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Compatibility of Modified Lignosulphonates (MLS) based Superplasticizer with Portland Pozzolona Cement (PPC)

Akewak Argu Sarbo
Department of Civil Engineering, JNTUH
Jawaharlal Nehru Technological University
Kukatpally Hyderabad, India

Dr. Maganti Janardhan Yadav
Professor of Civil Engineering, JNTUH
Jawaharlal Nehru Technological University
Kukatpally Hyderabad, India

***Abstract*— This study has been planned to do comparative Experimental investigation on the normal grades of M20 and M40 concrete made using Portland pozzolana cement (PPC) and modified lignosulphonate-based superplasticizer admixture and compatibility with Portland pozzolana cement before appropriate combination is used in concrete and compared with the corresponding conventionally cured concrete.**

Chemical admixtures like superplasticizers are required to be added to the concrete mix in fresh state to achieve high workability. Portland pozzolana cement is considered in this study for concretes with design strengths of M20 MPa and M40 MPa and early age strength of concrete and slump loss have been studied. To achieve high workability in the fresh state and desired characteristic compressive strength in the hardened state of the normal concretes, lignosulphonates based chemical admixture are incorporated. It is observed that the setting behavior of concrete varies significantly by the addition of modified lignosulphonate-based superplasticizer with the Portland Pozzolana cement. Setting time is delayed with this combination of superplasticizer for a particular percentage of dosages taken. Hence, it is required to study the compatibility between the superplasticizer and Portland pozzolana cement with polyethylene glycol and suitable combination is used in concrete, especially when high workability, slump retention and early age strength are required.

***Keywords*—(Cement, workablity , comprassive strength , setting time)**

I. INTRODUCTION

Concrete is the most commonly used construction materials in the world due to its effective cost, availability, high durability, and ability to sustain extreme environments. It is made by mixing Cement, water, coarse, fine aggregates and admixtures (if required) to make concrete that is simple to transporting, placing, compacting, finish which will fix, and harden to achieve a strong and durable product. The property of hardened concrete depends on the quantity of each material (i.e. cement, water and aggregates).

To easily place the concrete in the lowest price, A mix design of concrete is used. At early state concrete should be workable and cohesive, to provide durable and strong concrete then set and harden. In the mixture the proportions of each material affect the properties of the hardened concrete.

Superplasticizers are high range water reducing chemical admixture which are used to improve the workability of concrete at low water cement ratios. The use of superplasticizers in concrete highlight the problem such as slump loss, segregation of concrete, bleeding of concrete reduction in compressive strength of concrete etc., incases of some combinations of cement and superplasticizers, while in the other case a high slump can be maintained during the first 60 to 90 minutes following contact between the cement and water, without any sign of segregation, bleeding and reduction in compressive strength. The realization that properties of concrete in both the fresh and hardened states can be modified by adding certain materials to concrete mixtures is responsible for the large growth of the concrete admixtures industry during the last 40 years.

Janardhana Magnanti et al., (2012) have reported the compatibility of three brads of flay ash-based Portland Pozzolana Cements with four different kinds (families) of chemical admixture (superplasticizer) studied. It is illustrated that the proper selection of superplasticizer for each and every cement is necessary to understand the behaver of concrete. It is also observed that the different brand of cements (PPC) behaved differently even if the course and fine aggregates, water and chemical admixture and the method the concrete mix design were kept constant. Hence, it is advisable to know the interaction of the superplasticizer with the cement, even if they are of similar kind, and trial concrete mixes have to be studied in a laboratory before actually using them at site

Agarwal S.K. et al., (2000) have studded on the compatibility of admixture with different cements. Four commercial superplasticizers based on the four different functional groups, viz. five chemical admixtures and five types of cements, viz. three from the three grades of OPC (33, 43 and 53 grade) and one each of Granulated blast furnace slag cement and a Portland Pozzolana cement have taken to make the study on the effect of different superplasticizers with respect to the setting behavior and compressive strength. They found that the 33 grade OPC had shown retardation with naphthalene-based superplasticizer at the optimum dosage (2%) of manufacturer, whereas 43 grade OPC had observed retardation with blended polymer-based superplasticizer and they also found that Portland slag cement and 53 grade OPC were compatible with all superplasticizers. They found that Portland Pozzolana cement existed to be sensitive enough to the addition of superplasticizer so far as the setting time behavior is concerned. Set retardation compressive strength is observed in

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PPC concretes in case of all super extent of 10-20%. naphthalene based superplasticizer. *Magnanti Janardhana et al., (2004)* have conducted the experiments to study the effect of combination of admixtures on setting times of concrete. Super plasticizing admixture and retarding admixture were added in different dosages to the cement concrete made up of with ordinary Portland cement. They found that the initial setting times of concrete decreases with increase in grade of concrete and also superplasticizers prolong the setting times of concrete. *Min-Hong Zhang, et al., (2010)* presents an experimental study on the effect of a newly developed modified lignosulphonates (PLS) superplasticizer on the loss of workability and initial setting time of cement pastes in comparison to those of polycarboxylate (PCE) and polynaphthalene (PNS) superplasticizers. The workability loss was monitored by yield stress and effective viscosity of the pastes. The initial setting was monitored by heat development, change of rheological parameters with time, and penetration depth in cement pastes. The results indicate that the pastes with PLS lost workability more gently and had more initial setting time compared with those with PCE and PNS admixtures. Even if the longer workable time is important for hot weather concreting, the longer initial setting time of such material has to be taken into consideration where early strength development is essential.

Experimental Investigation

The experimental observations on different parameters of different concrete mixes are discussed. The parameters are workability, setting time and compressive strength of concrete.

From the early in construction industry pumpability and high slump or workable of concrete play major role, mostly where concrete is made far distance from strength superplasticizer base project site, for example as 'ready mixed concrete (RMC) is processed at a batching plant. In order to get high workability and also to obtain slump-retention needed away from water, aggregate, cement, superplasticizer is added in the concrete. If a particular type of cement and superplasticizer are not compatible, it may tend to adverse effect on quality of concrete. Common problems contain flash setting, returned setting, fast slump loss, strength loss, cracking etc. These problem in causes to affect the hardened properties of concrete, specially the durability and strength of The Initial slump value of 150 mm is taken and to have the minimum workable slump value of 50 mm after 1 hour, several trails with different dosage of superplasticizers are carried out until initial slump of 150mm is achieved.

Grade of Concrete	Dosage of Superplasticizer (SP) (% Weight of the Cement)	Slump observed (mm)		
		Initial	After 30minutes	After 60minutes
M20	0.5	78	42	28
M20	1	113	83	56
M20	1.25	156	115	75
M20	1.5	180	145	95

Grade of Concrete	Dosage of Superplasticizer (SP). (% Weight of the Cement)	Slump observed (mm)		
		Initial	After 30 minutes	After 60 minutes
M40	0.5	68	45	25
M40	1	110	76	52
M40	1.25	152	95	68
M40	1.5	190	150	84

Table 1. Slump retention value for M20 MLS based

Age of concrete	Dosage of SP (%)	Applied load			Average load (KN)	Compressive strength (MPa)
		Specimen I	Specimen II	Specimen III		
7 Days	0.5	387.4	525.6	456.5	456.5	20.29
	0.1	485.5	471.7	534.8	497.3	22.10
	1.25	515.5	520	544.5	526.66	23.40
	1.5	417.3	387.1	385.5	396.5	17.62
28 Days	0.5	452.1	634.2	639.6	5753	25.56
	0.1	744.28	592.2	712.3	682.92	30.35
	1.25	748	810	770	776	34.4
	1.5	379.6	506.9	455.5	447.4	19.88

Table 2. Slump retention value for M40 MLS based

Age of concrete	Dosage of SP (%)	Applied load			Average load (KN)	Compressive strength (MPa)
		Specimen I	Specimen II	Specimen III		
7 Days	0.5	748.1	775.5	700.8	741.46	32.96
	0.1	834.2	946	679.2	819.8	36.43
	1.25	848.1	985.5	734.8	856.13	23.40
	1.5	860	887	720	822.33	38.05
28 Days	0.5	1040	966.3	952	986.1	43.82
	0.1	1096.6	1100.7	1086.7	1094.66	48.65
	1.25	1134.2	1184.6	1179.2	11166	49.62
	1.5	1064.5	1127.4	1072.3	1088.06	38.05

Table 3. compressive strength superplasticizer based

Table 4. compressive strength for M40 superplasticizer based

Table 5. Setting time of M20 and M40 Based on MLS superplasticizer

Concrete grade	Optimum dosage of SP (%)	Setting times (hrs.)	
		Initial	Final
M20	1.25	9	16.5
M40	1.25	11.00	19

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DISCUSSION OF TEST RESULT

The workability and compressive strength of M20 and M40 grades concrete mix for different percentages of MLS based super plasticizer as shown in above tables. The results for various percentages as discussed below;

For M20 grade concrete the compressive strength at 7 days and 28 days addition of 1.25% MLS the compressive strength shows higher values of 30.5N/mm² and 36.45 N/mm². Similar trend of 1.25%, the initial slump 162 mm and slump after an hour is 72 mm. at 1.25% of MLS the initial setting time of concrete 11.5 hours and Final setting time of concrete 18.5 hours.

Compressive strength of M40 grade concrete at 7 days and 28 days addition for 1.25% of MLS the compressive strength shows an increased values of 39.39 N/mm² and 50.23N/mm².
At 1.25% of MLS based super plasticizer the initial slump 158 mm and slump after an hour is 66 mm.
At 1.25% of MLS based super plasticizer, the initial setting time of concrete 11 hours and Final setting time of concrete 21hours.

The optimum dosage of super plasticizer admixture for both M20 and M40 is found to be 1.25% by weight of cementitious materials for M20 grade of concrete for Workability and compressive strength. Increase of dosage of super plasticizer admixtures are increases setting times of concrete.

CONCLUSIONS

The following conclusion are made depend on the result analyzed for this experimental project;

PPC is compatible with MLS superplasticizer as it improves the property of concrete. For M20 and M40 grades, the workability and compressive strength of concrete mix with different percentages of MLS based superplasticizers are getting high as increasing dosage MLS until it reaches limit point strength of concrete. The concrete setting time getting more as the grade of concrete increases. using concrete strength relatively high as it has been compared with conventional concrete.

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