- Failure of Refractories
- Selection of Refractories
- Applications of Refractories

- **Failure of Refractories**

The most common causes of failure of refractories are:

1. **Chemical reaction with the environment**
2. **Spalling**
3. **Abrasion**

1- Chemical reaction with the environment:

- It should certainly not be in **a chemically dissimilar environment** e.g. an acid refractory should not be used in a furnace using basic fluxes and slags and vice versa.
- In the chemical reaction, **the porosity** of the refractory plays an important part. The more porous it is, the greater will be the depth to which the slag will penetrate and destroy the refractory.

2- Spalling:

The cause of spalling may be **thermal**, **mechanical** or **structural**.

- **Thermal spalling:**

may be due to **unequal expansion or contraction** cause by the difference in temperature at different parts or by **rapid changes in temperature**.

- **Mechanical spalling:**

is mostly due to careless in loading the furnace or in the removal of materials form the furnace thereby damaging the refractory.

- **Structural spalling:**

takes place because of the change in composition of the refractory due to reactions with molten slags or gases. This changes its coefficient of expansion.

3- Abrasion:

- Abrasion means mechanical rubbing away of the material.
- **In the furnace, there is:**
- A movement of materials slides along the refractory.
- The flowing of heavy molten slags.
- Dust and gases often move at high speeds. All these rub off the refractories and cause its failure.

Selection of Refractories

- The selection of refractories **aims to maximize the performance of the furnace, kiln or boiler**. The selection of a suitable refractory depends on a large number of factors classified into the following groups:
- **Factors related to refractories.**
- **Factors related to the furnace design.**
- **Factors related to operation.**
- **Cost factors.**

- **Factors related to refractories:**

  The properties of the refractories available.

- **Factors related to the furnace design:**

  The selection of refractory will depend upon the type of the furnace, conditions of heating and loading, degree of insulation, etc.

- **Factors related to operation:**

The most important factor in this group is:

- the **chemical nature** of the materials (like the ores, fluxes, fuels etc.) in contact with the refractory,

- the **temperature in different** parts of the furnace and temperature fluctuations.

- Any **furnace designer** should have a clear idea about the service conditions which the refractory is required to face. The furnace manufacturers or users have to consider the following points, before selecting a refractory.
- Area of application.
- Working temperatures.
- Extent of abrasion and impact.
- Structural load of the furnace.
- Stress due to temperature gradient in the structures and temperature fluctuations.
- Chemical compatibility to the furnace environment.
- Cost considerations.

- **Applications of Refractories**

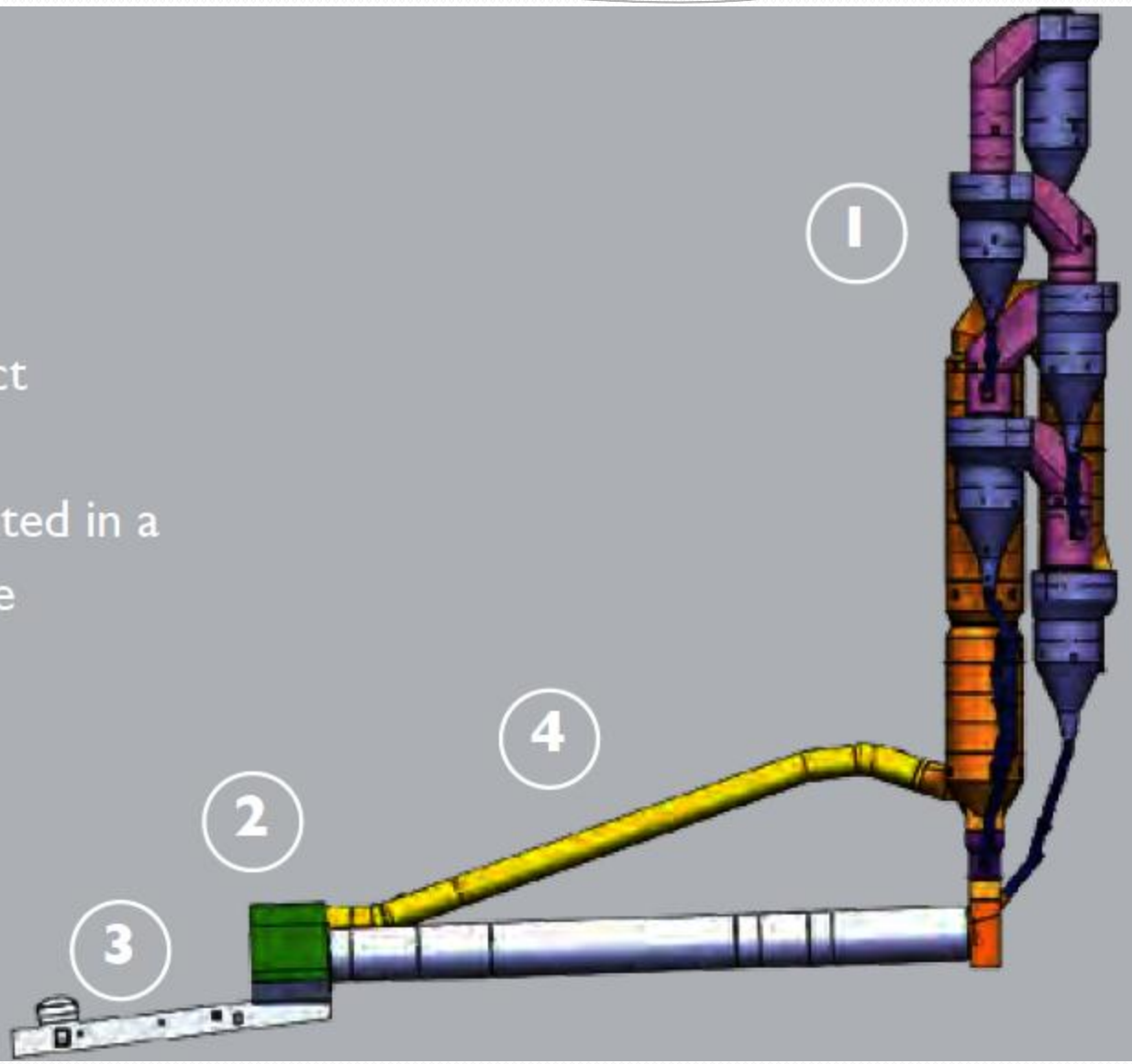
- Refractories are used wherever the control or containment of high temperature processes is required.
- There are many application of refractories in the industries such as: Refractories used in the: iron and steel, cement, refractories, ceramic materials, glass, building bricks and chemical industries and others.

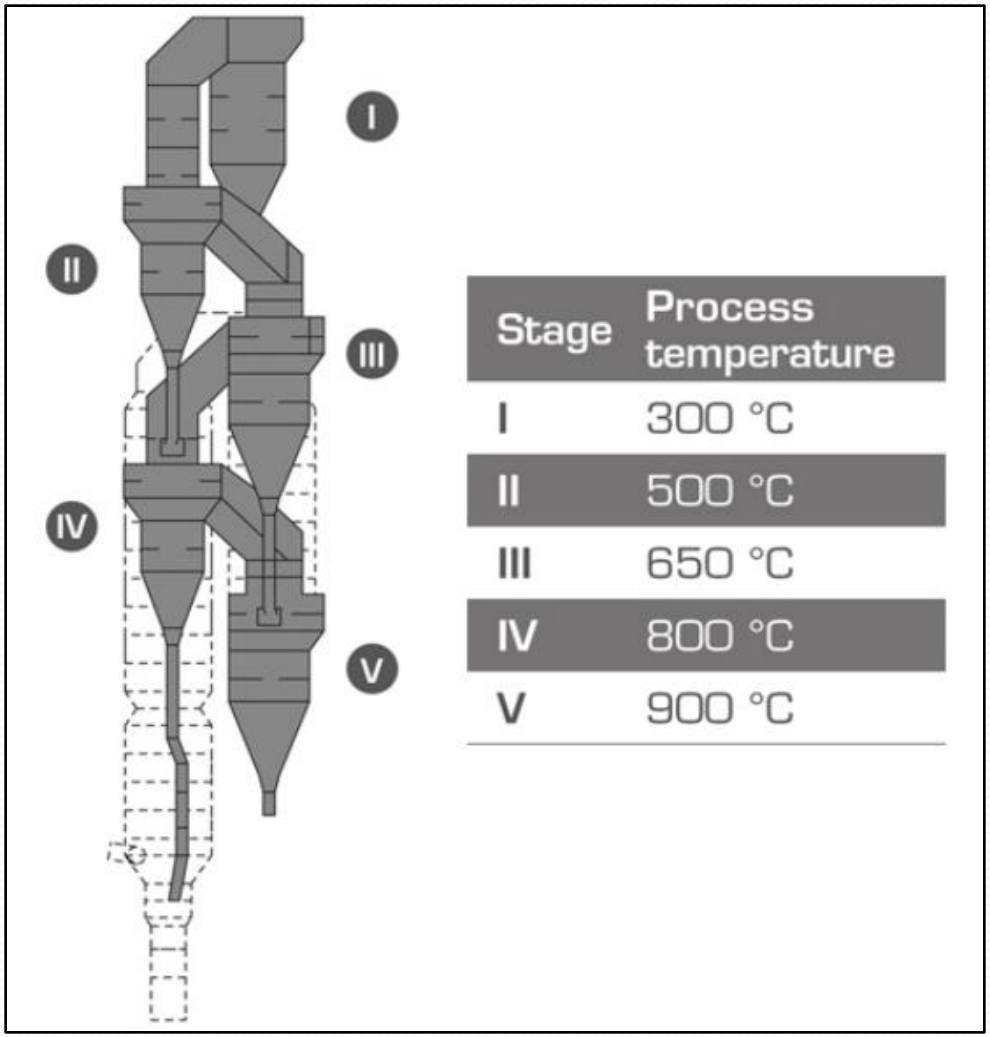
- **Refractory for Cement Industry Applications**
- Some common operational problems observed in cement plant refractories are:
- **high abrasion** that reduces lining thickness,
- **high thermal load** that softens refractories on account of high temperatures,
- **high mechanical load** that causes stresses in refractories, and
- **high thermal shock** that creates spalling.


Höganäs Bjuf AB

1. Preheater
2. Kiln hood
3. Cooler
4. Tertiary air duct

The kiln is presented in a separate brochure





Stage	Process temperature
I	300 °C
II	500 °C
III	650 °C
IV	800 °C
V	900 °C

Cement Plant Part	Refractory Material
Preheater	Alkali Resistant Brick
Kiln Hood	High Strength Corndum-Mullite Castable
Calciner	Spalling Resistant High Alumina Brick
Tertiary Air Duct	Silica-Mullite Brick
Cooler	High Alumina Low Cement Castable