Types of Refractories

10) Chromite Refractories

11) Pure Refractory Oxides

12) Carbide Refractories

13) SIALON Refractory

10) Chromite Refractories

There are chrome-magnesite refractories and magnesite-chrome-refractories.

Chrome-magnesite material usually contains 42-50% MgO and15-35% Cr_2O_3 whereas,

Magnesite-chromite refractories contain at least 60% MgO and 8-18% Cr_2O_3.

- **Chrome-magnesite** refractories are used for building the critical paths of high temperature furnaces. These materials can withstand corrosive slags and gasses.
- The **magnesite-chromite** products are suitable for service at the highest temperatures and in contact with the most basic slags used in steel melting. Magnesite-chromite usually has a better spalling resistance than chrome-magnesite.

- **Properties of Chromite bricks:**

1. Chromite bricks can be used up to 1800°C.
2. It has resistant to basic and moderately acid slags.
3. They have moderate thermal conductivity.

11) Pure Refractory Oxides

Pure oxides are used for making so called "***super refractories***", which are suitable to be used in contact with molten matels in oxidizing, conditions because of their high melting point.

- Fusion points and specific gravity of some pure refractory oxides are listed in the table below.

Refractory oxides	Fusion point, °C	Specific gravity
SiO_2	1715	2.32
MnO	1780	5.40
TiO_2	1850	4.24
BaO	1917	5.72
NiO	1950	6.80
V_2O_3	1977	4.87
$A1_2O_3$	2050	3.97
BeO	2550	3.03
CaO	2570	3.23
ZrO_2	2677	5.56
MgO	2800	3.58
HfO_2	2810	9.68
UO_2	2875	10.96
ThO_2	3070	9.69

- **12) Carbide Refractories**
- Carbides of various elements such as silicon carbide **(SiC),** tantalum carbide **(TaC),** zircoimim carbide **(ZrC),** titanium carbide **(TiC),** boron carbide **(B_4C),** etc.
- These carbides are very costly, so their use is restricted only to special purposes.

- **Silicon Carbide (SiC):**
- **Silicon carbide** or **carborundum** is one of the very important refractories. It is produced in electric furnaces by heating together up to 1300-2200°C, the following mixture :

Sand SiO_2	52—54%
Coke (C)	35%
Saw dust	7—11%
Salt	1.6—4%

- The following reaction takes place :
- $SiO_2 + 3C \rightarrow SiC + 2CO$
- Composition of carborundum produced is generally the following:

Silicon	65%
Carbon	30%
Impurities	5%

Properties of SiC:

- Hardness is very high.
- True **specific gravity** varies from 3.17 to 3.21. It is light in weight.
- **Melting point** is about 2500°C and thus has high refractoriness but starts **decomposing** at 2200°C.
- **It is chemically inert to acid slags**.
- It has high thermal conductivity.
- Very low coefficient of expansion and high thermal shock resistance.

- **Uses of SiC:**

Generally, Silicon carbide refractories are used for **crucibles** for melting non-ferrous metals and as **heating elements**.

- **13) SIALON Refractory:**
- SiAlONs are refractory ceramics based on the elements **(Si+Al+O+N).**
- SiAlONs are produced by first combining a mixture of raw materials including:
- Silicon nitride (**Si_2N_3**), aluminum nitride (**AlN**), alumina (**Al_2O_3**), silica (**SiO_2**) and the oxide of a rare earth element such as Y_2O_3.

- The powder mix is **hot pressed at (18–30) MPa and (1700 – 1760)°C** in graphite moulds in order to produce a low porosity dense product.

- **SIALON refractory shows:**
- Good resistance to oxidation, and action of molten metals like Al, Zn, Cd, Fe and steel; and
- Resistance to H_2SO_4, HCl, and alkalis.

Special Refractories

- These are **very expensive** refractory materials used for making crucibles and furnaces for special / experimental purposes where the cost of refractory is no consideration.
- They are **not very common** due to their manufacturing limitation.
- Special refractory include pure oxides (eg. Magnesia, Silica, Alumina, Thoria, etc), sialons, borides, nitrides, silicides, carbides etc.