2.3 PLASTICIZERS

To decrease the water content with higher workability of concrete, some chemicals may be added to concrete is called water reducer. The water reducing admixtures are two types;

- Plasticizer
- Super plasticizer

Plasticizers for concrete increase the workability of the wet mix or reduce the water required to achieve the desired workability and are usually not intended to affect the properties of the final product after it hardens.

These plasticizers can help the difficult conditions for obtaining higher workability without using excess of water. One must remember that addition of excess water, will only improve the fluidity or the consistency but not the workability of concrete.

The excess water will not improve the inherent good qualities such as homogeneity and cohesiveness of the mix which reduces the tendency for segregation and bleeding. The use of superplasticizers has become almost a universal practice to reduce water/cement ratio for the given workability, which naturally increases the strength. The organic substances or combinations of organic and inorganic substances, which allow a reduction in water content for the given workability, or give a higher workability at the same water content, are termed as plasticizing admixtures. The advantages are considerable in both cases: in the former, concretes are stronger, and in the latter they are more workable.

The basic products constituting plasticizers are as follows:

- ✓ Anionic surfactants such as lignosulphonates and their modifications and derivatives, salts of sulphonates hydrocarbons.
- ✓ Non-ionic surfactants, such as polyglycol esters, acid of hydroxylated carboxylic acids and their modifications and derivatives.
- ✓ Other products, such as carbohydrates etc. Among these, calcium, sodium and ammonium lignosulphonates are the most used.

Plasticizers are used in the amount of 0.1% to 0.4% by weight of cement. At these doses, at constant workability the reduction in mixing water is expected to be of the order of 5% to 15%. This naturally increases the strength. The increase in workability that can be expected, at the same w/c ratio, may be anything from 30 mm to 150 mm slump, depending on the dosage, initial slump of concrete, cement content and type. A good plasticizer fluidizes the mortar or concrete in a different manner than that of the air-entraining agents. Some of the plasticizers, while improving the workability, entrains air also. As the entrainment of air reduces the mechanical strength, a good plasticizer is one which does not cause air-entrainment in concrete more than 1 or 2%. Such a product would allow adsorption into cement particles without any significant interferences with the hydration process or hydrated products. Normal water reducing admixtures may also be formulated from wholly synthetic raw materials.

Amount used

- Plasticizers are used in the amount of 0.1% to 0.4% by weight of cement.

Limitations

- A good plasticizer is one which does not cause air-entrainment in concrete more than 1 or 2%.

Results – effects

- At constant workability –

The reduction in mixing water is expected to be of the order of 5% to 15%. Naturally increases the strength.

- At constant w/c ratio –

Increased workability.

Slump of 30mm to 150 mm.

Used at

Where high degree of workability is required

- Thin walls of water retaining structures with high percentage of steel reinforcement
- Deep beams, column and beam junctions
- Tremie concreting

- Pumping of concrete
- Hot weather concreting
- Concrete to be conveyed for considerable distance and in ready mixed concrete industries.

Action of Plasticizers

The action of plasticizers is mainly to fluidify the mix and improve the workability of concrete, mortar or grout. The mechanisms that are involved could be explained in the following way:

Dispersion. Portland cement, being in fine state of division, will have a tendency to flocculate in wet concrete. These flocculation entraps certain amount of water used in the mix and thereby all the water is not freely available to fluidify the mix.

When plasticizers are used, they get adsorbed on the cement particles. The adsorption of charged polymer on the particles of cement creates particle-to particle repulsive forces which overcome the attractive forces. This repulsive force is called Zeta Potential, which depends on the base, solid content, quantity of plasticizer used. The overall result is that the cement particles are deflocculated and dispersed.

When cement particles are deflocculated, the water trapped inside the flocks gets released and now available to fluidify the mix.

When cement particles get flocculated there will be inter particles friction between particle to particle and floc to floc. But in the dispersed condition there is water in between the cement particle and hence the inter particle friction is reduced.