International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 3.45 (SJIF-2015), e-ISSN: 2455-2585
Volume 4, Issue 5, May-2018

BEHAVIOUR OF MICRO FILAMENT POLYPROPYLENE FIBRE REINFORCED CONCRETE

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Abstract— The present paper deals with the behavior of micro filament polypropylene fibres in concrete. Polypropylene Fibre Reinforced Concrete is an embryonic construction material which can be described as a concrete having high mechanical strength, Stiffness and durability. By utilization of Polypropylene fibres in concrete results in optimum utilization of materials and reduction in cost reduction can be achieved. An investigation on M30 grade micro filament polypropylene fibre reinforced concrete was done by addition of various percentages of micro filament polypropylene fibres i.e., 0.%, 0.25%, 0.5%, 0.75%, and 1.0%. it was found that use of micro filament polypropylene fibres up to 1% can improve the mechanical properties like compressive strength, split tensile strength, flexural strength of concrete.

Keywords— Micro filament polypropylene fibre, poly propylene fibre reinforced concrete, compressive strength, split-tensile strength, flexural strength.

I. INTRODUCTION

Concrete is the most widely used construction materials which is characterized by its low tensile strength and strain capacity. The present day world is witnessing the construction of very challenging and difficult civil engineering structures. Quite often, concrete being the most important and widely used material is called upon to possess very high strength and sufficient workability properties. Researchers all over the world are attempting to develop high performance concretes by using fibres and other admixtures in concrete up to certain proportions. The interest in the use of fibres for the reinforcement of composites has increased during the last several years. A combination of high strength, stiffness and thermal resistance favorably characterizes the fibres with randomly distributed tend to be more closely than conventional reinforcement bars. Therefore, fibres of different size and type play an important role for bridging the cracks in the matrix which can prevent or control the initiation, propagation and coalescence of cracks leading to better concrete performance. Addition of polypropylene fibres decreases the unit weight of concrete and increases its strength.

II. LITERATURE SURVEY

Thirumurugan (2013) analyzed the influence of crimped polypropylene fibres in cementitious matrix, their experimental results showed that increase in compressive strength absorbed for polymer modified fibre concrete is mainly due to HRWR admixtures and their excellent water retention inside the concrete due to polymer film formation around the cement grains. Mehul J. Patel (2013) studied effect of polypropylene fibre on the high strength concrete and concluded that Polypropylene fibre can be used with admixtures, plasticizers, and super plasticizers, for increasing the strength of concrete with partial replacement of cement. Murahari (2013) studied the Effects of Polypropylene fibres on the strength properties of fly ash based concrete and concluded that strengths of concrete increased upon increase of polypropylene fibres.

III. OBJECTIVES

- To determine optimum dosage of micro filament polypropylene fibres in concrete.
- To determine the compressive strength, split tensile strength of polypropylene fibre reinforced Concrete (PPFRC).
- To study the Stress-Strain behaviour of Polypropylene fibre reinforced concrete (PPFRC)
- To determine the flexural strength of plain cement concrete beams with varying percentages of micro filament polypropylene fibres in concrete.

IV. MATERIALS USED

Cement: Ordinary Portland cement of 53 Grade confirming to IS: 12269-2013 with specific gravity 3.02 with 34% of standard consistency and 60 minutes of initial setting time was used in this study.

Fine aggregate: In this present study locally available river sand of Zone II confirming to IS: 383-1970. With a specific gravity 2.29 which is free from any type of deleterious materials was used.

Coarse aggregate: Crushed granite of the size 20mm procured from a local quarry was used as coarse aggregate in this work.

Water: Potable tap water available in the laboratory which satisfies drinking standards is used for mixing and curing the test specimens.

Polypropylene Fibres: Micro filament polypropylene fibres as shown in Figure.1 were used in the present experimental work, the properties are listed in Table 1.

Fig.1.Microfilament polypropylene fibre

TABLE I
PROPERTIES OF MICRO FILAMENT POLYPROPYLENE FIBRE

Specifications	Values
Diameter	33-35 µ
cut length	6mm, 12mm, 20mm
Tensile strength	6000 kg/cm^2
Melting point	>250ºC
Dispersion	Excellent
Acid resistance	Excellent
Alkaline resistance	Good

V. EXPERIMENTAL WORK AND RESULTS

Design Mix: M30 grade of concrete mix with mix proportions 1:1.44:2.89 with a water cement ratio of 0.45 was designed as per IS: 10262-2009.

Casting: Cubes of standard size 150 mm x 150 mm x150 mm, Cylinders of Diameter 150 mm and height 300 mm and beams of size 600mm x 150 mm x 100 mm were cast with varying (0%, 0.25%, 0.50%,0.75% and 1%) percentages of micro filament polypropylene fibres.

Curing: The specimens were cured for 28 days in curing pond. After completion of period, the specimens were removed from the water and kept under shadow for the specimen to get surface dry condition.

Testing: The Compressive Strength, Split-Tensile strength, stress-strain behavior and the flexural strength tests were done on 100T Universal Testing Machine as per to IS: 516-1959. Flexural strength specimens were tested under two point loading over an effective span of 500mm. the details of test set up with loaded specimen is shown in figure 2(a). the test specimens were simply supported on rollers and two point loads were applied at equidistance from both the supports and in between them. Loading was applied through a hydraulic jack arrangement to cause downward deflection. The load was given through the jack in small increments, to measure the deflection dial gauge is arranged. The loading was continued till the ultimate failure of the specimens is reached.the enlarged pattern of crack in failed specimen with distribution of microfilament polypropylene fibres is shown in figure 2(b).

The modulus of rupture is the ultimate strength determined in a flexure test. The modulus of rupture for each sample was evaluated using the following equation.

$$R = PL/bd^2$$

Here, R= Modulus of Rupture, P = ultimate Load, L= length of specimen, b = width of specimen, d = depth of specimen.

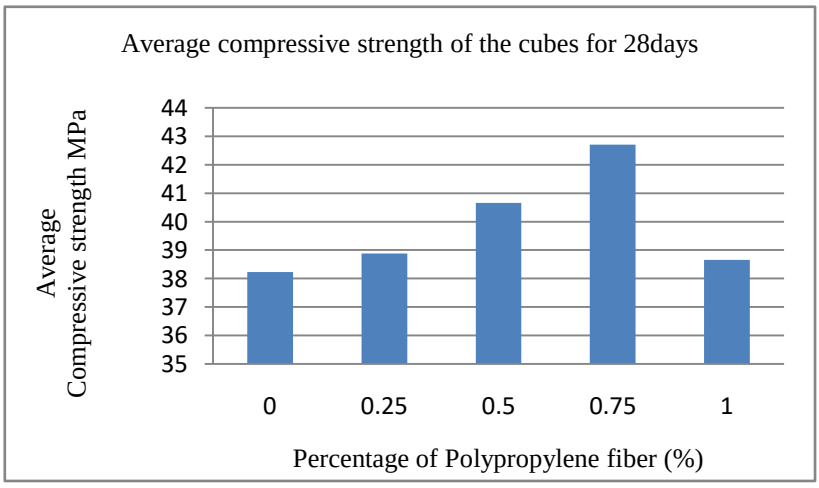
(a) *(b)*

Fig. 2(a) Details of test set up with loaded specimen (b) enlarged pattern of crack in failed specimen with distribution of microfilament polypropylene fibres

TABLE 2

COMPRESSIVE STRENGTH OF THE POLYPROPYLENE FIBER REINFORCED CONCRETE FOR 28 DAYS

S.No	Polypropylene Fiber (%)	Compressive Strength of the polypropylene fiber reinforced concrete (N/mm^2)
1	0	38.33
2	0.25	38.88
3	0.5	40.66
4	0.75	42.71
5	1.0	38.66



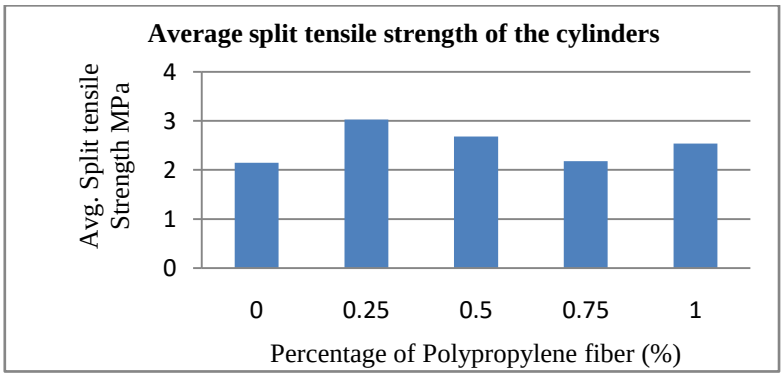
Graph 1: Average compressive strength of the cubes for 28 days

A.Split tensile strength of cylinders:

TABLE 3

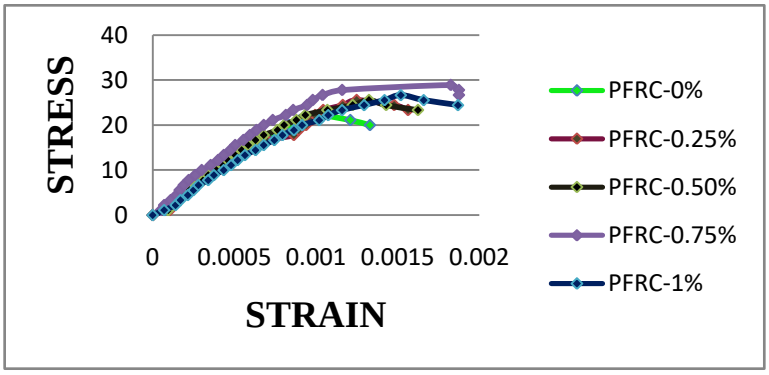
SPLIT TENSILE STRENGTH OF THE POLYPROPYLENE FIBER REINFORCED CONCRETE

S. no	Poly Propylene fiber (%)	Split tensile Strength for 28 days of Polypropylene fiber reinforced concrete (N/mm2)
1	0	2.15
2	0.25	3.03
3	0.5	2.68
4	0.75	2.18
5	1.0	2.54



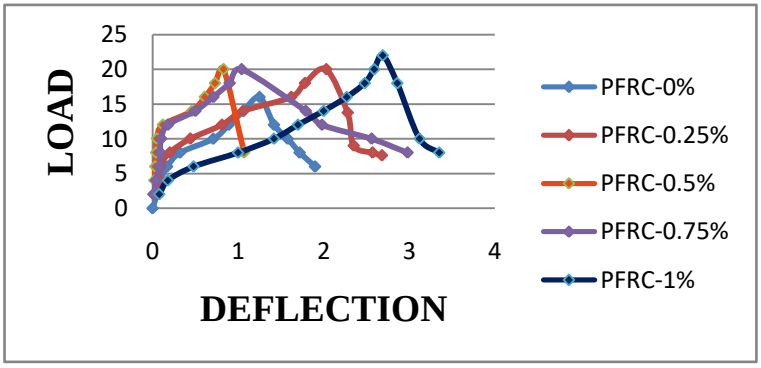
Graph 2: Split tensile strength of the cylinders for 28 days

B.Stress-strain behavior fiber reinforced concrete:



Graph 3: stress strain behavior of polypropylene fiber reinforced concrete

C.Load Vs deflection curves of beams:



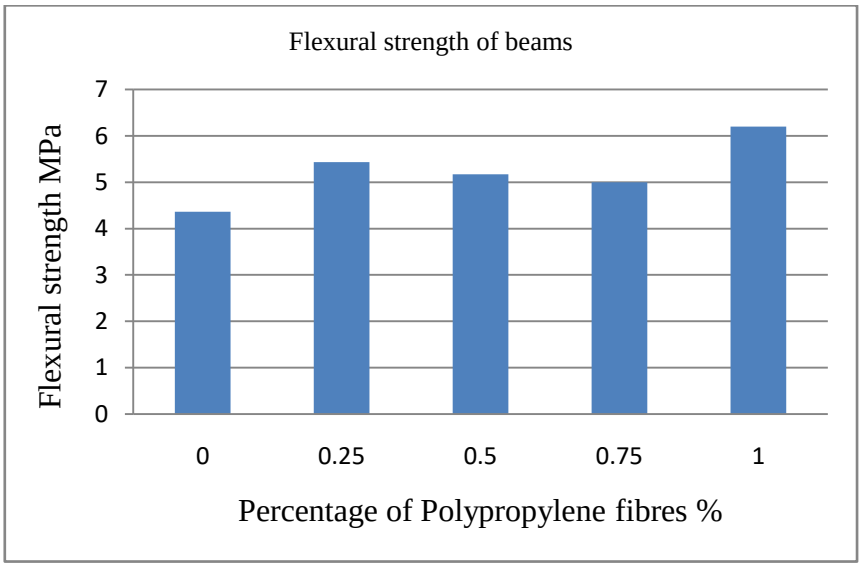
Graph 4: load Vs deflection of polypropylene fiber in concrete

D.Flexural Strength of the beams

TABLE 4

FLEXURAL STRENGTH OF THE POLYPROPYLENE FIBER REINFORCED CONCRETE

S .no	Poly Propylene Fiber (%)	Flexural Strength of Polypropylene fiber reinforced concrete MPa
1	0	4.36
2	0.25	5.43
3	0.5	5.17
4	0.75	5.01
5	1.0	6.2



Graph 5: Average modulus of rupture for 28 days

VI. DISCUSSION ON TEST RESULTS AND CONCLUSIONS

- The Highest compressive strength was found to be 42.71 MPa at 0.75% of micro filament polypropylene fiber which is 11.71% greater than that of conventional concrete.
- The highest split tensile strength was found to be 3.03 MPa at 0.25% of micro filament polypropylene fiber which is 40.93% greater than that of conventional concrete.
- The highest flexural strength was found to be 6.2 MPa at 1.0% of micro filament polypropylene fiber which is 42.20% greater than that of normal concrete.
- From stress strain curves it was observed that at 0.75 % of micro filament polypropylene fibres in concrete offeres a greater resistance to failure i.e; stress. Within the limiting stain.
- As the percentage of microfilament polypropylene fibres increases in concrete, there is a significant increase in the deflection as shown in load vs deflection curves.
- Micro filament Polypropylene fiber in concrete enhances the crack arresting capacity of concrete
- Increase in percentage of fibres resulted in better flexural strength in concrete
- Hence upto 1% of micro filament polypropylene fibres can be effectively used in concrete to improve the mechanical properties.

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