Summary by Statute for Selected Industries

Industry Sector	Number of Facilities Inspected	Total Inspections	Enforcement Actions	Clean Air Act		Clean Water Act		Resource Conservation and Recovery Act		FIFRA/TSCA/ EPCRA/Other	
				% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions	% of Total Inspections	% of Total Actions
Metal Mining	114	194	24	47%	42%	43%	34%	10%	6%	<1%	19%
Non-metallic Mineral Mining	253	425	54	69%	58%	26%	16%	5%	16%	<1%	11%
Lumber and Wood	142	268	42	29%	20%	8%	13%	63%	61%	<1%	6%
Furniture	293	160	5	58%	67%	1%	10%	41%	10%	<1%	13%
Rubber and Plastic	271	435	59	39%	14%	14%	4%	46%	71%	1%	11%
Stone, Clay, and Glass	146	330	66	45%	52%	18%	8%	38%	37%	<1%	3%
Nonferrous Metals	202	402	72	33%	24%	21%	3%	44%	69%	1%	4%
Fabricated Metal	477	746	114	25%	14%	14%	8%	61%	77%	<1%	2%
Electronics/ Computers	60	87	21	17%	2%	14%	7%	69%	87%	<1%	4%
Motor Vehicle Assembly	169	284	28	34%	16%	10%	9%	56%	69%	1%	6%
Pulp and Paper	189	576	88	56%	69%	35%	21%	10%	7%	<1%	3%
Printing	397	676	72	50%	27%	5%	3%	44%	66%	<1%	4%
Inorganic Chemicals	158	427	49	26%	38%	29%	21%	45%	36%	<1%	6%
Organic Chemicals	195	545	118	36%	34%	13%	16%	50%	49%	1%	1%
Petroleum Refining	109	439	114	50%	31%	19%	16%	30%	47%	1%	6%
Iron and Steel	167	488	46	29%	18%	35%	26%	36%	50%	<1%	6%
Dry Cleaning	80	111	11	21%	4%	1%	22%	78%	67%	<1%	7%

* Actions taken to enforce the Federal Insecticide, Fungicide, and Rodenticide Act; the Toxic Substances and Control Act, and the Emergency Planning and Community Right-to-Know Act as well as other Federal environmental laws.

XI.C. Review of Major Enforcement Actions

XI.C.1. Review of Major Cases

This section provides summary information about major cases that have affected this sector. As indicated in EPA's *Enforcement Accomplishments Report, FY 1991 - FY 1993* publications, 12 significant enforcement cases were resolved between 1991 and 1993 involving the nonferrous metals industry. Five of the cases were comprised of RCRA violations, five of CERCLA violations, and two involved violations of the Clean Water Act (CWA). One case, U.S. v. ILCO (Interstate Lead Company), et. al., settled in 1992 and 1993, involved violations of all three statutes.

Six of the 12 cases resulted in the assessment of a penalty. Civil penalties ranged from $453,750 to $3.5 million. The average penalty was approximately $1.9 million. In U.S. v. Cerro Copper (1991), a consent decree was entered requiring Cerro to recycle its waste waters in order to meet pre-treatment limits for copper and other nonferrous metals at one of its plants. In addition, the company was required to pay a civil penalty of $1.4 million for its CWA violation.

Some of the settlements required defendants to pay only the past or future cleanup costs of the remedial action. In U.S. et. al. v. Alcan Aluminum Corp. et. al. (1991), the District Court granted the government's motion of summary judgment against Alcan Aluminum, a PRP at the Pollution Abatements Services Superfund site. The penalty was $4 million in past costs from this case and $9.1 million in past costs from an unsettled 1987 case. Violations included illegal dumping of PCBs, and about 4.6 million gallons of waste emulsion contaminated with small quantities of metals including lead, cadmium, and chromium.

In U.S. v. Sanders Lead Co. (1993), a consent decree was entered requiring $2 million in civil penalties and the treatment of waste water as a hazardous waste. This consent decree resolved alleged violations involving illegal disposal of lead-bearing hazardous wastes and violations of land disposal restrictions. This was the first civil case that the U.S. filed to enforce land disposal restrictions, and settles a RCRA enforcement action concerning violations at a Troy, Alabama secondary lead smelter.

In the 1993 RCRA case of U.S. v. ILCO et. al., the Court of Appeals held that lead components from spent automobile batteries were discarded and hence could be regulated as "solid waste" under RCRA. The Appeals Court affirmed the district court's award of $3.5 million in civil penalties and $845,033 in CERCLA response costs for violations of RCRA, the

CWA, and corresponding Alabama statutes. The action arose from ILCO's operations at its secondary smelter which reprocessed spent-lead acid batteries.

XI.C.2. Supplemental Environmental Projects

Supplementary Environmental Projects (SEPs) are compliance agreements that reduce a facility's stipulated penalty in return for an environmental project that exceeds the value of the reduction. Often, these projects fund pollution prevention activities that can significantly reduce the future pollutant loadings of a facility.

In December, 1993, the Regions were asked by EPA's Office of Enforcement and Compliance Assurance to provide information on the number and type of SEPs entered into by the Regions. The following chart contains a representative sample of the Regional responses addressing the primary and secondary nonferrous metals industry. The information contained in Exhibit 30 is not comprehensive and provides only a sample of the types of SEPs developed for the primary and secondary nonferrous metals industry.

Exhibit 30 - SEP Chart
Supplemental Environmental Projects
Nonferrous Metal (SIC 33)

Case Name	EPA Region	Statute/ Type of Action	Type of SEP	Estimated Cost to Company	Expected Environmental Benefits	Final Assessed Penalty	Final Penalty After Mitigation
Kaiser Aluminum and Chemical Corporation Tacoma, WA	10	TSCA	Pollution Reduction	$ 12,750	Early disposal of PCB-contaminated electrical equipment.	$ 12,750	$ 6,375
Southern Foundry Supply	4	EPCRA	Pollution Reduction	$ 34,000	Assess the feasibility of a process to recover pure nickel from plant wastestreams. Construct a pilot plant to perform the recovery to reduce the quantity of heavy metals entering environment.	$ 15,840	$ 2,376
Aluminum Company of America (ALCOA) Port Lavaca, TX	6	CERCLA (failure to report release)	Equipmment Donation	$ 10,000	Donate equipment to the Local Emergency Planning Committee (LEPC) to assist local officials in emergency responses to chemical emergencies. Develop and submit article on CERCLA compliance to a national trade journal to assist other facilities in reporting duties.	$ 25,000	$ 3,000
Elken Metals Company Alloy, WV	3		Pollution Reduction	$ 449,000	Remove PCB items including PCB transforers and PCB capapcitors, and retrofilling PCB-contaminated transformers to reduce the amount of PCBs which may be released to the environment.	$ 280,000	$ 17,250
J.W. Harris, Inc. Cincinnati, OH	5	EPCRA	Pollution Prevention	$189,350	Correct past EPCRA violations and modify industrial processes. Modification will reduce the releases of silver by 713 lbs/yr; copper by 1592 lbs/yr; antimony by 55 lbs/yr; zinc by 5847 lbs/yr; and nickel by 15 lbs/yr.	$109,500	$10,950

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XII. COMPLIANCE ACTIVITIES AND INITIATIVES

This section highlights the activities undertaken by this industry sector and public agencies to voluntarily improve the sector's environmental performance. These activities include those independently initiated by industrial trade associations. In this section, the notebook also contains a listing and description of national and regional trade associations.

XII.A. Sector Related Environmental Programs and Activities

Voluntary Aluminum Industrial Partnership

The EPA's Voluntary Aluminum Industrial Partnership (VAIP) is an innovative environmental stewardship and pollution prevention program developed jointly by the EPA and the U.S. primary aluminum industry to promote cost-effective reduction in perflurocarbon. Companies joining the VAIP commit to reductions in perfluorocarbon (PFC) emission released during the production of aluminum and to provide data to EPA that tracks their progress toward reduction targets. In turn, EPA provides VAIP Partners with recognition for their pollution prevention initiative, and for their accomplishments in achieving PFC reductions.

The Partnership has been designed with important and unique characteristics that reflect both the diversity within the primary aluminum industry and the differences between this and other industries. These unique characteristics include: flexibility; a joint commitment to finding answers to critical technical questions; and a clear course for achieving substantial pollution prevention goals by the year 2000. EPA estimates that the VAIP will achieve reductions in PFC emissions of 30-60 percent across the U.S. primary aluminum industry — or 1.8 mmt of carbon equivalent — by the year 2000.

XII.B. EPA Voluntary Programs

33/50 Program

The "33/50 Program" is EPA's voluntary program to reduce toxic chemical releases and transfers of 17 chemicals from manufacturing facilities. Participating companies pledge to reduce their toxic chemical releases and transfers by 33 percent as of 1992 and by 50 percent as of 1995 from the 1988 baseline year. Certificates of Appreciation have been given to participants who met their 1992 goals. The list of chemicals includes 17 high-use chemicals reported in the Toxics Release Inventory.

Ninety-three companies listed under SIC 333-334 (primary and secondary metals industry) are currently participating in the 33/50 program. They account for 72 percent of the 129 companies under SIC 333-334, which is higher than the average for all industries of 14 percent participation. (Contact: Mike Burns 202-260-6394 or the 33/50 Program 202-260-6907)

Exhibit 31 lists those companies participating in the 33/50 program that reported under SIC code 333-334 to TRI. Many of the participating companies listed multiple SIC codes (in no particular order), and are therefore likely to conduct operations in addition to primary metals production. The table shows the number of facilities within each company that are participating in the 33/50 program; each company's total 1993 releases and transfers of 33/50 chemicals; and the percent reduction in these chemicals since 1988.

Exhibit 31
Nonferrous Metals Producers Participating in the 33/50 Program

Parent Facility Name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
3M Minnesota Mining & Mfg Co	St. Paul	MN	3643, 3699, 2851, 3644, 2821, 3357	1	16,481,098	70
Aluminum Company Of America	Pittsburgh	PA	3357	11	2,403,017	51
American Telephone & Telg. Co.	New York	NY	3357, 3661	4	512,618	50
Ampco Metal Mfg., Inc.	Milwaukee	WI	3362, 3351	3	3,395	*
Asarco Incorporated	New York	NY	3331	7	7,582,905	2
Avondale Industries. Inc.	Avondale	LA	3325, 3339, 3341	1	25,279	54
Baker Hughes. Incorporated	Houston	TX	3357	1	193,116	20
Ball Corporation	Muncie	IN	3341, 3356, 3471	1	721,859	86
Bethlehem Steel Corporation	Bethlehem	PA	3312, 3321, 3366	2	792,550	50
Bicc USA Inc.	Chicago	IL	3357	7	152,253	15
Brooklyn Park Oil Co., Inc.	Minneapolis	MN	3364, 3471	1	12,606	13
Cabot Corporation	Boston	MA	3339, 2819	2	2,407,581	50
Chrysler Corporation	Highland Park	MI	3363	1	3,623,717	80
Cooper Industries, Inc.	Houston	TX	3357	1	1,048,465	75
Corning, Inc.	Corning	NY	3357	2	1,521,528	14
Degussa Corporation	Ridgefield Park	NJ	3499, 3369	2	676,418	***
Dexter Corporation	Windsor Locks	CT	3341	1	122,127	51
Doe Run Company	Saint Louis	MO	3339	1	2,270,400	49
Engelhard Corporation	Iselin	NJ	3351, 2819	1	236,302	50
Farley Inc.	Chicago	IL	3366, 3743	1	58,844	2
Federal-Mogul Corporation	Southfield	MI	3365, 3366, 3471	2	255,996	50
Funk Finecast, Inc.	Columbus	OH	3324, 3365, 3366	1	491	*
General Electric Company	Fairfield	CT	2819, 3356, 3499, 3724	2	5,010,856	50
General Motors Corporation	Detroit	MI	3365, 3363	2	16,751,198	*
Halstead Industries, Inc.	Greensboro	NC	3351	1	239,910	50
Handy & Harman	New York	NY	3341	4	477,150	50
Hm Anglo-American, Ltd.	New York	NY	3646, 3363, 3469, 3471	1	1,265,741	2
Honeywell, Inc.	Minneapolis	MN	3822, 3820, 3363, 3900	1	386,054	50
Hydro Aluminum USA Inc.	Rockledge	FL	3354	1	54,700	100
INCO United States Inc.	New York	NY	3356	5	346,594	26
Indal, Ltd.	Weston, Ontario, Can		3354	2	303,909	*
Ingersoll-Rand Company	Woodcliff Lake	NJ	3369, 3471	1	96,553	60

Exhibit 31 (cont'd)
Nonferrous Metals Producers Participating in the 33/50 Program

Parent Facility Name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
Jefferson City Mfg. Co., Inc.	Jefferson City	MO	3363, 3451, 3469	1	4,850	**
Kanthal Furnace Prods.	Bethel	CT	3315, 3316, 3357	1	21,581	41
Katy Industries, Inc.	Englewood	CO	3316, 3351, 3353, 3356	1	82,256	52
Keywell Corp.	Baltimore	MD	3341, 5093	1	58,997	*
Linderme Tube Co.	Euclid	OH	3351	1	34,960	***
Litton Industries, Inc.	Beverly Hills	CA	3356	2	332,264	**
Lorin, Ind.	Muskegon	MI	3354, 3471	1	25,500	50
Louisiana-Pacific Corporation	Portland	OR	3354	1	294,823	50
Marmon Group, Inc.	Chicago	IL	3351	7	1,092,218	1
Mascotech	Taylor	MI	3364, 3544, 3471	1	3,163,830	35
Morgan Stanley Leveraged Fund	New York	NY	3357	12	2,166,420	13
National Metals, Inc.	Leeds	AL	3341	1	510	***
National Tube Holding Company	Birmingham	AL	3351	1	78,282	75
Newell Co	Freeport	IL	3341	1	324,283	23
NGK Metals Corp.	Temple	PA	3366	2	56,600	99
Norandal USA	Brentwood	TN	3365, 3714	5	627,740	6
North American Philips Corp.	New York	NY	3357	1	1,281,928	50
Northern Precision Casting Co.	Lake Geneva	WI	3324, 3365, 3366	1	90	99
Olin Corporation	Stamford	CT	3351	5	574,673	70
Pac Foundries	Port Hueneme	CA	3324, 3365	1	4,976	75
Pace Industries, Inc.	New York	NY	3363	3	14,530	**
Parker Hannifin Corporation	Cleveland	OH	3360	1	244,966	50
Pechiney Corporation	Greenwich	CT	3341	6	216,177	***
Peco Manufacturing Co. ,Inc.	Portland	OR	3089, 3363, 3382	1	16,409	100
Peerless Of America, Inc.	Chicago	IL	3354	1	60,463	69
Progress Casting Group, Inc.	Minneapolis	MN	3363	1	15,045	95
Raytheon Company	Lexington	MA	3361	1	706,045	50
Renco Group, Inc.	New York	NY	3339	1	204,629	7
Rexcorp U S, Inc. (Del)	Sandwich	IL	3363, 3364	1	494	***
Reynolds Metals Company	Richmond	VA	3334	9	2,055,294	38
RJR Nabisco Holdings Corp.	New York	NY	2754, 3334	1	1,149,070	12
Rome Group Inc.	Rome	NY	3357	1	8,878	**
RSR Holding Corp.	Dallas	TX	3341	3	2,499,338	***
RTZmerica, Inc.	Garden City	NY	3331	1	3,576,655	32
SEH America, Inc.	Vancouver	WA	3674, 3339	1	53,140	100

Exhibit 31 (cont'd)
Nonferrous Metals Producers Participating in the 33/50 Program

Parent Facility Name	Parent City	ST	SIC Codes	# of Participating Facilities	1993 Releases and Transfers (lbs.)	% Reduction 1988 to 1993
Spectrulite Consortium, Inc.	Madison	IL	3341, 3354, 3355, 3356	1	255	50
Spectrum ,Ltd.	Carrollton	GA	3357	6	355,325	3
T & N Inc.	Ann Arbor	MI	3321, 3365, 3714	1	670,624	**
Tecumseh Products Company	Tecumseh	MI	3361	1	29,510	28
Tenneco Inc.	Houston	TX	3353, 3081	1	1,272,423	8
Texas Instruments Incorporated	Dallas	TX	3822, 2812, 3356, 3471, 3714, 3341	1	344,225	25
U T I Corporation	Collegeville	PA	3569, 3357	1	473,872	50
United Technologies Corp.	Hartford	CT	3354	1	2,393,252	50
USX Corporation	Pittsburgh	PA	3356, 3369	1	1,510,772	25
Vanalco, Inc.	Vancouver	WA	3334	1	12,250	**
Watts Industries, Inc.	North Andover	MA	3366	3	128,842	8
Westinghouse Electric Corp.	Pittsburgh	PA	3356	2	1,137,198	28
Wolverine Tube, Inc.	Decatur	AL	3351, 3499	2	337,685	***

*** = not quantifiable against 1988 data.**
**** = use reduction goal only.**
***** = no numerical goal.**

Environmental Leadership Program

The Environmental Leadership Program (ELP) is a national initiative piloted by EPA and State agencies in which facilities have volunteered to demonstrate innovative approaches to environmental management and compliance. EPA has selected 12 pilot projects at industrial facilities and Federal installations which will demonstrate the principles of the ELP program. These principles include: environmental management systems, multimedia compliance assurance, third-party verification of compliance, public measures of accountability, community involvement, and mentoring programs. In return for participating, pilot participants receive public recognition and are given a period of time to correct any violations discovered during these experimental projects. (Contact: Tai-ming Chang, ELP Director, 202-564-5081 or Robert Fentress, 202-564-7023)

Project XL

Project XL was initiated in March 1995 as a part of President Clinton's *Reinventing Environmental Regulation* initiative. The projects seek to achieve cost effective environmental benefits by allowing participants to replace or modify existing regulatory requirements on the condition that they produce greater environmental benefits. EPA and program participants will negotiate and sign a Final Project Agreement, detailing specific objectives that the regulated entity shall satisfy. In exchange, EPA will allow the participant a certain degree of regulatory flexibility and may seek changes in underlying regulations or statutes. Participants are encouraged to seek stakeholder support from local governments, businesses, and environmental groups. EPA hopes to implement fifty pilot projects in four categories including facilities, sectors, communities, and government agencies regulated by EPA. Applications will be accepted on a rolling basis and projects will move to implementation within six months of their selection. For additional information regarding XL Projects, including application procedures and criteria, see the May 23, 1995 Federal Register Notice, or contact Jon Kessler at EPA's Office of Policy Analysis (202) 260-4034.

Green Lights Program

EPA's Green Lights program was initiated in 1991 and has the goal of preventing pollution by encouraging U.S. institutions to use energy-efficient lighting technologies. The program has over 1,500 participants which include major corporations; small and medium sized businesses; Federal, State and local governments; non-profit groups; schools; universities; and health care facilities. Each participant is required to survey their facilities and upgrade lighting wherever it is profitable. EPA provides technical assistance to the participants through a decision support software package, workshops and manuals, and a financing registry. EPA's Office of Air and Radiation is responsible for operating the Green Lights Program. (Contact: Susan Bullard at 202-233-9065 or the Green Light/Energy Star Hotline at 202-775-6650)

WasteWi$e Program

The WasteWi$e Program was started in 1994 by EPA's Office of Solid Waste and Emergency Response. The program is aimed at reducing municipal solid wastes by promoting waste minimization, recycling collection, and the manufacturing and purchase of recycled products. As of 1994, the program had about 300 companies as members, including a number of major corporations. Members agree to identify and implement actions to reduce their solid wastes and must provide EPA with their waste reduction goals along with yearly progress reports. EPA in turn provides technical assistance to member companies and allows the use of the WasteWi$e logo for promotional purposes. (Contact: Lynda Wynn, 202-260-0700 or the WasteWi$e Hotline at 1-800-372-9473)

Climate Wise Recognition Program

The Climate Change Action Plan was initiated in response to the U.S. commitment to reduce greenhouse gas emissions in accordance with the Climate Change Convention of the 1990 Earth Summit. As part of the Climate Change Action Plan, the Climate Wise Recognition Program is a partnership initiative run jointly by EPA and the Department of Energy. The program is designed to reduce greenhouse gas emissions by encouraging reductions across all sectors of the economy, encouraging participation in the full range of Climate Change Action Plan initiatives, and fostering innovation. Participants in the program are required to identify and commit to actions that reduce greenhouse gas emissions. The program, in turn, gives organizations early recognition for their reduction commitments; provides technical assistance through consulting services, workshops, and guides; and provides access to the program's centralized information system. At EPA, the program is operated by the Air and Energy Policy Division within the Office of Policy Planning and Evaluation. (Contact: Pamela Herman, 202-260-4407)

NICE^3

The U.S. Department of Energy and EPA's Office of Pollution Prevention are jointly administering a grant program called The National Industrial Competitiveness through Energy, Environment, and Economics (NICE^3). By providing grants of up to 50 percent of the total project cost, the program encourages industry to reduce industrial waste at its source and become more energy-efficient and cost-competitive through waste minimization efforts. Grants are used by industry to design, test, demonstrate, and assess the feasibility of new processes and/or equipment with the potential to reduce pollution and increase energy efficiency. The program is open to all industries; however, priority is given to proposals from participants in the pulp and paper, chemicals, primary metals, and petroleum and coal products sectors. (Contact: DOE's Golden Field Office, 303-275-4729)

XII.C. Trade Association/Industry Sponsored Activity

Various trade associations represent the interests of the nonferrous metals industry. Some of these organizations are discussed in greater detail below.

Aluminum

The Aluminum Association (AA) 900 19th Street, NW Washington, DC 20006 Phone: (202) 862-5100	Members: 86 Staff: 27 Budget: $4,300,000 Contact: David N. Parker

Founded in 1933, AA represents producers of aluminum and manufacturers of semi-fabricated aluminum products. This association represents members' interest in legislative activity and it also conducts seminars and workshops. Its committees cover such topics as legislative/regulatory affairs, environmental affairs, product standards, technical activities and programs, and health and safety. AA maintains a library of 3000 volumes on aluminum technology and the aluminum industry. Its publications include: *Aluminum Association Report* (10 times per year); *Aluminum Standards and Data* (biennially); *Aluminum Statistical Review* (annually); *World Aluminum Abstracts* (monthly), and a free catalog listing all of its publications, reprints, and audiovisual material. AA also maintains the *World Aluminum Abstracts* data base.

Aluminum Recycling Association (ARA) 1000 16th St. NW, Ste. 603 Washington, DC 20036 Phone: (202) 785-0951	Members: 20 Contact: Richard M. Cooperman

Founded in 1929, ARA represents producers of aluminum specification alloys refined from scrap aluminum. ARA has three committees: Environmental Protection, Government Liaison, and Technical. The association was formerly known separately as the Aluminum Research Institute, the Aluminum Smelters Research Institute, and the Aluminum Smelting and Recycling Institute. ARA publishes *Quarterly Reports on Industry Shipments* as well as a brochure.

Copper

International Copper Association (ICA) 260 Madison Ave. New York, NY 10016 Phone: (212) 251-7240 Fax: (202) 251-7245	Members: 42 Staff: 11 Budget: $ 9,000,000 Contact: Dr. William Drescher

Formerly known as the Copper Products Development Association, ICA represents both copper producing and copper fabricating companies. ICA works in concert with commercial, institutional, and university laboratories to conduct research on, and market development of, new and improved uses of copper. The association along with its committees, Chemical and Environmental Advisory; Corrosion Advisory; Electrical Advisory; Metallurgy Advisory; and Program Review conduct seminars and maintain a 300 volume library. ICA publishes an annual report in addition to a monograph series.

Copper and Brass Fabricators Council (CBFC) 1050 17th St. NW, Ste. 440 Washington, DC 20036 Phone: (202) 833-8575 Fax: (202) 331-8267	Contact: Joseph. L. Mayer

CBFC represents copper and brass fabricators in activities involving foreign trade in copper and brass fabricated products, and Federal regulatory matters including legislation, regulations, rules, controls, and other matter affecting brass and copper fabricators. The association has five committees: Critical Materials; Energy Conservation; EPA Advisory; Foreign Trade; and Government Information. CBFC was formerly known as Copper and Brass Fabricators Foreign Trade Association and was founded in 1966.

Copper Development Association (CDA) 2 Greenwich Office Park Box 1840 Greenwich, CT 06836 Phone: (212) 251-7200 or (800) CDA-DATA	Members: 100 Staff: 20 Contact: M. Payne

CDA represents domestic and foreign copper mining, smelting, and refining companies, and domestic fabricating companies. Functioning in committees divided along principal market areas such as transportation and construction and electronics, CDA seeks to expand the applications and markets of copper. CDA provides technical services to users of copper and its alloys, and also researches market statistics for the entire industry. *Copper Update* and *Copper Topics*, both published quarterly, are the primary publications of CDA in addition to handbooks, technical reports, and bulletins. CDA also operates an *Online Copper Data Center* which contains literature from around the world on copper and its alloys.

Lead

Lead Industries Association (LIA) 295 Madison Ave. New York, NY 10017 Phone: (212) 578-4750 Fax: (212) 684-7714	Members: 70 Staff: 4 Contact: Jerome F. Smith

Founded in 1928, LIA represents mining companies, smelters, refiners, and manufacturers of products containing lead. The association researches and gathers statistics and provides technical services and information to lead consumers. Some of the services LIA provides are a 2000-volume library concerning lead, and association committees focusing on: Battery Manufacturers, Environmental Health, Fabricated Products, Oxide and Chemical, and Solder Manufacturers. LIA publishes a semiannual newsletter, *Lead*, with a circulation of 60,000 that contains articles about the application of lead in architecture, chemicals, and other fields.

Association of Battery Recyclers (ABR) Sanders Lead Co. Corp. Sanders Rd. PO Drawer 707 Troy, AL 36081 Phone: (205) 566-1563	Members: 45 Staff: 1 Contact: N. Kenneth Campbell

ABR represents recyclers of lead, oxide manufacturers, industry equipment suppliers, and consulting services. The association's goals are to provide information services relating to worker safety and environmental controls through continuing industry-wide studies. ABR conducts research in: engineering and administrative controls, respiratory protection, and environmental and biological monitoring. ABR was known as the Secondary Lead Smelters Association until 1990.

Zinc

Independent Zinc Alloyers Association (IZAA) 1000 16th St. NW, Ste. 603 Washington, DC 20036 Phone: (202) 785-0558	Members: 15 Contact: Richard M. Cooperman

Founded in 1959, IZAA represents producers of zinc alloys for the die casting industry. The association has one committee which focuses on International Trade.

XIII. RESOURCE MATERIALS/BIBLIOGRAPHY

For further information on selected topics within the nonferrous metals industry, a list of publications is provided below:

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Air Pollution Engineering Manual, Anthony J. Buonicore and Wayne T. Davis, ed., Air & Waste Management Association, Van Norstrand Reinhold, New York, NY, 1992.

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Compilation of Air Pollutant Emission Factors (AP 42), U.S. EPA, Office of Air Quality Planning and Standards.

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