ABSTRACT

In theory, a water/cement ratio about 0.27 is adequate for hydration of the cement, and any water in the concrete above this ratio detracts from the potential compressive strength that can be achieved. Most common concrete placing practices demand a level of workability which cannot normally be obtained without addition of some, and often considerable water above the theoretical requirement, thus lowering the strength.

As a result of much improved workability that the addition of a superplasticizer gives to concrete made at a normal water/cement ratio, it is possible to make concrete having a slump = 50 to 75 mm but with a very much reduced w/c ratio.

The inclusion of fly ash in concrete affects all aspects of concrete properties. As a part of the composite concrete mass, fly ash acts in part as fine aggregate and in part as a cementitious component. It influences the rheological properties of the fresh concrete, the strength, finish, porosity and durability of the hardened mass.

An attempt has been made in this thesis to study the adsorption of various grades of cements and fly ash in the medium of superplasticizers. Zeta potential measurements have also been made for various grades of cements and cements blended with fly ash. The effects of the combination of mineral and chemical admixtures are discussed.

The water-cement ratio compressive strength relationship of superplasticized concrete with & without fly ash are assessed.
The slump retention of superplasticizer with respect to various grades of cement with and without fly ash at normal and higher ambient temperatures have been studied.

The study has lead to the following observations:

The adsorption of the superplasticizer (sulphonated melamine formaldehyde) is maximum for plain fly ash.

Zeta potential measurements of lignite fly ash and the different grades of cement indicates that, the lignite fly ash is dispersed well when a superplasticizer is used.

The slump retention capability of sulphonated melamine formaldehyde based superplasticizer is more or less the same (the time taken to attain zero slump) for all the three grades of cement.

At higher mixing temperatures of 42°C, the slump retention is not a problem with sulphonated melamine formaldehyde based superplasticizer upto a water cement ratio of 0.55. W/C ratio of 0.55 and beyond, at higher mixing temperatures, for all the three grades of cement the superplasticizer shows incompatibility manifested by bleeding of concrete.

The 28 day compressive strengths of concrete with superplasticizer, shows an increase greater than that due to water-reduction alone, when grades 43 and 53 cements are used.

The higher adsorption of the blended cement, the higher is its initial slump value. Accordingly, Grade 43 will give the highest value of initial slump, followed by Grade 33 and then by Grade 53 cements.
Fly ash addition increases the slump retention time of superplasticized concretes, when compared to those without fly ash addition. However, for each grade of cement, the slump retention is the same for different cement contents.

As in the case of concretes without fly ash addition, increasing cement content gives higher initial slump, but the slump retention is the same for all cement contents. In other words, the more the cement, the more rapid is the slump loss.

The early age strengths of lignite fly ash concretes with 3% superplasticizer is lower than the fly ash concrete without superplasticizer (control fly ash concrete). At later ages, after 28 days, control fly ash concretes show a consistent increase in strength, whereas for superplasticized concrete, there is drop in the rate of gain of strength.