

King Saud University Civil Engineering Department

Basics of Concrete Structures for Surveying Students (CE 363)

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Introduction

Concrete = Cement + Water + Aggregate
(FA+CA)

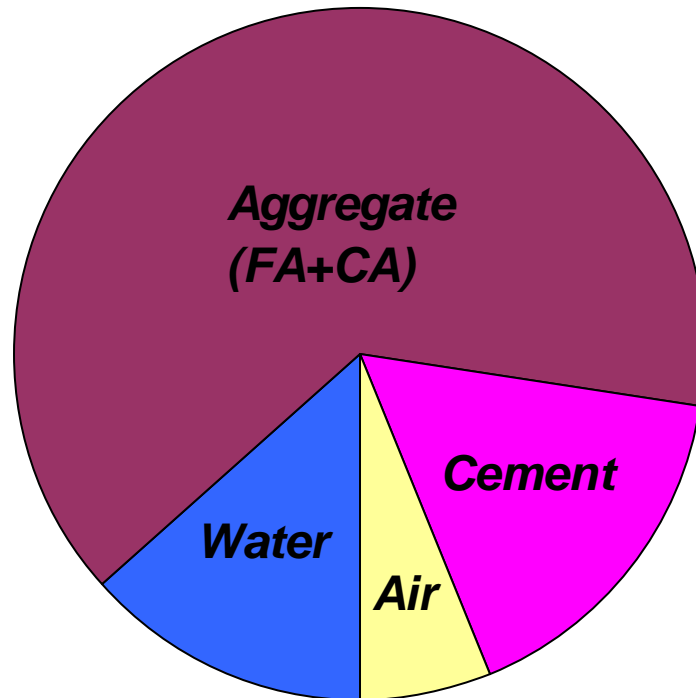
Mortar = Cement + Water + FA


Cement Paste = Cement + Water





Unit Volume of Concrete





Concrete is a widely used construction material because of :

- *Low cost of its Ingredients*
- *Availability of its Ingredients, (aggregate & cement).*
- *Its ease of construction (Molding, Mixing, ...etc.).*
- *Its good durability.*



Cement



Cement, in general, can be described as a material with adhesive and cohesive properties which make it capable of bonding mineral fragments into a compact whole.

→ Hydraulic cement: the cement that set in air as well as in water.



History of Portland Cement

*In 1824 Joseph Aspdin
(England), patented Portland
cement by calcining finely
ground limestone with finely
divided clay in a kiln, the
resulting cement was similar
to naturally occurring stone or
rock quarried at Portland,
England*



Manufacture of Portland Cement

Portland cement is essentially a calcium silicate cement, which is produced by firing to partial fusion, at a temperature of approximately 1500°C, a well-homogenized and finely ground mixture of calcareous materials (limestone or chalk) and an appropriate quantity of argillaceous materials (clay or shale), and grinding the resulting clinker (dark gray nodules or balls 3-25 mm in diameter), then add gypsum.



Manufacture of Portland Cement

1. Raw Materials

Cement is manufactured From:

limestone (or chalk) → CaCO_3

Clay or shale → Silica (SiO_2), Alumina (Al_2O_3), Iron Oxide (Fe_2O_3).



2. Crushing, Grinding, Blending in predetermined proportions.

Grinding and blending of the raw materials can be done either in water (wet process) or in dry condition (dry process)




3. Calcination

Burning in a large rotary kiln (6 m in diameter, 180 m in length, inclined slightly to horizontal, revolves $\frac{1}{2}$ - 2 revolution/min.) raw materials fuses into clinker at 1500°C.

Four major processes inside the rotary kiln:

- 1. Evaporation.*
- 2. Calcination.*
- 3. Clinkering.*
- 4. Cooling.*



4. Cooling of clinker, Grinding, and adding gypsum ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) to control setting time of cement (prevent flash set).

5. Storage in silos.

6. Testing for quality control.

7. Filling in bags 50 kg each.

8. To market.



Dry process

- ✓ *Mechanical grinding*
- ✓ *Perform adequate blending and avoid excessive loss of fines*