



e-ISSN: 2319-8753 | p-ISSN: 2320-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 6, June 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.512



9940 572 462



6381 907 438



ijirset@gmail.com



www.ijirset.com

Effect of Polypropylene Fiber on Concrete by Varying It's Percentage

Abhijit Chorage¹, Rakshit Nalla², Sumit Chavale³, Saichintan Pawar⁴, Manoj Nila⁵

Associate Professor, Department of Civil Engineering, Zeal College of Engineering and Research, Pune, India¹

U.G. Student, Department of Civil Engineering, Zeal College of Engineering and Research, Pune, India^{2,3,4,5}

ABSTRACT: The reinforced polymer in civil engineering increase rapidly, the various experimental investigation for determination of properties of polypropylene fiber are discussed in paper work. this paper presents the effect of polypropylene (PP) fiber on various properties of concrete such as compressive strength, tensile strength, workability and fractured properties with various content of fiber range of (0%, 0.5%, 1%, 1.5%) investigation was carried out to various type of effect such as compressive, spilt tensile, flexural shear strain, plastic shrinkage cracking by the curing period 7 & 28 days and that the addition in polypropylene fiber to concrete exhibit better performance. Furthermore, shrinkage cracking is reduced by 83 to 85% by addition of fibers in the range of 0.35 to 0.50%. Polypropylene fiber are hydrophobic, that is they do not absorb water. However, further investigation was highly recommended and should be carried out to understand more mechanical properties of fiber reinforced concrete.

(KEYWORDS: Concrete, polypropylene fiber, different curing condition shrinkage cracking.)

I. INTRODUCTION

Reinforced concrete can be used to produce frames, columns, foundation, beams etc. Reinforcement material used should have excellent bonding characteristic, high tensile strength and good thermal compatibility. Reinforcement requires that there shall be smooth transmission of load from the concrete to the interface between concrete and reinforcement material and then on to reinforcement material. Thus the concrete and the material reinforced shall have the same. The use of concrete as a structural material is limited to certain extent by deficiencies like brittleness, poor tensile strength and poor resistance to impact strength, fatigue, low ductility and low durability. It is also very much limited to receive dynamic stresses caused due to explosions. The brittleness is compensated in structural member by the introduction of reinforcement (or) pre-stressing steel in the tensile zone. However it does not improve the basic property of concrete. It is merely a method of using two materials for the required performance. The main problem of low tensile strength and the requirements of high strength still remain and it is to be improved by different types of reinforcing materials. Further concrete is also deficient in ductility, resistance to fatigue and impact. The importance of rendering requisite quantities in concrete is increasing with its varied and challenging applications in pre-cast and pre-fabricated building elements. The development in the requisite characteristics of concrete will solve the testing problems of structural engineers by the addition of fibers and admixtures. The role of fibers is essentially to arrest any advancing cracks by applying punching forces at the crack tips, thus delaying their propagation across the matrix. The ultimate cracking strain of the composite is thus increased to many times greater than that of unreinforced matrix. Admixtures like fly ash, silica fume, granulated blast furnace slag and metakaolin can be used for such purposes. However addition of fibers and mineral admixtures possess certain problems regarding mixing, as fibers tends to form balls and workability tends to decrease during mixing.



Figure 1. Polypropylene fiber

II. RELATED WORK

Analysis of work complete by many investigates deliberates the instrument of fiber-matrix interface, whereas numerous presentations remain used to calculate the attachment amongst the fibers and cement conditions. As the attachment of fiber and the background productions a main part in the compound performance. Also, this episode also presents a review of literature applicable to the exploration and trials completed for fiber reinforced concrete in universal with a eminence of civil engineering applications, fiber reinforced concrete was effectively used in variation of engineering presentation, as of its reasonable and outstanding routine in the production and building field. However, most of the engineers and examines have supposed that by what method and why

- ❖ **Waheeb Ahmed al-khaja (1997)** studied the mechanical properties and time dependent deformation of polypropylene fiber concrete. This investigation conducted to study the effect of PPF used for reinforcing concrete mixes. The compression, tension and flexural strength test were performed changing fiber 0.1 to 3 % of the cement weight content. Adding the 0.5 % of PPF the compressive strength can obtain the maximum value.
- ❖ **K.S.Sathyanarayann** studies on properties of concretes containing polypropylene, and reengineered plastic shred fiber work an attempt has been made to study the influence of polypropylene fibers, steel fibers and re-engineered plastic shreds with 0.1 %, 0.5 % and 0.5 % by volume of concrete mix. With the addition of polypropylene fibers to plain concrete, its strength is increased in the range of 4 %-17 %. The improvement in its wear and impact resistance were 28 %-58 % and 72 %-134 %, respectively and reduction in maximum crack width is to an extent of 21 %-74 %.
- ❖ **Mohammed and Kaushik (2000)** investigated the influence of mixed aspect ratio of fibers on compressive strength, splitting tensile strength, flexural strength, impact strength and ductility of SFRC. They tried different mixed aspect ratio of fibers with a total volume fraction of 1.0%. The authors concluded that the use of 65% long fibers and 35% short fibers gave optimum mechanical properties.
- ❖ **Dr. Y. P. Joshi (2014)** studied different types of fibers and their application. The development in concrete properties by polypropylene fibers, they analysed that compressive strength which is increased about 16%. The flexural strength of polypropylene fibers is better quality about 30%.

III. METHODOLOGY

Materials:

1) Cement: -

The cement used was Pozzolona Portland cement (PPC) with a specific gravity of 3.11. Initial and final setting times of the cement were 69 min and 195 min.

2) Aggregate:-

Good quality artificial sand was used as a fine aggregate. The material whose particles are of size as are retained on I.S. Sieve (4.75mm) is termed as coarse aggregate. The size of coarse aggregate depends upon the nature of work. The coarse aggregate used in this experimental investigation are of 20mm size crushed angular in shape

3) Fiber:-

Fibers vary in types, geometry, properties and availability in construction industry. Most common types of fibers are steel fibers, glass fibers, and polypropylene fibers. These usages may alter in concrete for different applications. The fibers are selected from their properties like, effectiveness, cost and availability. Special types of fibers such as carbon, natural fibers, mineral fibers, and asbestos fibers may use in harsh environment. These differences and usage of fibers depends on the requirement of behaviour and properties for a concrete, allowing the increase the explicit effects and mechanical properties.

Once the preparations are done for pouring, we proceed with the following:

- a. **Batching:** -We go through the process of measuring different concrete materials. These include cement, coarse aggregate (blue stone, etc.), sand and water. This process is known as batching.
- b. **Mixing:** -In the mixing process, the selected materials are mixed thoroughly to the required proportions. It's done until the resultant concrete paste has a uniform consistency and colour.
- c. **Transporting:** -Once the mixing process is complete, the concrete is transported to your site. the concrete is kept at the correct wetness and continually rotates to prevent it setting. At the site, the concrete is either poured directly into the cube.
- d. **Compaction & Levelling:** -Once the concrete has been evenly distributed into the cube, the process of compaction begins. The aim is to eliminate air bubbles to increase the strength of the concrete. Screeding is then done, which is essentially a levelling process using large, straight edges that scrape across and flatten the surface. It is at this point; the desired concrete finishing effect can be applied.
- e. **Curing:** -We then keep the concrete at an optimum moisture level for a certain time period, depending on the atmospheric conditions. This is required to complete the hydration process of the concrete, resulting in a high quality and long lasting concrete job and then take in to the water tank for curing purpose.

IV. EXECUTION

Proper design of concrete mixture is intended to obtain such proportioning of ingredients which will produce concrete of high durability performance during the designed life of a structure, usually 50 years.

For a particular strength and long term qualities and performance. Several factors determine these properties.

1. Quality of cement
2. Proportion of cement and other cementations materials in relation to water in the mixture (water/cementation ratio)
3. Strength and cleanliness of aggregate
4. Interaction or adhesion between cement paste and aggregate
5. Adequate mixing of ingredients
6. Proper placing, finishing, and compaction of fresh concrete
7. Curing at a temperature not below 50° F while the placed concrete gains strength.

➤ CONCRETE MIX DESIGN FOR INDIAN STANDARD METHOD:

STEP 1: Design stipulation

- A) Characteristic compressive strength = 25 N /mm²
- B) Max size of aggregate = 20 mm (angular)
- C) Degree of workability = 75 MM
- D) Degree of quality control = Good
- E) Type of exposure = Severe

STEP 2: Test data for materials

- Cement used OPC = 53 grade
 Specific gravity of cement = 3.15
 Specific gravity of fine aggregate = 2.6
 Specific gravity of coarse aggregate = 2.8
 Water absorption
1. Coarse aggregate = 0.5%,
 2. Fine aggregate = 1%

STEP 3: Target mean strength of concrete

- Target compressive strength $F_{ck} = f_{ck} + t.s$
 f_{ck} = Characteristic compressive strength at 28 days
 s = Standard deviation
 t = tolerance factor (its take 1.65)

For using table(1) the target mean strength for the specified characteristic strength,
 $25 + (1.65 \times 4) = 31.60 \text{ N/mm}^2$

STEP 4: Selection of water-cement ratio

The w/c ratio required for target mean strength of 31.60 N/mm^2 is 0.5 from table 5 of IS 456-2000.

STEP 5: Selection of water content.

Table 4 of IS 10262-1282 (for 20 mm nominal max size aggregate)

And confirming to grading zone-II

Water content per m^3 concrete = 186 kg sand content as percentage of total aggregate by absolute volume = 3% for changes in values in water-cement ratio for following adjustment is required.

Required water content = $186 + (186 \times 3)/100$

Required water content = 191.61 lit

STEP 6: Determination of cement content

Water cement ratio = 0.5

Water = 191.6 l

Cement = $191.6/0.5$

= 383 kg/m^3

This cement content is adequate for extreme exposure condition. According to IS: 456-2000

STEP 7: Determine aggregate content

By using equation 3.15 from 10262-1982

$V = [w + (C/S_c) + (1/p) + (fa/S_{fa})] \times (1/1000)$

Where

V = absolute volume of fresh concrete, which is equal to gross volume (m^3) minus the volume of entrapped air,

W = mass of water (kg) per m^3 of concrete,

C = mass of cement (kg) per m^3 of concrete,

S_c = specific gravity of cement,

p = ratio of fine aggregate to total aggregate by absolute volume,

fa = total masses of fine aggregate and coarse aggregate (kg) per m^3 of concrete respectively, and

S_{fa} = specific gravities of saturated surface dry fine aggregate and coarse aggregate respectively.

From IS: 383: 1970 specified maximum size of aggregate 20 mm, the amount of entrapped air in the wet concrete is 2%, taking this into account and apply into the above equation.

$0.98 = [191.6 + (383/31.5) + (1/0.315) + (fa/2.6)] \times (1/1000)$

fa = 545 kg/m^3

Therefore,

Ca = $(1 - 0.315/0.315) \times (1/1000)$

Ca = 1188 kg/m^3

fa = amount of fine aggregate

Ca = amount coarse aggregate

Materials	Water	Cement	Fine Aggregate	Coarse Aggregate
Weight	191.6 kg	383kg	545 kg	1188 kg
Ratio	0.5	1	1.4	3.1

Table 1.Quantity of Materials

Calculation for block size $150\text{mm} \times 150\text{mm} \times 150\text{mm}$

Dry volume = $0.15 \times 0.15 \times 0.15$

= 3.375×10^{-3}

= 0.00375 m^3

Wet volume = $0.00375 \times 1.54 = 0.005775$

Mass of cement = $383 \times 0.00375 = 1.43 \text{ kg}$

Mass of FA = $545 \times 0.00375 = 2.04 \text{ kg}$

Mass of CA = $1188 \times 0.00375 = 4.4 \text{ kg}$



Figure 2. Curing of blocks

V. EXPERIMENTAL RESULTS

SR No	Mix	Polypropylene fiber (%)	Compressive Strength (Mpa)			
			At 7days	At 14 days	At 21 days	At 28 days
1.	CC	0	15	21.6	22.56	24
2.	PPF1	0.5	16.82	23.247	24.28	25.83
3.	PPF2	1	17.06	23.625	24.67	26.25
4.	PPF3	1.5	17.48	24.28	25.36	26.98

Table 2.Results of different % of polypropylene

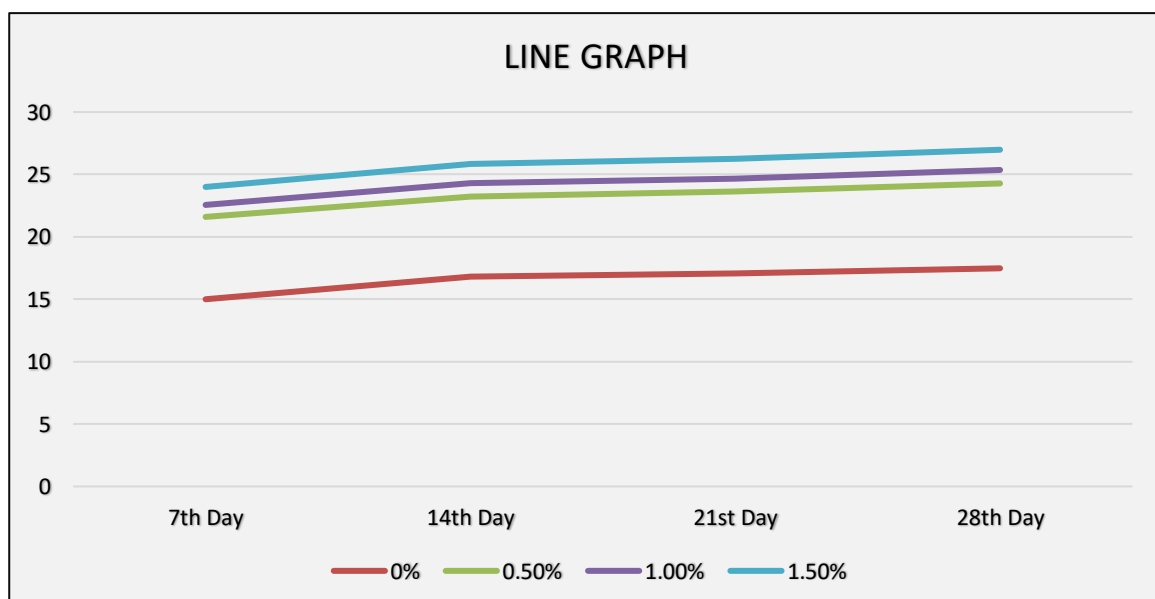


Figure 3 .Graphical Representation



VI. CONCLUSION

The primary objective of this study was to evaluate the optimal quantity of polypropylene fibers for improved physical and mechanical behaviour of concrete. The addition of marginal quantity of polypropylene fiber in the concrete mix showed positive effects on the compressive strengths of concrete. The optimum percentage of polypropylene to be added to the concrete mix to increase the compressive strength lies around 0.25%. Polypropylene fibers increased the 28 days' compressive strength of concrete by about 9%. Polypropylene fiber addition greater than the optimum percentage (0.25%) showed a slight increase for 0.50% and then decreased for higher values. The flexural strength of concrete increases by as much as 65% when low percentage fractions (0.25%) are added. It recorded slight increase for 0.50% and then decreases when 0.75% and 1% are added. From this study, it is observed that the optimum dosage of polypropylene fiber is between 0.25% and 0.5% both for compressive strengths and for flexural strengths. Further researches should be carried out to know the exact dosage of polypropylene fibers that yields the most favourable strengths of concrete and to apply this methodology to different types of Portland cements.

REFERENCES

- [1] Balaguru, P. N., and Shah, S. P., Fiber-Reinforced Cement Composites, Singapore, McGraw-Hill, 1992.
- [2] Banthia, N., and Sheng, J., "Fracture Toughness of Micro-Fiber Reinforced Cement Composites", Cement and Concrete Composites, Vol. 18, 1996, pp. 251-269.
- [3] Bentur, A., and Mindess, S., Fiber Reinforced Cementitious Composites, London, Elsevier Applied Science, 1990.
- [4] Dave U. V. and Desai Y. M. "Effect of Polypropylene, Polyester and Glass fibers on various strength of ordinary and standard concrete", The First International Conference On Recent Advance In Concrete Technology, Sep. 2007, Washington D.C. U.S.A.
- [5] Troxell G.E, Davies H.E and Kelly J.W, Composition and properties of concrete (New York, McGraw Hill Books Company, 1968).



**Impact Factor:
7.512**



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

9940 572 462 6381 907 438 ijirset@gmail.com



www.ijirset.com

Scan to save the contact details