



SRI VIDYA COLLEGE OF ENGINEERING & TECHNOLOGY
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DEPARTMENT OF CIVIL ENGINEERING



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Subject Code /Name: CE6002/ Concrete Technology

Unit - II

Chemical and Mineral admixtures.

Introduction:—

An admixture is a material other than water, aggregates and cement and is added to the batch immediately before or during its mixing. Admixtures consist chiefly of those which accelerate and those which retard hydration or setting of cement.

Classification of Admixtures:—

1) Chemical Admixtures

- a) plasticizers,
- b) super plasticizers,
- c) Accelerators,
- d) Retarders
- e) water proofers.

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2) Mineral Admixtures.

- a) Fly Ash,
- b) Silica fume,
- c) Ground Granulated Blast furnace slag (GGBS)
- d) Metakaolin.

Accelerators: —

The agents that are added to the cement to make it set and acquire strength more rapidly are called accelerators.

Accelerators shorten the set time of concrete, early surface finishing and early load application.

Uses: —

- * Reduce form time,
- * Shorten curing time.
- * Fasten the structure into service
- * Offset low-temperature retardation effects.

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Accelerating Materials:-

Calcium Chloride (CaCl_2) is the most commonly used accelerator, when used under normal conditions and in regular amounts 2% by weight of cement.

It reduces the initial setting time from approximately 3 to 1 hour, the final setting time from approximately 6 to 2 hours.

Other Benefits offered by Calcium Chloride are

- * Improved workability,
- * Reduction in bleeding,
- * More durable concrete surface.

Sometimes these benefits may vary with type of mix and cement.

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Retarders: -

Retarders, as the name implies that the delay in setting time of cement.

The rate of chemical reaction gets decreased and setting time increases.

Calcium Sulphate in the form of gypsum is generally added during the manufacture of cement to retard setting.

But the amount of gypsum, if added beyond a limited quantity produces unsoundness and other undesirable effects.

Calcium sulphate in form of plaster of paris can also be used.

Retarding admixtures slow down the hydration of cement, lengthening the setting time. (4)

Retarding materials:-

Some of the materials which are effectively used to retard the rate of hydration are

- 1) Ammonium chloride,
- 2) Ferrous and ferric chlorides,
- 3) Calcium borates and oxychlorides,
- 4) Calcium tartrate alkali bicarbonates (sodium bicarbonate)
- 5) Annic acid, gallic acid, humic acid and sulphonic acid in sodium hydroxide solutions.
- 6) Various forms of starch.
- 7) Salts of carboxy methyl cellulose and oxidized cellulose.
- 8) Calcium or sodium salt of lignin sulphuric acid.

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Plasticizers (water reducers)

Plasticizers are used during the process of making fresh concrete. They are used to increase the workability of concrete without adding any extra water.

Water reducing admixtures require less water to make a concrete of equal slump or increase the slump of concrete at the same water content.

They can have the side effect of changing initial setting time.

Water reducers are mostly used for hot weather concrete placing and to aid pumping.

Concrete should possess good workability. It requires different degree of workability in different situation like

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- * Terrene concrete, ,
- * Hot weather concrete,
- * pumping of concrete,
- * Deep beams,
- * Beam and column joints,
- * Ready mixed concrete industries
- * Thin walled structures. etc.,.

Conventional method for High workability:-

- * Improving the gradation.
- * Using higher percentage of fine aggregate.
- * Increasing the content of cement.
- * Using extra amount of water.

Effects of use of Extra water in Concrete:-

Harmful to concrete strength and durability.

Improve the consistency but not the workability of concrete.

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No improvement in homogeneity and cohesiveness of the mix, reducing the tendency for segregation and bleeding.

Effects of use of plasticizer in concrete:

* Reduces water/cement ratio for the given workability, which in turn increases the strength.

* The reduction in water/cement ratio improves the durability of concrete.

* Sometimes it is used to reduce the cement content and heat of hydration in mass concrete.

Super plasticizers:-

Super plasticizers (High range water reducers - HRWR) are chemical admixtures used where well-dispersed particle suspension is required.

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Super plasticizers are also known as plasticizers, include water-reducing admixtures.

Comparing to the commonly referred as water reducers or mid range water reducers, super plasticizers are called as High Range water Reducers.

Each type has defined ranges for the required quantities of concrete mix ingredients, along with the corresponding effects.

They can maintain a specific consistency and workability at a greatly reduction in the amount of water.

Dosages needed vary by the particular concrete mix and type of super plasticizer used.

They can also produce a high strength concrete.

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Effects of use of superplasticizer in Fresh concrete:-

A high dosage is required to fluidize no slump concrete.

An improvement in slump value can be attained to the extent of 25cm or more depending upon the initial slump of the mix, the dosage and cement content.

Water proofers:-

A water proof concrete has to fulfill two separate and distinct functions are,

- * To be impervious to the water under pressure
- * To resist the absorption of water.

These are all chemically active and hence may accelerate the setting time of concrete thus making it

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more impervious at an early age.

Materials for the water repellent class are soda and potash soap are used. Sometimes lime, alkaline silicates or calcium are also used.

Chemically inactive materials are calcium soaps, resin, vegetable oils, fats, waxes, coal residues and bitumen are also act as pore block agents.

Mineral Admixtures

Flyash:-

Flyash or pulverized ash (P.F.A) is the residue from the combustion of pulverized coal collected by mechanical or electrostatic separators from the fuel gases of power plants.

Its composition depends on
* Type of fuel burnt.

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* Load on the boiler

* Type of Separator

Classification of Flyash!—

* Class F

* Class C

Class F

Fly ash normally produced by burning anthracite or bituminous coal, usually has less than 5% CaO .

Class F flyash has pozzolanic properties only.

Class C

Flyash normally produced by burning lignite or sub-bituminous coal. Some class C flyash may have CaO content in excess of 10%.

In addition to pozzolanic properties class C flyash also

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Possesses cementitious properties.

Effects of use of flyash in Fresh and Hardened Concrete: -

When flyash is mixed with cement, the silica of pozzolana combines with the free lime released during the hydration of cement.

Due to replacement of cement by pozzolana cement there is a small increase in the tensile strength at later ages.

As per the Indian standards the pozzolana cement has to satisfy the requirements of IS 1489 - 1967.

Pozzolana cement is generally used in the construction of retaining walls, culverts and drains etc.,

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Silica fume:-

Silica fume also referred to as microsilica or condensed silica fume is another material that is used as artificial pozzolanic admixtures.

Silica fume is very fine pozzolanic material composed of ultrafine, amorphous glassy sphere (average diameter 0.10 to 0.15 μm) of silicon dioxide (SiO_2) produced during the manufacture of silicon or ferro-silicon by electric arc furnaces at temperature of over 2000°C .

Effects of ^{use of} silica fume in fresh concrete:

* The addition of microsilica will lead to lower slump but more cohesive mix.

* Concrete containing microsilica

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is vulnerable to plastic shrinkage cracking.

Micro silica concrete produces more heat of hydration at the initial stage of hydration. Finally, the total generation of heat will be less.

Ground Granulated Blast furnace slag (GGBS)

Ground Granulated slag (GGBS) is a non-metallic product consisting essentially of silicates and aluminates of calcium.

The molten slag is cooled rapidly quenching in water to form a glassy sand like granulated material.

The blast furnace slag is mainly used in India for manufacturing Slag Cement. There are two methods

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for making Blast furnace slag cement.

* In the first method, blast furnace slag is inter ground with cement clinker along with gypsum.

* In second method, blast furnace slag is separately ground and then mixed with cement.

Effects of use of GGBS in Fresh Concrete:-

Replacing cement with GGBS will reduce the unit water content necessary to obtain the same slump.

This reduction of unit water will be more pronounced with increase in slag cement content and also on the fineness of slag.

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Effects of use of GGBS in Hardened Concrete:—

- * Reduction in heat of hydration.
- * Reduced permeability to the external agencies.
- * Higher ultimate strength.
- * Resistance to chemical attack is higher.
- * Resistance to corrosion of steel reinforcement.
- * Saving of cement in concrete mix.
- * Improved workability of site mix.

Metakaolin:—

Considerable research has been done on natural pozzolans namely on thermally activated ordinary clay and kaolinite clay. These unpurified

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materials have often been called as Metakaolin.

Even though it showed certain amount of pozzolanic properties they are not highly reactive.

Highly reactive metakaolin is made by water processing to remove unreactive impurities to make 100% reactive pozzolana. Such a product, white or cream in colour, purified thermally activated is called High Reactive metakaolin (HRM).

Metakaolin is not a by-product as other pozzolanic materials, it is a specially manufactured material with definite properties.

It has been used in many other major projects like

* Kobra Tower.

* Burge Khalifa in Meera Dubai

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