Types of Refractories

6) Zircon Refractories

7) Magnesia Refractory

8) Magnesite Refractory

9) Dolomite Refractory

- **6) Zircon Refractories**
- Zircon is zirconium silicate **($ZrO_2.SiO_2$)** (a refractory compound of zirconium) exists in nature as 'Zircon' mineral.
- Zircon containing by chemical analysis, not less than **60 %** zirconium oxide **(ZrO_2)** and not less than **30 %** silica **(SiO_2)**.

- It is produced by heating tetragonal zirconia with silica at **1460°C**.

- Zircon is stable upto **1750°C** but at higher temperature, it decomposes yielding zirconia and silica glass or cristobalite (which is a stable form of silica above 1440°C).

- **Classification of Zircon Refractories**
- The Standard classification of zircon refractories as ASTM (C 545) are:

- **Type A** (Regular)—Zircon refractories having a **bulk density** of less than (**3.84** g/cm^3).

- **Type B** (Dense)—Zircon refractories having a **bulk density** of (**3.84** g/cm^3) or more.

- **Manufacturing of Zircon Bricks**

Zircon and zircon flour are mixed with the binder (such as sodium silicate, phosphoric acid etc.) to a stiff paste which is press moulded to the required shape.

Slip casting is also used for moulding zircon refractories which are dried and fired at 1600°C.

- **Properties of Zircon Refractories:**
- **Refractoriness** of zircon refractories is **2000°C** and **RUL is 1600°C** under a load of 2 kg/cm^2.
- **It has a high spalling resistance and low coefficient of expansion.**

- **Uses of Zircon Refractories:**
- Zircon refractories are used in **re-melting furnaces for aluminum** because they are not wetted by molten aluminum or alumina.
- It is also used in **boilers** as they offer excellent resistance to the action of **coal** and oil ash.
- Zircon refractories used in contact with some **phosphates**, **iron oxide** and **fluorspar** should be avoided as they react with these substances.

- **7) Magnesia Refractory**
- The principal magnesia refractory raw material is obviously magnesium oxide (MgO).
- Magnesium oxide has a very high melting point of about **2800°C.**

- **Production of MgO:**
- MgO is produced by the calcination of magnesium carbonate **($MgCO_3$)** or magnesium hadroxide **($Mg(OH)_2$)** or by the treatment of magnesium chloride **($MgCl_2$)** with **lime** followed by heat.

- $MgCO_3 \rightarrow MgO + CO_2$ ($\Delta H = +118$ kJ/mol)

- Calcining at different temperatures produces magnesium oxide with different reactivity.
- High temperatures calcinations (**1500 – 2000**)°C diminish the available surface area and **produced *dead-burned magnesia***, and it is un-reactive form used as a refractory.
- Intermediate temperatures calcinations (**1000 – 1500**)°C **produced *hard-burned magnesia*** which has limited reactivity,
- Lower temperature calcinations (**700 – 1000**)°C **produced *light-burned magnesia***, a reactive form, also known as caustic calcined magnesia.

- **Properties of MgO bricks:**
- Excellent performance of **basic slag** resistance, thermal stability, corrosion resistance and anti-erosion.
- Excellent thermal shock resistance and spalling resistance.
- High temperature refractoriness under loading.
- High mechanical strength.
- High temperature resistance.

- **8) Magnesite Refractory**
- Magnesite is **$MgCO_3$**. It occurs as a natural deposit and can be used as a refractory material.
- Magnesite refractories are chemically basic materials, containing at least **85% MgO**.

9) Dolomite Refractory Bicks

- Dolomite is a magnesium limestone ($CaMgCO_3$). It occurs in nature. Dolomite represented by **($CaCO_3.MgCO_3$).**
- Ideally, dolomite used for refractory bricks manufacture should have about **46** mole% of **$MgCO_3$** and **54** mole% of **$CaCO_3$**.
- The natural double carbonate dolomite ($CaCO_3$ – $MgCO_3$) can be converted to **doloma** refractory **(CaO.MgO)** by high temperature firing. High purity doloma has about (**58% CaO** + **42% MgO**).

- The **difficulty** in dolomite using it is that **lime absorbs water** and **carbon dioxide** at atmospheric temperature and thus causes the disintegration of the bricks. This can be prevented by either:
- **Coating** the bricks with **tar** so that during storage contact with water and carbon dioxide is avoided, or.
- **Stabilized by mixing serpentine ($MgO.SiO_2$) with dolomite** and calcining, resulting in the formation of **di or tri-calcium silicate** which does not absorb water and carbon dioxide.

- **Properties of Dolomite Bricks:**
- Dolomite bricks are more porous, more shrinkage and less stronger than magnesia bricks.
- They can be used up to **2300°C** without load and up to **1650°C** with load.

- **Uses of Dolomite Bricks**:
- Dolomite is generally used as a **repairing material** rather than as a direct refractory because of its defects like porosity, shrinkage and softness.

- However stabilized dolomites are used in electric furnaces, open hearth furnaces etc, cheap substitute for magnesia bricks.