

IRON AND STEEL INDUSTRIES



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INTRODUCTION

- ✘ India being a developing country, Iron and Steel Industry has a very important role to play. The manufacture of steel is regarded as one of the key industries. It is a prerequisite for modern industrial development.
- ✘ Large amounts of iron and steel is required for constructing bridges, rail tracts, railway rolling stock, ships, vehicles, various machines, power plants, airports, etc
- ✘ India is ranked as the fourth largest steel producing country in the world.

WHAT IS IRON?

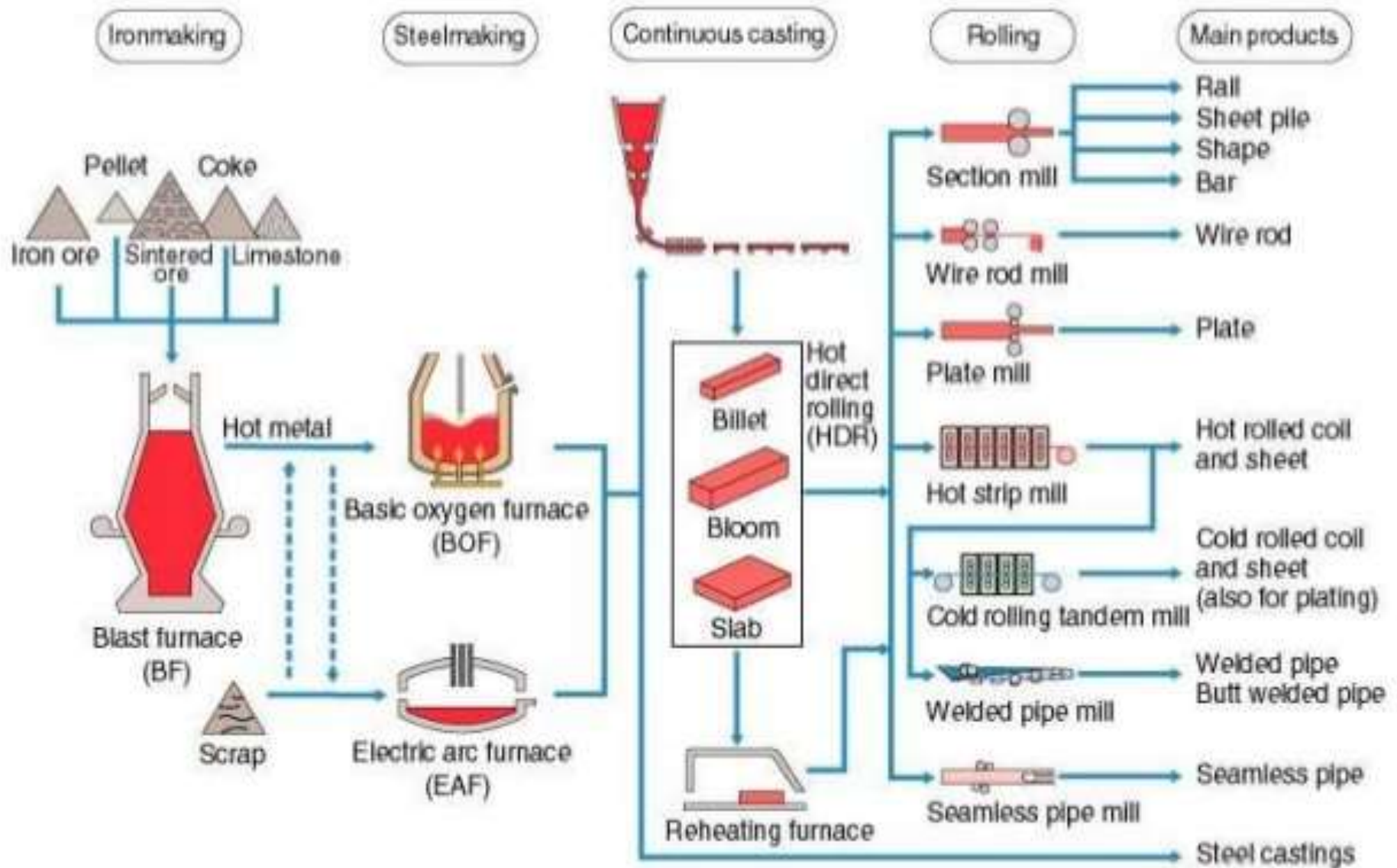
- ✘ It is a strong, hard magnetic silvery gray metal, with atomic no 26
- ✘ It is by mass the most element on earth, forming much of earth outer and inner core.
- ✘ Iron is necessary for the transport of oxygen (via hemoglobin) and for oxidation (via cells)
- ✘ Deficiency of iron is a common cause of anemia.

RAW MATERIALS

- ✘ IRON ORE(hemetite)- 1.5 tonne for 1 tonne pig iron
- ✘ FUELS(coal & coke)- 450 tonne for 1 tonne raw iron
- ✘ WATER- used for quench coke,for cooling blast furnace,steam etc.
- ✘ AIR- 4 tonne air required for 1 tonne steel
- ✘ FLUX(limestone & dolomite)- to draw impurities out of the melting ore
- ✘ REFRATORIES- for lining furnace
- ✘ SILICA&SAND- for moulding
- ✘ FERRO ALLOY—for different grade of ste



Manufacturing process for iron and steel

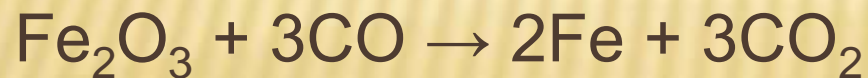
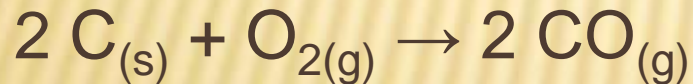


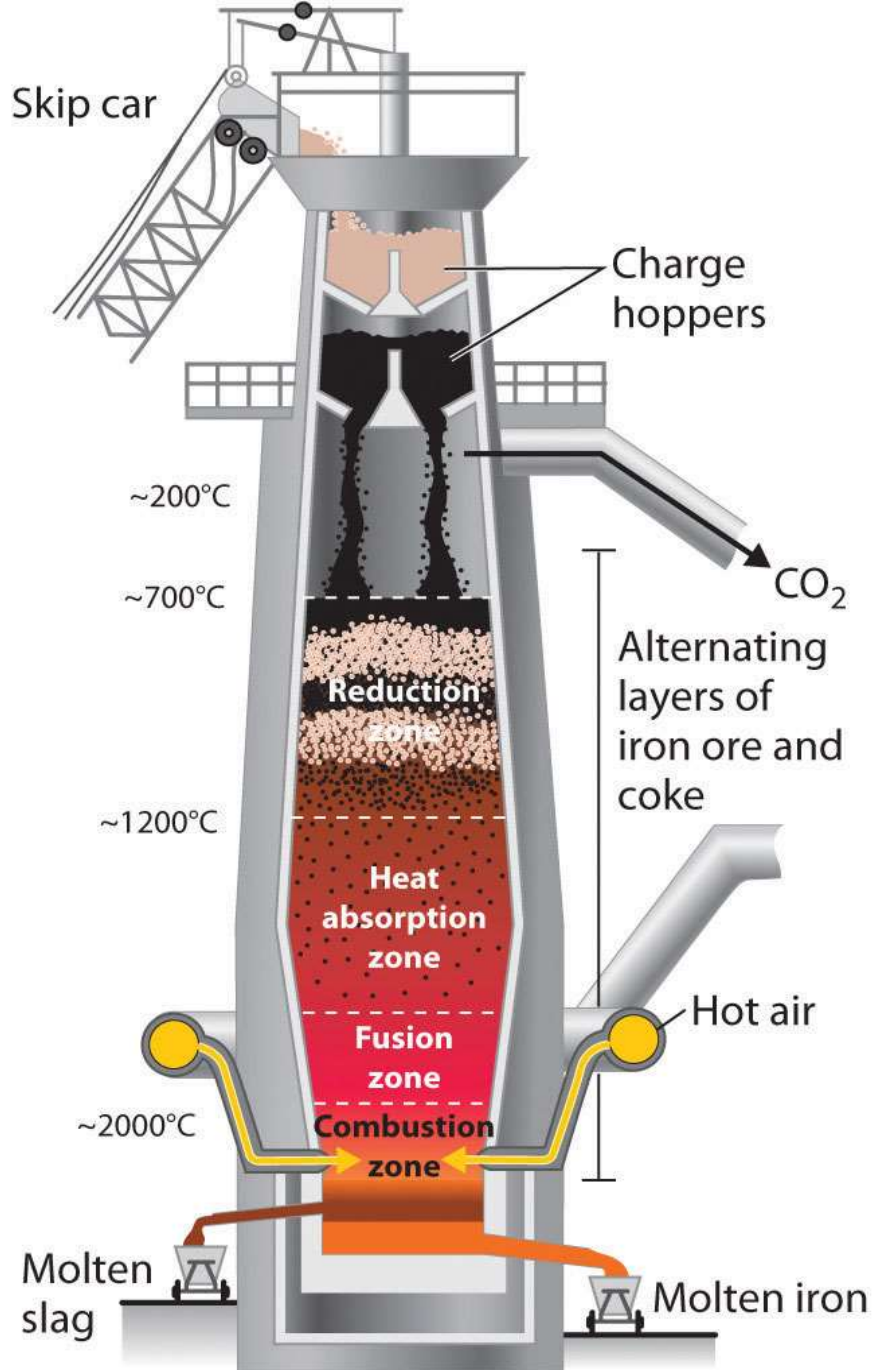
MANUFACTURING PROCESS

Iron-making in a Blast Furnace

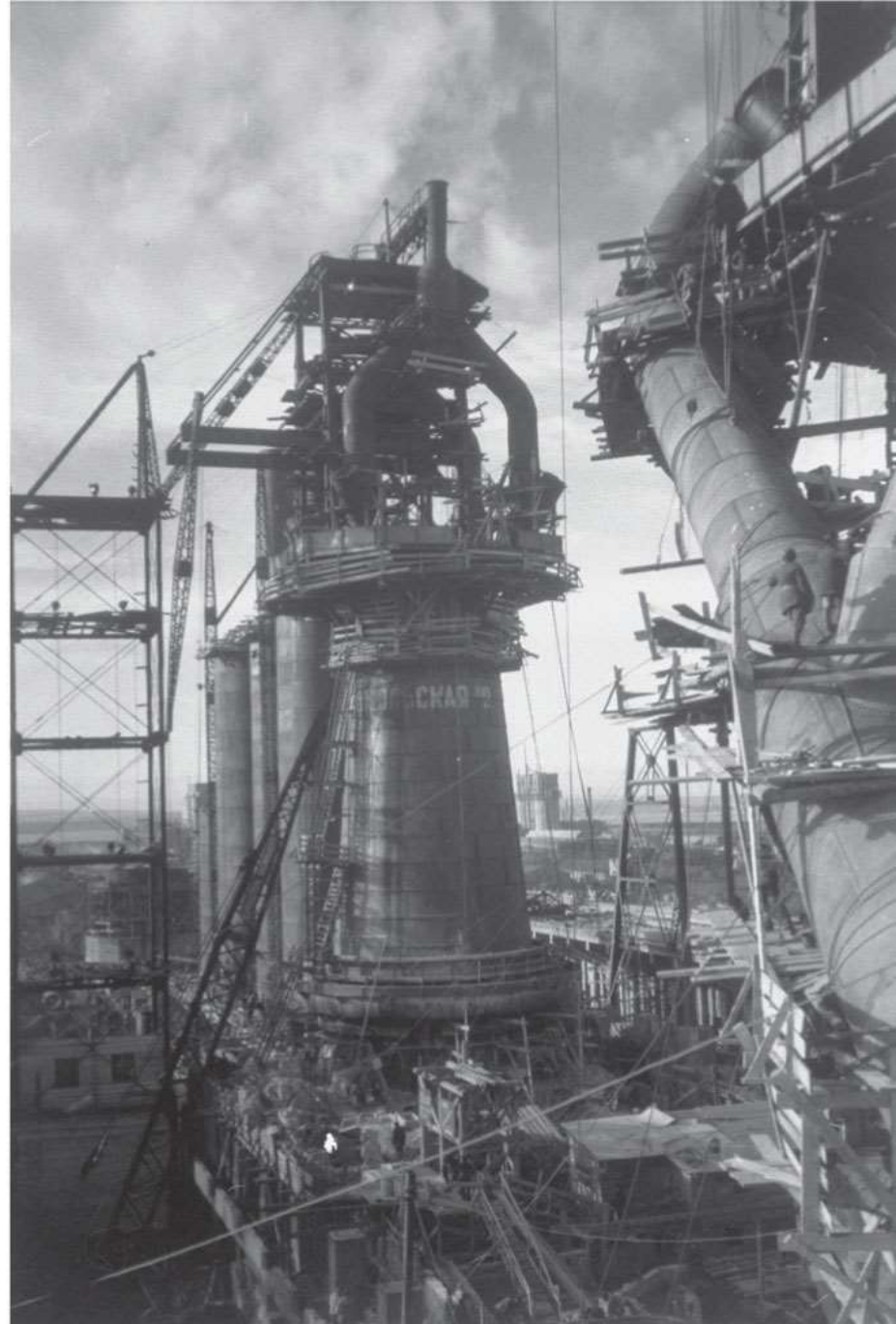
Blast furnace- a refractory-lined chamber with a diameter of about 9 to 11 m (30 to 35 ft) at its widest and a height of 40 m (125 ft)

- To produce iron, a charge of ore, coke, and limestone are dropped into the top of a blast furnace
- Hot gases are forced into the lower part of the chamber at high rates to accomplish combustion and reduction of the iron





(a) Blast furnace



(b) World's largest blast furnace in 1931

IRON FROM THE BLAST FURNACE

- Iron tapped from the blast furnace (called pig iron) contains over **4% C**, plus other impurities: **0.3-1.3% Si**, **0.5-2.0% Mn**, **0.1-1.0% P**, and **0.02-0.08% S**
- Further refinement is required for cast iron and steel
 - A furnace called a **cupola** is commonly used for converting pig iron into **gray cast iron**
 - **For steel**, compositions must be **more closely controlled** and impurities brought to much lower levels

STEEL-MAKING

- Since the mid-1800s, a number of processes have been developed for refining pig iron into steel.
- Today, the two most important processes are
 - Basic oxygen furnace (BOF)
 - Electric arc furnace
- Both are used to produce carbon and alloy steel.

➤ The Basic Oxygen Process is the most powerful and effective method of steel manufacturing.

➤ The scheme of the Basic Oxygen Furnace (BOF) (basic oxygen furnace, basic oxygen converter) is presented in the picture.

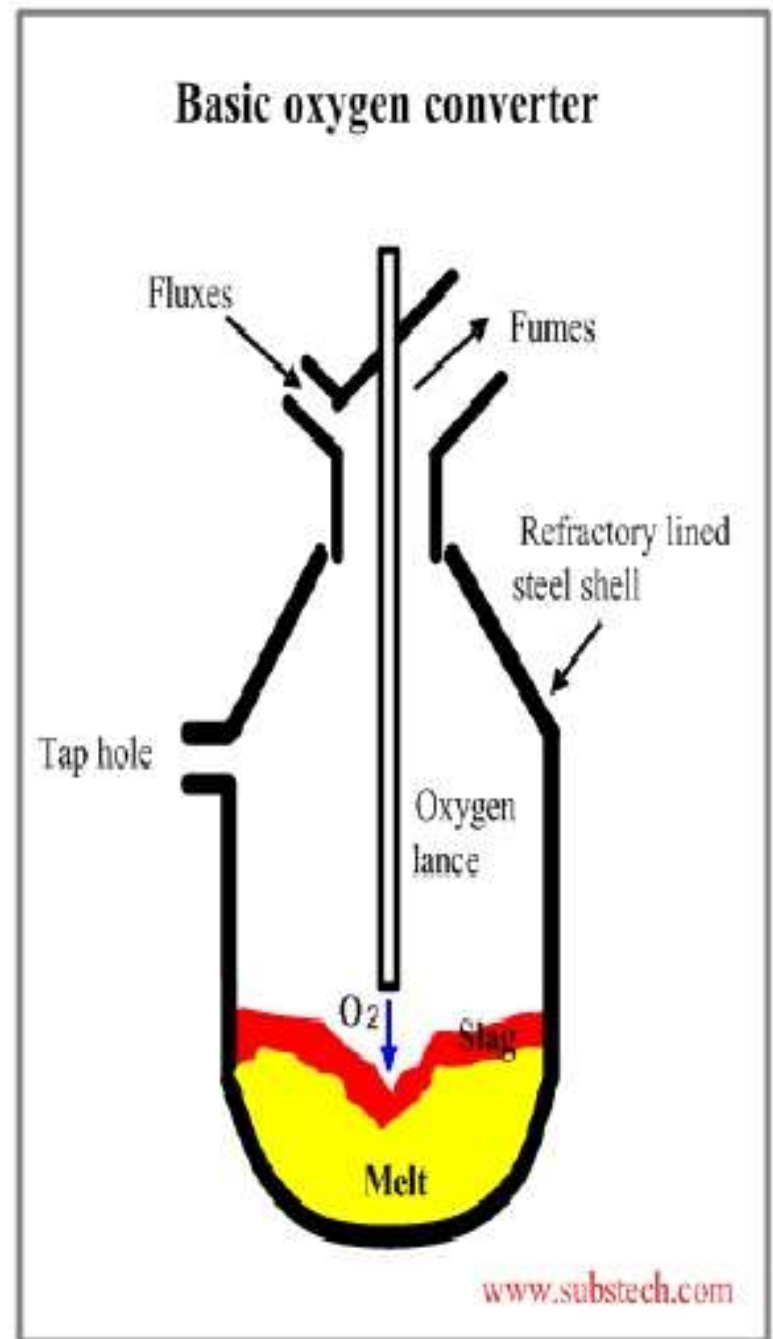
➤ Typical basic oxygen converter has a vertical steel shell lined with refractory lining.

➤ The furnace is capable to rotate about its horizontal axis on trunnions.

➤ This rotation is necessary for charging raw materials and fluxes, sampling the melt and pouring the steel and the slag out of the furnace.

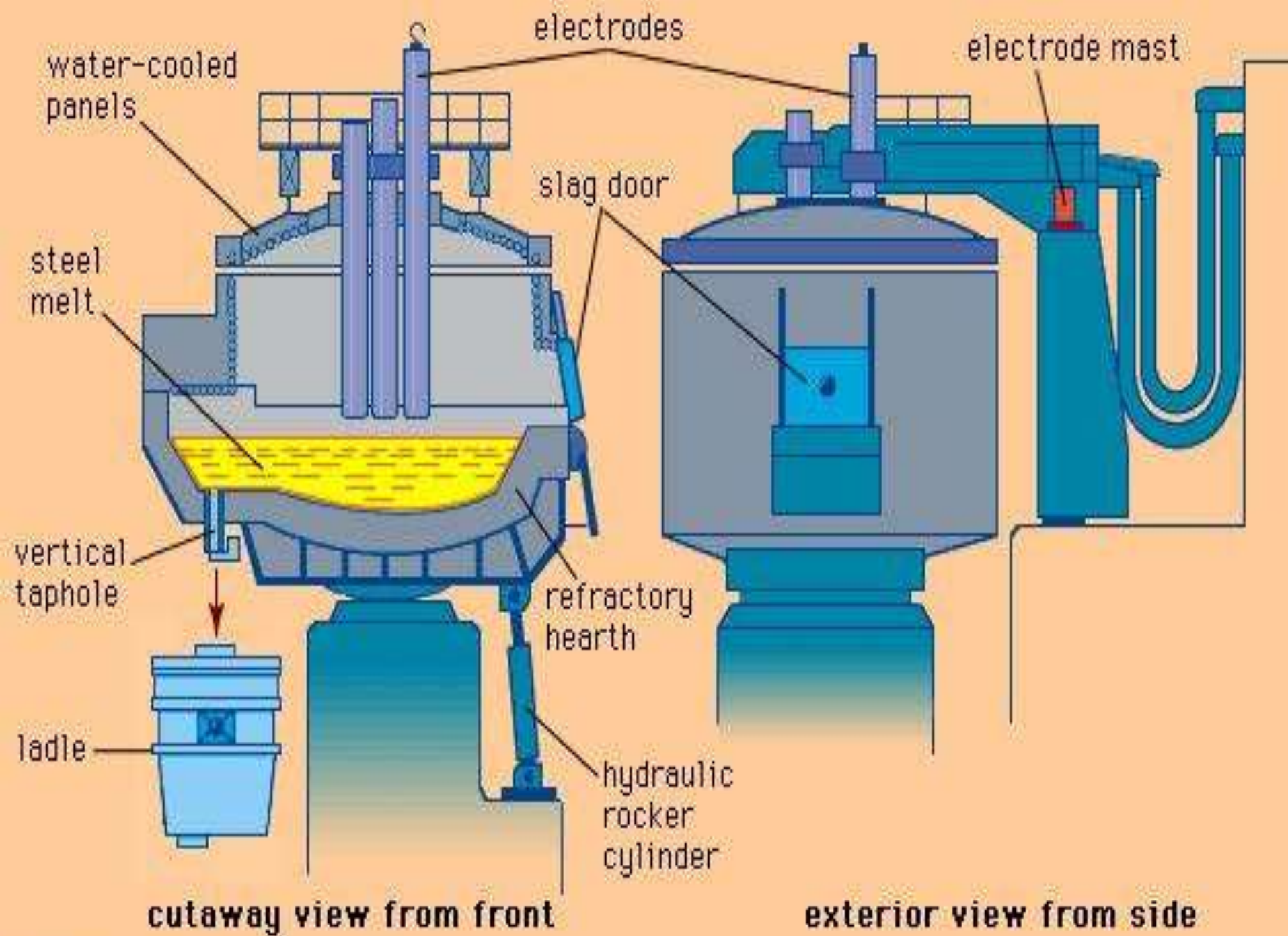
➤ The Basic Oxygen is equipped with the water cooled oxygen lance for blowing oxygen into the melt.

➤ The basic oxygen converter uses no additional fuel. The pig iron impurities (carbon, silicon, manganese and phosphorous) serve as fuel



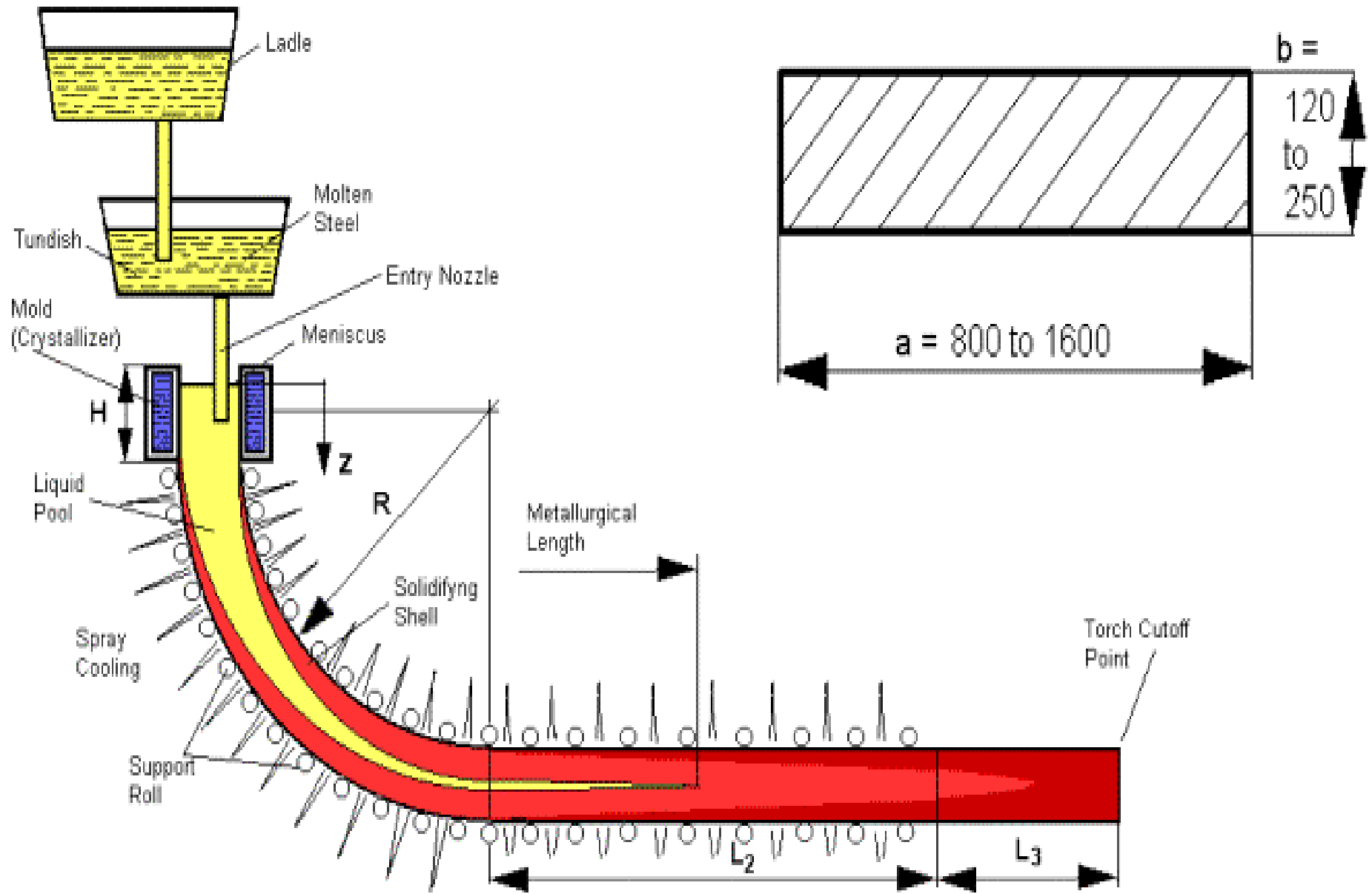
ELECTRIC ARC FURNACE

- Accounts for 30% of steel production in U.S.
- Scrap iron and scrap steel are primary raw materials.
- Complete melting requires about 2 hr; tap-to-tap time is 4hr.
- Usually associated with production of alloy steels, tool steels, and stainless steels
- Noted for better quality steel but higher cost per ton, compared to BOF.



CONTINUOUS STEEL CASTING PROCESS

- ✘ LIQUID STEEL IS DIRECTLY CAST INTO SEMI-FINISHED PRODUCTS, WHICH ELIMINATES THE SOLIDIFICATION TIME.
- ✘ THE LIQUID STEEL IS Poured INTO TUNDISH.
- ✘ BELOW THE TUNDISH, WATER-COOLED COPPER MOULDS OF DESIRED SIZE ARE PLACED.
- ✘ THE SOLIDIFIED STEEL IS SLOWLY PULLED OUT TO PRODUCE AN “ENDLESS” STRAND.
- ✘ AFTER GAS-CUT SEMI-FINISHED STEEL (BILLET, BLOOM, SLAB) PRODUCED.



WASTE CHARACTERISTICS



SOLID WASTE

× IRON BEARING-

BLAST FURNACE SLAG

STEEL MAKING SLAG

FLUE DUST

MILL SCALE etc

× NON IRON BEARING-

LIME FINES

BROKEN REFRACTORY

BRICKS

LIST OF SOLID WASTES WITH THEIR CHEMICAL COMPOSITION

Solid Wastes	Chemical Composition
BF Slag	Fe=46-52%, CaO=22-30%,MgO=4-10%,MnO=2-6% & SiO ₂ =26-31%
SMS Slag	FeO=18-21%,SiO ₂ =16-18%, CaO=47-53%
SMS Sludge	C=2-13%, ,SiO ₂ = 2.1%, Fe=51.8%,MgO=2%, S=0.21%, CaO=12.8%.
Mill scale	Mixture of iron oxides
Used refractory fire clay brick	CaO, Al ₂ O ₃ , Fe ₂ O ₃ , MgO

WASTE WATER

- × **DUE TO COOLING-** 80 cubic meter per tonne of steel
- × **DURING PIG IRON MANUFACTURING-**
 - total organic carbon- 100-200 mg per liter
 - total suspended solids- 7000mg per liter
 - dissolved solids: **cynide-** 15 mg per liter
 - fluoride-** 1000 mg per liter
 - COD - 500 mg per liter

DURING STEEL MANUFACTURING

Total suspended solids-	4000 mg per liter
Lead-	8 mg per liter
Chromium-	5 mg per liter



AIR POLLUTION

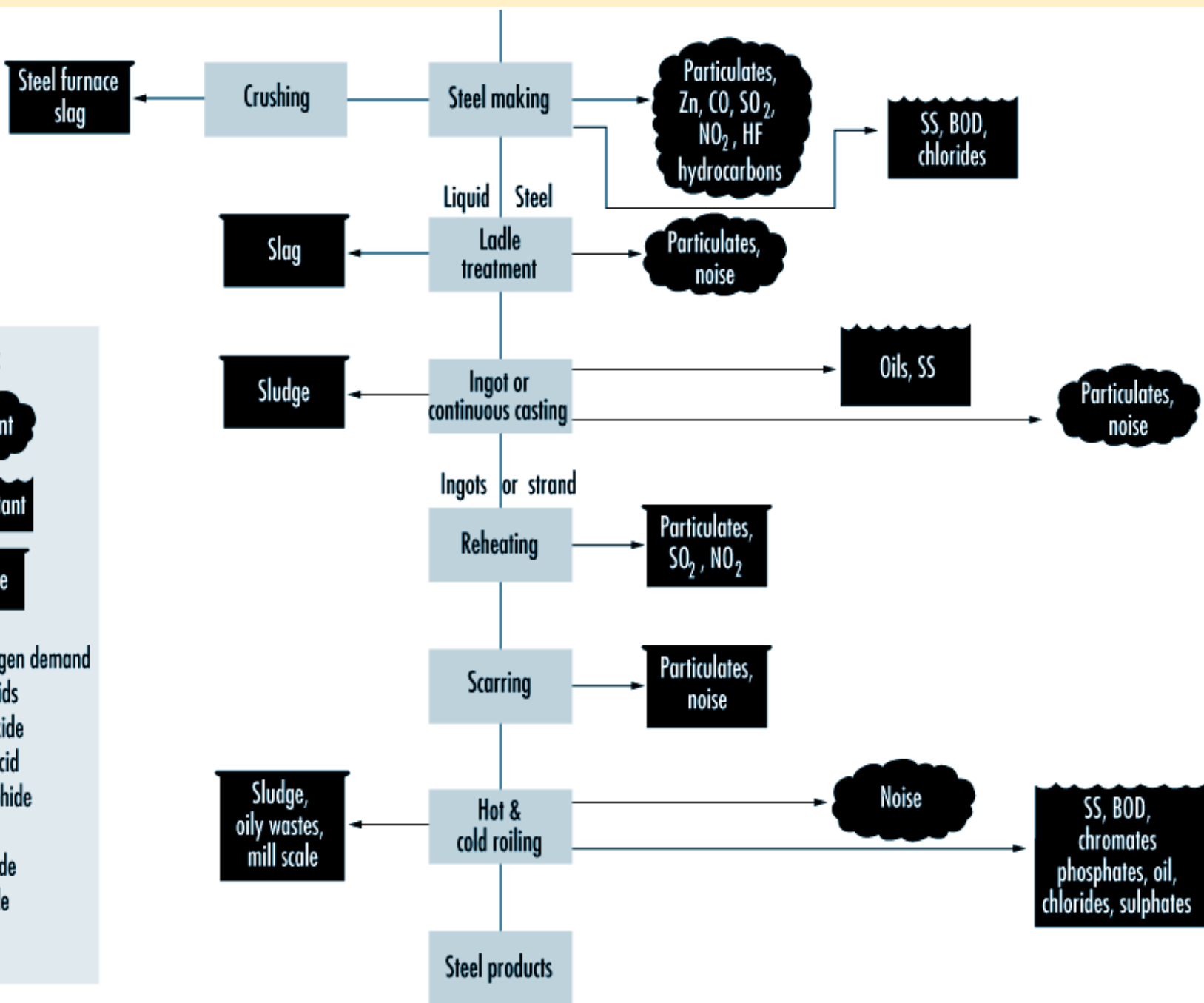
PM10- process	100 g/t of product(BF and BOF),300g/t from sintering
SO ₂ -	1200g/t
NO ₂ -	500 to 750 mg per normal cubic meter
Fluorides-	1.5g/t
Hydrocarbons, carbon monoxide etc.	



Legend:

- Air pollutant** (cloud icon)
- Water pollutant** (wavy icon)
- Solid waste** (rectangle icon)

BOD = biological oxygen demand
 SS = suspended solids
 CO = carbon monoxide
 HF = hydrofluoric acid
 H₂S = hydrogen sulphide
 NH₃ = ammonia
 NO₂ = nitrogen dioxide
 SO₂ = sulphur dioxide
 Zn = zinc
 ZnO = zinc oxide



WASTE TREATMENT

- ✘ AIR EMISSION TECHNOLOGY-
- ✘ SCRUBBERS, BAGHOUSES & ELECTRO STATIC PRECIPITATOR (99.9%) ARE USED TO REMOVE PERTICULATE MATTER
- ✘ USE LOW NO_x BURNERS.
- ✘ USE DRY SO_x REMOVAL SYSTEM i.e.CARBON ABSORPTION OR LIME SPRAYING ON FLUE GASES.
- ✘ USE DRY DUST COLLECTION &REMOVAL SYSTEM.

WASTE WATER TREATMENT

- × SEDIMENTATION , -TO REMOVE SUSPENDED SOLIDS.
- × PHYSICAL AND CHEMICAL TREATMENT SUCH AS PH ADJUSTMENT,FILTRATION.

(milligrams per liter, except pH and temperature)

<i>Parameter</i>	<i>Maximum value</i>
pH	6–9
TSS	50
Oil and grease	10
COD	250
Phenol	0.5
Cadmium	0.1
Chromium (total)	0.5
Lead	0.2
Mercury	0.01
Zinc	2
Cyanide	
Free	0.1
Total	1
Temperature increase	£ 3°C ^a

SOLID WASTE TREATMENT/MANAGEMENT

- SOLID WASTE GENERATION IS CONTROLLED BY EFFICIENT AND OPTIMUM USE OF RAW MATERIAL.
- NEW TECHNOLOGIES SHOULD BE ADOPTED FOR ECO-FRIENDLY SOLID WASTE DISPOSAL.
- TRANSPORTATION OF SOLID WASTE FROM GENERATION POINT TO DISPOSAL POINT SHOULD BE IN A CONTROLLED AND PROPER WAY.
- IF POSSIBLE, SELLING SOME OF THE SOLID WASTES TO BE FURTHER USED IN SOME OTHER WAYS CONVERTING WASTE INTO WEALTH



**Waste Disposal
&
Recycling
In
Steel Industry**

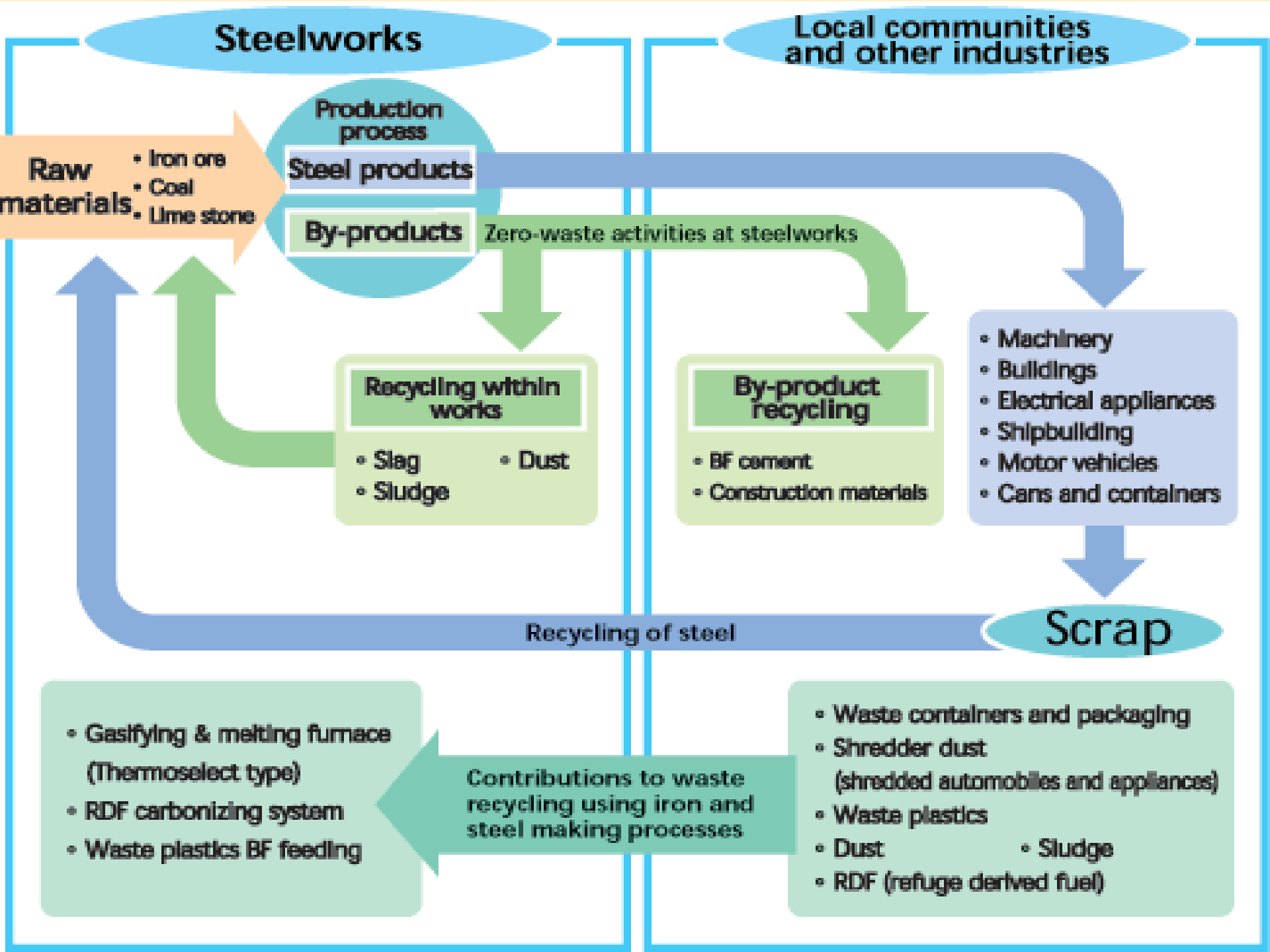
RECYCLE AND REUSE OF WASTE WATER

- ✘ RECYCLING OF WASTE WATER INCLUDES PURIFICATION OF WASTE WATER UPTO THE STANDARD IN A SEPARATE LAGOON AND INTERNAL CIRCULATION TO THE SYSTEM FOR ITS WATER REQUIREMENT.
- ✘ REUSE OF WATER IMPLIES FOLLOWINGS....
- ✘ COOLING AND PROCESSING WATER IS INDUSTRIAL APPLICATIONS.
- ✘ IRRIGATION FOR CROP LAND, GOLF COURSES, WATER REQUIREMENT FOR PLANT AND GRASS GROWTH.
- ✘ GROUND WATER RECHARGE



RECYCLE AND REUSE OF SOLID WASTE

- ✘ BLAST FURNACE SLAG ARE USED FOR CEMENT MANUFACTURING, ROAD BASE, RAILBLAST, GLASS, CONCRETE BLOCK etc.....
- ✘ ELECTRIC ARC FURNACE SLAG IS USED FOR FILLING THE LOW LAYING AREA.
- ✘ BROKEN REFRACTORIES CAN BE USED AS CONSTITUENTS IN MANUFACTURING BRICKS.
- ✘ BF & EAF DUST AFTER EXTRACTING ZINC AND OTHER METALS USED AS A SOURCE OF LIME PHOSPHORUS.
- ✘ SCRAP CAN BE SOLD AND REUSE TO PRODUCE IRON.
- ✘ FLY ASH IS USED IN CEMENT MANUFACTURING AS PPC & FLY ASH BRICKS etc.....



Steelworks

Local communities and other industries

Raw materials

- Iron ore
- Coal
- Lime stone

Production process

Steel products

By-products

Zero-waste activities at steelworks

Recycling within works

- Slag
- Sludge
- Dust

By-product recycling

- BF cement
- Construction materials

- Machinery
- Buildings
- Electrical appliances
- Shipbuilding
- Motor vehicles
- Cans and containers

Recycling of steel

Scrap

- Gasifying & melting furnace (Thermoselect type)
- RDF carbonizing system
- Waste plastics BF feeding

Contributions to waste recycling using iron and steel making processes

- Waste containers and packaging
- Shredder dust (shredded automobiles and appliances)
- Waste plastics
- Dust
- Sludge
- RDF (refuge derived fuel)

THANKS TO
ALL