Cement

Arch 109

Building & Finish Material

TYPES OF PORTLAND CEMENT

There are many types of Portland cement such as following:

Ordinary Portland Cement

- Has a **medium rate of hardening**
- **Suitable for most type of work**
- Can be **attacked by acids & sulphates** present in soil / groundwater
- Sulphates also occur in clay bricks

Rapid – hardening Portland Cement

- Similar chemical composition as OPC but different proportion
- More finely grounded than OPC
- This causes to the increased rate of early hardening
- Setting & stiffening time for OPC similar to RHPC
- It just that for RHPC, **after the initial period the RHPC gains strength more rapidly**.
- Concrete made with RHPC develops in 7 days the same strength that it
- Takes 28 days to develop in concrete made with OPC.
- This high early strength is achieved by increasing the CS & CA content of
- The cement and finer grinding.
- RHPC produce heat earlier than OPC, so **can be used in cold weather**
- Stored & used in same way as OPC

White and Colored Cement

- Usually **used for decorative work**, pre-cast panels, coping, pavings
- White cement is made by **using china clay** in place of ordinary clay.
- This is to exclude impurities, especially iron & limestone
- Needed care during curing as it is easily soiled coz it's hard to clean
- Plastic sheeting is excellent for curing & protection.
- Coloured cements made by mixing pigments with Portland Cement.

Low Heat Portland Cement

- **Hardens & evolves heat slower than OPC** because the proportion of *Dicalcium Silicate (C2S) was increased while the proportion of Tricalcium Silicate (C3S) & Tricalcium Aluminate (CA) decreased.*
- It's **slow in development of strength.**
- The ultimate strength is the same.
- Useful for **dam & other mass concrete construction**.

Portland – Blast furnace Cement

- Made by grinding a mixture of OPC with selected granulated blast furnace slag.
- It has resistance to sulphate which can be found in……
- Hydrates slower than OPC so this cement evolves less heat and hardens slower than OPC.

Sulphate - Resisting Portland Cement

- Applied at place where there Is expensive exposure to Sulphates such as used in concrete below ground
- The proportion of SRPC higher content of Tetracalcium Aluminoferrite (C4AF) & reducing the Tricalcium aluminate (C3A) to a minimum.
- SRPC has darker colour than OPC
- Chemical constituents are different in proportions
- Not resistant to acids same as OPC
- Produces a little less heat than the other Portland cement & this can be an advantage in mass pours, deeps basements & foundation.

Masonry Cement

- Consists of Portland cement with a fine inert admixture & air-entraining agent as a substitute for lime.
- So it gives cement a consistent workability for use in mortars for brickwork & block work.
- Mustn't be used for concrete.

High Alumina Cement

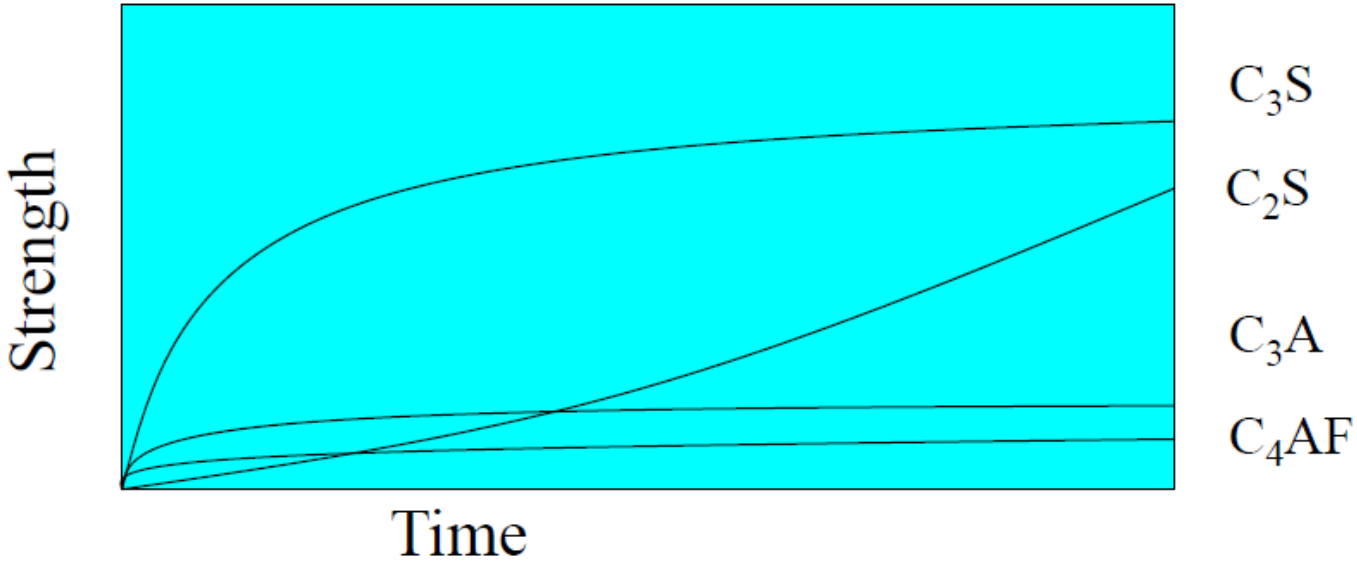
- Darker than OPC
- Stiffens at about the same rate as OPC
- Contamination with Portland cement causes a "flash set" so all mixers, shovels & barrow must be carefully cleaned to remove any traces of ordinary cement.
- Stored separately in clearly marked position
- Admixtures shouldn't be used
- Rapid gain in strength is useful for in roof repairs of shops by providing a working surface in a few hours.
- Also used in high temperature applications
- Prohibited from being used for structural purposes.

Properties of Cement

a) Chemical Composition

The major substituents of cements are:

- C3S – quick reaction
- C2S – slow reaction
- C3A - very quick reaction
- C4AF - not very important



b) Fineness

- ❑ Fineness of cement is a measure of the sizes particles of cement.
- ❑ It is expressed in terms of specific surface of cement.
- ❑ Most important factor that will determines the properties of cement
- ❑ Process of Hydration

• Since hydration starts at the surface of the cement particles it is the total surface area of cement that represents the material available for hydration

•The finer the cement is ground, the greater will be its specific surface.

•So the rate of hydration depends on the fineness of cement particles & for rapid development of strength higher fineness necessary.

•Fineness cement leads to a stronger reaction with alkali reaction aggregate & makes a paste though not necessarily concrete, exhibiting a higher shrinkage & a creates proneness to cracking.

•However, fine cement bleed less than a coarse one.

•The fineness is the most important factor which determines the properties of cement:

•Finer grinding increases the speed with which the various constituents reacts with the water

•Fineness of grinding is of some importance in relation on the workability of concrete mixes.

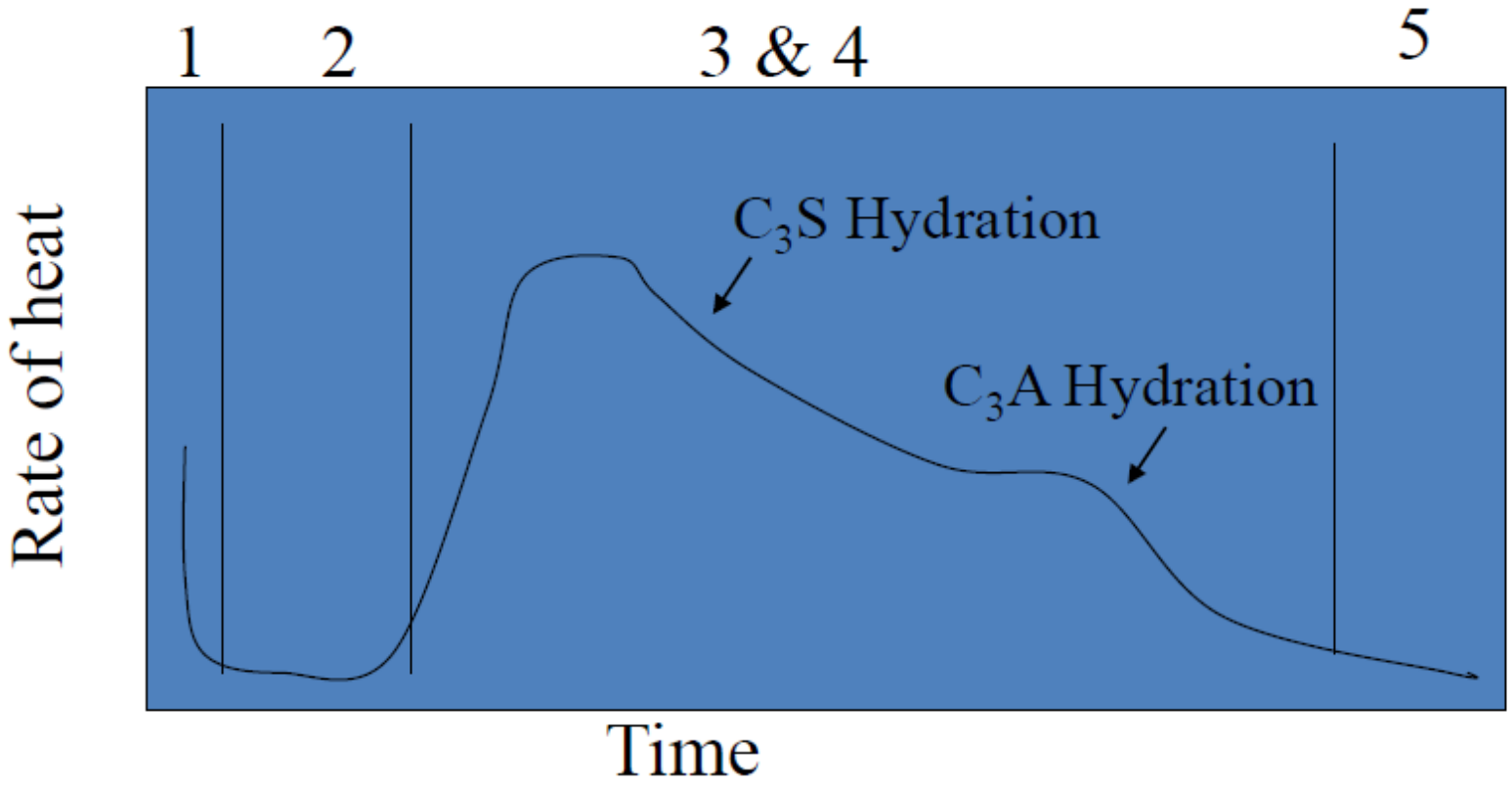
•Greater fineness increases the cohesiveness of a concrete mix

•Finer grinding reduces the chances of bleeding of concrete

•In some special type of cement the strength increases slowly than normal though they are finely grounded.

c) Hydration of cement

- Heat is liberated as cement sets and hardened by reacting with water.
- The rate of heat evolution as well as total heat depends on the composition of cement.
- The rate of hydration & the heat evolved increases with the fineness of cement but the total amount of heat liberated in unaffected by fineness.



d) Setting time

- ❑ The time from the addition of water to the initial & final setting stage.
- ❑ Also refers to time of changes of the cement paste from a liquid to a rigid stage.
- ❑ The setting process is accompanied by the temperature changes, hydration resolves in the formation of the gel around each parties of cement.
- ❑ The means of controlling the rate at which cement stiffened by intergrading a measured quantities of gypsum

Initial Setting

· Defined as the beginning of the noticeable stiffening in the cement paste.

- It's corresponds to a rapid rise in temperature.
- Normally takes about 45 – 175 minutes.

Final Setting Time

- Refers to completion of setting, which corresponds to the peak temperature in the cement paste.
- The stiffening of cement paste increases as the volume of the gel increases and the stage at which this is complete, the final hardening process begins.
- Normally takes between 3 hours to 10 hours for this to happen.

Hardening

- Referred to the gained of the strength of the cement paste.
- During the setting time the cement gained very little strength

Class 1: https://drive.google.com/file/d/1WUouE8FKanIc77uiiUWR02sziOG91RiT/view?usp=sharing
Class 2: https://drive.google.com/file/d/1ghx5KmEBMz3kQPhDdaEwniIdrTQM_wo5/view?usp=sharing

Thank you.