

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI (PILANI CAMPUS)
FIRST SEMESTER 2016 – 2017

Course: CE G562 Advanced Concrete Technology
Component: Mid Semester Exam (Closed Book)

Date: 08-10-2016 (4:00 - 5:30 AN)
Max. Marks: 68

Name:

ID No :.....

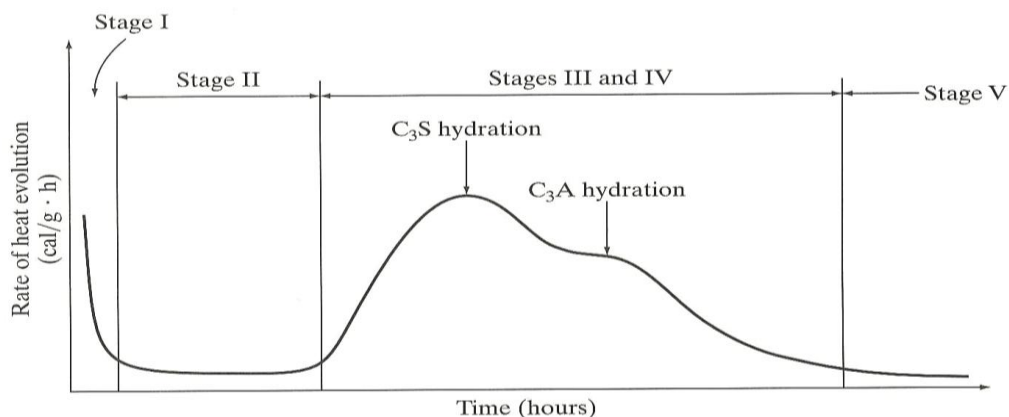
Part A (Answer in the question paper)

[Marks: 33]

1. A concrete structure is located 800m from sea shore. What is the major deteriorating agent which affects durability of the concrete structure **air prone chlorides**.....(1)
2. In quick setting cement, quick setting property is brought out by reducing **Gypsum**..... content (1)
3. Low heat cement is achieved by increasing **C₂S**..... content (1)
4. In IS 10262-2009, Table 2 consists of water content details based on maximum size of aggregate. Moreover, listed water content is based on the slump value of **25-50** mm (1)
5. 500 g cement was used to find consistency of cement. After the test, consistency was found as 32%. What is ratio of quantity of water is used for setting time test to quantity of water used for soundness test **1.089**..... (2)
6. In cement setting time test, a selected test point on top surface of prepared cement paste shall be away from **10 mm**.....mm from the mould (1)
7. Match the followings (3.5)

a) Fly ash	----- d ----- SP is must
b) Slag	----- b ----- Cementitious and Pozzolanitic
c) Celite	----- g ----- 20%
d) Silica fume	----- f ----- Sustainability
e) Metakaolin	----- c ----- Setting
f) SCM	----- a ----- Workability enhancement
g) Belite	----- e ----- Production cost
8. Aluminates influence on **setting**..... process whereas Silicates influences on **hardening**..... process during hydration of ordinary Portland cement. (2)
9. Which hydrated product has high water absorption capacity **Ettringite**..... (1)
10. Write chemical formula of set regulator **CaSO₄ 2H₂O**..... (1)
11. Average particle size of cement and fly ash are..... **15**..... μm and **20**..... μm respectively (2)

12. Three types of water highlighted in C-S-H model are**Interlayer water**.....,**adsorbed water**..... and**Capillary water**..... (1.5)
13.SNF..... interacts with C_3A in competition with sulphate ions (Gypsum). This results in retardation of C_3A hydration and leads to loss on fluidity in the paste. (1)
14. Porosity influences on**Strength**..... of concrete whereas permeability influences on ...**Durability**.....of concrete. (2)
15. Extra rapid hardening cement, is manufactured by inter grinding rapid hardening clinkers with $CaCl_2$. It is widely used for**Plain cement (without reinforcement)**..... concrete (1)
16. In cement hydration process, generally the increase in strength during a period of 14 days to 28 days is primarily due to hydration of **C_2S** (1)
17. When moisture content is greater than**15**..... % then wet blending is used in cement production. (1)
18. In UPV test, pulse velocity is 2 km/sec then quality of concrete is**Poor**..... (1)
19. In soundness test of cement as per IS standard, expansion shall not be more than ...**10 mm**.....(1)
20. Production of 1 kg of cement releases**1000**..... grams of CO_2 to the atmosphere (1)
21. In fly ash microstructure, large hollow spheres with solid spheres inside them is called..**plerospheres**... (1)
22. If you test roof concrete of your hostel room, then which mode of UPV test to be adopted....**Indirect**.. (1)
23. Excess sugar content in the lignosulphonate can be removed by...**fermentation**..... (1)
24. In mass concreting work (similar to dam construction), low heat cement or PPC is used to reduce heat of hydration. If you want to reduce heat of hydration further, then simple practical method is**Crushed ice**..... (1)
25. Draw: Rate of heat evolution curve for hydration process of cement (2)



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Part B

[10×2=20]

1. What are two major effects of slow cooling process after burning raw material in rotary kiln?
 - molten phase (containing C3A and C4AF) gets transformed to a glass;
 - if cooling is slow, C3A crystallizes out (causes setting problems)
 - alite converts to belite and free lime

2. What is the influence of ITZ on durability of concrete?
 - CH deposit – Large hexagonal crystals make more porous
 - Less C-S-H
 - CH is chemically attacked by external agents

3. Rate of heat of hydration and total heat of hydration. Which is important? State reason.
4. Explain: Mechanism of carbonation induced corrosion
5. CH is formed during hydration process of Alite and Belite. Additionally, initial CH formation is also observed in the starting time of reaction between cement and water. Justify CH formation in the starting time of hydration before C₃S and C₂S hydration.

More than 60 % of cement is CaO.
Therefore hydration leads to CH formation

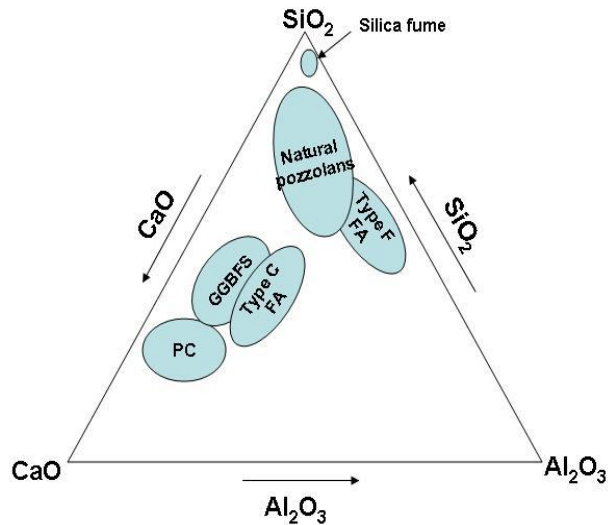
6. Fly ash was used as SCM in concrete. To evaluate reactivity of fly ash, mortar specimens were cast as per standard. Average compressive strength of fly ash blended mortar specimens (20 % level of replacement) was found as 48 MPa. Average compressive strength of cement mortar specimen (control specimens) was 54 MPa. Therefore, PAI of fly ash is.....89%.....

7. What is main difference in the failure pattern of normal strength concrete and high strength concrete under compressive load?
 - Failure through ITZ
 - Failure through aggregate
 - Highly brittle in case of high strength concrete

8. List different non-destructive tests (any eight)
 - Rebound hammer
 - UPV
 - Infrared Thermography
 - Profometer
 - Tomography
 - Hall cell potential

- GPR
- Wenner 4 probe resistivity meter

9. Draw pozzolanic material C-S-A ternary diagram



10. Metakaolin is prepared by burning of kaolinite at 1200°C. Comment on pozzolanic activity index of metakaolin.

Metakaolin is generally obtained from calcination of kaolinite clay in the range of 740 – 840 °C. The crystalline clay loses its structure at this temperature by the loss of bound water. Burning should strictly be done in this range, since beyond 1000 °C, recrystallization of the clay occurs. Therefore less reactivity and reduction in PAI

Part C

[15]

1. Explain the followings

- a) Write major changes in the kiln reaction after 1000 °C inside kiln with a sketch? (3)
- b) Short note on: Dry process, wet process and dry process with pre-calciner. (3)
- c) Draw and mark different components of C-S-H gel model. (2)
- d) Write about structure of cement clinker (Optical microscopic structure). (2)

- Initial compound formation
- 900 – 1200 °C: Belite (C₂S) formation
- 1250 °C (more particularly, > 1300 °C): liquid phase appears and promotes the reaction between belite and free lime to form alite (C₃S)

1. Wet method

2. Dry method

Wet process – More uniform mixing (outdated)

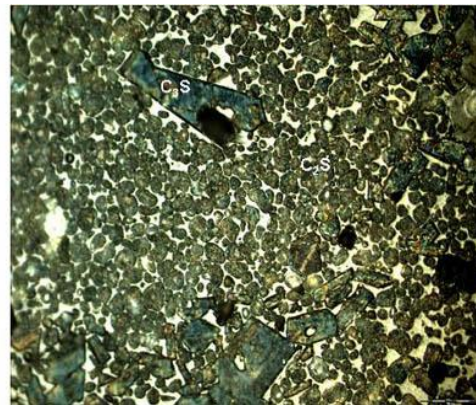
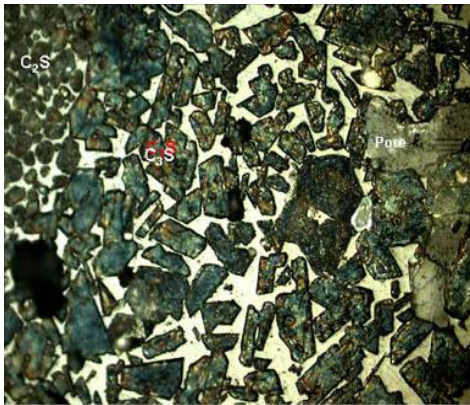
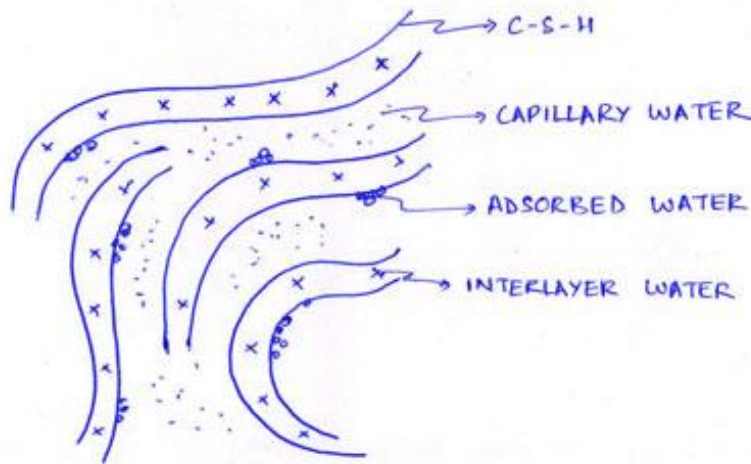
Dry process – Effective power consumption

Highly preferred

Modern plants adopt with preheater

Depends on moisture content of raw materials

- MC is $> 15\%$
wet blending (in slurry form)
- MC $< 8\%$
Dry blending
- For $8\% < MC < 15\%$,
Dry blending with precalciners



2. In Mumbai, a concrete bridge is designed to connect sea shore and a nearest island inside marine water. Concrete is prepared in the sea shore and transported long haul using pump. What are important recommendations suggested by you in the concrete used for this bridge construction. (5)

Slag cement

No sulphate resisting cement

Low w/c

Admixture : SNF due to hot climate

SP due to Low w/c

Pumping: aggregate reduction

Corrosion inhibitor

VMA