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An Experimental Study on Mechanical Properties of Steel Fiber Reinforced Self Curing Concrete

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***Abstract*— Today concrete is most widely used construction material due to its good compressive strength. Depending upon usage the cement, fine aggregate, coarse aggregate and water are mixed in various proportions to produce desired concrete. conventional concrete needs a minimum period of 28 days for good hydration to attain desired strength. Any laxity in curing will badly affect the performance of concrete. Self-curing concrete is one of the special concrete in dry areas, inaccessibility of structures in difficult terrains and in areas where the presence of fluoride content water will badly affect the concrete. The present study deals with use of shrinkage reducing admixture polyethylene glycol (PEG 400) in concrete that helps in self curing. The optimum value of PEG is fixed as 1% of weight of cement. In the present study, the affect of admixture (PEG 400) on compressive strength, split tensile strength and flexural strength by varying the percentage of steel fiber by weight of cement from 0%,0.25%,0.5%,0.75%,1%,1.25%,1.5% were studied M20 mix. It was found that PEG 400 helps in self curing by giving strength on par with conventional curing. It was also found that 0.75% of steel fiber for weight of cement for M20 grade concrete gives maximum strength in compression and 1% in tensile and flexural strength without compromising workability.**

I. INTRODUCTION

In concrete Proper curing of structures is important to meet performance requirements. In conventional curing strength is achieved by external curing applied after mixing, placing and finishing. In this curing is done from 'outside to inside' Self-curing or internal curing is a technique in which moist condition is maintained in concrete for this process of curing is done from 'inside to outside'.

1.1 Methods of self curing

There are three types of self curing they are explained as follows, the first method uses saturated porous lightweight aggregate (LWA) to supply an internal source of water, which can replace the water consumed by chemical shrinkage. The second method uses poly-ethylene glycol (PEG) which is a shrinkage reducing admixture (SRA), reduces the evaporation of water from concrete and also helps in water retention. The third method is use of super absorbent polymer (SAP) which is a polymeric material which is able to absorb significant amount of liquid from the surroundings and retains the liquid within its structure without dissolving and cures the concrete.

1.2 Mechanism of Internal Curing

Evaporation of moisture takes place in an exposed surface of concrete due to the difference in chemical potentials between the vapour and liquid phases. The polymers added to the mix forms hydrogen bonds with water molecules and reduces the rate of evaporation from the surface

1.3 Materials for Internal Curing (IC)

The materials that can provide internal water reservoirs are as follows

A. Super absorbent polymer(SAP)

B. Light weight aggregate

C. Shrinkage reducing admixture(SRA)

1.4 Polyethylene Glycol

It is a condensation polymer of ethylene oxide and water with the general formula $H(OCH_2CH_2)_nOH$, where n is number of repeating oxyethylene groups typically ranges from 4 to about 180. The abbreviation (PEG) is termed in combination of a numeric suffix which indicates the average molecular weight. One common feature of PEG is the water-soluble nature. It is non-toxic, odourless, non- irritating and is used in a variety of pharmaceuticals.

II. LITERATURE

Strength Characteristics Of Self- Curing Concrete

The optimum dosage of PEG400 for maximum strengths (compressive, tensile and modulus of rupture) was founded as 1% for M20 and 0.5% for M40 grades of concrete. The compaction factor increases with increase in dosage of PEG 400. It also states that self curing concrete is the only answer for many problems caused in curing.

Admixture Technical Sheet – ATS 15

Some literature gives only the dosage of SRA only in percentage say about 1 to 1.25% of weight of cement. This paper explains that the shrinkage reducing admixture must be added along with the second half of water that is added to prepare the concrete mix.

III. OBJECTIVE

The objective is to study the mechanical characteristics of concrete that includes compressive strength, splitting tensile strength and modulus of rupture for percentage of steel fiber such as 0%,0.25%,0.5%,0.75%,1%,1.25%,1.5% of weight of cement for both M20 grade concrete with 1% of PEG 400.

IV. EXPERIMENTAL PROGRAMME

The experiments were designed to investigate the strength of self curing concrete by adding steel fiber at proportions of 0.5%, 0.75%, 1%, 1.25% and 1.5% to the weight of cement. The experimental program was to study the workability, compressive , split tensile and flexural strength. These properties are studied from mix M20. The schemed experimental program is given in Table.

S.No	STEEL FIBER	SPECIMEN		
		CUBE	CYLINDER	PRISM
1	Plain (0%)	9	9	9
2	0.25%	9	9	9
3	0.5%	9	9	9
4	0.75%	9	9	9
5	1%	9	9	9
6	1.25%	9	9	9
7	1.5%	9	9	9

The size of specimens are as follows

- Cube is 100*100*100 mm
- Cylinder is 100 mm dia 200 mm length
- Prism is 100*100*500

V. MATERIALS USED

5.1 Cement: Cement used was 53 grade ordinary Portland cement confirming IS: 12269: 1987.

5.2 Fine aggregate: The fine aggregate was obtained from river source. The fine aggregate conforming zone III according to IS: 383-1970 was used.

***5.3* Coarse aggregate:** The coarse aggregate satisfying IS: 383-1970 was used. Maximum coarse aggregate size used is 20 mm.

***5.4* Polyethylene Glycol-400:** It is a condensation polymer of ethylene oxide and water with the general formula $H(OCH2CH2)_nOH$. The PEG-400 use in the investigation have Molecular Weight 400, Appearance Clear liquid, pH 5-7, Specific Gravity 1.126

5.5 Water: Portable water was used in the experimental work for both mixing and curing purposes

***5.6 steel fiber*:** fiber.20 mm fiber were used.

PROPERTIES OFMATERIALS

	SPECIFIC GRAVITY	FINENESS MODULUS
FINE AGGREGATE	2.32	3.9
COARSE AGGREGATE	2.46	6.64

CEMENT

Consistency	34%
Initial setting time	30 min
Specific gravity	3.18
Fineness	2.3%

VII. MIX PROPORTION

Mix design is done based on IS 10262:1982. The concreting were done according to IS 516: 1959. The concrete samples were cured for 28 days in portable water and the specimens with SRA were cured for 28 days at room temperature in shade. The M20 grade concrete is designed and the material required per cubic meter of concrete is shown in Table.

Water (lit/m^3)	Cement	Fine aggregate	Coarse aggregate
191.58	383.16	574.74	1072.848

VI. TESTING

7.1 compaction factor test: The compacting factor test is designed primarily for use in the laboratory but it can also be used in the field. From this we can check the workability also.

7.2 compression test: It is done in the machine capacity of 2000 KN. The axis of the specimen is carefully aligned with the centre of the spherically seated plate. The spherically seated block is brought to bear on the specimen and the load is applied without shock and continuously at a rate approximately 140 kg/cm^2/min until failure of the specimen. The maximum load applied to the specimen until failure is recorded. Then based on the load value the compression strength of the concrete specimen is calculated as follows

F_c = P/A , where, P is load & A is area

7.3 splitting tensile strength: It is done in the machine capacity of 500 KN. The cylinder is placed in such a way that the load is applied on the circumference area of the cylinder. The cylinder is then subjected to loading and then the strength is calculated as follows

Fsplit = 2 P/πDL, where L=length of the cylinder,P=load, D= diameter of cylinder

7.4 flexural strength: It is done in universal testing machine. The loading is, two point loading system as mentioned in IS 516, The strength is calculated by

fprism = PL/bd^2, where P= load, L=span length, b=breadth, d=depth

SPECIMEN TESTING

VII. RESULTS AND DISCUSSION

***Compaction factor*:** As the % of PEG400 increases the compaction factor is found to increase.

s.no	% of steel fiber	Compaction factor
1	0	0.909
2	0.25	0.910
3	0.5	0.905
4	0.75	0.893
5	1	0.891
6	1.25	0.885
7	1.5	0.876

Mechanical properties

S.No	% OF STEEL FIBER	F_c (N/mm^2)	F_{split} (N/mm^2)	F_{prism} (N/mm^2)
1	Plain(0%)	21	2.64	3.14
2	0.25%	21.8	2.71	3.56
3	0.5%	22.3	2.77	3.76
4	0.75%	23.1	2.83	3.94
5	1%	22.6	3.1	4.1
6	1.25%	21.95	2.96	3.79
7	1.5%	21.77	2.87	3.66

COMPRESSIVE STRENGTH

The compressive strength obtained at 0.5% of PEG 400 with 0.75% steel fiber is 23.1 N/mm^2 which is 9.1% more than controlled concrete.

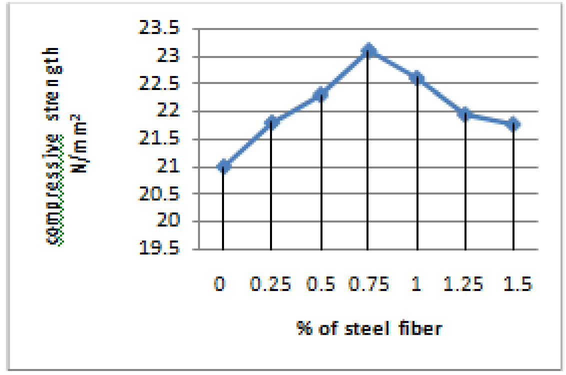
SPLITTING TENSILE STRENGTH

The splitting tensile strength obtained at 0.5% of PEG 400 with 1% fiber is 3.1 N/mm^2 which is 14.84% more than controlled concrete.

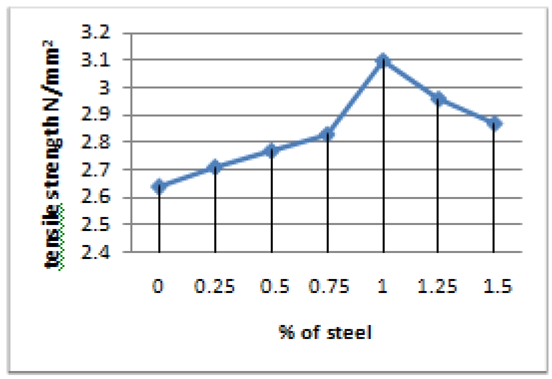
FLEXURAL STRENGTH

The flexural strength obtained at 0.5% of PEG 400 with 1% steel fiber is 4.1 N/mm^2 which is 24.86% more than controlled concrete.

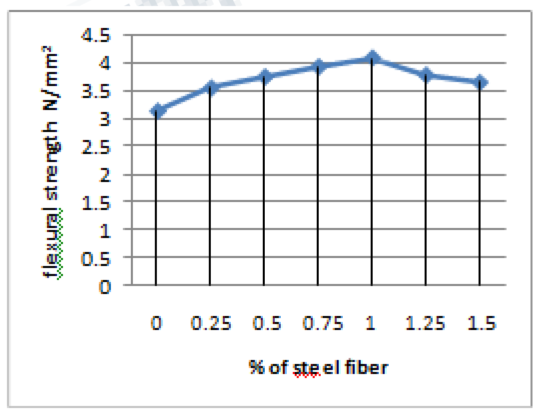
VARIATION IN COMPRESSIVE STRENGTH



VARIATION IN SPLITTING TENSILE STRENGTH



VARIATION IN FLEXURAL STRENGTH



VIII. CONCLUSION

From the experimental results the optimal dosage of steel fiber for peg 400 is 0.5% of weight of cement is 0.75% in compression and 0.75% for tensile and Flexural strength. It is also found that compressive Strength, Splitting Tensile Strength, Flexural Strength Of Self Curing Concrete Is Better Than Conventional Concrete.

REFERNCE

1. Dale P. Bentz, max A.peltz, Kenneth A.Synder and

Jeffery M.Davis , verdict : viscosity enhancers reducing diffusion in concrete technology, concrete international, January 2009

2. A.Aielstein Rozario, Dr.C.Freeda Christy, M.Hannah Angelin, experimental studies on effects of sulphate resistance on self curing concrete, Vol. 2 Issue 4, April – 2013, ISSN: 2278-0181

3. Tarun R. Naik and Fethullah Canpolat, self curing concrete, April 2006

4. Self-curing concrete using water soluble polymers, UAEU

5. M. S. Ravikumar, Selvamony .c,s.u.kannan, s.basil gnanappa, Behaviour of self compacted self curing kiln ash concrete with various admixtures, VOL. 4, NO. 8, OCTOBER 2009, ISSN 1819-6608

6. IS 383- 1970, 'Specification for coarse and fine aggregate from natural sources for concrete‟ Bureau of Indian Standards, New Delhi, India.

7. IS 10262 : 2009,‟Concrete mix proportioningguidelines‟ Bureau of Indian Standards, New Delhi, India.

8. IS: 516-1959, „Methods of tests for strength of concrete‟ Bureau of Indian Standards, New Delhi, India.

9. www.kraft-system.com