

## **PORTLAND CEMENT**

### **Definition of Cement**

*Portland cement* is the name given to a cement obtained by intimately mixing together calcareous and argillaceous, or other silica-, alumina-, and iron oxide-bearing materials, burning them at a clinkering temperature, and grinding the resulting clinker. And it is a material with adhesive and cohesive properties which make it capable of bonding minerals fragments into a compact whole.



Sample of Cement

For constructional purposes, the meaning of the term "cement" is restricted to the bonding materials used with stones, sand, bricks, building stones, etc. The cements of interest in the making of concrete have the property of setting and hardening under water by virtue of a chemical reaction with it and are, therefore, called hydraulic cement. The name "Portland cement" given originally due to the resemblance of the color and quality of the hardened cement to Portland stone – Portland Island in England.

## **Manufacture of Portland cement**

### **Raw materials**

- Calcareous material – such as limestone or chalk, as a source of lime (CaO).
- Clayey material – such as clay or shale (soft clayey stones), as a source of silica and alumina.

### **Methods of cement manufacturing**

1 - Wet process: grinding and mixing of the raw materials in the existence of water. Thus, the percentage of the moisture in the raw materials is high.

2 - Dry process: grinding and mixing of the raw materials in their dry state. Thus, the percentage of the moisture in the raw materials is low.

Dry process used in different cases, such as,

- Raw materials are so hard (solid) that they do not disintegrate.
- Cold countries, because the water might freeze in the mixture by water.
- Shortage of the water needed for mixing process.

They two methods can be described as follows:

### **Wet process**

**When limestone is used**, it has to be blasted, and then crushed, usually in two progressively smaller crushers (initial and secondary crushers), and then fed into a ball mill with the clay dispersed in water. The resultant slurry is pumped into storage tanks. The slurry is a liquid of creamy consistency, with water content of between 35 and 50%, and only a small fraction of material – about 2% - larger than a 90  $\mu\text{m}$ .

The slurry mix mechanically in the storage tanks, and the sedimentation of the suspended solids being prevented by bubbling by compressed air pumped from bottom of the tanks. The slurry analyze chemically to check the achievement of the required chemical composition, and if necessary changing the mix constituents to attain the required chemical composition. Finally, the slurry with the desired lime content passes into the rotary kiln. This is a large, refractory-lined steel cylinder, up to (3-8m) in diameter, and its length may vary anything from 30m to 200m, which lined with refractory materials, and slightly inclined to the horizontal. The slurry is fed in at the upper end while pulverized coal (oil or natural gas also might be used as a fuel) is blown in by an air blast

at the lower end of the kiln, where the temperature reaches about 1450°C. The slurry, in its movement down the kiln, encounters a progressively higher temperature. At first, the water is driven off and CO<sub>2</sub> is liberated; further on, the dry material undergoes a series of chemical reactions until. Finally, in the hottest part of the kiln, some 20 to 30% of the material becomes liquid, and lime, silica and alumina recombine. The mass then fuses into balls, 3 to 25 mm in diameter, known as clinker. The clinker is cooled and ground to fine powder with addition of about 3 to 5% of gypsum to produce Portland cement.



Clinker of Cement

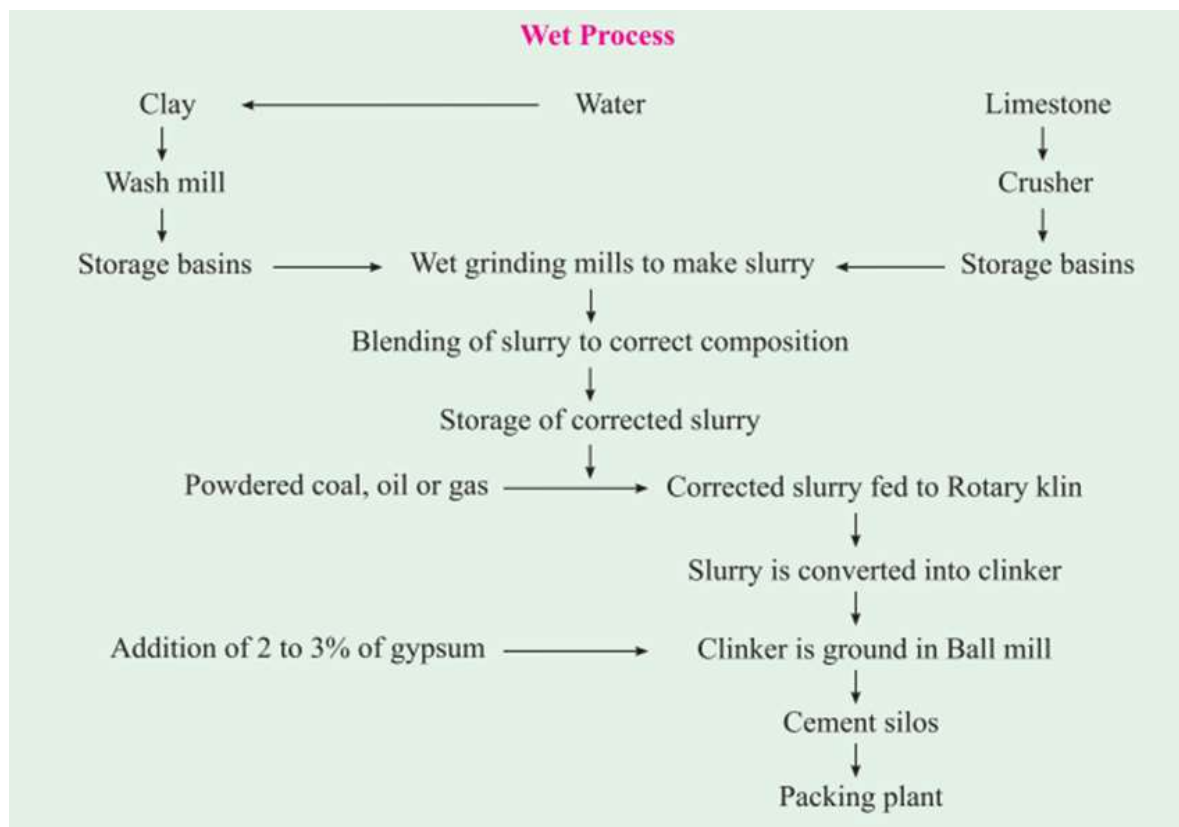


Diagram to Show Manufacture of Cement with Wet Process