ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

BEHAVIOUR OF M-SAND POLYPROPYLENE FIBER REINFORCED CONCRETE

MRS. CHANDRAKALA S[1], SHASHI KUMAR N V[2] , KIRAN KUMAR N V[3]

[1]*Assistant Professor, Department of Civil Engineering, S.J.C.I.T, Chickballapura, Karnataka, India*
[2]*Assistant Professor, Department of Civil Engineering, S.J.C.I.T, Chickballapura, Karnataka, India*
[3]*Post graduate student, Department of Civil Engineering, S.J.C.I.T, Chickballapura, Karnataka, India*

ABSTRACT

The interest in the use of fibers for the reinforcement of composite has increased during the last several years. A combination of high strength, stiffness and thermal resistance favorably characterizes the fibers. In this project, the results of the strength properties of polypropylene fiber reinforced concrete have been presented.The compressive strength, split tensile strength of concrete samples made with different fibers amounts varies from 0%,0.5%,1% 1.5% and 2.0% will be studied.

Concrete is the most widely used construction material in the world. It is used on highways and building, concrete is vital component of many other structures necessary for the function of society such as underground transit, wastewater treatment, marine structures and bridges.

One improvement that has been used commercially since the 1990s is the addition of small fibers, usually made of steel, glass, carbon etc and now in our project we are making use of polyproplene fibers to the concrete mixtures. This addition increases the bending strength of the material due to the flexible nature of fibers, this reduces the shrinkage cracks and acts as a secondary reainforcement.

Keywords—polypropylene fiber; compressive strength; split tensile strength; shrinkage cracks; secondary reinforcement.

I. INTRODUCTION

In recent years, many studies have been conducted in the mechanical characteristics of reinforced fiber concrete. Such concrete is also used in retofitting and repairing the covering of concrete structure, tunnels, etc. Polypropylene fibers (at relatively low volume fractions<0.3%)are used for secondary temperature shrinkage reinforcement, overlays and pavements, slabs, flooring systems, crash barriers, precast pile shells and concrete for tunnel linings, canals and reservoirs.according to the researches, the increase of formability and bending strength are the extra advantages of adding the fibers to the concrete. Two kinds of fibre that very often used in the concrete are steel fiber and polyproplene fiber.

The evaporation of concrete surface water is a factor in creating the contract paste fracture in concrete which leads to the formation of tension stress since the concrete starts to strengthen.. The paste fractures are formed when the acceleration of water evaporation is more than the movement of concrete emulsion to the surface. Here, the negative pressure is generated in the capillaries through which the concrete paste flows and proportionately the tension stress is formed. Such stress is developed during the concrete strengthening and the concrete is cracked where the stress is more than the concrete strength. The cracks caused by paste contracting in the concrete are formed in the first hours after pouring the concrete in the frames and before the concrete reaches its initial strength. Such cracks create critical points in the concrete sensitivity for attaching harmful materials to internal parts of concrete that finally can lead to corrosion and damaging the material in the concrete. In ordinary concrete, where vibration is necessary, the best and most acceptable method for preventing cracks formations caused by paste contract is by using fibers, particularly thin artificial ones with the volume of less than 0.5.

A. BACKGROUND ON USING POLYPROPYLENE FIBER

Polypropylene fibers are engineered micro fibers with a unique “TRIANGULAR” cross section, used in secondary reinforcement of concrete. It complements structural steel in enhancing concrete’s resistance to shrinkage cracking and improves mechanical properties such as flexural Or split tensile and transverse strength of concrete along with the desired improvement in abrasion and impact strength.

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

Fig 1. Polypropylene fiber

Polypropylene is a propene undergoes addition polymerization to produce poly (propene), often known as polypropylene, which is one of the most versatile thermoplastic polymer available commercially, Mixture of propene and other monomers from a wide range of important copolymers.

An overview of the polypropylene fiber reinforced concrete is the capacity of durable 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 reading mechanical characteristics and economic aspects of the construction, the brittle behavior of the material remains a large 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. The effect of polypropylene 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 fiber in crack prevention has also been discussed.

Table1: Properties of Polypropylene Fiber

Sl. No	Properties	Units	Polypropylene Fiber
1	Shape		Triangular
2	Cut length	mm	3/4.8/6/12/18/24
3	Effective Diameter	Microns	25-40
4	Specific Gravity		0.90-0.91
5	Melting Point	Deg. C	160-165
6	Tensile Strength	Mpa	550-700
7	Elongation	%	60-90
8	Young’s Modulus	Mpa	>4000
9	Alkaline Stability		Very good

B. 1.3 SCOPES AND OBJECTIVES

Polypropylene fibers are engineered micro fibers with a unique “TRIANGULAR” cross section, used in secondary reinforcement of concrete. It complements structural steel in enhancing concrete’s resistance to shrinkage cracking and improves mechanical properties such as flexural / split tensile and transverse strength of concrete along with the desired improvement in abrasion and impact strength.

1. Improves resistance to plastic and drying shrinking cracking.
2. Inhibits growth of cracks –bridges micro-cracks and provide stability to concrete.
3. Improves flexural toughness/increase split tensile strength.
4. Enhances abrasion resistance and increases energy absorption of concrete thereby improving impact resistance.
5. Acts as a pumping aid in making concrete more homogeneous.
6. Reduces surface water absorption/permeability in concrete.
7. Improves durability and enhances longevity of concrete or structure.

C. PRIMARY APPLICATIONS

1. Flooring/grade slab
2. Foundations/retaining wall

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

3. Pavement quality concrete
4. Roof slabs
5. Bridge Decks/Overlays
6. Parking slabs
7. Water retaining structures

II. LITERATURE REVIEW

A. STUDY OF POLY PROPYLENE FIBER MATERIAL IN CONCRETE

1. Adding of poly propylene fiber in concrete by 0%, 0.5%, 1% and 1.5% increases the compressive strength by 51.7%, 37% and 20.7% respectively.
2. Adding of poly propylene fiber in concrete by 0%, 0.5%, 1% and 1.5% increases the tensile strength by 32.3%, 7.28% and 3.64% respectively.
3. poly propylene fiber the compressive strength, tensile strength effectively.

B. THE COMPRESSIVE STRENGTH OF CONCRETE USED MANUFACTURESAND AS FINE AGGREGATE

The purpose of research is to study the compressive strength of concrete used manufacture sand as fine aggregate to replace some portion or all amount of sand. In this research, the mixture portion is cement: fine aggregate: stone= 1:2:4 by weight and W/C=0.50. the result of compressive strength at 28 days used manufacture sand to replace sand 55%, 65%, 100% by weight (sieve analysis) and 100% (not sieve analysis) .

III.MATERIAL

A. Cement

Table 2. Tests on Cement And Results

Standard Consistency Test.	34%
Initial setting Time.	46 mins
Final setting Time.	9 hours

B. Aggregates

Table 3. Tests on Tests On Aggregates And Results

specific gravity of normal sand	2.59
Specific Gravity Of Manufacture Sand	2.70
Water absorption of COARSE aggregates	0.6%

IV.MIX DESIGN

A. FACTORS AFFECTING THE CHOICE OF MIX PROPORTION

1. Compressive Strength
2. Workability
3. Durability
4. Maximum Nominal Size Of Aggregate
5. Grading And Type Of Aggregate
6. Quality Control

B. MIX DESIGN OF M_{30} GRADE OF NOMINAL CONCRETE

A .STIPULATIONS FOR PROPORTIONING

1. Grade designation : M_{30}
2 .type of cement : OPC 53 grade
3 .Minimum nominal size of aggregate: 20mm
4 .Minimum cement content :320 kg/ m^3

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

5 .Maximum water –cement ratio : 0.45
6. Work exposure condition : severe
7. Type of aggregate :angular
8. Maximum cement content : 450 kg/m^3
STEP1: Target strength for mix proportioning
f'ck=fck+1.65s
Where,
f'ck=target average compressive strength at 28^{th} days
fck=characteristic compressive strength at 28^{th} days
s=standard deviation.
From table1, standard deviations=5N/mm^2
f'ck=fck+1.65S
=30+1.65*5
=38.25N/ mm^2

STEP 2: Selection of water content
FROM Table 5, of is 456-2000, minimum water-cement ratio=0.45
STEP 3: Selection of water content
from table 2, maximum water content=186 liter (for 50 to 75mm slump range)
water content=186+3/100*186
=191.58 liter
STEP 4: Calculation of cement content
Water-cement ratio =0.45
Cement content =191.58/0.45=425.73Kg/m^3

From the table 5 of IS: 456-2000 minimum cement content for sever exposure condition is=320Kg/m^3
425.73Kg\m^3> 320Kg/m^3, hence OK.
STEP 5: Proportion of volume of coarse aggregate and fine aggregate content
Coarse aggregate=0.6
Fine aggregate=0.4
STEP 6: Proportion of volume of coarse aggregate and fine aggregate content
Coarse aggregate=0.6
Fine aggregate=0.4
STEP 7: Mix Calculations
Volume of concrete=1m^3
Volume of cement=mass/specific gravity of cement*1/100
=425.73/3.15*1/100
=0.139m^3
Volume of water= 191.58/1000
=0.192m^3
Volume of aggregate= (1-0.139+0.192)
= 0.67m^3
Volume of coarse aggregate=0.67*0.61*2.73*1000
=1117.42m^3
Volume of fine aggregate
M-sand =0.67*0.39*2.70*1000
=706.56m^3
Sand =0.67*0.39*2.59*1000
=677.77m^3

MIX PROPORTIONS

Cement=425.73
Water=191.58
Coarse aggregate=1117.42
Fine aggregate
M-sand=706.56
Normal sand=677.77
Water-cement ratio=0.45

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

GRADE OF CONCRETE M_{30}

Hence the mix proportion is

1:1.65:2.62:0.45(m sand)

1:1.60:2.62:0.45 (normal sand)

V. EXPERIMENTAL METHODOLOGY

A. GENERAL

This chapter deals with the methodologies in this report. The properties of cement like standard consistency, specific gravity, fineness etc, and the properties of fine aggregate and coarse aggregate like specific gravity, grain size, water absorption, etc. Is calculated, according to the above properties of materials as per IS 10262-1982, the properties of water: cement: fine aggregate: coarse aggregate for M_{30} grade is executed. Concrete cubes of size 150x150x150mm are casted in standard ISCM moulds (for both sand and quarry dust) as per obtained mix proportions and respective grades. The concrete cubes are tested under universal testing machine (UTM) for 7, 14 and 28 days of curing to know the compressive and split tensile strengths.

B. TESTS ON HARDENED CONCRETE

The tests conducted on hardened concrete are discussed briefly in the following articles.

1. COMPRESSIVE STRENGTH TEST

The compressive strength of varies mix cubes were recorded after crushing under compression testing machine. The size of cubes is 150x150x150mm. The specimens cured for 7, 14 and 28 days are crushed and the pertaining loads at ultimate (breaking) compressive strengths are calculated.

Fig 2. Cubes Testing Under Compressive Testing Machine

2. Split tensile strength test

The split tensile strength of various mix cylinders were recorded after splitting under compression testing machine. The size of cubes is 150x150x300mm. The specimens cured for 7, 14 and 28 days are crushed and the pertaining loads at ultimate (break) split tensile strength are calculated.

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

Fig 3.Cylinder Testing Under Compressive Testing Machine

C. *COMPRESSIVE STRENGTH TEST RESULTS*

Compressive strength results are as given in the following tables for M_{30} grade of concrete.

- **NORMAL SAND**

Table 4. Compressive Strength of normal sand

SL.NO.	%OF FIBER ADDED	Compressive Strength in N/mm^2		
		7 DAYS	14 DAYS	28 DAYS
1	0	27.78	34.00	37.71
2	0.5	29.99	36.40	40.89
3	1	31.11	39.01	42.00
4	1.5	32.44	42.50	43.78

- **MANUFACTURED SAND**

Table 5. Compressive Strength of M-sand

SL.NO.	%OF FIBER ADDED	Compressive Strength in N/mm^2		
		7 DAYS	14 DAYS	28 DAYS
1	0	31.77	37.71	39.78
2	0.5	33.10	40.89	41.63
3	1	33.11	42.00	44.90
4	1.5	34.67	43.78	46.86

D. *SPLIT TENSILE STRENGTH TESTS RESULTS*

- **NORMAL SAND**

Table 6. Split Tensile Strength

SL.NO.	%OF FIBER ADDED	Split Tensile Strength In N/mm^2		
		7 DAYS	14 DAYS	28 DAYS
1	0	2.15	2.42	3.05
2	0.5	2.50	2.91	3.40
3	1	2.85	3.26	3.67
4	1.5	3.12	3.60	4.02

- **MANUFACTURED SAND**

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

Table 7. Split Tensile Strength Of M-Sand

SL.NO.	%OF FIBER ADDED	Split Tensile Strength in N/mm^2		
		7 DAYS	14 DAYS	28 DAYS
1	0	2.36	2.77	3.40
2	0.5	2.70	3.19	3.67
3	1	3.12	3.53	3.95
4	1.5	3.47	3.82	4.44

E. GRAPHICAL REPRESENTATION

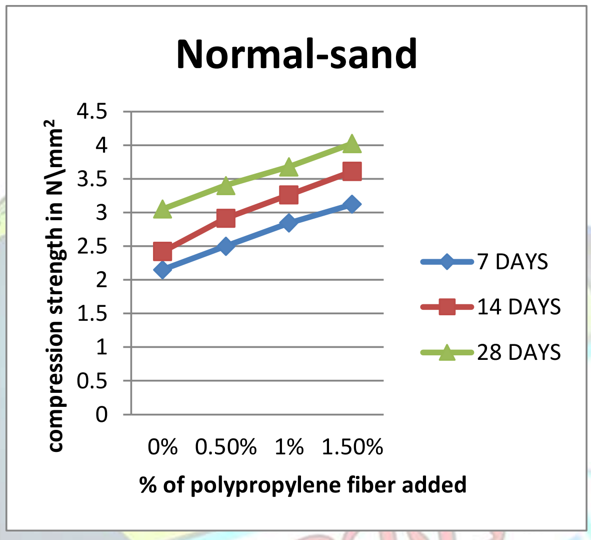

Fig 4. Split Tensile Strength Test Results

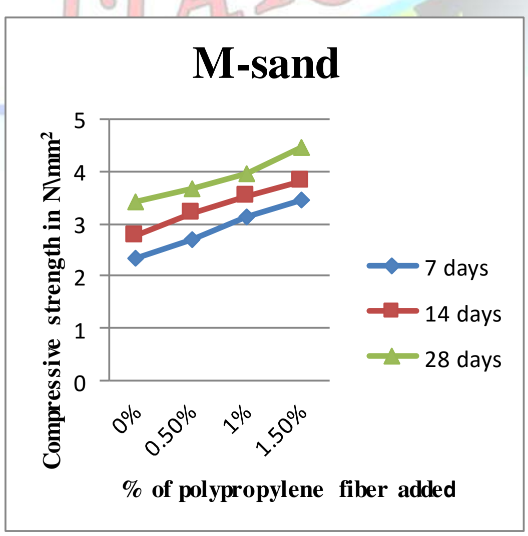

Fig 5. Split Tensile Strength Test Results (M-Sand)

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

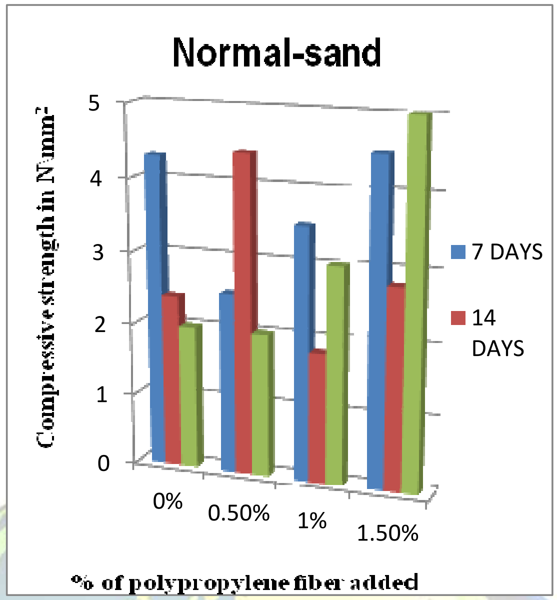

Fig 6. Compressive strength test result (Normal Sand)

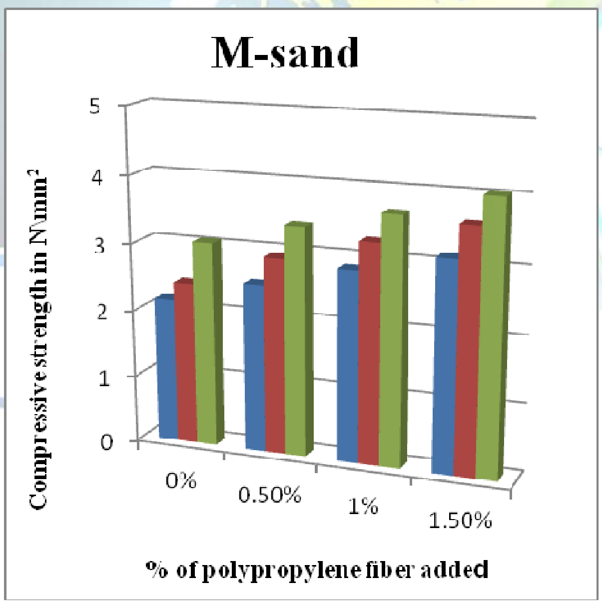

Fig 7. Compressive strength test result (M-Sand)

VI. CONCLUSIONS

- Polypropylene fibers enhance the strength of concrete, without causing the well known problems, normally associated with steel fibers.
- The problem of load tensile strength of concrete can be overcome by addition of polypropylene fibers to concrete.
- Notable increase in compressive strength is reported with addition of polypropylene fibers.
- Workability of concrete decreases with increase in polypropylene fiber volume fraction.

ISSN 2394-3777 (Print)
ISSN 2394-3785 (Online)
Available online at www.ijartet.com

International Journal of Advanced Research Trends in Engineering and Technology (IJARTET)
Vol. 5, Special Issue 3, January 2018

- Conventional concrete shows a 7 days compressive strength as 31.77 N/mm^2 and split tensile strength as 3.47 N/mm^2.
- Addition of polypropylene fiber in concrete mixture by 0.5%, 1% and 1.5% shows an negligible increase in the compressive strength and increases the split tensile strength by 9.86%, 12.36% and 18.55% respectively for 7 days curing.
- Polypropylene fibers reduce the water permeability, plasticity, shrinkage and settlement.

VII. REFERENCES

[1] **'Effects of polypropylene fiber on the high strength concrete'**, Mehul J Patel, S.M.Kulkarni (2012-2013) journal of information, knowledge and research in civil engineering volume-2, issue 2, page 127.

[2] **'Compressive strength index of crimped polypropylene fibers in high strength cementations matrix'**Thirumurugan.S, Sivakumar.A, (2013) world applied sciences journal, 2013.

[3] **Effects of polypropylene fibers on the strength properties of fly ash based concrete'**K.Murahari, Rama Mohan Rao.P (2013) International journal of Engineering Science Invention, Volume -2, Issue 5, May 2013. Page 13-19.

[4] **"ACI committee 544",** State-of-the-art report on fiber reinforced concrete, ACI 544 1.R-96.

[5] **Studies On The Properties Of Steel And Polypropylene Fiber Reinforced Concrete Without Any Admixtures"**M. Tamil Selvil,T.S.Thandavamoorthy,(July 2013) International Journal Of Engineering, Volume -3,Issue 1,Page 411-416.

[6] **"RECRON '3S FIBERS FOR CONCRETE"**Fiber Details And Its Properties Information From Mrs.Recron'3s.