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COIMBATORE

**19CEB201 – CONSTRUCTION MATERIALS
DEPARTMENT OF CIVIL ENGINEERING**

II YEAR / III SEMESTER

Unit 3 : Concrete

Topic 10 : Admixtures



Admixtures



- Concrete admixture is defined as the material other than the aggregate, water and cement added to the concrete.
- An admixture is a substance which can be added to concrete to achieve or modify its properties.
- Admixtures are added to the concrete, in addition to cement, water and aggregate, typically immediately before or during the mixing process.



Types of Admixtures



1. Water Reducing Admixtures
2. Retarding Admixtures
3. Accelerating Admixtures
4. Air entraining concrete admixture
5. Pozzolanic Admixtures
6. Damp-proofing Admixtures
7. Gas forming Admixtures
8. Air detraining Admixtures
9. Alkali Aggregate Expansion Inhibiting Admixtures
10. Anti-washout Admixtures
11. Grouting Admixtures
12. Corrosion Inhibiting Admixtures
13. Bonding Admixtures
14. Fungicidal, Germicidal, Insecticidal Admixtures
15. Coloring Admixtures



Water Reducing Admixtures



- Water reducing admixtures, the name itself defining that they are used to minimize the water demand in a concrete mix.
- Workability is the important property of concrete which is improved with the addition of water but if water is added more than required the strength and durability properties of concrete gets affected.
- In addition to increase in workability, it also improves the strength of concrete, good bond between concrete and steel, prevents cracking, segregation, honeycombing, bleeding etc.



Water Reducing Admixtures

- Water reducing admixtures are also called as plasticizers and these are classified into three types namely plasticizers, mid-range plasticizers and super plasticizers.
- Normal plasticizer reduces the water demand up to 10%, mid-range plasticizers reduce the water demand up to 15% while super plasticizers reduce the water demand up to 30%.
- Calcium, sodium and ammonium lignosulphonates are commonly used plasticizers.
- Some of the new generation super plasticizers are acrylic polymer based, poly carboxylate, multicarboxylate ethers etc.



Water Reducing Admixtures





Retarding Admixtures

- Retarding admixtures slow down the rate of hydration of cement in its initial stage and increase the initial setting time of concrete.
- These are also called as retarders and used especially in **high temperature** zones where concrete will set quickly.
- The quick setting in some situations may lead to discontinuities in structure, poor bond between the surfaces, creates unnecessary voids in concrete etc. Retarders are useful to eliminate this type of problems.
- Commonly used retarding admixture is calcium sulphate or gypsum.
- Starch, cellulose products, common sugar, salts of acids are some other retarders.
- Most of water reducing admixtures are also acts as retarding admixtures and they are called as retarding plasticizers.



Retarding Admixtures



Fig 2: Retarding Admixture (Gypsum)



Accelerating Admixtures

- Accelerating admixtures are used to reduce the initial setting time of concrete.
- They speed up the process of initial stage of hardening of concrete hence they are also called as accelerators.
- These accelerators also improves the strength of concrete in it early stage by increasing the rate of hydration.
- Earlier hardening of concrete is useful in several situations such as **early removal of formwork**, less period of curing, emergency repair works, for constructions in low temperature regions etc.
- Some of the accelerating admixtures are triethenolamine, calcium formate, silica fume, calcium chloride, finely divided silica gel etc.
- Calcium chloride is the cheap and commonly used accelerating admixture.



Accelerating Admixtures



Fig 3: Accelerator (Silica Fume)



Air Entraining Concrete Admixture



- Air entraining admixtures are one of the most important inventions in concrete technology.
- Their primary function is to increase the durability of concrete under freezing and thawing conditions.
- When added to concrete mix, these admixtures will form millions of non-coalescing air bubbles throughout the mix and improves the properties of concrete.
- Air entrainment in concrete will also improve the workability of concrete, prevents segregation and bleeding, lower the unit weight and modulus of elasticity of concrete, improves the chemical resistance of concrete and reduction of cement or sand or water content in concrete etc.
- Most used air entrainment admixtures are vinsol resin, darex, Teepol, Cheecol etc.
- These admixtures are actually made of Natural wood resins, alkali salts, animal and vegetable fats and oils etc.



Air Entraining Concrete Admixture





Air Entraining Concrete Admixture



Fig 4: Freezing and Thawing Effect on Concrete



Pozzolanic Admixtures



- Pozzolanic admixtures are used to prepare dense concrete mix which is best suitable for water retaining structures like dams, reservoirs etc.
- They also reduce the heat of hydration and thermal shrinkage.
- Best pozzolanic materials in optimum quantity gives best results and prevents or reduces many risks such as alkali aggregate reaction, leaching, sulfate attack etc.
- Pozzolanic materials used as admixtures are either natural or artificial.
- Naturally occurring Pozzolanic materials are clay, shale, volcanic tuffs, pumicite, etc. and artificial pozzolans available are fly ash, silica fume, blast furnace slag, rice husk ash, surkhi etc.



Pozzolanic Admixtures



Fig 5: Fly ash



Damp-proofing Admixtures



- Damp proofing or water proofing admixtures are used to make the concrete structure impermeable against water and to prevent dampness on concrete surface.
- In addition to water proof property, they also acts like accelerators in early stage of concrete hardening.
- Damp proofing admixtures are available in liquid form, powder form, paste form etc.
- The main constituents of these admixtures are aluminum sulfate, zinc sulfate aluminum chloride, calcium chloride, silicate of soda etc. which are chemically active pore fillers.



Damp-proofing Admixtures



Fig 6: Dampness on Concrete Surface



Gas forming Admixtures

- Aluminum powder, activated carbon, hydrogen peroxide are generally used gas forming chemical admixtures.
- When gas forming admixtures are added, it reacts with hydroxide obtained by the hydration of cement and forms minute bubbles of hydrogen gas in the concrete.
- The range of formation of bubbles in concrete is depends upon many factors such as amount of admixture, chemical composition of cement, temperature, fineness etc.
- The formed bubbles helps the concrete to counteract the settlement and bleeding problems.



Gas forming Admixtures

- Gas forming admixtures are also used to prepare light weight concrete. For settlement and bleeding resistance purpose, small quantity of gas forming admixtures which is generally 0.5 to 2% by weight of cement is used. But for making light weight concrete larger quantity generally 100 grams per bag of cement is recommended.



Gas forming Admixtures



Fig 7: Activated Carbon Powder



Air detraining Admixtures

- Air-detraining Admixtures are used to remove the excess air from the concrete voids.
- Sometimes, the aggregates may release the gas into concrete and air entrained is more than required then this type of admixtures are useful.
- Some of the mostly used air-detraining admixtures are tributyl phosphate, silicones, water insoluble alcohols etc.



Alkali Aggregate Expansion Preventing Admixtures



- Alkali aggregate expansion in concrete is happened by the reaction of alkali of cement with the silica present in the aggregates.
- It forms a gel like substance and cause volumetric expansion of concrete which may lead to cracking and disintegration.
- Use of pozzolanic admixtures will prevent the alkali-aggregate reaction and in some cases air-entraining admixtures are also useful.
- Generally used admixtures to reduce the risk of alkali aggregate reaction are aluminum powder and lithium salts.



Alkali Aggregate Expansion Preventing Admixtures



Fig 8: Effect of Alkali Aggregate Reaction on Concrete



Anti-washout Admixtures



- Anti-washout admixtures are used in concrete especially for under water concrete structure.
- It protect the concrete mix from being washed out under water pressure. It improves the cohesiveness of concrete.
- This type of admixtures are prepared from natural or synthetic rubbers, cellulose based thickeners etc.



Anti-washout Admixtures



Fig 9: Underwater Concreting



Grouting Admixtures



- Grouting admixtures are added to grout materials to improve the grout properties according to the requirement of grout.
- Sometimes, there is a need of quick set grout and sometimes there is a need of slow set grout to spread into deep cracks or fissures.
- Hence, different admixtures are used as grout admixtures based on situation.
- Accelerators like calcium chloride, triethanolamine etc. are used as grout admixtures when the grout is to be set rapidly.
- Similarly retarders like mucic acid, gypsum etc. are used to slow down the setting time of grout.
- Gas forming admixtures like aluminum powder is added to grout material to counteract the settle of foundations.



Grouting Admixtures



Fig 10: Grouting



Corrosion Preventing Admixtures



- Corrosion of steel in reinforced concrete structure is general and it is severe when the structure is exposed to saline water, industrial fumes, chlorides etc.
- To prevent or to slow down the process of corrosion preventing admixtures are used.
- Some of the corrosion preventing admixtures used in reinforced concrete are sodium benzoate, sodium nitrate, sodium nitrite etc.



Corrosion Preventing Admixtures



Fig 11: Corrosion of Steel in Concrete



Bonding Admixtures



- Bonding admixtures are used to create a bond between old and fresh concrete surfaces.
- In general, if fresh concrete is poured over a hardened concrete surface, there is a chance of failure of fresh concrete surface due to weak bond with old surface.
- To make the bond stronger, bonding admixtures are added to cement or mortar grout which is applied on the concrete surface just before placing fresh concrete.
- This type of admixtures are used for pavement overlays, screed over roof provision, repair works etc.
- Bonding admixtures are water emulsions and they are made from natural rubber, synthetic rubbers, polymers like poly vinyl chloride, polyvinyl acetate etc.



Bonding Admixtures



Fig 12: Concrete Pavement Overlay



Fungicidal, Germicidal, Insecticidal Admixtures



- To prevent the growth of bacteria, germs, fungus on hardened concrete structures, it is recommended that the mix should have fungicidal, germicidal and insecticidal properties.
- This properties can be developed by adding admixtures like polyhalogenated phenols, copper compounds and dieledren emulsions etc.



Fungicidal, Germicidal, Insecticidal Admixtures



Fig 13: Concrete affected by Fungi



Coloring Admixtures

- Coloring admixtures are the pigments which produce color in the finished concrete.
- The admixtures used to produce color should not affect the concrete strength.
- Generally coloring admixtures are added to cement in a ball mill, then colored cement can be obtained which can be used for making colored concrete.
- Some of the coloring admixtures and their resultant colors are tabulated below.



Coloring Admixtures

Coloring Admixtures and their Resultant Colors

Admixture	Color obtained
Iron or Red oxide	Red
Hydroxides of iron	Yellow
Barium manganite and Ultramarine	Blue
Chromium oxide and chromium hydroxide	Green
Ferrous oxide	Purple
Carbon black	Black
Manganese black , Raw umber	Brown



Thank You!!