SNS College of Technology

Department of Civil Engineering

19CEE409- Repair and Rehabilitation of Structures

UNIT III

MATERIALS FOR REPAIR

Admixtures ,Types of admixtures,

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Admixtures

Types of admixtures,

purposes of using admixtures

chemical composition, Natural admixtures

Fibres wraps

Glass and Carbon fibre wraps

Steel Plate

Admixtures

An admixture is defined as “a material other than water, aggregates, cementitious materials, and fiber reinforcement, used as an ingredient of a cementitious mixture to modify its freshly mixed, setting, or hardened properties and that is added to the batch before or during its mixing”

Types of Concrete Admixtures

Concrete admixtures are of different types and they are as follows:

- Water Reducing Admixtures
- Retarding Admixtures
- Accelerating Admixtures
- Air entraining concrete admixture
- Pozzolanic Admixtures
- Damp-proofing Admixtures
- Gas forming Admixtures
- Air detraining Admixtures
- Alkali Aggregate Expansion Inhibiting Admixtures
- Anti-washout Admixtures
- Grouting Admixtures
- Corrosion Inhibiting Admixtures
- Bonding Admixtures
- Fungicidal, Germicidal, Insecticidal Admixtures
- Coloring Admixtures

1. 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 are also called as plasticizers and these are classified into three types namely plasticizers, mid-range plasticizers and super plasticizers.

1. Water Reducing Admixtures

- 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, multicarbovylatethers etc.

Fig 1: Water Reducing Admixture

2. 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.

Fig 2: Retarding Admixture (Gypsum)

3. 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.
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- 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

Fig 3: Accelerator (Silica Fume)

4. 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.

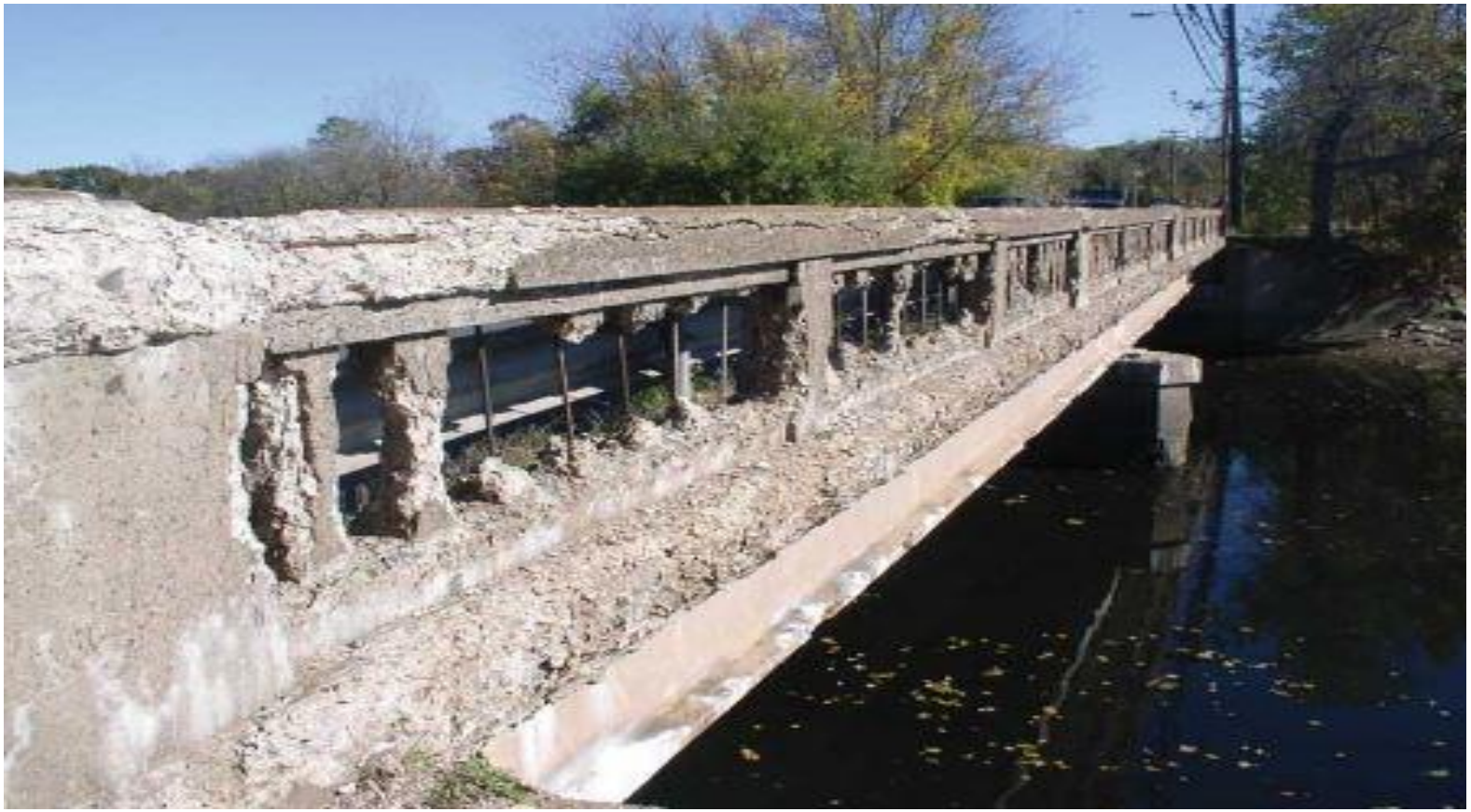

Fig 4: Freezing and Thawing Effect on Concrete

5. Pozzolanic Admixtures

- Pozzolanic admixtures are used to prepare dense concrete mix which is bets 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.

Fig 5: Fly ash

6. 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.
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- 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

Fig 6: Dampness on Concrete Surface

7. 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.
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Fig 7: Activated Carbon Powder

- 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.

8. 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.

9. 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

Fig 8: Effect of Alkali Aggregate Reaction on Concrete

10. 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.

Fig 9: Underwater Concreting

11. 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.

Fig 10: Grouting

12. 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.

Fig 11: Corrosion of Steel in Concrete

13. 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.

Fig 12: Concrete Pavement Overlay

14. 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.

Fig 13: Concrete affected by Fungi

15. 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.

- **Table 1: 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

Fig 14: Colored Concrete