

UNIT-1: CEMENT

QUESTION1. 1. Explain the procedure to determine fineness of cement by dry sieving method. (Win-23, Marks-4)

ANS: Determination of fineness of cement by method of sieving:

1. Take 100 gm of cement sample as W1 gm.
2. Put it on 90 micron IS Sieve with lid and pan at top and bottom respectively.
3. Shake the sieve manually for 10 – 15 minutes for complete sieving.
4. Take the weight of cement retained on sieve as W2 gm.
5. Calculate % fineness of given cement as $(W2/W1) \times 100$.

QUESTION 2. What are the field tests on cement.

ANS: Four field test on cement.

- 1) The colour of fresh cement should be greenish grey.
- 2) The hand in cement bag should give cool feeling.
- 3) A pinch of cement should give smooth feeling to fingers.
- 4) The handful cement should float on water for some time before its dipping. The sharp edged cake under water should remain sharp edged even after 24 hrs.
- 5) The color of cement should not be changed after burning.
- 6) The cement should not contain visible lumps in it.
- 7) The cement roll should give shiny surface after cutting with knife.

QUESTION 3. State three different grades of cement and where it is used.

(Win-2023, Marks-2,Sum-2016 ,Marks-4)

ANS: Grades of cement – 33, 43 and 53 grades.

1. **33 grade cement** – i. Plastering work by producing cement mortar.
ii. Masonry work of brick, block or stone materials.

2. 43 grade cement –

- i. Pre – cast and prestressed concrete. ii. Ready mix concrete.
- iii. PCC and RCC work of buildings and bridges.

3. 53 grade cement –

- i. Precast concrete sleepers for railways. ii. Industrial building, roads and runways.
- iii. Pre-stressed girders and RCC bridges. iv. RCC long span bridges and lofty buildings.

QUESTION 4. Explain the process of hydration of cement. (Sum-23, Marks-2)

ANS: **Hydration:** It is an exothermic chemical reaction which takes place due to addition of cement and water giving cement paste and heat evolved about 120 cal/gm of cement.

Hardening of cement: It is the process of gaining strength to cement due to its hydration.

QUESTION 5. Explain the procedure to determine Consistency of cement.

(Win-22, Marks-4)

ANS: Procedure of standard consistency test on cement:

1. Take 400 gm cement sample and add 20% water by weight to prepare cement paste within gauge time.
2. Fill this cement paste in Vicat's mould completely, having height 40 mm.
3. Now, attach the plunger of 10 mm dia. to Vicat's apparatus and take the initial reading 'd1' mm by keeping the plunger touching to top surface of cement.
4. Allow the penetration of plunger in cement paste by releasing dash-pot. Take the final reading on graduated scale as 'd2' mm.
5. Calculate total penetration of plunger as (d1 – d2) mm. if it is not 33-35 mm, then repeat all above steps by increasing water % in cement.
6. Note down the % water, which gives exact 33-35 mm penetration from top of mould. This water % should be taken as standard consistency of cement.

QUESTION 6. Define initial and final setting time of cement. (Sum-23, Marks-2)

ANS: **i) Initial Setting Time:** It is the time elapsed from mixing of cement and water up to when IST needle penetrates up to 33-35mm from top of Vicat's mould, is called as Initial Setting Time.

ii) Final Setting Time: It is the time elapsed from mixing of cement and water up to when FST needle gives just impression on cement paste in Vicat's mould, is called as Final Setting Time.

QUESTION 7. Enlist four Bogues compounds with their formula. (Win-22, Marks-2)

Sr. No.	Name of compound	Formula
1	Tricalcium Silicate (C ₃ S)	3 CaO SiO ₂
2	Dicalcium Silicate (C ₂ S)	2 CaO SiO ₂
3	Tricalcium Aluminate (C ₃ A)	3 CaO Al ₂ O ₃
4	Tetracalcium Aluminoferrite (C ₄ AF)	4 CaO Al ₂ O ₃ Fe ₂ O ₃

Bogue's compound and their effect on cement properties-

1. Tri-calcium Silicate – It gives early strength to cement by producing more heat of hydration.
2. Di-calcium Silicate- It gives ultimate strength to cement by generating comparatively lesser heat.
3. Tri-Calcium aluminate – It varies setting time of cement.
4. Tri-Calcium Alumino-ferrite – It is chemically inactive and does not contribute compressive strength and setting time of cement.

QUESTION 8. Explain the procedure for determination of compressive strength of cement. (Win-19, Marks-4)

Ans: Procedure for determination of compressive strength of cement in laboratory:

1. Take 200 gm cement, 600 gm standard sand and add water $((p/4)+3)$ % to that of combined weight of cement and sand. Prepare homogenous mortar.
2. Fill the prepared mortar in the cube mould of size 7.07 cm side by proper compaction. Compact the filled mould on vibrating machine for 3-5 minutes.
3. Keep filled moulds at room temperature for 24 hours and 90% humidity for initial hardening.
4. Remove cube moulds and keep cement cubes under fresh water for curing for 7, 14, 21, 28 days.
5. Remove cube from water after curing period and keep it under compression testing machine (CTM) for testing.
6. Apply compressive load at a rate of 35 N/mm² till failure of cube.

7. Note down the failure load in kN shown by red pointer of dial gauge.
8. Calculate compressive strength of cement cube by dividing failure load in N to cross sectional area of cube in mm².
9. Calculate average compressive strength of three test cubes in N/mm².

QUESTION 9 Laboratory method to find initial and final setting time of cement-

Ans: 1. Take 400 gm. of cement sample and add 0.85 times water required for its standard consistency to prepare homogenous cement paste.

2. Note down the time at which water is added to cement as T1 min.
3. Fill this cement paste in vicat's mould. Keep this mould under vicat's app. With IST needle attached to it.
4. Now allow the IST needle to penetrate in the paste by realize pin observe the total penetration. If the penetration is not 33 to 35 mm then change the position of penetration surface.
5. Note down the time at which IST needle will give required penetration as T2 min. Hence calculate the initial setting time i.e. $IST = T2 - T1$ min.
6. Replace IST needle with FST needle and allow FST needle to penetrate in same cement paste.
7. Note down the time at which FST needle will give the Just impression on a cement surface as T3 min.
8. Calculate final setting time i.e. $FST = T3 - T1$ min.

QUESTION 10 State the situations where white cement is used. Why white cement is costly as Compared to O.P.C. (Win-17, Marks-4)

Ans: 1. White cement can be used as a base for color cement.

2. The whiteness of white cement should not be less than 70% as measured by ISI.
3. The minimum compressive strength of white cement as per IS 8042:1989 is 29.7Mpa after 28 Days.
4. The minimum degree of fineness of white cement as per Blain air permeability apparatus is 225m²/Kg.

Uses: - 1. For manufacturing various colored cement white cement is used as a base.

2. It is used in filling joint between tiles.

QUESTION 11 Compare setting and hardening of cement. (Sum-23, Marks-4)

Setting of cement	Hardening of cement
1-setting is the stiffening of cement	1-Hardening is the development of measurable strength of cement.
2- Setting of cement does not require curing	2- Hardening of cement require curing
3- Setting of cement require less time compared to hardening.	3- Hardening of cement require more time compared to hardening.
4- setting of cement starts immediately after its initial setting time	4- Hardening of cement starts after its final setting time
5-setting gives onsite sufficient hardening to facilitate the removal of parts of formwork.	5-Hardening gives complete strength to facilitate finishing.

QUESTION 12 State precautions to be taken while storing the cement at site.

(sum-17, Marks-4)

Ans Precautions to be taken while storing the cement are:

1. Bags should not be stacked more than 8-10 bags vertically.
2. Stacking should be lengthwise and widthwise alternatively.
3. Stacking should be 300 mm away from walls with 1 m gap between two rows for easy handling.
4. Stacking should be on wooden planks 300 mm above ground floor to avoid dampness.
5. Exhaust fans and windows should be provided for ventilation.
6. Building should be with 150 mm concrete floor and 9" brick walls.

QUESTION 13 Name any four types of cement and state their uses.

Ans: Types of cement and their uses-

1. Ordinary Portland cement(OPC)

- i. Ordinary PCC and RCC construction work
- ii. Plastering and water proofing works
- iii. Drainage works

2. Rapid Hardening cement (RHC)

- i. Road construction where delay in traffic is not required
- ii. Tremie method of concreting in underwater construction works
- iii. Manufacturing of concrete products like fencing pole, electric pole, doors and windows frames

iv. Cold weather concreting.

3. Low heat cement (LHC)

i. Mass concreting works like construction of abutment, retaining wall bridge, dam etc.

ii. construction of chimney of factory

iii. construction of machine foundations

4. Portland pozzalana cement-

i. All construction works where OPC is used i.e. PCC and RCC.

ii. Construction of hydraulic structure

iii. Mass concreting work

5. Sulphate resisting cement-

i. Construction of foundation on soil and water containing high % of SO₄.

ii. Marine and seashore construction

iii. Underground laying of RCC pipes in acidic soils.

6. Blast furnace slag cement (BFSC) –

i. All construction works where OPC is used. ii. Mass concreting iii. Marine works

7. White Cement (WC) –

i. Decoration Works i.e. False ceiling ii. Finishing works i.e. internal plastering

iii. Waterproofing works

QUESTION 14 Which type of cement is required for:

a) Marine Structure b) Chimney of a factory

c) Canal Lining d) Dam construction

Ans: Type of cement required for-

a. Marine structure- Sulphate Resisting Cement

b. Chimney of a factory - low heat cement

c. Canal lining- Portland pozzolana cement

d. Dam construction- Blast furnace slag cement.

QUESTION 15 Compare the properties of rapid hardening cement and low heat cement.

Sr. No.	Property	RHC	LHC
1.	Fineness	Maximum 10% or 3250 cm ² /gm	Maximum 10% or 3000 cm ² /gm
2.	Soundness	Maximum 10 mm for aerated cement	Maximum 10 mm for aerated cement
3.	Setting time	IST = 20 mins (minimum) FST = 600 mins (maximum)	IST = 30 mins (minimum) FST = 600 mins (maximum)
4.	Compressive strength	3 days = 210 kg/cm ² (Ordinary sand) 3 days = 275 kg/cm ² (Standard sand)	3 days = 70 kg/cm ² (Ordinary sand) 3 days = 100 kg/cm ² (Standard sand)