International Journal of Advance Research in Science and Engineering
Volume No.07, Special Issue No.01, March 2018
www.ijarse.com
IJARSE
ISSN: 2319-8354

EFFECT OF FLY ASH AND ARTIFICIAL SAND ON THE COMPRESSIVE STRENGTH OF CONCRETE

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ABSTRACT

Slurry infiltrated fibrous concrete (SIFCON) is a unique fiber concrete with high percentage of fiber. SIFCON has tremendous potential for application in areas where high compressive strength is required. The SIFCON consists of cement slurry in which steel fibers are preplaced in the mould, after placement of fibers, cement slurry is poured into the fibre network.

To study the performance of SIFCON in compression strength, the cube specimens of dimension 150x150x150 mm were cast. In this paper effect of addition of fly ash, artificial sand & steel fiber on the properties of SIFCON is reported. Waste steel fibers were used in SIFCON. In this study aspect ratios of steel fiber like 80, 90, 100 and 110 are used with 6%, 8% and 10% fibers percentage. Specimens are cast by adding fly ash at varying percentages like 10%, 15%, 30% and 40% by weight of cement and 100% artificial sand. The compressive strength is evaluated.

Test results revealed the superior characteristics of SIFCON as compared with normal FRC

Keywords: SIFCON, aspect ratio, waste steel fibers, fly ash, artificial sand, compressive strength.

I.INTRODUCTION

Continuous use of natural sand in construction activity has needed a full or partial replacement, and one of the alternative is artificial sand. On the other hand fly ash is widely used material all over the world. The use of fly ash in concrete not only improves technical advantages to the properties of concrete but also contributes to the environmental pollution control. If it is possible to use this in making concrete by replacement of cement, then it will solve the problem of its disposal.

Concrete is a commonly used material in construction engineering all over the world. Concrete, by desirable quality of its low cost, easy availability, comparatively simple

Process technology, good compressive strength and durability under widely varying environmental conditions, has become great construction material. Even though concrete possesses many advantageous properties, its low tensile strength, low impact strength, cracking behavior hinders its full potential. During the past few decades there has been considerable research carried out throughout the world on the addition of short irregular fibers of glass, steel and plastic to cementious materials. These fibers serve as crack arrestors and improve physical properties of matrix materials. This is known as fiber reinforced concrete.

At present steel fibers are considered as structural fibers as they improve strength of the structure to a great extent. Slurry-infiltrated fibrous concrete (SIFCON) is considered as a special type of fiber-reinforced concrete (FRC). In two aspects, fiber content and the method of production of SIFCON is different from normal FRC. The fiber content of FRC generally varies from 1% to 3% by volume, but the fiber content of SIFCON varies between 6% and 20%. Again, the matrix of SIFCON consists of cement paste as opposed to FRC where regular concrete used. These make the production of SIFCON different from FRC. Unlike FRC, for which the fibers are added to the wet or dry concrete mix, SIFCON is prepared by dense cement slurry into a bed of fibers preplaced in the molds.

The addition of steel fibers into concrete can significantly increase the strength properties like compressive strength, tensile strength, and flexural strength and impact strength of concrete. The strength properties of FRC can be increased by increasing the percentage of fibers in the concrete. But as the percentage of fibers increases, there are some practical problems, which have to be faced. The higher percentage of fiber causes balling effect in which the fibers cling together to form balls. Thus uniform distribution of fibers in the mould cannot be guaranteed, if percentage of fibers is more. Also longer fibers obstruct with the aggregates during compaction thus hindering the proper orientation of fibers. This fact limits the fiber content from 1% to 3% by volume. The limitations of FRC and continuous ongoing demand for high performance material has lead to the invention of 'Slurry infiltrated fiber concrete' (SIFCON) by Lankard in 1979. The 'Slurry infiltrated fiber concrete' is high strength, high performance material containing comparatively high volume percentage of fibers as compared to FRC. SIFCON is also sometimes termed as 'High volume fibrous concrete'.

II.RESEARCH SIGNIFICANCE

SIFCON which is considered as a high performance concrete, can also be produced by using artificial sand, waste steel fibers and fly ash obtained from the MIDC area and foundry. Since these fibers are locally available, they can be easily used in the manufacturing of SIFCON. Due to their coiled nature they may offer more resistance to loads. The study of effect of addition of fly ash , artificial sand on production of SIFCON from such waste coiled fibers may result in an economic building material.

III.EXPERIMENTAL PROGRAMME

The main aim of this experimental programme is to find out effect of addition of fly ash, steel fiber and artificial sand on the strength properties of SIFCON.

Ordinary Portland cement of 53-grade and artificial sand with a specific gravity 2.6 and fineness modulus of 2.92 was used in the experimentation. To impart additional workability, superplastisizer (1% by weight of

cement) was used. The waste steel fibers were procured from local MIDC area. The fibers were of chrome steel having density 6.45 gm/cm^3. The percentage of fibers used in the experimentation is 6%, 8% and 10%. The average thickness was 0.6 mm, different aspect ratios were used in the experimentation were 80, 90, 100, and 110. The cement mortar slurry was prepared with 1:1 proportion using w/c ratio 0.45. A superplastisizer
(1% by weight of cement) was added to this slurry to increased infiltration capacity of the slurry. To study the effect of addition of fly ash on SIFCON, slurry was prepared by adding fly ash at varying percentages like adding fly ash at 10%, 15%, 30% and 40% by weight of cement

The moulds were filled with 6%, 8% and 10% fibers and slurry was filled into the moulds. after that Vibration was given to the prepared moulds using table vibrator. The slurry was fill until no more bubbles are seen. The top surface of the specimen was leveled and finished. After 24 hours the specimens were demoulded and kept for curing in water tank for 28 days.

The effect of addition of fly ash artificial sand and steel fiber on SIFCON was studied on compressive strength. After 28 days of curing, the specimens were taken out of the water tank, and then it is tested in CTM for compressive strengths.

IV.TEST RESULTS

The results of compressive strength test are shown in tables for SIFCON with addition of fly ash and 6%, 8%, and 10% fibers with complete artificial sand. The tables also indicate the percentage increase in the strength of SIFCON due to addition of fly ash with reference to normal mix and without addition of fly ash.

The graphs show the variation of compressive strength of SIFCON with and without addition of fly ash.

Table 4.1: Results of Compressive strength on 28 Days of curing with 6% fiber

Different aspect ratios of fibers	Compressive strength (MPa) of SIFCON without addition of fly ash (ref. mix)	Compressive strength (MPa) of SIFCON with addition of fly ash at varying percentages							
		10% addition	Percentage increase in comp.strength w.r.t ref mix	15% addition	Percentage increase in comp.strength w.r.t ref mix	30% addition	Percentage increase in comp.strength w.r.t ref mix	40% addition	Percentage increase in comp.strength w.r.t ref mix
80	31.33	33.01	5.33	34.22	9.19	35.15	12.16	31.67	1.05
90	33.86	36.00	6.29	36.97	9.15	38.09	12.46	34.29	1.24
100	34.65	36.98	6.72	38.34	10.65	39.10	12.84	35.33	1.96
110	36.67	39.22	6.95	40.71	11.02	41.63	13.53	37.42	2.05

Figure 4.1: Variation of Compressive strength on 28 Days of curing with 6% fiber for different aspect ratios

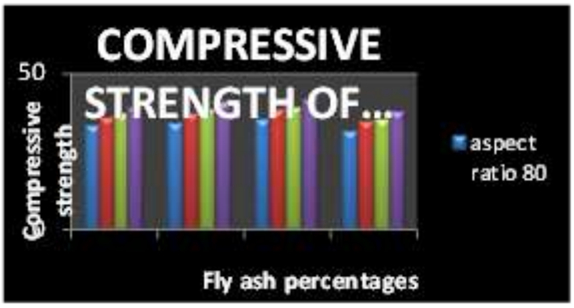


Table 4.2: Results of Compressive strength on 28 Days of curing with 8% fiber

Different aspect ratios of fibers	Compressive strength (MPa) of SIFCON without addition of fly ash (ref. mix)	Compressive strength (MPa) of SIFCON with addition of fly ash at varying percentages							
		10% addition	Percentage increase in comp.strength w.r.t ref mix	15% addition	Percentage increase in comp.strength w.r.t ref mix	30% addition	Percentage increase in comp.strength w.r.t ref mix	40% addition	Percentage increase in comp.strength w.r.t ref mix
80	32.66	34.90	6.86	35.61	9.03	35.97	10.13	33.03	1.13
90	34.78	37.23	7.04	37.98	9.20	38.81	11.59	35.24	1.32
100	35.45	38.01	7.22	39.16	10.47	40.21	13.43	36.28	2.34
110	37.70	40.44	7.27	41.72	10.66	43.22	14.64	38.67	2.57

Figure 4.2: Variation of Compressive strength on 28 Days of curing with 8% fiber for different aspect ratios

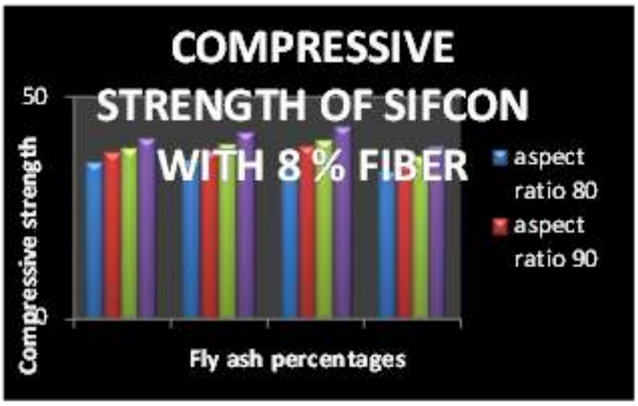
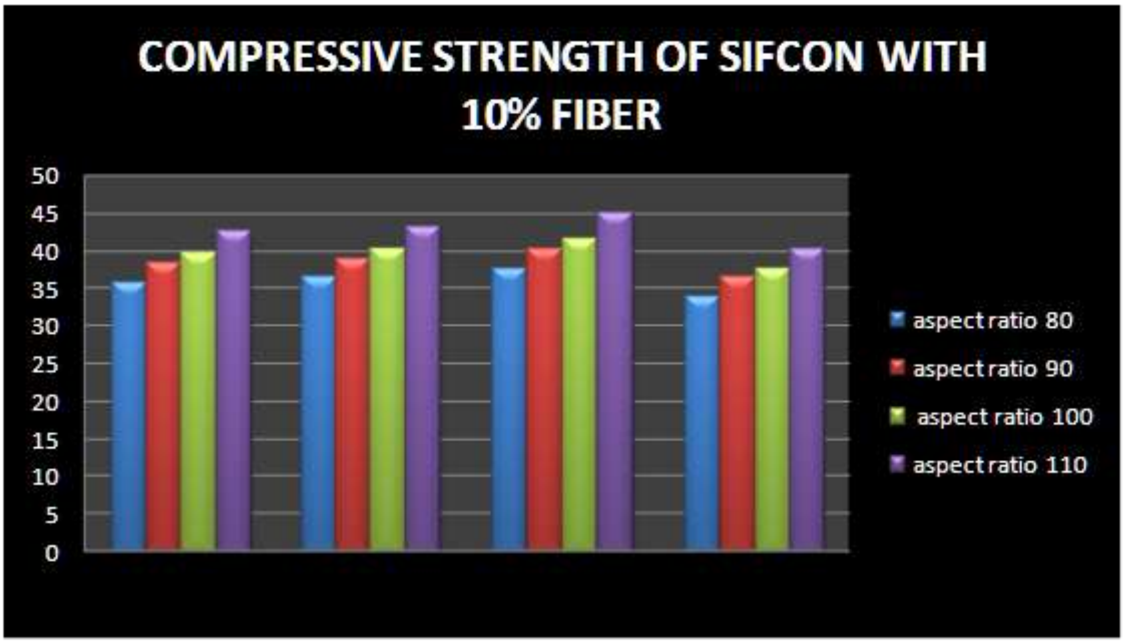


Table 4.3: Results of Compressive strength on 28 Days of curing with 10% fiber with varying percentages of fly ash

Different aspect ratios of fibers	Compressive strength (MPa) of SIFCON without addition of fly ash (ref. mix)	Compressive strength (MPa) of SIFCON with addition of fly ash at varying percentages							
		10% addition	Percentage increase in comp.strength w.r.t ref mix	15% addition	Percentage increase in comp.strength w.r.t ref mix	30% addition	Percentage increase in comp.strength w.r.t ref mix	40% addition	Percentage increase in comp.strength w.r.t ref mix
80	33.51	35.89	7.10	36.45	8.77	37.61	12.24	34.01	1.49
90	35.80	38.45	7.40	39.08	9.16	40.33	12.65	36.51	1.98
100	36.90	39.77	7.78	40.32	9.27	41.68	12.95	37.72	2.22
110	39.35	42.66	8.41	43.15	9.66	45.16	14.76	40.34	2.52

Figure 4.3: Variation of Compressive strength on 28 Days of curing with 10% fiber for different aspect ratios



V.DISCUSSIONS ON TEST RESULTS

1. It has been observed that the compressive strength, of SIFCON goes on increasing as the aspect ratio of fibers in it goes on increasing.
2. Compressive strength is on higher side for SIFCON produced from 10% fibers as compared to that other percentage of fibers.

3. It has been observed that the compressive strength of SIFCON goes on increasing as the percentage of fly ash increasing.
4. It has been observed that the compressive strength, of SIFCON goes on increasing with and without addition of fly ash.
5. The strength properties of SIFCON increase as the percentage replacement of fly ash increases up to 40%. Beyond 30% replacement the strength properties show a decreasing trend. The optimum percentage of replacement of cement by fly ash for SIFCON is 30% by weight of cement.
6. Thus waste steel fibers and artificial sand can be used effectively in the production of SIFCON, which can bring down the cost.

The increase in compressive strengths of SIFCON due to addition of fly ash and artificial sand may be credited to pozzolanic activity of fly ash. Further due to its fineness of fly ash, it fills the small pores in the concrete giving very dense concrete. As a result great increase in strength properties is seen. The values of strength properties of SIFCON increase with an increase in percentage of addition of fly ash.

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