iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** XI **Month of publication:** November 2017

DOI:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

Comparative Study of Concrete on the Effect of Fire between Conventional Concrete and Polypropylene Fibers

Gurinder Singh[1], Bhupinder Singh[2]
[1]Research Scholar, Civil Engineering Department, Indo global colleges, Abhipur, Punjab, India
[2]Assistant Professor, Civil Engineering Department, Indo global colleges, Abhipur, Punjab, India

Abstract: The capability of durable structure to resist weathering action during its service life But the fire accidents can occurred anywhere an time without any intimation .they can affected our human lives , property and environment . so we improve our structures against fire and build fire resistance structures .In this research fibers are used in concrete to improve fire resistance in concrete by partial replacement of fine aggregate with 0.6% of polypropylene fiber. To evaluate the comparison between polypropylene fiber reinforced concrete samples of M25 are casted and then fire test at temperature at 0^0C, 400^0 C and 800^0 C. These samples provide the increased compression strength, split tensile strength and flexural strength of 7 days and 28 days. Polypropylene fiber reinforced concrete shows better fire resistance than conventional concrete at serve temperature .They occurs better resistance towards spelling and creep.

Keywords: polypropylene fiber reinforced concrete (PPFRC), creep, compression strength, split tensile strength and flexural strength

I. INTRODUCTION

In the field of natural and man-made disasters, fire has played a predominant role. In every country around the world fires can have a serious impact on people, environment and property. In many cases fires may cause unimaginable losses resulting in hundreds of deaths, damage to structures and severe impact on environment. Fires usually affect a single home or a single casualty but the effect is eminently significant to those that are affected. Apart from these physical costs fire accidents in structures also have an adverse impact on natural environment which include air pollution due to fire plume whose deposition ultimately result in land and water contamination, water pollution due to runoff containing harmful products and other kind of pollution due to discharges from burned materials. Fires in buildings can reach to temperature of about 1000^0 C and can have a serious impact on the load bearing capacity of structural elements. If we have to protect our structures against fire then fire resistance material is used in structures from proper planning from its initial stage.

Concrete, bricks, steel are thebuilding material which is used in construction. Concrete consists of coarse aggregates and fine aggregates bond with cement fluid. Concrete can't be set on fire as it cannot burn. Like any other building material concrete does not emit obnoxious gases and toxic fumes.it have a good fire resistive property. But with increasing temperatures concrete also behave differently. The strength of concrete decreases with increasing temperatures and can ultimately result in failure of concrete elements. The failure of concrete during fires depends on many factors like fire load, nature of fire and type of structure. The failure of concrete can occur due to Loss of compressive strength, Loss of tensile strength, Spalling.

Fiber reinforced concrete is the concrete which is formed by the addition of fibers .fibers are natural materials which increase the structural integrity. Polypropylene is a thermoplastic polymer.as shown in figure 1. It is mostly used in textile industry, construction industry; packaging, medical applications etc. By adding polypropylene fiber in concrete the plastic shrinkage crack. Of concrete at the early age reduced and it can also reduce the surface bleeding and settlement of aggregate of fresh concrete .It is cheap and abundantly available .Its modulus of elasticity is 3 to 5 Giga Pascal. It is the lightest fiber which contains polyester (34%) and nylon (20%). Their weight is less as they are bulk in volume. Polypropylene fibers length are shorter .During fires in concrete polypropylene fibers melt and help in releasing the vapor pressure thereby decreasing the explosive impulse of concrete at high temperatures .The involvement of polypropylene fibers in concrete showed significant improvements in fire resistance of concrete. It also showed strength increase (compressive, flexural and tensile strengths), improvements in shrinkage and crack reduction

Fig 1. Polypropylene fiber

II. OBJECTIVE OF THESTUDY

The main objectives of the study are:

A. To improve the compressive, split tensile and flexural strength of concrete by addition of polypropylene fibers.
B. To improve fire resistance of concrete by addition of polypropylene fibers.
C. To study the behavior of concrete when exposed to elevated temperatures.
D. To obtain comparative strength between conventional concrete and polypropylene fiber reinforced concrete.

III. MATERIALUSED

The materials used in this study discuss below

A. Cement

The cement used was 53 grade Ordinary Portland Cement (OPC).According to IS 12269-1987. All the tests were carried out in accordance with procedure laid down as follow.
Fineness of Cement IS:4031(Part 1)-
1996. Specific Gravity IS:4031 (Part
11)-1988 Consistency IS:4031 (Part 4)-
1988
Initial setting time & Final setting time IS:4031 (Part 5)-
1988 Compressive strength IS:4031 (Part 6)-1988

Properties of Cement:

S.no	Properties	Value
i	Fineness	1.12%
ii	Specific Gravity	3.15
iii	Consistency	30%
iv	Initial setting time (minute)	30
v	Final setting time (minute)	210
vi	Compressive strength (28 days in (N/mm^2	53

B. Fine Aggregate

In concrete samples the locally available sand are used. Which are passing through 1.18 mm sieve, during sieve analysis. Sand used was clean and free from dust particles

Fineness modulus-IS:383-1970
Specific gravity-IS:2386 (Part 3)-
1988 Bulk density-IS: 2386 (Part 3)-
1988 Water absorption-IS:2386
(Part3)-1963

Properties of Fine Aggregate

S.no	Physical properties	Value
I	Fines modulus	3.25
II	Specific gravity	2.25
III	Bulk density	1.657
IV	Water absorption	0.80%

C. Course Aggregate

The coarse aggregates used for making concrete samples were extracted from common sources such as mines and are used with or without further processing. Locally available coarse aggregates of size 10mm and 20 mm were used during sieve analysis of aggregates confirms to the specification of IS 383:1970.

Fineness modulus-IS:383-1970 Specific gravity-IS: 2386 (Part 3)-1988
Bulk Density- IS: 2386 (Part 3)-
1988 Impact test- IS: 2386(Part
4)-1963

Properties of Coarse Aggregate:

S.no	Physical properties	Value
I	Fines modulus	6.25
II	Specific gravity	2.40
III	Bulk density	1.564
IV	Impact test	8.0%

D. Water

According to IS: 456-2000, water for concrete should be of portable quality (PH- 7). Ordinary tap water, which is fit for drinking has been used in preparing all concrete mixes and curing in this investigation

E. Polypropylene fibers

Polypropylene fibers which are generally available in market are shorter in length is 12mm. They are white in color and feel like shinny crystalline threads. They have a fire resistance property. There softening point, melting point and density are respectively is 140^0C, 165^0C and 0.91 gm/cm^3.

IV. METHODOLOGY

A. Mix Design

There M 25 Grade of concrete is used for the experimental purpose. In which the 0.6% of polypropylene fiber is replaced by fine aggregate with the water cement ratio is 0.50.

B. Experimental Procedure

In experiment the concrete samples were casted in various moulds for compressive strength, flexural strength and split tensile strength. There are dimensions as respectively 150mm x 150mm (cubes), 500mm x 100mm x 100mm (beams) and 150mm x

300mm (columns).Concrete samples were isolated into two classifications, Category 1 comprising of ordinary concrete with no addition of fiber which a few samples were utilized as control samples and others were utilized for flame testing. Category 2 comprises of concrete samples with fractional weight replacement of fine aggregates with 0.6% of polypropylene fibers. For fire test tests are presented to temperatures of 0^0 C, 400^0 C and 800^0 C for one hour in Annealing (gas) heater are shown in figure 2 to 5.

Figure 2.Addition of PPL fibers in concrete mix before addition of water

Figure 3. Annealing (gas) furnace

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

Figure 4. Concrete samples inside annealing furnace

Figure 5. Concrete samples after fire test (400^0 C and 800^0 C)

V. RESULT AND DISCUSSION

Comparison of result between the conventional concrete and polypropylene fiber reinforced concrete. The charts and tables are given below the information about compressive strength, split tensile strength and flexural strengths after performing the fire test at elevated temperature (0^0 C, 400^0 C and 800^0 C) for conventional concrete and M25 PPL fiber reinforced concrete for 7 and 28 days.

A. Compressive strength

The compressive strength after fire test for both conventional and PPL fiber reinforced concrete for 7days are shown in table 1 and Fig 6. The compressive strength after fire test for both conventional and PPL fiber reinforced concrete for 28 days is table 2 and Fig 7

Table 1.
Compressive strength of conventional concrete and polypropylene fiber reinforced concrete at different temperatures for 7 days

COMPRESSIVE STRENGTH (7 DAYS)		
Temperature (^{0}C)	CONVENTIONAL CONCRETE (N/mm^2)	POLYPROPLYLENE REINFORCED CONCRETE (N/mm^2)
0^0 C	22.58	24.12
400^0 C	20.28	22.56
800^0 C	10.21	12.37

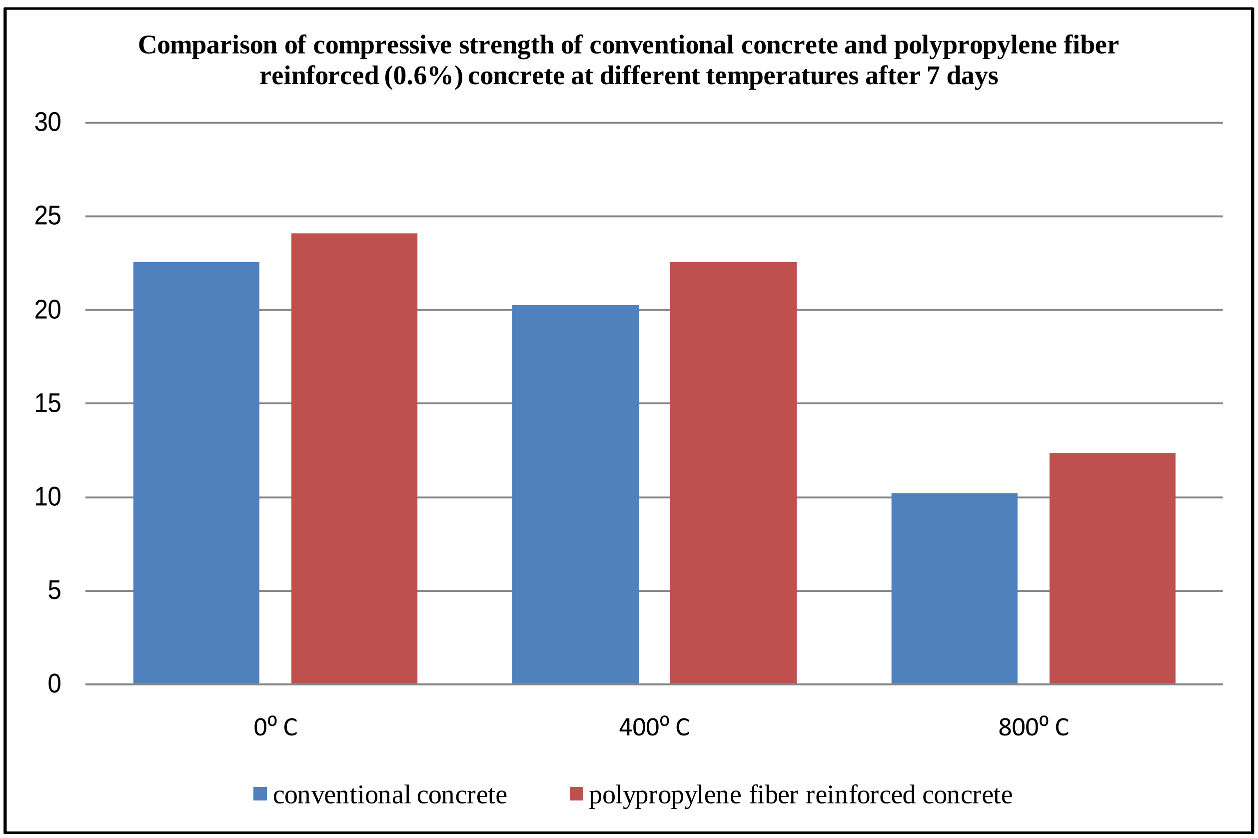


Fig 6. Comparison between the compressive strength of conventional concrete and polypropylene fiber reinforced concrete at different temperatures for 7 days

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

Table 2.
Compressive strength of conventional concrete and polypropylene fiber reinforced concrete at different temperatures for 28 days

COMPRESSIVE STRENGTH (28 DAYS)		
Temperature (^{0} C)	CONVENTIONAL CONCRETE (N/mm^2)	POLYPROPLYLENE REINFORCED CONCRETE (N/mm^2)
0^0 C	32.89	34.92
400^0 C	30.76	33.34
800^0 C	15.17	17.8

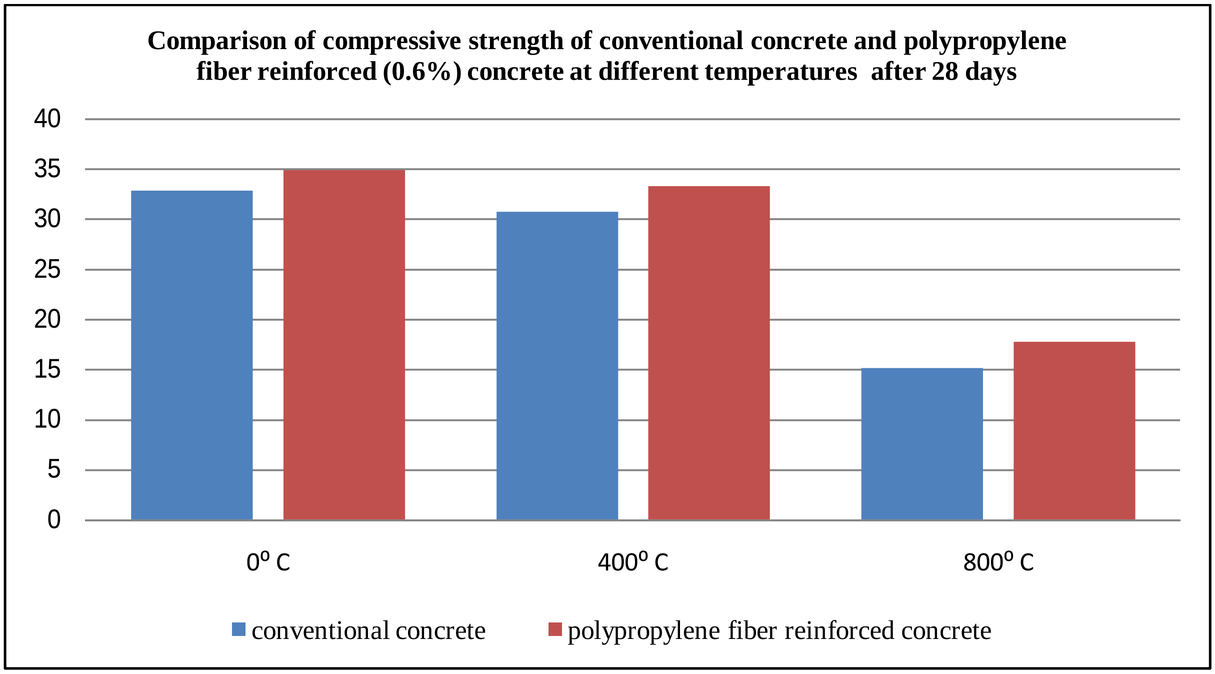


Fig 7. Comparison between the compressive strength of conventional concrete and polypropylene fiber reinforced concrete at different temperatures for 28 days

B. Split Tensile Strength

The split tensile strength after fire test for both conventional and PPL fiber reinforced concrete for 7days are shown in table 3 and Fig 8 .The split tensile strength after fire test for both conventional and PPL fiber reinforced concrete for 28 days are shown in table 4 and Fig 9.

Table 3.
Split tensile strength of conventional concrete and polypropylene fiber reinforced concrete at different temperatures for 7 days

SPLIT TENSILE STRENGTH (7 DAYS)		
Temperature (^{0} C)	CONVENTIONAL CONCRETE (N/mm^2)	POLYPROPLYLENE REINFORCED CONCRETE (N/mm^2)
0^0 C	1.51	2.56
400^0 C	1.27	2.19
800^0 C	0.76	1.83

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

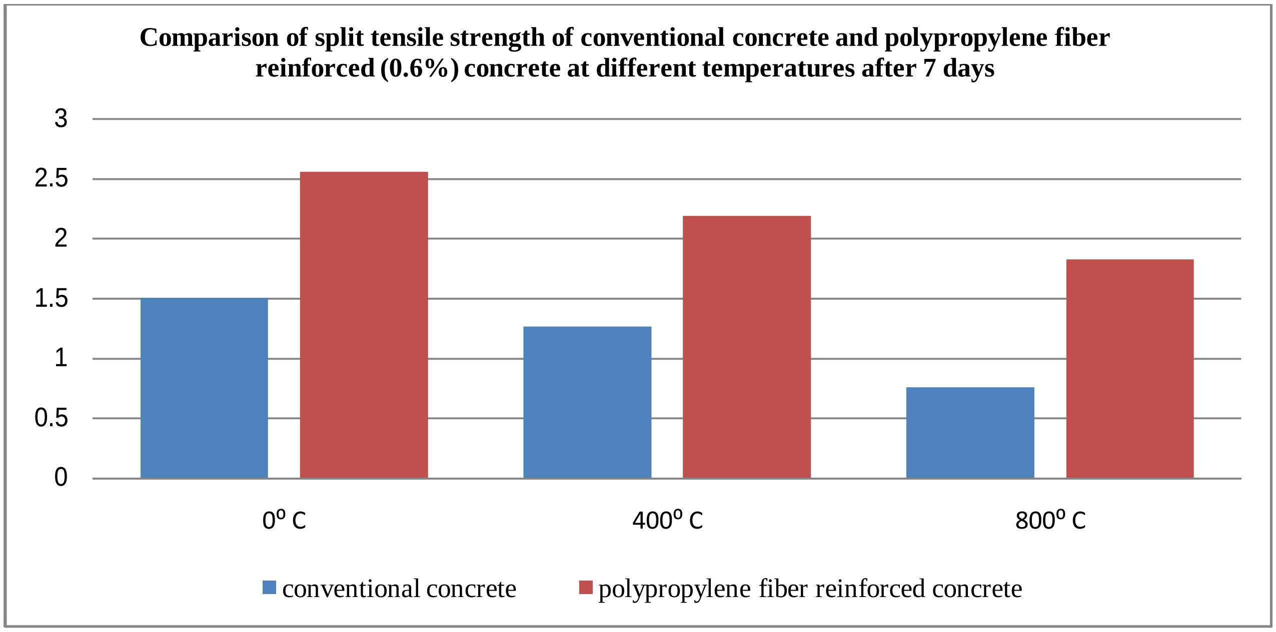


Fig 8. Comparison between the compressive strength of conventional concrete and polypropylene fiber reinforced concrete at different temperatures for 7 days

Table 4.
Split tensile strength of conventional concrete and polypropylene fiber reinforced concrete at different temperatures for 28 ays

SPLIT TENSILE STRENGTH (28 DAYS)		
Temperature (^{0} C)	CONVENTIONAL CONCRETE (N/mm^2)	POLYPROPLYLENE REINFORCED CONCRETE (N/mm^2)
0^0 C	2.28	3.81
400^0 C	2.15	3.20
800^0 C	1.47	2.18

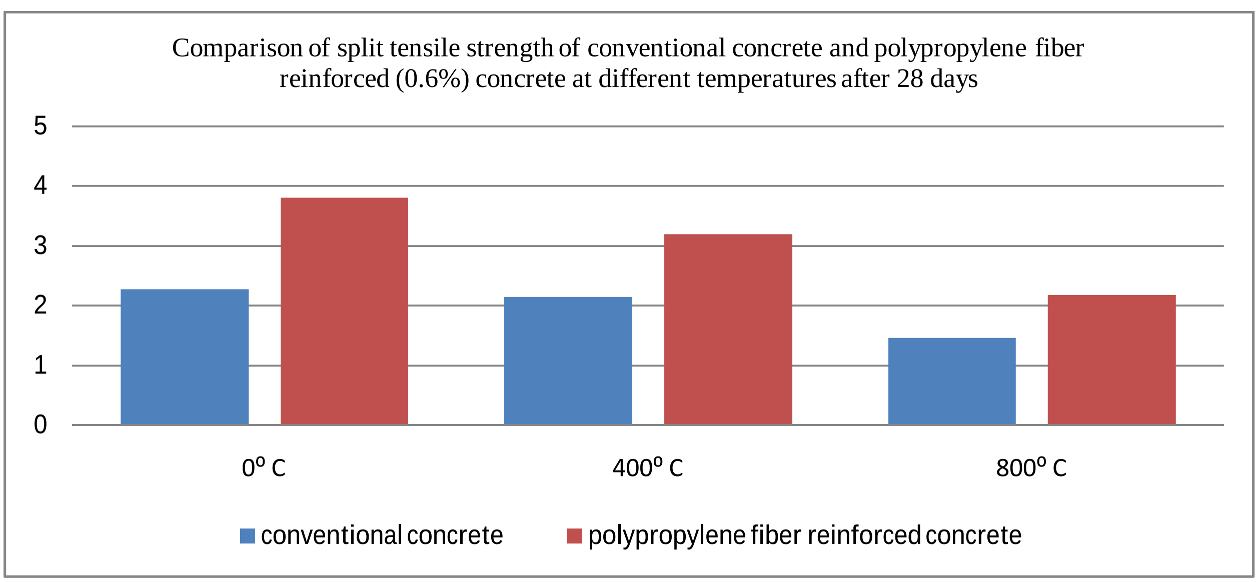


Fig 9. Comparison between the split tensile strength of conventional concrete and polypropylene fiber reinforced concrete at different temperatures for 28 days

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue XI November 2017- Available at www.ijraset.com

C. Flexural Strength

The flexural strength after fire test for both conventional and PPL fiber reinforced concrete for 7 days are shown in table 5 and Fig10.The flexural strength after fire test for both conventional and PPL fiber reinforced concrete for 28 days are shown in table 6 and Fig 11.

Table 5.
Flexural strength of conventional concrete and polypropylene fiber reinforced concrete at different temperatures for 7 days

FLEXURAL STRENGTH (7 DAYS)		
Temperature (^{0} C)	CONVENTIONAL CONCRETE (N/mm^2)	POLYPROPLYLENE REINFORCED CONCRETE (N/mm^2)
0^0 C	4.49	6.31
400^0 C	4.18	5.79
800^0 C	2.13	3.32

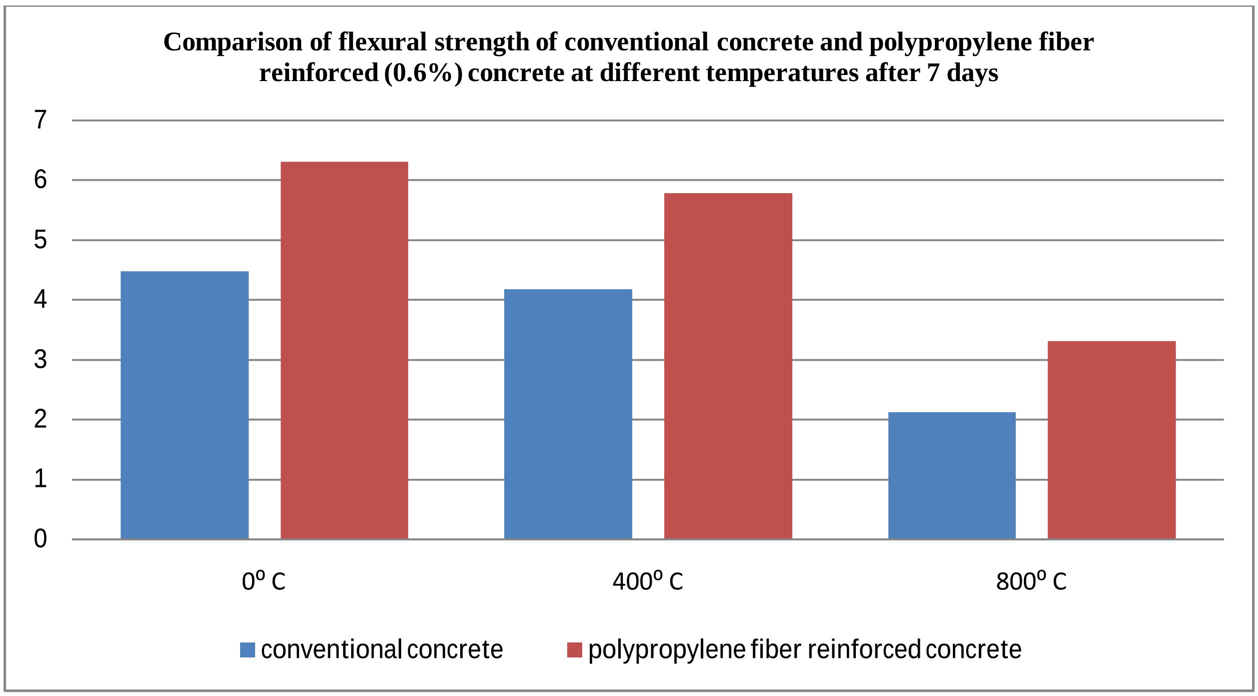


Fig 10. Comparison between the flexural strength of conventional concrete and polypropylene fiber reinforced concrete at different temperatures for 7 days

Table 6.
Flexural strength of conventional concrete and polypropylene fiber reinforced concrete at different temperatures for 28 days

FLEXURAL STRENGTH (28 DAYS)		
Temperature (^{0} C)	CONVENTIONAL CONCRETE (N/mm^2)	POLYPROPLYLENE REINFORCED CONCRETE6t (N/mm^2)
0^0 C	6.22	7.96
400^0 C	5.62	7.59
800^0 C	3.13	4.42

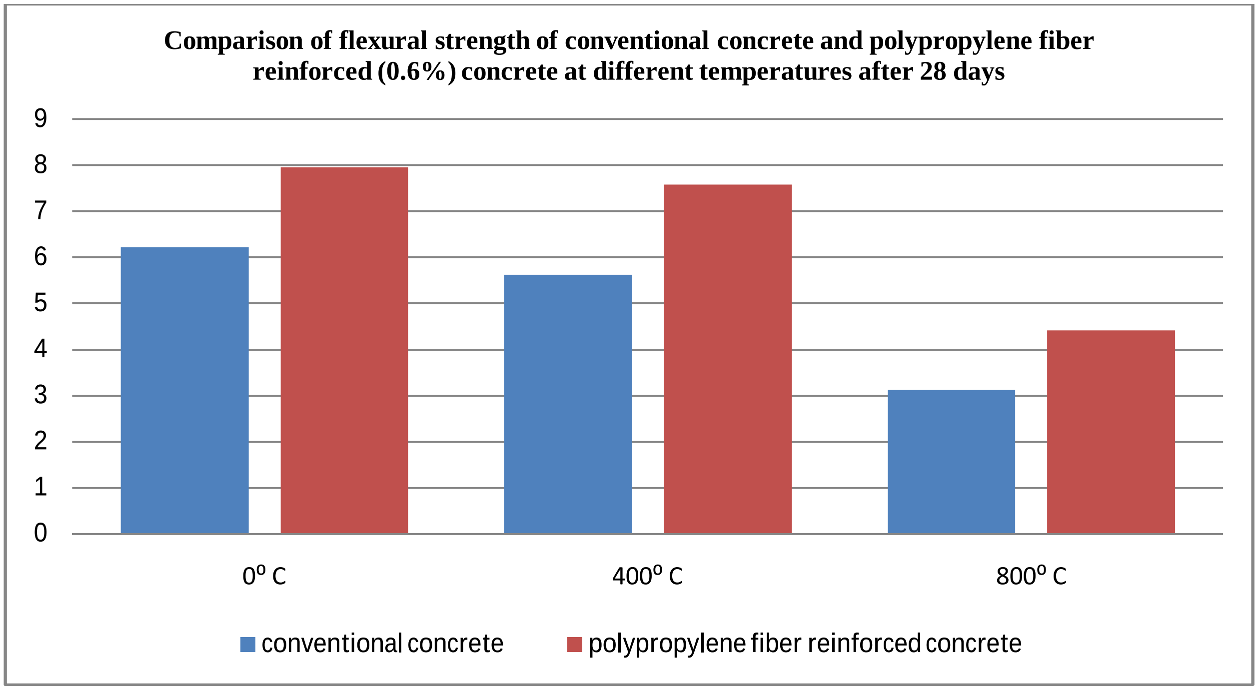


Fig 11. Comparison between the flexural strength of conventional concrete and polypropylene fiber reinforced concrete at different temperatures for 28 days

VI. CONCLUSION

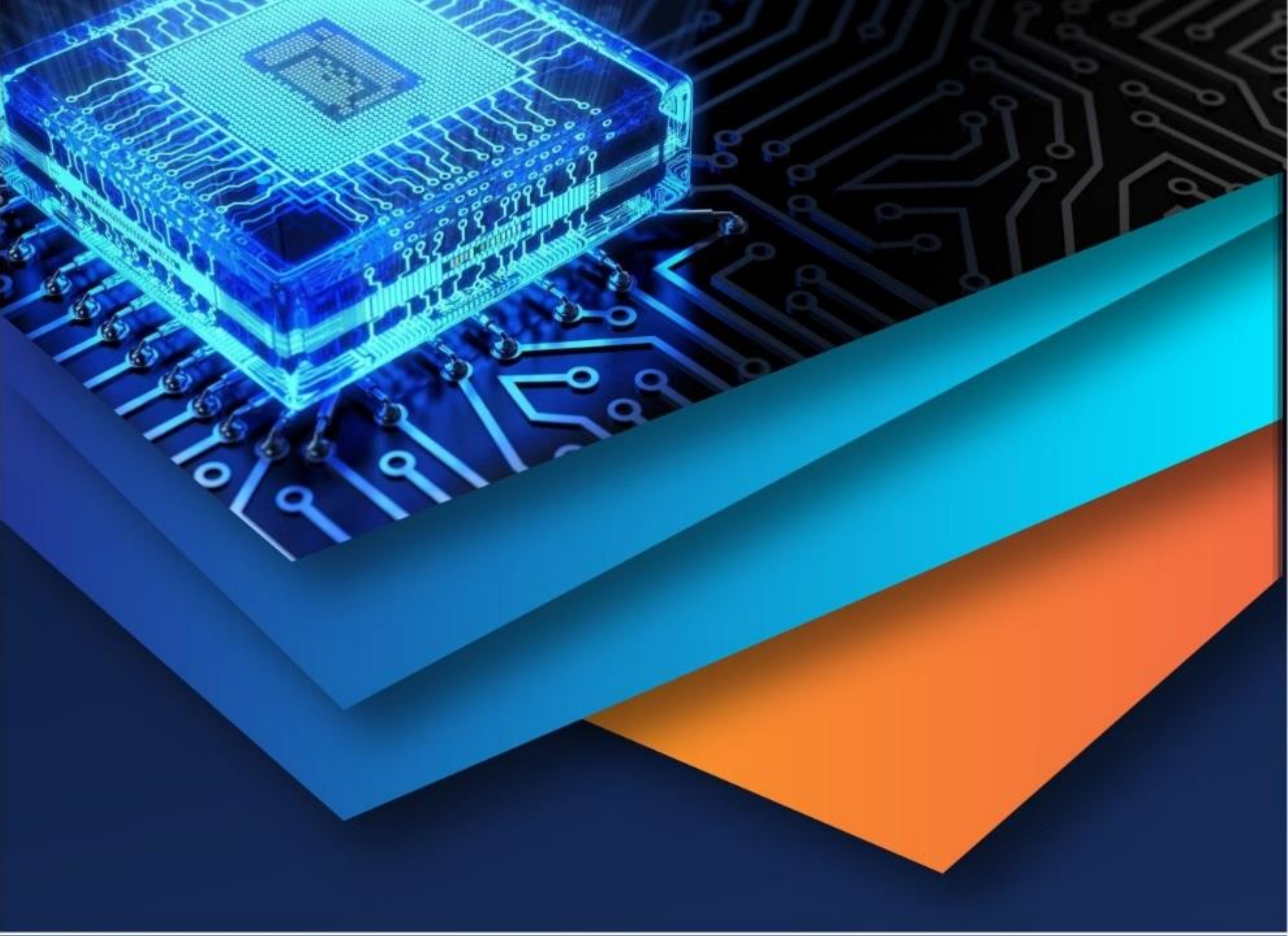
The conclusion can be summarized as

A. The compressive, split tensile and flexural strength of PPFRC is observed to be higher than conventional concrete.
B. At 0^0 C the rate increment in compressive, split tensile and flexural strength of PPFRC for 7 days is 6.38%, 41.02% and 28.84% and for 28 days is 5.81%, 40.16%, and 21.86%
C. At 400^0 C the rate increment in compressive, split tensile and flexural strength of PPFRC for 7 days is 10.11%, 42.01% and 27.81% separately and for 28 days is 7.74%, 32.81%, and 25.96% individually
D. At 800^0 C the rate increment in compressive, split tensile and flexural strength of PPFRC for 7 days is 17.46%, 58.47% and 35.84% separately and for 28 days is 14.78%, 32.57%, and 29.19% individually
E. Spalling of concrete surfaces additionally happens at higher temperatures.
F. PPFRC gives preferred imperviousness to fire and strength over the conventional concrete.
G. The increment in strength of concrete by addition of polypropylene fiber tends to build more at bring down temperatures.
H. At lower temperature observes that the strength of concrete is increase with the addition of PPF.
I. PPFRC tends to increase the ductility of concrete and preventing breakdown

REFERENCES

[1] Ede Anthony Nkemand Aina Adebodun Oluwaseyi, Effects of coconut husk fibre and polypropylene fiber on fire. International Journal of Engineering Sciences & Management.2015 January- March, Vol. 5, Issue 1, PP 171-179.
[2] Mrs. Lilly Grace Mural. P, Fire Accidents with High Fire Spread in Buildings. Index journal of applied research, June 2014, Volume 4, PP 198-202.
[3] Larbi J.A. and Polder R.B., Effects of polypropylene fibers in concrete: Microstructure after fire testing and chloride migration. HERON. 2007,Vol. 52, PP 289-306.
[4] RamujeeKolli., Strength properties of polypropylene fiber reinforced concrete. International Journal of Innovative Research in Science, Engineering and Technology. 2013 August ,Vol. 2, Issue 8, PP 3409-3413.
[5] MohodMilindV. ,Performance of Polypropylene Fiber Reinforced Concrete. IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE).2015 Jan- Feb, Volume 12, Issue 1, PP 28-36.
[6] Madhavi1.T.Ch.,RajuL.Swamy, Mathur Deepak, Polypropylene Fiber Reinforced Concrete- A Review. International Journal of Emerging Technology and Advanced Engineering.2014 June,Volume 4, PP 114-119.
[7] Shihada Samir, Effect of polypropylene fibers on concrete fire resistance.Journal of civil engineering and management.2011 Volume 17(2), PP 259–264.
[8] Chung Chul, Lee Hun Jungwhee ,and Kim Hyun Jun,Evaluation of Fire Performance of Polypropylene Fiber RC Slabs. Journal of Civil Engineering. 2013 July, volume 17, PP 1040-1050.

[9] Sathe A. P., Patil A. V., Experimental Investigation on Polypropylene Fiber Reinforced Concrete With Artificial.International Journal of Science and Research (IJSR).2015 June ,Volume 4 Issue 6, PP 1209-1212.
[10] Ahmed Saeed, Bukhari Imran A, IqbalJavedSiddiqui, QureshiShahzad Ali, A study on properties of polypropylene fiber reinforced concrete. 31st conference on our world in concrete & structures. 2006 August ,article online Id: 100031008.
[11] Fletcher I.A., Welch S, Torero J.L, Carvel R.O, Usmani A., Behavior of concrete structures in fire. Journal of Thermal Science. . 2007, Vol 11 , Issue 2, PP 37-52.
[12] Kodur V.K.R., Wang T.C., Cheng F.P., Predicting the fire resistance behavior of high strength concrete columns. ELSEVIER, Cement & Concrete Composites. 2004, PP 141-143.
[13] Cheng FP, Kodur VKR, Wang TC. Stress–strain curves for high strength concrete at elevated temperatures.Journal of Materials in Civil Engineering. 2004 January-February, vol. 16, issue no. 1, PP. 84-94
[14] Kodur VKR, Cheng FP, Wang TC, Effect of strength and fiber reinforcement on the fire resistance of high strength concrete columns. ASCE, Journal of Structural Engineering. 2003,PP 1–22.
[15] Kodur VKR, Spalling in high strength concrete exposed to fire concerns, causes, critical parameters andcures. ASCE Structures Congress 2000, Philadelphia, USA. 2000, PP 1-8.
[16] Ede, A.N., Measures to reduce the high incidence of structural failures in Nigeria. Journal of Sustainable Development in Africa. 2011, PP 153-16.
[17] Darshan, Sanjith J, Ranjith A, Chethan G, a critical review on fire resistance structures. International Journal of Current Engineering and Scientific Research (IJCESR). 2016, volume3, issue-3.
[18] Kodura V.K.R., PhanbL. ,Critical factors governing the fire performance of high strength concrete systems. ELSEVIER, Fire Safety Journal. 2007, vol. 42, PP 482–488.
[19] Mohamed M. M. Rashwan, Hesham M. A. Diab and Ahmed Fouad Abdullah Gad, elevated temperature resistance concrete using non-traditional materials. Journal of Engineering Sciences. November 2014 ,vol. 42 , issue no. 6 PP. 1367 – 1377.
[20] Ali Behnood, MasoudGhandehari, Comparison of compressive and splitting tensile strength of high-strength concrete with and without polypropylene fibers heated to high temperatures. Fire Safety Journal, 2009, Vol44 , PP 1015–1022.



10.22214/IJRASET

INDEX COPERNICUS
45.98

ISRA JIF
IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

ISI

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY