AN INVESTIGATION ON THE BEHAVIOUR OF TEXTILE REINFORCED CONCRETE

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ABSTRACT

In civil engineering, concrete is an important construction material which is used in all over the world. This building material inherently brittle in nature and have some of the dramatic demerits such as poor deformability and vulnerable crack resisting properties. Basically hybrid concrete containing, two or more different types of fibres are rationally combined to produce a composite that derives benefits from each of the individual fibres and exhibits a synergistic response in concrete and also it increases the structural integrity of concrete.

The main objective of this investigational work is to study the characteristics of hybrid textile fiber reinforced concrete. The influence of type of fibers and their content on the characteristics of hybrid textile fiber reinforced concrete having different combinations of textile fibers are studied. The workability characteristics are study through slump, compaction factor and Vee-Bee degree. To study the strength characteristics such as compressive strength, Split tensile strength, flexural strength. The specimens are incorporated with (0.5%+0.5%) volume fractions of (Steel fiber + Polypropylene fiber), (Steel fiber + Polyester fiber) and (Steel fiber + Nylon fiber). Also conduct the rapid chloride permeability test on M30 grade of concrete at 28 days cured concrete.

Keyword :- *Hybrid fibre, Steel fibre, Polyester fibre, Nylon fibre, Polypropylene fibre.*

1. INTRODUCTION

The mixture of cement, sand, aggregate and discontinuous, a discrete, uniformly dispersed suitable fibre is defined as fibre reinforced concrete. When compared with the efficiency of FRC with conventional concrete, FRC has far superior efficiency because of its advantages and applications and its important area of requisition includes earthquake resistant structures, blast resistant structures, highway pavements, airports, mining and tunnel linings work, hydraulic structures and bridge deck overlays. Comprehensive work that has been carried over FRC shows that there is increase in strength, ductility, toughness and post cracking resistance etc.

1.1 Textile-Reinforced Concrete

Textile reinforced concrete in which the usual steel reinforcing bar replaced by textile material. TRC represents an interesting new construction material, additional advantage compare to steel or fiber reinforced concrete. This material is low weight and high bearing capacity. The textile fiber materials like polyester, polyproplyne, nylon, kelvar, rayon, etc.

1.1.1 Polypropylene fibres

Polypropylene is the stereo regular synthetic polymer fibres. It consist 85% of monomer propylene and it is also a product of petroleum. Polypropylene fibre is the lightest of all fibres and it is lighter than water. The fibres having 12mm length and diameter of 24 micron are commonly used for concrete mix. These micro fibres reduce crack formation. Its use as apparel has been limited but it holds an important position in industrial applications.

1.1.2 Nylon Fibres

Nylon was the first man-made synthetic fiber. It is a polyamide fiber with amide linkage –NHCO-. It produces by diamine and a dicarboxylic acid. Nylon is produced by melt spinning and valued for its light weight, incredible tensile strength, durability and resistance to damage. Textile materials composed of nylon tend to be light in weight because of the low density of nylon.

1.1.3 Kevlar Fibre

Kevlar is a manmade fibre, it as an organic fibre in aromatic polyamide family. The unique properties anddistinct chemical composition of wholly aromatic polyamides (aramids) distinguish them from other man-made fibre Kevlar has a unique combination of high strength, high modulus, toughness and thermal stability. It was developed for demanding industrial and advanced-technology applications. Currently, many types of Kevlar are produced to meet a broad range of end uses.

1.1.4 Polyester Fibre

Polyester fibre is an example from the large group of 'truly' man-made fibres since they are produced from synthesised polymers which do not exist in nature. There are many different types of polyester but all of them are produced by condensation reaction and they all contain ester functional group COO. The most important type of polyester is poly(ethylene terephthalate) (PET), commonly referred to simply as polyester.Polyester fibres average lengths from 38 to 60 mm

2. MATERIALS

2.1 Cement

In this work, 43 Grade OPC conforming to IS: 8112 – 1989 was used with the brand name of Zuari. The properties of cement is given in table-1.

Table 1- Properties of cement

Properties	Values
Fineness	4%
Normal consistency	32%
Specific gravity	3.15
Initial setting time	43 min
Final setting time	360 n

2.2 Fine aggregates

In this experimental work sand used is collected from river Thungbadra, Karnataka, India. The properties of fine aggregates are given in table-2.

Table 2- Properties of fine aggregates

Properties	values
Particle shape, size	nd 4.75mm and down size
Specific gravity	2.64
Water absorption	1.0%

2.3 Coarse aggregates

Coarse aggregates were collected from crusher at Nellogal, Haveri, Karnataka, India. The properties of fine aggregates are given in table-3.

Table 3- Properties of coarse aggregates

Properties	Values
Particle shape, size	20mm and down size
Fineness modulus of 20mm aggregate	6.89
Specific gravity	2.68

2.4 Polypropylene fibre

In this project Recron 3s fibre CT-2424 is usedandit is developed after extensive research at Reliance Technology Centre. It is brought from Aahana enterprises, Chamarajpet, Bengaluru, Karnataka, India. The specifications of polypropylene fibres are given in table-4 and following figure 1 shows the sample of polypropylene fibre.

Table 4- Specifications of polypropylene fibre

Specifications	Value
Material	Polypropylene triangular fibre
Type	CT 2424
Filament diameter	25 Microns
Cut length	12mm
Tensile strength	600kg/cm2

Fig 1: Sample of polypropylene fibre

2.5 Nylon fibre

In this project work the nylon fibrer is brought from Aahana enterprises, Chamarajpet, Bengaluru, Karnataka, India. The nylon fibre was added by 0.5% of volume. The properties of nylon fibres are given in table-5 and following figure 2 shows the sample of nylon fibre.

Table 5- Properties of nylon fibre

Properties	values
Length	12 mm
Diameter	24 micron
Density	1.14 g/cc

Elongation at break	15-45%
Elasticity	Very good

Fig 2: Sample of nylon fibre

2.6 Polyester fibre

In this project work the polyester fibrer is brought from Aahana enterprises, Chamarajpet, Bengaluru, Karnataka, India. The polyester fibre was added by 0.5% of volume. The specifications of polyester fibres are in given table-6 and following figure 3 shows the sample of polyester fibres.

Table 6- Specifications of polyester fibre

Specifications	Value
Length	12 mm
Diameter	24 micron
Density	1.3g/cc
Water absorption	0.1%
Refractive index	1.58-1.64
Flammability	Self-extinguishing

Fig 3: Sample of polyester fibre

2.7 Steel fibre

In this project work Steel fibres was brought from STEWOLS INDIA (P) LTD Nagpur Industrial Estate Kamptee Road Uppalwadi ,Nagpur, Maharastra Krnataka, India. The properties of steel fibres are given in table-7 and following figure 44 shows sample of steel fibres.

Table 7- Properties of steel fibre

Properties	Value
Average thickness	0.75mm
Length	60mm
Density	7850 kg/m^3
Tensile strength	8500m^2

Fig 4: Sample of steel fibre

3. MIX DESIGN

Mixdesign of M30 grade concrete is done according to IS: 10262-2009 and arrived mix proportion is given table-8.

Table 8- Mix proportion

Mix proportion			
Water	**Cement**	**Fine aggregate**	**Coarse aggregate**
197 Litre/m3	438 kg/m3	655.9656 kg/m3	1129.464 kg/m3
W/C- 0.45	**1**	**1.497**	**2.578**

4. EXPERIMENTAL RESULTS

4.1 Workability Test Results

Sl No.	Combination of Fibres	Slump Value in mm	Compaction Factor	Vee-Bee Value in sec
01	Conventional concrete	20	0.86	29
02	Polypropylene Fibre	0	0.76	38
03	Polyester Fibre	0	0.80	35
04	Nylon Fibre	0	0.78	36

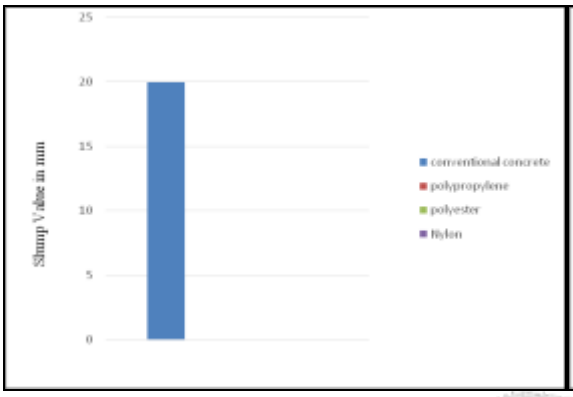

Fig 4.1Graphical representation of slump

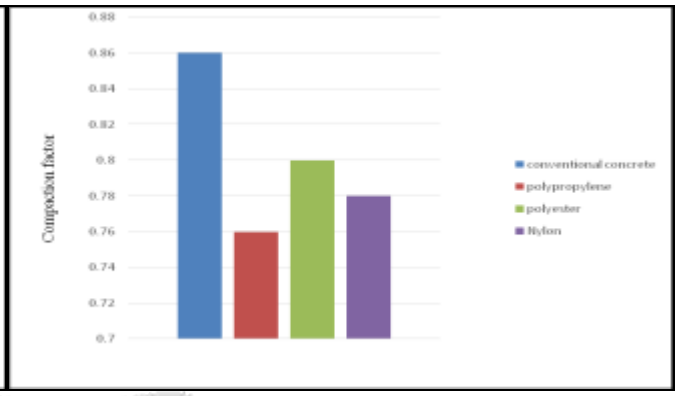

Fig 4.2Graphical representation of Compaction factor

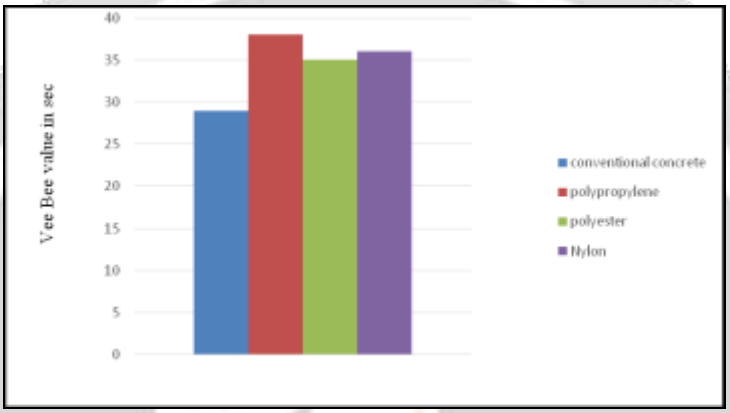

Fig 4.3Graphical representation of Vee-Bee degree

4.2 Harden Concrete Strength Test Results

Table 4.2 Compression Strength Test

SL. No	Description of Textile Fibre	Avg. Compressive Strength in N/mm2
01	Conventional concrete	**30.37**
02	Polypropylene Fibre	**33.48**
03	Polyester Fibre	**32.44**
04	Nylon Fibre	**31.53**

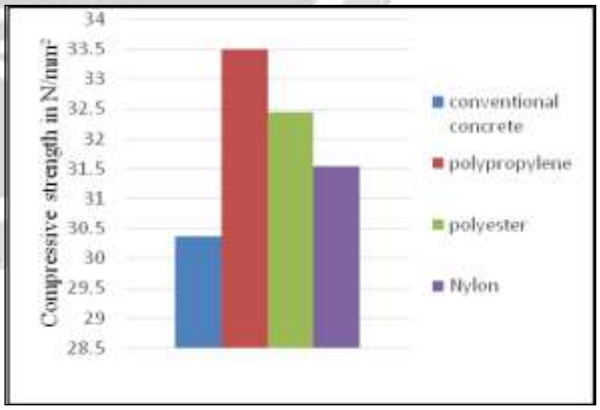

Fig4.4Graphical representation of compressive strength

Table 4.3 Flexural Strength Test

SL. No	Description of Textile Fibre	Avg. Flexural Strength in N/mm2
01	Conventional concrete	**4.73**
02	Polypropylene Fibre	**8.5**
03	Polyester Fibre	**6.47**
04	Nylon Fibre	**6.5**

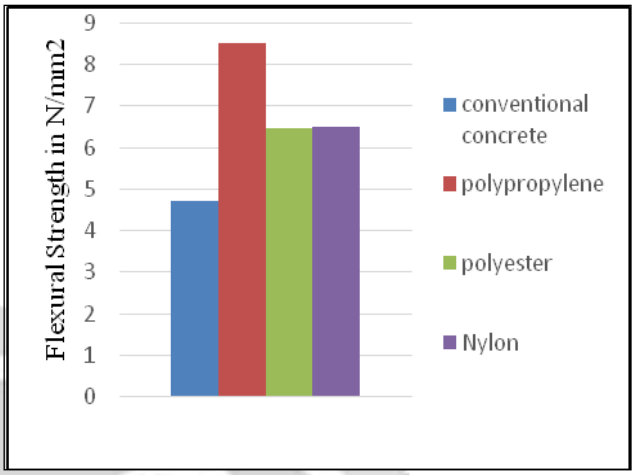

Fig 4.5Graphical representation of flexural strength

Table 4.4Split Tensile Strength Test

SL. No	Description of Textile Fibre	Avg. Split Tensile Strength in N/mm2
01	Conventional concrete	**2.40**
02	Polypropylene Fibre	**3.11**
03	Polyester Fibre	**2.69**
04	Nylon Fibre	**2.55**

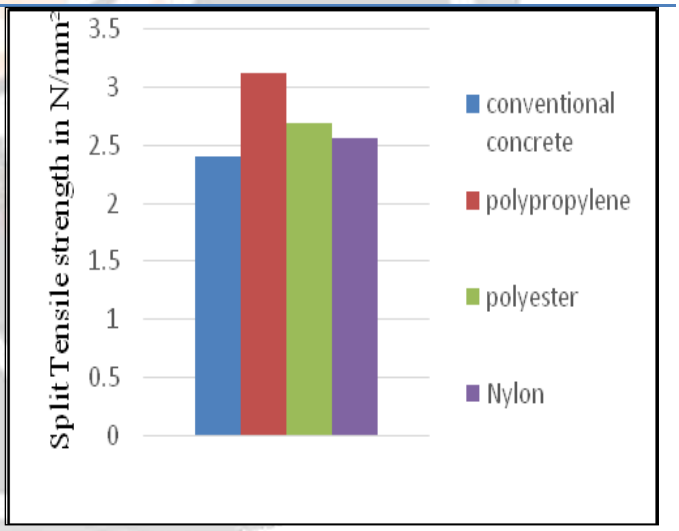

Fig 4.6Graphical representation of split tensile strength

Table 4.5 Shear Strength Test

SL. No	Description of Textile Fibre	Avg. Shear Strength in N/mm2
01	Conventional concrete	**4.26**
02	Polypropylene Fibre	**9.8**
03	Polyester Fibre	**8.15**
04	Nylon Fibre	**7.59**

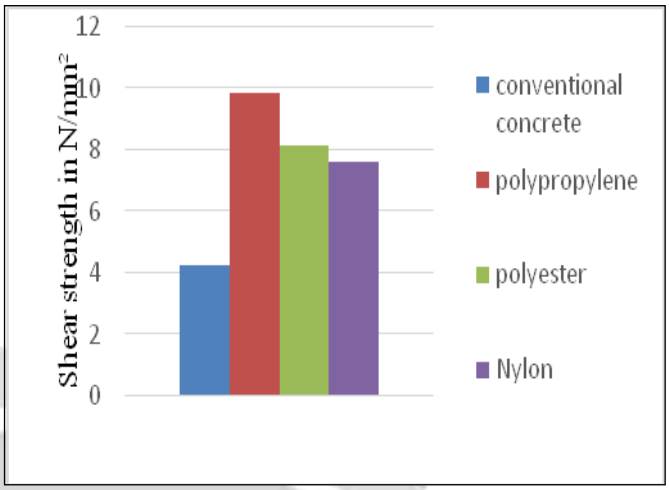

Fig 4.7Graphical representation of shear strength

Table 4.6 Impact Strength Test

SL. No	Description of Textile Fibre	Initial Impact Value	Final Impact Value
01	Conventional concrete	**2044.88**	**2337.00**
02	Polypropylene Fibre	**2237.25**	**2907.00**
03	Polyester Fibre	**2080.50**	**2572.13**
04	Nylon Fibre	**2137.50**	**2394.00**

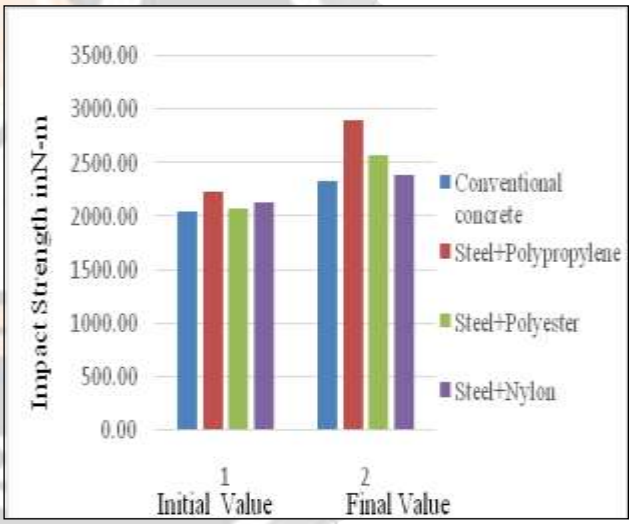

Fig 4.8Graphical representation of impact strength

Table 4.7 Soroptivity Test

SL. No	Description of Textile Fibre	Avg. Soroptivity in Cm/min
01	Conventional concrete	**4.73**
02	Polypropylene Fibre	**8.5**
03	Polyester Fibre	**6.47**
04	Nylon Fibre	**6.5**

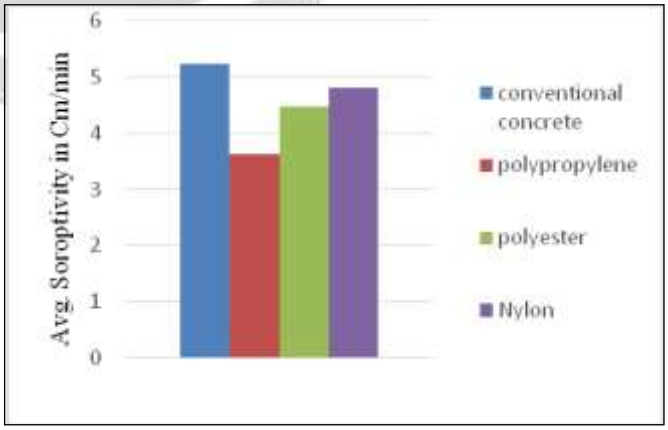

Fig 4.9 Graphical representation of Sorptavity

4.8 Table Rapid chloride penetration test

SL. No	Description of Textile Fibre	RCPT Value in Coulombs
01	Conventional concrete	**1043.26**
02	Polypropylene Fibre	**1173.6**
03	Polyester Fibre	**8578.26**
04	Nylon Fibre	**1723.54**

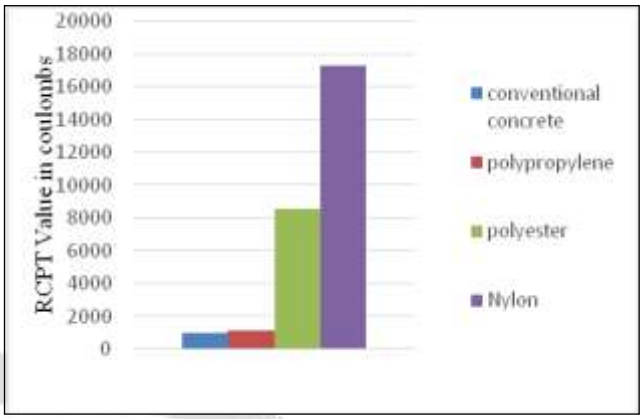

Fig 4.10 Graphical representation of RCPT

5. CONCLUSIONS

Based on the experimental investigations, the following conclusions were drawn

1) The workability of the three fibres reinforced concrete considered in this study, were found to be less than conventional concrete.
2) The workability of the polyester fiber concrete considered in this study, were found to be higher than polypropylene concrete and nylon fiber concrete.
3) On addition of fibers in concrete were conclude that compressive strength, tensile strength, shear strength, impact strength gets increased.
4) It can be conclude that use of polypropylene fiber in concrete can increases the strength properties of concrete.
5) The hardened concrete strengths like compressive strength, tensile strength, shear strength, impact strength of polypropylene fiber concrete were found to be more than steel polyester fiber concrete and nylon fiber concrete.
6) The sorptivity value of concrete produced with fibers shows a decresing trend as compared to conventional concrete.
7) The sorptivity value of concrete produced with polypropylene fiber shows a decreasing trnd as compared to concrete produced with polyester fiber and nylon fiber.
8) The RCPT value measured in coulumbs is more in nylon fiber concrete as compared to polypropylene fiber concrete and polyster fiber concrete.

6. ACKNOWLEDGEMENT

The author's special thanks to the **Vision Group of Science and Technology (VGST)** for providing project facility available at college and platform to fulfilling the vision (RCPT).

Our special thanks to the **Dept. of Civil Engineering Devagiri, Haveri, Karnataka** for providing facility for project.

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