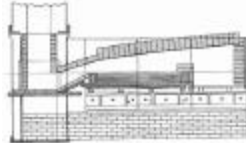


Puddling Furnace

- ◆ Low Arched Roof With Two Chambers
- ◆ Molten Iron & Combustion Chamber Are Separated



Bessemer Process

- ◆ Sir Henry Bessemer
 - ◆ Inventions
 - **Stamp That Could Not Be Forged**
 - **Improved Lead Pencils & Printers Type**
 - **New Way Of Making Bronze Powder**
 - **Machinery For Crushing Sugar Cane**
 - **Making Plate Glass**
 - **Guns For England**
 - ◆ Bessemer Process (Beginning 1855)
 - **Marked Beginning Of Steel Age**

Bessemer Process (Continued)

- ◆ Very Simple Idea
 - ◆ Dismissed At First By All So-Called Experts
 - ◆ Observation
 - **Molten Iron Reacted On the Surface With Air**
- ◆ Process
 - ◆ Recall, To Convert Molten "Cast" Iron To Wrought Iron, The Carbon Must Be Removed
 - ◆ Bessemer Blew Cold Air Through The Molten Iron
 - ◆ Though He Produced Wrought Iron
 - ◆ However, He Produced Malleable Iron "Steel"
 - **What We Call Mild Steel.**

Bessemer Process (Continued)

- ◆ Numerous Patents (1855 To 1856)
- ◆ Experimental Setup
 - ◆ 770 lb Iron (1/3 Ton) & Required 30 Minutes
 - **Compared To 550 lbs In Puddling Furnace For 2 hrs**
 - ◆ Ordinary Air - 21% Oxygen
 - ◆ Converter (Pear) Tilted For Charging & Pouring
- ◆ Produced Mild Steel
 - ◆ Could Be Bent & Formed Without Heat
- ◆ Process Difficulties
 - ◆ Bessemer Licensed Process
 - ◆ Licensees Could Reproduce Quality Of Steel

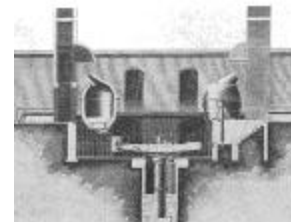
Bessemer Process (Continued)

- ◆ Iron Gets Hotter As Cold Air Passes Through It
 - ◆ Experts Thought It Would Cool Iron
- ◆ Like A Volcano
- ◆ Most Spectacular Sight In Iron & Steel Industry
- ◆ Clear Flame Finally From Converter
- ◆ Shown - 25 Ton



Bessemer Process (Continued)

- ◆ Experimental Plant At St. Pancras
 - ◆ Ore Mined At Blaenavon, Gwent (No Phosphorous)
- ◆ Bessemer Plant At Sheffield (1905)
 - ◆ Made A Fortune
 - ◆ Steam Boilers (1860)
 - ◆ Railway Rails (1863)



Thomas Process

- ◆ P.G. Thomas, Police-Court Clerk & Scientist
- ◆ Removed Phosphorous Problem
 - ◆ Lined Converter With Dolomite
 - **Chemically Basic**
 - **Noted With Phosphorus**
 - **West. Army. With Ship**
 - **Sold. As. Agricultural Fertilizer**
- ◆ Thomas Process Spread Quickly To Regions With Phosphorous Iron Ores (Most Abundant)

Basic Oxygen Process

- ◆ Advancement Of Bessemer & Thomas Process
- ◆ Air Is Replaced With High Pressure Stream
 - ◆ Pure Oxygen
 - ◆ Oxygen Lance (Water-Cooled Tip)
 - ◆ Supersonic Speed
- ◆ 275 tons Per hour

Siemens Process

- ◆ C.W. Siemens, Germany
 - ◆ Improving Furnaces For Glass Making
 - **By. 1857, Saved. 75%. Of. fuel. Used. to. Make. Glass**
 - **Waste. Gases. Used. To. Heat. Air. Needed. To. Burn. Fuel**
 - ◆ First Applied To Steel Making In France
 - **Emil. & Pierre. Martin. (1863)**
 - **Siemens. Set. Up. Iron. Works. In. Birmingham. (1866)**
 - **Company. At. Silesen. Producing. 75. tons. A. week**
 - ◆ Siemens Process
 - **Phosphorous. & Non-Phosphorous. Molten. Iron**
 - **Required. Fuel**

Siemens Process (Continued)

- ◆ Phosphorous & Non-Phosphorous Molten Iron
- ◆ Cost
 - ◆ Bessemer Was Cheaper (No Fuel) But Required Molten Iron
 - **Located. Near. Blast. Furnace**
 - ◆ Siemens Required Fuel
- ◆ Speed
 - ◆ Bessemer - 30 min
 - ◆ Siemens - 10 hours
- ◆ Could Melt Scrap Iron

Open-Hearth Process

- ◆ Derived From Siemen's Process
- ◆ Components
 - ◆ Rectangular Brick Hearth (20'x30'x8')
 - ◆ Regenerative Preheating
- ◆ Operates At 3000°F
 - ◆ Steel Melts At 2500°F
- ◆ Produces 100 tons Per hour

Open-Hearth Furnace

- ◆ Process Of Producing Steel
 - ◆ Furnace Can Be Charged With
 - **Pig. Iron. (Waste. Or. Cold)**
 - **Scrap. Steel**
 - **Iron. Ore**
 - ◆ Carbon Content Is Lowered By
 - **Oxidation**
 - ◆ Impurities Combine With Limestone As Slag
 - **Silicon, Phosphorous, Manganese, & Sulfur**

Open-Hearth Furnace



Electric Furnaces

- ◆ Electric Arc Or Electric Induction
- ◆ Primary Use Is Alloy & Specialty Steels
 - ◆ Charge Is Usually Scrap
 - ◆ Limestone & Iron Ore Are Added In Small Amounts
 - ◆ No Contamination From Fuel
 - ◆ Alloying Elements Are Added In Charge Or Later
- ◆ Electric Arc
 - ◆ Refractory Lined Vessel Of Drum Shape
 - ◆ Heat Is Generated By Electric Arc
- ◆ Electric Induction
 - ◆ Electric Current Induces Secondary Current In Vessel

Electric-Arc Furnace



Classifications Of Steels

- ◆ Carbon Steels
- ◆ Alloy Steels
- ◆ High-Strength Low-Alloy Steels
- ◆ Stainless Steels
- ◆ Tool Steels

Carbon Steels

- ◆ 90% Of All Steels
- ◆ Composition
 - ◆ Varying Amounts Of Carbon
 - ◆ Less Than 1.65% Manganese
 - ◆ Less Than 0.60% Silicon
 - ◆ Less Than 0.60% Copper
- ◆ Uses
 - ◆ Auto Bodies, Machines, Structural Steel For Buildings, Ship Hulls, Etc.

Alloy Steels

- ◆ Composition
 - ◆ Certain Percentages Of Vanadium, Molybdenum, Or Other Elements
 - ◆ Larger Amounts Of Manganese, Silicon, & Copper Than Carbon Steels
- ◆ Uses
 - ◆ Auto Gears & Axles, Knives

High-Strength Low-Alloy Steels

- ◆ Called HSLA
- ◆ Combination Between Carbon Steels & Alloy Steels
- ◆ Cost Less Than Alloy Steels
- ◆ Stronger Than Carbon Steels

Stainless Steels

- ◆ Composition
 - ◆ Chromium
 - ◆ Nickel
 - ◆ Other Alloying Elements
- ◆ Properties
 - ◆ Corrosion Resistance
 - ◆ Hard & Strong

Tool Steels

- ◆ Composition
 - ◆ Tungsten
 - ◆ Molybdenum
 - ◆ Cobalt
 - ◆ Other Alloying Elements
- ◆ Properties
 - ◆ Hardness