Concrete Technology

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Section: A

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HAYATABAD, PESHAWAR

1. **Which step is taken to prevent flash setting of cement? Also, write steps to prevent false setting of concrete. (4 marks, CLO1)**

Ans: Flash Setting

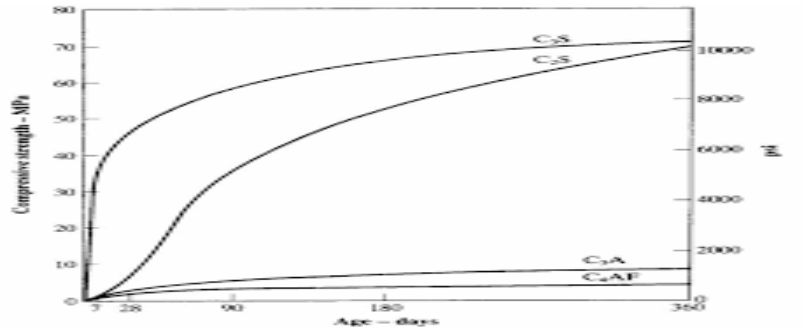
- The immediate stiffening of cement paste in a few minutes after mixing with water.It is a accompanied by large amount of heat generation upon reaction of C3A with water.
- Gypsum is placed in cement to prevent flash-setting.The rigidity can not be overcome and plasticity may not be regained without adition of water.
- Amount of gypsum must be such that it will be used upto almost hardening because expansion caused by ettringite can be distributed to the paste before hardening.More gypsum will cause undesirable expansion after hardening.

False Setting

- A phenomenon of abnormal premature stiffening (hardening) of cement within a few minutes of mixing with water,is turned has false setting.It defers from flash setting in that no appreciable heat is evolved,and remixing the cement paste without addition of water restores plasticity of the paste until it sets in the normal manner and without a loss of strength.
- Some of the cause of false stting are to be found in the dehydration of gypsum when interground with too hot a clinker.
- False setting can be due to the activation of C3S by aeration at moderately high humadities.Water is adsorbed on the grains of cement and these freshly activated surface can be combined very rapidly with more water during mixing; this rapid hyderation would produce false setting.

2. **Draw a graph showing the strength development of pure compounds of cement. (3 marks, CLO1)**

Ans:



3. **Why Type III cement is Rapid Hardening and Type IV Low Heat producing? Draw a graph showing the development of heat of hydration of different cement types. (3 Marks, CLO1)**

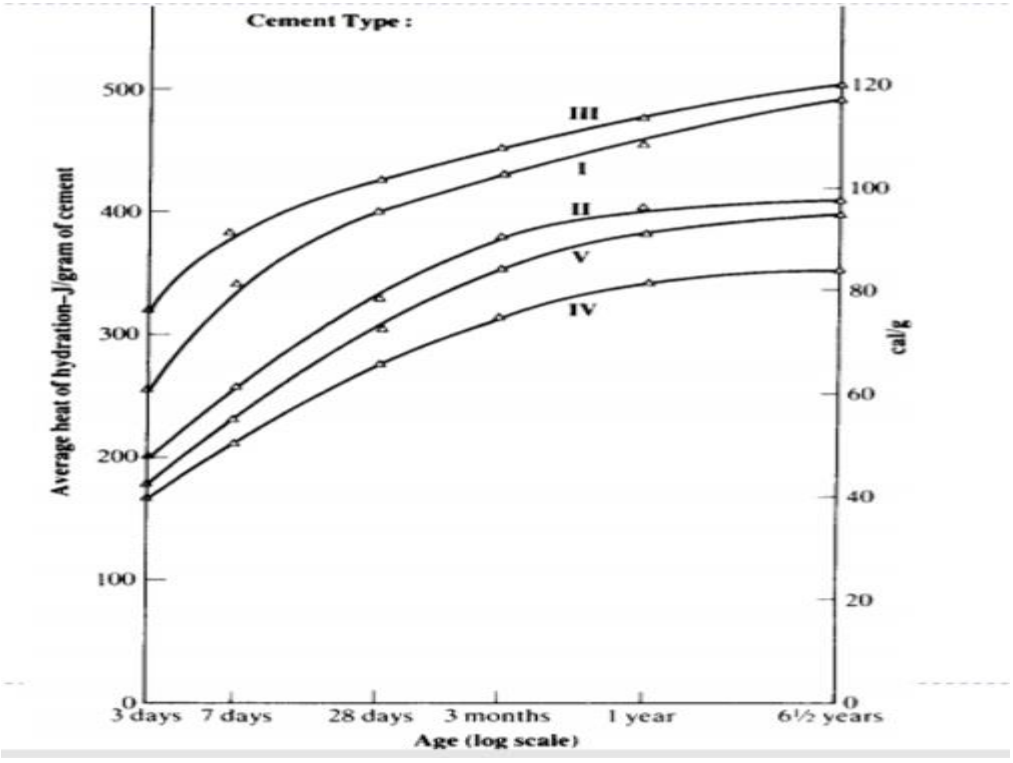
Ans: Type III cement

Type III cement is classified has a rapid hardening cement, it is finer than Type I and has a higher C3S content and Sulphite level. It also gains "28 day: Strength in 7 days. Useful where the formwork must be quickly stripped or areas that allow traffic early on the road surfaces.

Type IV cement

Type IV cement is used where the rate and amount of heat generated from hydration must be minimized. It develops strength at a slower rate than other cement types. Type IV cement is intended for using massive concrete structures, such as large gravity dams, where the temperature rise resulting from heat generated during hardening must be minimized.

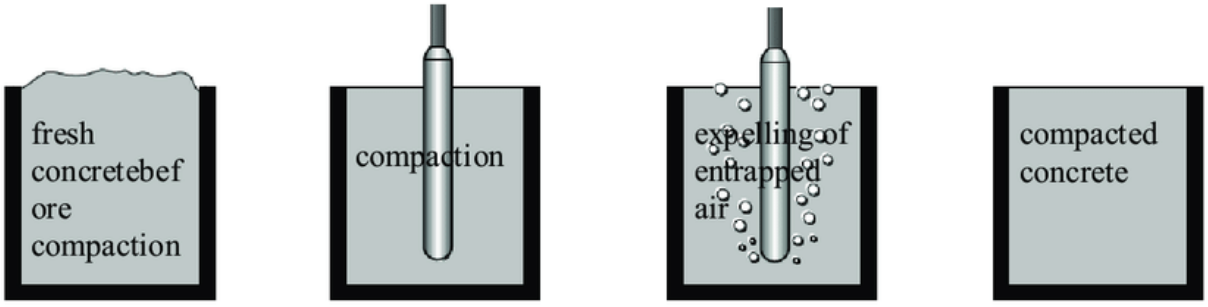
Draw a graph showing the development of heat of hydration of different cement types



4. **What is the effect of compaction on entrapped air of concrete? What will be the effect on strength if concrete is not compacted sufficiently? Explain with graph. (3 marks, CLO1)**

Ans: Compaction On Entrapped Air of Concrete

Compaction is the process which expels entrapped air from freshly placed concrete and packs the aggregate particles together so as to increase the density of concrete. It increases significantly the ultimate strength of concrete and enhances the bond with reinforcement.



Effect On Strength If Concrete Is Not Compacted Sufficiently

Compaction of concrete is an important component in the process of laying a concrete slab. If compaction is not carried out as required, a series of defects may become apparent and the concrete slab will suffer from significant loss of strength.

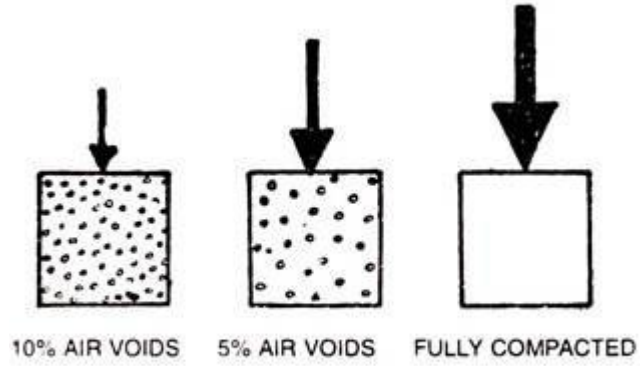


Fig. 11.1. Effect of amount of compaction on strength and density of concrete

5. **Why is the percentage of gypsum added to cement limited only to 5%? (2 marks, CLO1)**

Ans: Gypsum is a mineral and is hydrated calcium sulfate in chemical form. Gypsum plays a very important role in controlling the rate of hardening of the cement. During the cement manufacturing process, upon the cooling of clinker, a small amount of gypsum is introduced during the final grinding process.Gypsum is added to control the "setting of cement". If not added, the cement will set immediately after mixing of water leaving no time for concrete placing. Gypsum, 2 to 3% is added to cement in powdered form to slow down the setting of cement. % of gypsum to be added depends on properties of cement required, it is added up to 5%.

6. **What is the effect of following on the bond strength of concrete? (Use not more than 2 sentences to answer each part) (4 marks, CLO1)**
   - **I. Shape of aggregate**
   - **II. Size of aggregate**
   - **III. Texture of aggregate**
   - **IV. Bleeding**

Ans: Factors Affecting Strength of Concrete. Concrete strength is affected by many factors, such as quality of raw materials, water/cement ratio, coarse/fine aggregate ratio, age of concrete, compaction of concrete, temperature, relative humidity and curing of concrete.

I. Shape Of Aggregate

Angular aggregates assure high compressive strength in concrete because of the interlocking between the angular aggregates due to their higher specific surface area.

II. Size Of Aggregate

With increase in maximum aggregate size used in concrete, the compressive strength and splitting tensile strength decrease. When higher maximum aggregate size of coarse aggregates values are used in concrete, there is no variation in bond strength but it reduces when maximum aggregate size of less than 10mm is used.

III. Texture Of Aggregate

The surface texture of aggregate can be either smooth or rough. A smooth surface can improve workability, yet a rougher surface generates a stronger bond between the paste and the aggregate creating a higher strength.

IV. Bleeding

Bleeding in fresh concrete refers to the process where free water in the mix is pushed upward to the surface due to the settlement of heavier solid particles such as cement and water.

7. What is the effect if following on workability of concrete? (4 Marks, CLO1)

I. Porosity and absorption

II. Air entraining agent

III. Coarse aggregate to fine aggregate ratio

IV. Grading of aggregate

Ans: Workability is a property of raw or fresh concrete mixture. In simple words, workability means the ease of placement and workable concrete means the concrete which can be placed and can be compacted easily without any segregation.The desired workability is not same for all types of concrete.

I. Porosity and absorption

Compressive/tensile strength ratio decreases with increase porosity. The compressive, flexural and splitting tensile strength of cement mortar has been measured and inter- preted in terms of its porosity.

II. Air Entraining Agent

Air entrainment affects compressive strength of concrete and its workability. It increases the workability of concrete without much increase in water-cement ratio.In this case, air entraining admixture is added to increase workability without adding water.

III. Coarse Aggregate To Fine Aggregate Ratio

Fine aggregates, because of its cohesiveness and high surface area, along with its gradation characteristics plays a crucial role in concrete's workability.However, particles smaller than 300µ tend to increase concrete's workability by acting as a ball bearing. This effect has been incorporated into 'surface index'.

IV. Grading Of Aggregate

Grading of aggregates have the maximum effect on the workability of concrete.With less volume of voids, the aggregate particles slide past each other and less compacting effort is required for proper consolidation of aggregates. Thus low water cement ratio is sufficient for properly graded aggregates.

8. What is the effect of fineness of cement on the following? (Use not more than 2 sentences to answer each part) (4 marks, CLO1)

I. Strength of concrete

II. Rate of heat evolution during hydration

III. Total heat of hydration

IV. Workability of concrete

Ans: Increasing fineness causes an increased rate of hydration, high strength, and high heat generation. Bleeding can be reduced by increasing fineness. However, increased fineness can also lead to the requirement of more water for workability, resulting in a higher possibility of dry shrinkage.

I. Strength Of Concrete

The 28-day compressive strength of concrete, with or without entrained air, increases with an increase in cement fineness.The fineness of cement influences the drying shrinkage of concrete. When the water content is increased because of fineness, the drying shrinkage is increased.

II. Rate Of Heat Evolution During Hydration

Partially replacing cement with fly ash, of different fineness, decreased the cumulative heat evolution; the reduction in heat evolved increased with an increase in fly ash content. However, the finer grade fly ash generated more heat of hydration compared to the coarser grade fly ash.

III. Total Heat Of Hydration

The size of cement particles directly affects the hydration, setting and hardening, strength and heat of hydration. The finer the cement particles are, the larger the total surface area is and the bigger the area contacting with water is.

IV. Workability Of Concrete

The workability of non air-entrained concrete is increased by increasing the cement fineness. In air-entrained concrete the effect of fineness of cement on workability is very much less pronounced.The 28-day compressive strength of concrete, with or without entrained air, increases with an increase in cement fineness.

9. What steps can be taken during transportation and placement of concrete to prevent segregation of concrete? (3 marks, CLO1)

Ans: Prevention of Segregation in Concrete

- Always use concrete which is predesigned with optimum quantity of water i.e. not too wet nor too dry.
- Weight the ingredients of concrete properly before you mix them. They should be in proportion according to the concrete mix design. The proportioned of concrete ingredients can be decided by carrying out weigh or volumetric batching of concrete .
- Make sure the concrete is properly mixed. It is important that the concrete is mixed at the correct speed in a transit mixer for at least two minutes immediately prior to discharge.
- If you buy ready mix concrete, choose the supplier in such a way that the transportation of concrete should be done via shortest route. Before you order ready mix concrete.
- Place the concrete in its final position as soon as possible. Never pourconcrete fromhigher heights. Remember that the distance between the mixing and pouring place is minimum.
- Use the vibrator correctly and never use the vibrator to spread a heap of concrete over a large area. i.e. Do not allow concrete to flow.
- If any segregation is observed in concrete, remixing should be done to make it homogeneous again.