IRON AND STEEL

A. Commodity Summary

The iron and steel industry, including primary and secondary producers, is composed of 79 companies that produce raw steel at 116 locations. Iron is generally produced from iron ore (taconite) in a primary mineral production process, while steel is produced using both primary and secondary processes. Primary production refers to those operations where the feedstock is composed of at least 50 percent ore (or ore that has been beneficiated). Electric arc furnaces use a high percentage of scrap steel as the feedstock in their operations and are therefore classified as secondary production and not considered primary minerals processing. Although the electric arc furnace process is described in this section, some of the wastes generated from this operation are currently regulated under RCRA Subtitle C. Specifically, electric arc furnace dust (K061) is a listed hazardous waste.

The annual aggregate raw steel production capacity is 99 million metric tons; 1993 production is reported to be 87 million metric tons. According to the U.S. Bureau of Mines, the iron and steel producers and ferrous foundries produced goods valued at $55 billion. Currently, pig iron (i.e., molten iron from iron blast furnaces) is produced at 15 companies operating integrated steel mills, with approximately 58 blast furnaces (of which 41 or 42 are in continuous operation). Integrated companies accounted for approximately 67% of steel production, including output of their electric arc furnaces (which are classified as secondary production).[1]

Pig iron production in 1994 is estimated at 49 million metric tons. Pig iron is sent to either basic oxygen furnaces or electric arc furnaces for further processing at steel facilities. Basic oxygen furnaces (BOFs) and electric arc furnaces (EAFs) account for 61 percent and 39 percent of steel production, respectively. Continuously cast steel accounted for 89 percent of steel production. Lastly, open hearth furnaces (OHFs) have been phased out and were not used domestically to produce steel in 1993.[2] Exhibit 1 presents the names and locations of facilities involved in the primary production of iron and steel.

EXHIBIT 1

SUMMARY OF PRIMARY IRON AND STEEL PRODUCERS IN 1989

Facility Name	Location	Type of Operations
Acme	Riverdale, IL	Iron; BOF Steel
Alleghany Ludlum	Brackenridge	Iron; BOF Steel
Armco Steel Co., L.P.	Middletown, OH	Iron; BOF Steel
Armco Steel Co., L.P.	Ashland, KY	Iron; BOF Steel
Bethlehem Steel	Sparrows Point, MD	Iron; BOF Steel
Bethlehem Steel	Bethlehem, PA	Iron; BOF Steel
Bethlehem Steel	Chesterton, IN	Iron; BOF,OHF Steel
Geneva Steel	Orem, UT	Iron; OHF Steel
Gulf States Steel	Gadsden, AL	Iron; BOF Steel
Inland Steel	E. Chicago, IN	Iron; BOF Steel
LTV	E. Cleveland, OH	Iron; BOF Steel
LTV	W. Cleveland, OH	Iron; BOF Steel
LTV	Indiana Harbor, IN	Iron; BOF Steel

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[1] Gerald Houck, "Iron and Steel," from Mineral Commodity Summaries, U.S. Bureau of Mines, January 1995, p. 86.

[2] Ibid.

EXHIBIT 1 (continued)

SUMMARY OF PRIMARY IRON AND STEEL PRODUCERS IN 1989

Facility Name	Location	Type of Operations
McLouth Steel	Trenton, MI	Iron; BOF Steel
National Steel	Granite City, IL	Iron; BOF Steel
National Steel	Escore, MI	Iron; BOF Steel
Rouge Steel	Dearborn, MI	Iron; BOF Steel
Sharon Steel	Farrell, PA	Iron; BOF Steel (shut down in November 1992)[a]
Shenango	Pittsburgh, PA	Iron
US Steel	Braddock, PA	Iron; BOF Steel
US Steel	Gary, IN	Iron; BOF Steel
US Steel	Fairless Hills, PA	Iron; OHF Steel
US Steel	Fairfield, AL	Iron; BOF Steel
US Steel/Kobe	Lorain, OH	Iron; BOF Steel
Warren Steel	Warren, OH	Iron; BOF Steel
Weirton Steel	Weirton, WV	Iron; BOF Steel
Wheeling-Pittsburgh Steel	Steubenville, OH	Iron; BOF Steel
Wheeling-Pittsburgh Steel	Mingo Junction, OH	Iron; BOF Steel

B. Generalized Process Description

1. Discussion of Typical Production Processes

The production of steel products from iron ore involves two separate steps: ironmaking and steelmaking. Each of these is described in detail below. Iron blast furnaces produce molten iron (pig iron) that can be cast (molded) into products; however, the majority of pig iron is used as the mineral feedstock for steel production. Steel furnaces produce a molten steel that can be cast, forged, rolled, or alloyed in the production of a variety of materials.

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[a] Gerald Houck, "Iron and Steel." from Minerals Yearbook Volume 1. Metals and Minerals, U.S. Bureau of Mines, 1992, p. 649.

EXHIBIT 1 (continued)

SUMMARY OF PRIMARY IRON AND STEEL PRODUCERS IN 1989

Ironmaking

On a tonnage basis, about nine-tenths of all metal consumed in the United States is iron or steel. Iron and steel are used in the manufacture of transportation vehicles, machinery, pipes and tanks, cans and containers, and the construction of large buildings, roadway superstructures, and bridges.[3] According to the U.S. Bureau of Mines in 1993, steel consumption was divided amongst the following uses: warehouse and steel service centers, 26%; transportation (mainly for automotive production), 16%; construction 15%, cans and containers, 5%; and other uses, 38%.[4]

Iron is produced either by blast furnaces or by one of several direct reduction processes; blast furnaces, however, account for over 98 percent of total domestic iron production.[5] The modern blast furnace consists of a refractory-lined steel shaft in which a charge is continuously added to the top through a gas seal. The charge consists primarily of iron ore, sinter, or pellets; coke; and limestone or dolomite. Iron and steel scrap may be added in small amounts. Near the bottom of the furnace, preheated air is blown in. Coke is combusted in the furnace to produce carbon monoxide which reduces the iron ore to iron. Silica and alumina in the ore and coke ash are fluxed with limestone to form a slag that absorbs much of the sulfur from the charge. Molten iron and slag are intermittently tapped from the hearth at the bottom. The slag is drawn off and processed. The product, pig iron, is removed and typically cooled, then transported to a steel mill operation for further processing in either an electric arc furnace or a basic oxygen furnace, as depicted in Exhibit 2. As shown in Exhibit 2, the iron can also be directly reduced before it is sent for further processing.

Recent changes in the process include modifications in the fluxing practices. Flux is often introduced through fluxed sinter or fluxed pellets rather than by direct charging. The use of external desulfurization of hot metals prior to steel making has also increased.[6]

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[3] Gerald Houck, "Iron and Steel," from Mineral Facts and Problems, U.S. Bureau of Mines, 1985, p. 412.

[4] Gerald Houck, 1994, Op. Cit., p. 90.

[5] American Iron and Steel Institute, "Annual Statistical Report," 1984, p. 78.

[6] Harold R. Kokal and Madhu G. Ranade, "Fluxes for Metallurgy," from Industrial Minerals and Rocks, 1994, pp. 668-669.

Steelmaking

All contemporary steelmaking processes convert pig iron, scrap, or direct-reduced iron, or mixtures of these, into steel by a refining process that lowers the carbon and silicon content and removes impurities (mainly phosphorus and sulfur). Three major furnace types can be used for making steel:

- open hearth furnaces, no longer used for domestic steel production;
- basic oxygen furnaces, with 62 percent of the total; and
- electric arc furnaces, accounting for the remaining 38 percent.

The latter predominantly uses scrap (i.e., non-mineral material) as feedstock and is classified as a secondary process. The open-hearth process was prevalent in the United States between 1908 and 1969, but it is no longer in use domestically. The basic oxygen process has supplanted it as the predominant primary steel-making process, making up approximately 95 percent of domestic primary steel production in 1987.[7]

Modern steelmaking also includes treatment of steel in ladles. This use of ladles (1) improves the cleanliness of the steelmaking process, (2) increases throughput in steel vessels, and (3) allows for shape control of inclusions in continuous casting operations.[8]

2. Generalized Process Flow Diagram

A general flow diagram for the production of raw steel from iron ore is presented in Exhibit 2. In general, the process involves (1) beneficiation of the iron ore, (2) either direct-reduction or reduction in an iron blast furnace, (3) processing in steelmaking furnaces, and (4) casting.

Ironmaking

Beneficiation of the Iron Ore: Sintering, Pelletizing, or Briquetting

There are a variety of beneficiation methods that can be used to prepare iron ores, depending on the iron content in the ores. Some ores contain greater than 60 percent iron and require only crushing and blending to prepare them for further processing. In other cases, operations including screening and concentrating are necessary to prepare the raw materials. The characteristics of the iron-bearing ores vary geographically. Specifically, magnetite is the main iron-bearing ore in the Lake Superior district and in the northeastern United States, while hematite and hematite magnetite mixtures tend to be found in ores in Alabama and the Southwest.

When magnetite occurs in lower grade deposits, the ore is ground, and the concentrate is separated magnetically from the gangue with the ore in a water suspension. Ore containing hematite can be high in clay content and requires washing to remove the clay and concentrate the iron. Low grade ores that can not be separated magnetically may also need to be concentrated via washing, jigging, heavy media separation, or flotation.[9]

Ores that will be sent to blast furnaces for ironmaking need to be permeable to allow for an adequate flow of gas through the system. Additionally, concentrates in raw ores that are very fine need to be agglomerated before they can be used as feed stock for the blast furnaces. The three major processes used for agglomeration include:

- sintering;
- pelletizing; and
- briquetting.

Sintering. Sintering involves mixing the iron-bearing material such as ore fines, flue dust, or concentrate with fuel (e.g., coke breeze or anthracite).[10] The mixture is then spread on surface beds which are ignited by gas burners. The heating process fuses the fine particles, and the resulting product is lumpy material known as sinter.

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[7] Frederick J. Schottman, "Iron an Steel," from Minerals Yearbook Volume I. Metals and Minerals, U.S. Bureau of Mines, 1989, p. 511.

[8] Harold R. Kokal and Madhu G. Ranade, 1994, Op. Cit., pp. 668-9.

[9] U.S. Environmental Protection Agency, "Iron and Steel," from 1988 Final Draft Summary Report of Mineral Industrial Processing Wastes, Office of Solid Waste, 1988, p. 3-128.

[10] Ibid.

The sinter is sized and the fines are recycled. Sintering operations are used to recycle wastes from other iron and steel manufacturing processes.

Pelletizing. Pelletizing involves forming pellets from the raw ore or concentrates, then hardening the pellets by heating. Solid fuel can be combined with the concentrate to promote the heating necessary to harden the pellet. Common binders added to strengthen the pellets include limestone, dolomite, soda ash, bentonite, and organic compounds. After the pellets are sized, any remaining fraction of materials are recycled back through the sintering process.

Briquetting. Briquetting, another form of agglomeration, involves heating the ore and pressing it into briquettes while the materials are still hot. Once the briquettes are cooled, they are sent directly to the blast furnaces.

Reduction of the Iron Ore

There are two basic methods for reducing iron ore:

- direct reduction; and
- reduction in a blast furnace.

Direct Reduction. Direct reduction involves the reduction of iron ore that is in the solid state - at less than 1000 °C.[11] The solid primary metal produced by direct reduction of iron ores (DRI) can be used to supply electric arc furnaces.

Blast Furnace. During ironmaking, agglomerated iron ore is combined with prepared limestone, silica, and coke and placed into a blast furnace. Heated air is blown into the furnace and causes the limestone and silica to form a fluid slag which combines with other impurities. The slag can be separated from the molten iron and sent to a slag reprocessing unit. Generally, the molten iron from the blast furnace is transferred directly to the steelmaking furnaces.

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[11] J. Astier, "Present Status of Direct Reduction and Smelting Reduction," from Steel Times, October 1992, pp. 453-458.

A number of integrated steelwork facilities in the United States have increased their use of fluxed pellets, which are more easily reducible. The fluxed pellets are produced by adding limestone ($CaCO_3$) and/or dolomite [$(Ca,Mg)CO_3$] to the iron ore concentrate during the balling stage. Flux is added until the ratio of calcium and magnesium oxide to silicon dioxide and aluminum oxide $((CaO+MgO)/(SiO2+Al_2O_3))$ in the pellet is above 0.6. The most common ratio documented is approximately 1.0.[12]

Steelmaking

Processing in Steelmaking Furnaces

There are three basic methods of steel production:

- open hearth furnaces (no longer in use domestically);
- basic oxygen furnaces; and
- electric arc furnaces (secondary production).

Open Hearth Furnace (no longer used). During the open-hearth process, a relatively shallow bath of metal was heated by a flame that passed over the bath from the burners at one end of the furnace while the hot gases resulting from combustion were pulled out the other end. The heat from the exhaust gas was retained in the exhaust system's brick liners, which were known as checker-brick regenerators. Periodically the direction of the flame was reversed and air was drawn through what had been the exhaust system; the hot checker-bricks preheated the air before it was used for combustion in the furnace. Impurities were oxidized during the process and fluxes formed a slag; this slag was drawn off and processed or discarded.

Basic Oxygen Furnace. The basic oxygen process uses a jet of pure oxygen that is injected into the molten metal by a lance of regulated height in a basic refractory-lined converter. Excess carbon, silicon, and other reactive elements are oxidized during the controlled blows, and fluxes are added to form a slag. This slag, one of the RCRA special wastes, is drawn off and processed or discarded.

The first step in the BOF process is charging the furnace. Hot metal (molten iron from the blast furnace) which accounts for most of the metallic charge is added to the furnace by ladles. Once the furnace has been charged, a water-cooled oxygen lance is lowered into the furnace and high purity oxygen is blown in the top of the furnace. One modification to this process is the Q-BOP in which the oxygen and other gases are blown in from the bottom of the furnace instead of the top. In the bottom blown process, oxygen is introduced through a number of tuyeres, consisting of two concentric pipes in the bottom of the converter.[13]

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[12] William S. Kirk, "Iron Ore," from <u>Minerals Yearbook Volume 1. Metals and Minerals</u>, 1992, p. 618.

[13] Association of Iron and Steel Engineers, <u>The Making, Shaping and Treating of Steel</u>, 1985, pp. 539-652.

EXHIBIT 2

IRONMAKING AND STEELMAKING PROCESSES

Graphic Not Available.

In the furnace, oxygen combines with the carbon and other unwanted elements to oxidize the impurities in the molten charge, and thereby converting the molten charge to steel. The lime and other fluxes help remove the oxidized impurities as a layer of slag. The refined steel is then poured into ladles. At this point, any alloys can be added to the steel to obtain the desired strength and characteristics required in the final product.

Electric Arc Furnace (secondary production). Electric arc furnaces are generally used for scrap processing and have traditionally been used to produce alloy, stainless, tool, and specialty steels. Scrap steel is the principal metallic charge to electric furnaces. Direct reduction of iron ore also produces pellets with high enough iron content to be used. Limestone and other fluxes are charged after the scrap becomes molten. As in the blast furnace operation, the impurities in the steel form a floating layer of slag that can be poured off. The molten steel is then poured into ladles and sent to be cast.

In all steelmaking operations, gases from the furnace must be cleaned in order to meet air pollution control requirements. Facilities may use dry collection (e.g., bag houses, filters, or electrostatic precipitators) or wet scrubbers or, as is most often practiced, both types of controls. Large volumes of dust and scrubber sludge are collected for either further processing or disposal. Some of these air pollution control residuals are RCRA special wastes.

The molten steel, from whichever type of furnace is used, flows into ladles and is sent for further processing at rolling mills to form the finished products.

3. Identification/Discussion of Novel (or otherwise distinct) Process(es)

- Dezincing and Detoxification of Electric Arc Furnace Steelmaking Dust via Ammonium Carbonate Leaching. The use of ammoniacal ammonium carbonate (AAC) leaching for the treatment of carbon steel making EAF dust has been investigated on a laboratory scale. The tests were performed using dust samples from three European steel companies. The dusts were found to be toxic due to the leachability of silver, mercury, lead, and cadmium. After treatment, the toxicity tests indicated leachates below past and current EPA toxicity threshold limits.[14]

- Recovery of Manganese from Steel Plant Slag by Carbamate Leaching. The U.S. Bureau of Mines investigated the feasibility of using ammonium carbamate leaching to recover manganese from steel plant slag. It was found that treatment of the slag with hydrogen prior to the leaching increased the amount of manganese recovered. Results indicated that the method cannot be applied satisfactorily to all steelmaking slags.[15]

- Glassification[16] of Electric Arc Furnace Dust. A new process has been developed to treat hazardous materials, including electric arc furnace dust, slag, and spent refractories. The process, known as Glassification, utilizes electric arc furnace dust from both the steel and nonferrous metals industries to produce glass products.[17]

- Treatment of Steel Plant Wastes by Magnetic Cyclones. Steel plants generate sludges containing high concentrations of iron which display ferromagnetic properties. Methods of treating these wastes to take advantage of these properties using magnetic cyclones have been evaluated. The results indicated that the cycloning process creates an underflow with a high solids content and a clean water overflow.[18]

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[14] R.L. Nyirenda et al, "Dezincing and Detoxification of Electric Arc Furnace Steelmaking Dust via Ammonium Carbonate Leaching," The Minerals, Metals, & Mining Society, 1993, pp. 894-906.

[15] S.N. McIntosh and E.G. Baglin, "Recovery of Manganese from Steel Plant Slag by Carbamate Leaching," U.S. Bureau of Mines, 1992.

[16] **Glassification is a registered trademark.**

[17] R.B. Ek and J.E. Schlobohm, "Glassification of Electric Arc Furnace Dust," from Iron and Steel Engineer, April 1993, pp. 82-84.

[18] John L. Watson and Suren Mishra, "The Treatment of Steel Plant Wastes by Magnetic Cyclones," Conference Paper from Symposium on Emerging Process Technologies for a Cleaner Environment, Phoenix, AZ, February 24-27 1992.

4. Beneficiation/Processing Boundary

EPA established the criteria for determining which wastes arising from the various mineral production sectors come from mineral processing operations and which are from beneficiation activities in the September 1989 final rule (see 54 Fed. Reg. 36592, 36616 codified at 261.4(b)(7)). In essence, beneficiation operations typically serve to separate and concentrate the mineral values from waste material, remove impurities, or prepare the ore for further refinement. Beneficiation activities generally do not change the mineral values themselves other than by reducing (e.g., crushing or grinding), or enlarging (e.g., pelletizing or briquetting) particle size to facilitate processing. A chemical change in the mineral value does not typically occur in beneficiation.

Mineral processing operations, in contrast, generally follow beneficiation and serve to change the concentrated mineral value into a more useful chemical form. This is often done by using heat (e.g., smelting) or chemical reactions (e.g., acid digestion, chlorination) to change the chemical composition of the mineral. In contrast to beneficiation operations, processing activities often destroy the physical and chemical structure of the incoming ore or mineral feedstock such that the materials leaving the operation do not closely resemble those that entered the operation. Typically, beneficiation wastes are earthen in character, whereas mineral processing wastes are derived from melting or chemical changes.

EPA approached the problem of determining which operations are beneficiation and which (if any) are processing in a step-wise fashion, beginning with relatively straightforward questions and proceeding into more detailed examination of unit operations, as necessary. To locate the beneficiation/processing "line" at a given facility within this mineral commodity sector, EPA reviewed the detailed process flow diagram(s), as well as information on ore type(s), the functional importance of each step in the production sequence, and waste generation points and quantities presented above in this section.

EPA determined that for this specific mineral commodity sector, the beneficiation/processing line occurs between agglomeration (sintering, pelletizing, and briquetting) and reduction of iron ore in a blast furnace. EPA identified this point in the process sequence as where beneficiation ends and mineral processing begins because it is here where a significant chemical change to the iron ore occurs. Therefore, because EPA has determined that all operations following the initial "processing" step in the production sequence are also considered processing operations, irrespective of whether they involve only techniques otherwise defined as beneficiation, all solid wastes arising from any such operation(s) after the initial mineral processing operation are considered mineral processing wastes, rather than beneficiation wastes. EPA presents the mineral processing waste streams generated after the beneficiation/processing line in section C.2, along with associated information on waste generation rates, characteristics, and management practices for each of these waste streams.

C. Process Waste Streams

1. Extraction/Beneficiation Wastes

Waste characterization data, waste generation data, and waste management data are not available for all of the wastes identified as generated from the production of iron and steel.

Tailings. Wastes from magnetic separation include tailings consisting mostly of silicate rock. The magnetite ore from lower grade deposits is ground, and the concentrate is separated magnetically from the gangue with the ore in a water suspension. These wastes are typically managed in tailing impoundments.

Wastewater and Waste Solids. Ore containing hematite can be high in clay content and require washing to remove the clay and concentrate the iron. The wastewater and waste solids generated from washing ores containing clay are not expected to be hazardous. No information is available on management practices for these wastes.[19]

2. Mineral Processing Wastes

Ferrous metal production operations generate four RCRA special mineral processing wastes: iron blast furnace slag, iron blast furnace air pollution control dust/sludge, steel furnace slag, and steel furnace air pollution control dust/sludge. The Agency did not evaluate the four RCRA special mineral processing wastes further. Besides these RCRA special wastes, the only other types of wastes generated appear to be various types of wastewater, including cooling water, wash water, and scrubber water.

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[19] U.S. Environmental Protection Agency, 1988, Op. Cit., p. 3-128.

Iron Blast Furnace Slag. In 1988, iron blast furnace slag was reported as generated at 26 of the 28 ferrous metal production facilities in the United States surveyed by the U.S. Environmental Protection Agency in 1989 -- all 24 integrated iron/steel facilities and two additional blast furnace operations.

Blast furnace slag contains oxides of silicon, aluminum, calcium, and magnesium, along with other trace elements. There are three types of blast furnace slag: air-cooled, granulated, and expanded. Air cooled slag comprises approximately ninety percent of all blast furnace slag produced. The physical characteristics of the slags are in large part determined by the methods used to cool the molten slag. In the surveys, all facilities characterized their slags as solid, though slag is molten at the point of generation.[20]

The primary management practice for iron blast furnace slag is processing (e.g., crushing, sizing) and sale for use as aggregate. In 1990, only one facility disposed its slag in an adjacent water body in order to build up a land area that was intended for use managing other waste materials as part of an Army Corp of Engineers approved fill project.[21]

Iron Blast Furnace Air Pollution Control (APC) Dust/Sludge. In 1988, iron blast furnace APC dust/sludge was generated at 26 of the 28 ferrous metal facilities in the United States submitting surveys, including all 24 integrated iron/steel facilities and the two additional blast furnace operations.

Air pollution control (APC) devices treat the top gases emitted from iron blast furnaces. The air pollution control devices generate either dusts or sludges. APC dust/sludge is composed primarily of iron, calcium, silicon, magnesium, manganese, and aluminum.[22]

The two primary waste management practices at the iron facilities regarding APC dust/sludge are disposal in on-site units and the return of the material to the production process via the sinter plant operation or blast furnace.[23]

Steel Furnace Slag. In 1988, steel furnace slag was generated at 26 of the 28 ferrous facilities in the United States that submitted surveys, including all 24 integrated iron/steel facilities and the two additional steel production operations. Steel slag is composed primarily of calcium silicates and ferrites combined with fused oxides of iron, aluminum, manganese, calcium, and magnesium. At the point of generation, the slag is in a molten form. The molten slag is air cooled and is broken into varying sizes once processing (e.g., crushing) begins.[24]

The primary management practice for steel slag is processing (e.g., granulating, crushing, sizing) and sale for use as aggregate, though several facilities dispose or stockpile their steel slag.

Steel Furnace Air Pollution Control (APC) Dust/Sludge. Steel furnace APC dust/sludge was generated at 26 of the 28 domestic ferrous metal production facilities surveyed in 1989, including all 24 integrated iron/steel facilities and the two additional steel production facilities. Steel APC dust/sludge consists mostly of iron, with smaller amounts of silicon, calcium, and other metals.

Waste management practices were reported for only ten of the 26 facilities in 1989. Eight of the ten reportedly dispose the APC dust/sludge on-site; the remaining two return the material to the production process via the sinter plant operation.

Wastewater. Wastewater is generated from a number of sources during both the ironmaking and the steelmaking processes. In addition to process wastewaters, wastewater streams also are generated from non-contact operations (i.e., cooling tower water, cooling tower blowdown) and from non-process operations including maintenance and utility requirements. However, the primary source of wastewater

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[20] U.S. Environmental Protection Agency, "Chapter 8," from Report to Congress on Special Wastes from Mineral Processing, Vol II, Office of Solid Waste, July 1990.

[21] **Ibid**.

22 **Ibid**.

23 **Ibid**.

24 **Ibid**.

from ironmaking is water used for the cleaning and cooling of gases. Most plants either recirculate or recycle their cooling process wastewater to reduce the total pollutant load discharged from their facilities. The wastewaters from the blast furnace process contain suspended particulate matter and cyanide, phenol, and ammonia. All of these pollutants are limited by NPDES permit requirements. Other wastewaters contain toxic metals (predominantly zinc) and organic pollutants which come from the raw materials or form during the reduction process.

Many of the pollutants in the process wastewaters are the result of compounds found in the charges and fluxes added to the furnace. In both iron and ferromanganese blast furnaces operations, ammonia is present in the exit gases and as a result is also present in the process wastewater. The ammonia is formed from the various nitrogen compounds that are removed from the coke charge during blast furnace operations. Fluoride is also present in the wastewater as a result of fluoride compounds, primarily calcium chloride from the limestone flux. Manganese is present in wastewaters from ferromanganese production and other elements may be present depending on the various ores and alloys used in production. Lastly, cyanide is generated as a result of the reaction of nitrogen, in the blast air, with carbon from the coke charge in the reducing atmosphere of the blast furnace.

Existing data and engineering judgment suggest that this material does not exhibit any characteristics of hazardous waste. Therefore, the Agency did not evaluate this material further.

D. Ancillary Hazardous Wastes

Ancillary hazardous wastes may be generated at on-site laboratories, and may include used chemicals and liquid samples. Other hazardous wastes may include spent solvents (e.g., petroleum naphtha), acidic tank cleaning wastes, and polychlorinated biphenyls from electrical transformers and capacitors. Non-hazardous wastes may include tires from trucks and large machinery, sanitary sewage, and some waste oil and other lubricants. Other ancillary wastes associated with the coke making process, stainless steel production, and the spent pickling liquors resulting from steel finishing at some integrated steel mills are currently classified as listed and/or characteristic wastes and regulated under RCRA Subtitle C requirements.

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