

MEMORANDUM

TO: Urban Strategy Docket

FROM: Barbara Driscoll

DATE: November 18, 2002

SUBJECT: Expanded Description of Source Categories Listed in June 2002 for Future Regulatory Development

This memo was developed to expand the definitions for categories previously listed for future regulatory development in the Urban Area Toxics program. The source categories listed for regulation consist of the following groups:

1. Acrylic Fibers/Modacrylic Fibers Production
2. Agricultural Chemicals and Pesticides Manufacturing
3. Auto Body Refinishing Paint Shops
4. Flexible Polyurethane Foam Production
5. Iron Foundries
6. Lead Acid Battery Manufacturing
7. Miscellaneous Organic Chemical Manufacturing (MON)
8. Pharmaceutical Production
9. Plating and Polishing
10. Polyvinyl Chloride and Copolymers Production
11. Pressed and Blown Glass and Glassware Manufacturing
12. Primary Nonferrous Metals– Zinc, Cadmium, and Beryllium
13. Secondary Copper Smelting
14. Secondary Nonferrous Metals
15. Sewage Sludge Incineration
16. Stainless and Nonstainless Steel Manufacturing Electric Arc Furnaces (EAF)
17. Steel Foundries
18. Wood Preserving

The source categories cover only area sources. Section 112 of the Clean Air Act defines an area source as any stationary emission source or group of stationary sources located within a contiguous area and under common control that emits or has the potential to emit, considering controls in the aggregate, less than 10 tons per year of the 188 regulated hazardous air pollutants and less than 25 tons per year of any combination of hazardous air pollutants.

The definitions for the source categories were developed from readily available information including the 1996 National Toxics Inventory and the 1987 Standard Industrial Classification Manual. Other sources of information included the Environmental Protection Agency web site and other sources on the Internet.

This set of definitions does not mean that EPA will regulate all of these sources. These draft definitions are only a beginning point, and a separate description will be developed during the regulatory process.

1. Acrylic Fibers/Modacrylic Fibers Production

NAICS: 325222, Noncellulosic Organic Fiber Manufacturing

SIC: 2824, Manmade Organic Fibers, Except Cellulosic

SCC: 30102408, Industrial Processes, Chemical Manufacturing, Synthetic Organic Fiber Manufacturing, Acrylic: Copolymer (Inorganic)

30102409, Industrial Processes, Chemical Manufacturing, Synthetic Organic Fiber Manufacturing, Acrylic: Controlled

30102410, Industrial Processes, Chemical Manufacturing, Synthetic Organic Fiber Manufacturing, Acrylic: Uncontrolled

30102411, Industrial Processes, Chemical Manufacturing, Synthetic Organic Fiber Manufacturing, Modacrylic: Dry Spun

30102412, Industrial Processes, Chemical Manufacturing, Synthetic Organic Fiber Manufacturing, Acrylic and Modacrylic: Wet Spun

30102413, Industrial Processes, Chemical Manufacturing, Synthetic Organic Fiber Manufacturing, Acrylic: Homopolymer (Inorganic): Wet Spun

The Acrylic Fibers/Modacrylic Fibers Production source category includes establishments primarily engaged in the manufacturing of manmade organic fibers, except cellulosic (including those of regenerated proteins, and of polymers or copolymers of such components as vinyl chloride, vinylidene chloride, linear esters, vinyl alcohols, acrylonitrile, ethylenes, amides, and related polymeric materials), in the form of monofilament, yarn, staple, or tow suitable for further manufacturing on spindles, looms, knitting machines, or other textile processing equipment. These industries use refined petroleum products and synthetic organic chemicals to make polymers, or large molecules made up of simple repeating chemical units. The polymers are then processed into manmade fibers.

Polymers can be synthesized on-site or purchased and used in fiber operations. The principle raw materials used include organic chemicals, polymers, and wood pulp. Principle end uses for the fibers include apparel, home textiles, carpets and rugs, industrial textiles, and miscellaneous consumer goods such as sewing thread. Associated processes important to this industry include preparation of reactants, polymerization, polymer recovery, polymer extrusion, and supporting operations such as unloading and storage of chemicals and equipment cleaning. Polymerization is accomplished in either continuous, batch or semi-batch processes using stirred tank reactors or linear-flow reactors. The five general methods used for polymerization are; bulk, solution, suspension, emulsion, and polycondensation. Polymer recovery usually involves three separation and purification steps: 1) unreacted monomer is separated from the polymer; 2) liquids and solids are separated, and 3) residual water or solvents trapped in the polymer are purged through drying. Subsequent processes to polymerization can include drawing, crimping, texturizing, and twisting.

2. Agricultural Chemicals and Pesticides Manufacturing

NAICS: 325311, Nitrogenous Fertilizer Manufacturing

325312, Phosphatic Fertilizer Manufacturing

32532, Pesticide and Other Agricultural Chemical Manufacturing

SIC: 2873, Nitrogenous Fertilizers

2874, Phosphatic Fertilizers

2879, Agricultural Chemicals, NEC

SCC: 301130, Industrial Processes, Chemical Manufacturing, Ammonium Sulfate (Use 301210 for Caprolactum Production)

301027, Industrial Processes, Chemical Manufacturing, Ammonium Nitrate Production

30101301, Industrial Processes, Chemical Manufacturing, Nitric Acid, Absorber Tail Gas (Pre-1970 Facilities)

30101302, Industrial Processes, Chemical Manufacturing, Nitric Acid, Absorber Tail Gas (Post-1970 Facilities)

30101399, Industrial Processes, Chemical Manufacturing, Nitric Acid, Other Not Classified

301040, Industrial Processes, Chemical Manufacturing, Urea Production

301033, Industrial Processes, Chemical Manufacturing, Pesticides

301028, Industrial Processes, Chemical Manufacturing, Normal Superphosphates

301029, Industrial Processes, Chemical Manufacturing, Triple Superphosphates

301030, Industrial Processes, Chemical Manufacturing, Ammonium Phosphates

The Agricultural Chemicals and Pesticides Manufacturing industry includes establishments involved in fertilizer manufacturing and formulating operations; the mixing, preparing, and packaging of nitrogenous and phosphatic fertilizers; and the formulating, preparing, and packaging of pesticides and other agricultural chemicals.

Nitrogenous fertilizer and materials production encompasses establishments primarily engaged in manufacturing nitrogenous fertilizer materials or mixed fertilizers from nitrogenous materials produced in the same establishment. Included are ammonia fertilizer compounds and anhydrous ammonia, nitric acid, ammonium nitrate, ammonium sulfate and nitrogen solutions, urea, and natural organic fertilizers (except compost) and mixtures.

Phosphatic fertilizer and materials production encompasses establishments primarily engaged in manufacturing phosphatic fertilizer materials, or mixed fertilizers from phosphatic materials produced in the same establishment. Included are phosphoric acid; normal, enriched, and concentrated superphosphates; ammonium phosphates; nitro-phosphates; and calcium meta-phosphates.

Also included in this source category are establishments primarily engaged in the formulation and preparation of ready-to-use agricultural and household pest control chemicals, including insecticides, fungicides, and herbicides, from technical chemicals or concentrates; and the production of concentrates which require further processing before use as agricultural pesticides. This category also includes establishments primarily engaged in manufacturing or formulating agricultural chemicals, not elsewhere classified, such as minor or trace elements and soil conditioners.

Pesticide production involves two main steps: 1) the manufacturing of the pesticide concentrate from basic chemical feedstocks such as petrochemicals and inorganic acids, and 2) the formulation and preparation of the pesticides for final use. Pesticide production processes generally include blending or diluting operations, particle size reduction operations, and packaging of formulations. Formulating, packaging, and repackaging can be performed in a variety of ways using automated or manual lines.

3. Auto Body Refinishing Paint Shops

NAICS: 81121, Automotive Body, Paint and Interior Repair and Maintenance

332812, Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers

SIC: 7532, Top, Body, and Upholstery Repair Shops and Paint Shops

3479, Coating, Engraving, and Allied Services, NEC- Includes Painting of Metal Products

SCC: 40200101, Petroleum and Solvent Evaporation, Surface Coating Operations, Surface Coating Application - General, Paint: Solvent-base

40200110, Petroleum and Solvent Evaporation, Surface Coating Operations, Surface Coating Application - General, Paint: Solvent-base

40200301, Petroleum and Solvent Evaporation, Surface Coating Operations, Surface Coating Application - General, Varnish/Shellac

40200310, Petroleum and Solvent Evaporation, Surface Coating Operations, Surface Coating Application - General, Varnish/Shellac

40200401, Petroleum and Solvent Evaporation, Surface Coating Operations, Surface Coating Application - General, Lacquer

40200410, Petroleum and Solvent Evaporation, Surface Coating Operations, Surface Coating Application - General, Lacquer

40200501, Petroleum and Solvent Evaporation, Surface Coating Operations, Surface Coating Application - General, Enamel

40200510, Petroleum and Solvent Evaporation, Surface Coating Operations, Surface Coating Application - General, Enamel

40200601, Petroleum and Solvent Evaporation, Surface Coating Operations, Surface Coating Application - General, Primer

40200610, Petroleum and Solvent Evaporation, Surface Coating Operations, Surface Coating Application - General, Primer

402016, Petroleum and Solvent Evaporation Surface Coating Operations,

Automobiles and Light Trucks

Included in the Auto Body Refinishing category are establishments primarily engaged in the repair of automotive tops, bodies, and interiors, or automotive painting and refinishing. Also included in the industry are establishments primarily engaged in customizing automobiles, trucks, and vans, except on a factory basis.

Also included in this category are establishments primarily engaged in performing the following types of services on metals, for the trade: (1) enameling, lacquering, and varnishing metal products; (2) hot dip galvanizing of mill sheets, plates and bars, castings, and formed products fabricated of iron and steel; hot dip coating such items with aluminum, lead, or zinc; retinning cans and utensils; (3) engraving, chasing and etching jewelry, silverware, notarial and other seals, and other metal products for purposes other than printing; and (4) other metal services, not elsewhere classified. This includes facilities which perform these types of activities on their own account on purchased metals or formed products.

Auto body refinishing is the repairing of worn or damaged automobiles, light trucks, and other vehicles, and refers to any coating applications that occur subsequent to those at original equipment manufacturing (OEM) assembly plants. This category covers solvent emissions from refinishing of automobiles, including paint solvents, thinning solvent, and solvents used for surface preparation and cleanup.

Auto body refinishing operations consist of four steps: (1) vehicle preparation, (2) primer application, (3) topcoat application, and (4) spray equipment cleaning. Prior to any painting, the surface is prepared, i.e., washed thoroughly with water and detergent and allowed to dry. It is then cleaned with a solvent to remove any wax, grease, and dirt to ensure proper adhesion of the primer and topcoats. A tack cloth is often used as a final step to remove any remaining dirt or debris prior to the coating application.

Next, the surface is primed to provide corrosion resistance, fill surface imperfections, and provide a bond for the topcoat. Primers fall into four general categories: prepcoat, primer-surfacers, primer-sealers, and sealers. A prepcoat is a metal conditioner that etches the surface and prevents flash rusting, which can occur from base metal exposure to the atmosphere. Prepcoats have good corrosion resistance and adhesion properties, but have little or no filling capacity. Primer-surfacers provide the best filling or 'build' properties for deep scratches or dents, but some of these provide limited corrosion protection. They are frequently used over prepcoats. The three types of primer-surfacers are nitrocellulose lacquer, acrylic lacquer, and alkyd enamel. Primer-sealers combine the corrosion resistance and adhesion properties of prepcoats with some of the scratch-filling capacity of primer-surfacers. Primer-sealers also add a sealing property needed when an old finish is being repainted. This type of primer is typically enamel-based. Sealers differ from primer-sealers in that they cannot be used as a primer and must be sprayed over a prepcoat, a primer-surfacer, or an old finish. Sealers are acrylic and lacquer-based products.

The third step is topcoat application, which consists of a series of coats applied over the primer. Topcoat determines the final color and appearance of the refinished area. For optional results, topcoats (as well as other coating applications) are typically applied in a spray booth, which minimizes the possibility of dirt adhering to the wet coating. Metallic finishes and some other finishes require a two-stage topcoat system, consisting of a basecoat and a clearcoat.

The last step in auto body refinishing is spray equipment cleaning. Spray equipment can be cleaned manually or with gun cleaning systems specially designed for this purpose. Shops that do not have spray gun cleaning systems usually rinse the outside of the gun and cup, add solvent to the cup, and then spray the solvent into the air or into a drum set aside for spent solvent. The cleaning solvent is recirculated until it is too contaminated to use. Waste solvents are then disposed of by evaporation or incineration, or are reclaimed via distillation.

4. Flexible Polyurethane Foam Production

NAICS: 32615, Urethane and Other Foam Product (except Polystyrene) Manufacturing

SIC: 3086, Plastic Foam Products (urethane and other foam products)

SCC: 30800801, Industrial Processes, Rubber and Miscellaneous Plastics Products, Plastic Foam Products, Expansion Process via Steam

30800802, Industrial Processes, Rubber and Miscellaneous Plastics Products, Plastic Foam Products, Molding

30800803, Industrial Processes, Rubber and Miscellaneous Plastics Products, Plastic Foam Products, Bead Storage

30801005, Industrial Processes, Rubber and Miscellaneous Plastics Products, Plastic Products Manufacturing, Foam Production– General Processes

The Flexible Polyurethane Foam Production source category includes facilities engaged in manufacturing foam made from a polymer containing a plurality of carbamate linkages in the chain backbone (polyurethane). Three types of polyurethane foam facilities fit in this category; slabstock flexible polyurethane foam (slabstock foam), molded flexible polyurethane foam (molded foam), and rebond foam. Slabstock foam is produced in large continuous buns that are then cut into the desired size and shape. Molded foam is produced by ‘shooting’ the foam mixture into a mold of the desired shape and size. Rebond foam is made from scrap foam that is converted into a material primarily used for carpet underlay.

Flexible slabstock foam is produced as a large continuous ‘bun’ that is later cut into sections

with the desired dimensions. There are variations in the design of the machines that produce the foam, they may be horizontal or vertical, with the horizontal foam line being the most common. A slabstock foam facility may have more than one foam line and there are different types of horizontal and vertical machines. One typical process moves raw ingredients from bulk chemical storage to smaller feed tanks. The chemicals are pumped from the feed tanks to the mixing head of the foam line where they are vigorously mixed. The amount of each chemical sent to the mixing head is controlled by metering pumps. The mixture is discharged through a mixing head into a trough where the reactions begin to occur. From this trough, the froth flows onto the foam tunnel. The mixture quickly spreads evenly across the width of the tunnel.

The bottom of the tunnel consists of a series of five adjustable fall-plates that are covered by paper. The foam reaches its maximum height, or full rise, about 25 feet from the nozzle. The full rise time is dependent on the grade of foam, with lower density foams rising highest and at the fastest rate. Instead of rising, the foam is actually expanding downward along the slope of the fall plates. The slope of the tunnel can be altered to allow for the changing reaction rates of different foam grades. The downward slope helps to flatten the top of the bun by cutting down on side-wall drag. Flat-top buns are desirable to eliminate waste foam. The sides of the foam tunnel are vertical conveyors, covered with plastic as they move the foam down the tunnel. The fall plates are stationary, and it is the moving side plastic and the bottom paper that move the foam to the belt conveyor.

The belt conveyor carrying the foam block moves at an average speed of 15 to 20 feet per minute. Additional time on the conveyor after full rise is required to allow the polymerization reactions to be completed so the foam will solidify. The side papers are then removed from the bun, and the bun is sawed into the desired lengths. After sawing, the end of the bun is marked with the foam grade, and the bun moves off the belt conveyor onto a roller-type conveyor moving at a higher rate. This conveyor continues through the wall of the pouring area, through the foam storage area, and then into the foam curing area. In the curing area, the buns are removed from the conveyor with overhead cranes and placed on the floor. Typically, buns are cured 12 to 24 hours before being moved into storage.

A typical molded foam production line includes multiple molds, with each mold consisting of top and bottom sections joined by hinges. The molds are mounted on a circular or oval-shaped track. Both the molds and the track can vary broadly in size. Mold sizes range from less than one foot to several feet. The track can be a small carousel, with fewer than 10 molds, or a large racetrack with over 20 molds. The molds travel around the track, and the necessary process operations are performed at fixed stations.

The first step in the molding cycle is the application of mold release agent. This is a substance that is applied to the mold to facilitate removal of the foam product. The mold release agent is typically a wax in a solvent carrier. The carrier may be either a chlorinated solvent or a naphtha petroleum solvent. Mold release agent is typically applied by a spray system. After the mold release agent is applied, any special components to be molded into the foam are placed in the mold. These might

include covers, springs, or reinforcing materials.

Raw materials, including polyol, diisocyanate, water, catalyst, and surfactant are all pumped to a common mixhead in predetermined amounts. The mixhead injects a precisely measured 'shot' of raw material into each mold. There are two types of mixheads, high-pressure and low-pressure. In a high-pressure system, mixing is achieved by the impingement of the high pressure streams within the mixhead. The low-pressure system relies on a rotating mixer within the mixhead to blend the raw chemicals together. The two types of mixheads have different cleaning requirements, resulting in a dramatic difference in overall emissions from the process.

After the raw materials are charged by the mixhead, the molds may be heated to accelerate foam curing reactions. This can be accomplished by pumping hot water through tubes in the body of the mold, or by passing the mold through the curing oven. The amount of heating required, if any, depends on the specific process.

The mold is then closed, and the polymerization reaction occurs, producing a foam product that fills the mold. Most molded foams are produced without any auxiliary blowing agent (ABA), using only the blowing action of carbon dioxide gas from the water-isocyanate reaction. After curing, the molds are opened and the product is removed. The mold is then cleaned and starts the circuit again. The entire cycle takes approximately ten minutes.

Another important variation of molded foams is the integral skin foam, also known as self-skinning foam. An integral skin foam is a foam with a dense, tough, outer surface. The skin is produced by overpacking the mold and using an ABA. The skin production is also driven by the temperature gradient between the center of the foam mass and the relatively cooler surface of the mold.

Most grades of molded foam, especially those using more reactive raw materials, have closed cells when they are initially removed from the mold. The cells are opened by mechanical or physical processes to prevent shrinkage. The most common methods used to open the foam cells is to 'crush' the foam by passing it through a set of rollers.

After a foam piece is removed from the mold and its cells are opened, it generally is trimmed and inspected for tears or holes. Any tears and holes are repaired. Repair operations are carried out at glue stations, which may be equipped with local ventilation systems to remove solvent vapors emanating from the glue.

Another flexible foam product is rebond. Rebond foam is also produced at stand-alone, or off-site facilities. Rebonding is a process where scrap foam is converted into a material that is used for carpet underlay and several other end-uses such as school bus seats.

A typical rebond production process uses scrap foam. The scraps are received in 'bales.' The

baled foam is loaded by conveyor into the bale breaker, which ‘chews’ the foam into smaller pieces. The scrap bales are sent to the bale-breaker as received, and often contain plastic and other non-foam materials. Magnets at the exit of the bale-breaker remove any metal pieces that could damage the grinders. The foam pieces from the bale-breaker fall through screens into the grinder where the scrap is converted into 3/4 to 3/8 inch pieces.

These small pieces are loaded into a blender, where a mixture of polyol and toluene diisocyanate (TDI) (or methylene diphenyl diisocyanate, MDI) is added. The foam and binder mixture, and occasionally a dye, is poured into a cylindrical mold, that is below floor level. This mold has a central core so that there is a hole that runs the length of the cylinder. Pressure and steam are applied to the mixture in the mold, and then the roll is taken out of the mold and allowed to cool or ‘set’ for about 24 hours.

5. Iron Foundries

NAICS: 331511, Iron Foundries (pt)

SIC: 3321, Gray Iron Foundries

3322, Malleable Iron Foundries

SCC: 304003, Secondary Metal Production: Grey Iron Foundries

304009, Secondary Metal Production: Malleable Iron

The Iron Foundries category includes establishments primarily engaged in manufacturing gray and ductile iron castings, including cast iron pressure and soil pipes and fittings, and establishments primarily engaged in manufacturing malleable iron castings. Five processes are involved in metal casting; (1) pattern making (2) mold and core preparation and pouring; (3) furnace charge preparation and metal melting; (4) shakeout, cooling and sand handling; and, (5) quenching, finishing, cleaning, and coating.

Pattern making, or foundry tooling, requires a high level of skill to achieve the close tolerance required of the patterns and coreboxes. This step is critical in the casting process since the castings produced can be no better than the patterns used to make them. In some pattern making shops, computer-aided drafting is used in the design of patterns. Patterns and corebox materials are typically metal, plastic, wood or plaster.

Molds and cores are usually made for each casting. These molds and cores are destroyed and separated from the casting during shakeout. Most sand is reused over and over in other molds; however, a portion of sand becomes spent after a number of uses and must be removed as waste.

Foundries typically use recycled scrap metals as their primary source of metal, and use metal ingot as a secondary source when scrap is not available. The first step in metal melting is preparation of the scrap materials. Preparation, which may also be done by the foundry's metal supplier, consists of cutting the materials to the proper size for the furnace and cleaning and degreasing the materials. Prepared scrap metal is weighed and additional metal, alloys, and flux may be added prior to adding the metal to the furnace. Adding metal to a furnace is called charging. Five types of furnaces are commonly used to melt metal in foundries; cupola, electric arc, reverberatory, induction and crucible.

For those foundries using sand molding and core making techniques, castings need to be cooled and separated from the sand mold. After molten metal has been ladled into the mold and begins to harden, it is transported to a cooling area where the casting solidifies before being separated from the mold. Larger, more mechanized foundries use automatic conveyor systems to transfer the casting and mold through a cooling tunnel on the way to the shakeout area. Less mechanized foundries allow the castings to cool on the shop floor. In the shakeout area, molds are typically placed on vibrating grids or conveyors to shake the sand loose from the casting. In some foundries, the mold may be manually separated from the casting.

Pressure die casting uses a permanent die (metal mold) in which molten metal is forced under high pressure. Dies are usually made from two blocks of steel, each containing part of the cavity, which are locked together while the casting is being made. The metal is held under pressure until it cools and solidifies. The die halves are then opened and the casting is removed, usually by means of an automatic ejection system. Dies are preheated and lubricated before being used, and are either air- or water-cooled to maintain the desired operating temperature.

6. Lead Acid Battery Manufacturing

NAICS: 335911, Storage Battery Manufacturing

SIC: 3691, Storage Batteries

SCC: 304005, Secondary Metal Production-Lead Battery Manufacture

The Lead Acid Battery Manufacturing source category includes establishments primarily engaged in manufacturing storage batteries. Lead acid storage batteries are produced from lead alloy ingots and lead oxide. The lead oxide may be prepared by the battery manufacturer or may be purchased from a supplier.

Battery grids are manufactured by either casting or stamping operations. In the casting operation, lead alloy ingots are charged to a melting pot, from which the molten lead flows into molds that form the battery grids. The stamping operation involves cutting or stamping the battery grids from lead sheets. The grids are often cast or stamped in doublets and split apart (slitting) after they have

been either flash dried or cured. The pastes used to fill the battery grids are made in batch-type processes. A mixture of lead oxide powder, water, and sulfuric acid produces a positive paste, and the same ingredients in slightly different proportions with the addition of an expander (generally a mixture of barium sulfate, carbon black, and organics), make the negative paste. Pasting machines then force these pastes into the interstices of the grids, which are made into plates. At the completion of this process, a chemical reaction starts in the paste and the mass gradually hardens, liberating heat. As the setting process continues, needle-shaped crystals of lead sulfate form throughout the mass. To provide optimum conditions for the setting process, the plates are kept at a relative humidity near 90 percent and a temperature near 32°C for about 48 hours and are then allowed to dry under ambient conditions.

After the plates are cured they are sent to the 3-process operation of plate stacking, plate burning, and element assembly in the battery case. In this process the doublet plates are first cut apart and, depending on whether they are to be dry-charged or wet-formed, are stacked in an alternating positive and negative block formation, with insulators between them. These insulators are made of materials such as non-conductive plastic or glass fiber. Leads are then welded to tabs on each positive or negative plate or in an element during the burning operation. An alternative to this operation, and more predominantly used than the manual burning operation, is the cast-on connection, and positive and negative tabs are then independently welded to produce an element. The elements are automatically placed into a battery case and a top is placed on the battery case. The posts on the case top are then welded to two individual points that connect the positive and negative plates to the positive and negative posts, respectively.

During dry-charge formation, the battery plates are immersed in a dilute sulfuric acid solution; the positive plates are connected to the positive pole of a direct current (DC) source and the negative plates connected to the negative pole of the DC source. In the wet formation process, this is done with the plates in the battery case. After forming, the acid may be dumped, fresh acid is added, and a boost charge is applied to complete the battery. In dry formation, the individual plates may be assembled into elements first and then formed in tanks or formed as individual plates. In the case of formed elements, the elements are then placed in the battery cases, the positive and negative parts of the elements are connected to the positive and negative terminals of the battery, and the batteries are shipped dry. Defective parts are either reclaimed at the battery plant or are sent to a secondary lead smelter. Lead reclamation facilities at battery plants are generally small pot furnaces for non-oxidized lead.

7. Miscellaneous Organic Chemical Manufacturing (MON)

Organic chemical manufacturing involves chemical reactions and separation processes conducted at elevated temperatures. Emissions from these processes result from exothermic reactions, vessel heating, gas sparging, depressurizations, displacements, as well as other events.

NAICS: 3521, Basic Chemical Manufacturing

This industry group comprises establishments primarily engaged in manufacturing chemicals using basic processes, such as thermal cracking and distillation. Chemicals manufactured in this industry group are usually separate chemical elements or separate chemically-defined compounds.

NAICS: 325110, Petrochemical Manufacturing

SIC: 2869, Industrial Organic Chemicals, NEC (aliphatics)

This industry comprises establishments primarily engaged in (1) manufacturing acyclic (i.e., aliphatic) hydrocarbons such as ethylene, propylene, and butylene made from refined petroleum or liquid hydrocarbon and/or (2) manufacturing cyclic aromatic hydrocarbons such as benzene, toluene, styrene, xylene, ethyl benzene, and cumene made from refined petroleum or liquid hydrocarbons.

NAICS: 325120, Industrial Gas Manufacturing

SIC: 2813, Industrial Gases

2869, Industrial Organic Chemicals, NEC (fluorocarbon gases)

This industry comprises establishments primarily engaged in manufacturing industrial organic and inorganic gases in compressed, liquid, and solid forms.

NAICS: 325191, Gum and Wood Chemical Manufacturing

SIC: 2861, Gum and Wood Chemicals

This U.S. industry comprises establishments primarily engaged in (1) distilling wood or gum into products, such as tall oil and wood distillates, and (2) manufacturing wood or gum chemicals, such as naval stores, natural tanning materials, charcoal briquettes, and charcoal (except activated).

NAICS: 325193, Ethyl Alcohol Manufacturing

SIC: 2869, Industrial Organic Chemicals, NEC (carbon bisulfide)

This U.S. industry comprises establishments primarily engaged in manufacturing nonpotable ethyl alcohol.

NAICS: 325199, All Other Basic Organic Chemical Manufacturing

SIC: 2869, Industrial Organic Chemicals (ethyl alcohol)

This U.S. industry comprises establishments primarily engaged in manufacturing basic organic chemical products (except aromatic petrochemicals, industrial gases, synthetic organic dyes and pigments, gum and wood chemicals, cyclic crudes and intermediates, and ethyl alcohol).

NAICS: 325221, Cellulosic Organic Fiber Manufacturing

SIC: 2823, Cellulosic Manmade Fibers

This U.S. industry comprises establishments primarily engaged in (1) manufacturing cellulosic (i.e., rayon and acetate) fibers and filaments in the form of monofilament, filament yarn, staple, or tow or (2) manufacturing and texturizing cellulosic fibers and filaments.

NAICS: 325520, Adhesive Manufacturing

SIC: 2891, Adhesives and Sealants

This industry comprises establishments primarily engaged in manufacturing adhesives, glues, and caulking compounds.

NAICS: 325611, Soap and Other Detergent Manufacturing

SIC: 2841, Soaps and Other Detergents, Except Specialty Cleaners

2844, Toilet Preparations (toothpaste)

This U.S. industry comprises establishments primarily engaged in manufacturing and packaging soaps and other detergents, such as laundry detergents; dishwashing detergents; toothpaste gels, and tooth powders; and natural glycerin.

NAICS: 325612, Polish and Other Sanitation Good Manufacturing

SIC: 2842, Specialty Cleaning, Polishing, and Sanitary Preparations

This U.S. industry comprises establishments primarily engaged in manufacturing and packaging polishes and specialty cleaning preparations.

NAICS: 325613, Surface Active Agent Manufacturing

SIC: 2843, Surface Active Agents, Finishing Agents, Sulfonated Oils, and Assistants

This U.S. industry comprises establishments primarily engaged in (1) manufacturing bulk surface

active agents for use as wetting agents, emulsifiers, and penetrants, and/or (2) manufacturing textiles and leather finishing agents used to reduce tension or speed the drying process.

NAICS: 325620, Toilet Preparation Manufacturing

SIC: 2844, Perfumes, Cosmetics, and Other Toilet Preparations (except toothpaste)

This industry comprises establishments primarily engaged in preparing, blending, compounding, and packaging toilet preparations, such as perfumes, shaving preparations, hair preparations, face creams, lotions (including sunscreens), and other cosmetic preparations.

NAICS: 325910, Printing Ink Manufacturing

SIC: 2893, Printing Ink

This industry comprises establishments primarily engaged in manufacturing printing and inkjet inks and inkjet cartridges.

NAICS: 325920, Explosives Manufacturing

SIC: 2892, Explosives

This industry comprises establishments primarily engaged in manufacturing explosives.

8. Pharmaceutical Production

NAICS: 325411, Medicinal and Botanical Manufacturing

325412, Pharmaceutical Preparation Manufacturing

325414, Biological Product (except Diagnostic) Manufacturing

SIC: 2833, Medicinal Chemicals and Botanical Products

2834, Pharmaceutical Preparations Manufacturing

2835, In Vitro and In Vivo Diagnostic Substances

2836, Biological Products, Except Diagnostic Substances

SCC: 301060, Industrial Processes, Chemical Manufacturing, Pharmaceutical Preparations

Pharmaceutical Production includes establishments primarily engaged in manufacturing, fabricating, or processing medicinal chemicals and pharmaceutical products. Also included are establishments primarily engaged in the grading, grinding, and milling of botanicals. Medicinal and botanical manufacturing includes establishments primarily engaged in: (1) manufacturing bulk organic and inorganic medicinal chemicals and their derivatives, and (2) processing (grading, grinding, and milling) bulk botanical drugs and herbs. Included in this industry are establishments primarily engaged in manufacturing agar-agar and similar products of natural origin, endocrine products, manufacturing or isolating basic vitamins, and isolating active medicinal principals such as alkaloids from botanical drugs and herbs.

Pharmaceutical preparations include establishments primarily engaged in manufacturing, fabricating, or processing drugs in the pharmaceutical preparations for human or veterinary use. The greater part of the products of these establishments are finished in the form intended for final consumption, such as ampoules, tablets, capsules, vials, ointments, medicinal powders, solutions, and suspensions. Products of this industry consist of two important lines, namely: (1) pharmaceutical preparations promoted primarily to the dental, medical, or veterinary professions, and (2) pharmaceutical preparations promoted primarily to the public.

In Vitro and In Vivo diagnostic substances include establishments primarily engaged in manufacturing in vitro and in vivo diagnostic substances, whether or not packaged for retail sale. These materials are chemical, biological, or radioactive substances used in diagnosing or monitoring the state of human or veterinary health by identifying and measuring normal or abnormal constituents of body fluids or tissues.

Biological products, except diagnostic substances, include establishments primarily engaged in the production of bacterial and virus vaccines, toxoids, and analogous products (such as allergenic extracts), serums, plasmas, and other blood derivatives for human or veterinary use, other than in vitro and in vivo diagnostic substances. Included in this industry are establishments primarily engaged in the production of microbiological products for other uses.

Most pharmaceutical products are produced in a multi-step manufacturing process. Pharmaceutical manufacturers themselves may perform all of the manufacturing steps that take comparatively basic chemicals and transform them into the typically complex molecules that are the active ingredients. The active ingredients are combined with excipients, binders, and fillers to produce finished dosage forms of the drug. Manufacturers might perform all of the steps at one site or they may perform steps at the manufacturer's different production sites.

Pharmaceutical manufacturers can also purchase commercially available pharmaceutical active ingredients and intermediates from other manufacturers or chemical brokers and rely on other manufacturers to perform some of the early or intermediate steps in the pharmaceutical manufacturing process. Many chemical manufacturers have divisions that specifically manufacture these

pharmaceutical active ingredients and intermediates for sale to pharmaceutical manufacturers. Finally, pharmaceutical manufacturers often contract with another manufacturer to have a particular pharmaceutical intermediate produced.

9. Plating and Polishing

NAICS: 332813, Electroplating, plating, polishing, anodizing, and coloring

SIC: 3471, Electroplating, plating, polishing, anodizing, and coloring

SCC: 30901001, Industrial Processes, Fabricated Metal Products, Electroplating Operations, Entire Process, General

30901002, Industrial Processes, Fabricated Metal Products, Electroplating Operations, Entire Process, General

30901003, Industrial Processes, Fabricated Metal Products, Electroplating Operations, Entire Process, Nickel

30901004, Industrial Processes, Fabricated Metal Products, Electroplating Operations, Entire Process, Copper

30901005, Industrial Processes, Fabricated Metal Products, Electroplating Operations, Entire Process, Zinc

30901007, Industrial Processes, Fabricated Metal Products, Electroplating Operations, Entire Process, Cadmium

30901097, Industrial Processes, Fabricated Metal Products, Electroplating Operations, Other Not Classified

30901098, Industrial Processes, Fabricated Metal Products, Electroplating Operations, Other Not Classified

30901099, Industrial Processes, Fabricated Metal Products, Electroplating Operations

30906005, Industrial Processes, Fabricated Metal Products, Porcelain Enamel/Ceramic Glaze Spraying, Ceramic Glaze: Plating

30500860, Industrial Processes, Mineral Products, Ceramic Clay/Tile Manufacture, Final Processing - Grinding and Polishing

30900303, Industrial Processes, Fabricated Metal Products, Abrasive Cleaning of Metal Parts, Polishing

This source category includes establishments primarily engaged in all types of electroplating, plating, anodizing, coloring, and finishing of metals and formed products for the trade. Also included in this industry are establishments which perform these types of activities, on their own account, on purchased metals or formed products.

Polishing can be performed using physical, chemical, or electrochemical processes. Hand polishing can be accomplished by applying hand held straight grinding machines to the surface of the workpiece. Both a chemical and mechanical process is used in the semiconductor manufacturing industry. Wafers are polished using an aluminum oxide/glycerin solution to provide uniform flatness. A final polishing step is performed to provide a smooth surface on the wafer for subsequent processing. In this step, wafers are mounted on a fixture, pressed against a polishing pad under high pressure, and rotated relative to the pad. The polishing slurry used typically contains silicon dioxide particles in a sodium hydroxide.

Electroplating is the process of applying a metallic coating to an article by passing an electric current through an electrolyte in contact with the article, thereby forming a surface having properties or dimensions different from those of the article. Essentially any electrically conductive surface can be electroplated. Special techniques, such as coating with metallic-loaded paints or silver-reduced spray, can be used to make nonconductive surfaces, such as plastic, electrically conductive for electroplating. Electroplated materials are generally used for a specific property or function, although there may be some overlap.

The essential components of an electroplating process are an electrode to be plated (the cathode or substrate), a second electrode to complete the circuit (the anode), an electrolyte containing the metal ions to be deposited, and a direct current power source. The electrodes are immersed in the electrolyte with the anode connected to the positive leg of the power supply and the cathode to the negative leg. As the current is increased from zero, a point is reached where metal plating begins to occur on the cathode. The plating tank is either made of or lined with totally inert materials to protect the tank. Anodes can be either soluble or insoluble, with most electroplating baths using one or the other type. The majority of power supplies are solid-state silicon rectifiers, which may have a variety of modifications, such as stepless controls, constant current, and constant voltage. Plate thickness is dependent on the cathode efficiency of a particular plating solution, the current density, and the amount of plating time.

Metal spraying or flame spraying involves applying a metallic coating to a workpiece by projecting molten or semimolten metal particles onto a substrate. Coatings can be sprayed from rod or wire stock or from powdered material. The process involves feeding the material into a flame where it is melted. The molten stock is then stripped from the end of the wire and atomized by a high-velocity

stream of compressed air or other gas that propels the material onto a prepared substrate or part. Metal spraying coatings are used in a wide range of special applications, including in insulating layers in applications such as induction heating coils, electromagnetic interference shielding, thermal barriers for rocket engines, nuclear moderators, films for hot isostatic pressing, and dimensional restoration of worn parts. Metal spraying is sometimes performed in front of a water curtain, which is a circulated water stream used to trap overspray, or a dry filter exhaust hood that captures the overspray and fumes. With water curtain systems, water is recirculated from a sump or tank. Wastewater is generated when the sump or tank is discharged. Metal spraying is typically not followed by rinsing.

Brass, which is an alloy of copper and zinc, is the most widely used alloy electroplate. Brass plating primarily is used for decorative applications, but it is also used for engineering applications such as for plating steel wire cord for steel-belted radial tires.

Cadmium plating is generally performed in alkaline cyanide baths that are prepared by dissolving cadmium oxide in a sodium cyanide solution. However, because of the hazards associated with cyanide use, noncyanide cadmium plating solutions are being used more widely. The primary noncyanide plating solutions are neutral sulfate, acid fluoborate, and acid sulfate.

Copper cyanide plating is widely used in many plating operations as a strike. However, its use for thick deposits is decreasing. For copper cyanide plating, cuprous cyanide must be complexed with either potassium or sodium to form soluble copper compounds in aqueous solutions. Other types of baths used in copper plating include copper pyrophosphate and copper sulfate baths. Copper pyrophosphate plating, which is used for plating on plastics and printed circuits requires more control and maintenance of the plating baths than does copper cyanide plating. Copper sulfate baths are used for plating printed circuits, electronics, rotogravure, and plastics, and for electroforming and decorative uses.

Gold and gold alloy plating are used in a wide variety of applications. Gold plating solutions can be classified in five general groups: alkaline gold cyanide, for gold and gold alloy plating; neutral cyanide gold, for high purity gold plating; acid gold cyanide, for bright hard gold and gold alloy plating; noncyanide (generally sulfite), for gold and gold plating; and miscellaneous.

Indium is generally electroplated using three types of plating baths: cyanide, sulfamate, and fluoborate. Indium is the only trivalent metal that can be electrodeposited readily from a cyanide solution. Cyanide baths are used in applications that require very high throwing power and adhesion.

Nickel plating is used for decorative, engineering, and electroforming purposes. Decorative nickel plating differs from other types of nickel plating in that the solutions contain organic agents. Nickel plating for engineering applications uses solutions that deposit pure nickel.

Palladium plating solutions are categorized as ammoniacal, chelated, or acid. Palladium alloys

readily with other metals, the most important of which is nickel. Solutions for platinum plating are similar to those used for palladium plating.

Rhodium plating has traditionally been used as decorative plating in jewelry and silverware, but its use for electronics and other industrial applications has been increasing.

Ruthenium electroplating is a good electrical conductor and produces a hard deposit.

Silver plating traditionally has been performed using a cyanide-based plating solution. Although some noncyanide solutions have been developed, due to various shortcomings, cyanide solutions are still commonly used.

Fluoroborate and fluoboric acid can be used to plate all percentages of tin and lead. Alloys of tin and lead are most commonly used for plating in the proportions of 60 percent tin and 40 percent lead. Tin plating is generally performed using one of three types of plating solutions; stannous fluoborate, stannous sulfate, or sodium or potassium stannate, or by the halogen tin process. Tin-nickel alloy plating is used in light engineering and electronic applications and is used as an alternative to decorative chromium plating.

The most widely used zinc plating solutions are categorized as acid chloride, alkaline noncyanide, and cyanide. The most widely used zinc alloys for electroplating are zinc-nickel, zinc-cobalt, and zinc-iron.

10. Polyvinyl Chloride and Copolymers Production

NAICS: 325211, Plastics Material and Resin Manufacturing

SIC: 2821, Plastics Materials-Includes Polyvinyl Chloride Resins

SCC: 646300, MACT Source Categories, Vinyl-based Resins, Polyvinyl Chloride and Copolymers Production, Suspension Process

646310, MACT Source Categories, Vinyl-based Resins, Polyvinyl Chloride and Copolymers Production, Dispersion Process

646320, Polyvinyl Chloride and Copolymers Production, Solvent Process

646330, Polyvinyl Chloride and Copolymers Production, Bulk Process

The Polyvinyl Chloride (PVC) and Copolymers Production source category includes establishments primarily engaged in manufacturing synthetic resins, plastics materials, and

nonvulcanizable elastomers. Important products of this industry include: cellulose plastics materials; phenolic and other tar acid resins; urea and melamine resins; vinyl resins; styrene resins; alkyd resins; acrylic resins; polyethylene resins; polypropylene resins; rosin modified resins; coumarone-indene and petroleum polymer resins; miscellaneous resins, including polyamide resins, silicones, polyisobutylenes, polyesters, polycarbonate resins, acetal resins, and fluorohydrocarbon resins; and casein plastics.

Polyvinyl chloride and copolymer products have a large number of commercial and industrial applications. It is the manufacture of the resins used to make these products that is considered PVC and copolymers production. The resins are produced in a variety of mediums resulting from one of four basic polymerization process types: suspension, emulsion, bulk, and solution. Producing these resins involves batch reactor processes where vinyl chloride monomer (VCM) is polymerized with itself as a homopolymer or copolymerized with varying amounts of vinyl acetate, ethylene, propylene, vinylidene chloride or acrylates. The resulting resins are generally dried into nontoxic powders or granules that are compounded with auxiliary ingredients and converted into a variety of plastic end products. These end products can be used in a large number of applications, including latex paints, coatings, adhesives, clear plastics, rigid plastics, and flooring.

The PVC is not a HAP, but manufacturing PVC requires VCM, which is a HAP, as a primary feedstock, and trace amounts of unreacted VCM may linger in the PVC product. There are basically two ways for HAP to be introduced to the atmosphere from these processes: either the HAP is released from an opening or leak in the process equipment, or the residual HAP in the product become airborne. Stripping at the production stage to recover unreacted feedstock reduces the air emissions from the product by reducing the residual HAP in the product.

11. Pressed and Blown Glass and Glassware Manufacturing

NAICS: 327212, Other Pressed and Blown Glass and Glassware Manufacturing

327213, Glass Container Manufacturing

SIC: 3229, Pressed and Blown Glass

3221, Glass Containers

SCC: 30501404, Industrial Processes, Mineral Products, Glass Manufacture, Pressed and Blown Glass, Melting Furnace

30501408, Industrial Processes, Mineral Products, Glass Manufacture, Pressed and Blown Glass, Forming/Finishing

30501410, Industrial Processes, Mineral Products, Glass Manufacture, Raw Material

Handling (All Types of Glass)

30501411, Industrial Processes, Mineral Products, Glass Manufacture, General

30501412, Industrial Processes, Mineral Products, Glass Manufacture, Hold Tanks

30501416, Industrial Processes, Mineral Products, Glass Manufacture, Glass Manufacturing

The Pressed and Blown Glass and Glassware source category includes establishments primarily engaged in manufacturing glass and glassware, not elsewhere classified, pressed, blown, or shaped from glass produced in the same establishment. Establishments primarily engaged in manufacturing textile glass fibers are also included in this industry, as are those primarily engaged in using different types of lime, silica, soda ash and other additives to manufacture glass container products.

Production of glass involves five main procedures: mixing, melting, forming, annealing, and finishing. These procedures typically apply to all types of commercial glass formation. The two principle types of mixing are wet mixing and batch agglomeration. Glass with a large silicon dioxide content is wet mixed in a pan-type mixer, which is first dry-blended and then wet-blended by adding small amounts of water. Glasses with high lead oxide are mixed by batch agglomeration, whereby batch particles are coated with each other using the smearing action of a Muller-type mixer. The mixed batch is delivered to a melting unit through a feeder.

The type of melting unit employed depends on the quantity and quality of glass to be processed. For small production and special glass, melting is performed in pot furnaces or crucibles containing up to two tons of glass. In large factories, a dozen or so pot furnaces may be heated by one central furnace. Larger batches are melted in large covered furnaces or tanks to which heat is supplied by a flame. For high quality glass, small continuous melting tanks are used to process low volumes of material. Large quantities of high quality glass are melted in continuous regenerative furnaces that recover waste heat from burned gases. Flat glass furnaces provide a larger amount of quality glass and are longer than furnaces used by glass container manufacturers. Although glass tanks are fired by gas or oil, auxiliary heating with electricity is common in the United States. After the glass has melted, the molten glass is taken from the tanks to the forming operation.

Forming processes are different for each type of glass product. Container glass products such as glass bottles and jars are sometimes mouth blown, but are typically formed with automatic machines. In automatic processes, a stream of glass is cut by shears into individual gobs, which are fed to a blank mold. The gob is then formed into a rough blank, or parison, by either a plunger or compressed air; at this stage the bottle opening is shaped. The blank mold opens and is then transferred to the final or blow mold, where it is blown into shape using an air compressor. Pressing is used to form flat items such as plates by pressing the glass between a plunger and a mold. Drawing and casting are forming

processes which involve pouring molten glass into a mold. The molds for the glass containers resemble the containers.

Once formed, all glass articles need to be slowly cooled or annealed, usually in a long oven called a lehr. The purpose of annealing is to reduce the internal stresses which can crack the glass during cooling. Internal stresses are created because of temperature variations throughout the piece; different parts of the glass become rigid at different times.

The two types of finishing processes are mechanical and chemical. Mechanical processes include cutting, drilling, grinding, and polishing. Chemical treatments are used to alter the strength, appearance, and durability of the product. Acid polishing is performed with a mixture of hydrofluoric and sulfuric acids to alter the strength or durability of the glass. Chemically strengthened glass is formed by immersing the product into a potassium nitrate bath. The larger potassium ion replaces the sodium ion which produces a surface compression layer. Chemical strengthening is an expensive process which is most often used in the production of large screen television faceplates. Frosting and etching are performed with dilute hydrofluoric acid. Commercial glass contains oxides, such as aluminum and magnesium oxides, and other ingredients to help in oxidizing, finishing, or decolorizing. Once finished, the glass products are cleaned using several agents, including aqueous solvents, organic solvents, and hydrocarbon or halocarbon solvents.

12. Primary Nonferrous Metals– Zinc, Cadmium, and Beryllium

NAICS: 331419, Primary Smelting and Refining of Nonferrous Metals, Except Copper and Aluminum

SIC: 3339, Primary Smelting and Refining of Nonferrous Metals, Except Copper and Aluminum

SCC: 303030, Industrial Processes, Primary Metal Production, Zinc Production

30399999, Industrial Processes, Primary Metal Production, Other Not Classified

This source category includes establishments primarily engaged in smelting and refining the nonferrous metals; zinc, cadmium, and beryllium. Primary smelting and refining produces metals directly from ores. 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.

Primary zinc smelters process zinc sulfide ore (sphalerite) concentrates to produce metallic zinc or zinc oxide. Cadmium oxide is a major by-product of primary zinc smelting. Smelters reduce zinc sulfide concentrates to metallic zinc using either of two processes; electrolytic deposition from a sulfate solution or by a pyrometallurgical reduction process using distillation in electric retort furnaces. Both of these processes begin with the elimination of most of the sulfur in the ore concentrate using a roasting process that converts the zinc sulfide concentrate to an impure zinc oxide called calcine. Sulfur dioxide emissions from the roasting processes at all of the U.S. primary zinc smelters are controlled by routing the roaster off-gases to an on-site sulfuric acid plant. Cadmium and lead volatilize during roasting and are discharged in the roaster off gases. These metal vapors are subsequently recovered by the downstream particulate matter controls necessary to protect the sulfuric acid plant catalysts.

In the electrolytic deposition process, the desulfurized calcine from the roaster is first processed through a series of leaching and purification operations to dissolve the zinc oxide into an electrolyte solution. This solution is poured into cells where metallic zinc is recovered in a batch operation by passing current through the electrolyte solution, causing zinc to deposit on an aluminum cathode.

During the acid leaching step of the electrolytic process, zinc and other metals present in the calcine are dissolved into solution. Cadmium is precipitated from the solution by adding zinc dust. The cadmium precipitate is filtered and formed into a cake. Cake is further purified and cadmium metal is recovered using an electrolytic process. Recovered cadmium is melted in a kettle furnace and poured from the furnace into casting molds. Molten cadmium can also be charged to a second oxidizing furnace (an indirect-fired furnace with a sealed chamber) to produce cadmium oxide. By maintaining a controlled oxidizing atmosphere in the chamber, cadmium metal vapors are converted into cadmium oxide. The cadmium oxide is cooled and discharged to a dedicated baghouse to recover the cadmium oxide as powder. The solid cadmium oxide is then screened and packaged in an enclosed room which is ventilated through a separate baghouse to control cadmium oxide emissions to the atmosphere.

13. Secondary Copper Smelting

NAICS: 331423, Secondary Smelting, Refining, and Alloying of Copper

SIC: 3341, Secondary Smelting and Refining of Nonferrous Metals

SCC: 30400230, Industrial Processes, Secondary Metal Production, Copper, Scrap Metal Pretreatment

30400299, Industrial Processes, Secondary Metal Production, Copper, Other Not Classified

The Secondary Copper Smelting source category includes establishments primarily engaged in recovering copper from new and used scrap and dross or in producing alloys from purchased refined metals.

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. 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.

The matte is further processed by a method known as ‘converting.’ The slag is tapped from the furnace and stored or discarded in slag piles on the 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 fitted with a row of pipes. 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.

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. Sulfur dioxide from the converters is collected and fed into the gas purification system together with that from the smelting furnace and is 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 or more 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' (SXEW) process.

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-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.

14. Secondary Nonferrous Metals

NAICS: 331492, Secondary Smelting, Refining, and Alloying of Nonferrous Metal (except Copper and Aluminum)

SIC: 3341, Secondary Smelting and Refining of Nonferrous Metals

SCC: 304006, Secondary Metal Production, Magnesium

30400801, Secondary Metal Production, Zinc

30400812, Industrial Processes, Secondary Metal Production, Zinc, Crushing/Screening of Zinc Residues

30400840, Industrial Processes, Secondary Metal Production, Zinc, Alloying

30400851, Industrial Processes, Secondary Metal Production, Zinc, Retort and Muffle Distillation: Pouring

30400852, Industrial Processes, Secondary Metal Production, Zinc, Retort and Muffle Distillation: Casting

30400853, Industrial Processes, Secondary Metal Production, Zinc, Graphite Rod Distillation

30400854, Industrial Processes, Secondary Metal Production, Zinc, Retort Distillation/Oxidation

30400855, Industrial Processes, Secondary Metal Production, Zinc, Muffle Distillation/Oxidation

30400866, Industrial Processes, Secondary Metal Production, Zinc, Sodium Carbonate Leaching

30400874, Industrial Processes, Secondary Metal Production, Zinc, Graphite Rod Distillation

30400875, Industrial Processes, Secondary Metal Production, Zinc, Retort Distillation/Oxidation

30400876, Industrial Processes, Secondary Metal Production, Zinc, Muffle Distillation/Oxidation

30400877, Industrial Processes, Secondary Metal Production, Zinc, Retort Reduction

30400899, Industrial Processes, Secondary Metal Production, Zinc, Other Not Classified

304010, Secondary Metal Production, Nickel

304020, Secondary Metal Production, Furnace Electrode Manufacture

304022, Secondary Metal Production, Metal Heat Treating

304049, Secondary Metal Production, Miscellaneous Casting and Fabricating

304051, Secondary Metal Production, Metallic Lead Products

304800, Secondary Metal Production, Equipment Leaks

304820, Secondary Metal Production, Wastewater, Aggregate

304825, Secondary Metal Production, Wastewater, Points of Generation

304888, Secondary Metal Production, Fugitive Emissions

304820, Industrial Processes, Secondary Metal Production, Wastewater, Aggregate

304825, Industrial Processes, Secondary Metal Production, Wastewater, Points of Generation

304888, Industrial Processes, Secondary Metal Production, Fugitive Emissions

304900, Secondary Metal Production, Fuel Fired Equipment

30499999, Secondary Metal Production, Other Not Classified

The Secondary Nonferrous Metals source category includes establishments primarily engaged in recovering nonferrous metals and alloys from new and used scrap and dross or in producing alloys from purchased refined metals. This industry includes establishments engaged in both the recovery and alloying of precious metals. Plants engaged in the recovery of tin through secondary smelting and refining, as well as by chemical processes, are included in this industry.

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.

15. Sewage Sludge Incineration

NAICS: 562213, Solid Waste Combustors and Incinerators

SIC: 4953, Refuse Systems

SCC: 50200506, Solid Waste Disposal, Commercial/Institutional, Sludge

50200515, Solid Waste Disposal, Commercial/Institutional, Sewage Sludge Incinerator, Multiple Hearth

50200516, Solid Waste Disposal, Commercial/Institutional, Sewage Sludge Incinerator, Fluidized Bed

50200517, Solid Waste Disposal, Commercial/Institutional, Sewage Sludge Incinerator, Electric Infrared

50200518, Solid Waste Disposal, Commercial/Institutional, Sewage Sludge Incinerator, Single Hearth Cyclone

50200519, Solid Waste Disposal, Commercial/Institutional, Sewage Sludge Incinerator, Rotary Kiln

50200520, Solid Waste Disposal, Commercial/Institutional, Sewage Sludge Incinerator, High Pressure, Wet Oxidation

50300506, Waste Disposal, Solid Waste Disposal, Industrial, Incineration, Sludge

50300515, Solid Waste Disposal, Industrial, Sewage Sludge Incinerator, Multiple Hearth

50300516, Solid Waste Disposal, Industrial, Sewage Sludge Incinerator, Fluidized Bed

50300517, Solid Waste Disposal, Industrial, Sewage Sludge Incinerator, Electric Infrared

50300518, Solid Waste Disposal, Industrial, Sewage Sludge Incinerator, Single Hearth Cyclone

50300519, Solid Waste Disposal, Industrial, Sewage Sludge Incinerator, Rotary Kiln

50300520, Solid Waste Disposal, Industrial, Sewage Sludge Incinerator, High Pressure, Wet Oxidation

50100506, Waste Disposal, Solid Waste Disposal, Government, Other Incineration, Sludge

50100515, Waste Disposal, Solid Waste Disposal, Government, Other Incineration, Sludge, Multiple Hearth

50100516, Waste Disposal, Solid Waste Disposal, Government, Other Incineration, Sludge, Fluidized Bed

50100517, Waste Disposal, Solid Waste Disposal, Government, Other Incineration, Sludge, Electric Infrared

50100518, Waste Disposal, Solid Waste Disposal, Government, Other Incineration, Sewage Sludge Incinerator, Single Hearth Cyclone

50100519, Waste Disposal, Solid Waste Disposal, Government, Other Incineration, Sewage Sludge Incinerator, Rotary Kiln

50100520, Waste Disposal, Solid Waste Disposal, Government, Other Incineration, Sewage Sludge Incinerator, High Pressure, Wet Oxidation

The Solid Waste Combustors and Incinerators source category includes establishments primarily engaged in the collection and disposal of refuse by processing or destruction or in the operation of incinerators, waste treatment plants, landfills, or other sites for disposal of such materials. Three main types of incinerators are used: multiple hearth, fluidized bed, and electric infrared. Some sludge is co-fired with municipal solid waste in combustors based on refuse combustion technology. Refuse co-fired with sludge in combustors based on sludge incinerating technology is limited to multiple hearth incinerators.

The basic multiple hearth furnace (MHF) is a vertically oriented cylinder. The outer shell is constructed of steel, lined with refractory, and surrounds a series of horizontal refractory hearths. A hollow cast iron rotating shaft runs through the center of the hearths. Cooling air is introduced into the shaft which extends above the hearths. Each rabble arm is equipped with a number of teeth, approximately 6 inches in length, and spaced about 10 inches apart. The teeth are shaped to rake the sludge in a spiral motion, alternating in direction from the outside in, to the inside out, between hearths. Typically, the upper and lower hearths are fitted with four rabble arms, and the middle hearths are fitted with two. Burners, providing auxiliary heat, are located in the sidewalls of the hearths.

In most multiple hearth furnaces, partially dewatered sludge is fed onto the perimeter of the top hearth. The rabble arms move the sludge through the incinerator by raking the sludge toward the center shaft where it drops through holes located at the center of the hearth. In the next hearth the sludge is raked in the opposite direction. This process is repeated in all of the subsequent hearths. The effect of the rabble motion is to break up solid material to allow better surface contact with heat and oxygen. A sludge depth of about 1 inch is maintained in each hearth at the design sludge flow rate.

Scum may also be fed to one or more hearths of the incinerator. Scum is the material that floats on wastewater. Scum may be removed from many treatment units including preaeration tanks,

skimming tanks, and sedimentation tanks.

Ambient air is first ducted through the central shaft and its associated rabble arms. A portion, or all, of this air is then taken from the top of the shaft and recirculated into the lowermost hearth as preheated combustion air. Shaft cooling air which is not circulated back into the furnace is ducted into the stack downstream of the air pollution control devices. The combustion air flows upward through the drop holes in the hearths, countercurrent to the flow of the sludge, before being exhausted from the top hearth. Air enters the bottom to cool the ash. Provisions are usually made to inject ambient air directly into the middle hearths as well.

From the standpoint of the overall incineration process, multiple hearth furnaces can be divided into three zones. The upper hearths comprise the drying zone where most of the moisture in the sludge is evaporated. The combustion zone can be further subdivided into the upper-middle hearths where the volatile gases and solids are burned, and the lower-middle hearths where most of the fixed carbon is combusted. The third zone, made up of the lowermost hearth(s), is the cooling zone. In this zone, the ash is cooled as its heat is transferred to the incoming combustion air.

Multiple hearth furnaces are sometimes operated with afterburners to further reduce odors and concentration of unburned hydrocarbons. In afterburning, furnace exhaust gases are ducted to a chamber where they are mixed with supplemental fuel and air and completely combusted. Some incinerators have the flexibility to allow sludge to be fed to a lower hearth, thus allowing the upper hearth(s) to function essentially as an afterburner.

Fluidized bed combustors (FBCs) consist of a vertically oriented outer shell constructed of steel and lined with refractory. Tuyeres (nozzles designed to deliver blasts of air) are located at the base of the furnace within a refractory-lined grid. A bed of sand rests upon the grid. Two general configurations can be distinguished on the basis of how the fluidizing air is injected into the furnace. In the "hot windbox" design the combustion air is first preheated by passing through a heat exchanger where heat is recovered from the hot flue gases. Alternatively, ambient air can be injected directly into the furnace from a cold windbox.

Partially dewatered sludge is fed into the lower portion of the furnace. Air injected through the tuyeres simultaneously fluidizes the bed of hot sand and the incoming sludge. As the sludge burns, fine ash particles are carried out the top of the furnace. Some sand is also removed in the air stream; sand make-up requirements are on the order of 5 percent for every 300 hours of operation.

Combustion of the sludge occurs in two zones. Within the bed itself, evaporation of the water and pyrolysis of the organic materials occur nearly simultaneously as the temperature of the sludge is rapidly raised. In the second zone, the remaining free carbon and combustible gases are burned. The second zone functions essentially as an afterburner.

Fluidization achieves nearly ideal mixing between the sludge and the combustion air and the turbulence facilitates the transfer of heat from the hot sand to the sludge. The most noticeable impact of the better burning atmosphere provided by a fluidized bed incinerator is seen in the limited amount of excess air required for complete combustion of the sludge.

Electric infrared incinerators consist of a horizontally oriented, insulated furnace. A woven wire belt conveyor extends the length of the furnace and infrared heating elements are located in the roof above the conveyor belt. Combustion air is preheated by the flue gases and is injected into the discharge end of the furnace. Electric infrared incinerators consist of a number of prefabricated modules, which can be linked together to provide the necessary furnace length.

The dewatered sludge cake is conveyed into one end of the incinerator. An internal roller mechanism levels the sludge into a continuous layer approximately one inch thick across the width of the belt. The sludge is sequentially dried and then burned as it moves beneath the infrared heating elements. Ash is discharged into a hopper at the opposite end of the furnace. The preheated combustion air enters the furnace above the ash hopper and is further heated by the outgoing ash. The direction of air flow is countercurrent to the movement of the sludge along the conveyor. Exhaust gases leave the furnace at the feed end.

Other technologies used for incineration of sewage sludge include cyclonic reactors, rotary kilns, and wet oxidation reactors. The cyclonic reactor is designed for small capacity applications. It is constructed of a vertical cylindrical chamber that is lined with refractory. Preheated combustion air is introduced into the chamber tangentially at high velocities. The sludge is sprayed radially toward the hot refractory walls and combustion occurs rapidly. The ash is removed with the flue gases. Rotary kilns are also generally used for small capacity applications. The kiln is inclined slightly from the horizontal plane, with the upper end receiving both the sludge feed and the combustion air. A burner is located at the lower end of the kiln and ash is deposited into a hopper located below the burner. The wet oxidation process is not strictly one of incineration; instead it utilizes oxidation at elevated temperature and pressure in the presence of water (flameless combustion). Thickened sludge is first ground and mixed with a stoichiometric amount of compressed air. The slurry is then pressurized. The mixture is circulated through a series of heat exchangers before entering a pressurized reactor. Steam is usually used for auxiliary heat. The water and remaining ash are circulated out the reactor and are finally separated in a tank or lagoon. The liquid phase is recycled to the treatment plant. Offgases must be treated to eliminate odors: wet scrubbing, afterburning, or carbon absorption may be used.

16. Stainless and Nonstainless Steel Manufacturing Electric Arc Furnaces (EAF)

NAICS: 324199, All Other Petroleum and Coal Products Manufacturing

331221, Rolled Steel Shape Manufacturing

331111, Iron and Steel Mills

33121, Iron and Steel Pipe and Tube Manufacturing from Purchased Steel

332811, Metal Heat Treating

332211, Cutlery and Flatware (except Precious) Manufacturing

332999, All Other Miscellaneous Fabricated Metal Products Manufacturing

339912, Silverware and Hollowware Manufacturing

SIC: 3312, Steel Works, Blast Furnaces, and Rolling Mills

3317, Steel Pipes and Tubes

3398, Metal Heat Treating

3914, Silverware, Plated Ware, and Stainless Steel Ware

SCC: 30300910, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Pickling

30300911, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Soaking Pits

30300912, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Grinding

30300915, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Hot Metal (Iron) Transfer to Steelmaking Furnace

30300916, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Charging: BOF

30300917, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Tapping: BO

30300918, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Charging: Open Hearth

30300919, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Tapping: Open Hearth

30300920, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Hot Metal Desulfurization

30300921, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Teeming (Unleaded Steel)

30300923, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Steel Furnace Slag Tapping and Dumping

30300924, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Steel Furnace Slag Processing

30300925, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Teeming (Leaded Steel)

30300927, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Steel Scrap Preheater

30300928, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Argon-oxygen Decarburization

30300929, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Steel Plate Burner/Torch Cutter

30300930, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Q-BOP Melting and Refining

30300931, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Hot Rolling

30300932, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Scarfing

30300935, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Cold Rolling

30300936, Industrial Processes, Primary Metal Production, Steel Manufacturing (See

3-03-015 for Integrated Iron & Steel MACT), Coating: Tin, Zinc, etc.

30300998, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Other Not Classified

30300999, Industrial Processes, Primary Metal Production, Steel Manufacturing (See 3-03-015 for Integrated Iron & Steel MACT), Other Not Classified

303003, Industrial Processes, Primary Metal Production, By-product Coke Manufacturing

The Stainless and Nonstainless Steel Manufacturing Electric Arc Furnaces (EAF) source category includes establishments primarily engaged in manufacturing hot metal, pig iron, and silvery pig iron from iron ore and iron and steel scrap; converting pig iron, scrap iron, and scrap steel into steel; and in hot-rolling iron and steel into basic shapes, such as plates, sheets, strips, rods, bars, and tubing. Merchant blast furnaces and byproduct or beehive coke ovens are also included in this industry. Also included are establishments primarily engaged in the production of welded or seamless steel pipe and tubes and heavy riveted steel pipe from purchased materials, those establishments primarily engaged in heat treating of metal for the trade, and establishments primarily engaged in manufacturing flatware (including knives, forks, and spoons), hollowware, ecclesiastical ware, trophies, trays, and related products made of sterling silver; of metal plated with silver, gold, or other metal; of nickel silver; of pewter; or of stainless steel. Also included are establishments primarily engaged in manufacturing table flatware with blades and handles of metal.

In the steelmaking process that uses an electric arc furnace (EAF), the primary raw material is scrap metal, which is melted and refined using electric energy. During melting, oxidation of phosphorous, silicon, manganese, carbon and other materials occurs and a slag containing some of these oxidation products forms on top of the molten metal. Oxygen is used to decarburize the molten steel and to provide thermal energy. This is a batch process with a cycle time of about two to three hours. Since scrap metal is used instead of molten iron, there are no cokemaking or ironmaking operations associated with steel production that use an EAF.

The process produces metal dust, slag, and gaseous products. Particulate matter and gases evolve together during the steelmaking process and are conveyed into a gas cleaning system. These emissions are cleaned using a wet or dry system. The particulate matter that is removed as emissions in the dry system is referred to as EAF dust, or EAF sludge if it is from a wet system and it is a listed hazardous waste. The composition of EAF dust can vary greatly depending on the scrap composition and furnace additives. The primary component is iron or iron oxides, and it may also contain flux (lime and/or fluorspar), zinc, chromium and nickel oxides (when stainless steel is being produced) and other metals associated with the scrap. The two primary hazardous constituents of EAF emission control dust are lead and cadmium. Generally, 20 pounds of dust per ton of steel is expected, but as much as

40 pounds of dust per ton of steel may be generated, depending on production practices. Oils are burned off charges of oil-bearing scrap in the furnace. Minor amounts of nitrogen oxides and ozone are generated during the melting process. The furnace is extensively cooled by water; however, this water is recycled through cooling towers.

17. Steel Foundries

NAICS: 331512, Steel Investment Foundries

331513, Steel Foundries (except Investment)

SIC: 3324, Steel Investment Foundries

3325, Steel Foundries, Not Elsewhere Classified

SCC: 304007, Industrial Processes, Secondary Metal Production, Steel Foundries

30301501, Industrial Processes, Primary Metal Production, Integrated Iron and Steel Manufacturing (See also 3-03-008 & 3-03-009)

The Steel Foundries source category includes establishments primarily engaged in manufacturing steel investment castings and establishments primarily engaged in manufacturing steel castings, that are not elsewhere classified. The basic operations in all foundries are pattern and mold making, metal melting, pouring of the molten metal into some type of mold, cooling of the casting, and separation of the solid casting from the mold.

The traditional forming method, called ingot teeming, has been to pour the metal into ingot molds, allowing the steel to cool and solidify. The alternative method of forming steel, called continuous casting accounted for more than 86 percent of raw steel produced in the U.S. in 1992. The continuous casting process bypasses several steps of the conventional ingot teeming process by casting steel directly into semifinished shapes. Molten steel is poured into a reservoir from which it is released into the molds of the casting machine. The metal is cooled as it descends through the molds, and before emerging, a hardened shell is formed. As the semifinished shapes proceed on the runout table, the center also solidifies, allowing the cast shape to be cut into lengths.

Process contact water cools the continuously cast steel and is collected in settling basins along with oil, grease, and mill scale generated in the casting process. The scale settles out and is removed and recycled for sintering operations, if the mill has a Sinter Plant. Waste treatment plant sludge is also generated.

The steel is further processed to produce slabs, strips, bars, or plates through various forming operations. The most common hot forming operation is hot rolling, where heated steel is passed between two rolls revolving in opposite directions. Modern hot rolling units may have as many as 13 stands, each producing an incremental reduction in thickness. The final shape and characteristics of a hot formed piece depend on the rolling temperature, the roll profile, and the cooling process after rolling. Wastes generated from hot rolling include waste treatment plant sludge and scale.

In subsequent cold forming, the cross-sectional area of unheated steel is progressively reduced in thickness as the steel passes through a series of rolling stands. Generally, wires, tubes, sheet and strip steel products are produced by cold rolling operations. Cold forming is used to obtain improved mechanical properties, better machinability, special size accuracy, and the production of thinner gages than hot rolling can accomplish economically. During cold rolling, the steel becomes hard and brittle. To make the steel more ductile, it is heated in an annealing furnace.

Process contact water is used as a coolant for rolling mills to keep the surface of the steel clean between roller passes. Cold rolling operations also produce a waste treatment plant sludge, primarily due to the lubricants applied during rolling. Grinding from resurfacing of the worn rolls and disposal of used rolls can be a significant contributor to the plant's wastestream.

18. Wood Preserving

NAICS: 321114, Wood Preservation

SIC: 2491, Wood Preserving

SCC: 30700407, Industrial Processes, Pulp and Paper and Wood Products, Pulpboard Manufacture, Coating Operations

307005, Industrial Processes, Pulp and Paper and Wood Products, Wood Pressure Treating

30701199, Industrial Processes, Pulp and Paper and Wood Products, Paper Coating and Glazing, Extrusion Coating Line with Solvent Free Resin/Wax

The Wood Preserving source category includes establishments primarily engaged in treating wood, sawed or planed in other establishments, with creosote or other preservatives to prevent decay and to protect against fire and insects. This industry also includes the cutting, treating, and selling of poles, posts, and piling, but establishments primarily engaged in manufacturing other wood products, which they may also treat with preservatives, are not included.

Wood is treated with preservatives to protect it from mechanical, physical, and chemical

influences. Preserved wood is used primarily in the construction, railroad, and utilities industries to prevent rotting when wood is exposed to damp soil, standing water, or rain, and as protection against termites and marine borers. The most common preservatives include water-borne inorganics like chromated copper arsenate (CCA) and ammoniacal copper zinc arsenate (ACZA), and oil-borne organics like pentachlorophenol (PCP) creosote. Generally, waterborne inorganic solutions constitute approximately 78 percent of all preservatives used, while oil-borne creosote and PCP comprises 15 percent and 6 percent, respectively.

Creosote, PCP, and inorganic wood preservatives are all applied using similar processes. More than 90 percent of the wood preservation in the U.S. is performed using pressure treatment processes. A limited quantity of wood is preserved using non-pressure treatment processes in which the preservative is allowed to diffuse into the wood. This process is used with some oil-borne preservatives, but not with waterborne inorganics.

The penetration required to adequately preserve wood can be achieved only if the wood has been conditioned properly; that is, if the moisture content of the freshly-cut wood is reduced to a point where the preservative can penetrate and be retained by the wood. Wood is usually conditioned in the open air or conditioned in the cylinder (retort) in which the pressure treatment is performed. The sawn lumber is sometimes incised to increase preservative penetration. Open air drying is typically used to prepare large stock for treatment with oil-borne preservatives. Other methods for conditioning wood prior to treatment with oil-borne preservatives include steaming, heating, and vapor drying. Kiln drying is used primarily for water-born treatment. Conditioning is a major source of wastewater in the wood preserving industry.

After the moisture content of the wood has been reduced, the wood is preserved using either non-pressure or pressure methods. Non-pressure processes include brushing, spraying, dipping, soaking, and thermal processes. These processes involve the repeated use of preservative in a treatment tank with fresh preservative solution added to replace consumptive loss. The continual reuse of preservative leads to the accumulation of wood chips, sand, stones, and other debris contaminated with various hazardous constituents in the bottom of the treating tanks. This contaminated debris is a major source of process waste for non-pressure processes.

There are two basic types of pressure treatment processes, distinguished by the sequence in which vacuum and pressure are applied. These are 'empty-cell' and 'full-cell' or 'modified full cell' processes. The term 'empty' and 'full' are measures of the level of preservative retained by the wood cells.

'Empty-cell' processes obtain relatively deep penetration with limited absorption of preservative. In the Reuping empty-cell process, air pressure is applied to the wood as preservative is pumped into the treating cylinder. Once the desired level of retention has been achieved, the unused preservative is drained off and the excess preservative is vacuum pumped away from the wood. The

process is the same in the Lowry empty-cell process, except no initial pressure is applied. In both processes, air compressed in the wood drives out part of the preservative absorbed during the pressure period when pressure is released.

The second method, known as the 'full-cell' (Bethel) process, results in higher retention of preservative but limited penetration compared to the empty cell process. The full-cell or modified full cell procedures are used with both oil- and water-borne preservatives. A vacuum is created in the treating cylinder and preservative is pumped in without breaking the vacuum. Once full, hydrostatic or pneumatic pressure is applied until the wood will retain no more preservative. A final vacuum may then be applied to remove excess preservative, which is returned to the work tank for reuse. The treated wood is removed from the cylinder and placed on a drip pad where it remains until dripping has ceased. Preservative solution, washdown water, and rainwater are collected on the drip pad and maintained in the process. At waterborne plants, these materials are transferred to a dilution water tank where they are blended with additional concentrate to make fresh treating solution. At oil-borne plants, these materials are processed to recover preservative and usable process water. Excess waste water is treated either on-site in a wastewater treatment unit or off-site at a publicly owned treatment works.