Admixture

Concrete admixture is defined as the material other than the aggregate, water and cement added to the concrete. Various types of admixtures are used in concrete to enhance the performance of concrete.

Mineral admixtures include fly ash (FA), silica fume (SF), ground granulated blast furnace slag (GGBS), metakaolin (MK), and rice husk ash (RHA) which possess certain characteristics through which they influence the properties of concrete differently.

Advantages of Mineral Admixtures

- Less costs
- Results in Energy Savings
- Improve Workability
- Improve extensibility
- Reduce the alkali-aggregate reaction

Admixture

- Increase water tightness
- Increase strength
- Less water demand
- Less Heat of Hydration
- Less thermal shrinkage
- Ease of Compaction

Chemical Admixtures

Admixtures are natural or manufactured **chemicals** added to the concrete before or during mixing. The most often used chemical admixtures are air- entraining agents, water reducers, water-reducing retarders, and accelerators. Admixtures are **used** to give special properties to fresh or hardened concrete.

Admixture

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

Admixture

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**. 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 ligno sulphonates are commonly used plasticizers. Some of the new generation super plasticizers are **acrylic polymer based, poly carboxylate, multicarbovylatethers** etc.

Admixture

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.

Admixture

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.

Admixture

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.

Admixture

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.

Admixture

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.

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.

Admixture

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.

Admixture

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.

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

Admixture

Supplementary cementing materials (SCMs) contribute to the properties of hardened concrete through hydraulic or **pozzolanic activity**. Typical examples are fly ashes, slag cement (ground, granulated blast-furnace slag), and silica fume. These can be used individually with portland or blended cement or in different combinations. Supplementary cementing materials are often added to concrete to make concrete mixtures **more economical, reduce permeability, increase strength, or influence other concrete properties**.

Fly ash, the most commonly used pozzolan in concrete, is a by-product of thermal power generating stations. Commercially available fly ash is a finely divided residue that results from the combustion of pulverized coal and is carried from the combustion chamber of the furnace by exhaust gases.

Two classes of fly ash are defined by ASTM C618: **Class F fly ash and Class C fly ash**. The chief difference between these classes is the amount of calcium, silica, alumina, and iron content in the ash.

In the presence of water, Class C fly ash hardens and gets stronger over time. Class C fly ash generally contains more than 20% lime (CaO). Unlike Class F, self-cementing Class C fly ash does not require an activator. Alkali and sulfate (SO4) contents are generally higher in Class C fly ashes.

Admixture

This **fly ash** is pozzolanic in nature, and contains less than 7% lime (CaO). Possessing pozzolanic properties, the glassy silica and alumina of **Class F fly ash** requires a cementing agent, such as Portland cement, quicklime, or hydrated lime—mixed with water to react and produce cementitious compounds.

Slag Cement, formerly referred to as ground, granulated blast-furnace slag, is a glassy, granular material formed when molten, iron blast-furnace slag is rapidly chilled - typically by water sprays or immersion in water - and subsequently ground to cement fineness. Slag cement is hydraulic and can be added to cement as an SCM.

Silica fume, also called condensed silica fume or micro silica, is a finely divided residue resulting from the production of elemental silicon or ferro-silicon alloys that is carried from the furnace by the exhaust gases. Silica fume, with or without fly ash or slag, is often used to make high-strength concrete.