Refractories

Introduction to Refractories

- Refractories are material having high melting points, with properties that make them suitable to act as heat-resisting barriers between high and low temperature zones.

- **ASTM C71** defines refractories as "non-metallic materials having those chemical and physical properties that make them applicable for structures or as components of systems that are exposed to environments above **1000** °F (**538** °C)".

- Refractories are inorganic nonmetallic material which can **withstand high temperature without undergoing physical or chemical changes** while remaining in contact with molten slag, metal and gases.

- Refractories are useful in constructing application-specific high temperature areas/surfaces, particularly in furnaces or boilers, as they minimize heat losses through structure.

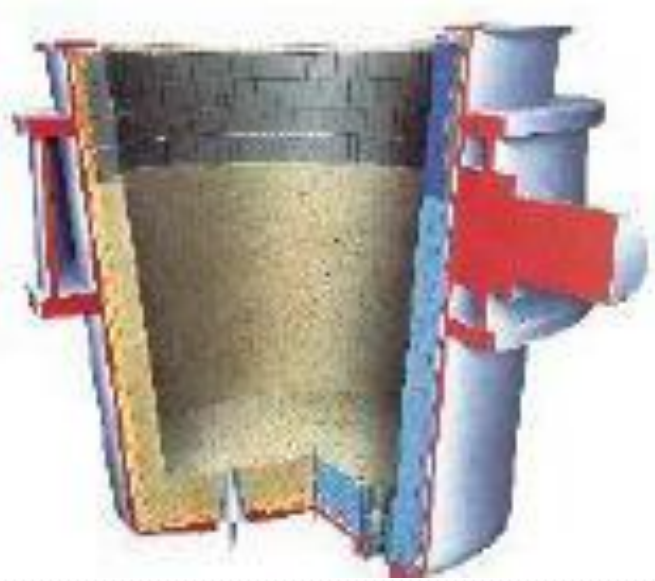
- Depending on the operating environment, they need to be resistant to thermal shock, be chemically inert, and/or have specific ranges of thermal conductivity and of the coefficient of thermal expansion.

- **Alumina**, **silica** and **magnesia** are the most important materials used in the manufacturing of refractories. Another oxide usually found in refractories is the oxide of calcium (**lime**).
- **Fire clays** are also widely used in the manufacture of refractories.

Refractories perform four basic functions:

- They act as a **thermal barrier** between a hot medium (e.g., flue gases, liquid metal, molten slags, and molten salts) and the wall of the containing vessel.

- They insure a strong **physical protection**, preventing the erosion of walls by the circulating hot medium.



- They represent a **chemical protective barrier** against corrosion.
- They act as **thermal insulation**, insuring heat retention.
- The principal raw materials used in the production of refractories are: the **oxides** of silicon, aluminum, magnesium, calcium and zirconium and some **non-oxide** refractories like carbides, nitrides, borides, silicates and graphite.

Requirements of right refractory

- Its ability to **withstand high temperatures** with sudden changes of temperature.
- Its ability to **withstand action of molten metal, hot gasses and slag erosion** etc.
- Its ability to **withstand load** at service conditions.
- Its ability to **resist contamination** of the material with which it comes into contact.
- Its ability to **maintain sufficient dimensional stability** at high temperatures and after/during repeated thermal cycling.
- Its ability to **conserve heat**.

Melting point of some pure compounds used to manufacture refractory

Compounds	Melting point (℃)
MgO (pure sintered)	2800
CaO (limit)	2571
SiC pure	2248
MgO (90-95%)	2193
Cr_2O_3	2138
Al_2O_3 (pure sintered)	2050
Fireclay	1871
SiO_2	1715