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Research Article

Effect Of Polypropylene Fiber On The Properties Of Self-Compacting Concrete With M-Sand

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ABSTRACT

Concrete made from agro-industrial waste is frequently utilized for both environmental and economic benefits. Extensive research has explored the incorporation of such waste materials in both plain and self-compacting concrete (SCC). This study investigates the recent advancements in SCC incorporating agricultural and industrial waste, with a focus on the use of admixtures to enhance SCC quality. Specifically, the impact of polypropylene fiber on the properties of self-compacting concrete with manufactured sand (M-sand) is examined. Experimental results indicate that incorporating polypropylene fiber improves the concrete's strength due to the bond formed between the fiber and concrete matrix. Compressive strength tests conducted using a Universal Testing Machine (UTM) revealed that an optimal fiber content of 0.5% yields the highest compressive strength. Higher fiber content results in decreased strength. Testing of M20 grade concrete blocks (150 x 150 x 150 mm) after 7 and 14 days of curing showed that 0.5% fiber content provided the best results, with a compressive strength of 22.755 MPa after 14 days. These findings suggest that adding 0.5% polypropylene fiber significantly enhances the performance of self-compacting concrete with M-sand, providing a viable option for improving concrete properties while utilizing agro-industrial waste.

Keywords- SCC- Self Compacting concrete, FA-Fine aggregate, FRC- Fiber Reinforced Concrete, PP-Polypropylene, HSSCC-high strengths self-compacting concrete, SNFC- sulphonated naphthalene Formaldehyde condensates.

1. INTRODUCTION

The use of agro industrial waste as a novel material to make high-quality concrete, whether it be plain concrete or self-compacting concrete, has been the subject of numerous research investigations. The current study examines recent advancements in self-compacting concrete that contains agricultural and industrial waste components. This article discusses the use of several cutting-edge materials as ingredients in SCC and their impact on the fresh and hardened qualities. Self-Consolidating Concrete (SCC) is a unique type of concrete that is very flowable, does not segregate, and spreads into place by weight alone. It fills the formwork fully even when there is dense reinforcement and rebar present without the need for additional compaction. This study looked at how adding polypropylene fibre to SCC mixtures affected their fresh state characteristics as well as how it affected parts of the SCC's toughened properties. In this study, polypropylene fibre was added to concrete mixes in volume fractions of 0%, 0.05%, 0.10%, and 0.15%. According to test results, polypropylene fibres have a tendency to decrease the flow ability and passing ability but enhance the viscosity and segregation resistance of SCC. Additionally, polypropylene fibre lessens SCC's deformability in its fresh state. Tests on concrete specimens after 28 days of curing show that polypropylene fibre addition up to 0.10% of volume was present. It is also possible to propose allowing polypropylene fibres up to 0.10% of the concrete's volume to be added to the SCC mix. A series of composite materials known as fiber-reinforced concrete combines cement mortar's great compressive strength with the significantly higher impact, flexural, and tensile strengths provided by the fibre reinforcement. Without any fiber in the concrete, there was the development of the cracks due to plastic shrinkage, drying shrinkage, and other reasons for changes in the volume of concrete.

2. METHODOLOGY

Self-compacting concrete (SCC) could be a flowing concrete that doesn`t need vibration and, indeed, shouldn't be vibrated. With no segregation of the coarse mixture, it produces compaction into each section of the mild or formwork just by implying that of its own weight. Self-compacting concrete (SCC) has several edges in terms of production and placement compared to ancient concrete specifically, elimination of external or internal vibration for compaction, higher flow ability, workability and pump ability, likewise as accumulated bonding with engorged reinforcement.

Self-consolidating concrete must be able to flow through highly reinforced areas and fill unique forms while supporting itself. It also needs to be able to prevent aggregate segregation. This kind of concrete needs to adhere to specific project placement and flow specifications. When compared to conventional vibrated concrete, self-compacting concrete with a similar water-to-cement or cement-binder ratio typically has a little higher strength because the absence of vibration improves the interface between the aggregate and hardened paste.

3. EXPERIMENTAL TESTS

3.1 Preparation of concrete block with addition of Polypropylene fiber

1. The sand and gravel are stored outside in piles until they are needed for processing, at which point they are relocated to storage bins within the plant. In order to keep it dry, enormous vertical silos are used to store ordinary Portland cement (OPC) grade 53 outdoors.
2. As a manufacturing run begins, the necessary amounts of sand, gravel, Polypropylene Plastic, and cement are transported to a weigh batcher, which measures the right amounts of each material by gravity or mechanical means.

Fig. 1 Concrete Fiber

3. The dry elements are then poured into a stationary mixer, where they will combine for many minutes. There are typically two types of mixers. A shallow pan with a cover is what a planetary or pan mixer resembles. A vertical rod within the mixer connects the mixing blades. A horizontal drum mixer is the polar opposite of this. Mix blades are attached to a horizontal rod within the mixer, which resembles a tin can have flipped upside down.
4. A little water is added to the mixer after the dry ingredients have mixed. The water may initially pass through a heater or hair-raiser to control its temperature if the plant is situated in a very hot or cold environment. Chemicals for blending and colouring colours might also be different right now. After that, the concrete is mixed for 6 to 8 minutes.

3.2 Polypropylene Fiber

Grade of concrete is denoted by prefixing M to the specified strength in MPa. For an example, M20 concrete has a grade of M20, where M stands for combine. Combine proportion are going to be 1:1.5:3 for cement: sand: coarse aggregates.

3.3 Manufacturing Sand (M-Sand)

M-Sand is artificial sand made from crushing arduous stones into tiny sand sized angular formed particles, washed and finely hierarchal to be used as construction combination.

3.4 Preparation of Mould

For calculating both compressive strength of the mixes at 7, 14 and 28 days' cubes are prepared. The dimensions of cube moulds are 150x150x150 mm3 mixes and while filling the concrete in to the molds no compaction is adopted compaction is done only using a tamping rod because the concrete is self-compactable. Testing is carried out for 7, 14, and 28 days.

Fig. 2 Mould-150X150X150mm

4. TEST CONDUCTED

4.1 Compressive Strength Test

In mechanics, compressive strength or compression strength is that the potential of AN whole or structure to resist immeasurable tending to chop back size. In numerous words, compressive strength resists compression, whereas strength resists tension. within the study of strength of materials, durability, compressive strength, and shear strength is analysed severally. Some materials fracture at their compressive strength limit, whereas others deform permanently. As a result, a certain amount of deformation may even be considered a result of the compressive load limit. For certain types of buildings, compressive strength is essential. A universal testing device is frequently used to determine compressive strength.

Fig. 3 Testing of Mould

5. TEST RESULTS

5.1 Case 01

The following are the test results of Polypropylene Fibre Concrete Block of M20 Grade, Size 150 x 150 x 150mm after 7 days of curing.

Table. 1 Fiber content after 7 days

Polypropylene fibre (gm)	50	150	250
Average Maximum Force (KN)	475.62	349.15	220.30
Average Compressive Strength (MPa)	20.922	13.986	9.543
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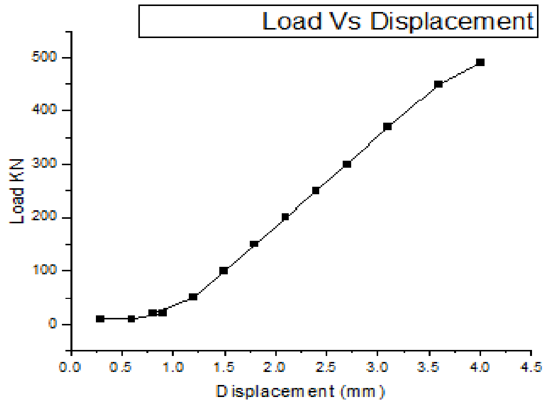

Fig 04. fiber vs force(50 gm)

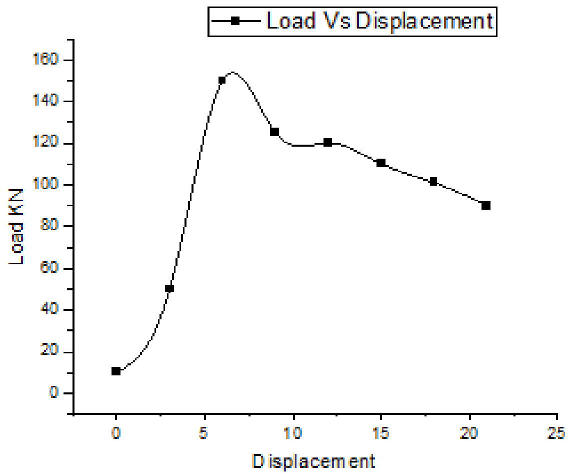

Fig 05. Graph load VS Displacement (150gm)

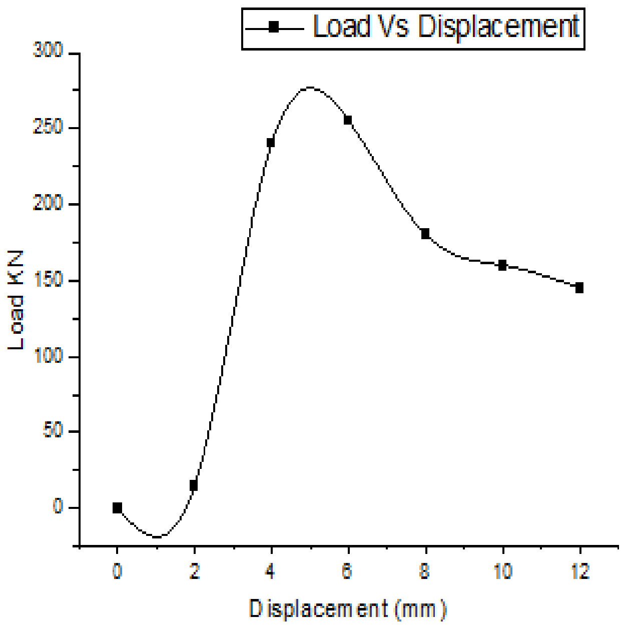

Fig 06. Graph load VS Displacement (250gm) 5.2 Case 02

The following are the test results of Polypropylene Fibre Concrete Block of M20 Grade, Size 150 x 150 x 150mm after 14 days of curing.

Table. 2 Fiber content for 14 days

Polypropylene fibre (gm)	50	150	250
Average Maximum Force(KN)	495.85	245.300	210.682
Average Compressive Strength(MPa)	22.755	10.685	9.375

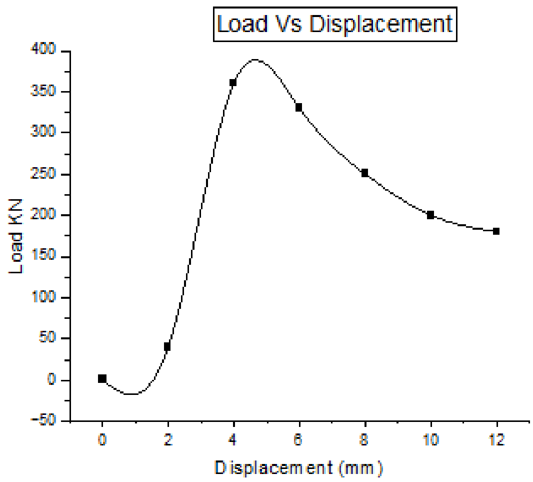

Fig 07. Graph load VS Displacement (50gm)

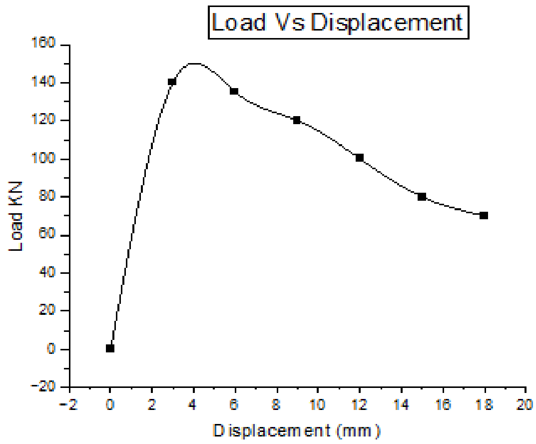

Fig 08. Graph load VS Displacement (150gm)

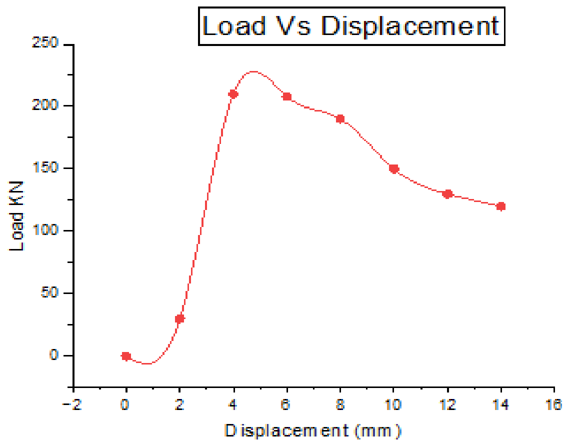

Fig 09. Graph load VS Displacement (250gm)

Although it is observed that only 50 gram of fiber content can increase the strength of concrete block. It is also being observed that the strength of 150,250 gm of fiber content are not gradually decreasing, there were fluctuations in strength. But eventually 50gm had shown maximum strength.

6. CONCLUSION

By the following tests, it can be concluded that Polypropylene fibre content can improve the strength of the concrete block because of the corresponding bond formed between the fibre and concrete. However, after conducting compressive strength test on Universal Testing Machine (UTM), it is observed that only 0.5% of Polypropylene fibre can be added in the block in order to achieve maximum strength. Increasing the fibre percent reduced the strength. Thus, addition of Polypropylene fibre of 0.5% has proven more effective with exceptional outcome.

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