Admixture

Lecture - 2

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Superplasticizers (High Range Water Reducers)

- ✓ Develop in Japan and Germany during 1960-1970.
- ✓ Chemically different than normal plasticizer
- ✓ Use of SP permits the reduction of water up to 30% whereas 15% is maximum possible reduction of water while using plasticizer.
- ✓ It is used for production of flowing, self levelling, self compacting and for the production of high strength and high performance concrete.

Superplasticizers (High Range Water Reducers)

- ✓ The mechanism is similar to plasticizer. Only thing is that the SPs are more powerful as dispersing agents and they are high range water reducers.

- ✓ SP enable to reduce the w/c as low as 0.25 or even lower and yet to make flowing concrete to obtain strength of the order120 Mpa or more.

- ✓ Use of SP made possible to use fly ash, slag and particularly silica fume to make high performance concrete.

Superplasticizers (High Range Water Reducers)

- ✓ SP in the construction of high rise buildings, long span bridges and the recently become popular Ready Mixed Concrete Industry.
- ✓ ***SPs Can produce:***
- ✓ At the same w/c ratio much more workable concrete than the plain ones
- ✓ For the same workability, it permits the use of lower w/c ratio.
- ✓ As a consequence of increased strength with lower w/c ratio, it also permits a reduction of cement content.

The SPs also produce a homogeneous, cohesive concrete generally without any tendency for segregation and beldding.

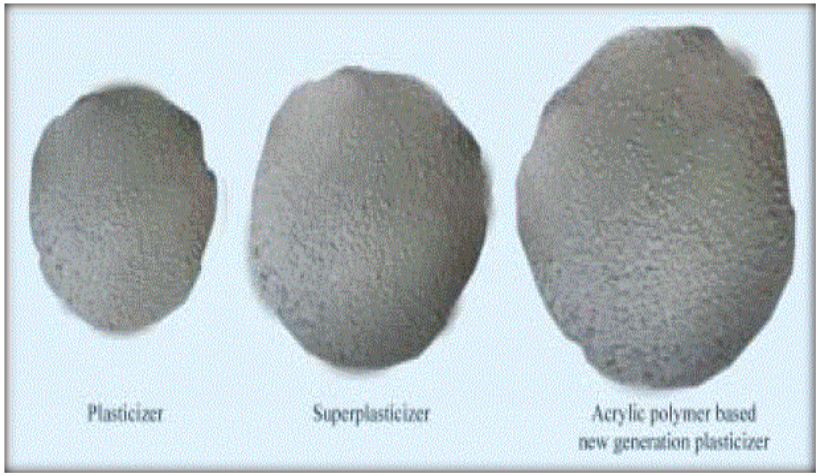
Type of Superplasticizers

- ✓ Sulphonated malanie-formaldehyde condensates
- ✓ Sulphonated naphthalene-formaldehydecondensates (SNF)
- ✓ Modified lignosulphonates (MLS)
- ✓ Other types

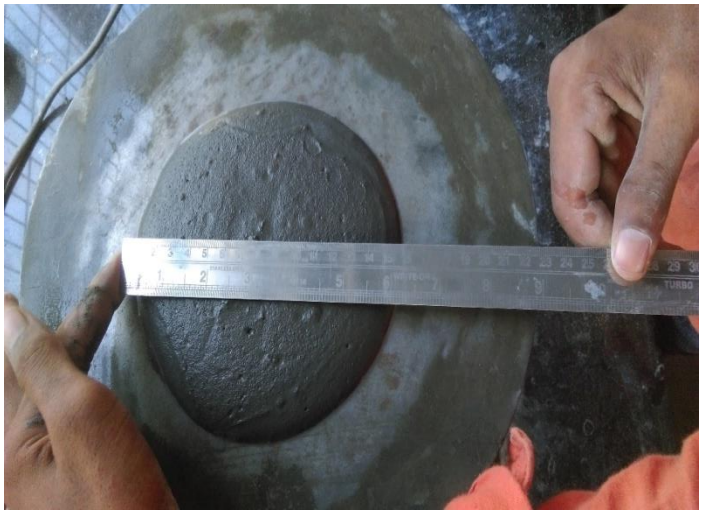
Effect of different type of water reducing admixture

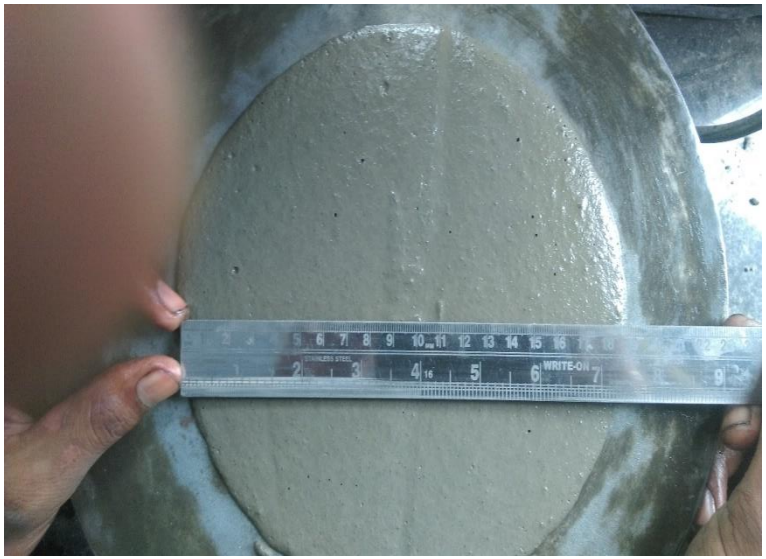
In addition to the above, in other countries the following new generation SPs are also used.

- Acrylic plymer based (AP)
- Copolymer of carboxylic acrylic acid with acrylic ester (CAE)
- Cross linked acrylic polymer (CLAP)
- Polycrboxylatethers (MCE)
- Combinations of above



Effect of different type of water reducing admixture

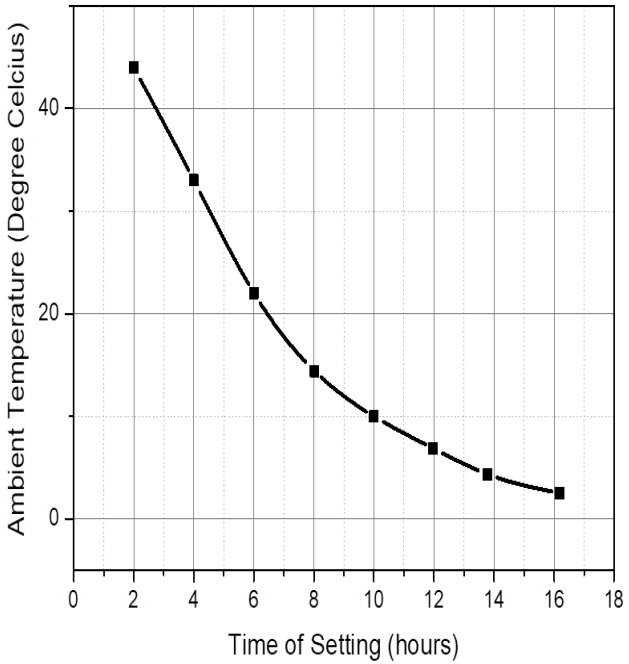




Type C (Accelerating Admixture)

Accelerating admixtures are added to concrete to ***decrease both the initial and final time of set and accelerate the early strength development***.

The ***early setting time*** and **increased early strength gain of concrete** brought about by an ***accelerating admixture*** will results in a number of benefits i.e. ***earlier finishing, earlier use of structure improved protection against early exposure to freezing and thawing.***



Relationship between temperature and setting time of concrete

Type C (Accelerating Admixture)

Calcium chloride is the most effective and economical acceleration for concrete. The following guidelines should be considered before using calcium chloride or chloride bearing admixture.

1.Not applicable for ***prestressed concrete*** because of its potential for causing corrosion

2.With sulphate- resisting concrete calcium chloride should not be used.

3. Calcium chloride should be *avoided in reinforced concrete* in moist condition. In ***non – reinforced concrete***, the level of calcium chloride used ***should not exceed 2% by weight of cementitious material***.

Type C (Accelerating Admixture)

4.Calcuim chloride should be dissolved in a portion of mixing water before batching because undissolved lumps may late disfigure concrete surfaces.

- Non chloride accelerating admixture are available that provide the benefits of an accelerating admixture without the increased risk of corrosion from chloride. Formulation based on salt of formats, nitrates, nitrites and thiocynates are available from admixture manufactures. No chloride accelerators are effective for set acceleration and strength development. Degree of effectiveness of these admixtures is dependent on the ambient temperature and concrete temp. at the time of placement.

Type B (Retarding Admixture)

Conventional Retarding Admixtures

Two types of admixtures are used for the same basic purpose;

To offset unwanted effects of high temperature, such as ***acceleration of set*** and ***reduction of 28 days compressive strength***, and

To keep concrete workable during the ***entire placing and consolidation period***.

Type B (Retarding Admixture)

Various benefits derived from retarding formulations includes the following;

1.Permits greater flexibility in extending the time of set and the prevention of cold joints

2.Facilitates finishing in hot weather

3.Permits full form deflection before initial set of concrete.

Type A admixtures, their dosage rates are based on the amount of cementitious material in the concrete mixture.

While both Type B and Type D may provide some water reduction Type D is more effective in achieving this goal.

Extended Set Admixture

Advances in admixture technology have resulted in the development of highly potent retarding admixtures called extended set admixtures or hydration controlling admixtures. ***These admixtures are capable of stopping the hydration of cementitious system, thereby means to control the hydration and setting characteristics of concrete.*** Extended –set admixtures are used in applications e.g.

Specialization of freshly batched concrete for long haults.

Corrosion Inhabiting Admixture

Reinforcing steel corrosion is a major concern with regard to the durability of reinforced concrete structure. Each year, numerous bridges, parking garages, and other concrete structure year undergo extensive repair and rehabilitation to restore their structural integrity as a result of corrosion damage.

The high alkalinity of new concrete protects reinforcement from corrosion due to the formulation of a corrosion resistant passive layer at the surface of the steel.

Corrosion Inhabiting Admixture

However, this passive layer can be destabilized in concrete contaminated by chlorides, which allows corrosion to begin if there is sufficient moisture and oxygen present at the surface of the steel. Chlorides can be introduced into concrete from dicing salts that are used in winter months to melt snow or ice, from seawater, or from the concrete moisture ingredients.

The penetration of water and water-borne chemicals is the root cause of most of the destructive mechanisms that damage concrete. There are several ways of combating chloride induced corrosion, one of which is the use of corrosion inhabiting admixtures

Corrosion Inhabiting Admixture

These admixtures are added to concrete during batching and they protect embedded reinforcement by delaying the onset of corrosion and also by reducing the rate of corrosion after initiation. There are several commercially available inhibitors on the market. Active ingredient include inorganic materials such as calcium, nitrite and organic material such as amines and esters. Calcium nitrite resists corrosion by stabilizing the passive layer in the presence of chloride ions.

Permeability- Reducing Admixtures

The penetration of water and water-borne chemicals is the root cause of most of the destructive mechanisms that damage concrete. Water can entre concrete through the network of pores and capillaries that forms during cement hydration, or through cracks and other voids in the concrete. Therefore, almost all concrete structure require protection from water.

There are wide variety of PRAs available and it is important to match the properties of an admixture to the actual service condition. For this reason ACI 212 divides PRAs into two categories.

PRA for hydrostatic conditions (PRAH),

PRA for non hydrostatic condition (PRAN

PRAH

PRAH

It is primarily intended for use in concrete that is exposed to water under pressure and are sometimes called water proffing admixture. They provide highest level of water resistance and are suitable for permanently damp or submerged environment (e.g. concrete installed underground, pools, tunnels and water reservoir.)

To resist water under pressure PRAHs use a pore blocking mechanism that is stable even under high hydrostatic pressure. Materials include hydrophilic grow pore blocking deposits or polymer that pack into pores under pressure

PRAN

PRAN are intended for applications that are nor subjected to hydrostatic pressure and are sometime called dam proofing admixtures. Most PRANs contain water repellent chemicals that shed water and reduce water absorption into the concrete water repellent ingredient include various soaps, oil, and long chain fatty derivatives. Other PRAN are based on finely divided solids such as bentonite, colloidal silica, and silicates.

PRAN

These fillers reduce water migration through pores although not at the same degree as a PRAH, and are sometime called densifiers.

Coloring Admixtures (Pigments)

Natural and synthetic materials are used to color concrete for aesthetic and safety reasons. Red concrete is used around buried electrical or gas lines as a warning to anyone near these facilities. Yellow concrete safety curbs are used in paving applications. Generally, the amount of pigments used in concrete should not exceed 10% by weight of the cement. Pigments used in amounts less than 6% generally do not affect concrete properties.

Calcium chloride should not be used with pigments to avoid color distortion pigments should be confirm to ASTM 979.

Type of Admixture as Per ASTM C494

The code classified admixtures into categories based on performance.

- Type A – Water- Reducing Admixtures
- Type B - Retarding Admixture
- Type C – Accelerating Admixtures
- Type D - Water-Reducing & Retarding Admixture
- Type E- Water-Reducing & Accelerating Admixture
- Type F - Water-reducing, High-Range Admixture
- Type G – Water- Reducing, High Range and retarding Admixtures
- Type S - Specific Performance Admixture

Summary

- Superplasticizer (High Range Water Reducer)
- Accelerating Admixture
- Retarding Admixture
- Corrosion Inhabiting Admixture
- Colouring Admixture

THANK YOU