Classification of Refractories

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Refractories are classified into number of ways according to following:

1. **According to the Chemical Composition**
2. **According to the Refractoriness**
3. **According to the Methods of Manufacture**
4. **Depending on the Sources of Raw Materials**
5. **Depending on the Heat Treatment**
6. **According to the Porosity of Produced Refractories**
7. **According to Shape of Refractories**
8. **According to the Softening Point**

1) Classification Based on Chemical Composition

A- Acid Refractories.

B- Neutral Refractories.

C- Basic Refractories.

1) Classification Based on Chemical Composition

A- Acid Refractories:

Acid refractories are those which are attacked by alkalis (basic slags). These are used in areas where slag and atmosphere are acidic. Examples of acid refractories are:

- 1) Silica (SiO_2).
- 2) Zirconia (ZrO_2).
- 3) Aluminosilicate.

1) Classification Based on Chemical Composition

B- Neutral Refractories:

Neutral Refractories are chemically stable to both acids and bases and are used in areas where slag and atmosphere are either acidic or basic.

The common examples of these materials are:

- 1) Carbon graphite (most inert)
- 2) Chromites (Cr_2O_3)
- 3) Alumina

Out of these graphite is the least reactive and is extensively used in metallurgical furnaces where the process of oxidation can be controlled

1) Classification Based on Chemical Composition

C- Basic Refractories:

Basic refractories are those which are attacked by acid slags but stable to alkaline slags, dusts and fumes at elevated temperatures.

These refractories are of considerable importance for furnace linings where the environment is alkaline; for example non-ferrous metallurgical operations.

The most important basic raw materials are:

1) Magnesia (MgO) - caustic, sintered and fused magnesia

2) Dolomite (CaO.MgO) - sintered and fused dolomite

2. Classification According to the Refractoriness

A. Low heat duty (PCE)19-28.
B. Intermediate heat duty (PCE) 28-30.
C. High heat duty (PCE) 30-33.
D. Super duty (PCE) above 33.

PCE: Plyometric Cone Equivalence-test is made by heating cone-shaped samples of the test material together with different standard cones that are already defined by PCE-number. When the tip of the test cone reaches its base simultaneously as a standard cone then the PCE-number is found.

3) Classification Based on Method of Manufacture

The refractories can be manufactured in either of the following methods:

- a) Dry Press Process.
- b) Fused Cast.
- c) Hand Molded.
- d) Formed (Normal, Fired or chemical bonded).
- e) Unformed (Monolithic – Plastics, Ramming mass, Gunning, Cast able, Spraying).

4. Classification Depending on the Sources of Raw Materials

A. Refractories produced from natural raw material like (fire clay, silica bricks, dolomite bricks and magnesite bricks).

B. Refractories produced from synthetics raw materials prepared from natural raw materials extracted from natural minerals such as aluminum, zirconia and magnesia to produce special fire bricks as alumina, calcium carbide, silicon carbide.

5. Classification Depending on the Heat Treatment

A. Fired refractories
B. Unfired refractories
C. Molten refractories.

6. Classification According to the Porosity of Produced Refractories

A. Sintered refractories and has porosity **less than 1%.**
B. Dense refractories that has porosity **(10-30) %.**
C. Light weight refractories that has porosity **more than (50) %** from the volume of the refractory bodies.

7. Classification According to Shape of Refractories

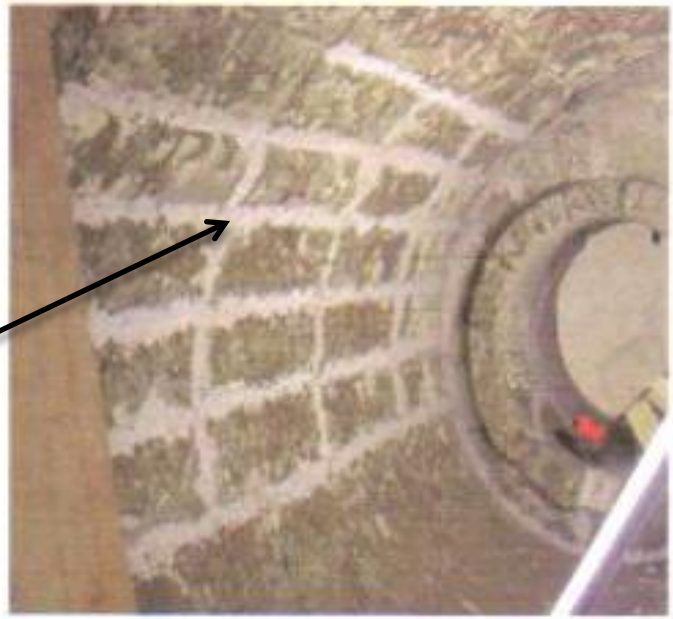
A. **Shaped Refractories:** which have fixed shaped when delivered to the user. These are what we call bricks. Brick shapes may be divided into two: **standard shapes** and **special shapes**.

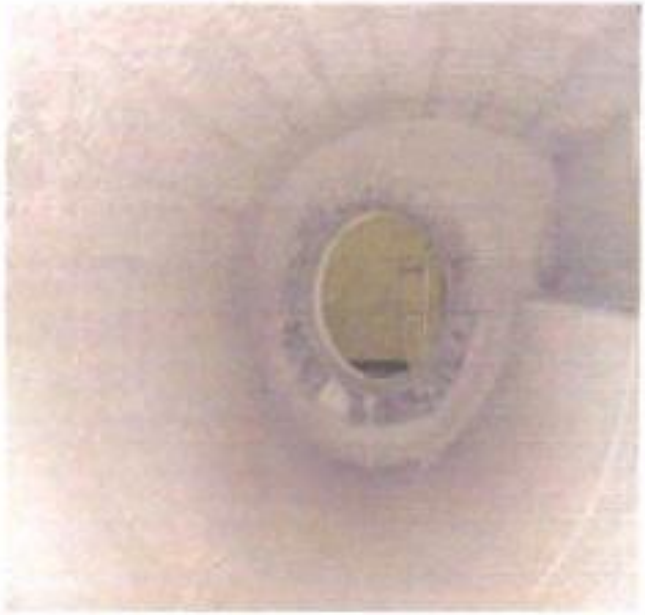
standard shapes

Shaped Refractories - special shapes

B. **Unshaped Refractories:** are without definite form and are only given shape upon application. These are categorized as Plastic refractories, ramming mixes, castables, gunning mixes, and mortars. The unshaped refractories can be used for temporary repaired lining in furnaces

Unshaped Refractories





8) Classification According to the Softening Point

A. **Low Refractories:** softening point between **(1580-1790) °C.**

B. **Medium Refractories:** softening point ranged from **(1790-2000) °C.**

C. **High Refractories:** softening point more than **(2000) °C.**