

A Review on Analogy of Admixtures in Concrete

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Abstract: Concrete is the key component for providing strength to the structures. For building strong and stable structure, it is necessary that the concrete must have the desired characteristics. Sometimes, after the preparation of concrete it doesn't have the required characteristics. To counteract this problem, admixtures come into role. Admixtures are used to make concrete more suitable for construction purpose. The present study aims at utilization and to focus on the availability (economical) and suitability of admixtures, which are taken in use for preparing concrete in present scenario. The strength performance and the other behavioural characteristics of admixtures in concrete will be studied and important findings will be reported. The study on the same concrete mix with different admixtures can depict which one is more suitable.

Keywords: *Superplasticizers, Sulphonated Naphthalene Formaldehyde (SNF), Poly Carboxylate Ether (PCE), Modified Poly Carboxylate Ether (MPCE).*

Introduction

Admixtures are chemicals added to concrete, mortar or grout at the time of mixing, to modify the properties, either in the wet state immediately after mixing or after the mix have hardened. They can be a single chemical or a blend of several chemicals and may be supplied as powders but most are aqueous solutions because in this form they are easier to dispense accurately into, and then disperse through the concrete.

The major reasons for using admixtures are:

- To reduce the cost of concrete construction.
- To achieve certain properties in concrete more effectively than by other means.
- To maintain the quality of concrete during the stages of mixing, transporting, placing and curing in adverse weather conditions.
- To overcome certain emergencies during concreting operations.

There are various mechanisms of admixtures. They work by one or more of the following actions:-

- Chemical interaction with the cement hydration process, typically causing an acceleration or retardation of the rate of reaction of one or more of the cement phases.
- Adsorption onto cement surfaces, typically causing better particle dispersion (plasticizing or superplasticizing action).
- Affecting the surface tension of the water, typically resulting in increased air entrainment.
- Affecting the rheology of the water, usually resulting in an increased plastic viscosity or mix cohesion.
- Introducing special chemicals into the body of the hardened concrete that can affect specific properties such as corrosion susceptibility of embedded steel or water repellence.

In this paper, the study is been done to discuss about the properties of concrete when superplasticizers are added to them. Superplasticizers also known as high range water reducers are chemical admixtures used where well-dispersed particle suspension is required. When they are added to the concrete or mortar, they reduce the water cement ratio but don't affect the workability of the mixture and hence produce the self-consolidating concrete and high performance concrete. When the cement water ratio decreases, the strength on the other hand increases. There are three different superplasticizers used in this study which are Sulphonated Naphthalene Formaldehyde (SNF), Poly Carboxylate Ether (PCE) and Modified Poly Carboxylate Ether (MPCE).

Sulphonated Naphthalene Formaldehyde (SNF) is a polymer which is produced by the condensed polymerisation of the naphthalene, sulphonic acid and formaldehyde. Due to the negative charge left on the admixture adsorbed cement particle, they repel the other cement particles and thus causing dispersion of cement particles. This phenomenon is called Electrostatic Repulsion.

Poly Carboxylate Ether (PCE) is composed of a methoxy-polyethylene glycol copolymer (side chain) grafted with methacrylic acid copolymer. Under this, dispersion of cement particles occurs due to the steric hindrance which depends on the length of main chain, length and number of side chain. These admixtures are highly sensitive to overdosing, as it can cause several problems like retardation and air-entrainment

Modified Poly Carboxylate Ether (MPCE) is a modified version of Poly Carboxylate Ether as it has better water retaining properties than PCE.

Literature Review

1. **Evageline K, Dr. M. Neelamegam:-** The study is been carried out on the behaviour of a specific concrete mix with different superplasticizers which are Sulphonated Naphthalene Formaldehyde (SNF), Poly Carboxylate Ether (PCE), Modified Poly Carboxylate Ether (MPCE).

According to this study, SNF does not passed some tests like V- funnel test, V- funnel test at $t_{5\text{minutes}}$ and U-box test which are essential properties. Its performance is lower than other two admixtures. It is also cheapest among three i.e. Rs. 60/litre ($1\text{m}^3 = \text{Rs. } 5216$). The retention in workability of SNF changes drastically over time.

PCE when mixed with concrete gives good results. It passes every test been done on it but it is costlier than other two superplasticizers i.e. about Rs. 180/litre ($1\text{m}^3 = \text{Rs. } 5846$). It gives a better workability for a longer time.

MPCE gives good result compared to PCE. It also passes every test. It is cheaper than PCE but costlier than SNF i.e. Rs. 140/litre ($1\text{m}^3 = \text{Rs. } 5416$). The workability versus time graph for concrete mixed with MPCE is near to constant, hence giving a better workability for a longer time.

Hence, it is found that MPCE is better among three selected superplasticizers in terms of characteristic behaviour of fresh and hardened concrete and economy.

2. **Manu Santhanam:-** The study on superplasticizers like Sulphonated Naphthalene Formaldehyde (SNF) & Poly Carboxylate Ether (PCE) is been done to counteract the problems that arises as a result of incompatibility between cement and water reducers such as rapid loss of workability, excessive quickening / retardation of setting, and low rates of strength gain.

In this study, following important results were marked:-

- According to this study, delayed addition of superplasticizers is required to maintain the fluidity. When cement is hydrated, the admixture adsorbed, reduces, thus adsorption is greater on unhydrated compounds than hydrated. As a result, when delayed addition is done there are more admixtures present in the mix to maintain fluidity.
- It's been found that temperature had a great influence on superplasticizers demand and other properties. With increase in temperature, the superplasticizers demand for a given slump and 1 day compressive strength increases while slump retention and initial setting time decreases. Effect of temperature is seen only till initial setting time but after that temperature doesn't have any effect on concrete.
- It is also noticed that in different temperature conditions, PPC (Portland Pozzolana Cement) is better than OPC (Ordinary Portland Cement).
- With increase in mix size, initial slump for both PCE and SNF based concretes also increases uniformly. The slump retention for PCE was not affected but the slump retention of SNF concretes was affected adversely. Increasing the mixing speed uniformly increases the initial slump, while not affecting the final slump after 1 hour.

3. **Dhanya Sathyan, KB Anand, KM Mini, Aparna S:-**The study is been done on superplasticizers like Polycarboxylate Ether (PCE), Ligno sulphate (LS), Sulphonated Naphthalene Formaldehyde (SNF) and Sulfonated Melamine Formaldehyde (SMF) mixed in Portland Pozzolana Cement Concrete and Mortar. The study is been carried out on fresh stage properties of mortar & concrete. Under mortar, they did Flow Table Test & Marsh Cone Test and under concrete, they did Flow Table Test & Slump Test.

In the study, following results were noted down:-

- In the study it's found that saturation dosages of superplasticizer in cement concrete are observed to be at a higher range than that of cement mortar.
 - The difference in the superplasticizer quantity for optimum dosage in mortar and concrete is less in the case of PCE based superplasticisers due to its better dispersing action contributed by steric hindrance and electrostatic repulsive force.
 - Addition of superplasticizer beyond saturation point doesn't show any improvement in the workability of mortar/concrete rather it causes segregation of concrete/mortar.
 - Good quality control is required in concrete construction if PCE based superplasticizer is used because slight increase beyond saturation point causes segregation and bleeding.
 - Due to enhancement in workability, superplasticized concrete yielded higher compressive strength than the PPC control mixtures.
4. **Salahaldein Alsadey:-**Under this study, the experimental tests for fresh and hardened properties of concrete for M35 grade are studied and the results are compared with normal concrete. The aim of the study was to know the effect of superplasticizers on workability and strength development and also to find out the optimum dosage of superplasticizer to obtain desired properties.

Properties of concrete containing superplasticizer had been successfully studied and the results were:-

- Workability of concrete can be increased by adding the superplasticizers but higher dosages can lead to bleeding or segregation.
- Slump loss can also be reduced by adding superplasticizers and hence it increases the effectiveness of concrete.
- Compressive strength of concrete is also increased by superplasticizer. Its ultimate strength is higher than desired characteristic strength.

Summary of Results

S.No.	Properties	SNF	PCE	MPCE
1.	Slump Flow Test	560mm	650mm	800mm
2.	Slump Flow at t_{500mm}	4.5sec	3.8sec	3.2sec
3.	V-Funnel Test	52sec	13.7sec	14sec
4.	V-Funnel at $t_{5minutes}$	90sec	16sec	18sec
5.	L-Box Test	0.82	0.95	0.93
6.	U-Box Test	50mm	28mm	25mm
7.	Compressive strength on 3 rd day	28.2MPa	31.8MPa	37.9MPa
8.	Compressive strength on 7th day	36.2MPa	38.1MPa	43MPa
9.	Compressive strength on 28th day	53.5MPa	55.7MPa	59.2MPa
10.	RCPT	1337.7 C	1981.2 C	1601.1C
11.	Dosage Used	1.4%	1.0%	0.8%
12.	Cost per m ³ concrete	Rs. 5216	Rs. 5846	Rs. 5416

Tables

Properties of Superplasticizers Used

S.No.	Name of the admixture	Relative Density	Colour	Dosage
1.	SNF	1.24 at 25°C	Dark Brown	0.5-2%
2.	PCE	1.08 at 25°C	Honey Brown	0.4-1.2%
3.	MPCE	1.08 at 25°C	Golden Brown	0.6-1.2%

Conclusion

- According to the studies been done, it is found that superplasticizers increases the workability of the concrete upto the saturation point and after that limit the concrete starts bleeding.
- Superplasticizers also increase the compressive strength of the concrete.
- Good quality control and also the optimum dosages of superplasticizers are necessary to obtain the desired characteristics of the concrete.
- In superplasticizers, Modified Poly Carboxylate Ether (MPCE) is found a better one as it passes all tests and also economical.
- Temperature had a great effect on superplasticizers properties as it increases certain properties while it also decreases others.

References

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