



SNS COLLEGE OF TECHNOLOGY

Vazhiampalayam, Coimbatore-35

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DEPARTMENT OF CHEMISTRY

**COURSE NAME : 23CHT102- CHEMISTRY OF ENGINEERING
MATERIALS**

I YEAR / I SEMESTER

UNIT : 5. ALLOYS AND ENGINEERING MATERIALS

TOPIC : 1. PORTLAND CEMENT



What do you understand from these images?



- ❖ Structural deficiency due to construction defects.
- ❖ Damage due to fire, floods, earthquakes, cyclones etc.
- ❖ Damage due to chemical attack.
- ❖ Damage due to marine environments.
- ❖ Damage due to abrasion of granular materials.
- ❖ Movement of concrete due to physical characteristics.



How will you improve the quality of cement





Why concrete gets affected ?



- ❖ **Chemical attack** can occur because **concrete** is alkaline and chemically reactive.
- ❖ It can be **attacked** by acids; some alkalis; numerous salt solutions; and organics such as fermenting liquids, sugars, and animal oils, especially if they contain free acids. Seawater will **attack concrete**.





Cement:

Cement is the mixture of calcareous, siliceous, argillaceous and other substances. Cement is used as a binding material in mortar, concrete, etc.

Chemical Composition of Cement

Oxide	Percent content
CaO (Lime)	60-67%
SiO₂ (Silica)	17-25%
Al₂O₃ (Alumina)	5-8%
Fe₂O₃ (Iron oxide)	0.5-6%
MgO (Magnesia)	0.1-4%
Alkalies (K₂O, Na₂O)	0.2-1.0%
SO₃ (Sulphur trioxide)	1-3%



TYPES OF CEMENT:

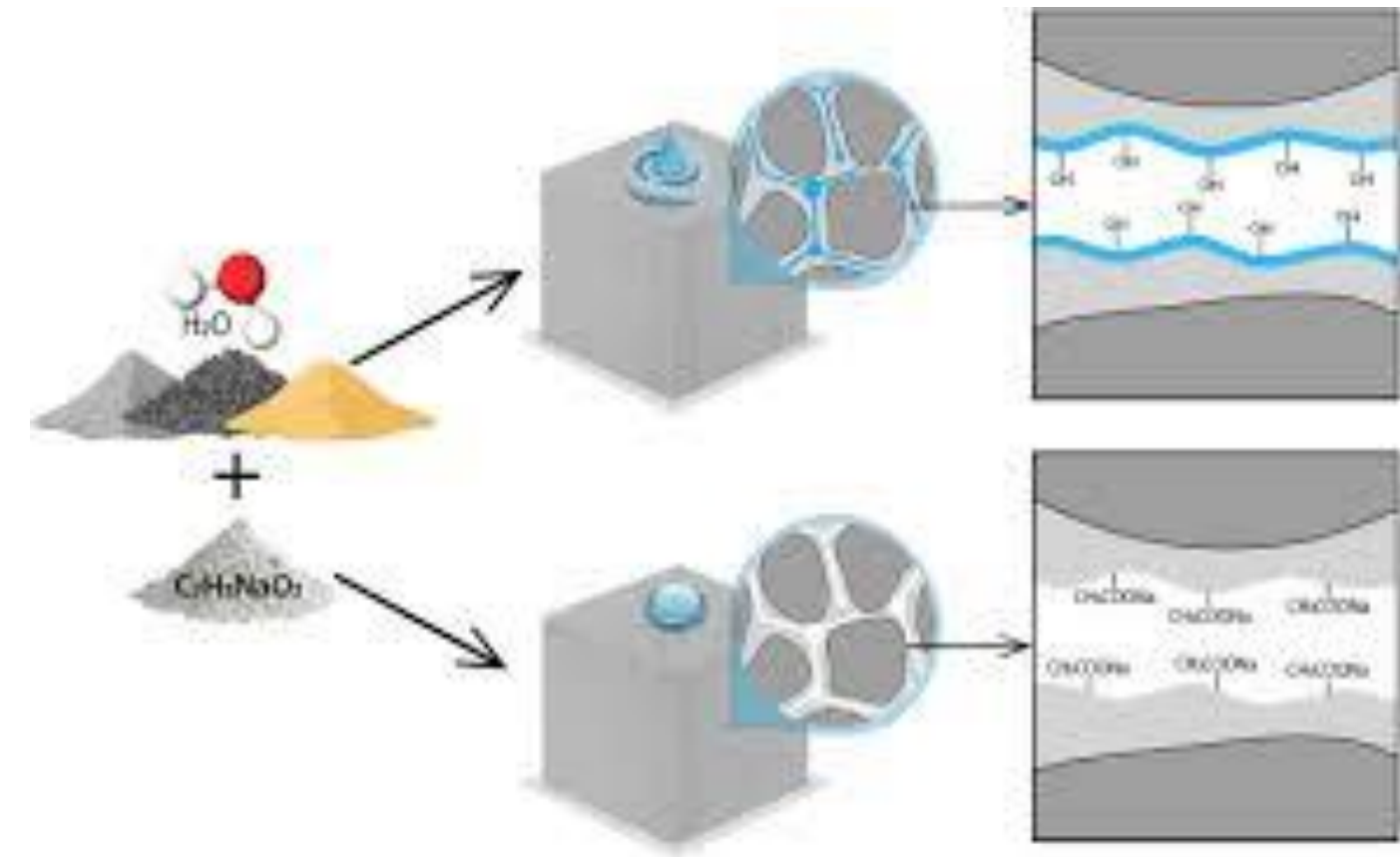
1. Ordinary Portland Cement
2. Rapid Hardening Cement (or) High Early Strength cement
3. Extra Rapid Hardening Cement
4. Sulphate Resisting Cement
5. Quick Setting Cement
6. Low Heat Cement
7. Portland Pozzolana Cement
8. Portland Slag Cement
9. High Alumina Cement
10. Air Entraining Cement
11. Supersulphated Cement
12. Masonry Cement
13. Expansive Cement
14. Colored Cement
15. White Cement



PORTLAND CEMENT



- ❖ Portland cement is made up of four main compounds: tricalcium silicate ($3\text{CaO} \cdot \text{SiO}_2$), dicalcium silicate ($2\text{CaO} \cdot \text{SiO}_2$), tricalcium aluminate ($3\text{CaO} \cdot \text{Al}_2\text{O}_3$), and a tetra-calcium aluminoferrite ($4\text{CaO} \cdot \text{Al}_2\text{O}_3\text{Fe}_2\text{O}_3$).
- ❖ Portland cement gets its strength by the process known as hydration.



Hydration of cement



Activity



PORTLAND CEMENT COMPOSITION



Constituent Ordinary Portland cement % by Weight

Lime (CaO)	64.64
Silica (SiO ₂)	21.28
Alumina (Al ₂ O ₃)	5.60
Iron Oxide (Fe ₂ O ₃)	3.36
Magnesia (MgO)	2.06
Sulphur Trioxide (SO ₃)	2.14
N ₂ O	0.05
Loss of Ignition	0.64
Lime saturation factor	0.92
C3S	52.82
C2S	21.45
C3A	9.16
C4AF	10.2



Functions of Cement

Manufacturing

Constituents



(i) Lime (CaO):

1. Lime forms nearly two-third ($2/3$) of the cement. Therefore sufficient quantity of the lime must be in the raw materials for the manufacturing of cement.
2. Its proportion has an important effect on the cement. Sufficient quantity of lime forms di-calcium silicate and tri-calcium silicate in the manufacturing of cement.
3. Lime in excess, causes the cement to expand and disintegrate.



(ii) Silica (SiO₂):

1. The quantity of silica should be enough to form di-calcium silicate and tri-calcium silicate in the manufacturing of cement.
2. Silica gives strength to the cement.
3. Silica in excess causes the cement to set slowly.



(iii) Alumina (Al₂O₃):

1. Alumina supports to set quickly to the cement.
2. Lowers the clinkering temperature.
3. Alumina in excess, reduces the strength of the cement.



(iv) Iron Oxide (Fe₂O₃):

Iron oxide gives colour to the cement.

(v) Magnesia (MgO):

- 1.It also helps in giving colour to the cement.
- 2.Magnesium in excess makes the cement unsound.



(vi) Calcium Sulphate (or) Gypsum (Ca SO₄) :

At the final stage of manufacturing, gypsum is added to increase the setting of cement.



PROPERTIES OF COMPONENTS



Tricalcium aluminate, C_3A :-

It liberates a lot of heat during the early stages of hydration, but has little strength contribution.

Dicalcium silicate, C_2S :

C_2S hydrates and hardens slowly. It is largely responsible for strength gain after one week.

Ferrite, C_4AF :

This is a fluxing agent which reduces the melting temperature of the raw materials in the kiln (from 3,000° F to 2,600° F).



ASSESSMENT



1. Mention the components of Portland cement ?
2. What is meant by Hydration of cement?
3. What are the advantages of Portland cement over other cement?



SUMMARY



REFERENCES



1. Wiley, “Engineering Chemistry”, John Wiley & Sons, Inc, USA (2014]

THANK YOU