Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency (EEAA)

Inspection Manual

Secondary Metallurgical Industry

2002

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1. Introduction

The Egyptian Pollution Abatement Project (EPAP) sponsored by FINIDA has assigned Finish and Egyptian consultants for the task of developing Sector specific inspection and monitoring guidelines. This task is based on a previous collaboration between FININDA and EPAP that resulted in the development of four Inspection Guidelines:

- Fundamentals and Background Manual that provides basic information about air pollution, wastewater characteristics, solid waste, hazardous materials and wastes and work environment.
- Guidelines for Inspectorate management that discusses the strategy, objectives and tasks of the inspectorate management.
- Guidelines for Team Leaders that identifies the team leader responsibilities and tasks.
- Guidelines for Inspectors that presents a methodology for performing all types of inspection. Tasks during the various phases of planning, performing field inspection, report preparation and follow-up are discussed. Several checklists are included.

The four guidelines were later summarized into one manual named General Inspection Manual, which was developed and will be referred to as (GIM EPAP 2002). This manual covers aspects common to all industrial sectors.

On the other hand, a self-Monitoring manual was also developed to present the industrial community and government officials with the general principles, both managerial and technical, to be followed for self-monitoring. The textile industry was chosen as a case study for implementing and testing the manual and a self-monitoring manual for this industry was developed.

2. Processes Description

Secondary metallurgical processes are the production processes that starts with the output of the ore reduction process, scrap …etc as the input to the industry and its products is semi-finished products, finished products.
It includes the melting, giving the aimed shape to the final output, through forming, poring liquid metal and alloys to the mold cavity and forging.

2.1 Raw materials, Chemicals, and Other Inputs

Table (1) represents the material inputs to each operation in secondary metallurgical industries.

Table (1) Material Inputs In Secondary Metallurgical Processes

Process	Material inputs
furnaces	
Induction and electric arc furnace Preheating furnace Cupola and crucible furnace	Steel scrap, liquid steel, direct reduced iron, or /and pellets priquettes, metal scrap and big iron, coke or carbonizes, ferro-alloys, limestone, gas fuel, bentonite and binding materials.
Continuous casting	
Tundish treatment process	Gas fuels, liquid fuels, Refining additions and water. Liquid steel
Rolling, drawing, extrusion and forging	
Rolling Drawing Extrusion Forging	Pillets or slabs, bars, blooms, lubricating oils, greases,
Conventional casting	
Molding Casting	Green sand, dry sand, clay, core sand, raw material, scrap, gaseous and solid fluxes (CO_2, He, N_2, Ar, cl, AlCl, ZnCl, AlF)

2.2 Production Processes

2.2.1 Furnaces

a. Electric Arc Furnace

Electric arc furnaces are the prime means of recycling steel scrap into liquid steel. They are, also increasingly being used to produce liquid steel from iron sources such as direct reduced iron (DRI) pellets or briquettes and blast furnace liquid molten steel or pig iron.

The EAF steel is batch produced. Each batch is called a "pouring". The furnaces generally range in capacity from 1 tons to over 250 tons. Smaller furnaces (5-ton capacity and up) are used to produce batches of special steels. Alloying is done in the ladle during tapping, in ladle metallurgy stations, or in ladle furnaces. A ladle furnace is a small EAF that allows the temperature of the molten steel in the ladle to be raised to the casting temperature.

The charge includes steel scrap, molten steel and the iron produced from direct reduction. They are in ratio equal 1130 kgm of scrap or iron from direct reduction/ 1 ton of product. For chemical control and purification purposes, several materials are used including:

- Coke coal and carbonizers
- Iron casts
- Lime stones (10 kgm of casting elements & 100 kgm of flux for each 1 ton of product)
- Energy
    - Electric
    - Gaseous fuel, which may be used as a source of heat to reduce the electricity consumption
    - Mazout
- Water

As shown in the block diagram of Fig. 1, the steel making process begins with the first addition of scrap. The furnace roof swings open and the overhead crane

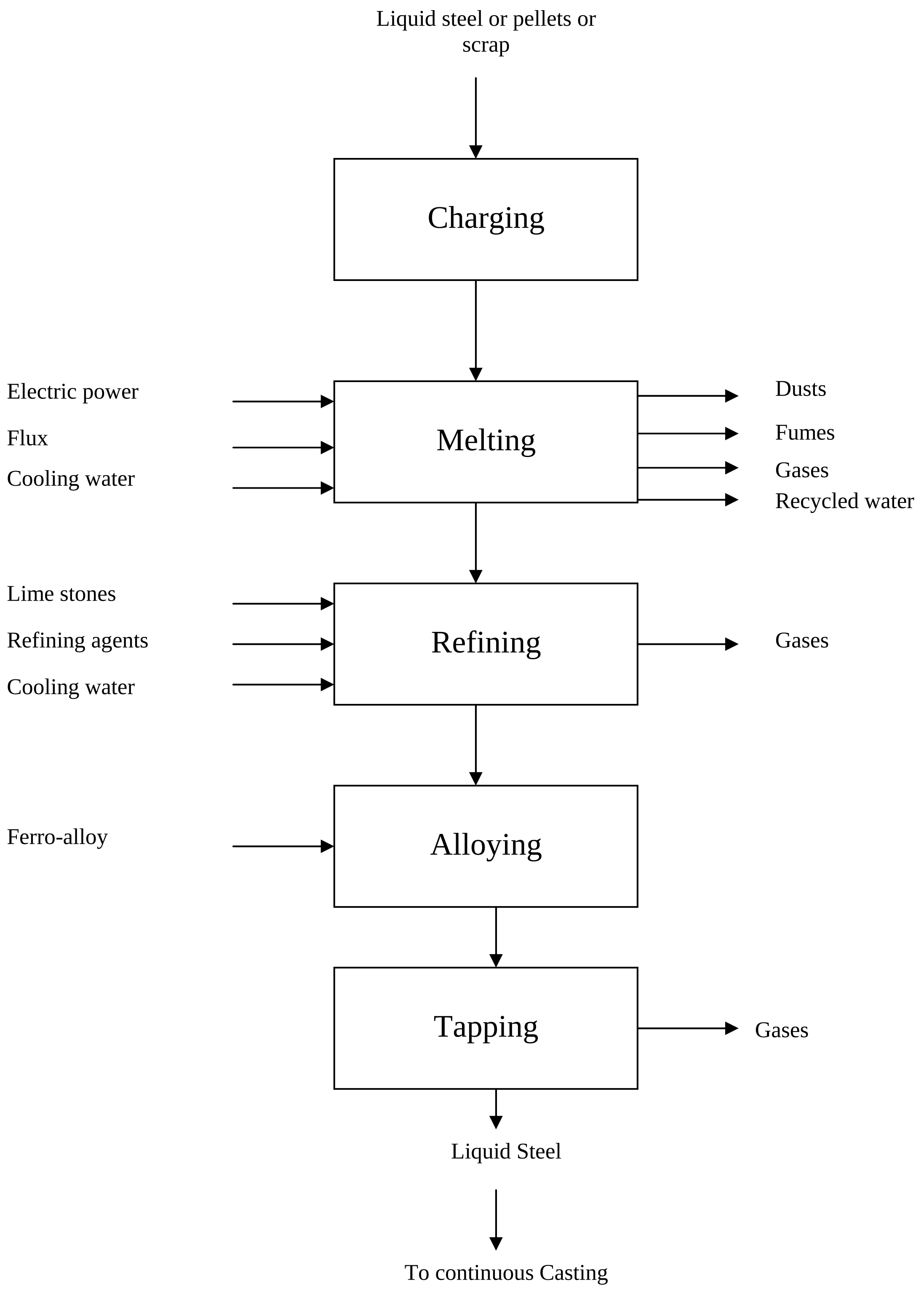
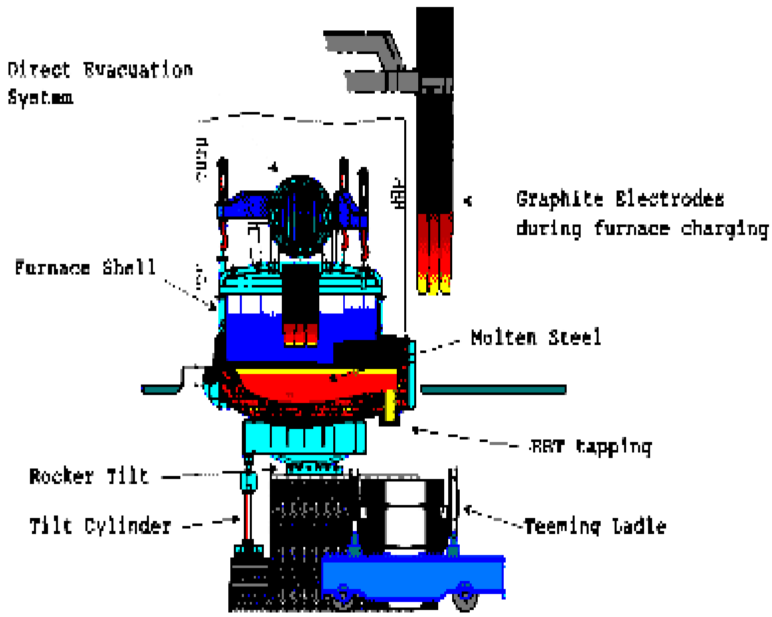


Fig (1) Steel Making in Electric Arc Furnace



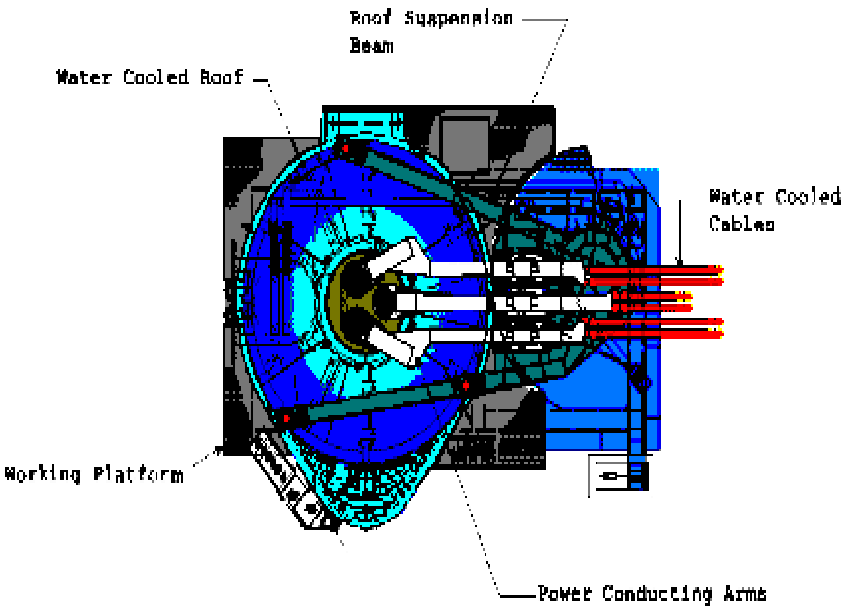


Fig (2) Electric Arc Furnace

Operator opens the clamshell bottom of the scrap bucket and let the scrap drop into the furnace. The roof closes & power is applied. Fig (2) shows an elevation and a plan for the EAF.

Most furnaces nowadays use oxy-fuel burners. At least three oxy-fuel burners arc (their number differs from one type to another) turned on during the first 5 to 10 minutes of the heat (this period is relative to the furnace type, charge composition and the desired product composition) in order to accelerate melting and add heat to the cold spots of the furnaces. Oxygen lances are used to make the scrap collapse into the melt and to burn combustibles in the furnace, thereby accelerating the scrap heating and melting process. Carbon and/or lime are often added with the scrap charge. The coke or coal provides the proper reducing environment for the process. The limestone removes impurities from the steel through the formation of slag.

Alloy additions, if needed, can be provided either directly to the furnace or into the ladle. Many melt shops homogenize the melt for temperature and chemistry by injecting inert gas into the ladle. Gas is bubbled through the ladle by either a lance or a porous bottom plug.

b. Preheating Furnaces

Before forming a furnace is used to preheat different metals for hot forming, preheating furnaces are used to preheat metals to a suitable temperature before hot forming the metal inputs are generally slaps, blooms, bars, rounds and billets, this furnaces have several sources of heating energy electric, mazout, or gas. For steel forming slabs or blooms are heated to temperature 1100-1250^{o}C then formed.

Gaseous emissions from these furnaces include CO, CO_2, SO_2, No_x and suspended particulates. Emissions depend on the fuel type and the combustion properties.

c. Cupola Furnace

The cupola is a vertical, cylindrical shaft furnace that may use pig iron, scrap iron, scrap steel, and coke as the charge components. The mechanism by which melting is accomplished in the cupola is heat release through the combustion of coke and the reaction between oxygen in the air and carbon in fuel that is in direct contact with the metallic portion of the charge and the fluxes. Fig (3) illustrates a block flow process diagram of cupola furnace.

One of the advantageous features of such a furnace is that counter-flow preheating of the charge material is an inherent part of the melting process. The upward flowing hot gases come into close contact with the descending burden, allowing direct and efficient heat exchange to take place. The running or charge coke is also preheated which aids in the combustion process as it reaches the combustion zone to replenish consumed fuel.

Greater understanding of these features accounts in part, for the continued popularity of the cupola as a melting unit. However, recent design improvements such as coke-less, plasma-fired types that alter emission characteristics are now encountered.

d. Crucible Furnace

Fig (4) shows a process flow diagram of crucible melting. Most commercial melting of nonferrous metals is done in oil-and gas-fired furnaces. These are of two basic types: stationary and tilting furnaces. In stationary furnaces the crucible is lifted in and out for pouring, while tilted crucible furnace requires a crucible with a suitable lip for pouring metals when the furnace is tilted.

Most nonferrous metals and alloys oxidize, absorb gasses and other substances, and form dross readily when heated. Various practices are followed for each kind of metal to preserve purity and obtain good castings.

In case of using crucible furnaces, for melting metals, the electric arc energy is then used to melt the steel with agitation by using nitrogen or argon. The chemicals composition is adjusted by adding certain cast addititves.

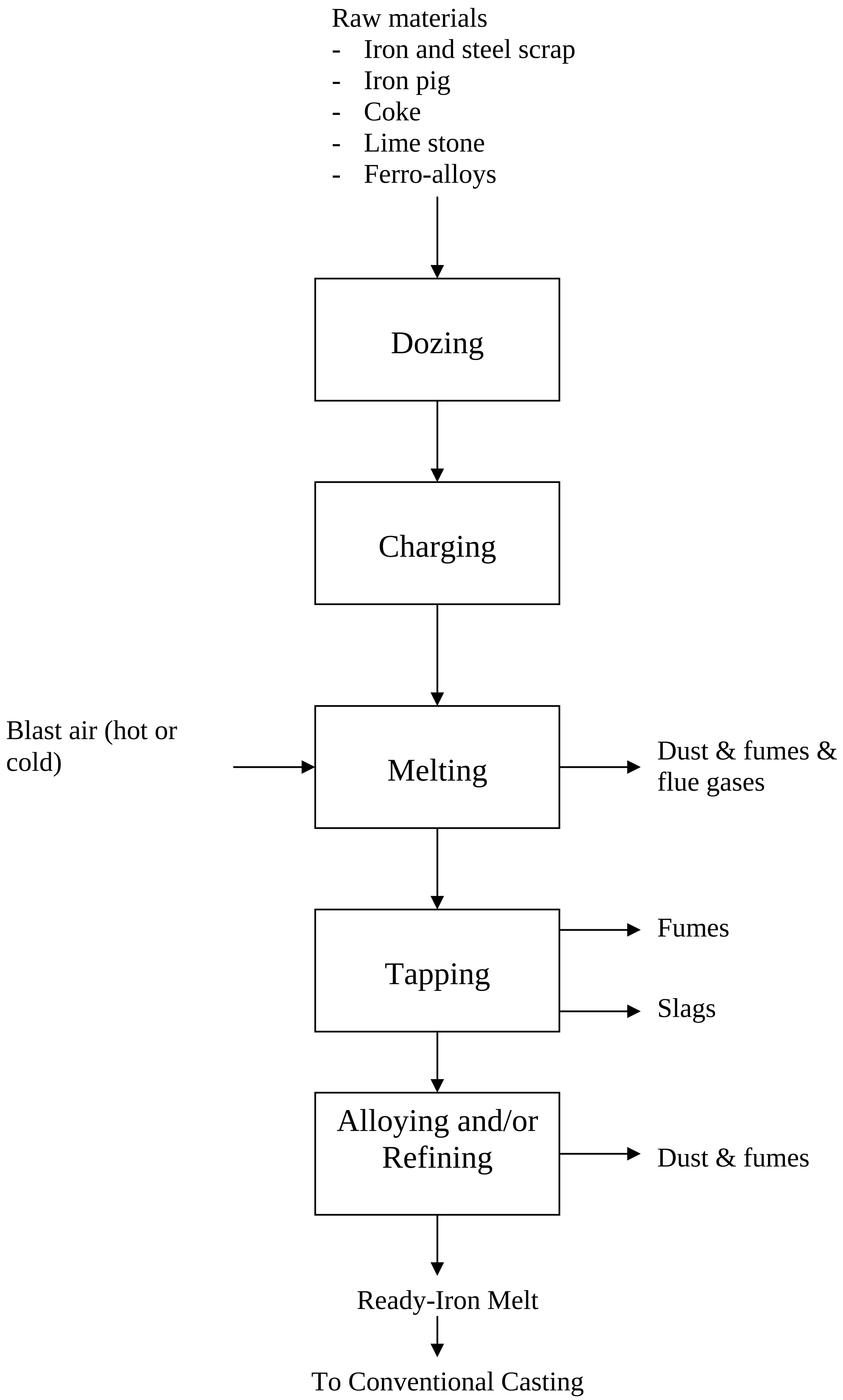


Fig (3) Block Flow Diagram for Cupola Furnace

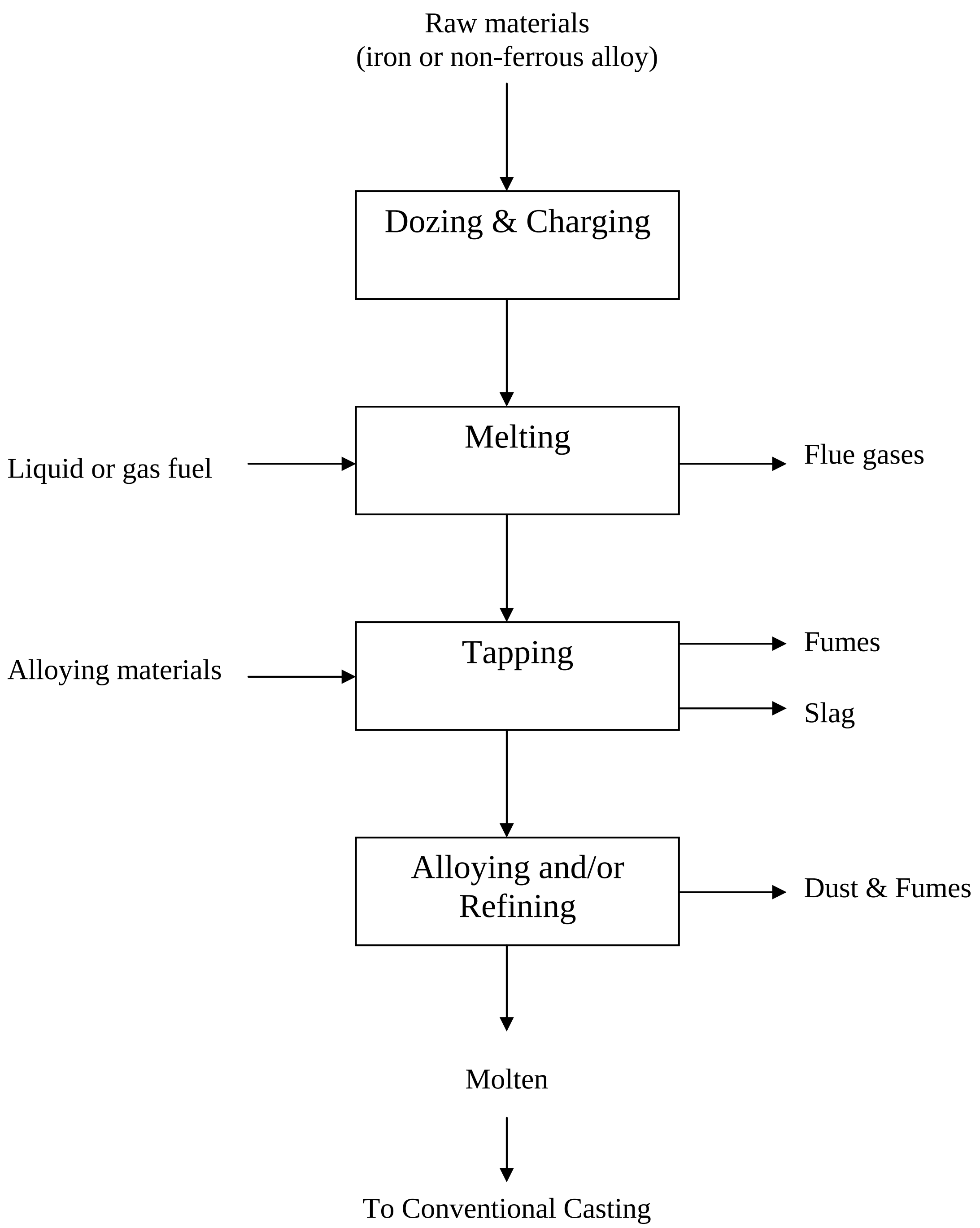


Fig (4) Block Flow Diagram for Crucible Melting

2.2.2 Continuous Casting

Continuous casting aims to produce molten steel with proper viscosity. The molten is treated in the furnace or in the ladle to be ready for pouring in the casting equipment. Liquid of gaseous fuel is used to ignite the “tundish” and for preheating, water is also used for cooling the mold and the molten metal.

Casters are steel plant equipment, which are used to process liquid steel into continuous lengths of solid steel of various cross sections. The most common sections are less than 20 cm square (billets). Larger squares are blooms and rectangles averaging 120cm in width (slabs). Special sections are rounds and so-called (near net shapes), such as beam blanks and slabs or sheets, are as thin as 2cm.

Fig (5) shows a block diagram of continuous casting of steel. Molten steel is tapped from the furnace into a refractory-lined ladle. The molten steel stream emerges from the slide gate in the ladle bottom and fills tube-like distribution vessel (tundish). The number of drain holes in the tundish corresponds to the number of strands to be cast simultaneously. The molten steel streams emerging from the tundish bottom fill oscillating water-cooled copper molds in which the molten steel solidifies as it passes through the mold and emerges from its bottom. The olds provide immediate cooling of the outer skin of the steel. As the steel emerges from the mold, the center is still molten. After complete solidification, the continuous strip is cut into convenient lengths using torch machines or shears.

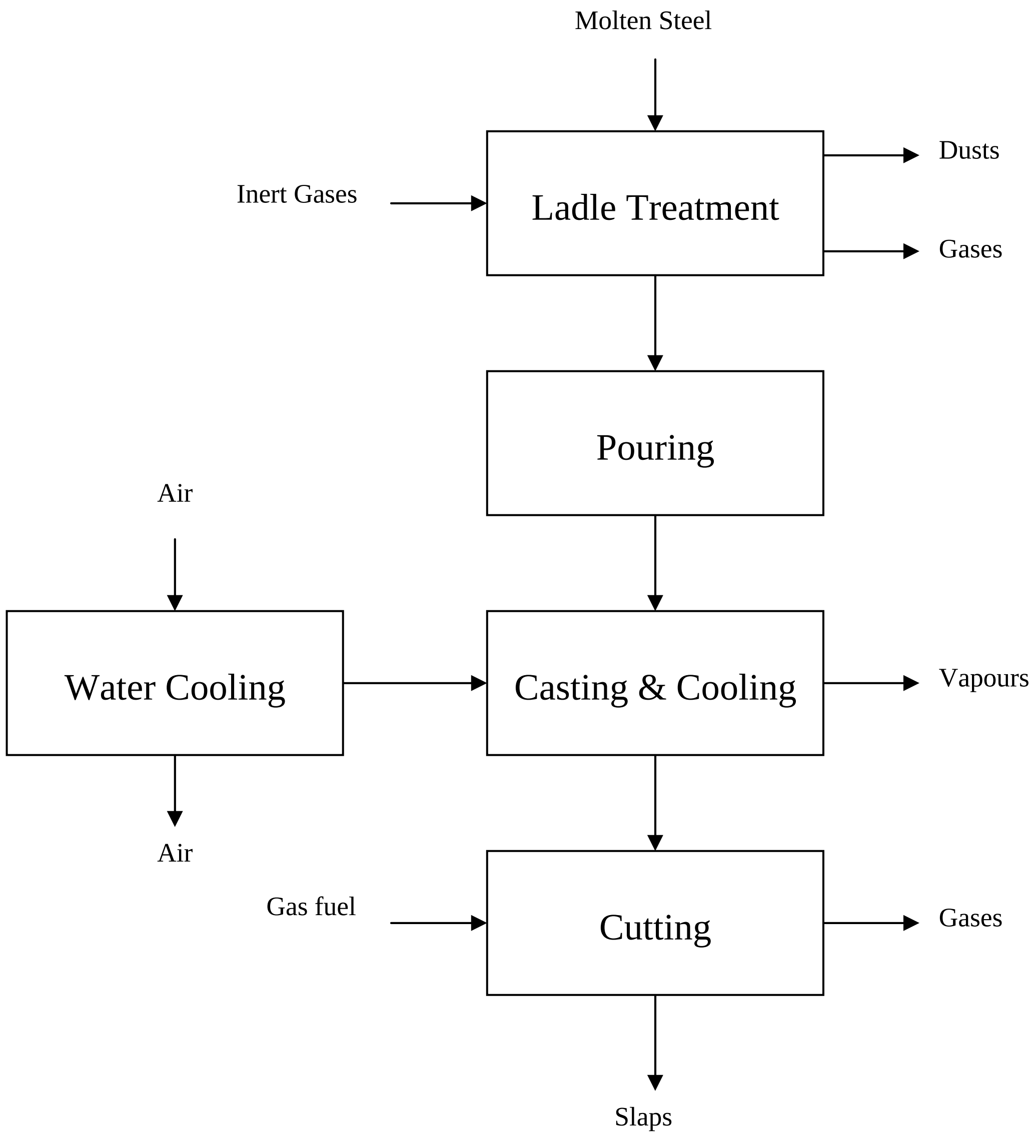


Fig (5) Block Flow Diagram for Continuous Casting of Steel

2.2.3 Conventional Casting

a. Molding

After melting, molten metal is tapped from the furnace and poured into a ladle or directly into molds. If poured into ladle, the molten iron may be treated with a variety of alloying agents predetermined by the desired metallurgical properties. It then is ladled into molds, where it solidifies and is allowed to cool further before separation of the casting from the mold (shakeout).

Molds are forms used to shape the exterior of castings and green sand mold, the most common type, uses moist and mixed with 3-20% clay and 2-5% water, depending on the process. Additives to prevent casting defects include organic material such as sea coal (a pulverized high volatility low-sulfur bituminous coal), wood or corn flour, oat hulls, or similar organic matter Cores are molded sand shapes used to form the internal voids in castings. They are made by mixing sand with various binders, shaping it into a core, and curing the core with a variety of processes.

In larger more mechanized foundries, the molds are conveyed automatically through a cooling tunnel before they are placed on a vibrating grid to shake the mold and core sand loose from the casting. in some foundries, molds are placed in an open floor space and molten iron is poured into the molds and allowed to cool. Molding and core sand are separated from the casting(s) either manually or mechanically. Fig (6) illustrates flow diagram for the molding process.

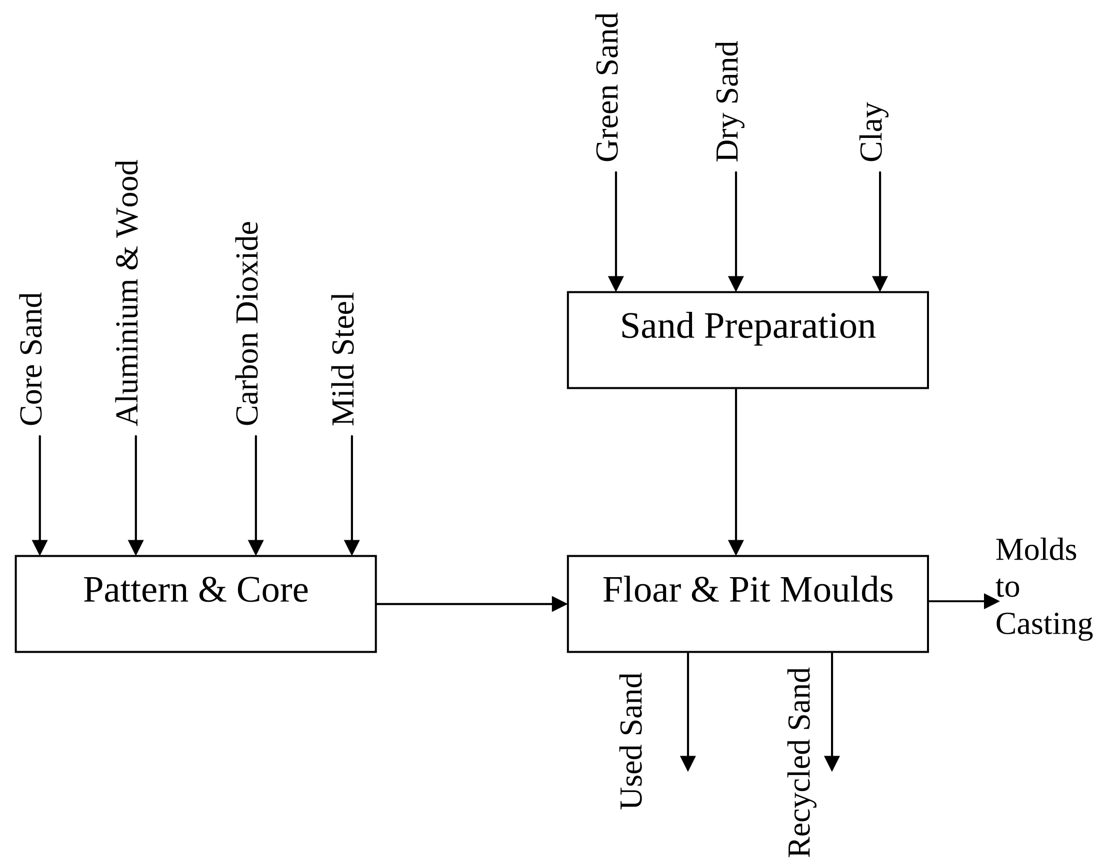


Fig (6) Block Flow Diagram for Molding Process

Used sand from casting shakeout is usually returned to the sand preparation area and cleaned, screened, and processed to make new molds. Because of process losses and potential contamination, additional makeup sand may be required.

When castings have cooled, any unwanted appendages, such as spurs, gates, and risers, are removed by an oxygen torch, abrasive saw, friction cutting tool, or hand hammer, The castings then may be subjected to abrasive blast to be cleaned and/or tumbling to remove any remaining scales.

b. Ferrous Casting

The production of ferrous castings (low-carbon, mild-alloy, high-alloy steel, or cast iron), the technology of mold and core preparation, in a general way, is similar to that used to produce castings from metals other than steel as described earlier.

Today, in Egyptian ferrous foundry production, melting is primarily accomplished with two types of electric furnaces-direct arc and induction. Arc furnace has the same construction as described before, but foundry arc furnaces are usually small in size and works relatively at higher temperature and with non-processed scrap.

The major processing operations of the typical ferrous foundry are raw-materials handling, metal melting, mold and core production, and casting and finishing (see Fig 7).

The raw-materials handling operations include the receiving, unloading, storage, and conveying of all raw materials for the foundry. Some of the raw materials used by ferrous foundries are pig iron, iron and steel scrap, foundry returns metal turnings, ferroalloys, carbon additives, fluxes (Lime- Stone, soda ash, fluorspar), sand, sand additives. And binders these raw materials are received in ships railcars trucks, or containers and are transferred by trucks, loaders, and conveyors to both open piles and enclosed storage areas. The materials are then transferred by similar means from storage to the subsequent processing areas.

When the total charge is melted, the bath surface is skimmed free of slag and the heat is tapped into the pouring ladle. At this time, adding alloys or de-oxidizers, depending on the type of alloy being melted and the melting procedure that has been established may treat the molten metal. When the castings have solidified and the molds are partially cooled, the castings are placed on a vibrating grid and the sand of the mold and- core is broken away from the casting. The sand is recycled to the sand-preparation center and then to the molding center, where a repeat of the total mold/core procedure for pouring is again carried out.

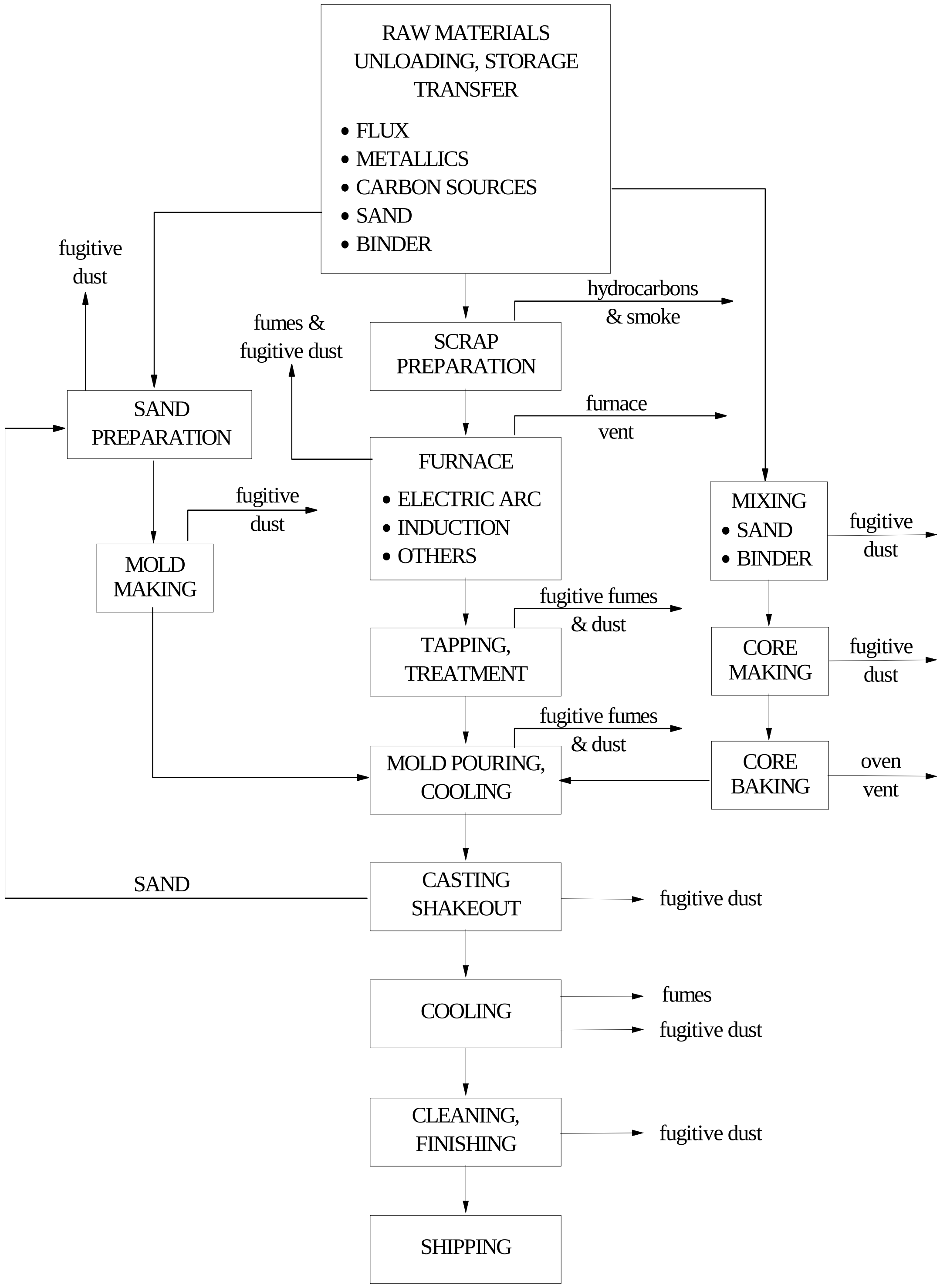


Fig (7) Block Flow Diagram for Steel Foundries and Sources of Emissions

c. *Non-Ferrous Casting*

The same as ferrous casting, some additional processes should be considered. Special care should be given to dross formation of Al &Cu oxides, which accumulates on the surface of molten metal.

Aluminum alloys will absorb or dissolve considerable quantities of Hydrogen gases in the molten state, Copper alloys dissolve a substantial amounts of oxygen & hydrogen. Flushing &fluxing are used to provide more effective separation of molten metal, dross and to remove dissolved hydrogen entrapped dross

2.2.4 Rolling, Drawing, Extrusion and Forging

Formation processes depend mainly on mechanical operations, which are applied to the casts to form the desired shapes. The major forming processes are rolling, drawing, extrusion and forging. The used raw materials include:

- Produced sections (bars, slabs, blooms and billets) from continuous casting. No pollution accompanying handling of these materials.
- Natural gas, solar or mazout is used in reheating the casts to a temperature 1050- 1100^o C inorder to make them flexible during formation.

a. *Rolling*

As shown in the block diagram of Fig (8), shaping by rolling consists of passing the metal to be rolled between rolls that revolve at the same speed, but in opposite direction.

The ingot process makes semi-finished forms (slabs, blooms, and billets). The newer continuous casting process makes semi-finished forms (slabs, bars, rounds, blooms, and billets). In the ingot method, the finishing stages of steel making begin when ingots are lowered into furnaces called soaking pits that reheat them to an even temperature for rolling. The ingot is rolled in a primary mill into semi-finished slabs or into rectangular shapes called blooms. In the newer continuous casting process, steel is poured directly into tundish, which feeds a curved mold where the steel is solidified directly into semi-finished products. The end product can be slabs, blooms, or billets, depending on the final proportions.

During hot rolling, steel heated to about 1050- 1100 ^{o}C is placed onto the end of the rolling line. As an example, a slabs metallurgical analysis, size, weight, and intended end-use are fed into the mill's computer. Sensing devices continuously record the slab's thickness, width, and temperature, and the squeezing force of the rolls as the slab moves through the roughing and finishing. Steel rolled on the hot strip mill can be sold in this form or further processed into cold-rolled, galvanized, or aluminized steel.

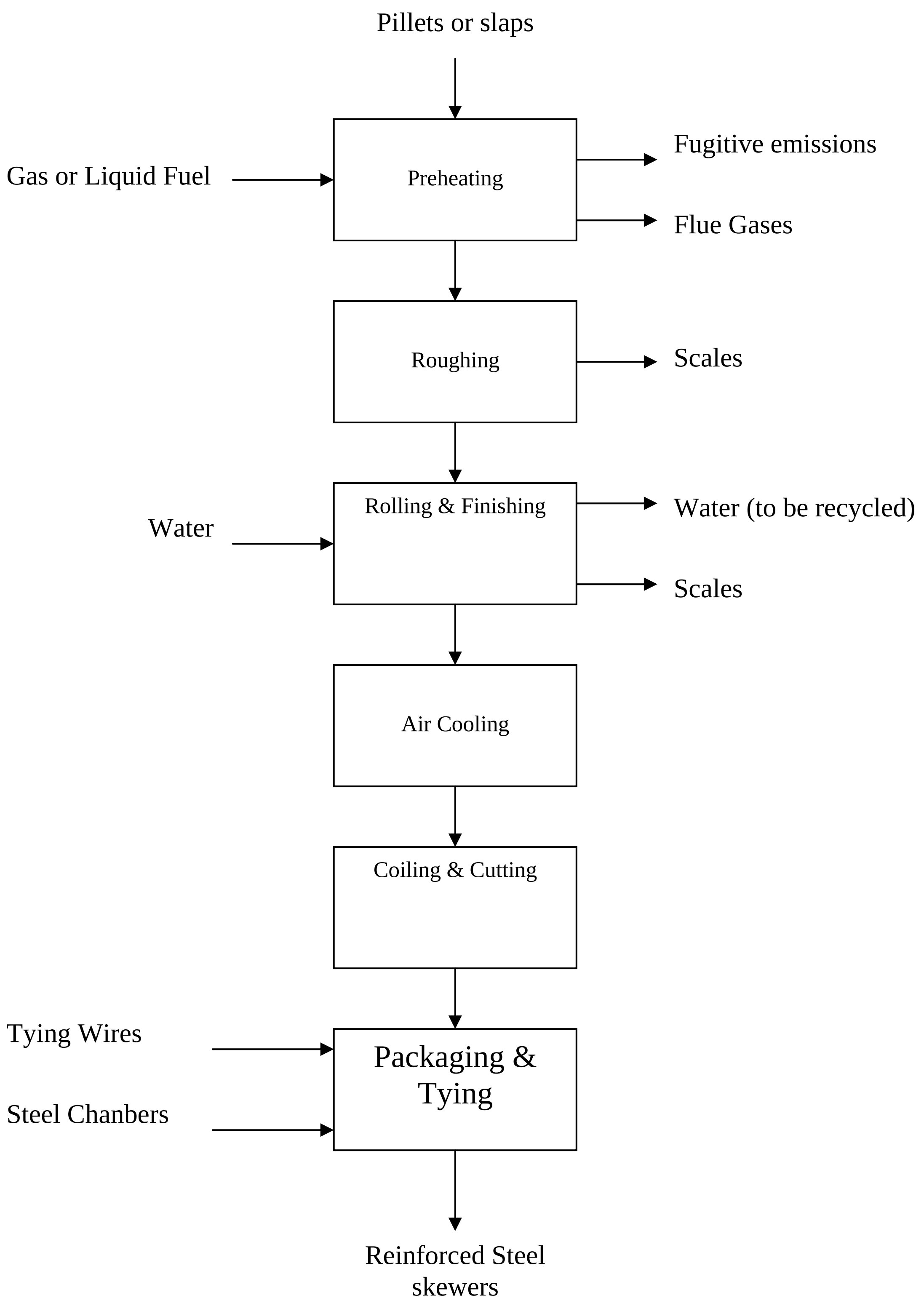


Fig (8) Flow Diagram for Hot Rolling Process

b. Extrusion and Drawing

Fig (9) shows a block diagram of both drawing and extrusion of metals. Round, rectangular, square, hexagonal and other shapes of bars up to about 4in across or in diameter, wire of all sizes, and cold drawing commonly finishes tubes. Wire cannot be hot rolled economically smaller than 0.2in. in diameter and is reduced to smaller sizes by cold-drawing. Steel, aluminum, an When metal is extruded, it is compressed above its elastic limit in a chamber and is forced to flow through and take on the shape of an opening. An everyday analogy is the dispensing of paste from a collapsible tube. Metal is extruded in a number of basic ways. The metal is normally compressed by a ram and may be pushed forward or backward. The product may be solid or hollow. The process may be done hot or cold.

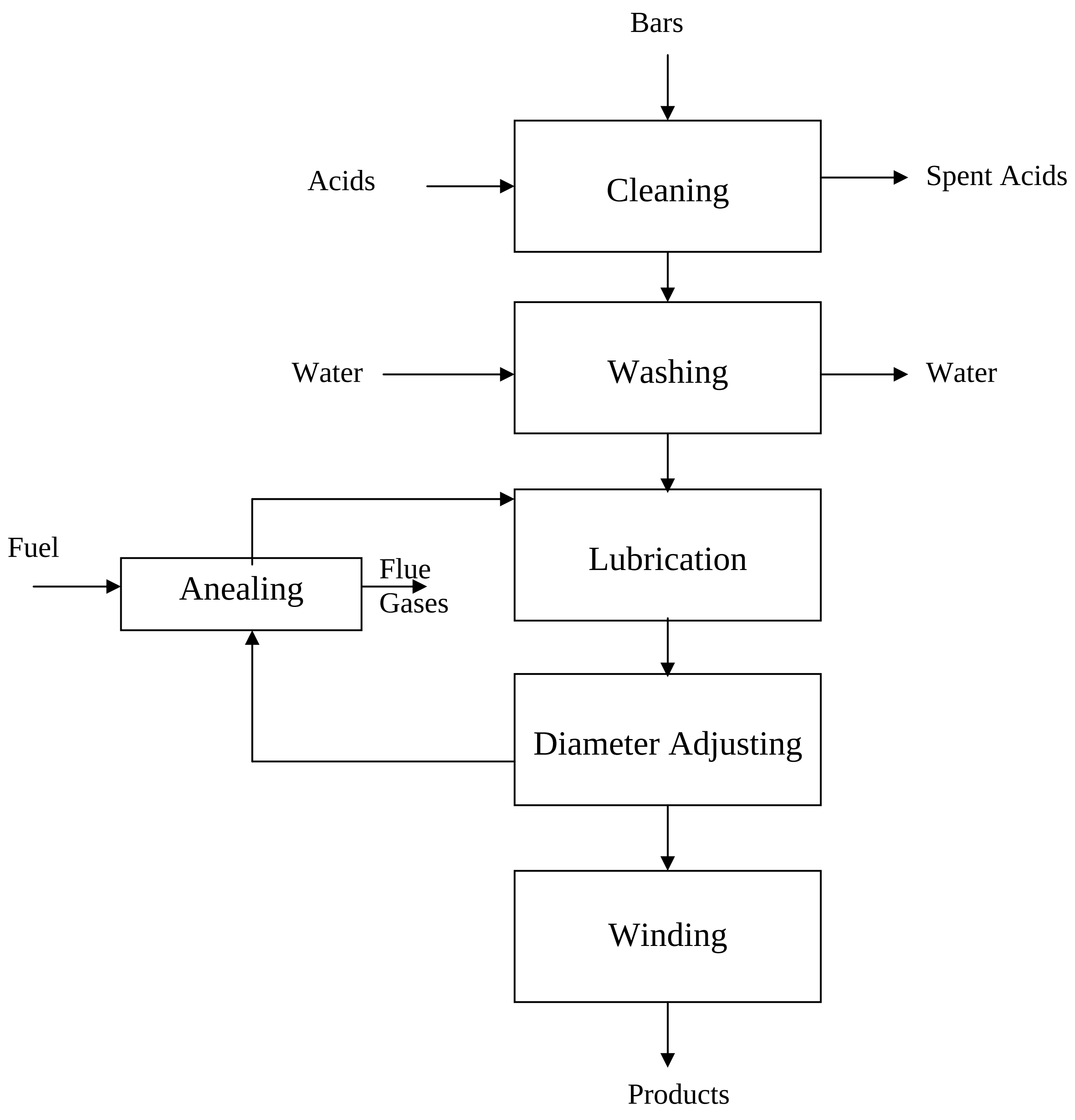


Fig (9) Block Flow Diagram for Drawing and Extrusion

c. Forging

Fig (10) shows a block diagram of a forging process. Forging is the forming of metal, mostly hot, by individual and intermittent applications of pressure instead of applying continuous pressure as in rolling. The products generally are discontinuous also, treated and turned out as discrete pieces rather than as a flowing mass.

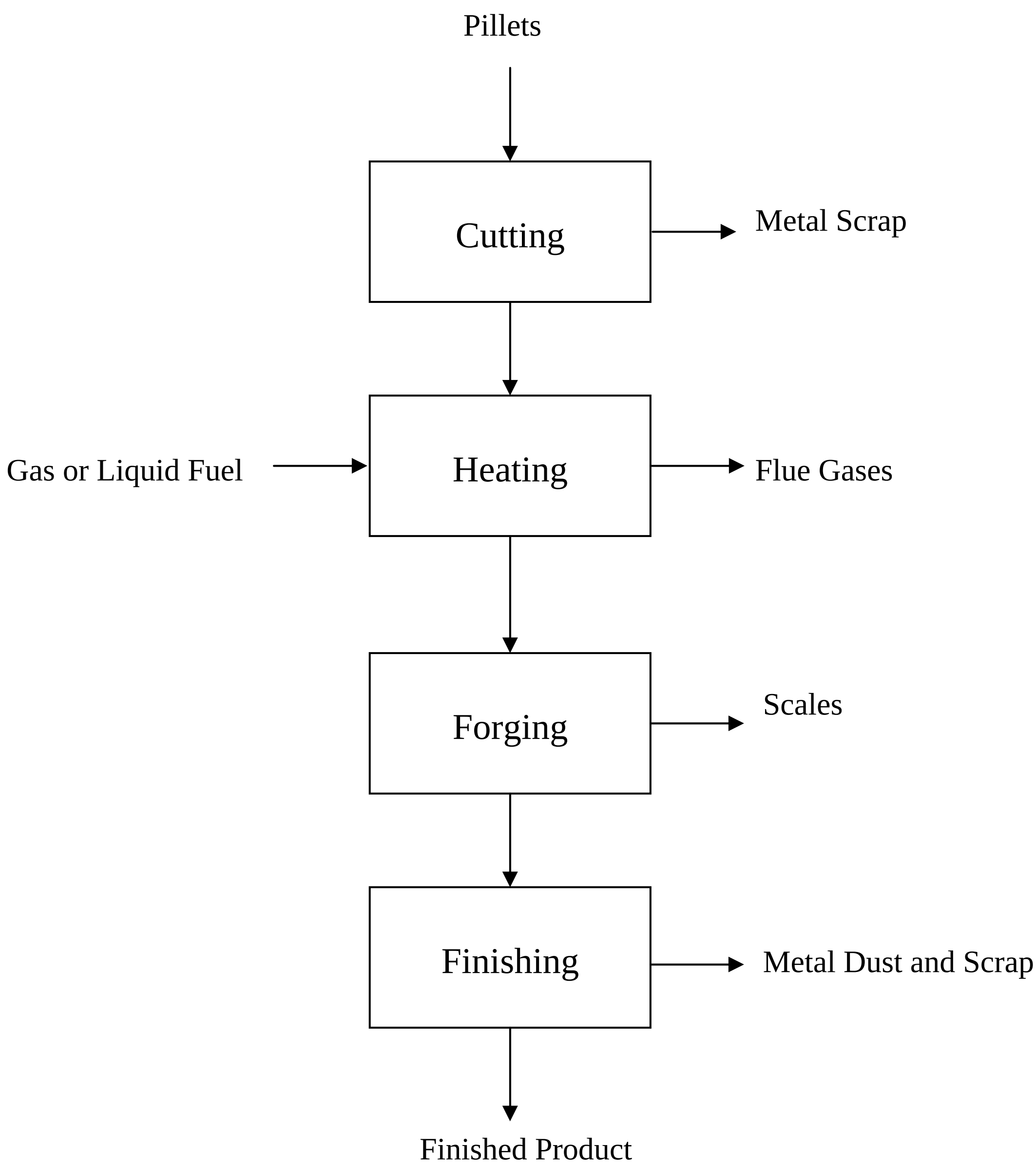


Fig (10) Block Flow Diagram for Forging Process

The forging process may work metal by compressing its cross section and making it longer, by squeezing it lengthwise and increasing its cross section or by squeezing it within and making it conform to the shape of the cavity.

Forging may be done in open or close dies. Open die forging are nominally struck between two flat surfaces, but in practice the dies are sometimes vee shaped, half round, or half oval. Closed die forging are formed in die cavities. All forging takes skill, but more is required with open than with closed dies. Faster output and smaller tolerance are obtained with a closed die. Open dies are of course, much less costly than closed dies and more economical for a few parts. Either open or closed die forging may be done on most hammers and presses.

2.3 Service Units, Description and Possible Pollutant Sources

2.3.1 Boilers

Medium and large facilities, of secondary metallurgical industries may include electricity generating stations. This electricity is used in emergency or when an addition electricity is needed. Boilers are necessary, for electricity generating stations, to produce steam. Fuel is burned in boilers to convert water to high pressure steam, which is used to drive the turbine to generate electricity. The gaseous emissions, due to boilers burning fuel oil (Mazot) or diesel oil (solar), contain primarily particulates (including heavy metals if they are present in significant concentrations in the fuel), sulfur and nitrogen oxides (SOx and Nox) and volatile organic compounds (VOCs). The concentration of these pollutants in the exhaust gases depends on firing configuration (nozzle design, chimney height), operating practices and fuel composition.

Wastewater is generated due to the blowdown purged from boilers to keep the concentration of dissolved salts at a level that prevents salt precipitation and consequently scale formation. The blowdown will be high in (TDS)

Also large quantities of water is used for cooling the turbines which pollutes the discharged wastewater. The amount of wastewater generated depends on whether cooling is performed in open or closed cycle and on the recycling of steam condensate. Contamination may arise from lubricating and fuel oil. The steam condensate from the production processes, may return to the boiler (closed circuit) or discharged as wastewater causing pollution source to effluents.

The heat stress may be high, in work place, in case of absence of thermal insulation for steam pipelines.

2.3.2 Water Treatment Units

There are different treatment processes, depending on the water source and the application in the industry.

i) ***Water softening for medium hardness water :*** calcium and magnesium ions are removed from hard water by cation exchange for sodium ions. When the exchange resin has removed the ions to the limits of its capacity, it is regenerated to the sodium form with a salt solution (sodium chloride) in the pH range of 6-8. This is performed by taking the softener out of service, backwashing with the salt solution, rinsing to eliminate excess salt, then returning it to service. The treated water has a hardness level of less than 1 ppm expressed as calcium carbonate.

ii) ***Water softening for very high bicarbonate hardness:*** Water from wells and canals is pre-treated before softening. Water is treated first by the lime process, then by cation exchange. The lime process reduces dissolved solids by precipitating calcium carbonate and magnesium hydroxide from the water. It can reduce calcium hardness to 35 ppm if proper opportunity is given for precipitation. A coagulant such as aluminum sulfate (alum) or ferric sulfate is added to aid magnesium hydroxide precipitation. Calcium hypochlorite is added in some cases. Currently the use of organic polyelectrolytes is replacing many of the trorditional inorganic coagulant aid. Sludge precipitates and is discharged to disposal sites whereas the overflowing water is fed to a sand filter followed by an activated carbon filter that removes any substances causing odor and taste. A micro filter can then be used to remove remaining traces. A successful method to accelerate precipitation is contacting previously precipitated sludge with the raw water and chemicals. The sludge particles act as seeds for further precipitation. The result is a more rapid and more complete reaction with larger and more easily settled particles.

iii) ***Reverse Osmosis:*** Demineralization can also be performed by reverse osmosis. In this process water is forced through a semi-permeable membrane by applying pressure.

2.3.3 Cooling Towers

Moderate quantities of cooling water is used for cooling furnaces and the formation equipment in this industry. Cooling towers provide the means for recycling water and thus minimizing its consumption. The cooling effect is performed through partial evaporation. This causes an increase in the concentration of dissolved salts which is controlled by purifying some water (blowdown). The blowdown will be high in TDS and will represent a source of pollution to the wastewater to which it is discharged.

2.3.4 Laboratories

Laboratories, in secondary metallurgical industries, are responsible for:

- Testing chemicals, water, wastewater, …etc. to check compliance with required standards.
- Quality control of product to check agreement with standard specifications.
- Check the physical and mechanical properties of products.

Chemicals, including hazardous materials, are used in laboratories. Storage and handling should be checked by the inspectors.

2.3.5 Workshops and Garage

Workshops are very important in the secondary metallurgical industries, where they are divided into mechanical and electrical workshops. They are responsible for repairing and maintenance of the foundary' equipment. Environmental violation could be due to:

- Noise
- Rinse water contaminated with lube oil

Pollution in the garage will depend upon the services offered. The presence of a gasoline or diesel station implies fuel storage in underground or over the ground tanks that require leak and spill control plans.
Replacing lube oil implies discharge of spent oil to the sewer system or selling it to recycling stations.

2.3.6 Storage Facilities

The specifications for the storage facilities depend on the nature and properties of the stored material

- Environmental laws stipulate that special system should be applied for handling and storing hazardous chemicals.
- Fuel is kept in under/or above ground tanks. Storage requires proper preventive plans for spills and leaks.

Table (2) shows the service units related to the metallurgical industries and their pollution sources.

Table (2) Service Units and their Related Pollution Sources

Inputs	Service Units	Pollution
Water Lime + chemicals Fuel	Treatment → Softening Units → Boilers → Steam	Sludge Back wash Boiler Blow Down (TDS) Flue Gases
Hot Water	Cooling Towers	Cooling Tower Blowdown (TDS)
Chemicals	Laboratory	Wastewater Hazardous Materials (handling)
Lube Oil Floor and equipment rinse water Cleaning Chemicals	Electrical & Mechanical Workshops	Oily Rinse Water Solid Wastes
Fuel Oil Rinse Water	Garage	Oily rinse water Solid wastes
Raw materials Fuel Chemicals Products	Storage	Spills Raw material Hazardous material

2.4 Emissions, Effluents and Solid Wastes

2.4.1 Air Emissions

a. Electric Arc Furnace

The EAF emissions are generally generated from three sources: charging, melting, and tapping. Fume contained in the rising plume has to be exhausted from the melt shop. The evacuation system should be able instantaneously to extract these emissions as the arriving scrap bucket and cranes disperse them. The volume flow rate and emission level in the mushroom cloud is also increased if the steel maker places additives such as coal and lime into the scrap bucket. The following table summarizes the most important emissions in EAF.

Table (3) Air Emissions from Electric Arc Furnace

Emissions	kg/ton iron produced
CO	0.5 - 19
Nox	0.02 - 0.3
VOC	0.03 - 0.15
Pb	0.005 - 0.05
PM	6.3

An immense amount of heat, gases and fume are generated during melting. Carbon monoxide (CO) can be generated in the production of steel in an EAF. Carbon containing compounds in the additives, scrap contamination, and particularly the foamy slag practice are the source of these emissions. (2.5 kg CO, 50 g SO2, 0.25 kg NO2, 100 g particulate) per ton cast product.

As the furnace contents are heated to approximately 1600^{o}C, any metals that volatilize below this temperature will be carried away by the furnace off-gases. When Coke, coal, or limestone is injected into the furnace, fine particulate of these commodities may be drawn into the off-gas system. (5 g oil, 4 g suspended solids, 145 kg EAF slag) per ton produced.

In EAF steel making, a fair amount of heavy solid particulate injected into the off-gas. A furnace using the foamy slag practice can expect to collect 26 pounds of dust per ton of molten steel, but one could expect to collect more with unfavorable oxygen injection practices or too small a fourth hole.

Furnace spout and furnace bottom tapping produce similar emissions. The emissions are mostly iron oxide and slag particulate. However, almost all EAF steel making processes add alloying elements of the ladle while tapping. This procedure can significantly increase tapping fume evolution. Therefore, the emissions, also, contain particulate consisting of oxides of these additives.

b. Heating Furnace

They are used to reheat the different metals to prepare it for the hot formation processes. These furnaces are utilized to heat the metal to a proper temperature

(1100- 1250 ^{O} C, before hot formation. Inputs to heating furnaces are slabs, blooms, bars, billets and rounds.

The major emissions generating from heating furnaces are CO, CO2, SO2, Nox and particulate matter. These emissions depend on the type of the used fuel and the combustion conditions.

c. Cupola and Crucible Furnace

The quantity and composition of particulate emissions vary among cupolas, and even at intervals in the same cupola. Causes include changes in iron-to-coke ratios, air volumes per ton melted, stack velocity, and the quality of the scrap melted.

Where oily scrap is charged, the raw emissions potentially not only will be greater in quantity, but also can be much more visible. The American Foundrymen Society compiled a survey of cupola emissions and found that an average emission from an uncontrolled cupola was approximately 5.8 to 7.6 kg of particulate per ton melted. Eighty-five percent of the emissions may be greater than 10 m in size.

Dust composition and amounts vary from cupola to have a significant impact on dust composition and quantity. The dust could include some or all of the following Materials

- Iron oxide
- Magnesium oxide
- Manganese oxide
- Zinc oxide
- Silicon dioxide
- Calcium oxide
- Lead
- Cadmium

In addition, other gases and organic compounds may be emitted as part of the melting process. These include carbon monoxide, sulfur oxides, lead, and organic emissions. Both sulfur and organic emissions may be affected by the amount of oil or grease on the scrap.

The quantity of sulfur oxides also is large enough to be a definite consideration in the corrosion of air pollution control equipment. There are a number of instances of rapid deterioration of dust collectors on cupolas where corrosion protection was not considered.

Where fluorspar is used as an additive, the fluorine driven off can cause a corrosion problem with dust collection equipment. Fluorine also has the potential to dissolve glass bags. The carbonic acid formed when carbon dioxide reacts with water vapor may cause corrosion problems as well.

Cupola repair needs a charge of lining, which is considered a solid waste. Besides, during tapping, a 10-20% molten slag is obtained, which is treated by quenching. Table (4) gives emissions factors resulting from cupola furnace.

Table (4) Emission Factors of Cupola Furnace

Emissions	Factors, kg/ t
CO	7
SO_2	0.6*sulphur content in the coke
Pb	o.o5-o.o6
PM	6.9

d. Continuous Casting

Ladle emissions are negligible. The molten steel is sometimes gdriven a cover of inert material such as rice hulls to provide thermal insulation. In addition, many modern casting facilities employ refractory-lined lids. The molten steel stream from the ladle bottom generates almost no emissions, particularly when a ceramic submersion tube surrounds it. Some emissions are seen to emerge from the molds. The emissions are caused by mold powders and mold lubricating oils. These emissions are mostly a white-blue haze generated by evaporated oil condense or mold powder combustion products. The emissions are greater if the molten steel stream is nitrogen shrouded because nitrogen prevents the burn-off of combustibles. The caster cut-off torches may also generate minor emissions because a traveling torch with an oxidizing flame cuts the red-hot steel section that emerges from the casting machine. Other emissions are generated during the maintenance of tundishes and casting ladles. These are mostly dust and iron oxide fumes from dumping and oxygen lancing sculls.

e. Rolling, Extrusion, Drawing and Forging

During the state-of-the-art of forming, the metal is introduced onto the line and passes through the major processing steps.

Uncontrolled emission estimates, calculated controlled emissions, the types of air pollution control utilized, and the techniques expected control efficiencies are summarized in Table (5). Continuous Cold Mill with BACT Controls. In both hot and cold forming, one can expect nitrogen oxides (NOx) emissions resulting from combustion in reheat furnaces, in annealing furnaces, or from boilers. The primary means of controlling NOx emissions is through combustion modification or selective catalytic reduction. Nitrogen oxides formed from combustion of air constituents are referred to as thermal NOx. In both hot and cold forming, one can expect nitrogen oxides (NOx) emissions resulting from combustion in reheat furnaces, in annealing furnaces, or from boilers. The primary means of controlling NOx emissions is through combustion modification ore selective catalytic reduction. Nitrogen oxides formed from combustion of air constituents are referred to as thermal NOx. The general technique to control thermal NOx is to suppress the natural gas combustion temperature to below 1400C. Above this temperature, NOx formation is exponential, while below this temperature, it is linear at a very limited rate.

Table (5) Continuous Cold Mill with BACT Controls

Purpose	Emission type	Expected uncontrolled emissions, mg/nm^3	Control technology	Calculated controlled emissions mg/m^3	Percent control
Flattens steel	Particulate matter	1000	Fabric filter	10	99
Connects coil	Particulate matter	300	Fabric filter	3.6	99
Remove oxidation	Particulate matter	1000	Fabric filter	10	99
Cleans surfaces	HCl vapor	3250	Counter current packed tower scrapper with missed eliminator	6.5	99
Reduces thickness of strip	Roll coolant spray (water & oil)	100	Baffle plate collision mist eliminator	20	80
Removes oil from strip	Alkali mist	100	Horizontal air washer	5	95
Removes light oxide	HCl vapor	140	Gas washing tower	1.7	99
Tempers/ restores/flatens	Negligible	-	Non	-	-
Applies protective oil coat	Oil aerosols	13	mist eliminator	1.3	90

Table (6) summarizes the main sources and the type of air pollutant produced from the secondary metallurgical processes.

Table (6) Main Metallurgical Industry Air Pollutants

Air pollutant	Main Characteristic	Principal Sources
Carbon monoxide (CO)	Colorless, odorless gas with strong affinity to hemoglobin in blood	Incomplete combustion of fuels and other carbonaceous materials
Hydrocarbons (HC)	Organic compounds in gaseous or particulate form (such as methane, ethylene, acetylene); component in forming photochemical reaction	Incomplete combustion of fuels and other carbon containing substances
Lead (Pb)	Heavy, soft, malleable , gray metallic chemical element ; often occurs as lead oxide aerosol or dust	Occupational exposure in nonferrous metal smelting , metal fabrication, battery making and from automobiles, if tetraethyl lead is still used as an anti-knock compound
Nitrogen oxides (NOX)	Mixture of gases ranging from colorless to reddish-brown	Stationary combustion (power plants) , mobile sources and atmospheric reactions
Particulate matter	Any solid or liquid particles dispersed in the atmosphere, such as dust , ash , soot metals, and various chemicals; often classified by diameter size-particles >(50 microns), (50 microns), fine particulate (<3 microns)	Stationary combustion of solid fuels; industrial process such as cement and steel manufacturing
Sulfur dioxide (SO_2)	Colorless gas with pungent odor; oxidizes to from sulfur trioxide (SO_3) and sulfuric acid with water	Combustion of sulfur containing fossil fuels, smelting of sulfur-bearing metal ores, certain industrial establishments
Temperature	____	Heating, preheating and melting furnaces ladle preheating , Molten metal
Moisture	____	Rolling water cooling circuits, foundries furnaces Cooled by water chills, continuous casting and slag cooling
Noise	____	All rotating and movable machine parts, gas flow

2.4.2 Effluents

The major source of effluents in the EAF is the water used in cooling, the rolling processes is also using a substantial amounts of oils and lubricating fluids. The conventional casting process may use some liquid chemicals for the cleaning process of the casting, but it comprises minor amounts of effluents.

Table (7) gives water pollutants from metallurgical processes.

Table (7) Main Metallurgical Industry Wastewater Pollutants

Indicator	Main Characteristics	Principal Sources
Dissolved oxygen level	Dissolved oxygen is necessary in stream life to survive. Soluble organic matters deplete the oxygen by the activity of aerobic reaction. The quantity of soluble organic matters in a waste is measured either by biochemical oxygen demand, chemical oxygen demand, total organic compounds, or total oxygen demand. These measurements calculate the quantity of oxygen that a given waste will take from a stream.	Different metallurgical industries
Total dissolved solids (TDS)	TDS is a measure of the total inorganic salts and other inorganic substances that are dissolved in water.	Occurs in wide variety of industrial wastes, but in particular, high quantities in the manufacture of . Iron steel and aluminum production washing of raw materials.
Suspended solids	Includes soil and other solid particles.	Caused by industrial processes such as the manufacture of iron and aluminum production and foundries
Nutrients (phosphorous and nitrogen)	Essential for aquatic life in small amounts.	Produced slag granulation , washing of some raw materials
Color and turbidity	Produced by compounds such as lignin and tannin	Result from processes in cooling , raw materials washing
Oil and grease	Oils and greases are generally biodegradable .	Generated by many metallurgical industrial processes including those form aluminum, iron and steel.
pH value	Measures acidity and alkalinity of a stream	Wastewater from virtually all metal industrial processes causes some change in the PH level.
Temperature	Increases temperature caused by discharge of industrial cooling water into streams.	Result from several metallurgical processes that use water for cooling such as smelting and refining furnaces, ladle preheating and heat treadmill furnaces.

2.4.3 Solid Wastes

Solid waste from EAF is mainly the slag and the scales. In continuous casting the pilots of the pillets, scale of the continuous rolled pillets. In conventional casting, including molding the burned sand deserves a special attention, through the molding process there is a possibility of attaining burned hydrocarbon compounds (used in binding, cementing of thee mould, degassing practice and some additions for gas adsorption during poring).

3. Environmental and Health Impact

3.1 Impacts of Air Pollutants on Health and Environment

Table (8) shows the major effects of air pollutants on the human health.

Table (8) Impact of Air Pollutants on Health

Air pollutant	Principal Health Effects
Carbon monoxide (CO)	Absorbed by lungs; impairs physical and mental capacitors; affects fetal development; aggravates
Hydrocarbons (HC)	Acute exposure cases eye, nose, and throat irritation; chronic exposure is suspected to cause cancer
Lead (pb)	Enters primarily through respiratory tract and wall of digestive system; accumulate in body organs causing serious physical and mental impairment
Nitrogen oxides (NO_X)	Major role as component in creating photochemical smog evidence linking respiratory problems and cardiovascular illnesses
Particulate matter	Toxic effects or aggravation of the effects of gaseous pollutants; aggravation of respiratory or cardio respiratory symptoms
Sulfur dioxide (SO_2)	Classed as mild respiratory irritant; major cause of acid rain
Temperature	Physiological load tire feeling , heat stress
Moisture	Unfavorable working condition, heat stress
Noise	Hearing loss, decreased unfavorable working condition

Pollution emitted from metallurgical industry is measured in terms of volume and the hazards it presents. Air pollutants in the atmosphere cause concern primarily because of their potential adverse affects on human health. The adverse human heath effects attributable to air pollution from metallurgical industry include acute conditions such respiratory illness and long term effects such as cancers and birth defects: Other potential adverse impacts of air pollution include damage to animal life, vegetation and buildings, and the degradation of visibility.

3.2 Impacts of Effluents on Health and Environment

Water pollution threatens individuals who come in direct contact with surface such as the river Nile and lakes, as well as those who depend on surface and ground water for drinking water. Water pollutants can enter the food chain through crop irrigation and the contamination of aquatic life. Impacts of pollutants of wastewater of metallurgical industry can range from a loss of aesthetics to a reduction in biological health, which is reflected in a variety of ways: From the loss of species diversity in the ecosystem to direct human health hazards.

Metallurgical industry discharges of concern are, heavy metals, metals, total and suspended solids. They have seriously degraded the quality of important water bodies such as the Nile river. Modern industrial facilities use a range of physical, chemical, and biological treatment technologies to bring the water quality of discharges to acceptable levels. Table (9) gives the impacts of effluent' pollutants on health and environment.

Table (9) Impact of Effluent' pollutants on Health and Environment

Indicator	Impacts on Health and Environment
Dissolved oxygen level	As the level of dissolved oxygen falls below five parts per million, adverse effects are observed on aquatic life. Many fish and marine species cannot survive significant reductions in dissolved oxygen
Total dissolved solids (TDS)	Accelerates corrosion in water system and pipes. Depresses crop yields when used for irrigation, and at high levels adversely affects fish and other aquatic life; may make water unfit for drinking.
Suspended solids	Turns waterways brown; adversely affects aquatic life; creates sludge blankets that can produce noxious gases; interferes with operation of water purification plants.
Nutrients (phosphorous and nitrogen)	At high levels nutrients stimulate growth of algae and seaweed, tend to accelerate eutrophication, and increase oxygen depletion.
Color and turbidity	Major aesthetic problem
Oil and grease	Unsightly and possibly flammable
pH value	Changes in the pH value may upset the ecological balance of the aquatic environment; excessive acidity may create air pollution problems from hydrogen.
Temperature	Decreases ability of water to assimilate waste; increase bacterial activity; may upset ecological balance of aquatic environment.

3.3 Impact of Solid Wastes on Health and Environment

Heavy metals, cyanide, inorganic matters, acids or bases, are the main wastes produced from metallurgical industries that can poses substantial hazards to human health or the environment when improperly managed. Because some of these hazardous wastes may undergo violent chemical reaction with water or other materials generates toxic gases, vapors or fumes; or if it is a cyanide or sulfide bearing waste that can generate toxic gases vapors, or fumes.

Table (10) provides some toxic chemicals with their health impacts. Table (11) lists some toxic chemicals possibly produced from hazardous wastes.

Table (10) Effects of Some Toxic Chemical on Health

Chemical	Effects on Human Health
Arsenic	Vomiting, poisoning, liver etc damage
Cadmium	Suspected cause in human kidney pathologies: tumors, renal dysfunction, hypertension, arterio-sclerosis. Itaiitai disease (weakened bones)
Carbon tetrachloride	liver damage, heart disorder and failure
Chloroform	Kidney and liver damage
Copper	Gastrointestinal irritant liver damage
Cyanide	Acutely toxic
Lead	Convulsions, anemia, Kidney and brain damage
Mercury	Irritability, depression, kidney and liver damage Minamata disease
Nickel	Gastrointestinal and central nervous system
Iron and its oxides	Causes lungs fibrosis due to inhalation of dusts resulting from raw materials preparation
Carbon Tetra Chloride	Causes sickness, vomit, colic, diarrhea, frustration for central nerves system which causes dizziness. These effects lead to unconsciousness

Table (11) Some Toxic Chemicals Produced from Hazardous Wastes

Chemical	Effects on Environment
Low oxygen level	Toxic to aquatic organisms, causes reproductive defects in and fish, bioacumulates in aquatic organisms
Arsenic	Birds and toxic legume crops
Benzene	Toxic to some fish and aquatic invertebrates
Bis-(2- ethyl-hexyl) phthalate	Eggshell thinning in birds, toxic to fish
	Toxic to fish and bio-accumulation in aquatic organisms
Carbon tetrachloride	Ozone- depleting effects
Chloroform	Ozone- depleting effects
Copper	Toxic to fish
Cyanide	Kills fish, retards growth and development of fish
Lead	Toxic to domestic plants and animals, biomagnifies in food chain
Mercury	Reproductive failure in fish, inhibits growth of and kills fish, methylmercury biomagnifies
Nickel	Impairs reproduction of aquatic species
Silver	Toxic to aquatic organisms

4. Egyptian Laws

There are a number of laws and regulations that address the different environmental violations. The following are the laws applicable to the dairy industry.

4.1 Concerning Air Emissions

Article 40 of Law 4/1994, article 42 of the executive regulations and annex 6 deal with gaseous emissions from combustion of fuel. The statutes relevant to the fuel combustion are:

- The use of mazout and other heavy oil products, as well crude oil shall be prohibited in dwelling zones.
- The sulfur percentage in fuel used in urban zones and near the dwelling zones shall not exceed 1.5%.
- The design of the burner and fire-house shall allow for complete mixing of fuel with the required amount of air, and for the uniform temperature distribution that ensure complete combustion and minimize gas emissions caused by incomplete combustion..
- Gases containing sulfur dioxide shall be emitted through chimneys rising sufficiently high in order that these gases become lighter before reaching the ground surface, or using fuel that contains high proportions of sulfur in power generating stations, as well as in industry and other regions lying away from inhabited urban areas, providing that atmospheric factors and adequate distances to prevent these gases from reaching the dwelling and agricultural zones and regions, as well as the water courses shall be observed.
- Chimneys from which a total emission of wastes reaches 7000 – 15000 kg/hr, shall have heights ranging between 18 – 36 meters.
- Chimneys from which a total emission of gaseous wastes reaches more than 15000 kg/hour, shall have heights exceeding at least two and a half times the height of surrounding buildings, including the building served by the chimney.

The permissible limits of emissions from sources of fuel combustion are given in tables (12 and 13) (Ministerial decree no. 495, 2001).

Table (12) Maximum Limits of Emissions from Sources of Fuel Combustion in Boilers

Pollution	Maximum limit mg/m^3 of Exhaust
Sulfur Dioxide.	3400
Carbon Monoxide.	250
Smoke.	50

Table (13) Maximum Limits of Emission from Fuel Burning Sources

Pollutant	Maximum Permissible Limit, mg/ m^3
SMOKE	250
DISPERED ASHES	250 (sources existing in urban regions, or close to residential areas)
	500 (sources for from habitation)
	500 (burning of wastes)
SULPHUR DIOXIDE	Existing 4000 New 2500
ALDEHYDES	Burning of waste 20
CARBON MONOXIDE	Existing 4000 New 2500

4.2 Concerning Effluents

Limits for pollutants in wastewater vary depending on the type of receiving water body. The parameters that should be monitored and/or inspected are BOD, COD, pH, temperature, residual chlorine, TSS, TDS, Oil and Grease.

Table (14) presents the permissible limits for discharges to the different recipients (sea, Nile, canals, agricultural drains, public sewer) according to the different relevant laws.

Spent lube oil has a negative impact on water and soil and therefore its disposal should be monitored/inspected. A record should be kept for this purpose.

Table (14) Egyptian Environmental Legal Requirements for Industrial Wastewater

Parameter (mg/1 unless otherwise noted)	Law 4/94: Discharge Coastal Environment	Law 93/62 Discharge to Sewer System (as modified by Decree 44/2000)	Law 48/82: Discharge into :			
			Underground Reservoir & Nile Branches/Canals	Nile (Main Stream)	Drains	
					Municipal	Industrial
BOD (5day,20 deg.)	60	<600	20	30	60	60
COD	100	<1100	30	40	80	100
pH	6-9	6-9.5	6-9	6-9	6-9	6-9
Oil & Grease	15	<100	5	5	10	10
Temperature (deg.)	10C>avg. temp of receiving body	<43	35	35	35	35
Total Suspended Solids	60	<800	30	30	50	60
Settable Solids	—	8 cm^3/ l (10 min) 15 cm^3/ l (30 min)	—	20	—	—
Cadmium	0.05	0.2	0.01	0.01	Total concentration for theses metals should be: 1 for all flow streams	
Chromium	1	—	—	—		
Chromium Hexavalent	—	0.5	1	1		
Copper	1.5	1.5	1	1		
Iron	1.5	—	1	1		
Lead	0.5	1	0.05	0.05		
Nickel	0.1	1	0.1	0.1	—	—
Zinc	5	—	1	1	—	—
Total heavy metals	—	<5	<1	1	1	1
Aluminum	3	—	—	—	—	—

4.3 Concerning Solid Waste

A number of laws address solid waste management. The following laws apply to scrap and sludge from the WWTP:

- Law 38/1967 which addresses public cleanliness, regulates the collection and disposal of solid wastes from houses, public places, commercial and industrial establishments.
- Ministry of Housing, Utilities and Urban Communities (MHUUC) decree No. 134 of 1968, which provides guidelines from domestic and industrial sources, including specifications for collection, transportation, composting, incineration and land disposal.
- Law 31/1976, which amended law 38/1967
- Law 43/1979, the Law of Local administration, which provided that city councils are responsible for “physical and social infrastructure”, effectively delegating responsibility for infrastructure functions.
- Law 4/1994 regulates incineration of solid waste

4.4 Concerning Work Environment

Violations of work environment could be encountered:

- Wherever burning fuel is performed: gas emissions, regulated by article 43 of Law 4/1994, article 45 of the executive regulations and annex 8. The limits for the relevant pollutants are presented in table (15).
- Wherever heating is performed: temperature and humidity are regulated by article 44 of Law 4/1994, article 46 of the executive regulations and annex 9. Table (16) shows the maximum limits for heat stress.
- Near heavy machinery: noise is regulated by article 42 of Law 4/1994, article 44 of the executive regulations and table 1, annex 7. These limits are given in the tables (17, 18 and 19).
- Ventilation is regulated by article 45 of Law 4/1994 and article 47 of the executive regulations.
- Work environment conditions are addressed in Law 137/1981 for Labor, Minister of Housing Decree 380/1983, Minister of Industry Decree 380/1982.

Table (15) Threshold Limits for Some Pollutants in Work Place

Material	Threshold			
	Time average		Exposure limits for short periods	
	ppm	mg/m^3	ppm	mg/m^3
Acetone	750	1780	1000	2375
Aluminum metal and its oxides	10		20	
Welding smoke and fumes	5			
Carbon Dioxide	5000	9000	15000	27000
Carbon Monoxide	50	55	400	440
Ethylene Glycol Vapor	50	125	50	125
Ethyl Methyl Ketone	200	590	300	885
Trichloro Ethylene	50	270	150	805
Fine Saw Dust		5		10
Carbon Tertiary Chloride	100	435	150	655
Xylene			5	

Table (16) Maximum Permissible Limits for Heat Stress (law 4/1994)

Type of Work	Low Air Velocity	High Air Velocity
Light work	30^o C	32.2 ^{o} C
Moderate work	27.8 ^{o} C	30.5 ^{o} C
Severe work	26.1 ^{o} C	28.9 ^{o} C

Table (17) Maximum Permissible Noise Levels (law 4/1994)

No	Type of place and activity	Maximum permissible noise decibel (A)
1	Work place with up to 8 hour and aiming to limit noise hazards on sense of hearing	90 dB
2	Work place where acoustic signals and good audibility are required	80 dB
3	Work rooms for the follow up, measurement and adjustment of high performance operations	65 dB
4	Work rooms for computers, typewriters or similar equipment	70 d.B
5	Work rooms for activities requiring routine mental concentration	60 dB

Table (18) Noise Intensity Level Related to the Exposure Period

Noise intensity level decibel (A)	95	100	105	110	115
Period of exposure (hour)	4	2	1	½	¼

Table (19) Noise Intensity Level In Intermittent Knocking Places

Noise Intensity db	Max Allowable Knocks During Daily Work Period
135	300
130	1000
125	3000
120	10,000
115	30,000

4.5 Concerning Hazardous Material and Wastes

Law 4/1994 introduced the control of hazardous materials and wastes. The dairy industry does not generate any hazardous wastes. Hazardous chemicals such as hydrochloric and nitric acids are used for washing vessels. The hazardous chemicals used in the lab and the fuel for the boilers, fall under the provisions of Law 4/1994. Articles 29 and 33 of the law makes it mandatory for those who produce or handle dangerous materials in gaseous, liquid or solid form, to take precautions to ensure that no environmental damage shall occur. Articles 25, 31 and 32 of the executive regulations (decree 338/1995) specify the necessary precautions for handling hazardous materials. Storing of fuel for the boilers is covered by the Law 4 as hazardous material There is no explicit articles in Law 4/1994 or in decree 338/1995 (executive regulations), regarding holding a register for the hazardous materials; article 33 is concerned with hazardous wastes. However, keeping the register for the hazardous materials is implicit in article 25 of the executive regulations regarding the application for a license.

4.6 The Environmental Register

Article 22 of Law 4/1994 states that the owner of the establishment shall keep a register showing the impact of the establishment activity on the environment. Article 17 and Annex 3 of the executive regulations specify the type of data recorded in the register.

The emergency response plan and the hazardous materials register will also be part of the environmental register as stated in law 4/ 1994.

5. Pollution Abatement Procedures

5.1 Air Pollution

a. Electric Arc Furnace (EAF) Steel Melting

Most EAF have fabric filters (baghouses) for fume cleaning and collection. Both positive- and negative-pressure fabric filters are used. Cleaning methods of all types-reverse air, shaker, and pulse jet-are employed. The reverse air filter is the most commonly used type of filter.

Pulsejet bag-houses are sometimes used for EAF fume cleaning. Most EAF fume systems carry furnace sparks to the baghouse where they tend to cause bag spark damage. Well-designed baghouse hopper inlets have the ability to drop these sparks out in the hopper before they have a chance to travel onto the bag surface. Collected dust should be removed from the baghouse hoppers as soon as possible in order to prevent dust re-entrapment and bridging of dust in baghouse hoppers. As an alternative to the baghouse (dry) emission control system, scrubbers are also in use today. These systems use water sprays to trap the particulate mailer the water is collected and re-circulated to the scrubber. Sludge is collected in a clarifier. This sludge must be dewatered prior to further handling.

Contact of the molten steel with air should be minimized. Maintaining a slag layer, shrouding and using ladle covers are examples of this type of control and reduce the formation of particulate emissions. The degree of inert gas stirring may increase the fumes generated. High gas rates lead to vigorous agitation of the steel heat, exposing molten steel to the air.

Certain wire or powder additions, such as calcium silicate, greatly increase fume emissions owing to their high vapor pressures and high reactivity. When injected into the ladle, vigorous reactions result in the release of a white fume. The LM furnace may share a common bag house with an EAF or other secondary emission sources in the foundry.

b. Forming Processes

During the state-of-the-art of forming processes, metals are introduced onto the line and passes through the major processing steps. In both hot and cold forming, one can expect nitrogen oxides (NOx) emissions resulting from combustion in reheat furnaces, in annealing furnaces, or from boilers. The primary means of controlling NOx emissions is through combustion modification or selective catalytic reduction. The general technique to control thermal NOx is to suppress the natural gas combustion temperature to below 1400C. Above this temperature, NOx formation is exponential, while below this temperature, it is linear at a very limited rate.

c. Casting

a-1 Iron Foundries

There are two primary collection methods for foundry particulate-wet and dry. Wet scrubbers include low- and high-energy types. Dry collection includes baghouses mechanical collectors, and electrostatic precipitators. In addition, the control of organic compounds may require incineration or afterburners. Air toxics merit special consideration, requiring careful selection of the collection method.

- Wet Collectors

All wet collectors have a fractional efficiency characteristic-that is, their cleaning efficiency varies directly with the size of the particle being collected. In general, collectors operating at a very low-pressure loss will remove only medium to coarse particles. High-efficiency collection of fine particles requires increased energy input, which will be reflected in higher collector pressure loss. In addition, gas scrubbers may be used to control odors, toxic and sulfur dioxide emissions. In this case, acids, bases, or oxidizing agents may have to be added to the scrubbing liquid.

- Dry Collectors

The most frequently encountered equipment for the removal of solid particulate matter from an air stream or gas stream is the fabric dust collector or bag-house. Filter media are available for hot corrosive atmospheres, such as furnace emissions. Operating inlet temperatures up to260C are not uncommon.

Teflon-coated woven-glass-fiber bags have been used on a large majority of cupola installations because of their high temperature resistance. Afterburners may be used in some processes to control emissions, particularly when oily scrap or hydrocarbons in any form are charged into the furnaces or scraps preheat systems. If afterburners are not used, carbon monoxide and oil vapors may be emitted through the discharge stack of the air pollution equipment.

In general, in the selection of collection devices for all processes, moisture, temperature, and the presence of corrosive materials must be considered.

a-2 Steel Foundries

Controls for emissions during the melting and refining operations focus on venting the furnace gasses and fumes directly to an emission collection duct and control system. Controls for fugitive furnace emissions involve the use of either building roof hoods or special exhaust hoods near the furnace doors to collect emissions and route them to emission-control central gathering points. Emission control systems commonly used to control particulate emissions from the electric arc and induction furnaces are normally bag filters, electrostatic precipitators, or venturi scrubbers. Many of the present-day electric arc furnaces incorporate the canopy hood with other systems

5.2 Liquid Wastes

a. Electric Arc Furnace Steel Melting

Some parts of the electric arc furnace must be water-cooled (electrodes champs, cover rings, bottom side of the furnace…). No contamination of this water is expected. That water may be completely cooled and recycled. Also the water used in cooling compressors are recycled. If wet scrubbers are used, water is sprayed to trap the particulate; then water is collected and re-circulated to the scrubber. Sludge must be de-watered prior to further handling.

b. Rolling

Usually cooling water is completely recycled with an addition of about 20% per day as a loss. The mills collect waste oil which must be stored in two ways to be sold to licensed suppliers. Mill scales (1-3% of the production) can be reused in sintering plants.

c. Iron and Steel Casting Production

Water is used in iron and steel foundries as an addition of 3-5% of molding mixtures; this water goes in vapor. Also water is completely recycled by making use of it for cooling the furnaces and compressors. Some foundries use water in washing. This water must be treated before discharging.

d. Metal Drawing and Extrusions

Water is used for cooling the dies. Because contamination is expected, water is completely recycled.

e. Oils

Different types of oils are used as lubricants, which amounts of its wastes depend upon working contamination conditions and machine design. In metallurgical plants oils (rejects) ranges from 60-80%; these amounts must be collected, stored in a proper and safe way to be sold.

5.3 Solid Wastes

a. Electric arc Steel Making

From 10-20 kg of slag is produced from smelting carbon steel in a medium size electric arc furnace. The amount of slag also depends upon the refining and alloying process. Usually slags mixed with broken and waste refractors are collected to be dumped.

b. Rolling

Scales are the main solid wastes of steel rolling. These scales are collected from the rolling pass or from the cooling water to be reused as a part of charging material of sintering or to be added to the steel melt as a de-oxidizer and refiner.

c. Iron and Steel Castings

Waste refractories, burned sands, and slag are the main solid wastes of iron foundries, which must collected and dumped in a proper way. Defected castings, rejects and heeding systems are completely recycled in the shop. They are used as charging metals in the melting unit.

5.4 Examples of Cleaner Production

To avoid possible facility closings, the iron steel industry has been actively investigating alternatives cleaner. One promising technology, the direct steel-making project that was jointly funded by the American Iron and Steel

Institute (AISI) and the U.S. Department of Energy (DOE), concluded on March 31, 1994. This technology reduces, melts, and refines iron in a single reactor. An opt-in, DOE cost-sharing program for the smelting of steel plant waste oxides began on April 1, 1994. Based on the success of recent trials, and the further knowledge that was gained from this follow-on program, the technology is now well understood and fully developed. A feasibility study for a demonstration plan may now be available.

6. Industrial Inspection:

The environmental inspection of the metallurgical industries is to follow the procedures described in the General Inspection Manual (GIM EPAP 2002). This chapter summarizes the inspection process regarding objective, different inspection types and the suggested inspection procedures concerning secondary metallurgical industry.

The overall purpose of inspection is to enforce compliance with the environmental laws. Table (20) lists the various types of inspections and the objectives that have to be fulfilled for each type.

Table (20) Various Types of Inspections and Relative Objectives

Inspection type	Inspection Objectives
Site Inspection 1. Comprehensive 2.Specific site inspection	- Checking compliance with the aspects of the law4. - Checking compliance with some specific aspects of the law4/1994. - Checking special conditions set by EEAA in EIA studies. Investigate complaints.
2. follow up	- Checking environmental register and implementation of compliance measures.
Inspection Campaigns 1. Geographically oriented	- Checking specific pollution sources to specific receiving media
2. sector oriented	- Checking the environmental aspects related to the specific sector

As evident from the above table, comprehensive inspection deals with all aspects of environmental laws, and therefore is considered in this manual. Other inspection types can be tailored accordingly.

Developing an inspection strategy and quarterly and/or monthly plans are the responsibilities of the inspectorate management. Developing site-specific inspection plans for carrying out the scope of work that fulfills inspection objectives is the responsibility of the inspection team. Planning for inspections is presented in more detail in the General Inspection Manual, (GIM EPAP-2002).

The following chapters describe the application of the general guideline of the inspection team to the metallurgical industries, taking into account the specific features of the metallurgical industries as described in section 2. It is important to note that the check-list must be tailored to the specific facility depending on the existing production lines and service units.

7. Inspection Planning at the Inspectorate Level

7.1 Defining the Objectives

Taking the comprehensive inspection as an example, the objectives stated in table (16) dictate the activities required for covering all aspects of compliance with environmental laws and regulations. The required personnel, equipment and logistics are determined accordingly.

As evident from the information presented in section 1, the size of metallurgical facilities may range over wide span, from small foundries to large factories so it is important to determine the targeted sampling and the order of inspection before proceeding with the inspection.

7.2 Providing Information About the Facility

Chapter 2 presents the technical aspects regarding the metallurgical industries, its pollution sources and the corresponding environmental laws. Information regarding compliance history related to other inspection parties (irrigation inspectors, occupational health inspectors, etc) can be helpful in anticipating potential violations and preparing necessary equipment.

Compliance action plans for the facilities, environmental impact assessment and block flow diagrams are considered the main information sources, which provide the necessary data base for inspection before the field visit.

7.3 Providing Required Personnel, Tools and Equipment

The required tools, personnel and equipment depend on the size of the facility to be inspected. The team leader, in coordination with inspectorate, should assess the number of needed inspectors relevant to the size of facility.

The team is divided into groups of different tasks, which guarantees that inspection is implemented in a synchronous way.

8. Preparation of the On-Site Visit

As presented in the General Inspection Manual (GIM EPAP-2002). Tasks for preparation for on-site visit are:

- Gathering information about the specific facility to be inspected
- Preparing the inspection plan
- Preparing the checklists

This manual presents, in annex (E), the case of comprehensive multi-media site inspection of a large metallurgical facility since it represents the highest level of the inspection complexity.
Tasks for inspecting less complicated facility can be easily deduced.

8.1 Collecting and Reviewing Information

The inspection team should review the general information prepared for the metallurgical industry (chapter 2) and then check- if possible- what production lines and what service units are present in the targeted facility. In addition to the required information listed in the Annex (C) of the General Inspection Manual (GIM EPAP 2002) it is important at this stage to determine the following:

- The type of receiving body for the industrial wastewater and review relevant Egyptian laws.
- The scope of inspection and related activities based on the type and objectives of inspection required by the inspectorate management.
- The potential pollution hazards as addressed in section 2, and accordingly, define measurements and analyses needs.
- The characteristics of the metallurgical industries as presented in section 2, and their implications on the inspection process of the targeted facility.

8.2 Preparation of the Inspection Plan

An example of the inspection plan is included in Annex (E) of the General Inspection Manual, (GIM EPAP-2002). The plan should take into account the following:

- For large facilities, the inspection team could be divided into smaller groups. Each group will be responsible for inspecting a specific number of production lines and service units.
- At the beginning of on-site visit the inspection team should check the environmental register for completeness using the check-list provided in Annex (G) of the General Inspection Manual (GIM EPAP-2002).
- The results of the analyses included in the environmental register should be checked at the end of the on-site visit (if suspicion arises about them) and copies of these results should be obtained.

- Planning for stacks measurement, should be taken as well as the noise and heat stress measurements. This means that inspection team should provide the mobile measuring equipment.

At the end of inspection visit, the team should compare the data in the environmental register with those were taken during field inspection.

8.3 Preparation of the Required Checklists

The checklist for the metallurgical industries is presented in the Annex (1) of this manual. The checklist has been prepared in such a way that it starts with general information about the facility and its operation. Separate check-lists are then filled for each production unit or service unit independently for relevant environmental aspects and media.

- Draw the block flow diagrams for the production lines with their pollution sources.
- Identify the areas of possible non-compliance and the parameters that need checking.
- Identify what to observe, ask and/or estimate that can convey information about pollutants.

8.4 Legal Aspects

Section (2.4) of this manual gives a detailed description of emissions and wastes generated from this industry. This enables the inspectors to identify the violations in these facilities.
The inspection team should be prepared for legally establishing such a violation.

General Inspection Manual describes in details the procedures should be taken in case of violating the environmental laws.

Note to inspector*:*
It is the responsibility of the inspector to assess the seriousness of the violation, which the enforcement action will be based. His information about the nature and cause of violation must be well and the evidence sound. The case could be contested in court and the inspector will be asked to defend his technical judgment

9. On-Site Visit

9.1 Starting the Field Visit

The General Inspection Manual (GIM EPAP-2002) describes the procedures involved for entering an industrial facility. The inspectors' attitude and behavior are very important from the start and will dictate the factory's personnel response to the inspection tasks. If entry is the denied to the team, the team leader must document the circumstances and actions taken. This includes recording the name, title and telephone number of the person(s) denying entry.

Note to the inspector:

- It is preferable, in the first phase of the inspection visit, not to ask direct questions about pollutants. It is better to conclude some information during the interview with the workers.
- Inspectors should check the results of wastewater analysis, the sampling date and place. They should also take their own samples.
- Inspectors should take a copy for the facility' map, which shows the points of gaseous emissions (stacks), sewage system and the final wastewater discharge points.

9.2 Proceeding with the On-Site Visit

Information gathered during the facility tour is dependent on interviews of facility personnel and visual observation. Annex (H) in the General Inspection Manual (GIM EPAP- 2002) presents some useful interviewing techniques.
Using the facility layout, start by checking the final disposal points and the various plants and/or service units connected to each point(e.g. storage facilities, sand stacking, cleaning and finishing). inspection of the production lines should start with the feeding of raw materials and end with the product storage. This will determine where and how to take effluent and emissions samples. The inspector should follow the process of charging the electric arc furnace. Efficient charging directly affects the mass balance and the energy consumed referring to stage (1) the figures for efficient charging is related to the capacity of the furnace. The quality of the charge and the time of charging/ton, are the main factors, which could be considered in inspection

Inspecting secondary metallurgical facilities starts from preparing scrap metals and the other row materials charged into the furnaces. They pass through different processes, which are previously discussed (molds processing, casting, pouring into molds and rolling processes). Inspectors, finally, check product storage areas and the other service units in the facility.

Inspectors should take into consideration the following general notes:

- the furnaces opening doors should be equipped with reflectors, especially for the preheating furnaces.
- The ultra-violet radiation evolving from the electric arc should be carefully avoided, check if protection glasses were in use.
- In the scrap yard find out the relative amount of lead and Zn-coated sheets.
- Check if the facility is using an air suction system in molding and sand manipulation units.
- Inspection should take into consideration the slag gemmated from melting process, its amount, collection, treatment and disposal method. Cooling of slag generates vapors, which need protective measures for the workers.
- Inspectors should check the hazardous materials storage and handling, as well as the fuel. They must also check the absence of any fuel leakage or spill and the protective procedures taken by the facility.
- Inspectors should check the availability of protective and safety measures, which are proper to heat stress and noise.

The following are the important aspects that should be inspected carefully in the different secondary metallurgical facilities:

a. Production Processes

a.1 Metal Melting Process

- Check the type of scrap charged into the furnace, its content of heavy metals, its preparation and the disposal methods of scrap wastes (these solid wastes contain plastic and rejected metallic parts).
- Check for the furnaces type, their charge, products, fuel type, slacks specifications and gaseous emissions measurement.
- Check for the cooling circuit for the furnace (open or closed), and check the discharge point in case of open circuit.
- Check the types and consumption rates of oils and greases, as well as its disposal methods.
- Take the necessary measurements in work place (heat stress, noise, emissions and light intensity when checking the metal molten or the electric arc).
- Check metal pouring operation in the ladle, type of treating additives, and the impact of this process on the workers (fumes and heat). This process results in an intensive bubbling which should be considered.
- Check slag drawing operation, its treatment and disposal method, as well as the effect of this process or work environment (fumes, heat and humidity).
- Inspect the protective and safety measures and its properness to the existing hazard.
- Check the ventilation and suction equipment.

a.2 Continuous Casting Process

- Check metal molten pouring in the ladle (tundish) and its effect on work place (fumes, heat and humidity). Check the safety measures.
- Check cooling circuit for casting equipment (open or closed), where is this water discharged to in case of open circuit.
- Check gaseous fuel type, which is used for flame cutting operation. Check the safety measures for the workers operating these equipment.
- Check the ventilation methods in the unit.

a.3 Conventional Casting Process

- Check the sand molds processing and its raw materials preparation and transportation (covering the belt conveyors).
- Check the ventilation and suction system and the collection method of the wasted sand.
- Check the molds roasting operation, furnace fuel type and heat stress.
- Inspect the pollution parameters concerning work place (heat, dust and Noise) in the unit.

a.4 Formation Processes

- ***Rolling***

- Inspect the casts reheating process for rolling operation, fuel type and work environment near the heating furnace.
- Check the rolls and furnace cooling water discharge and its oil content. Is it a closed or open circuit.
- Check, visually, the stack emissions of the heating furnace and take your own measurements, if necessary.
- Inspect the safety and protection measures for the workers in this unit and the ventilation system.
- Check the generated solid wastes and their disposed methods.

- ***Drawing and Extrusion Processes***

- Inspect the annealing furnace, fuel type, stack emissions, handling of raw material and work environmental near the furnace.
- Check for handling hazardous materials handling and storage, such as acids, and the disposal method for their wastes.
- Check oil and grease spent and their disposal methods.
- Check for noise beside coiling machines.
- Inspect the used water in the unit and its discharge (furnace cooling water and metallic bas washing water, which contains acids).

- ***Forging***

- Inspect the heating furnace, fuel type, stacks emissions, handling of raw materials, heat stress and cooling water.
- Check for the disposal method of oils and grease.

- Check for the noise and exposing period beside forging equipment and take your own measurements if necessary.
- Check the disposal methods for solid wastes.

Note to the inspector:

- Most of the emissions of the furnaces, which are heated by coke or oil, are due to incomplete fuel combustion, so it is important that the inspector considers carefully the combustion parameters and the working factors, which disturb the production flow.
- The inspector could visualize the burning efficiency of the burners by examining the color of the flame. Also he must consider the possibility of leakage in the fuel piping system. If the inspector suspects that the emissions are not in compliance with standards, it is recommended to analyze the gas emissions with portable gas analyzer.

9.3 Ending the On-Site Visit

When violation is detected a legal report is prepared stating information pertaining to sampling location and time. Violations of work environment regulations should be stated with location and time of measurements. Other violations such as solid waste accumulation, hazardous material, waste handling and storage, and material spills should be photographed and documented.

At the end of the visit, a closing meeting with the facility management can be held and the facility' representative signs the minutes of meeting. Later, the inspectors prepare the inspection report, accompanied with the laboratory report. The violations in the facility are written, in the inspection report, based on the concerned laws and their executive regulations.

Note to the inspector:

- In case of suspecting a violation in a certain facility, the inspectors should not discuss it during the ending meeting.

10. Conclusion of the On-Site Visit

The activities performed during the site inspection are essential for preparation of the inspection report, assessing the seriousness of violation, pursuing a civil action against the facility, presenting the legal case and making it stand in court without being contested, and for further follow up of the compliance status of the facility.

10.1 Preparing the Report

An example of an inspection report is included in Annex (K) of General Inspection Manual (GIM EPAP, 2002). The inspection report presents the findings, conclusions, recommendations and supporting information in an organized manner.

10.2 Supporting the Enforcement Case

Many issues may be raised and disputed in typical enforcement action. Enforcement officials should always be prepared to:

- Prove that a violation has occurred. The inspector must provide information that can be used as evidence in the court of law.
- Establish that the procedures were fairly followed.
- Demonstrate the environmental and health effects of the violating cases.

10.3 Following-Up Compliance Status of the Violating Facility

After performing the comprehensive inspection and detecting the violations, the inspectorate management should:

- Decide on the sanctions and send the legal report to the judicial authority.
- Plan routine follow-up inspection. This type of inspection focuses on the violation sources and its related pollution abatement measures. Self-monitoring results are reviewed during the visit.
- Follow-up the enforcement case (legal department).

Annex (1)

Inspection Checklist for Secondary Metallurgical Facility

Ministry of State for Environmental Affairs
Egyptian Environmental Affairs Agency
Basic Data Sheet

Date of visit:……………………………………. Visit number:………………………….

Facility name:……………………………………

Commercial name:…………………………………………………………………….

Licensed Activity:………………………………... Days off:………………………

Legal status:……………………………………………………………………………

Address of facility

Area of facility:………………………………… Governorate:………………………….

City:…………………………………………… Zone:……………………………….

Phone no. :………………………………… Fax no.:……………………………….

………………………………... ………………………………….

Year of operation :……………………………….. Postal code:……………………………

The Facility Representative:……………………………………………………………..

Environmental management representative:…………………………………………………….

Chairman/Owner:…………………………………………………………………………

Address of Administration

e-mail:……………………………………………..

Phone no. :………………………………… Fax no.:……………………………….

………………………………... ………………………………….

The industrial sector:………………………………………………………

No. of male employees: …………………… No. of female employees:…………………

Do they work in production …………………………….

Total no. of employees: ………………………….

Number of shifts/day:……….…………shifts/day

Duration of shift:……………………….…hrs/shift

Environmental register:………………………….. Hazardous waste register:…………….

EIA:…………………………………………….. Self monitoring:……………………….

Nature of Surrounding Environment

Industrial ❑ Coastal ❑ Coastal/ Residential ❑

Industrial/ Residential ❑ Residential ❑ Agricultural ❑

Agricultural/ Industrial ❑ Agricultural/ Residential ❑ Desert ❑

Power Consumption

Electricity ❑ Fuel ❑

Electric power: ……………...kWh/(day-month-year)

Type of fuel	Fuel consumption	
Mazot	………………………	Ton/(day-month-year)
Solar	………………………	Ton/(day-month-year)
Natural gas	………………………	Ton/(day-month-year)
Butagas	………………………	Ton/(day-month-year)
Other ….	………………………	Ton/(day-month-year)

The GPS (Global Positioning System) reading for Gaseous Emissions

1- LAT(Latitude):..……. LONG(Longitude):…….
2- LAT(Latitude):……… LONG(Longitude):…….
3- LAT(Latitude):……… LONG(Longitude):…….

Production

Product	Quantity/ (day-month-year)
………………………………………………	………………………………………………
………………………………………………	………………………………………………
………………………………………………	………………………………………………
………………………………………………	………………………………………………
………………………………………………	………………………………………………
………………………………………………	………………………………………………
………………………………………………	………………………………………………
………………………………………………	………………………………………………
………………………………………………	………………………………………………
………………………………………………	………………………………………………
………………………………………………	………………………………………………

Water Supply

Artesian well ❑ Municipal water ❑ Treated water ❑ Nile water ❑

Canal water ❑ Other………….. ❑

Water Consumption

Amount of water consumed in operation (day-month-year):

Process ……..m^3/ Boilers…………………..m^3/

Domestic usage………....m^3/ Cooling………………....m^3/

Other…….. …………….m^3 /

Total amount of water consumed (day-month-year)……… …………..m^3/

Type of waste water:
Industrial ❑ Domestic ❑ Mixed ❑

Wastewater Treatment:
Treated ❑ Untreated ❑

Type of Treatment:
Septic tanks ❑ pH adjustment ❑ Biological treatment ❑
Chemical treatment ❑ Tertiary treatment ❑

Amount of treated water/ (day-month-year)……………..m^3 /
Amount of waste water/(day-month-year)……………………….m^3 /

Final wastewater receiving body:
Nile ❑ Lakes (fresh water) ❑ Drain ❑
Groundwater ❑ Public sewer system ❑ Canals❑
Agricultural Land ❑ Desert Land ❑ Other………………………❑

The Global Positioning System(GPS) reading for final disposal
1-LAT(Latitude):……. LONG(Longitude):…….
2-LAT(Latitude):……. LONG(Longitude):…….

Engineering Drawings for the Facility
Gaseous emissions map Yes ❑ No ❑

Sewer map: Domestic ❑
Industrial ❑
Mixed ❑
Factory Layout ❑
Production process flow diagram ❑

Raw material consumption

No.	Trade name	Scientific name	CAS no.	UN no.	Physical state	Type of container	Amount	Classification	
								Hazardous	Non-Hazardous

Inspection Team Member:

Team member	**Position**

Date:

Inspector signature:

Annex (1- B)

Inspection Checklist for Hazardous Materials and Wastes

Annex (F-2)
Inspection checklists for hazardous materials and wastes for a facility

1. Hazardous materials (to be filled in case the facility uses hazardous materials) [1]

Fill the following table according to the codes below

Hazardous material	Amount	Field of utilization	Storage method[2]	Method of disposal of the containers	Conformity of containers to specifications[3]	Presence of MSDS[4]

[1] To be filled from the list of used raw material and chemicals according to the hazardous material list issued by the Ministry of Industry, checking the presence of a valid license for handling

[2] According to law 4/1994, does the storage area have:

S_1: alarm, precaution and fire fighting system?

S_2: first aid procedures?

[3] Check containers' compliance with law4/1994:

C_1: sealed and don't cause any threats while handling

C_2: unaffected with along storing period

C_3: labeled with hazard and toxicity signs

C_4: labeled in Arabic (production, origin, utilization instruction)

C_5: labeled with its content, the effective substance and its concentration

[4] Material safety data sheet

2. Hazardous wastes (to be filled in case the facility generates hazardous wastes)[1]

Fill the following table according to the codes below

Hazardous waste	Source	Amount generated/ year	Storing method			On-site treatment and disposal			Transportation method	Presence of documents indicating off-site disposal[6]
			Method of storage inside the facility	Compliance of containers' specifications and labels with law 4/1994[2]	Compliance of storage areas with law 4/1994[3]	Treatment[4]	Final disposal[5]	Compliance of treatment and disposal with law 4/1994		

[1] Hazardous wastes can be identified according to law 4/1994 and by using the hazardous wastes list of the Ministerial decree no.65 for 2002 as refrence

Is there a hazardous wastes register? Yes ❑ No ❑

[2]Does the facility take into consideration that the storage containers should be:
C_1: with sealed covers to protect the container from rain water and dust and to prevent any wastes leakage during storage and/or transportation
C_2: constructed or lined by impermeable material which doesn't react with the contained material
C_3: of suitable capacity C_4: labeled

[3 Specification of storage area: determining specified locations for storage of hazardous wastes where safety conditions are set up to prevent the occurrence of any harm to the public or to those persons exposed to the wastes

[4] Which of the following methods are used by the facility for the treatment of hazardous wastes?
N_1: biodegradation N_2: incineration N_3: physical or chemical treatment

[5] Which of the following methods are used by the facility for the hazardous wastes final disposal?
F_1: land filling in specially engineered landfill F_3: other (specify)……………….

[6] Contracts with wastes' contractors and receipts.

Annex (1- C)

Inspection Checklist for
Production Lines and Service Units

Check list for Electric Arc Furnace (EAF)

1- General	
1-1 Housekeeping Floor status Solid wastes accumulation	 ---------------------------- ----------------------------
1-2 Furnace capacity	----------------------Ton
1-3 Cooling circuit, open or closed	Open ❑ Closed ❑
1-4 Last maintenance date for the furnace	--------/------/-----------
1-5 Operating cycle for the furnace Charging time Melting time Casting time Injection time	 ----------------------min -----------------------min -----------------------min ----------------------min
2- Status of Ambient Air	
2-1 Check stacks emissions measurements (heavy metals) Are they included in the environmental register	Yes ❑ No ❑
Note*: In case of suspecting the measurement, then take your own one.*	
2-2 Identify the stack height.	----------------------------
Note*: The stack height should be 2.5 the height of surrounding buildings*	
3- Status of Work Environment	
Are there any personal protective equipment for the workers during the handling of molten metals?	Yes ❑ No ❑
Identify the applied procedures concerning emitted vapors resulting from melting process	----------------------------
Check the work environment measurements concerning gaseous emissions during melting (Pb,Cd,PM) Are they included in the environmental register?	---------------------------- No ❑ ❑ Yes
Check the efficiency of ventilation system	----------------------------
Check for the measurement of noise beside transformers and furnaces. Are they included in the environmental register?	---------------------------- ❑ Yes ❑ No
Are there any personal protective measures for the noise?	Yes ❑ No ❑
Check for the heat stress measurements beside furnaces and during pouring. Are they included in the environmental register?	---------------------------- ❑ Yes ❑ No
8 Does the slag quenching process applied in an open area, or in a closed one?	----------------------------
Note*: In case of suspecting the measurements, then take your own one.*	
4- Status of Effluents	
Identify types and amounts of generated oil and grease	----------------------------
What is the disposal method of the spent oil and grease?	----------------------------

5- Status of Solid Wastes	
Identify the daily average of generated slag, and its disposal method	----------------------------
Identify the rate of replacing the lining brick of the furnace	----------------------------
Identify its disposal method	----------------------------

Checklist for Crusible, Cupola and Heating Furneses

1- General	
1-1 Housekeeping Floor status Solid wastes accumulation	 ---------------------------- ----------------------------
1-2 Furnace capacity	----------------------------
1-3 Cooling circuit, open or closed	----------------------------
1-4 Last maintenance date for the furnace	----------------------------
1-5 Operating cycle for the furnace Charging time Melting time Casting time Injection time	 ----------------------------- ----------------------------- ----------------------------- -----------------------------
Type and amount of used gaseous fuel and Mazout amount	Type of fuel:-------------------------------- Quantity of fuel:---------------------------- Mazout amount:--------------------------
***Note**: Environmental laws forbid the usage of mazout as fuel in residential zones*	
2- Status of Ambient Air	
Check stacks emissions measurements Are they included in the environmental register Do they include heavy metals	 Yes ❑ No ❑ Yes ❑ No ❑
In case of suspecting the measurement, then take your own one.	
2-2 Identify the stack height.	----------------------------
***Note**: The stack height should be 2.5 the height of surrounding buildings*	
Identify the measurements places in the stacks	----------------------------
Check the flame' color.	----------------------------
***Note**: the incomplete combustion, generates higher emission rates for pollutants.*	
3- Status of Work Environment	
1 Are there any personal protective equipment for the workers for the molten metals?	Yes ❑ No ❑
Identify the applied procedures concerning emitted vapors, resulting from melting process	------------------------------
Check the work environment measurements concerning gaseous emissions melting (Pb,Cd,PM) Are they included in the environmental register?	------------------------------- ------------------------------
Check the efficiency of ventilation system	
Check for the measurement of noise beside transformers and furnaces. Are they included in the environmental register?	---------------------------- ❑ Yes ❑ No
Check for the heat stress measurements beside furnaces and during pouring. Are they included in the environmental register?	---------------------------- ❑ Yes ❑ No
Does the slag quenching process applied in an open area, or in a closed one?	----------------------------
***Note**: In case of suspecting the measurement, then take your own one.*	

4- Status of Effluents	
Identify types and amounts of generated (spent) oil and grease	---------------------------- ----------------------------
What is the disposal method of the spent oil and grease?	----------------------------
Check the presence of leaks in fuel pipeline system	----------------------------
5- Status of Solid Wastes	
Identify the daily average of generated slag and its disposal method	----------------------------
Identify the rate of replacing the lining brick of the furnace	----------------------------
5-3 Identify its disposal method	----------------------------

Checklist for Continuous Molding Operations

1- General	
1-1 Housekeeping Floor status Solid wastes accumulation	 ---------------------------- ----------------------------
1-2 Cooling circuit, open or closed	----------------------------
Identify the type of gaseous fuel, which is used in flame cutting process.	----------------------------
2- Status of Work Environment	
Check the work environment measurements concerning gaseous emissions (heavy metals)	----------------------------
Are there any personal protective equipments in the unit?	Yes ❑ No ❑
2-3 Check the efficiency of ventilation system	----------------------------
2-4 Check for the heat stress measurements beside molding operation. Are they included in the environmental register?	---------------------------- ❑ Yes ❑ No
***Note**: In case of suspecting the measurement, then take your own one.*	
3- Status of Effluents	
What are the sources of industrial wastewater pollution in the unit	----------------------------
Identify the amount of wastewater discharged from the unit	----------------------------
What is the final discharging point of this wastewater	----------------------------
4- Status of Solid Wastes	
Identify types and quantities of generated solid wastes	----------------------------
What is the applied disposal method?	----------------------------

Checklist for Conventional Molding Operations

1- General	
1-1 General Status Floor status Solid wastes accumulation	 ---------------------------- ----------------------------
Identify the used molds type	❑ Sand molds ❑ Iron Molds
Type of fuel used for molds hardening furnaces	----------------------------
Identify the type of equipment used for handling and transporting the raw materials (manually, trucks, conveyors, ….).	----------------------------
2- Status of Work Environment	
Check the work environment measurements concerning gaseous emissions Are they included in the environmental register?	---------------------------- No ❑ ❑ Yes
Are there any personal protective equipment for the workers during materials handling?	❑ Yes ❑ No
Identify the protective procedures concerning dust emission during sand molds preparation and molding process	----------------------------
Check for the heat stress measurements beside the furnace. Are they included in the environmental register?	---------------------------- No ❑ ❑ Yes
Check the efficiency of ventilation system	
Are there any cyclones to control work environment air emissions	----------------------------
***Note**: Crystallized silica is one of the carcinogenic materials* *In case of suspecting the measurement, then take your own one.*	
3- Status of Effluents	
What are the sources of industrial wastewater pollution in the unit	----------------------------
Identify the amount of wastewater discharged from the unit	----------------------------
What is the final discharging point of this wastewater	----------------------------
4- Status of Solid Wastes	
What are the final disposal methods for dust and sand	----------------------------
What is the final disposal method for broken sand molds	----------------------------

Checklist for Formation Processes

1- General	
1-1 Housekeeping Floor status Solid wastes accumulation	 ---------------------------- ----------------------------
1-2 Heating furnace capacity	----------------------------
Type of fuel used for the heating furnace	----------------------------
2- Status of Ambient Air	
Check for the stacks emissions measurements for heating furnace - Are they included in the environmental register? - In case of suspicion, then take your own measurements	---------------------------- ❑ Yes ❑ No
2-2 Identify the stack's height.	----------------------------
***Note**: The stack height should be 2.5 the height of surrounding buildings.*	
3- Status of Work Environment	
Check the work environment measurements concerning gaseous emissions	----------------------------
Are there any personal protective equipment for the workers?	❑ Yes ❑ No
Identify the applied procedures concerning dust emission during sand molds preparation and molding process	----------------------------
Check the efficiency of the ventilation system	------------------------------
3-5 Check for the heat stress measurements beside the heating furnace. Are they included in the environmental register?	----------------------------- ❑ Yes ❑ No
Check for the noise measurements beside rolling and smiting equipments. Are they included in the environmental register?	---------------------------- ❑ Yes ❑ No
***Note**: In case of suspecting the measurement, then take your own one.*	
4- Status of Effluents	
What are the sources of industrial wastewater pollution in the unit	----------------------------
Identify the amount of wastewater discharged from the unit	----------------------------
What is the final discharging point of this wastewater	----------------------------
Identify quantities and methods of disposal for spent oils	----------------------------
Identify quantity and disposal method for spent acids	----------------------------
5- Status of Solid Wastes	
Identify types and amounts of solid wastes and their disposal methods	----------------------------
Check for the confirming documents in the environmental register.	

Checklist for Boilers and Water Treatment Units

1. General	
1.1 Number of boilers and capacity	--- ---
1.2 What is the method used for water treatment?	❑ Lime ❑ Ion exchange ❑ Reverse osmosis
2. Status of Ambient Air	
2.1 What is the height of the stack of each boiler	Boiler (--)--------------------------- Boiler (--)--------------------------- Boiler (--)---------------------------
Note: the height of the stack must be 2.5 times the height of adjacent buildings.	
2.2 Type of fuel used for boilers	❑ Mazout ❑ Solar ❑ Natural gas ❑ Other…….
2.3 In case of using mazot for boilers, is the surrounding area residential?	❑ Yes ❑ No
Note: The use of mazot as fuel in the residential area is Prohibited by law.	
2.4 If mazot is used in non residential area, are there analysis of the flue gases for sulfur dioxide, carbon monoxide, and particulate matter	❑ Yes ❑ No
2.5 If Yes Check the compliance of the analysis readings in the register with your observations	-- -- --
Note : Whatever the fuel used ,if you notice any smoke, take a sample for analysis	
3. Status of Work Environment	
3.1 Check the heat stress next to the boilers	---
3.2 Check the noise next to the boilers and duration of exposure	-- --
3.3 Are they included in the environmental register?	❑ Yes ❑ No
Note : In case of suspicious perform your own measurements	
4. Status of Effluent	
4.1 What is the blow down rate from the boilers?	--- m^3/d
4.2 What are the blow down and back wash rates for the treatment units?	--- m^3/d --- m^3/d
4.3 Steam condensate is	❑ Recycled to the boilers ❑ Discharged to sewer
5. Status of Solid Wastes	
5.1 If lime method is used, sludge is generated, what is the amount of sludge produced per day?	--- ---
5.2 What is the sludge disposal method?	---
6. Status of Hazardous Material	
6.1 Check the storage method of chemicals used in the treatment process. Is it in compliance with law 4?	-- -- ❑ Yes ❑ No
6.2 Is there any fuel leaks from fuel tanks	❑ Yes ❑ No
6.3 Is there any fire extinguishing devices and fire fighting measures?	❑ Yes ❑ No
6.4 Is there a spill prevention plan?	❑ Yes ❑ No
6.5 Do you notice anything that can provoke a fire? Such as the presence of a pump underneath the fuel tank (the start-up of the engine can produce a spark)	❑ Yes ❑ No Comment --- ---

Checklist for Cooling Towers

1.General	
1.1 Number and capacity of cooling towers	-- -- --
1.2 Cooling tower make-up rate Note : Blow-down = 10-15% of make-up	Rate -- Blow-down --
2. Status of Effluent	
2.1 Cooling water for the compressors is performed in	☐ Open Cycle ☐ Closed Cycle
Note : If performed in open cycle it will dilute the final effluent	
2.2 Record the amount of open cycle cooling	--

Checklist for Garage

1. General	
1.1 Are detergents or solvents used for washing equipment, trucks, floor,….etc?	❑ Yes ❑ No
1.2 What is the amount of oil and grease used per day?	--- ---
1.3 What is the amount of spent lube oil per day ?	---
1.4 How does the facility dispose the spent oil ?	---
2. Status of Effluent	
2.1 What is the amount of wastewater generated ?	---
2.2 Do you observe any oil / foams / solid matter in the inspection manhole?	❑ Yes ❑ No

Checklist for Mechanical Workshops (Maintenance)

1. Status for the Effluents	
1.1 What is the amount of wastewater produced?	--------------------------------
1.2 What is your visual observation for the inspection? Manhole of the workshop?	----------------------------------
2. Status of Solid Wastes	
2.1 What is the amount of solid waste generated?	-----------------------------------
2.2 How does the facility dispose the solid waste produced?	-----------------------------------
3. Status of the Work Environment	
3.1 Are there any noise in work place If yes	❑ Yes ❑ No
Are there any measurements for noise If not Perform measurements	❑ Yes ❑ No

Check list for Laboratories

1. General	
1.1 What is the amount of eflluents generated per day?	--
1.2 Check the disposal method of eflluents	--
1.3 List the chemicals used in the laboratories	--
2. Status of Work Environment	
2.1 Are there any odor/ gases/ noise in the work environment? 2.2 Check the exposure time	❑ Yes ❑ No --
3. Status of Hazardous Material	
3.1 Check storage of hazardous material. Is it in compliance with the requirements of law 4/1994?	❑ Yes ❑ No
3.2 Are there any first aid measures in place?	❑ Yes ❑ No