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Effect of carbon and glass fibre on compressive strength, split tensile strength and flexural strength of SCC

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Abstract

Self-compacting concrete is the concrete which possess the ability to flow and consolidate under self-weight. Its placement in difficult and congested conditions due to its flowing ability is possible. SCC (self-compacting concrete) is defined as highly deformable and provides better resistance to segregation. Its main characteristic is the higher cement matrix aggregate ratio as compared to ordinary concrete. In this paper, present the various experiments like compression strength, split tensile strength, flexural strength, that are performed for various mixes of carbon and glass fiber mixed SCC. This study reveals that an appreciable amount of improvement observed in split tensile strength and flexural strength with the addition of optimum percentage of carbon and glass fiber.

Keywords: Fibre Reinforced, Self Compacting Concrete, Glass, Carbon Fibre.

Introduction

Self-compacting concrete (SCC) is non-segregating concrete that is moved with fluidity under gravitation and also, the addition of super-plasticizers and viscosity modifier are added to concrete to make it that way [1]. SCC inhibits segregation by the use of mineral fibres which help in holding the components together and so that all has equivalent viscosity and does not separate under the gravitation and hence, it helps in the thorough movement of the concrete [2]. Self-consolidating concrete is needs to be placed in its own weight, Flow-ability should be high enough to makes it flow under its own weight. It is necessary to meet this kind of requirement. Self-compacting concrete has higher strength when compared to the vibrated concrete of the same proportion and hence it is more convenient in providing a better interface between aggregates and the cement. Carbon fibres have low density, high thermal conductivity, good chemical stability and exceptional abrasion resistance, and can be used to decrease or reduce cracking and shrinkage. These fibers increase some structural properties like tensile and flexural strengths, flexural toughness and impact resistance [3].

Carbon fibers also help to improve freeze-thaw durability and dry shrinkage. The adding of carbon fibers decreases the electrical resistance. Glass fibres are formed by the process in which molten glass is drawn in the form of filaments. The 204 filaments are drawn simultaneously and cooled, once solidified they are together on a drum into a strand containing 204 filaments. The treatment of filaments is done with a sizing which shields the filaments against weather and abrasion effects prior to winding. Different types of glass fibres are there such as C-glass, E-glass, S-glass, AR-glass etc. Are manufactured having different properties and specific applications.

Effect of carbon and glass fibre on compressive strength of SCC

The below given table shows that the compressive strength increases as the percentage of carbon fibre increases but after the optimum percentage of carbon fibre the compressive strength reduces. It is due to the concrete microstructures gets negatively affected as the CSH layer breaks after the optimum dosage.

Table 1: Compressive Strength with Carbon Fibre Addition

Carbon Fibre (%)	Compressive Strength, Mpa			
	(3 days)	(7 days)	(14 days)	(28 days)
0	12.3	22.65	27.62	33.24
0.4	14.2	23.68	28.48	36.84
0.6	16.8	24.15	30.35	37.71
0.8	18.4	25.2	31.22	39.45
1.0	15.4	22.1	29.21	38.54
1.2	14.8	21.58	27.47	36.63

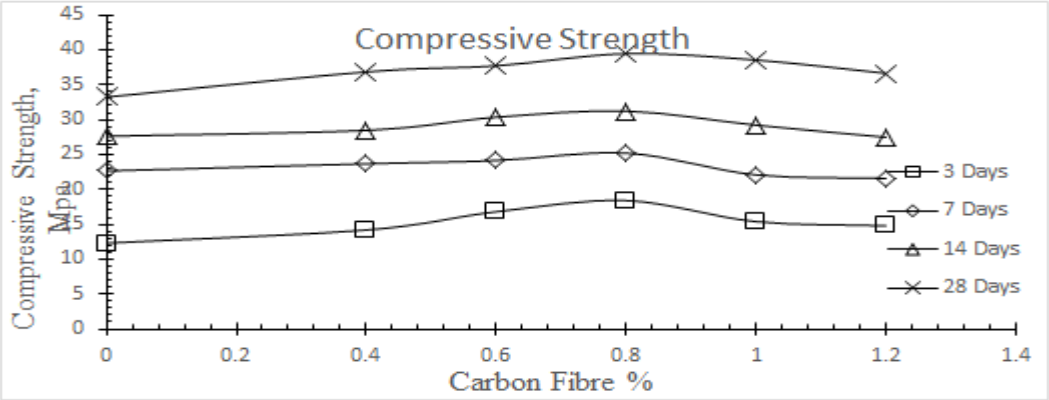

Fig 1: Effect of carbon fibre on Compressive strength of SCC

Table 2: Compressive strength with glass fibre addition

Glass Fibre (%)	Compressive Strength, MPa			
	(3 days)	(7 days)	(14 days)	(28 days)
0	12.3	23.45	28.22	33.24
0.4	15.3	25.72	29.68	36.98
0.6	16.8	25.25	31.45	38.54
0.8	19.4	26.32	31.42	39.72
1.0	16.4	23.1	29.41	38.23
1.2	15.8	22.58	28.47	37.63

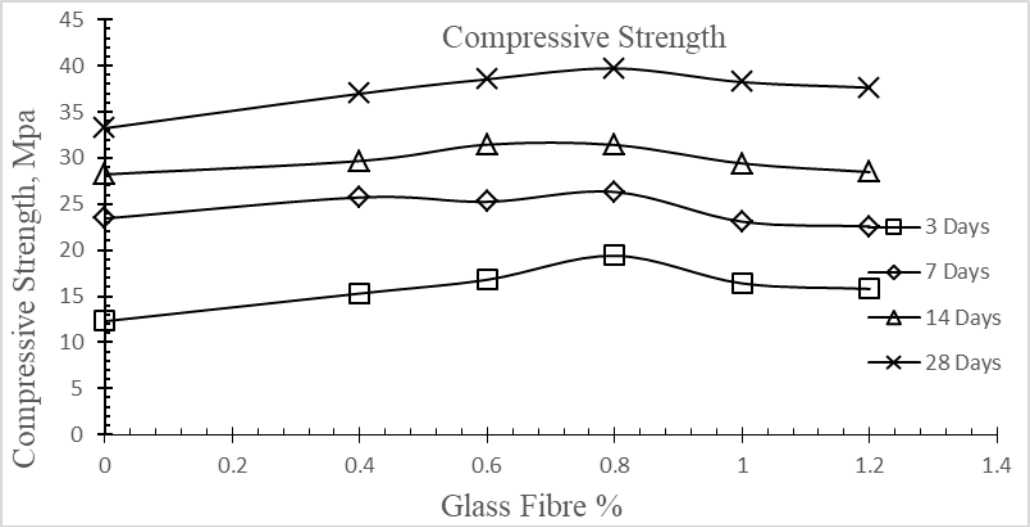

Fig 2: Effect of glass fibre on Compressive strength of SCC

The compressive strength is at its peak at around 0.8% so this is the optimum percentage at which the compressive strength becomes maximum further addition of fibre decreases the compressive strength. Glass has got significant strength to resist compressive forces but is weak in resisting tensile forces.

Effect of carbon and glass fibre on split tensile strength of SCC

Table 3: Split tensile strength of SCC with Carbon Fibre

Carbon Fibre (%)	Split Tensile Strength (MPa)			
	(3 days)	(7 days)	(14 days)	(28 days)
0	1.23	2.34	2.8	3.32
0.4	1.70	3.01	3.32	3.87
0.6	1.79	3.22	3.58	4.42
0.8	2.12	3.55	4.10	4.9
1.0	2.34	3.8	4.52	5.45
1.2	1.91	3.30	3.64	4.65

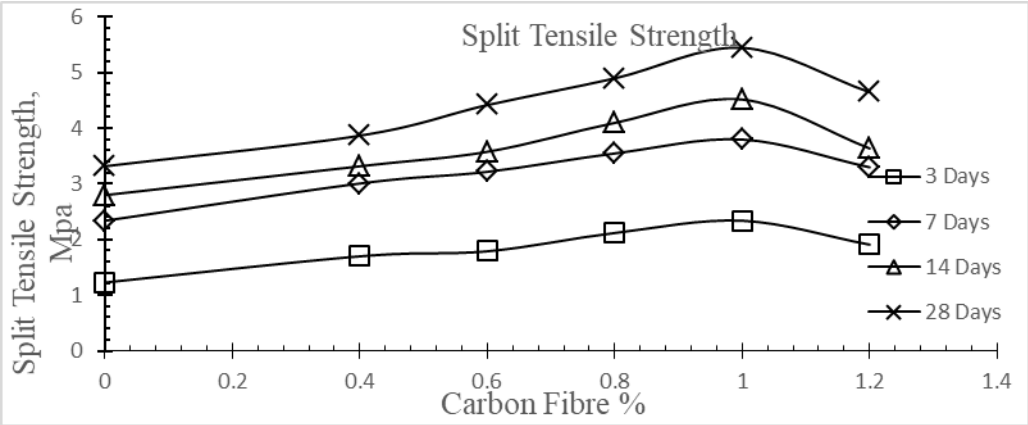

Fig 3: Effect of Carbon fibre on Split tensile strength of SCC

Similar observation of compressive strength is carried in split tensile strength of SCC addition with carbon fibre shows the optimum percentage at 0.8% after 3, 7,14 and 28 days.

Table 4: Split tensile strength of SCC with Glass Fibre

Glass Fibre (%)	Split Tensile Strength MPa			
	(3 days)	(7 days)	(14 days)	(28 days)
0	1.23	2.34	2.8	3.32
0.4	1.62	2.91	3.21	3.64
0.6	1.71	3.01	3.45	4.21
0.8	2.01	3.25	3.92	4.72
1.0	2.20	3.55	4.22	5.22
1.2	1.76	3.22	3.34	4.41

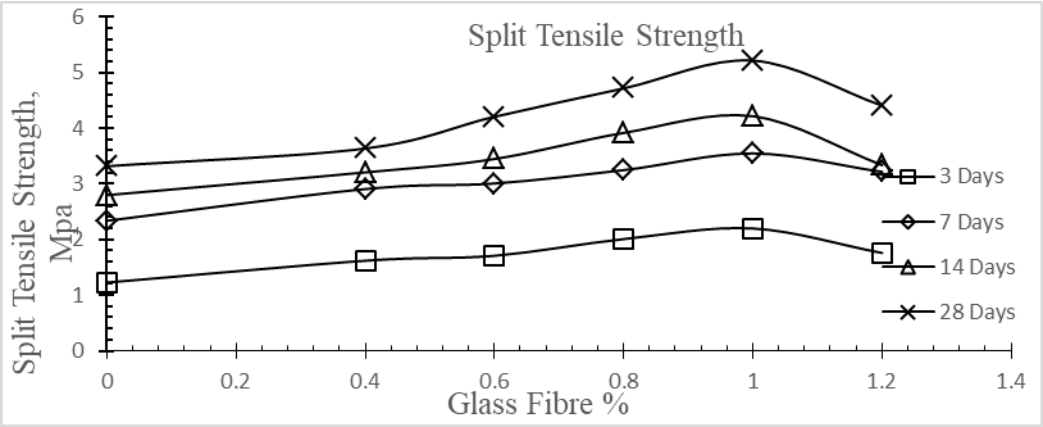

Fig 4: Split tensile strength of SCC on glass-fiber

Similar observation of compressive strength is carried in split tensile strength of SCC addition with glass fibre shows the optimum percentage at 0.8% after 3, 7,14 and 28 days.

Effect of carbon and glass fibre on flexural strength of SCC

The trend is followed when flexural strength test is that it increases as the percentage of fibre content increases. Flexural strength is the strength when the cylinder is cut into halves by applying lateral load.

Table 5: Flexural Strength with Carbon Fibre

Carbon fiber %	Flexural strength (Mpa)			
	(3 days)	(7 days)	(14 days)	(28 days)
0	3.55	5.68	6.39	7.1
0.4	4.6	7.36	8.2	9.2
0.6	4.9	7.84	8.62	9.8
0.8	5.2	8.32	9.24	10.4
1.0	5.5	8.8	9.8	11
1.2	5.3	8.48	9.45	10.6

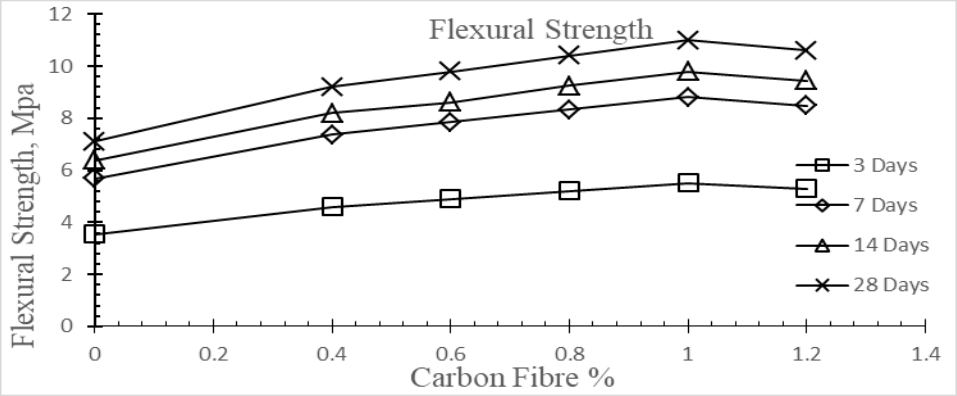

Fig 5: Flexural Strength with Carbon Fibre

The trend is followed when flexural strength test is that it increases as the percentage of fibre content increases. But the optimum percentage of carbon fibre is at 1% for the flexural strength.

Table 6: Flexural strength of SCC with Glass Fibre

Glass fiber %	Flexural strength (MPa)			
	(3 days)	(7 days)	(14 days)	(28 days)
0	3.55	5.68	6.39	7.1
0.4	4.3	6.88	7.61	8.6
0.6	4.6	7.36	8.09	9.2
0.8	4.9	7.84	8.84	9.8
1.0	5.2	8.32	9.24	10.4
1.2	4.8	7.68	8.51	9.6

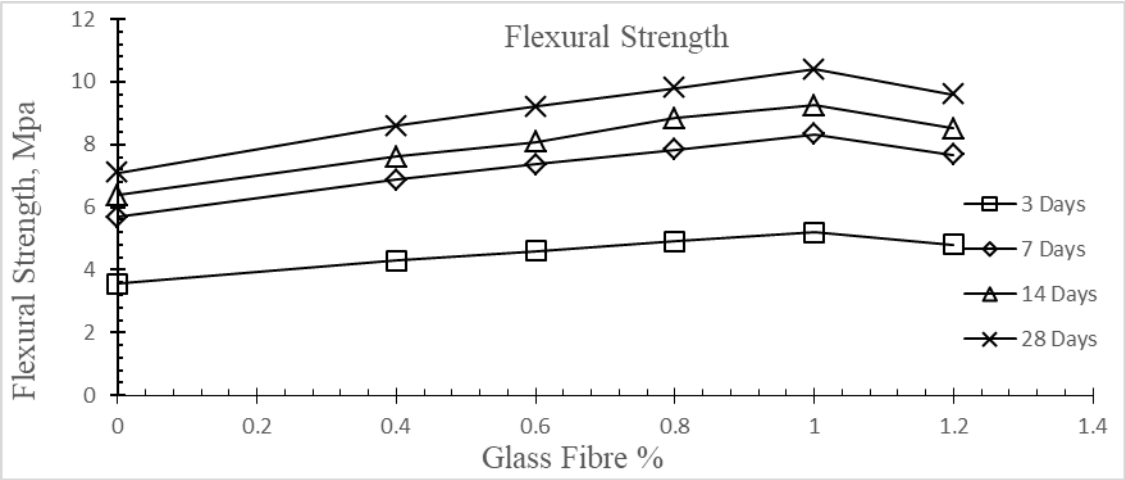

Fig 6: Flexural strength with Glass fibre

The trend is followed when flexural strength test is that it increases as the percentage of fibre content increases. But the optimum percentage of glass fibre is at 1% for the flexural strength.

Conclusion

In this give an overview and present the mechanical properties of SCC with carbon and glass fiber. The performance and the strength is checked which are compressive strength, split tensile strength and flexural strength moreover workability. In this paper, present the various experiments like compression strength, split tensile strength, flexural strength, that are performed for various mixes of carbon and glass fiber mixed SCC. This study reveals that an appreciable amount of improvement observed in split tensile strength and flexural strength with the addition of optimum percentage of carbon and glass fiber.

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