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Self-Compacting Concrete using Superplasticizers – A Review

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Abstract - *The Concrete is a hard building material which is made up of cement, fine aggregates, coarse aggregates and water in a permissible quantity. Due to its properties such as high strength, adaptability to different forms, fire resisting capacity, low cost etc., concrete has got wide acceptance nowadays in the field of construction sector. In nowadays, infrastructure developments such as multistoreyed buildings, bridges, airports etc. are increasing widely all over the world. In the cases of huge construction areas, longer span, lack of proper compaction, lack of labours, concreting dense reinforcements, a special concrete has higher importance in construction industries. This review paper focused on the effect of superplasticizers on self compacting concrete as a guideline for the further research work by analyzing different studies.*

***Key Words*: Self–Compacting Concrete, Superplasticizers, Admixtures, Workability, Strength, Durability**

1.INTRODUCTION

Self-compacting concrete (SCC) is an special concrete that require no vibration during placing and compaction. It is the concrete that able to flow under its self weight, or under gravity. It is completely fills formwork and achieve full compaction, even in the presence of congested reinforcement. The hardened concrete is dense and homogeneous. It has the same engineering properties and durability as traditional vibrated concrete. For the improvement of concrete properties, modifications are done from the time of invention of concrete. Concretes can be modified either by the replacements of any material or by the extra addition of new materials. Admixtures are available in mineral form or chemical form. Many researches were conducted for determining the effect of superplasticizers and admixtures.

2. OBJECTIVE

Main objective of conducting the research is to finding out the most effective, easily available superplasticizer that can be used for imparting self compacting property and can improve the quality in performances.

3. LITERATURE REVIEW

Hajime Okamura[6] et.al (2003) discussed about technique for attaining self- compactability, self - compactability factors. They proposed a mix design method for SCC based on paste and mortar studies for super plasticizer compatibility followed by trial mixes. However, it was more relevant to test for passing ability, filling ability, and flow ability and segregation resistance.

Burak Felekoglu [2] et.al (2007) discussed about three synthetic PC-based superplasticizers were synthesized by using radical polymerisation techniques. The effect of superplasticizers on setting time, workability of SCC and strength development of SCCs were studied. Along with the usage of superplasticizer, it is observed that, W/C ratio were also has greater importance in imparting the workability retention. The mix with 2.3 wt % of P3 type SP performs better results. However, some longer setting times and early strength reduction should also be expected.

Evangeline K [5] et.al (2011) studied about the effect of 3 types of superplasticizers such as Sulphonated Naphthalene Formal-dehyde (SNF), Poly Carboxylate Ether (PCE) and Modified Poly Carboxylate Ether (MPCE) on mechanical properties and workability of self compacting concrete. From the comparative study, it is observed that, with the concrete, both the PCE and MPCE showed better results. The workability retention of concrete with PCE does a longer time workability for concrete. Also, the concrete using MPCE give a better workability for a longer time. Hence, MPCE performed as a better superplasticizer than the three selected superplasticizers considered in the study, considering characteristic behaviour of fresh and hardened concrete and economy point of view.

C. Parra[3] et.al (2011) discussed the hardened properties like splitting tensile strength, modulus of elasticity and Mercury Intrusion Porosimetry (MIP) test of self-compacting concrete. Based on the test results, the splitting tensile strength of the SCC prepared with limestone filler is on average 15% less than that of Normally-Vibrated Concretes (NVC). From the point of view of deformability, the behaviour of SCCs is very similar to that of NVCs. Also, it was found that adding limestone filler produces a greater particle packing, the SCC's porous structure is finer than that of the NVCs, which explains the greater stiffness of the paste in the SCCs.

Rafat Siddique [11] (2011) studied the properties of self-compacting concrete made with five percentages of class F fly ash ranging from 15% to 35%. In this paper, self-compactability parameters of SCC, strength properties and durability properties were investigated. The carbonation depth increased with the increase in age from 90 days to 365 days in all the SCC mixes and maximum carbonation depth was observed for SCC with 20% fly ash content. Except the mix with 15, the increase in fly ash content, deicing salt surface scaling weight loss increased. In spite of maximum weight loss observed with 15% fly ash at 90 days and was almost consistent for all percentages of fly ash at 365 days age. Reduction in rapid chloride ion penetrability for the SCC made with flyash to a range less than 700 and 400 coulomb at the age of 90 and 365 days respectively.

Krishna Murthy [8] et.al (2012) proposed an experimental procedure for the design of self- compacting concrete mixes. A design tool has been used for the mix design of SCC with 29% of coarse aggregate, cement is replaced with Metakaolin and class F flyash, combinations of both. 16mm and 12.5mm sized crushed granite stones were used as coarse aggregates in a ratio of 60:40 by percentage weight of total coarse aggregate. The mix design tool is very simple and user friendly for the self- compacting concrete mix design designers and civil engineers. Moreover it can be used for the SCC mix with or without blended cement and coarse aggregate with or without coarse aggregate blending.

Janardhana Maganti[7] et.al (2012) studied the compatibility of SNF and lignosulphonates based superplasticizer with 3 Portland slag cements. 25 MPa and 40 MPa mixes were selected. From the results, it is identified that less dosage of SP is for Cement 3. Also observed that compressive strength of concrete with Cement 3 is high.

Nanak J Pamnani[10] et.al (2013) conducted experimental studies for finding and comparing the optimum dosage of different super-plasticizers for SCC using marsh cone. For this study, three different brands of PCE based superplasticizers were used. The paper concludes that all the three superplasticizers are compatible with cement but their optimum dosage differs.

S M Maheshwarappa[12] et.al (2014) studied the effect of superplasticizers compatibility on the workability, early age strength and stiffening characteristics of OPC, PPC and PSC pastes and mortar. In this paper investigations are done based on three different brands of cement and two types of superplasticizers. Hence, it stated that among PCE and SNF based SP's, PCE exhibits better compatibility with all types of cements in terms of workability and strength .0.8-1% was found to be the dosage of superplasticizer required for mortar more than the dosage required for cement paste.

Durgesh Jadhav[4] (2016) studied about the compatibility of chemical admixture with cement using marsh cone test. He deals with the properties such as optimum dosage, retention period for Ambuja cement (PPC) and two different admixtures named Conplast SP 440 and Auromix 300 were taken for the study. It is observed that admixture dosage decreases with the retention time. The result showed that Ambuja cement was more compatible with Conplast SP 440 than Auromix 300.

A.K. Shrivastava [1] et.al (2016) studied about compatibility issues of cement with water reducing admixture in concrete. For this study, a brand of PPC cement and two brands of SNF based admixture were taken for the study. For studying compatibility issues marsh cone test was selected for this work. Cement pastes were made with different admixture dosage for two brands of SNF based admixture and retention time period was noted at 5 minutes, 60 minutes, 120 minutes, 180 minutes and 240 minutes. For same PPC cement one brand of SNF base admixture dosage was 0.9% whereas second brand of SNF base admixture it was 1.1%.

Nagaraju.S [9] et.al (2018) aimed towards the study of effect of different admixtures dosage on fresh properties of Self-compacting concrete and also compressive strength of concrete. For determining the optimum dosage of admixture, 7 mixes of M40 grade were used.ADVA960 admixture which is a Poly-carboxylic-ether based was used for conducting the study. It is observed that the concrete satisfied all the requirements of SCC and also the strength gain at 0.5% dosage of admixture and cement content of 550kgs.

4. CONCLUSION

By analyzing the research papers, it is observed that various types of superplasticizers and other materials in different quantities can be used for self-compacting concrete. Determining the saturation point of superplasticizers is a very important aspect. Marsh cone test is mostly adopted one for determining the saturation point of superplasticizers. Also in most of the studies, the PCE based superplasticizers exhibit better results in durability, workability and also in strength.

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