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Chloride Resistance of Slurry Infiltrated Fiber Concrete (SIFCON) Produced with Steel and Polypropylene Fiber

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Abstract - *This work reports on the experimental study of the chloride resistance of Slurry Infiltrated Fiber Concrete (SIFCON) Produced with Steel and Polypropylene Fiber. And also check the mechanical properties such as flexural strength and compressive strength. Slurry Infiltrated Fiber Concrete (SIFCON) is a high-volume fiber reinforced concrete with significant improvement in the properties such as strength, durability, ductility, and toughness. Fiber-reinforced concrete has a wide variety of structural applications, in which the ductility depends on the amount of fiber present in the concrete. A total of sixteen mix samples for three different tests each sample three modules are cast means total one hundred and forty-four molds. Like 100mm dia. And 50mm thick RCPT mold, 150mmX150mmX150mm cubes, and 100mmX 100mm X 500mm beam specimens. The use of various volume of steel fiber and polypropylene fiber 0%,2%,5%,10% and 0%,0.5%, 1%,1.5% respectively. in the experimental work, an attempt has been made to determine the influence of steel and polypropylene fiber on the durability of concrete. Its variations were determined using a Rapid Chloride Permeability Test (RCPT) apparatus and the results are compared with that of the conventional concrete. The averagely values high chloride penetrate. The investigated the flexural strength 2.5 times more than the conventional concrete and compressive strength is 1.04 times more than the conventional concrete. The ultimate carrying capacity, stiffness, ductility, and energy absorption capacity are increased to a greater extent for composite material with that of conventional concrete.*

Key Words: SIFCON, Steel Fiber, Polypropylene Fiber, Compressive Strength, Flexural Strength, Rapid Chloride Penetration Test.

1.INTRODUCTION

Reinforced concrete structures often have to face change and improvement of their performance during their service life. The main factors are change in their use, new design standards, rusting, crumbling, due to slow chemical breakdown of something/rust in the steel caused by exposure to aggressive surrounding conditions and sudden unplanned bad event/crash event such as earthquakes. A promising new way of resolving this problem is to in a picky way where only certain things are selected use advanced things made up of different things such as high-performance fiber-reinforced cementitious things made up of different things (HPFRCCs). SIFCON is a new type of material. SIFCON stands for Slurry infiltrated Fiber Concrete. It is a high strength, high-performance material containing a compared to other things high-volume percentage of steel fibers as compared to steel fiber reinforced concrete (SFRC). It is also sometimes termed as high-volume fibrous concrete. The origin of SIFCON dates to 1979 when Prof. D.R. Lankard carried out long/big experiments in his laboratory in Columbus, USA, Ohio and proved that if the percentage of steel fibers in a cement matrix could be increased, then a material of very high strength could be received, which he named as SIFCON [1]. While in ordinary SFRC, the steel fiber content usually differs from 1 to 3 percent by volume, it differs from 4 to 20 percent in SIFCON depending on the geometry of the fibers and the type of application. SIFCON is high volume percentage of steel therefore to study the chloride resistance is needed. The rate of chloride ion going into something into concrete is mostly dependent on the internal pore structure. The pore structure, in turn, depends on other factors such as the mix design, degree of filling with water, curing conditions, use of additional cementitious materials, and construction practices. Therefore, wherever there is a possible risk of chloride caused the slow chemical breakdown of rust.

2. MATERIAL PROPERTIES

2.1 Cement

Ordinary Portland cement (OPC) of 53 grade cement is used in experimental work, all properties of cement are tested by referring IS 12269:1987.

2. 2 Fine aggregate

The fine aggregate used for experimental program was locally procured and confirming to zone II. Fine aggregate passing through IS sieve 1.18 mm

2.3 Water

The tap water is used available in the campus was tested for suitability.

2.4 Superplasticizer

"CONPLAST 300" superplasticizer was used in experimental work for workability of concrete.

2.5 Steel fibre and Polypropylene fibre

The crimped steel fibre is used. And 0.5 mm dia. And 30mm length respectively. Synthetic polypropylene fibre is used.

Table -1 Properties of Steel fiber and Polypropylene fiber

Properties	Steel fibre	Polypropylene fibre
Diameter	0.5	0.028
Length	30	18
Aspect ratio	60	643
Unit weight kg/m3	7850	0.9

Figure -1: Crimped steel fiber

Figure -2: Polypropylene fiber

3. MIX DESIGN AND CASTING OF SPECIMENS

The sixteen SIFCON mixes are used with ratio of 1:1 mortar likewise cement and fine aggregate (sand) respectively. The steel fiber and polypropylene fiber having the various of fiber friction shown in table 2. When water-cement ratio (w/c) 0.4 and 1.5% superplasticizer used.

Table -2: SIFCON Mix Proportions

Mix no.	Cement	FA	Steel fiber %	Polypropylene fiber %
M1	1	1	0	0
M2	1	1	0	0.5
M3	1	1	0	1
M4	1	1	0	1.5
M5	1	1	2	0
M6	1	1	2	0.5
M7	1	1	2	1
M8	1	1	2	1.5
M9	1	1	5	0
M10	1	1	5	0.5
M11	1	1	5	1
M12	1	1	5	1.5
M13	1	1	10	0
M14	1	1	10	0.5
M15	1	1	10	1
M16	1	1	10	1.5

3.1 Mould Preparations

The cube mould size is 150mmX150mmX150mm, the beam size is 100mmX100mmX500mm and RCPT mould size is 100mm diameter and 50mm thick respectively.

4. EXPERIMENTAL PROGRAM

The experimental investigation is carried out to determine the mechanical properties of SIFCON such as compressive strength and flexural strength and RCPT test as per ASTM C 1202 carried on determine the chloride penetration value in SIFCON.

4.1 Compressive strength test

The surface of the CTM testing machine are cleaned and the cube are placed in the machine in such a manner that the load is applied to side face of the cube as cast. The load was increased and decreased stages up to final failure of the specimen.

Figure -3: Compressive strength test

4.1 Flexural strength test

The specimen is placed in UTM in such a manner that load shall be applied to the upper most surface, the load shall be applied with two-point loading. The load shall be applied increased at rate such that the extreme fiber stress increases at approximately.

Figure -4: Flexural strength test

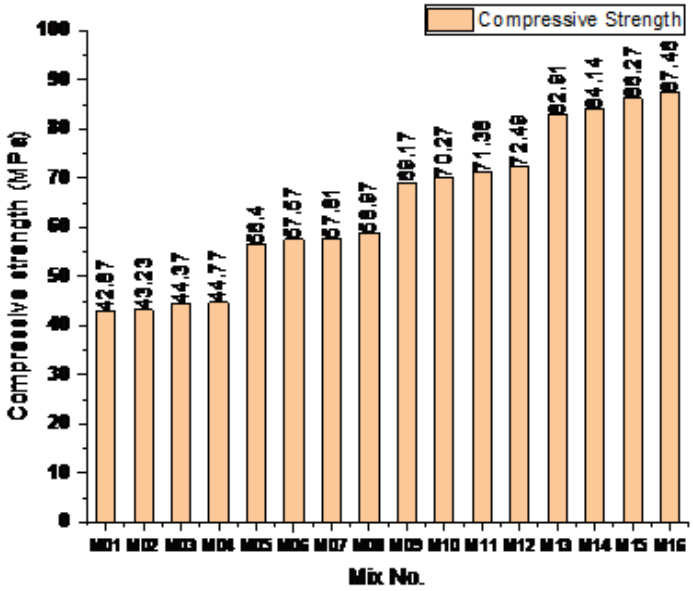
4.2 RCPT test

The RCPT test specimen is carefully placed in RCPT mould and all side pack with silicon sealant and then be carefully the 3Nacl (sodium chloride) fill in black nob and 03N NaOH (sodium hydroxide) fill in red nob respectively. This is 6-hour test with 30 min. intervals, and 60-volt DC current is constant. As per the ASTM C 1202-12.

Figure -5: RCPT test

5. RESULTS AND DISCUSION

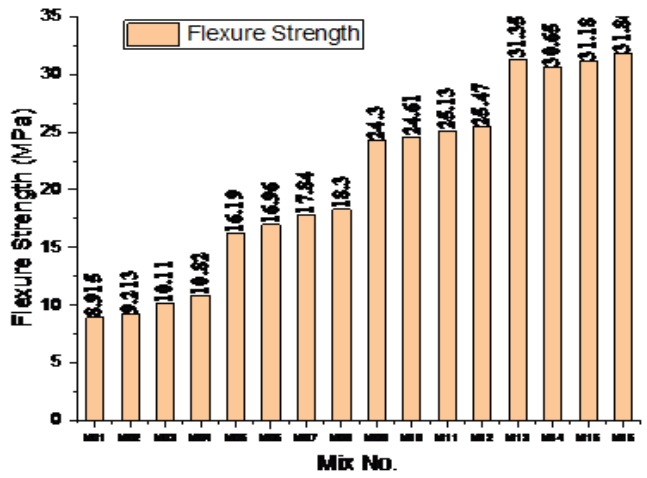
5.1 Compressive strength



Graph -1: Compressive strength

After testing of specimens, known their failure load. By using failure load of all specimens computed their compressive strength and finally draw a graph. The graph draws between compressive strength and Different mix proportion of steel fiber and polypropylene fiber by % of volume. Graph showed the steel and polypropylene fiber % increases also compressive strength are increases. The highest compressive strength is 87.46Mpa.

5.2 Flexural strength



Graph -2: Flexural strength

As per IS 516 calculated the flexural strength of all beam specimens. The Graph is drawn between flexural strength and Different mix proportion of steel fiber and

polypropylene fiber by % of volume. In 0% steel fiber volume is range between 8Mpa to 10Mpa, 2% steel fiber volume is range between 16Mpa to 18Mpa, 5% steel fiber volume is range between 24Mpa to 25Mpa, 10% steel fiber volume is range between 31Mpa to 32Mpa. Polypropylene fiber are also used to combination of steel fiber. as per graph a polypropylene fiber are increase flexural strength but as compared to steel fiber their flexural strength is negligible.

5.1 Rapid chloride penetration test

As per the ASTM C 1202-12 chloride resistance test was conducted. Drawn the graph between Charge passing (coulombs) and different mix proportion of steel fibre and polypropylene fibre. In M01 to M04 mix proportion charge passing in between 2000 coulombs and 4000 coulombs. In M05 to M08 mix proportion charge passing in between 3500 coulombs and 3200 coulombs. In M09 to M12 mix proportion charge passing in between 4250 coulombs and 4000 coulombs. In M13 to M16 mix proportion charge passing in between 4850 coulombs and 4750 coulombs. i.e. if % polypropylene fibre is increase then decreases charge passing through the specimens. The polypropylene fibre is resist charge passing through the specimens.

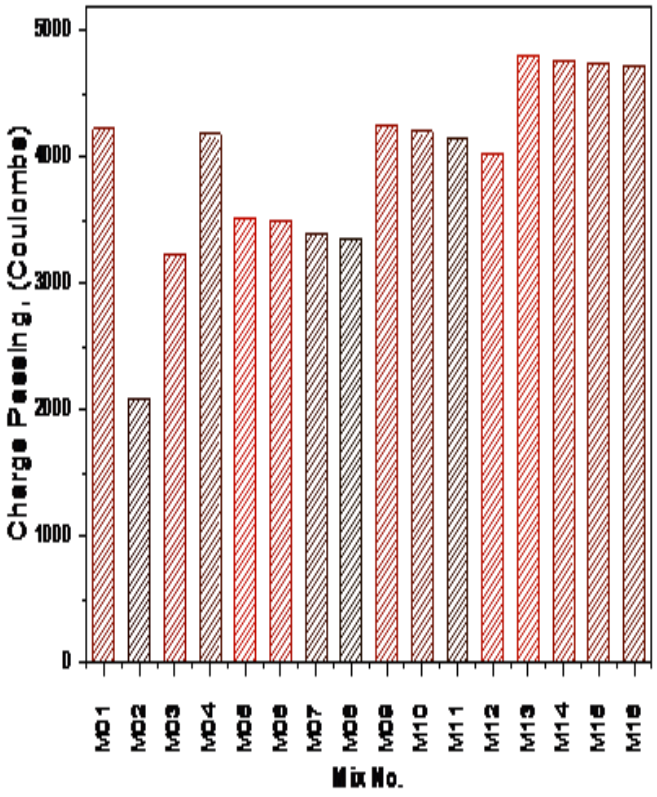


Chart -3: RCPT test result

6. CONCLUSIONS

A detailed study has been carried out to observed the Chloride resistance of slurry infiltrated fiber concrete produced with steel and polypropylene fibers. Hence following conclusion are considered based on the results and observations.

1. In 0%, 2%, 5% and 10% steel fiber volume and combination of polypropylene fiber volume the averagely compressive strength is 43.81Mpa, 57.73Mpa, 70.83Mpa and 85.24Mpa respectively.

2. In 0%, 2%, 5% and 10% steel fiber volume and combination of polypropylene fiber volume the averagely flexural strength is 9.76Mpa, 17.32Mpa, 24.88Mpa and 31.26Mpa respectively.

3. For 0% steel fiber volume and combination of 0%, 0.5%, 1.00%, 1.5% polypropylene fiber volume the charged passed values are in between the 2000-4000 coulombs, so we concluded that the variation of polypropylene fiber the medium chloride ion penetration.

4. For 2% steel fiber volume and combination of 0%, 0.5%, 1.00%, 1.5% polypropylene fiber volume the charged passed values are in between the 2000-4000 coulombs, so we concluded that the variation of polypropylene fiber the medium chloride ion penetration.

5. For 5% steel fiber volume and combination of 0%, 0.5%, 1.00%, 1.5% polypropylene fiber volume the charged passed values are above the 4000 coulombs, so we concluded that the only variation of polypropylene fiber the high chloride ion penetration.

6. For 10% steel fiber volume and combination of 0%, 0.5%, 1.00%, 1.5% polypropylene fiber volume the charged passed values are above the 4000 coulombs, so we concluded that the only variation of polypropylene fiber the high chloride ion penetration.

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