Pak. J. Biotechnol. Vol 15 (4) 975-978 (2018)
www.pjbt.org
ISSN Print: 1812-1837
ISSN Online: 2312-7791

EXPERIMENTAL INVESTIGATION ON THE DURABILITY CHARACTERISTICS OF HYBRID FIBER REINFORCED SELF COMPACTING CONCRETE

K. Tamilselvan, N. Balasundaram and [1]T.S. Kumanan

Karpagam Academy of Higher Education, Coimbatore and [1]Paavai Engineering College, Namakkal, India. *Email: honeyassociate13@gmail.com

Article received 25.10.2018, Revised 22.11.2018, Accepted 30.11.2018.

ABSTRACT

Concrete is a recently developed material in the last few decades, which is made up of cement, fine aggregates and water. Self-Compacting concrete can be classified as an advanced construction material. The SCC, as the name suggests, does not require to be vibrated to achieve full compaction. In this project, an attempt is made to study experimentally the durability properties of M40 Self compacting concrete containing Hybrid admixtures such as steel fibre and polypropylene at 0.5% and 1%. Natural sand is replaced by 30% to the weight of sand. Durability characteristics have been studied for both the reference concrete as well as admixture concrete.

Keywords: SCC, hybrid, VMA, super plasticizer, M sand, Durability.

I. INTRODUCTION

The utilization of self-compacting concrete started prolife rating in order to reduce cost. The self-compacting concrete contains fluidity and fibre elements which provide integrity. Fibers include steel Fibers and polypropylene fibres. (Amit Mittal et al., (2004), Annie Peter (2004), Arnaud Castel et al., (2006), Bapat (2004)).

II. MATERIALS USED

In this experimental study cement, fine aggregate, coarse aggregate, steel fibers and nylon fibers are to be used.

Cement: The properties of Ordinary Portland cement of 53 grade shown in table 1.

Table 1: Properties of Cement

Property	Values
Grade of Cement	53
Specific Gravity	3.11
Standard consistency	33.2
Initial Setting time	33 Minutes
Final Setting Time	545 Minutes

River Sand: Clean and dry river sand passing through IS 4.75 mm sieve, and available locally, was used. Sand properties are shown in table 2.

Table 2: Properties of River Sand

Property	Values
Specific Gravity	2.47
Zone of Passing	Zone II

M-Sand: M-Sand passing through IS 4.75millimeter sieve was utilized for all of the specimens except control specimens. In the literature analysis, it has been discovered that replacement of river sand by M-sand at 30% gives better results for SCC. Hence for assessing the exact fiber reinforced behavior of SCC consequently with M-sand, 30 percent of fine aggregate was substituted in this study work.

Table 3: Properties of M-Sand

Property	Values
Specific Gravity	2.42
Zone of Passing	Zone II

Coarse aggregate: Locally available, aggregate passing through 20 mm sieve and retained on 12.5 mm sieve and as given in IS: 383–1970 is used for all the specimens.

Table 4: Properties of Coarse Aggregate

Property	Values
Specific Gravity	2.70
Size Of Aggregates	20 mm

Water: Potable water was used for the experimentation.

Fly ash: In this experimental program, fly ash (Viscosity modifying Agent) obtained from thermal power station was utilized and table 5 shows the chemical composition of the flyash used.

Table 5: Chemical Compositions of Flyash

Component	% Composition
SiO_2	57.3
Al_2O_3	27.13
Fe_2O_3	8.06
MgO	2.13
SO_3	1.06
Na_2O	0.73
CaO	0.03
LOI	1.60

Steel Fiber: Steel fibers having an aspect ratio in the range of 20-100, with properties as shown in Table 6 are used in this experimental program.

Table 6: Properties of Steel Fiber

Specification	Values
Length(mm)	35
Modulus of Elasticity	200

(GPa)	
Fiber type	Straight, corrugated, hooked

Polypropylene Fiber: Polypropylene Fibers, the most popular of the synthetics, are chemically inert and light in weight. The properties of the polypropylene fibers used in this work are recorded in table 7.

Table 7: Properties of Polypropylene Fiber

Specification	Values
Length(mm)	6
Melt point	165ºC
Fibertye	Monofilament

Super Plasticizer: Polycarboxylic, ether-based Master Glenium SKY, was used as a superplasticizer for this research work. Super plasticizer has been initially formed for purposes of developing high-performance concrete, where the highest performance and durability is required. The properties of the super plasticizer used in this work are recorded in table 8.

Table 8: Properties of Master Glenium SKY

Specification	Values
Appearance	Light brown liquid
Relative density	1.09
Ph	>6
Chloride ion content	<0.2

Mix Proportion: Mix design has been adopted from IS 10262:2009 to design for the M40 grade of concrete. Table 9 shows the specimen details of SCC.

Table 9: Specimen details

Specimen Name	Proportions (C,F.A,C.A)	Hybrid proportions (S:PP)
CC1	0%,0%,0%	0%,0%
CC2	0%,30%,0%	0%,0%
SP1A	0%,0%,0%	0.5%,1%
SP2A	0%,30%,%	0.5%,1%
SP1B	0%,0%,0%	1%,0.5%
SP2B	0%,30%,0%	1%,0.5%

III.EXPERIMENTAL ANALYSIS:

Durability:

Water absorption test: The specimens were immersed in water for 24 hours and dried in open air to make the surface clean. The dried specimens were weighed accurately and noted at dry weight. The dry specimens were immersed in potable water (Fig. 1 and 2, Table 10).

Fig.1: Water Absorption Test

Table 10: Water Absorption Test Results

S. No	Mix	Water Absorption (%)
1	CC 1	1.521
2	CC 2	1.428
3	SC 1A	1.779
4	SC 1B	1.657
5	SC 2A	1.621
6	SC 2B	1.543

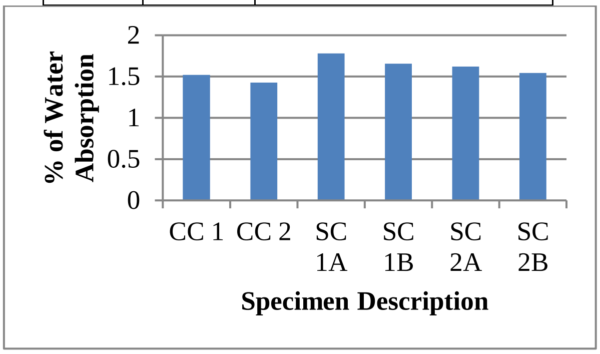

Fig.2: Water Absorption Test Results

Sulphate attack test: The concrete was cured and then immersed in 3 % of H_2So_4 solution up to 28 days. After 28 days immersion, the specimens were taken out and visually observed for the deterioration of concrete due to sulphate attack (Fig. 3 & 4, Table 11)

Before attack **After attack**

Fig 3: Sulphate attack

Table 11: Sulphate attack test results

S.No	Mix	Compressive Strength in N/mm²		% of loss in strength
		Before attack	After attack	
1	CC 1	43.6	21.3	51.15
2	CC 2	41.8	22.4	46.42
3	SC 1A	51.3	29.8	41.92
4	SC 1B	48.7	29.4	39.64
5	SC 2A	52.5	26.8	48.96
6	SC 2B	50.4	28.2	44.05

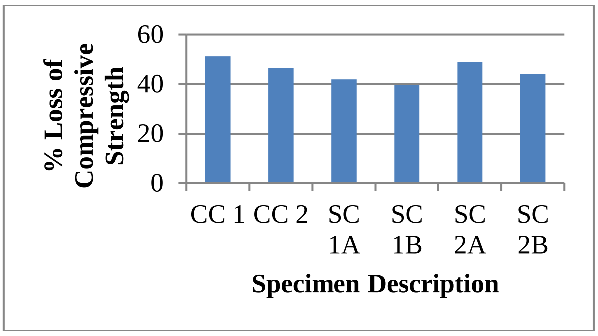

Figure 4: Sulphate attack test results

Chloride Attack Test: Chloride solution had been prepared by adding 3.5% sodium chloride of distilled water. The initial weights of this cube were found. They were then immersed in a chloride solution. After drying, the changes in cube weight were determined (Fig. 5 & 6, Table 12)

Before attack **After attack**

Fig. 5: Chloride attack on cube specimen

Table 12: Chloride attack test results

S. No	Mix	Compressive Strength in N/mm²		% of loss in strength
		Before attack	After attack	
1	CC 1	43.6	20.7	52.53
2	CC 2	41.8	21.8	47.85
3	SC 1A	51.3	22.9	55.37
4	SC 1B	48.7	24.4	49.90
5	SC 2A	52.5	23.3	55.62
6	SC 2B	50.4	24.9	50.60

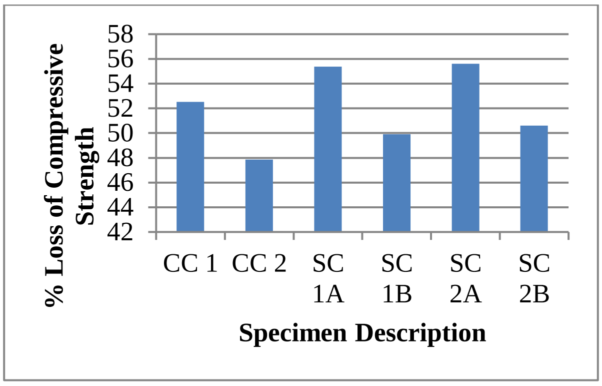

Fig. 6: Chloride Attack Test Results

Acceleration Corrosion Test: The cylinder specimens embedded with the steel rod of 12mm diameter were kept immersed in a 3.5% sodium chloride solution taken in a fibre tank. (Arnaud Castel, 2006).The specimens were subjected to a current supply 12 volts from an external DC source. The setup was kept for 21 days (Fig. 7 & 8, Table 13).

Fig. 7: Acceleration corrosion test

Table 13: Acceleration corrosion test results

Mix	Initial weight of rod (W1) (Grams)	After corrosion (504 hours) weight of rod (W2) (Grams)	Corrosion Rate (mmpy)	Average Corrosion Rate (mmpy)
CC 1	240	200	0.078	0.074
	235	198	0.072	
	245	207	0.074	
CC 2	230	198	0.062	0.061
	240	209	0.060	
	235	204	0.060	
SC 1A	230	186	0.086	0.084
	230	187	0.084	
	235	193	0.082	
SC 1B	235	196	0.076	0.072
	225	189	0.070	
	230	194	0.071	
SC 2A	235	190	0.088	0.086
	225	181	0.086	
	240	197	0.084	
SC 2B	230	190	0.078	0.078
	225	186	0.076	
	235	194	0.080	

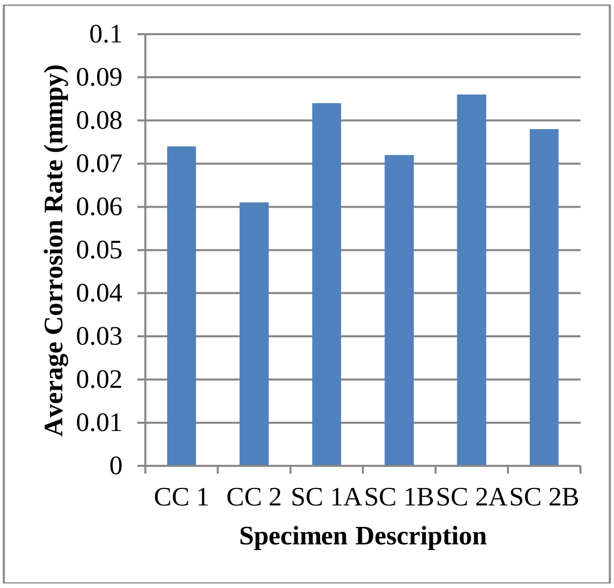

Fig. 8: Acceleration corrosion test results

Sorptivity Test: The 50mm thick cylinders of 100mm diameter specimen were cast. The specimen was kept in an oven for 48 hours at 100±5°c, Weights of the specimens were noted, after 30 and 60 minutes, after wiping off any excess water with a damp tissue. The quantity of absorbed water during the period from 30 to 60 minutes was determined from the difference in weights (Fig. 9 & 10, Table 14)

Fig. 9: Sorptivity test

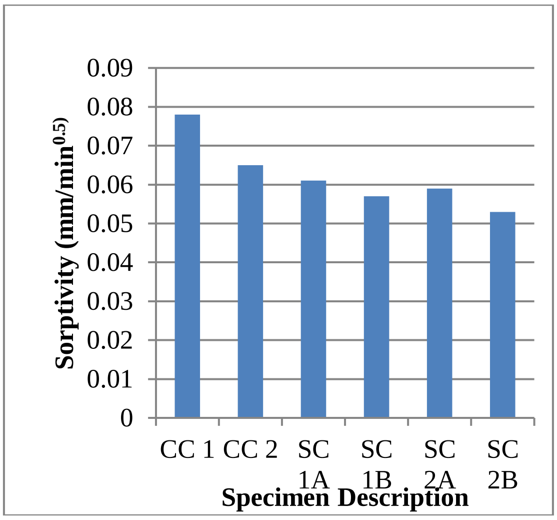

Fig.10: Sorptivity test results

Table 14: Sorptivity test results

S. No	Mix	Sorptivity (mm/min$^{0.5}$)
1	CC 1	0.078
2	CC 2	0.065
3	SC 1A	0.061
4	SC 1B	0.057
5	SC 2A	0.059
6	SC 2B	0.053

IV. RESULT AND DISCUSSIONS

The following are the results drawn from the experiments made on Self-compacting concrete with hybrid fibres.

- Addition of M-Sand 30% by weight of fine aggregate shows a good result of a water absorption compared to the other mixes of SCC.
- When adding M-Sand 30% by weight of fine aggregate and addition of 1% Polypropylene and 0.5% Steel fibre shows very good resistance against Sulphate when compared to the other mixes of SCC.
- When adding M-Sand 30% by weight of fine aggregate shows very good resistance against chloride when compared to the other mixes.
- The results of Sorptivity of SCC show better results in adding 30% M-Sand by weight of fine aggregate and addition of 0.5% Polypropylene and 1% Steel fibre compared to other mixtures.
- Addition of M-Sand 30% by weight of fine aggregate shows a good result of Accelerated Corrosion compared to the other mixes of SCC.

REFERENCES

Amit Mittal, Kaisare M.B. and R.G. Shetti, Use of SCC in a pumphouse at TAPP3 & 4, Tarapur. The Indian Concrete Journal 78(6): 30-34 (2004).

Annie Peter J., Lakshmanan N., Devadas Manoharan P., Rajamane N.P. and S. Gopalakrishnan, Flexural behavior of RC Beams using Self-Compacting Concrete. The Indian Concrete Journal 78(6): 66-72 (2004).

Arnaud Castel, Thierry Vidal, Kriengkai Viriyametanont and Raoul Francois, Effect of Reinforcing Bar Orientation and Location on Bond with Self-Consolidating Concrete. ACI Structural Journal 103(4): (2006).

Bapat S.G. Kullkarni S.B. and K.S. Bandekar, Using SCC in nuclear power plants-Laboratory and mock-up trails at Kaiga. The Indian Concrete Journal 78(6): 51-57 (2004).