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Experimental Study on Self Curing Fiber Concrete

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Abstract:
Water is the major demand in today's world. For concrete water curing needs to be done minimum of 28days. Internal water curing is the one way of finding root cause of shrinkage on concrete. This study is about self curing concrete .Self curing concrete is nothing but curing takes place internally. Super Absorbent Polymer (SAP) is act as a curing agent. The dosage of SAP used is 0.3% of binder content. The grade designated is M40. Using of SAP gives the strength more than that of conventional concrete. And also Sisal fibreupto 0.4% added to the concrete to improve its durability. Mechanical strength and ability of hardening were found by the concrete using SAP & Sisal fibre addition. And also the long term properties such as a water absorption, presence of voids, carbonation depth were tested at 28, 56 and 90 days.

Keywords*: Self-curing Concrete, Self curing Admixture, Fibrous Self curing Concrete, super absorbent polymer, sisal Fibe.*

1. INTRODUCTION

Concrete is the combination materials such as cement, sand, coarse aggregate and water. In that all the material were binded with the help of water. And also water is used for curing process which is essential for the hardening of concrete. Water is important for heat of hydration process. Nowadays the water sources are getting reduced and the demand in water is high. To avoid the scarcity of water in concrete field self curing concrete gives the better solutions. The water present in the internal surface of the concrete is used for self curing. The main concept behind self-curing is to minimize the loss of water from the surface of concrete. The requirement of water for concreting is high. Self curing concrete is also gives the required strength and durability required for conventional concrete. Curing ability affects majorly the durability of concrete.

2. LITERATURE REVIEW

Magda I. Mousa A,*Et Al (23 April 2015), Study involves with silica fume as a binder and shrinkage reduction admixture. Polyethylene-glycol (Ch) as a self curing agent is used. At a temperature of 25^0C & 50^0C the concrete was maintained under self cured .The long term properties called durability test was conducted. Results shows silica fume with Ch gives good water retention and durability of the concrete.

ShikhaTyagi Et Al (Sep-2015),.Study involves that POLYETHYLINE GLYCOL (PEG 400) used as a self curing agent. The grade used in this method is M25& M40. The test results shows that self curing concrete with PEG gives good performance on strength and durability compared with the

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conventional concrete.

S. Jemin Joel, Et Al., The study is about self curing concrete with super absorbent polymer. The dosage use upto 0.5% of binder. The grade of concrete used is M40.The compressive strength, tensile strength and flexural strength was found. The result shows that the dosage of SAP about 0.3% gives the good results in all the characteristics of concrete tested.

Sanjay et_al (2012),"Metakaolin- Pozzolanic Material as a High Strength Concrete".The usage of metakaolinwhich gives good pozzolanic activity ,and gives high strength concrete. The optimal isfound by replacing upto 15% of the cement with metakaolin. The strength of concrete at 28 days creeps by 20%. With the 15% of metakaolin decrease the workability of suspension in time. Increasing amount of metakaolin in concrete is requiring higher dosage of super plasticizer to ensure longer workability.

R. Aarthi, R. Venkatakrishnaiah(2014) , This work involves the the use of SAP and steel fibre as admixtures and it is compared with the Fly ash based concrete. M30 grade of concrete was used. The dosage of SAP up to 0.5% and steel fibre up to 2%.The results shows that SAP at 0.3% and steel fibre at 1.5% gives higher results compare with the fly ash based concrete.

MAGDA I, MOUSA ET (18 MAY 2014), This study involves with the use of different curing agents. One is pre soaked lightweight aggregate (leca) another one is Polyethylene geogel (Ch). The dosage of leca is used upto 20% and Ch is used at a dosage up to 3% of weight of cement. The results shows that self curing agent Ch is better than the leca curing agent. High binder content and low W/C ratio gives better results with self curing agents.

3. OBJECTIVES

- To minimize the usage of water resources
- To increase the self curing ability of concrete by adding absorbent.
- To improve the ability against loading of concrete along with self curing ability by sisal fibre
- To compare the durability on concrete with SAP & fiber with normal concrete.

4.MIX DESIGN FOR M40 GRADE CONCRETE

Mix design is used to maintain the required quality and strength on concrete as per standards. This study is use the mix of M40 grade.

4.1 DESIGN STIPULATIONS

Mix proportioning is used for determining the proportion of concrete binding ingredients that meet the mix design standards. The mix proportion used for our requirement are as follows:

Table -1characteristics of a concrete mixture.

Grade of concrete	M40
Cube compressive strength on concrete at 28 days	40 N/mm²
Size of aggregate (Max)	16mm
Degree of workability	100mm (slump value)
Degree of control	Good
Type of exposure	Mild

4.3MIX DESIGN

The mix characteristics are as follows

Table-2 Volume of concrete per unit length

Target mean strength	44.4 N/mm²
Water/cement ratio	0.36
Weight of cement	438 kg
Weight of water	157.6 litre
Weight of fine aggregate	770.6 kg
Weight of coarse aggregate	1061.6kg

4.4 MIX PROPORTION

Therefore required mix proportion for ternary blended is given below.

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Table-3Mix proportion of concrete

Water	cement	fine aggregate	coarse aggregate
0.36	1	1.75	2.42

5. SPECIMEN IDENTIFICATION

The various specimen cast are shown in below table.

Table-4.Specimen Identification

Mix	**Cement (kg/m^3)**	**FA (kg/m^3)**	**CA (kg/m^3)**	**SAP (%)**	**Fiber (kg/ m^3)**	**Water ($litre/m^{3)}$**	**S.P ($litre/m^3$)**
C M	438	770.6	1061	-----	-----	158	4.7
SCC	438	770.6	1061	0.3	-----	211.32	4.7
FSCC1	438	770.6	1061	0.3	0.9	211.32	4.7
FSCC2	438	770.6	1061	0.3	1.8	211.32	4.7
FSCC3	438	770.6	1061	0.3	2.7	211.32	4.7
FSCC4	438	770.6	1061	0.3	4.5	211.32	4.7

6. TEST ON FRESH CONCRETE

6.1 FRESH CONCRETE PROPERTY

To decide the concrete quality and strength we are in need to do fresh concrete test. This helps to know the concrete setting properties and strength on concrete.

6.2 TESTS FOR FRESH CONCRETE

1. SlumpCone Test

6.2.1 SLUMP CONE TEST

Slum cone test was the most commonly used for workability test. It is used to know the concrete consistency with provided water cement ratio.

Fig-1 Testing of Slump Cone test

7. TEST ON HARDENED CONCRETE

7.1 HARDENEND CONCRETE PROPERTY

Concrete strength and durability are getting know by hardened concrete test. And also it is used to determine the concrete quality of concrete.

7.2 TESTS FOR HARDENED CONCRETE

1. Compression strength Test
2. Split Tensile Test
3. Flexural strength Test

7.2.1 CUBE COMPRESSION TEST

Compression strength test was conducted with the use of Universal Testing Machine. The load acts at normal direction to the surface of cube specimen. The specimen is used at a dimension of 150mm x 150mmx 150mm.

Compressive strength, C = load/area

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Fig-2 Testing of Compressive strength test

7.2.2 SPLIT TENSILE STRENGTH OF CONCRETE

The concrete ability to resist against lateral loading is found by using split tensile test. The cylinder is used to find the split tensile strength has the dimension of 300mm x 150mm x 150mm.

Tensile strength = $2P/\pi DL$

Where,

P is the applied load,

D and L are the diameter and the length of the specimen

Fig-3 Testing of Split tensile strength test

7.2.3FLEXURAL STRENGTH OF CONCRETE

The resistance against bending is found by using flexural strength test.The prism at a dimension of 750mm x 150mm x 150mm is used.It has two methods 1)Two point loading 2) three point loading. In this study we use two point loading

$$\sigma_{fs} = PL/BD^2$$

Where

P is the applied load

L,B& D is the length, breath and diameter of prism.

Fig-4 Testing of flexural strength test

8 DURABILITY STUDY ON CONCRETE

Durability is the concrete performance at long durations. A concrete should be durable to acheive the the long term usage of structure.The check should satify against all sort of environmental conditions.

8.1 SATURATED WATER ABSORPTION

Concrete should have low water absorption.This test is carried out by alternative wetting and drying. The drying temperature were obtain at 105^0 C of oven curing.Wetting is done by immersed in water.This test is continued upto constant weight obtain at wetting and drying process.

% of water absorbed = $(Ws-W_d) \times 100/W_d$

Fig-5 Oven Drying Specimen

8.2 POROSITY TEST

The concrete should be free from porosity. If excess voids are present water permeability gets higher which reduce the strength on concrete. This porosity was measure by immersed the specimen into water. The results obtain from soaked and dried volume difference.

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Effective porosity= (V_V/V)*100

V_v – Volume of voids
V - Bulk Volume

Fig-6 Testing for porosity

8.2 CARBONATION DEPTH

The alkaline present in concrete is used to find this method. The effects of reduction of Ph by chemicals are known as carbonation.Phenophthalcin solution is used as indicator. If the colour changes to pink shows the concrete in good condition. The depth of carbonation results for 28,56,90 days are tabulated. The carbonated mortar remains unchanged in colour .

Fig-7 Testing for Carbonation

9. RESULTS AND DISCUSSION

9.1 SLUMP FLOW OF CONCRETE

Table-5.Slump Cone Values

Mix Proportions	Slump value (mm)
CM	110
SCC	111
FSCC0.1	105
FSCC 0.2	100
FSCC 0.3	95
FSCC 0.4	90

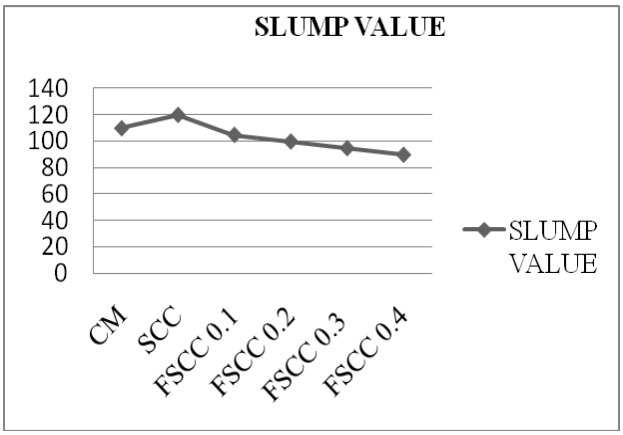

Fig-7 Slump cone results

Slump results shows that using SAP the workability of concrete is still in optimum range .

9.2COMPRESSIVE STRENGTH OF CONCRETE

Table-5.Compression Test Result

Mix Proportions	7^{th} Day Strength in MPa	28^{th} Day Strength in MPa
CM	26	40.18
SCC	32.12	43.65
FSCC 0.1	35.67	45.23
FSCC 0.2	36.78	47.32
FSCC 0.3	38.01	48.78
FSCC 0.4	30.12	41.86

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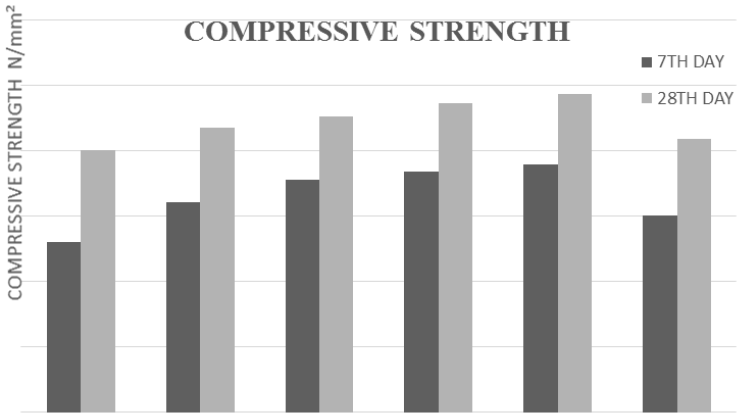

Fig- 8 Compressive Strength Result on Concrete

The strength test results shows that the influence of SAP and sisal fibre has increase the compression strength on concrete as compared to the normal concrete. At the ratio of 0.3% of fiber gives greater strength compare to the other proportions.

9.3SPLIT TENSILE STRENGTH OF CONCRETE

Table-6.Split Tensile Strength Test Result

Mix Proportions	**7th Day Strength in MPa**	**28th Day Strength in MPa**
CM	3.54	4.79
SCC	3.32	4.81
FSCC 0.1	3.52	4.93
FSCC 0.2	3.61	4.99
FSCC 0.3	3.98	5.54
FSCC 0.4	3.14	4.79

From the results clearly shows that FSCC 0.3 gives the higher results.0.3% fibre gives significant results compare to the conventional concrete.

9.4 FLEXURAL STRENGTH OF CONCRETE

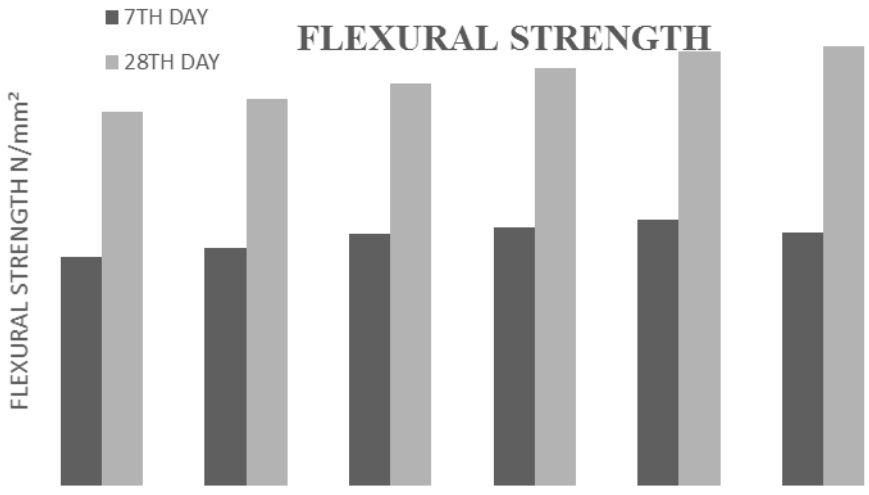

Fig-9 Flexural strength Results

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Fibre used to give greater inflence on flexure.This results shows that 0.3% fibre gives greater result compare to the conventional concrete.Even other addition of fibre also gives the higher results comopare to the conventional concrete.

9.5 SATURATED WATER ABSORPTION

SWA at various concrete specimen at the age upto 90 days are shown below graph.

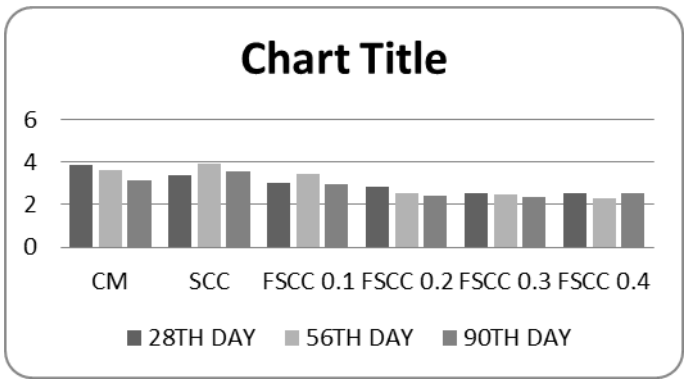

Fig-10 saturated water absorption

Water absorptions are used to tend increse with the fines of the concrete.

9.6 POROSITY

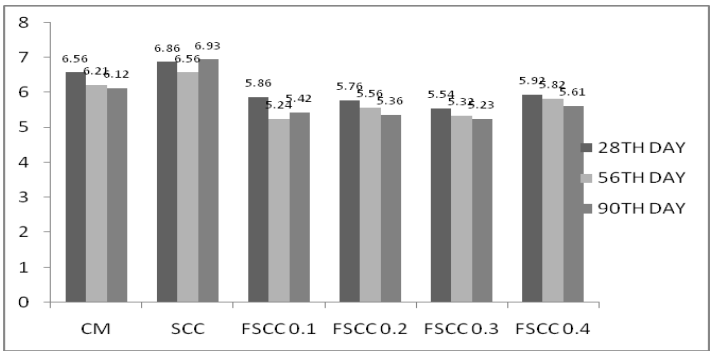

Fig-11 Porosity of Concrete

There was noticeable reduction in % of effective porosity from control mix to 0.4%Fibre addition of fibrous self-curing concrete.

9.7CARBONATION DEPTH

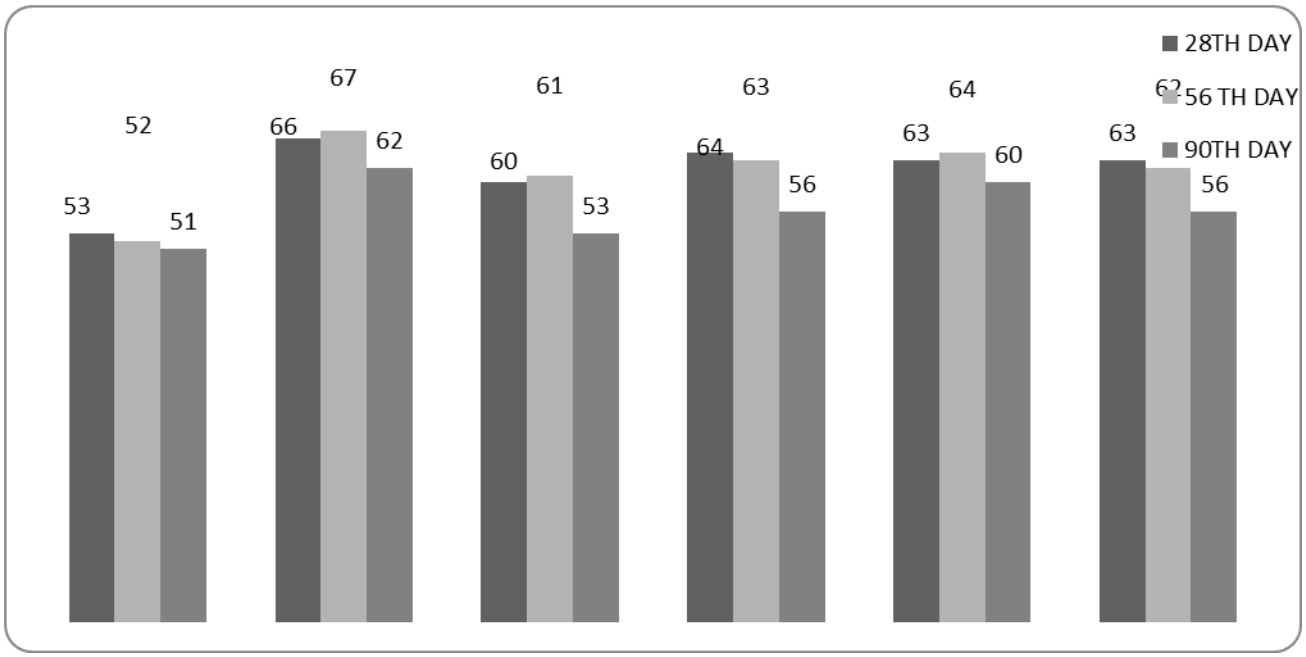

Fig-12 Carbonation Depth Of concrete

Because of fibre present the carbonation depth gets increase in Fibre concrete compare to conventional

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concrete. There was gradually increase in depth of penetration from control mix to 0.4%Fibre addition of fibrous self-curing concrete.

CONCLUSION:

- Water reduction is higher with the use of SAP compared with conventional concrete.
- With the inclusion of SAP the strength of the concrete getting higher.
- Strength with the dosage of SAP at 0.3% is higher than the conventional curing concrete.
- The addition of 0.3% FSCC concrete by volume fraction gives compressive strength of concrete by 7% increases.
- The addition of 0.3% FSCC increased the tensile strength of concrete at 28 days by 9.3 %
- The fibre also influences the strength on concrete by adding fibre the strength getting higher than non fibre concrete.
- Fibre also gives the good durability performance of concrete even at 90 days.
- Water absorption decreased with increase in fibre content in concrete. The reduction of absorption of water is in the range of 2.58% to 3.63%.
- There was noticeable reduction in % of effective porosity from control mix to 0.5%Fibre addition of fibrous self-curing concrete.
- There was gradually increase in depth of penetration from control mix to 0.5%Fibre addition of fibrous self-curing concrete

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