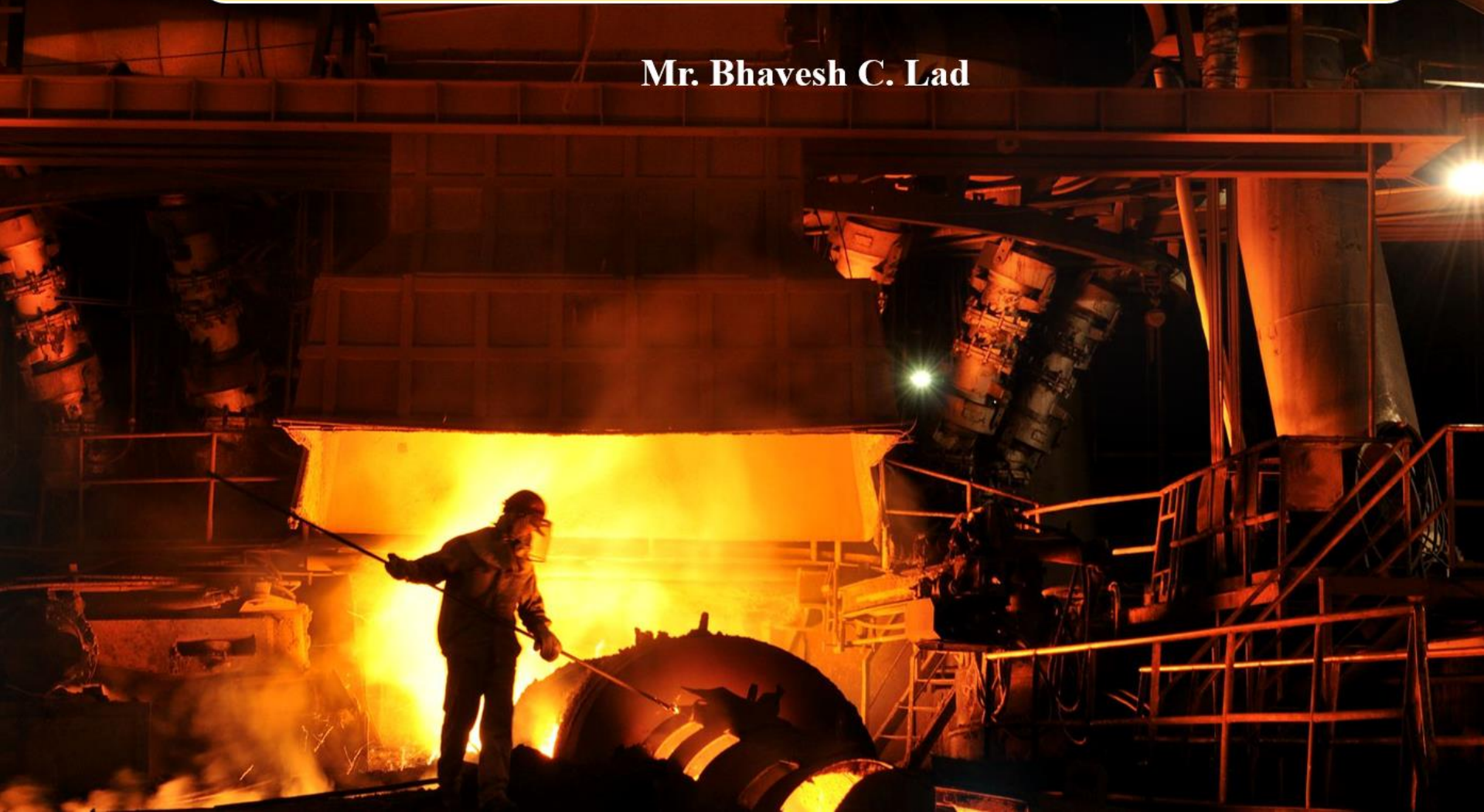


# *Over-view of Iron & Steel Making*

**Mr. Bhavesh C. Lad**



1. History of iron making
2. Flow diagram of iron making to steel making
3. Different Section of Iron making
4. Basics of Blast Furnace (Introduction to blast furnace)
5. History of Steel Making
6. Introduction of Steel Making Furnaces
7. Ladle treatment / degassing treatment
8. Continuous casting process
9. Hot rolling

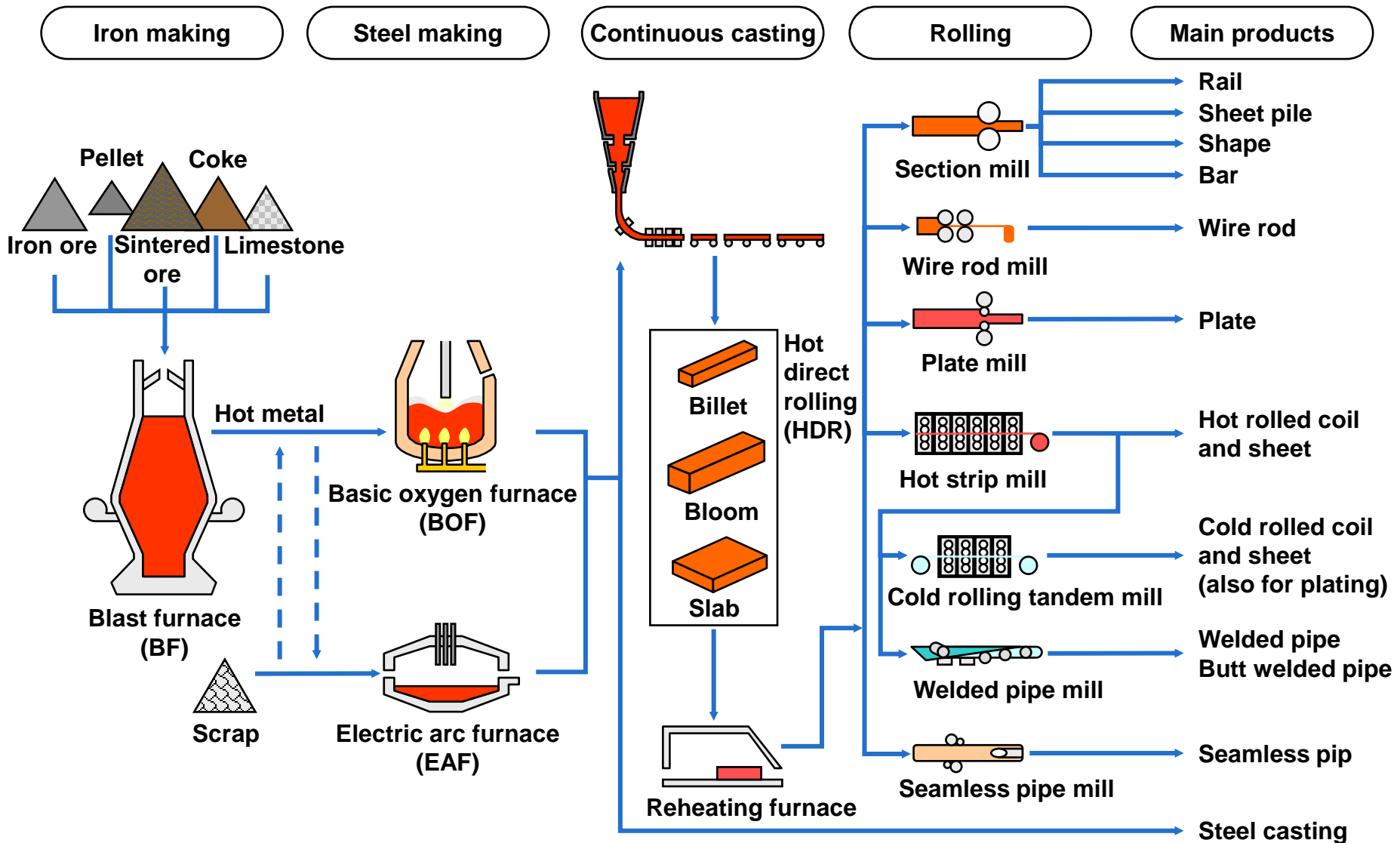


## History of Iron making

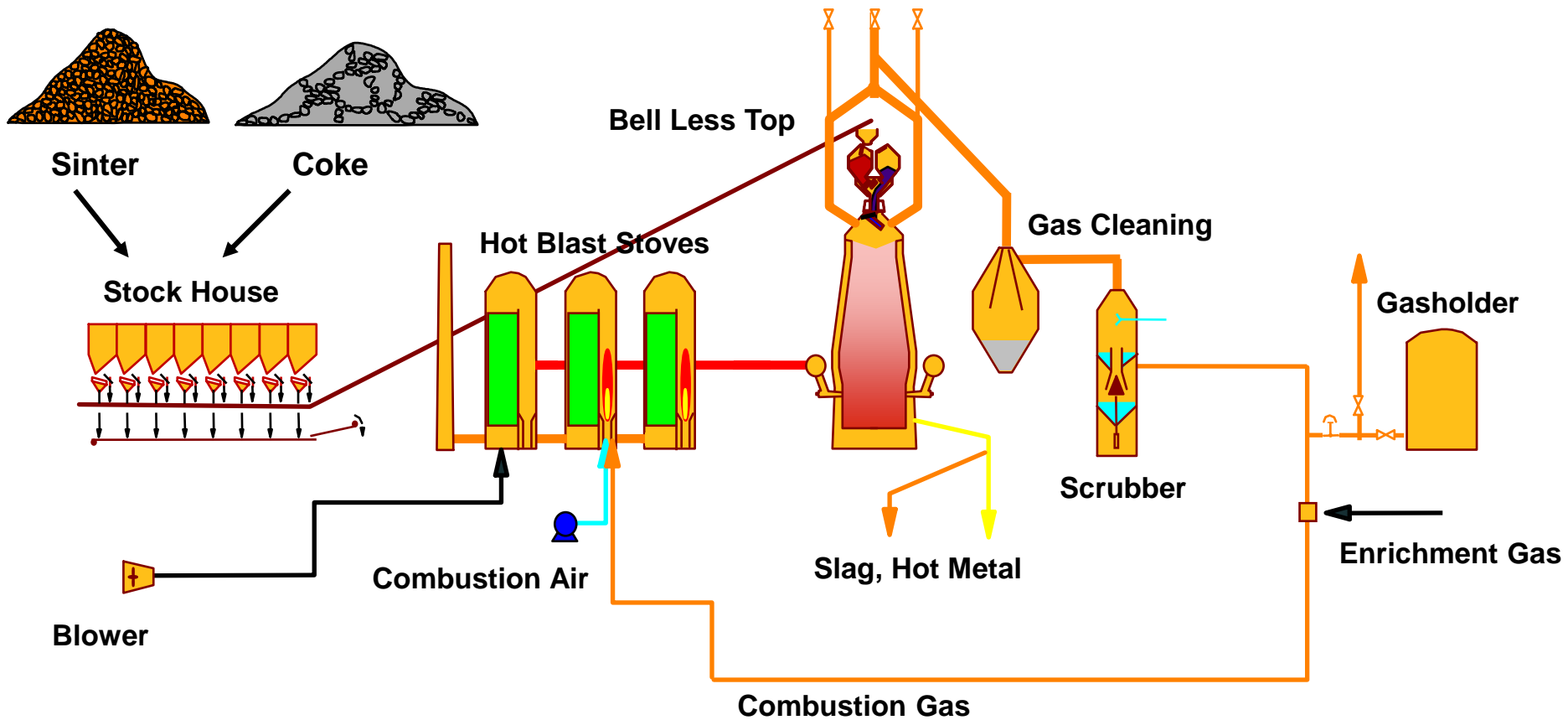
- 1.3500BC Beads in Ancient Egypt for iron.
2. First Iron Production 3000BC Syria and Mesopotamia the comparatively advanced technique of hardening iron weapons by heat treatment was known to the Greeks about 1000 BC.
3. They were made by heating a mass of iron ore and charcoal in a forge or furnace having a forced draft.
4. The iron produced under these conditions usually contained about 3 percent of slag particles and 0.1 percent of other impurities. Occasionally this technique of iron`making produced, by accident, a true steel rather than wrought iron.
5. Ironworkers learned to make steel by heating wrought iron and charcoal in clay boxes for a period of several days. By this process the iron absorbed enough carbon to become a true steel.



# General Flow Diagram Of Iron – Steel Making Process



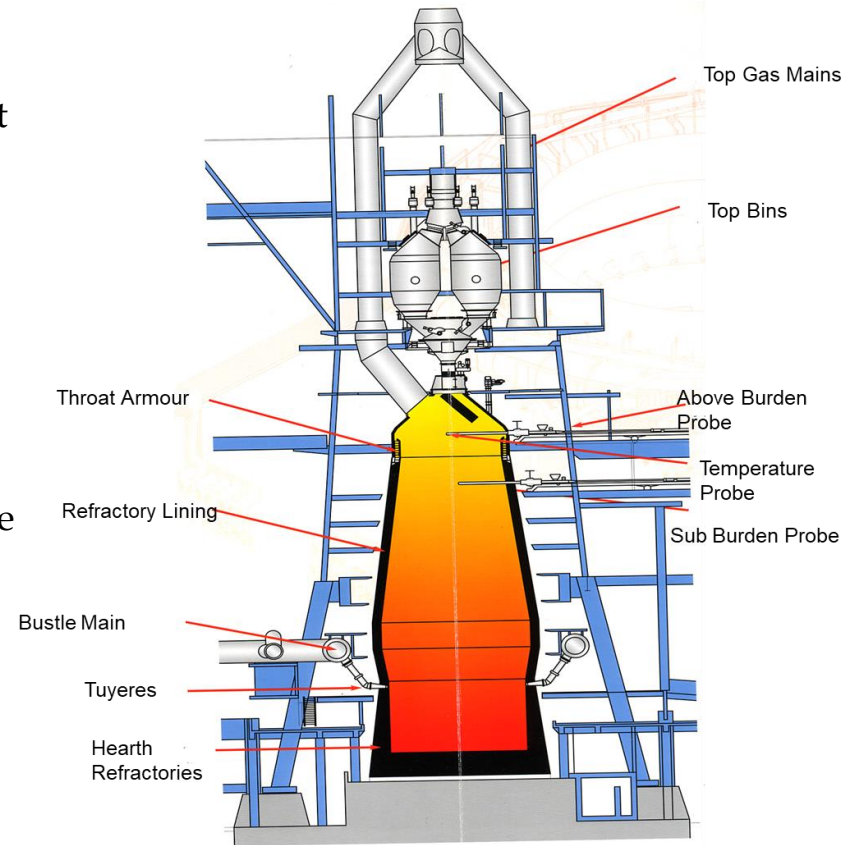
# Different Section Of Blast Furnace Plant



## The Blast Furnace Process

- 1.The Iron Ore, Coke and Limestone, (the Charge), is conveyed to the top of the Furnace.
- 2.The Charge is stored in Bells until the timing is right for the charge to be dropped into the Furnace.
- 3.Hot air is then blown through pipes called Tuyeres, to fire the mixture.
- 4.The Coke burns to increase the temperature in the Furnace.
- 5.The Limestone attracts the impurities in the Iron Ore and forms Slag. This Slag is lighter than the molten Iron and so floats on top of it.
- 6.As the Furnace fills, the molten Iron is Tapped off. The Slag is also tapped off at regular intervals.

Most Iron is taken straight from the Blast Furnace to the Steel Mill, but some is poured into buckets called Pigs. This Iron is called Pig Iron and is used to make Cast Iron.



## Raw Material for Blast Furnace:



**Iron  
Ore**



Hematite  $\text{Fe}_2\text{O}_3$       Limonite  $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$   
 Magnetite  $\text{Fe}_3\text{O}_4$       Siderite  $\text{FeCO}_3$

*Fe content : 20 - 70%*



**Flux**



$\text{SiO}_2$      $\text{Al}_2\text{O}_3$      $\text{CaO}$      $\text{MgO}$     P, As

**S** - unwanted, less than 0,15%



**Coke**



Lime, dolomite  $\text{CaMgCO}_3$ ,  $\text{CaO}$

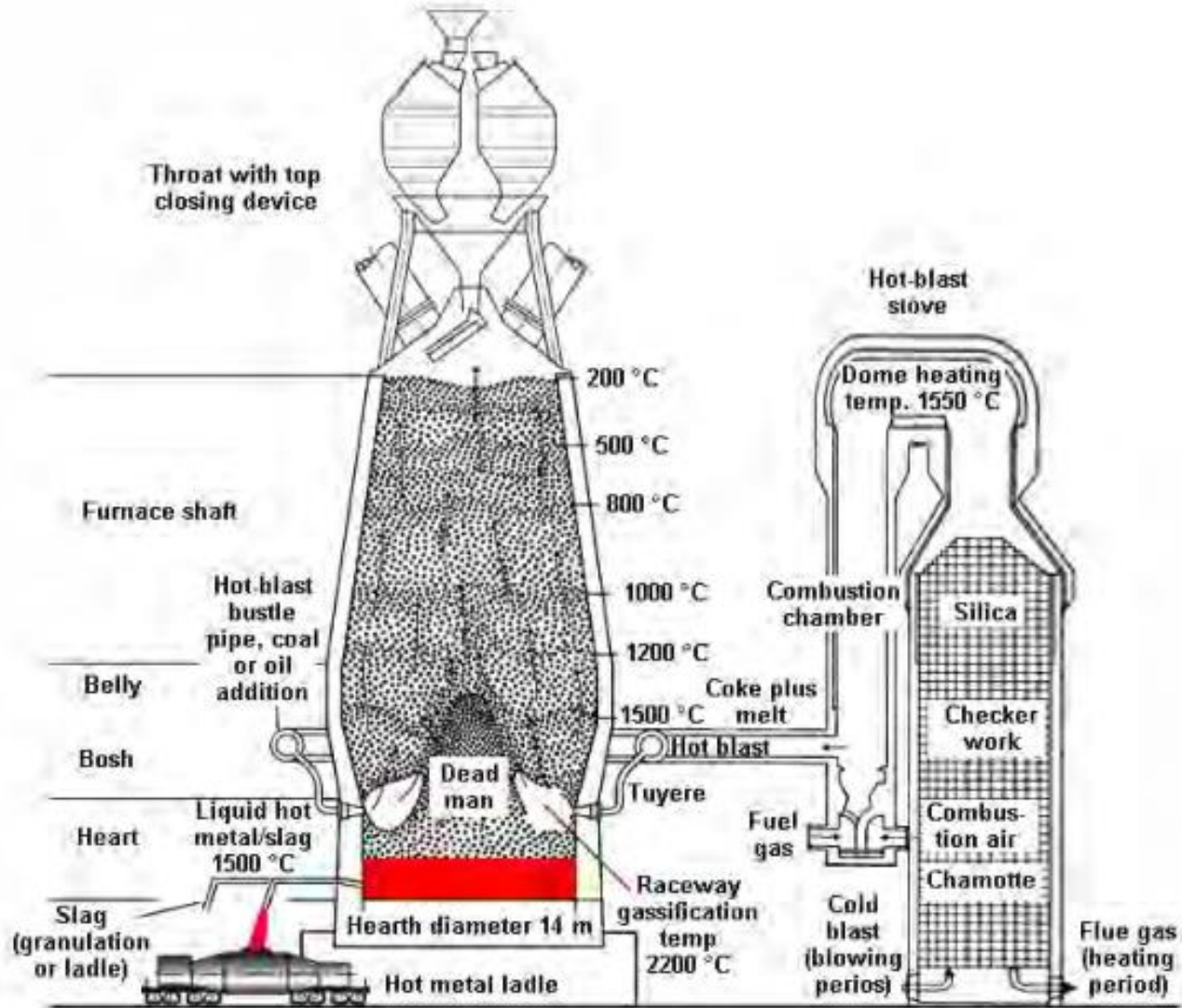
Metallurgical coke

**Hot Air / Gas**



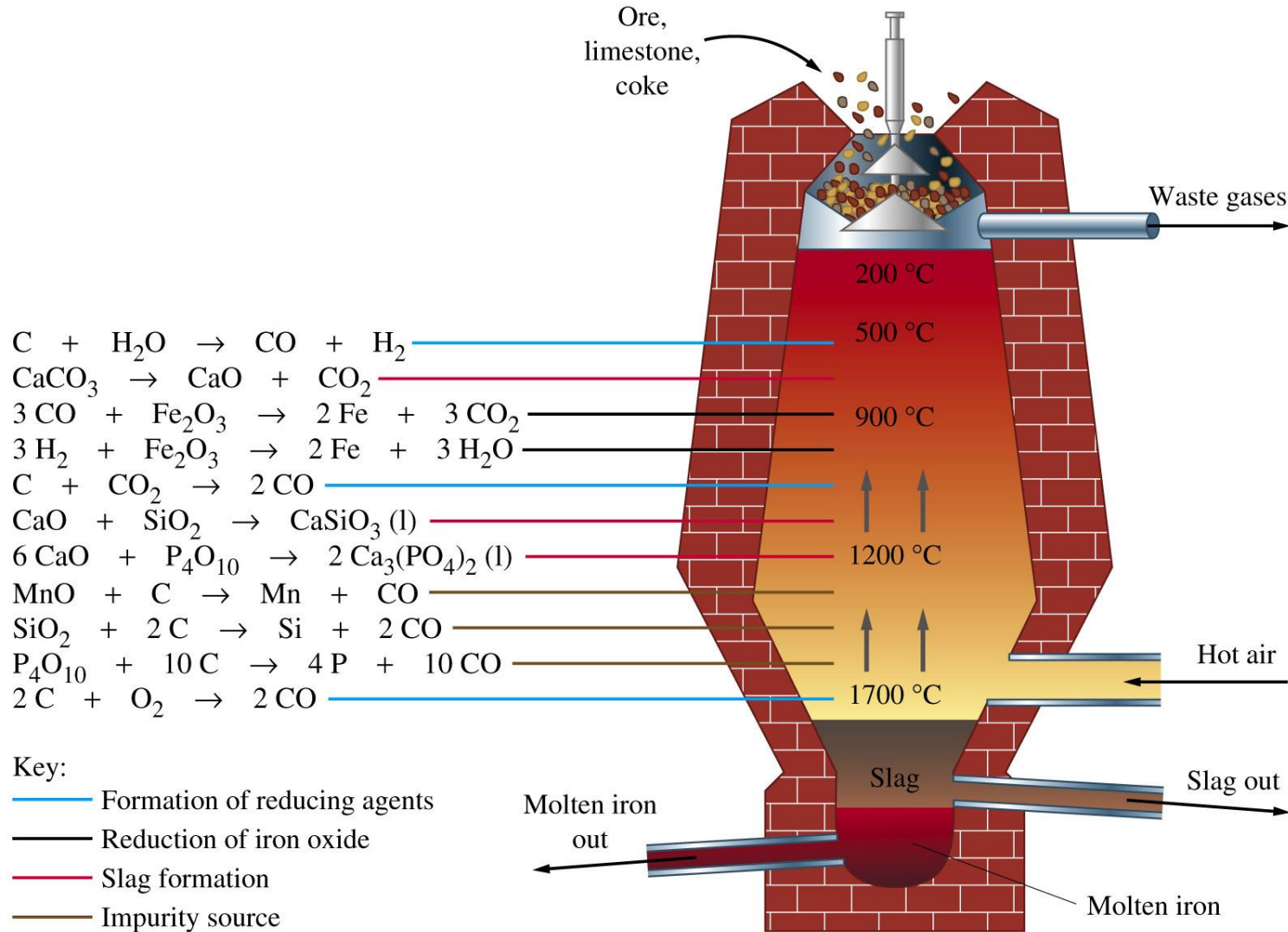
Coke oven / Blast Furnace Gas / Hot Air

# Schematic Diagram of B/F



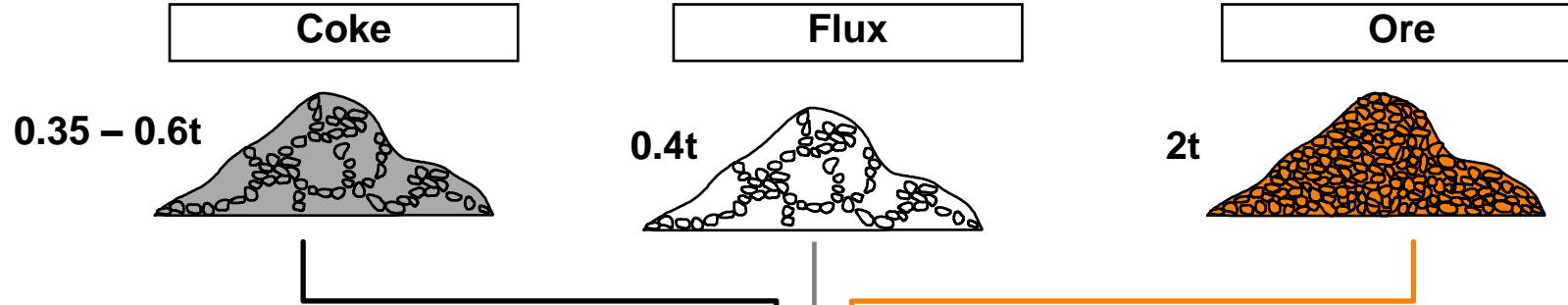


## Main Reactions in Blast Furnace



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# Avg. Input for 1 T Iron Production with Chemistry

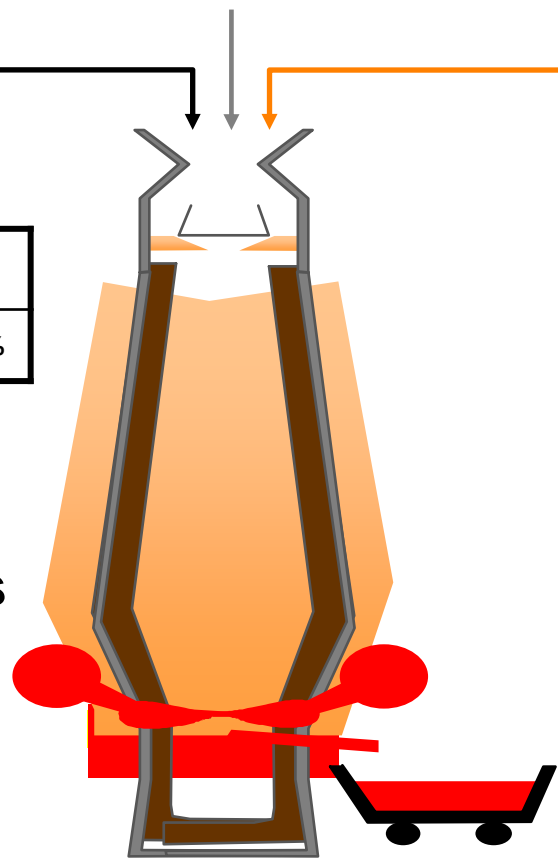


## Chemical composition

Fe	C	Si	Mn	P	S
90-95%	<b>3.0-4.3%</b>	0.5-3.0%	0.5-3.0%	0.05-2%	<b>do 0.1%</b>

## Hot Gases

3.5 t Gas



**1t Pig Iron**

Pig Iron is being casted to

ingot



TORPEDO LADLE



## Chemical composition

**Slags**



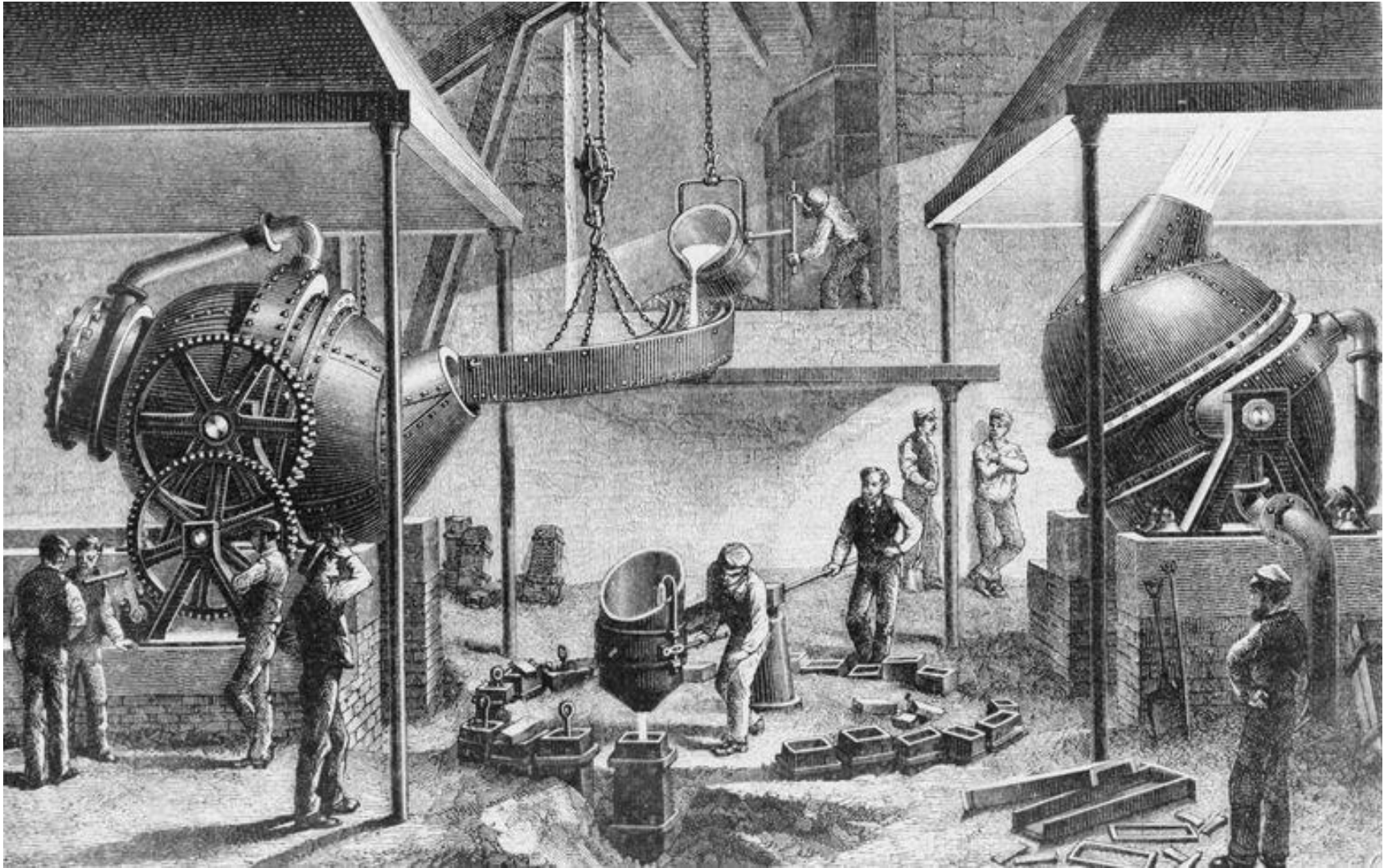
$\text{SiO}_2$	$\text{CaO}$	$\text{Al}_2\text{O}_3$	$\text{MgO, MnO, FeO, CaS, MnS, P}_2\text{O}_5, \text{BaS, atd.}$
26-40%	36-48%	10-20%	<b>negligible</b>

## Chemical composition

**Stock gas**



$\text{CO}_2$	$\text{CO}$	$\text{H}_2$	$\text{CH}_4$	$\text{N}_2$
8-14%	23-32%	1-4%	0,2-0,4%	55-60%



There are three core root for production of steel

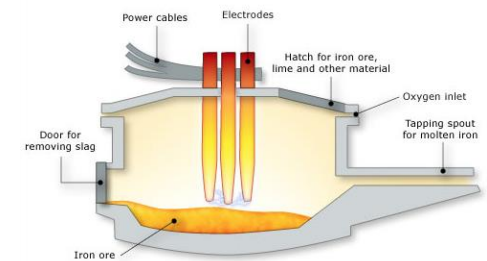
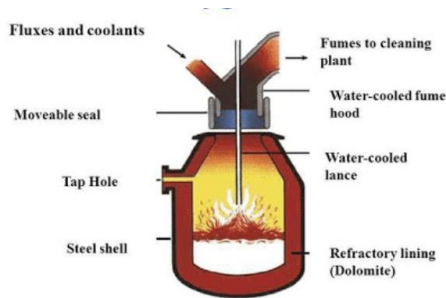
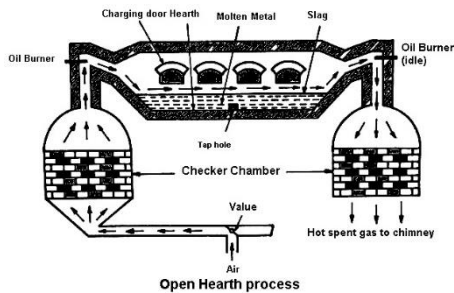
Open Hearth  
Process



Basic Oxygen  
Process

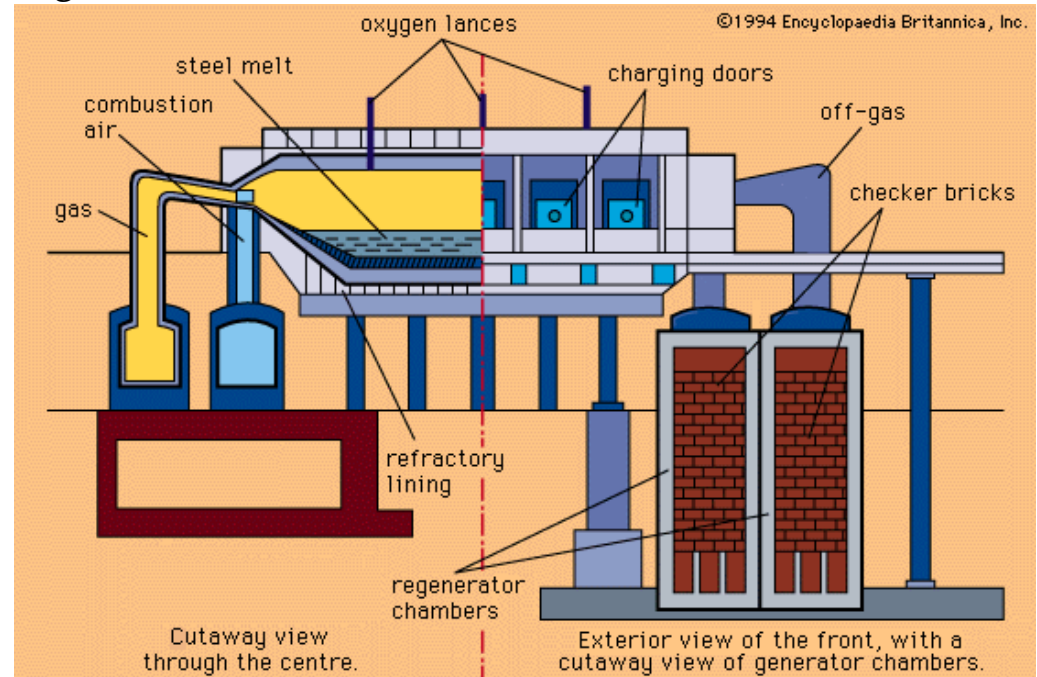


Electric Arc  
Furnace

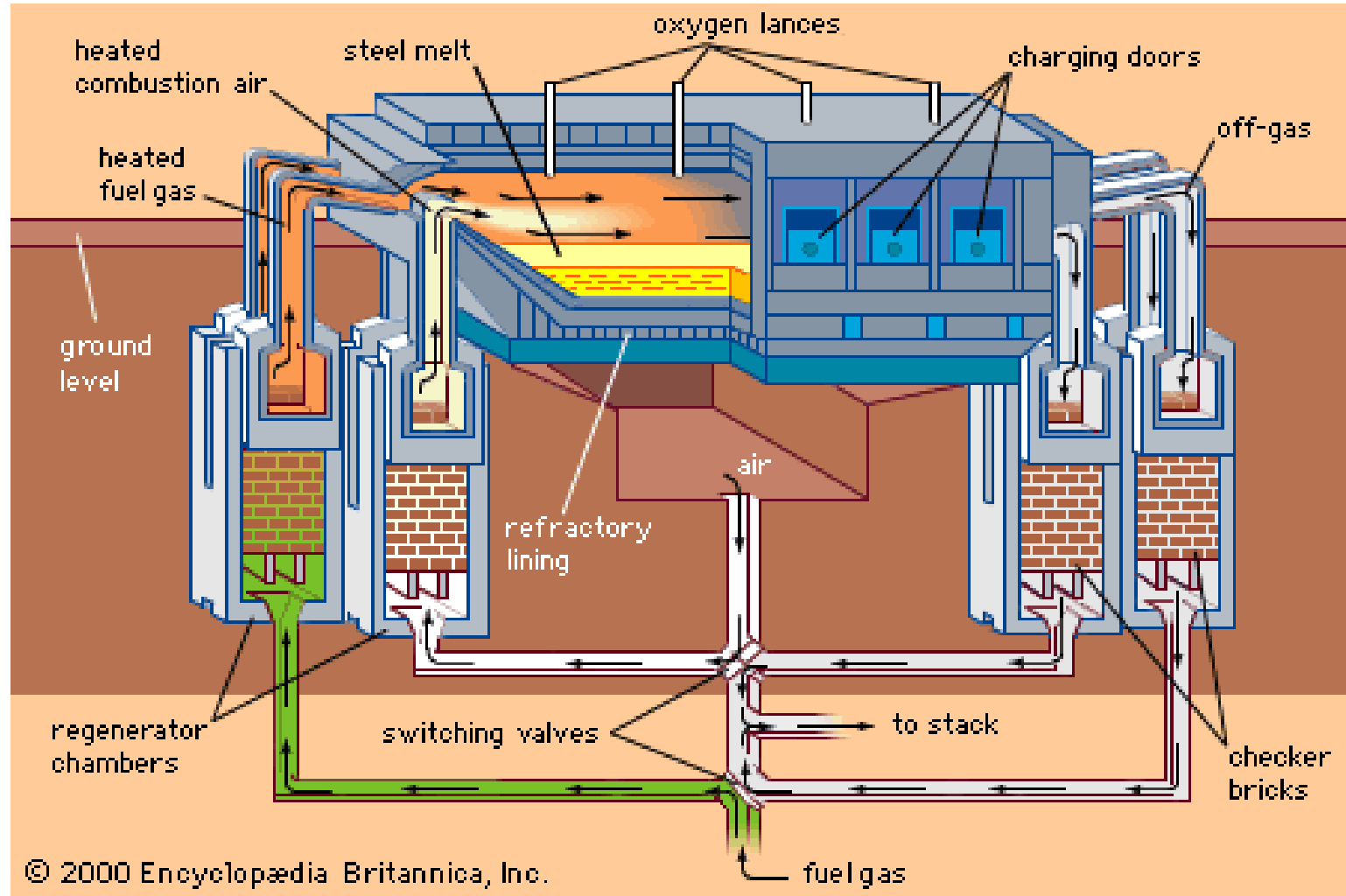


## Open Hearth Process

- The Converter
- Melted high carbon iron (pig iron) + bottom injected air
- Fast reaction:
 
$$[\text{Fe-C}] + \{\text{O}_2\} \rightarrow [\text{Fe}] + \{\text{CO}\}$$
- Minor reaction :
 
$$[\text{Fe}] + \{\text{O}_2\} \rightarrow (\text{FeO})$$
- Liquid steel product
- SiO<sub>2</sub> lining (acidic)
- Melted iron (pig iron + scrap) + hot air + flue gas  
+ magnesite lining + CaO powder



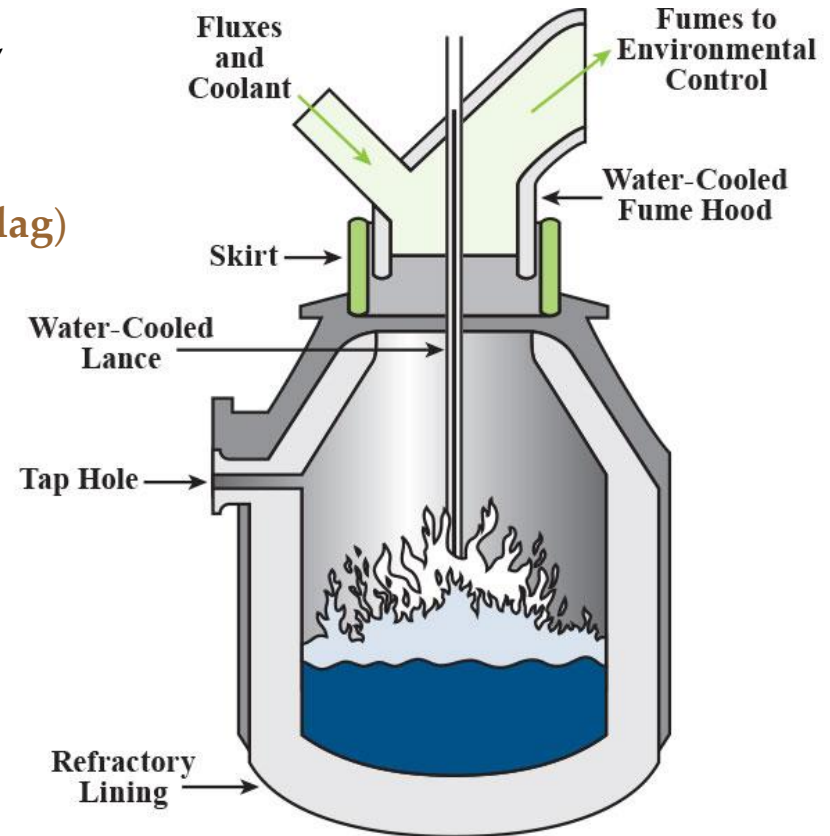
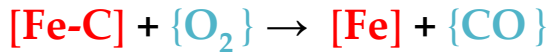
# Open Hearth Process





## Basic Oxygen Process

- **Liquid pig iron from blast furnace** (higher content of C, Si, P, S,...)
- **Steel scrap** (variable composition - also Cu, Zn, Pb, Cd,...)
- **Iron from direct reduction process** (bloom, sponge, briquettes – quite pure Fe)



# Operation over-view of Basic Oxygen Process



Ladle



Scrap

Liquid steel



Oxygen Lance



Oxygen tuyere



Steel



Slag

## BOS

Steel batch 200 000 kg

O<sub>2</sub>: 500 normal m<sup>3</sup>/min

20 min

Superficial velocity 1.5 m/s

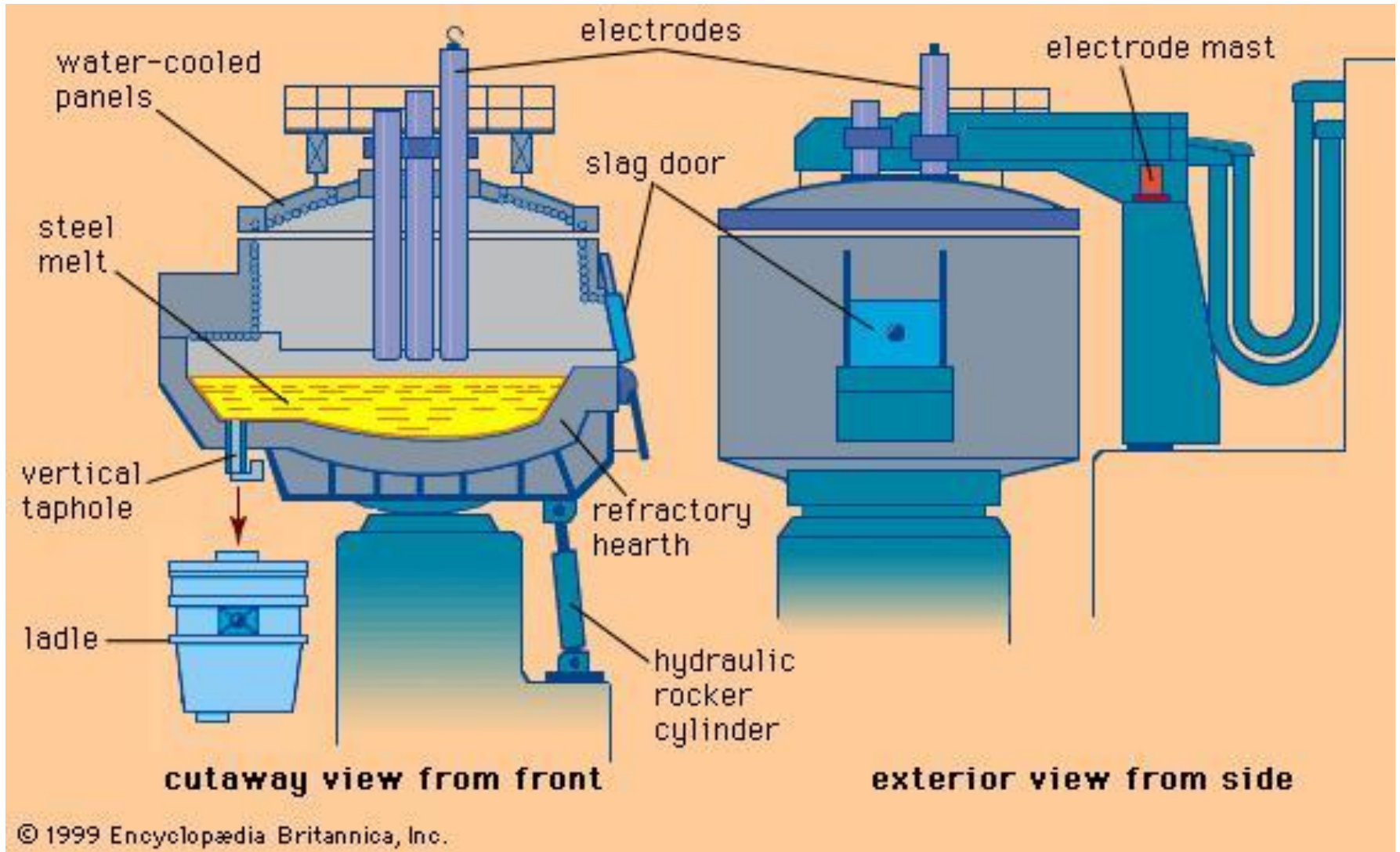
250 vvm

Gas power input 60 kW/m<sup>3</sup> (or 8 W/kg)

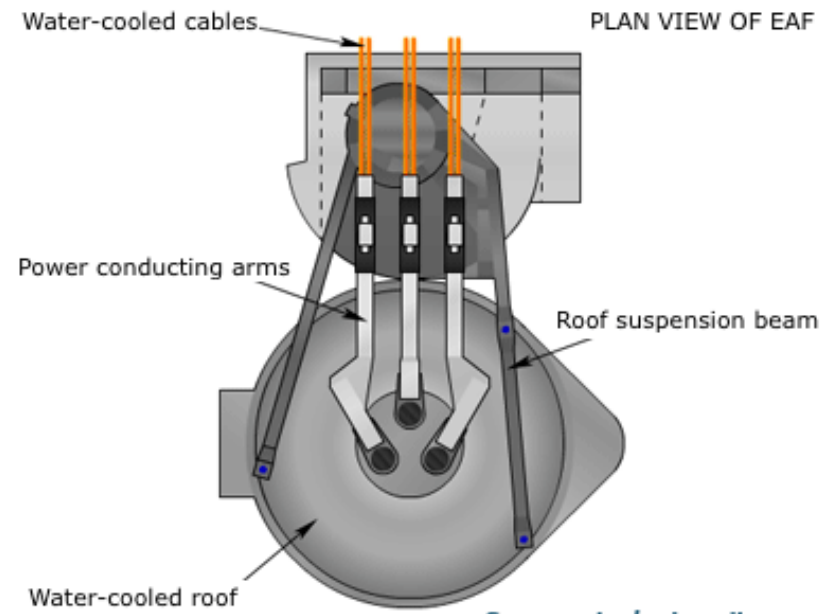
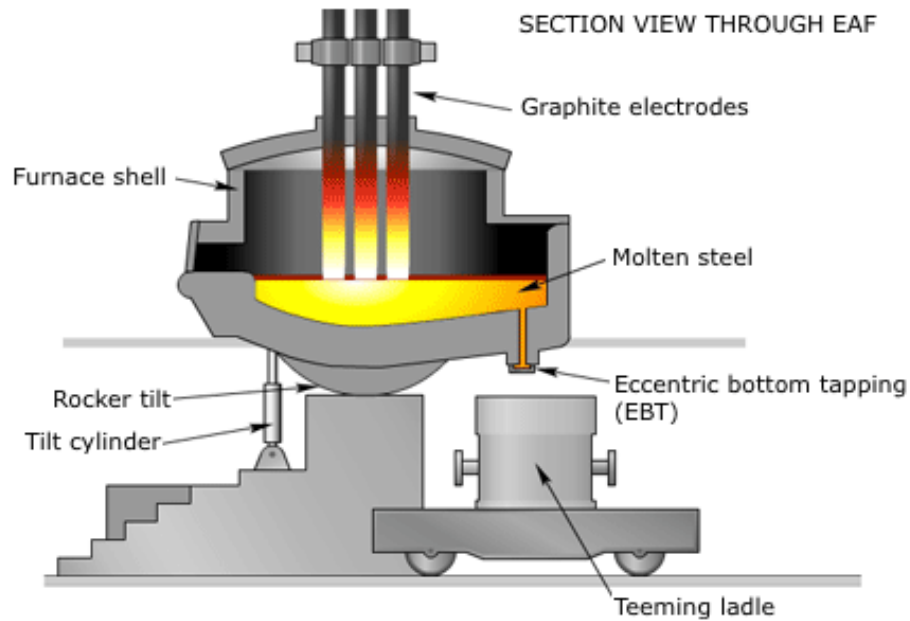
Mixing time 10-100 s

Whole cycle 50 min

# Electric Arc Furnace

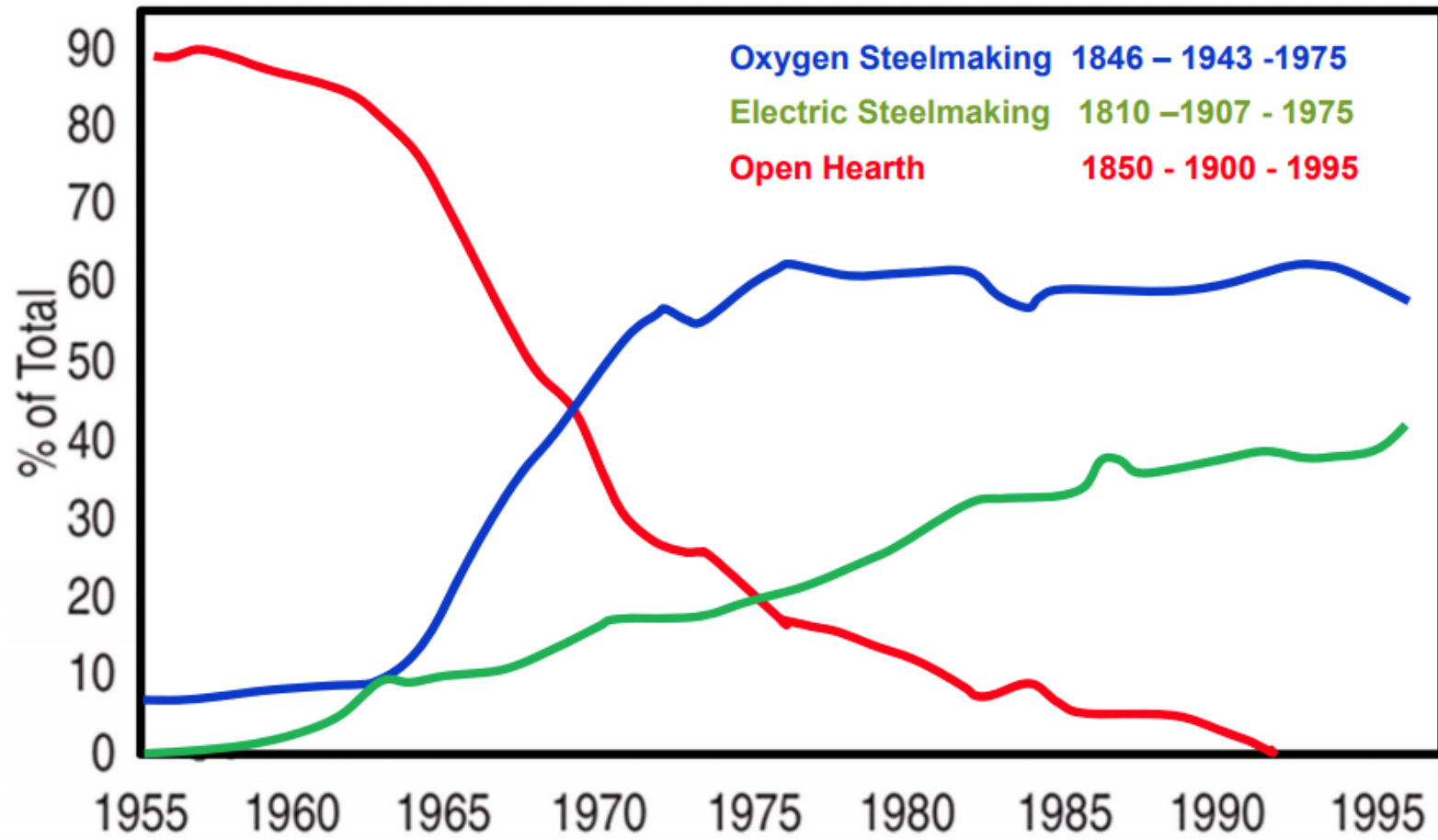


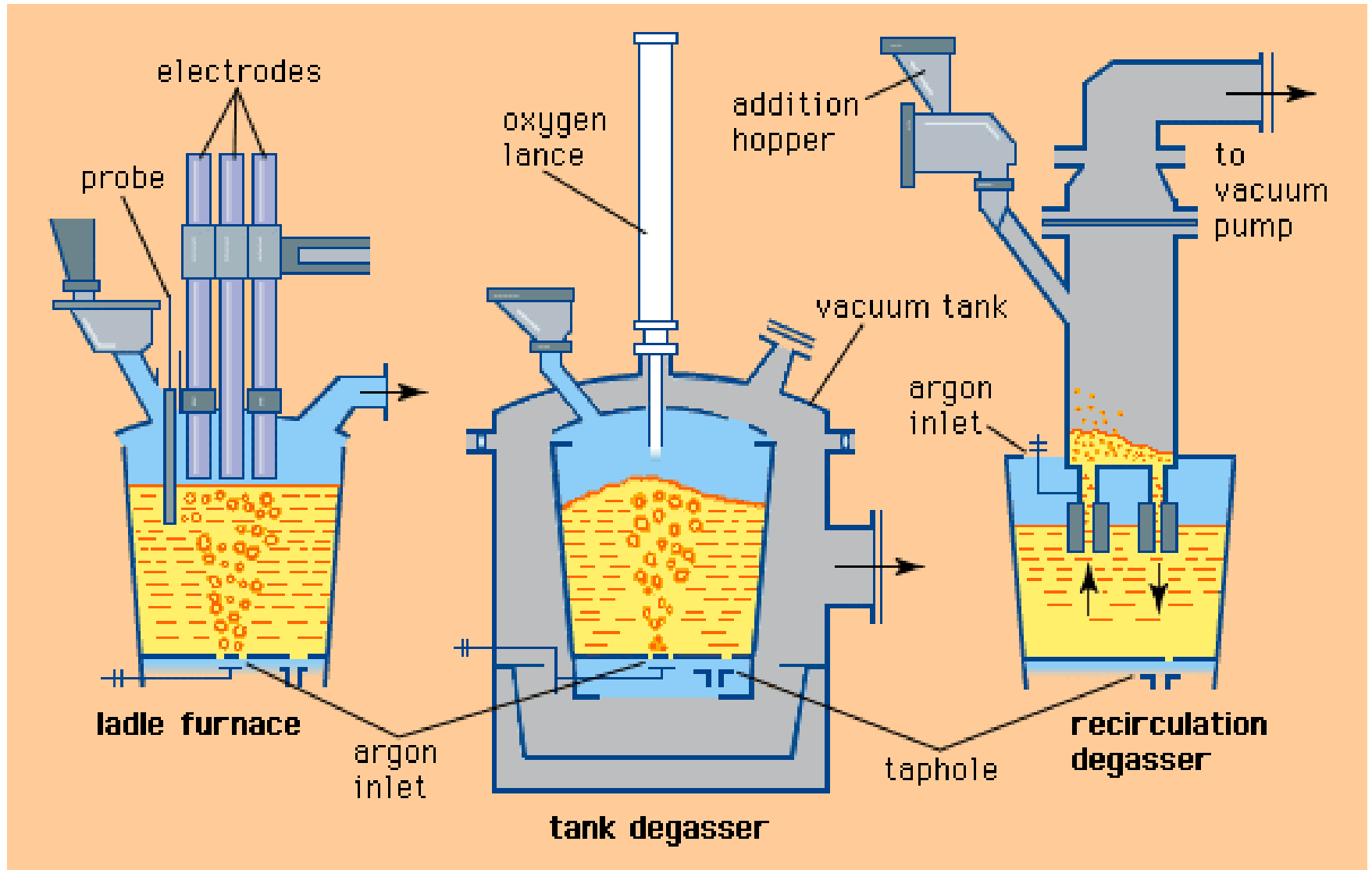
## Section and Plan View of Electric Arc Furnace

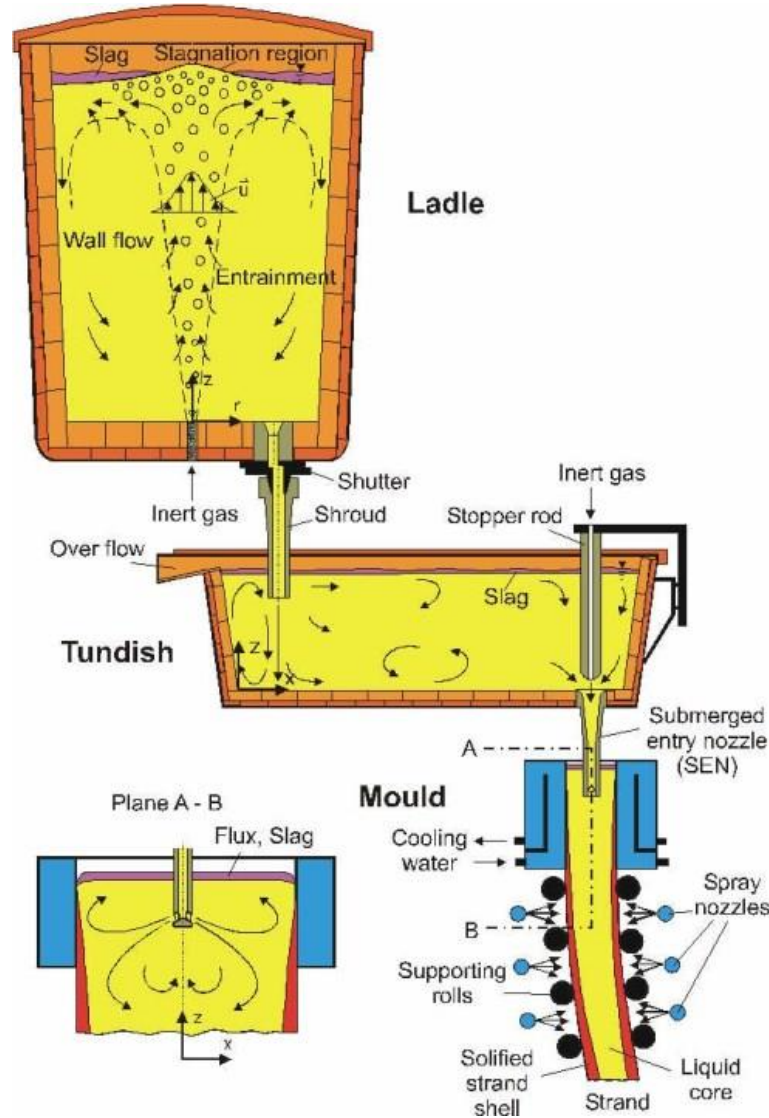


Source: [steeluniversity.org](http://steeluniversity.org)

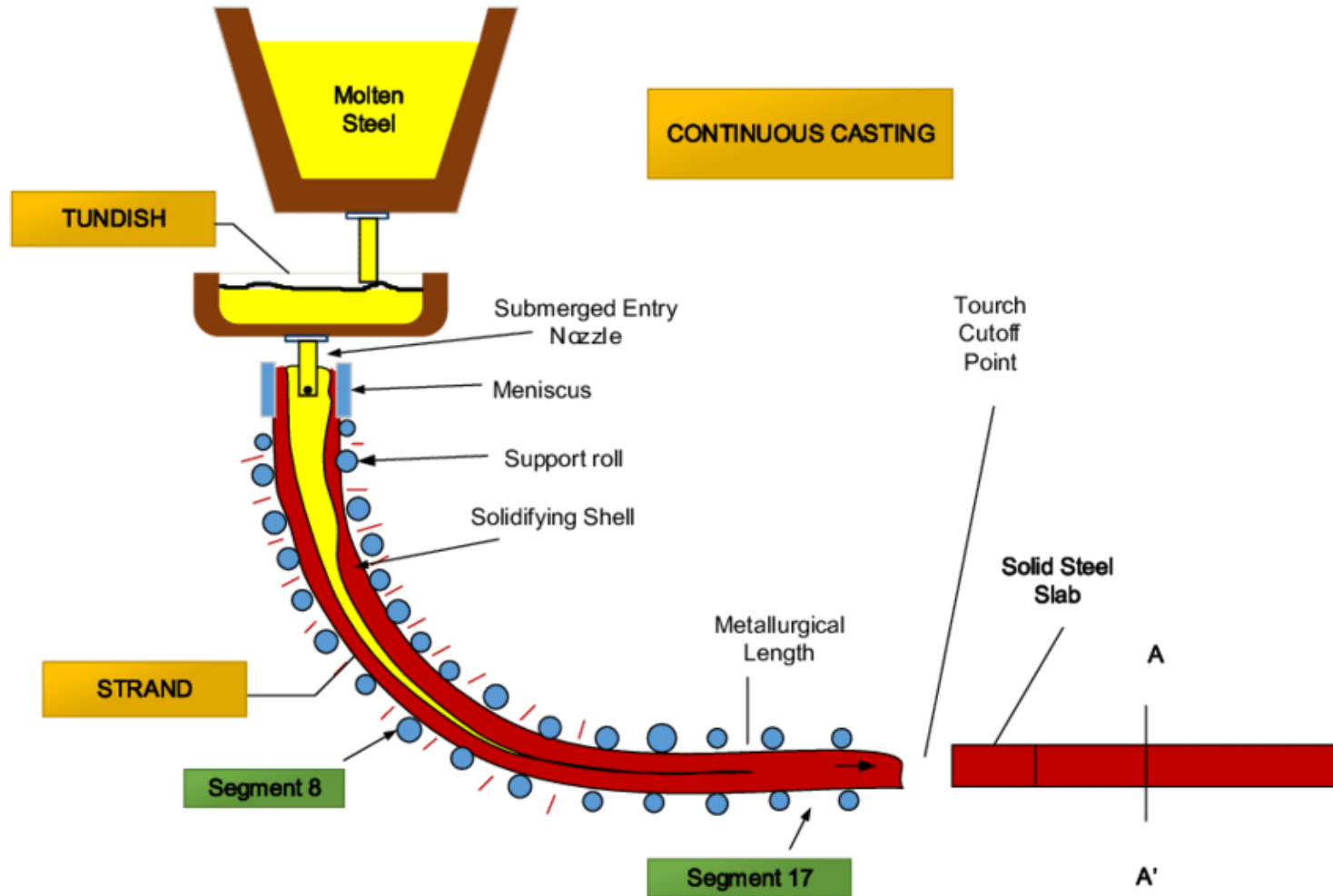
Steelmaking technology has always advanced





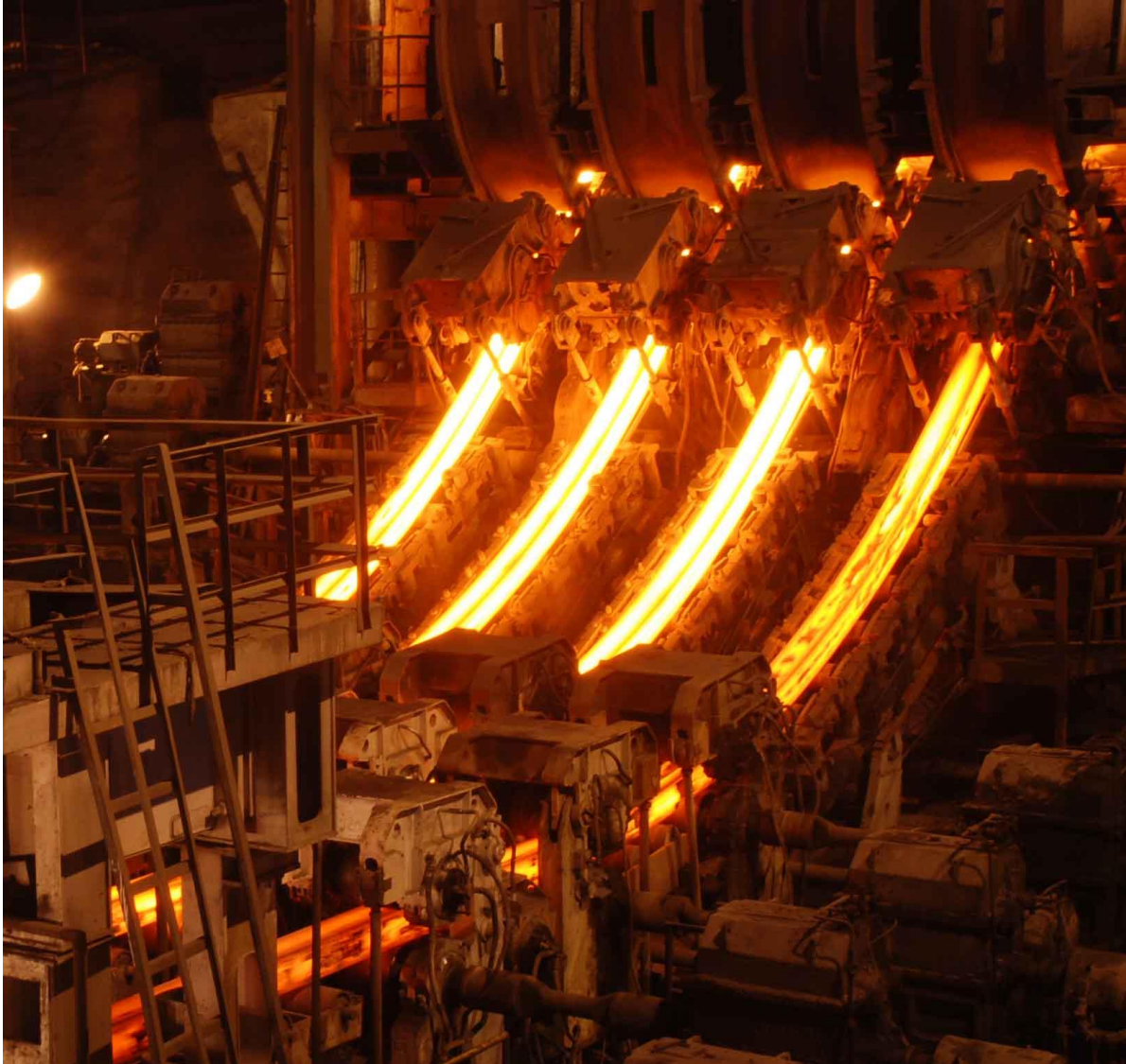


# Continues Casting of Steel





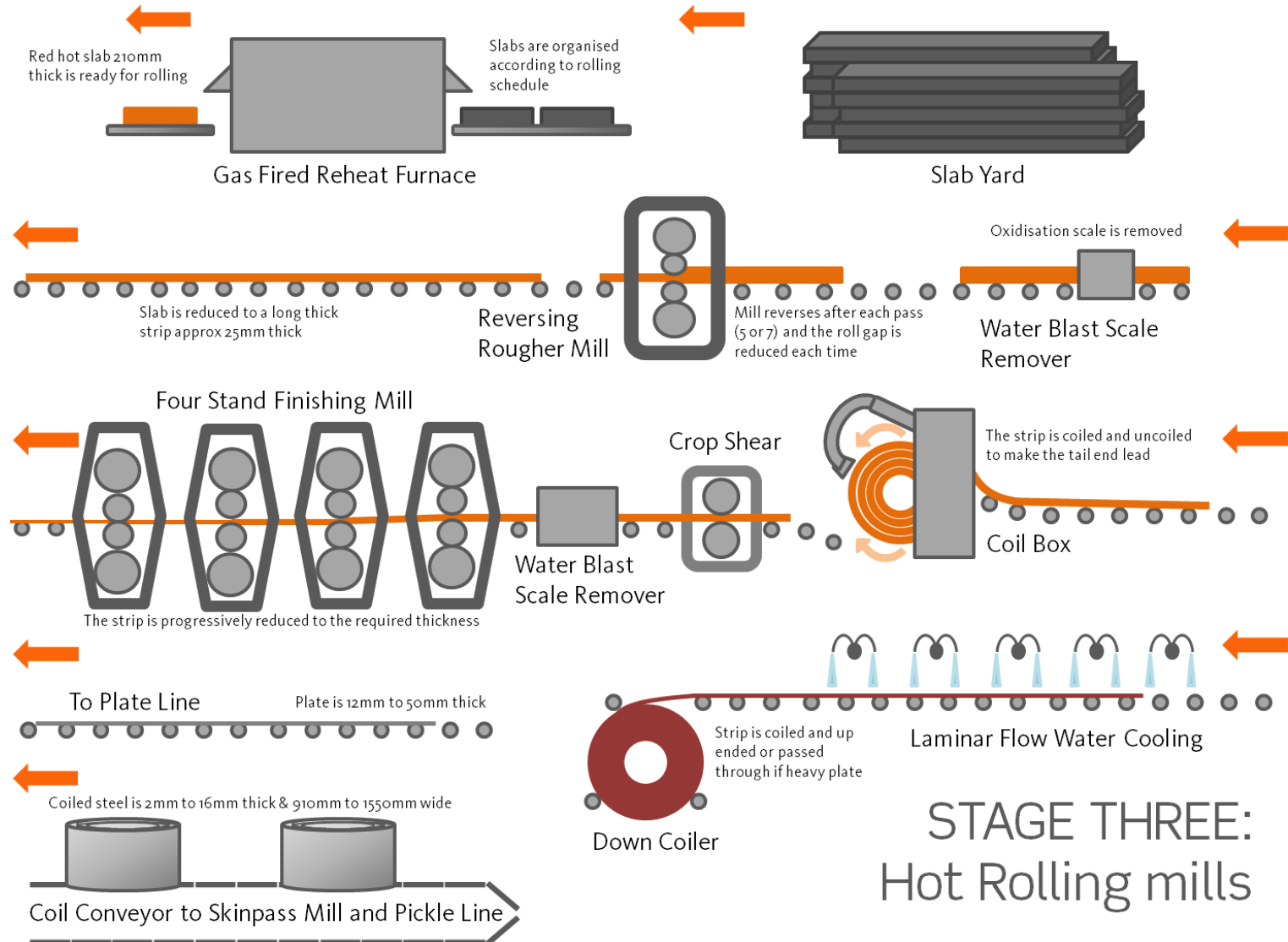
# Continues Casting of Steel



# Hot rolling of steel




# Hot rolling of steel



## STAGE THREE: Hot Rolling mills

**Terminology**



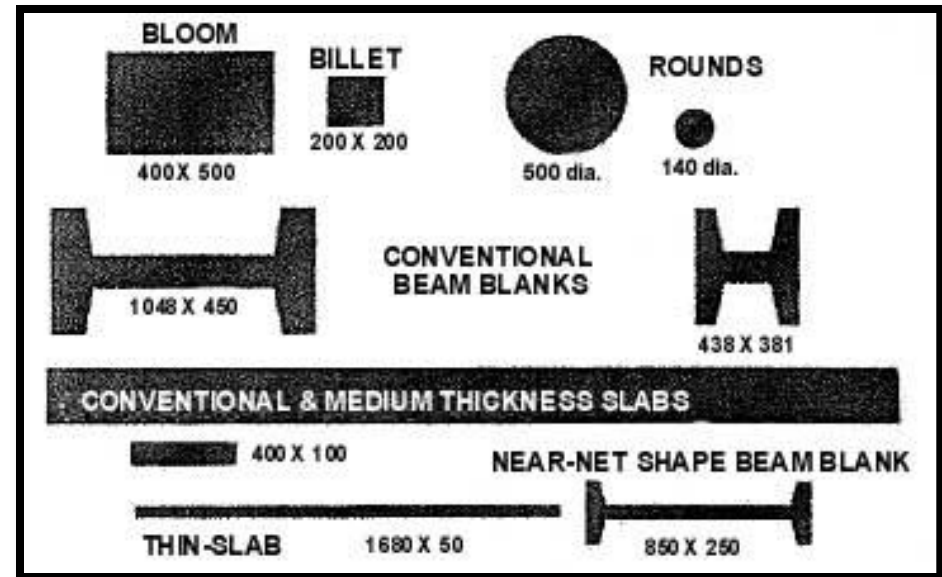
**Semi-finished products**

- **Bloom** is the product of first breakdown of ingot (cross sectional area  $> 230 \text{ cm}^2$ ).
- **Billet** is the product obtained from a further reduction by hot rolling (cross sectional area  $> 40 \times 40 \text{ mm}^2$ ).
- **Slab** is the hot rolled ingot (cross sectional area  $> 100 \text{ cm}^2$  and with a width  $\geq 2 \times$  thickness).

**Further rolling steps**

**Mill products**

- **Plate** is the product with a thickness  $> 6 \text{ mm}$ .
- **Sheet** is the product with a thickness  $< 6 \text{ mm}$  and width  $> 600 \text{ mm}$ .
- **Strip** is the product with a thickness  $< 6 \text{ mm}$  and width  $< 600 \text{ mm}$ .



# TÜRK ÇELİK SEKTÖRÜNÜN ORTAK GÜCÜ

