EXPERIMENTAL STUDY OF SELF COMPACTING SELF CURING CONCRETE WITH USING LIMESTONE LIQUID AND POLYETHYLENE GLYCOL400

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Abstract : Self-curing is done in order to fulfill the water requirements of concrete whereas self-compacting concrete is prepared so that it can be placed in difficult positions and congested reinforcements. This investigation is aimed to utilize the benefits of both self-curing as well as self-compacting. Self-Compacting concrete is a type of concrete that gets compacted under its self-weight. It's commonly abbreviated as SCC and defined as the concrete which can placed and compacted into every corner of a formwork; purely means of its self-weight by eliminating the need of either external energy input from vibrators or any type of compacting effort. In this study, the effect of replacing the cement by limestone liquid with (4%,8%,12%,16%,20%24%) respectively and the effect of admixture (PEG 400) on compressive strength, split tensile strength, flexure strength and modulus of rupture by varying the percentage of PEG by weight of cement from 0.5% to 3% were studied for M40. And polycarboxylate based super plasticizer is added to concrete. It was found that PEG 400 could help in self curing by giving strength with conventional curing.

Keywords— self-compacting concrete; self curing concrete; polyethylene glycol 400; limestone liquid; mix design; casting

I. INTRODUCTION

Self-Compacting Concrete (SCC) which requires no vibration for compaction. When behavior with SCC segregation or bleeding should be taken care. SCC ensures the proper filling capability in seriously reinforced structural members, thereby development in performance. And the advantages of SCC include (i) shortening of the construction time and labour cost (ii) better quality surface finishing (iii) decrease of noise due to vibration and (iv) Better working situations. Segregation may be escaped by increasing the percentage of fine aggregate. When increasing of fine aggregate cement content also should be increased. To decrease the adverse effects of cement, mineral admixtures such as Limestone liquid and Polyethylene glycol 400 may be used.

Efficient curing improves the strength and stability of concrete. Concrete curing is a major experiment in the construction industry, especially in areas, which suffer from the shortage of water. Normal curing methods seem to be the best methods for curing giving maximum strength and stability. Sometimes the sufficient curing conditions cannot be formed so, self-curing concrete is suggested in such cases. Self-curing or internal curing is a new procedure that can be used to provide extra moisture in concrete for more effective cement hydration and reduced self-desiccation without the need to use conventional curing regimes. The self-curing main concept is to reduce the departure of water from concrete and therefore increase the water retention capacity of the self-cured concrete when compared to conventional concrete by using chemical curing agents. Shrinkage-reducing admixture (SRA) (like propylene glycol type and polyethylene glycol), based on the use of poly-glycol products in the concrete mixtures, has been recently advised to reduce the crashes in concrete structure caused by drying shrinkage. The mechanism of this admixture based on the reduction of the surface tension of the mixing water as a physical change quite than on a reduction of water evaporation. Self-curing (SC) concrete with curing agents gives about 10% less compressive strength than standard water curing.

Self-compacting concrete :-

In early eighties in Japan, the concrete structures get declined everywhere in the country. The reason for decline was found to be insufficient compaction. The quality of construction work gets worse due to the lack of skilled workers in construction engineering. So to eliminate these social and technical problems, Prof. Okamura from Tokyo University in 1986 proposed a new system called self-compacting concrete (SCC). Having high flexibility the self compacting concrete fills the molding board and covers the reinforcement. Due to its high flexibility, it is not isolated. SCC works well with the low water/cement ratio. No air is get trapped inside the concrete. SCC exhibitions good mechanical properties and durability. The problems like outflow vibration, over vibration and bar dense are prohibited by SCC. Self-Compacting Concrete is proportioned with an optimum aggregate content, low water/cement ratio and high level dosage of super plasticizer. Self-Compacting Concrete has different properties like:

- Filling ability: It fills the voids in the formwork
- Passing ability: It passes through congested reinforcements.
- Separation resistance: To remain regular in composition during transport and placing.

Self-Curing concrete:-

Curing is the procedure of adding water to the concrete externally after the concrete is being mixed, placed and finished. Proper curing of concrete agrees hydration of cement and constant gain of strength. Curing sustains the moisture movement from and into the concrete. Hydration stops when relative moisture within capillary pores drops to 80%.Self curing or internal curing is a system by which the hydration of cement prevails with the accessibility of extra internal water is not the external water. The internal water is maintained by including the self-curing agent polyethylene glycol (PEG 400) by weight of cement from 1% to 3% were studied for M40 mixes. Which reduces the evaporation of water from the concrete, thereby increasing the water retaining capacity of concrete.

Experimental Investigation:-

[1]Material Used:

Cement -Cement is one of the important elements of mortar it is the binding material in mortar which is used for all building elements. Most important value is the faster rate of development of strength. Ordinary Portland cement 53 grade is used for casting the mortar cubes. Cement properties are evaluated as per the IS methods.

Fine Aggregate -Natural river sand well graded passing over 4.75 mm sieve is will be used. Fine aggregate followed to Indian Standard Specifications IS: 383-1970.

Coarse Aggregate -Uncrushed gravel or stone which is the result of natural breakdown and crushed gravel or stone are usually called the "Coarse Aggregates". As stated earlier, coarse aggregates are stones that are retained on 4.75mm sieve. Nearly all natural aggregates make from bed rocks. Fine aggregate properties are calculated as per the IS 2386-1963 methods.

Superplasticizer -CeraHyperplastxr– 40 is a polycarboxylate ether based new range water reducing admixture. It helps in the production of self - compacting concrete. It improves pump ability at low water - cement ratios and low cement contents. It also achieves a higher slump than normal plasticizer and it retain slumps to extend than the normal superplasticizer.

Polyethylene glycol 400-The compressed polymer of ethylene oxide and water is polyethylene glycol. Polyethylene glycol 400 by weight of cement 0.5% to 3% were studied both for M40. In this study where 400 is the molecular weight. It has general formula H (OCH2CH2)nOH. They solvable in water. It is nontoxic, odorless, non-volatile and non-irritating. It has wide variation of uses in medicine.

Lime stone liquid -A high quality lime stone liquid mostly permits a decrease in water content of a concrete mixture, without loss of workability. The effect of replacing the cement by limestone powder with (4%,8%,12%,16%,20%,24%) used.

[2] Mixing Proportion:-

Following table showing mix design of SCC with addition of different proportion of Limestone liquid. Limestone liquid replacement ranges from 0% to 24% in the step of 4% by volume. And added by Polyethylene glycol 400 by varies percentage of 0% to 3%. Course aggregate and Fine aggregate volume remained constant.

Table-1: Mix Proportion

Cement (kg/m^3)	F.A (kg/m^3)	C.A (kg/m^3)	Water (Ltr/m^3)	SP (2.5%) (kg/m^3)
394.3	956	781	174.9	9.857

Table-2: Partial Replacement of Limestone liquid with Cement and added PEG 400

Replacement % of Limestone liquid	Cement (kg/m^3)	Lime-stone liquid (kg/m^3)	PEG 400 (%)	PEG 400 (Ltr/m^3)
0	394.3	0	0	0
4	378.52	15.77	0.5	1.97
8	362.75	31.54	1	3.94
12	347.24	47.35	1.5	5.91
16	331.52	63.08	2	7.89
20	315.44	78.86	2.5	9.86
24	299.66	94.63	3	11.83

[3] Test on fresh SCC:-
Tests of SCC on fresh properties include slump flow, v-funnel test and L-box test. The result of this test is given in table 3.

Slump Flow: - The maximum flow of concrete in absence of any obstructions was conducted by slump flow test in which the slump cone was filled mixed without any compaction. The value of Slump flow is the average of the two diameters cone in perpendicular directions of the concrete after lifting the cone and until concrete stops flowing.

Fig.1- Slump Flow Test

Fig.2- V-funnel test specimen

V-funnel: - This test is used to determine the filling ability properties (flow ability) of the concrete. The funnel is filled up with 12 liter of concrete. Find the time taken for its flow down. V-funnel value is the time of concrete flowing from the opening at the bottom of the funnel. Both the test gives indications of flow ability of concrete.

L- Box: - This test assesses the flow of concrete and also the extended to which the concrete is subjected to blocking by reinforcement. About 14 liter of concrete is required for the test and let it rest for 1 minute before the test.

Fig.3- L-Box test

Table 3:- Result of fresh concrete

Test	Properties	Time	Flow
Slump Flow	Falling ability	8 sec.	620
V-funnel	Falling ability	12 sec.	-
L-box	Passing ability	1.5,2 sec.	-

Results and Discussion:-

[1]Compressive strength:-
Concrete cubes of size 150×150×150mm were casted and tested for compressive strength of 7, 28 days for 0%, 4%, 8%, 12%, 16%, 20%, and 24% replacement of Limestone liquid and added by Polyethylene glycol 400 of 0%, 0.5%, 1%, 1.5%, 2%, 2.5%, 3% for M40 grade of concrete.

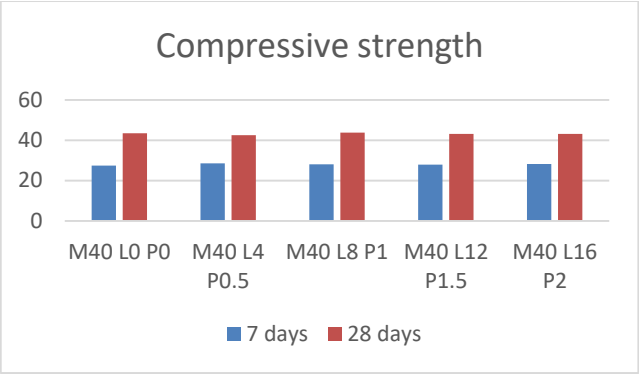

Fig 4

[2] Split Tensile strength:-

Fig.5 shows tensile strength results for mix with different percentage of Limestone liquid and polyethylene glycol 400.

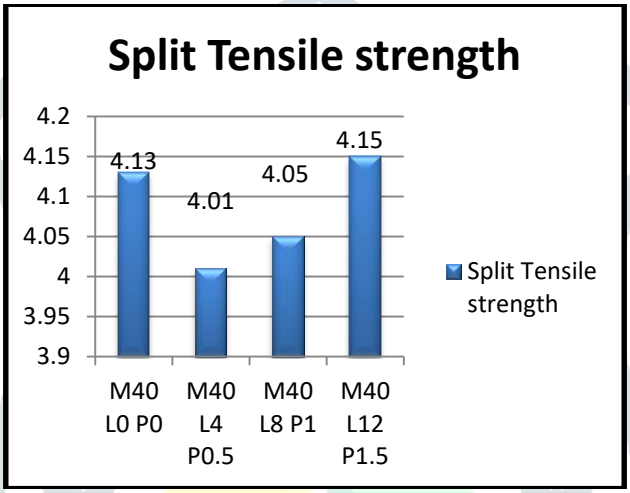

Fig 5

[3] CONCLUSION

1. The self compacting self curing concrete in optimum percentage of 6% using limestone liquid and polyethylene glycol 400.
2. Self compacting self curing concrete After 7 days and 28 days compressive strength is increased and no cured speciments.
3. After 28 days Split Tensile strength is increased.

REFERENCES

[1] ASTM.C-494, Chemical Admixtures, American Society for Testing and Materials ASTM International, Philadelphia, USA, 2003.
[2] H.A. Mohamed, Effect of fly ash and silica fume on compressive strength of self compacting concrete under different curing conditions, A Shams Eng. J. no. 2 (2011) 79–86.
[3] G.S. Rampradheep, M. Sivaraja, Experimental investigation on self-compacting self curing concrete incorporated with the light weight aggregates (no. spe2, pp. 1- spe11), Braz. Arch. Biol. Technol. 59 (2016) (no. spe2, pp. 1-spe11).
[4] M. Ravikumar, C. Selvamony, S. Kannan, B. G..S, self-compacted self-curing Kilnash concrete, Int. J. Des. Manuf. Technol. 5 (1) (2011).
[5] D.P. Bentz, P. Lura, J.W. Roberts, Mixture proportioning for internal curing, Concrete Int. 27
[6] (2005) 35–40. B. Felekoglu, K. Tosun, B. Baradan, A. Altun, B. Uyulgan, The effect of fly ash and limestone fillers on the viscosity and compressive strength of self-compacting repair mortars, Cem. Concr. Res. 36 (2006) 1719–1726.
[7] E. Guneyisi, M. Gesoglu, E. Ozbay, Effects of marble powder and slag on the properties of self-compacting mortar, Mater. Struct. 42 (2009) 813–826.
[8] Benchaa Benabed, El-Hadj Kadri, Lakhdar Azzouz, Said Kenai, Properties of self-compacting mortar made with various types of sand, Cem. Concr. Compos. 34 (2012) 1167–1173.
[9] M. Sahmaran, H.A. Christianto, I. Ozgur Yaman, The effect of chemical admixtures and mineral additives on the properties of self-compacting mortars, Cem. Concr. Compos. 28 (2006) 432–440. H. Okamura, M. Ouchi, Self-compacting concrete.

Development, present use and future, in: Proceedings of first international RILEM symposium on self-compacting concrete, RILEM Publications, S.A.R.L., Stockholm, 1999, pp. 3–14.
[10] P.J.M. Bartos, M. Grauers, Self-compacting concrete, Concrete 33 (4) (1999) 9–13.
[11] D.W.S. Ho, A.M.M. Sheinn, C.C. Ng, C.T. Tam, The use of quarry dust for SCC applications, Cem. Concr. Res. 32 (2002) 505–511.
[12] Wenzhong Zhu, J.C. Gibbs, Use of different limestone and chalk powders in self-compacting concrete, Cem. Concr. Res. 35 (2005) 1457–1462.
[13] Interim SCC Guidelines FAST Team, TR-6-03 Interim Guidelines for the Use of self-Consolidating Concrete in Precast/Prestressed concrete institute Member Plants, Precast/Prestressed Concrete Institute, Chicago, April 2003.
[14] H. Okamura, M. Ouchi, Self-Compacting Concrete, Journal of Advanced Concrete Technology, Vol.1, April 2003, pp. 5-1.
[15] European Project Group, The European Guidelines for Self Compacting Concrete, Specification production and use, 2005.
[16] ACI Commitee 226, Use of Fly Ash in Concrete, ACI Materials Journal, September- October, 1987, pp. 381-409.