INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume 4, Issue 5)
Available online at: www.ijariit.com

A study on surface absorption characteristics of concrete made with polypropylene fiber

Sidhamuni Thombre
tsidhamuni@gmail.com
Lakshmi Narain College of Technology, Bhopal, Madhya Pradesh

Sherin Felix
sherin.felix007@gmail.com
Lakshmi Narain College of Technology, Bhopal, Madhya Pradesh

ABSTRACT

The objective of this research is to produce polypropylene fibers with improved interface bonding with a concrete matrix. In the present experimental investigation, attempts are made to study on the various strength properties like compressive strength, split tensile strength, an also durability properties like CSAT test were held on long-term durability properties of PPFRC. Experiments were conducted for both Ordinary Concrete and polypropylene fiber Concrete with different percentages of polypropylene fiber. It was observed capillary section absorption conducted for determining the surface absorption test for polypropylene fiber concrete results shows increasing % of fiber than increasing surface absorption and minimum surface absorption value obtained a minimum of certain limit containing PPF in concrete. The 0.0% 0.2%, 0.4%, 0.6%, 0.8% and 1% addition of polypropylene fiber into the concrete shows better result in mechanical properties and durability.

Keywords— *Polypropylene fiber, Silica fume, Admixture, Workability, Compressive strength, Split tensile strength, CSAT test, Water absorption test*

1. INTRODUCTION

The capability of durable structure to resist weathering action, chemical attack, abrasion, and other degradation processes during its service life with the minimal maintenance is equally important as the capacity of a structure to resist the loads applied on it. Although concrete offers many advantages regarding mechanical characteristics and economic aspects of the construction, the brittle behavior of the material remains a larger handicap for the seismic and other applications where flexible behavior is essentially required. Recently, however, the development of polypropylene fiber-reinforced concrete (PFRC) has provided a technical basis for improving these deficiencies. This paper presents an overview of the effect of polypropylene (PP) fibers on various properties of concrete in fresh and hardened state such as compressive strength, tensile strength, flexural strength, workability, bond strength, fracture properties, creep strain, impact and chloride penetration. The role of fibers in crack prevention has also been discussed. Polypropylene is the first stereo regular polymer to have achieved industrial importance.

2. MATERIALS USED

2.1 Cement

Ordinary Portland cement (OPC) from a single lot was used throughout the course of the investigation. The physical properties of the cement as determined from various tests 30 conforming to Indian Standard IS: 1489-1991(Part-1) are listed in Table 3.1. All the tests were carried out as per recommendations of IS: 4031-1988. Cement was carefully stored to prevent deterioration in its properties due to contact with the moisture.

2.2 Course aggregate

Crushed angular aggregate from a local source was used as coarse aggregate. The specific gravity was 2.78.

2.3 Fine Aggregate

River sand was used as fine aggregate. The specific gravity was using 2.67. The fine aggregate passed through 4.75 mm sieve and had a specific gravity of 2.68. The sand belonged to zone III as per IS standards

2.4 Polypropylene Fiber

The Polypropylene fibers used are of with modulus of elasticity 72 GPa, Filament diameter 14 microns, specific gravity 2.67, length 14 mm.

2.5 Admixtures

Superplasticizer CONPLAST SP 430 is a chloride-free workability retention admixture based on selected organic polymers. Designed to provide workability retention where rapid workability loss is caused by high ambient temperatures or to compensate for delays in transportation. It is particularly suited to concrete mixes containing micro silica.

3. RESULT AND DISCUSSION ON EXPERIMENTAL TESTS

3.1 Workability of concrete mixes

Slump test was performed for the testing of fresh properties of concrete mix Slump cone of 200mm base diameter and 100 mm top diameter were used. Slump cone placed on the rigid surface and fill in three layers.

Table 1: Workability values for different concrete mixes

Mix no.	Description	Superplasticizer (%) by weight of the binder	Slump (mm)
1.	90%OPC+10%SF+0%PPF	1.00	110
2.	90%OPC+10%SF+0.2%PPF	1.00	100
3.	90%OPC+10%SF+0.4%PPF	1.00	100
4.	90%OPC+10%SF+0.6%PPF	1.00	100
5.	90%OPC+10%SF+0.8%PPF	1.00	100
6.	90%OPC+10%SF+1.0%PPF	1.00	90

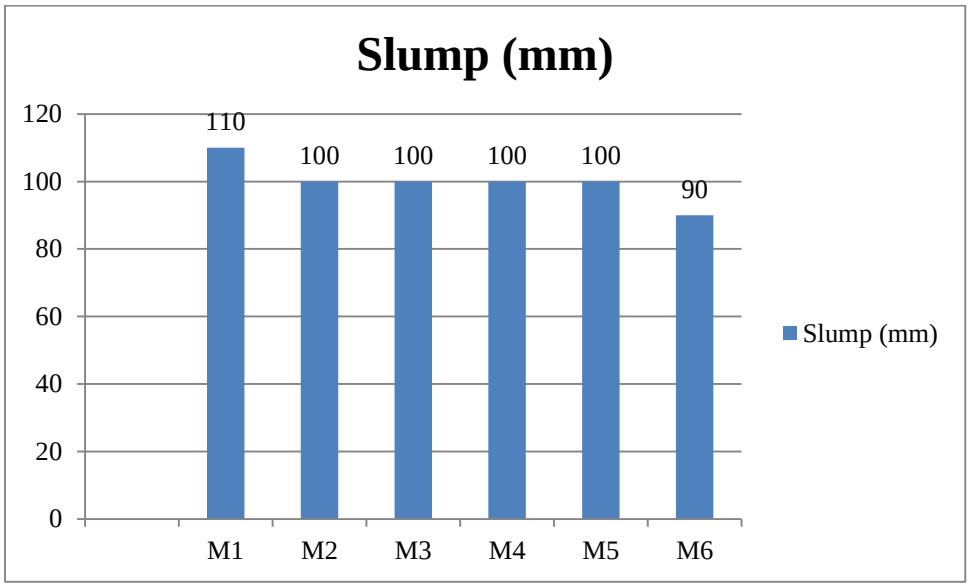

Fig. 1: Graph showing slump test results on different concrete mix

Table 1 shows that as the addition of Polypropylene fibers to concrete mix increases, the workability of the concrete mix was found to decrease as compared to the control mix. Maximum slump value obtained from control mix and increasing the percentage of PPF decreasing slump value maximum value in control mix M1 is100mm and increasing of PPF up to 1% of slump value is obtained 90 mm respectively.

3.2 Compressive strength

The compressive strength test is carried out on a specimen (cube) of size 15cmx15cmx15cm for 3, 7, 14, 28 56, and 90 days and the test results obtained can be compared with that of conventional concrete and 56, and 90 days curing of the cube for long durability of concrete.

Table 2: Compressive strength (MPa) results of all mixes at different curing ages.

Mix no.	Description	7 days	14 days	28 days	56 days	90 days
1.	90%OPC+10%SF+0%PPF	32.00	33.00	35.10	38.25	42.31
2.	90%OPC+10%SF+0.2%PPF	37.50	38.00	40.25	42.31	46.11
3.	90%OPC+10%SF+0.4%PPF	37.90	38.40	41.20	41.10	46.85
4	90%OPC+10%SF+0.6%PPF	36.20	36.85	39.65	40.01	45.09
5	90%OPC+10%SF+0.8%PPF	33.20	34.82	37.28	38.21	43.01
6	90%OPC+10%SF+1.0%PPF	32.25	33.20	35.23	36.51	39.14

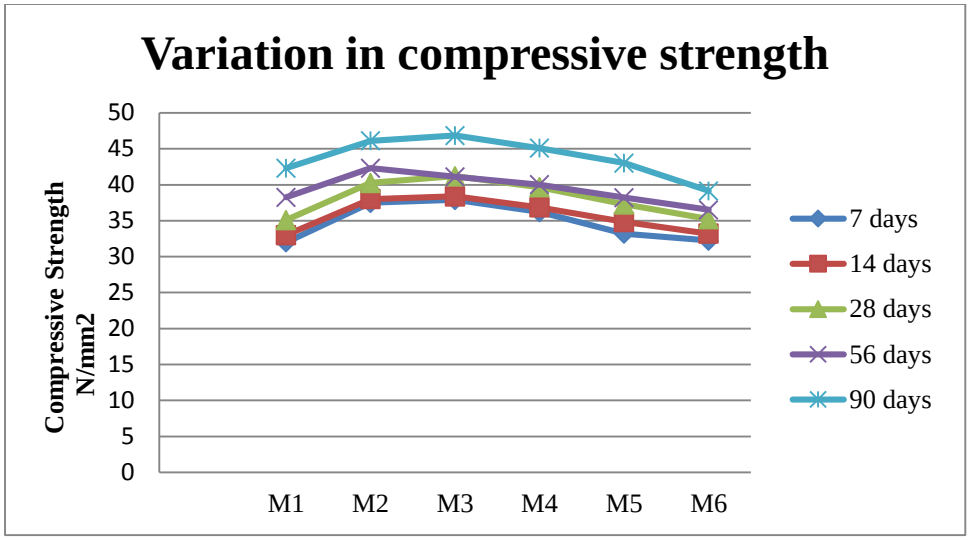

Fig. 2: Graph showing variations in compressive strength

3.3 Split tensile strength test results

The Split Tensile strength was studied and the values of the 3 samples studied are shown in the tabular form. Table 3 shows the data of 3, 7, 14, 28, 56, and 90 days compressive strength obtained

Table 3: Splitting tensile strength (MPa) results of all mixes at different curing ages.

Mix no.	Description	7 days	14 days	28 days	56 days	90 days
1	90%OPC+10%SF+0%PPF	3.98	4.00	4.11	4.83	5.19
2	90%OPC+10%SF+0.2%PPF	4.65	4.95	5.20	5.72	5.89
3	90%OPC+10%SF+0.4%PPF	4.50	4.91	5.09	5.64	5.81
4	90%OPC+10%SF+0.6%PPF	4.32	4.51	4.56	4.75	5.09
5	90%OPC+10%SF+0.8%PPF	4.21	4.21	4.30	5.10	5.29
6	90%OPC+10%SF+1.0%PPF	3.41	3.31	3.95	4.14	4.63

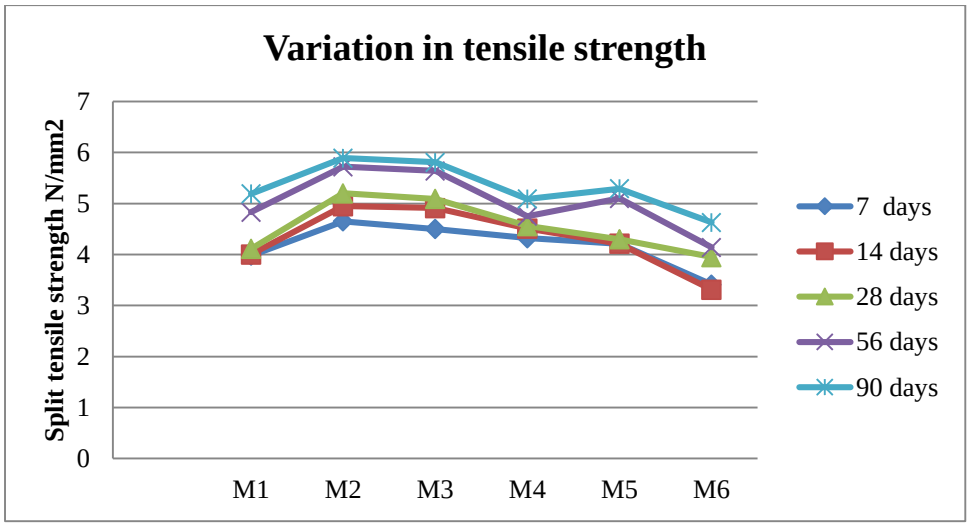

Fig. 3: Graph showing variation in Tensile strength

4. CAPILLARY SUCTION (SORPTIVITY) TEST RESULTS

Sorptivity is defined as the rate of movement of a waterfront through a porous material under capillary action. Sorptivity test differs from the ISAT as the former measures the rate of capillary suction as opposed to the bulk effect of capillary suction in the latter at a specified time. The lower the sorptivity value, the higher the resistance of concrete towards water absorption.

Table 4: Average IRA (mm/Sec$^{1/2}$) at 56 and 90 days of curing

Mix no.	Description	Average IRA (mm/Sec$^{1/2}$)	
		56 days	90 days
1.	90%OPC+10%SF+0%PPF	0.0131	0.0122
2.	90%OPC+10%SF+0.2%PPF	0.0089	0.0092
3.	90%OPC+10%SF+0.4%PPF	0.0086	0.0078
4.	90%OPC+10%SF+0.6%PPF	0.0085	0.0081
5.	90%OPC+10%SF+0.8%PPF	0.0125	0.0130
6.	90%OPC+10%SF+1.0%PPF	0.0145	0.0135

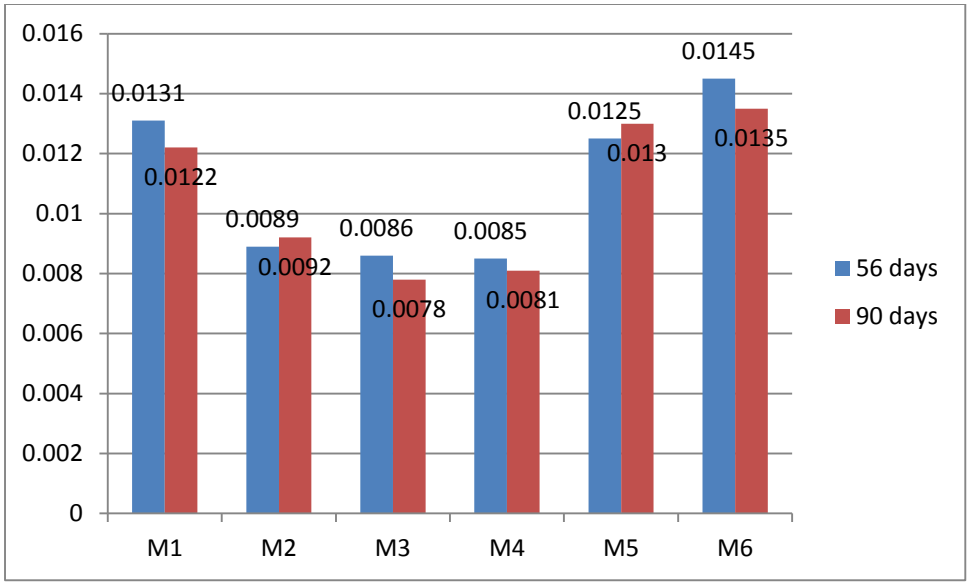

Fig. 4: IRA graph at 56 and 90 days of curing

4. CONCLUSIONS

In the current investigation, polypropylene fiber (PPF) was used to examine the strength and water absorption characteristics using the Capillary Suction test as per C 1585 – 04, water absorption test. The experimental data obtained has been analyzed and discussed in Chapter-4, to fulfill to the best of ability, the objectives set forth for the present investigation. This chapter gives the broad conclusions that are drawn from the investigation.

a. It was observed that decreasing in bleeding is observed by the addition of polypropylene fiber in the concrete mixes up to 1.0% by weight of cement.
b. It was observed that as the mixing of polypropylene fiber to concrete mix increases, the workability of the concrete mix was found to decrease as compared to the control mix.
c. It was observed the compressive strength obtained maximum in mix 0.2% PPF in 28 days is 41.15Mpa.
d. At mixing PPF fiber in concrete up to the certain limit to increase the tensile strength of concrete and maximum value obtained from the mix M2 and M3 as compare to control mix and finally result in the tensile strength decreasing with increasing percentage of PPF.
e. It was observed that mixing of polypropylene fiber into the concrete mixture marginally improves the compressive strength, as well as tensile strength at 28 days at 0.2% and 0.4%addition of polypropylene fiber into the concrete, shows a better result in mechanical properties and durability.
f. The concrete containing 0.4% GF by weight of binder shows a less capillary rise in concrete.
g. The durability of concrete from the aspect of water absorption on concrete increases by adding polypropylene fiber in concrete. The optimum value of polypropylene fiber for water absorption was 0.2% and 0.4% by weight of the binder.

5. REFERENCES

[1] ACI committee 544. 1982. State-of-the-report on fibre reinforced concrete, (ACI 544.1R-82), Concrete International: Design and Construction. 4(5): 9-30, American Concrete Institute, Detroit, Michigan, USA.
[2] ACI Committee 544. 1989. Measurement of properties of fibre reinforced concrete, (ACI 544.2R-889). American Concrete Institute, Detroit, Michigan, USA.
[3] Ali, M., Liu, A., Sou, H., Chouw, N. (2012). Mechanical and dynamic properties of coconut fiber reinforced concrete. *Construction and Building Materials*, *30*, 814–825.
[4] Asokan, P., Osmani, M., Price, A. (2010). Improvement of the mechanical properties of glass fiber reinforced plastic waste powder filled concrete. *Construction and Building Materials*, *24*(4), 448–460.
[5] ASTM C 1585 -04 (2007) Standard test method for measurement of the rate of absorption of water by hydraulic-cement concretes.
[6] ASTM C 1240-11 "standard specification for silica fume used in cementitious mixtures".
[7] ASTM C494/C494M-11 "Standard specifications for chemical admixtures for concrete"
[8] Avci, A., Akdemir, A., Arikan, H., (2005). Mixed-mode fracture behavior of glass fiber reinforced polymer concrete. *Cement and Concrete Research*, *35*(2), 243–247.
[9] Barhum, R., Mechtcherine, V., (2012). Effect of short, dispersed glass and carbon fibers on the behavior of textile-reinforced concrete under tensile loading. *Engineering Fracture Mechanics*, *92*, 56–71.
[10] Barluenga, G., Hernández-Olivares, F., (2007). Cracking control of concretes modified with short AR-glass fibers at an early age. Experimental results on standard concrete and SCC. *Cement and Concrete Research*, *37*(12), 1624–1638.
[11] Behnood A., and Ghandehari M., (2009). "Comparison of compressive and splitting tensile strength of high-strength concrete with and without polypropylene fibers heated to high temperatures". *Construction and Building Materials* 27 (2012) 73–77.
[12] Bhanja, S., B. Sengupta, b., (2003) "Modified water-cement ratio law for silica fume concrete ". *Cement and Concrete research*, 33, pp 447-450.
[13] BS 1881-208 (1996) Testing concrete — Part 208: Recommendations for the determination of the initial surface absorption of concrete. BSI 389 Chiswick High Road London W4 4AL.

