EFFECT OF POLYPROPYLENE FIBRE ON THE HIGH STRENTH CONCRETE

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ABSTRACT:
The paper deals with the effects of addition of various proportions of polypropylene fibers on the properties of High strength concrete. An experimental program was carried out to explore its effects on compressive, tensile, flexural, shear strength and plastic shrinkage cracking. A notable increase in flexural, tensile and shear strength was found.

The main aim of the investigation program is first to prepare the strength of concrete of grade M40 with locally available ingredient and then to study the effect of different proportion of Polypropylene fiber in the mix and to find optimum range of Polypropylene fiber content is 0.5%,1.0%,1.5% in the mix. The concrete specimens were tested at different age level for mechanical properties of concrete, namely, cube compressive strength, split tensile strength, flexural strength and other test were conducted for cement, chemical admixture, coarse aggregate & fine aggregate.

***KEY WORDS: High Strength Concrete and Polypropylene fibre, compressive strength,* plastic shrinkage cracking.**

I. INTRODUCTION:

Concrete is a composite construction material made primarily with aggregate, cement, and water, admixture. There are many formulations of concrete, which provide varied properties, and concrete is the most used man-made product in the world. Concrete is widely used for making architectural structures, foundations, brick/block walls, pavements, bridges/overpasses, motorways/roads, runways, parking structures, dams, pools/reservoirs, pipes, footings for gates, fences and poles and even boats. Famous concrete structures include the Burj Khalifa (world's tallest building), Hoover Dam, the Panama Canal and the Roman Pantheon.

Concrete can be formulated with high compressive strength, but always has lower tensile strength. For this reason it is usually reinforced with materials that are strong in tension (often steel). Concrete can be damaged by many processes, such as the freezing of trapped water."Mineral admixtures" are becoming more popular in recent decades.

The advantages of using concrete include high compressive strength, good fire resistance, High water resistance, low maintenance, and long service life. The Disadvantages of using concrete include poor tensile strength, low strain of fracture and formwork requirement. The major disadvantage is that Concrete develops micro cracks during curing. It is the rapid propagation Of these micro cracks under applied stress that is responsible for the low Tensile strength of the material. Hence fibers are added to concrete to over Come these disadvantages. The addition of fibers in the matrix has many important effects. Most notable among the improved mechanical characteristics of Fiber Reinforced Concrete (FRC) are its superior fracture strength, toughness, impact resistance, flexural strength resistance to fatigue, improving fatigue performance is one of the primary reasons for the extensive use of Polypropylene Fiber Reinforced Concrete (PFRC) in pavements, bridge decks, offshore structures and machine foundation, where the composite is subjected to cyclically Varying load during its lifetime.

The character of the concrete is determined by quality of the paste. The key to achieving a strong, durable concrete rests in the careful proportioning, mixing and compacting of the ingredients. Numerous tests are performed on wet concrete such as workability tests such as compaction factor test and slump test. The tests on hardened concrete are destructive test while the destructive test includes compressive test on concrete cube for size (150 x 150 x 150) mm, Flexural strength on concrete beam (150 x 150 x700) and split tensile strength on concrete cylinder (150 mm ø x 300mm) as per IS: 516 – 1959, IS: 5816 – 1999 and IS: 516 – 1959 respectively.

II. EXPERIMENTAL PROGRAM:

Materials

A. Cement:
The cement used was Ordinary Portland cement (53Grade) with a specific gravity of 3.15. Initial and final setting times of the cement were 69 min and 195 min, respectively. Its chemical composition is given in Table 1.

Table 1: Chemical composition of cement. (%)

Oxide	Cement
SiO2	19.71
Al2O3	5.20
Fe2O3	3.73
CaO	62.91
MgO	2.54
SO3	2.72
K2O	0.90
Na2O3	0.25
LOI	0.96

Test on Cement:
53 Grade OPC cement was used throughout the investigation. The various physical properties of cement were determined in accordance with BIS specification and the results are listed in Table 2.

Table 2: Results of tests on Cement

Tests	Results
Normal Consistency %	29.50 %
Initial setting time test	69
Final setting time test	195
Fineness test	5% retained
Specific gravity	3.15
Soundness test	2.00
Compressive strength	
7 days	37 N/mm2
28 days	58 N/mm2

B. Aggregate:

1. Fine Aggregate (Sand):
Good quality river sand was used as a fine aggregate.Ref. Code : IS: 383 & 2386

Table 3: Results of tests on Fine Aggregate

Description	Results
Fineness Modules	3.50
Zone	II
Water Absorption	2.10
Specific Gravity	2.59
Silt Content	1.00

2. Coarse Aggregate:
Ref. Code: IS: 2386 & 383

Table 4: Results of tests on Coarse Aggregate

Tests	Results
Coarse aggregate (kapchi)	
Water Absorption	1.80
Specific Gravity	2.77
Impact Value	10.70
Crushing Value	13.90
Coarse Aggregate (Grit)	
Water Absorption	2.10
Specific Gravity	2.78

C. Super plasticizer:
In modern concrete practice, it is essentially impossible to make high performance concrete at adequate workability in the field without the use of super plasticizers. Conplast SP-430 (200ml per 50kg) was used for the experimental work.

Use of Super plasticizer: Conplast-SP430

Properties:
Specific gravity - 1.220 to 1.225 at 300C
Chloride content- Nil to IS: 456
Air entrainment - Approx. 1% additional air is entrained.

Polypropylene fibre:

Addition of Polypropylene fibres to concrete enhances the longevity of the structure by controlling micro cracks due to shrinkage during curing. In this experimental work fibrillated fibre length is 12mm and diameter is 34 micron is used. Its has a low density is 0.9 kn/m3.

Material	Polypropylene fiber
Density kg/m3	900
Length mm	12
Diameter Micron	34
Geometry Mm	Fibrillated

III. MIXTURE PROPORTIONING:

The target mean strength was 40 MPA for the OPC control mixture, the total binder content was 400 kg/m ,fine aggregate is taken 698.27 kg/m and coarse aggregate is taken 1185.01 kg/m the water to binder ratio was kept constant as 0.42, the Super plasticizer content was varied to maintain a slump of (50-100 mm) for all mixtures. The total mixing time was 3 minutes, the samples were then casted and left for 24 hrs before demoulding They were then placed in the curing tank. Water absorption capacity and moisture content were taken into consideration and appropriately subtracted from the water/cement ratio used for mixing. Reported the blending of Polypropylene fibre in cement is recommended in most international building codes now. Hence, cement was replaced in percentages of 0%, 0.5%, 1.0%,1.5% with Polypropylene fibre 150 × 150 × 150mm, Beam and Cylinder moulds were used for casting. The concrete was left in the mould and allowed to set for 24 hours before the cubes were de moulded and placed in curing tank. The concrete cubes were cured in the tank for 7, 14 days.

IV. TESTING METHODS:

Experimental investigation of fresh mix Properties of fiber reinforced rice husk ash concrete were conducted based on IS: 516 - 1959 using a slump cone. Compressive and Flexural strength of each specimen was determined using IS: 516 - 1959 and splitting tensile strength of each specimen was determined using IS: 5816 - 1959.Length change was measured according to IS: 516 - 1959. Compressive strength were measured 7, 14, days and flexural tensile strengths were measured 7 days of testing. Splitting tensile strengths were measured at 7 days. Specimens were cube with a 150 mm side for compressive strength, prism with dimensions of 150 * 150 * 700 mm for flexural tensile strength, cylinder with 150 mm diameter and 300 mm height for splitting tensile strength.

V. TESTING PROGRAMME:

1. Compressive Strength:

The cube specimen was placed in the machine, of 2000kN capacity. The load was applied at a rate of approximately 140 kg/sq.cm/min until the resistance of the specimen to the increasing load can be sustained, was shown in Figure 1.

Figure 1: Test for Compressive Strength

C. Flexural Strength:

The specimen was placed in the machine in such a manner that the load was applied to the uppermost surface as cast in the mould, along two lines spaced 13.33cm apart. The axis of the specimen was carefully aligned with the axis of the loading device. The load was applied through two similar steel rollers, 38mm in diameter, mounted at the third points of the supporting span that is spaced at 13.33cm centre to centre. The load was applied with out shock and increasing continuously at a rate of 180 kg/min until the specimen filed. Test results are presented in Table 6.The failure pattern has been presented in Figure 2.

Figure 2: Test for Flexural Strength of Concrete

C. Splitting Tensile Strength:

The cylinder specimen was placed horizontally in the centering with packing skip (wooden strip)/or loading pieces carefully positioned along the top and bottom of the plane of loading of the specimen. The load was applied without shock and increased continuously at a nominal rate with in the range 1.2 N/mm2/min to 2.4 N/mm2/min until failure the specimen. The maximum load applied was recorded at failure. Appearance of concrete and unused features in the type of failure was also observed are shown in Figure 3.The test results are presented in Table 7.

Figure 3: Test for Splitting Tensile Strength

Table 5: Compressive Strength of M40 Grade Polypropylene fibre Concrete

Polypropylene Fibre	Compressive Strength	
	7 days	14 days
0%	32.51	35.34

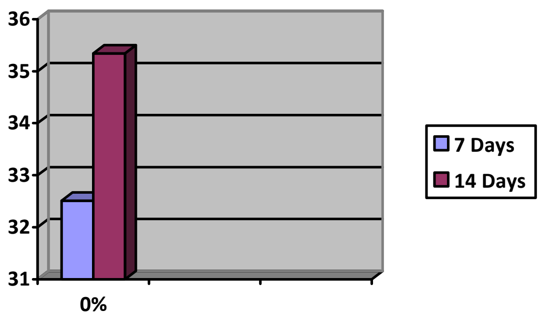

Table 6: Flexural Strength of Concrete of M40 Grade Polypropylene Fibre Concrete

Polypropylene Fibre	Flexural Strength
	7 days
0%	4.56

Table 7: Splitting Tensile Strength of Concrete of M40 Grade Polypropylene Fibre Concrete

Polypropylene Fibre	Splitting Tensile Strength
	7 days
0%	2.49

VI. CONCLUSIONS:

1. The study on the effect of fibrillated Polypropylene Fibers with different cut length can still be a promising work as there is always a need to overcome the problem of brittleness of concrete.
2. Compressive strength increases with the increase in the percentage of Fly ash and Polypropylene fibre up to addition of Cement in Concrete for different mix proportions.
3. Polypropylene fibre can be used with admixtures, plasticizers, and super plasticizers, for increasing the strength of concrete with partial replacement of cement.
4. The workability of Polypropylene fibre concrete has been found to decrease with increase in Polypropylene fibre content replacement.
5. Polypropylene fibre is Reduce number of joints And Reduce repair due to subsequent damage.
6. Used of long fiber with same volume of fraction gives maximum split tensile strength over fiber short cut length.

VII. REFERENCES:

1. Website

[1] www.civilengineering.com
[2] www.google.com
[3] www.civilengineeringportal.com
[4] www.ultratech.com
[5] www.alcon.com
[6] www.holsim.com
[7] www.icjonline.com
[8] www.soople.com

2.Journals Review

[1] Bentur A, Mindess S (1990). Fibre Reinforced Cementitious Composites, Elsevier Applied Science, London, UK. 1990

[2] Banthia N, Nandakumar N (2003). Crack Growth Resistance of Hybrid Fiber Composites, Cem. Con. Comp., 25(1): 3-9.

[3] Chen B, Liu J (2000).Contribution of hybrid fibers on the properties of the polypropylene hybrid fibers, Cem. Con. Comp. 22(4): 343-351

[4] Kawamata A., Mihashi H., Fukuyama H. (2003) "Properties of hybrid fiber reinforced cement-based composites." Journal of advanced concrete Technology, 1-3, Japan concrete institute, pp 283-290.

[5] Balaguru P N & Shah S P. Fiber Reinforced Cement Composites", McGraw-Hill Inc; 1992

. [6] Marcovic I., Walraven J.(2003), " Self-Compacting hybrid fiber Concrete-mix design, Workability and Mechanical Properties", Third International Symposium on Self-Compacting Concrete 2003, Reykjavik, pp. 763-775

[7] Dawood E. T and Ramli M. (2011), "Contribution of Hybrid Fibers on The Hybrid Fibers on the Properties of High Strength Concrete Having High Workability", The Twelfth East Asia-Pacific Conference on Structural Engineering and Construction, Procedia Engineering 14 (2011) 814–820

[8] Ahmed S.F.U, Maalej M., Paramasivam P (2007), "Flexural responses of hybrid steel–polyethylene fiber reinforced cement composites containing high volume fly ash" Construction and Building Materials, 21 (2007), pp. 1088–1097

[9] Nataraja MC, Dhang N, Gupta AP (1999). Statistical variations in impact resistance of steel fibre-reinforced concrete subjected to drop weight test. Cem. Con. Res., 29(8): 989-995.

[10] Ravichandran A.,Suguna K., And Ragunath P.N.(2009)," Strength Modeling of High-Strength Concrete with Hybrid Fibre Reinforcement", American Journal of Applied Sciences, vol 6(2), pp219-223