BEHAVIOR OF CONCRETE USING HYBRID FIBER (POLYPROPYLENE) WITH AND WITHOUT ADMIXTURE

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Abstract

Concrete is most widely used construction material in the world. Fiber reinforced concrete (FRC) is a concrete in which small and discontinuous fibers are dispersed uniformly. The fibers used in FRC may be of different materials like steel, carbon, glass, polypropylene etc. The addition of these fibers into concrete mass can dramatically increase the compressive strength, tensile strength, flexural strength and impact strength of concrete. The effect of addition of hybrid fibers on the mechanical properties of concrete mixture is studied in the present investigation. In The present study specimens incorporated fly ash and polypropylene fibers in the mix proportions is described as cement is replaced with fly ash (from 0%, 5%, 10 and 15%) and polypropylene is added 0.1% to 0.2 %. And length of fiber 40mm and 60mm is used.This study gives detail analysis of compressive strength and cost comparison between polypropylene and normal mix.

Key words Polypropylene Fiber, fly ash, compressive strength, compaction factor, workability,

I. Introduction

Concrete is a main element of construction material in these days, it is necessary to enhance its characteristics by means of strength & durability. It is also reasonable to compensate concrete in the form of using waste materials and saves in cost by the use of admixture such as fly ash. As partial replacement 5%, 10% and 15% of cement, one of the many ways this could be achieved by developing new concrete composites with the fiber which are locally and easily available extensively encouraged. **Hybrid Fiber:** -These different types of fibers have different uses depending upon the requirement. There are many general advantages of plastic e.g. they are moth-proof, resistant to fungi and rot, provide excellent insulation against temperature and sound, not easily combustible, flame-retardant, unaffected by moisture and dampness, tough and durable, resilient, springs back to shape even after constant use, totally static free and easy to clean.

There are many kinds of fibers, no matter metallic or polymeric, widely used in concrete engineering for their advantages. In fact, no single fiber-reinforced concrete has the perfect mechanical properties. Recently, many researchers have an orientation to discuss the mechanical properties of the hybrid fiber-reinforced concrete, such as a proper proportion between carbon fibers and polypropylene fibers.

II. Objectives of Mix Design

The objectives of this experimental investigation are to study the variation in strength characteristics of concrete structural elements, for the proportion of M10, M15 and M20 grade of concrete. In each mixes containing different percentages of fly ash is replaced by means of cement starting from 0% as normal concrete, i.e. controlled concrete 5%, 10%, and 15%, and two percentages of polypropylene fibers 0.1% and 0.2% with different lengths of 40 mm, 60mm were used.

Objective of thesis are as follows: Fibers and Polymers are unique because it covers interdisciplinary areas related to fibers, polymers, textiles, apparels, colorants, fiber composites, and polymer processing.

1. Workability of concrete test like slump cone test and compaction factor test.
2. Mechanical properties like Compressive strength,
3. Cost analysis of normal mix and mix with polypropylene.

III. Methodology and Experimental Program

The experimental investigations has been carried out on test specimens using one basic mix proportion with three variations of fly ash and two ratio of hybrid polypropylene

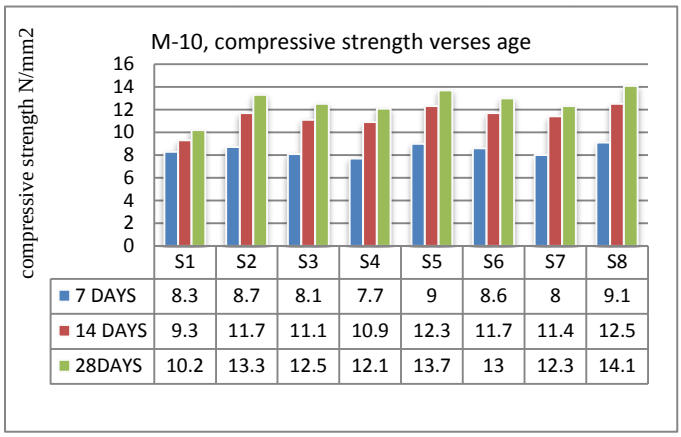
fiber, and different weight fraction of hybrid polypropylene fiber.

Number of samples:-

- Compressive strength test design procedure: 40mm, 60mm length and two percentages of polypropylene and three percentage of fly ash x 24 samples = 24x3x3 (7days, 14days, 28days) =27+189=216 samples.
- Conventional mix tests (0% pp) = 9 samples.
- pp addition tests: 3 different percentages of fly ash (from 5%, 10% and 15%) with pp of 0.1% and 0.2% and 40mm,and 60mm length = 15 sample.
- Samples made= approximately 60 samples.

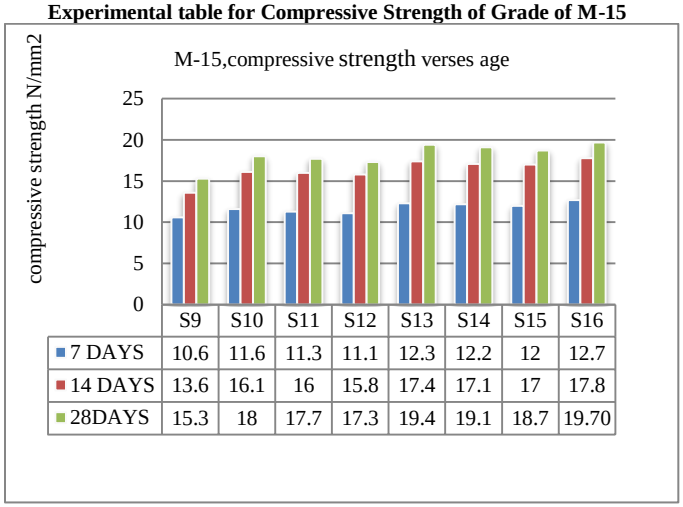
Laboratory Test Procedure:-

1. **Mixing procedure:**-The dry cement and aggregates were mixed for two minutes by hand in a $0.1m^3$ laboratory mixer pan. The mixing continued for further few minutes while about 80% of the total water was added. The mixing was continued for another few minutes and the fibers were fed continuously to the concrete for a period of 2-3 min while stirring. Finally, the remaining water was added.
2. **Method of compaction:**-The moulds with half filled fresh concrete were vibrated vertically while casting for about 30 seconds. The moulds were then fully filled with fresh concrete and vibrated further for about 60 seconds. This method of compaction was to align the fibres normal to the direction of vibration.
3. **Preparation of Polypropylene Fiber**:-Shredding of fibers has been done in the laboratory in the size of 40mm and 60mm.
4. **Mixing of concrete with polypropylene fiber:** Evenly Distribution of fibers throughout the concrete mix, sometimes it became necessary to stop the mixer, remove the mixing paddles, sprinkled a layer of fibers onto the concrete surface and reactivated the machine for approximately five revolutions after each addition. fibers should be well distributed and randomly orientated, and thus prevent balling or interlocking, the concrete together with the fibers were mixed by hand in this research work.



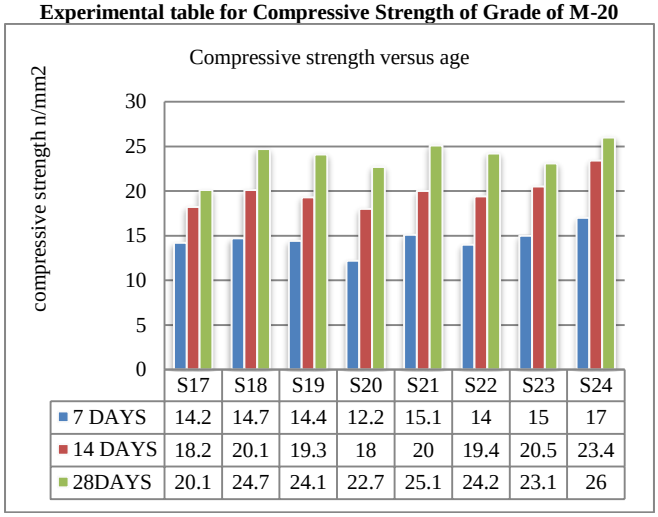
	S1	S2	S3	S4	S5	S6	S7	S8
7 DAYS	8.3	8.7	8.1	7.7	9	8.6	8	9.1
14 DAYS	9.3	11.7	11.1	10.9	12.3	11.7	11.4	12.5
28DAYS	10.2	13.3	12.5	12.1	13.7	13	12.3	14.1

Experimental table for Compressive Strength of Grade of M-15



	S9	S10	S11	S12	S13	S14	S15	S16
7 DAYS	10.6	11.6	11.3	11.1	12.3	12.2	12	12.7
14 DAYS	13.6	16.1	16	15.8	17.4	17.1	17	17.8
28DAYS	15.3	18	17.7	17.3	19.4	19.1	18.7	19.70

Experimental table for Compressive Strength of Grade of M-20



	S17	S18	S19	S20	S21	S22	S23	S24
7 DAYS	14.2	14.7	14.4	12.2	15.1	14	15	17
14 DAYS	18.2	20.1	19.3	18	20	19.4	20.5	23.4
28DAYS	20.1	24.7	24.1	22.7	25.1	24.2	23.1	26

MIX CALCULATION FOR M20 GRADE CONCRETE:-

The Mix Calculations per Unit Volume of Concrete are As Follows:-

1. Volume of concrete = 1 m^3
2. Calculation of sand for 1 m^3 of concrete

$= \frac{1.5}{1+1.5+3} \times 1.57 =$ **$0.43m^3$**

- Bulk density for $1m^3$ of sand = 1920kg/m^3
- 0.43m^3 of sand = 0.43× 1920

= **825.6kg**

For $1m^3$ of M20 grade concrete required 825.6 kg of sand

3. Course aggregates in $1m^3$ of concrete

$$= \frac{3}{1+1.5+3} \times 1.57 = \mathbf{0.85m3}$$

- Bulk density of 1m3 of aggregates = 1560kg
- 0.85m3 of course aggregates
- = 0.85×1560 = **1326kg**

For 1m3 of concrete required 1326 kg of course aggregates

4. Cement required for 1m3 of concrete $= \frac{1}{1+1.5+3} \times 1.57 =$ $\mathbf{0.285m3}$

- Bulk density of cement = 1440 kg/m^3
- 0.285m^3 of cement = 0.285×1.57

= **411kg**

For $1m^3$ of concrete required 411 kg of cement or 8.07 **bags** of cement

COST ANALYSIS FOR 1M^3 OF CONCRETE

: Material required for 1m3 of concrete

- Cement 8.07 bags at 310 Rs per bag = 2501.7 Rs
- Sand 0.43m3 at 600rs per m3 = 258 Rs
- Course aggregates 0.83 m3 at 900rs per m3 = 765Rs

Total cost of 1m3 concrete = 2501.7+258+765 = 3524.70 Rs

COST ANALYSIS FOR 1 CUBE OF CONCRETE (150x150x150mm^3)

Approximate weight of 1 cube of concrete (150mm) = **8.1 kg**

- Weight of cement in 1 cube of concrete

$$= \frac{1}{1+1.5+3} \times 8.1 = \mathbf{1.472kg}$$

-Cost of 1kg of cement = 6.6RS

- Cost of 1.472 kg of cement = 6.6×1.472 = **9.72 Rs**

- Weight of sand in 1cube

$$= \frac{1.5}{1+1.5+3} \times \mathbf{8.1} = \mathbf{2.21kg}$$

- Cost of 1 kg of sand = 0.3125rs
- Cost of 2.21 kg of sand = 2.21×0.3125 = **0.69 Rs**

- Weight of course aggregates in 1 cube

$$\frac{3}{1+1.5+3} \times 8.1 = \mathbf{4.41\ kg}$$

- Cost of 1 kg of course aggregates = 0.58 Rs
- Cost of 4.41 kg of aggregates
- = 4.41×0.58 = **2.56 Rs**

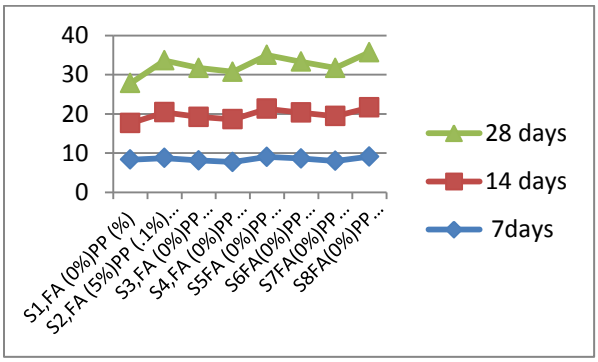
Total Cost of 1 Cube of Concrete (150mm)
= 9.72+ 0.69 +2.56 = **12.97 Rs**

IV. RESULTS

Compressive strength, of Concrete Cube based (Fine aggregate is replaced by two percentage (0.1% and 0.2 % of Polypropylene) concrete specimens were higher than the Control Mix and Polypropylene concrete specimens at all the ages. The strength differential between the specimens having no polypropylene and after adding pp in mix aggregate and concrete specimens became more distinct after at 28 days.

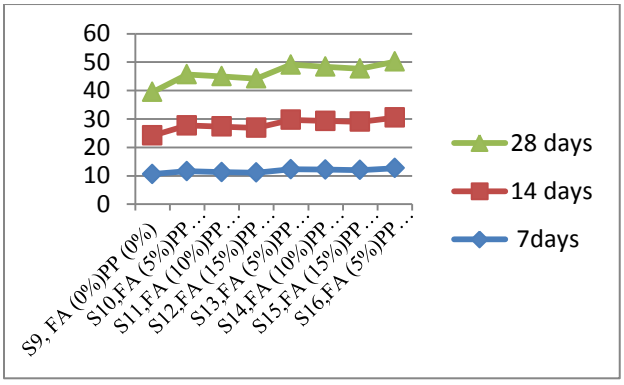
FOR M-10

The maximum 28 day compressive strength of normal cube obtained was 10.2 N/mm², for a mix with polypropylene of 0.1%, 4.1N/mm²compressive strength is found, and hence an increase in strength over polypropylene concrete is 38.23%.



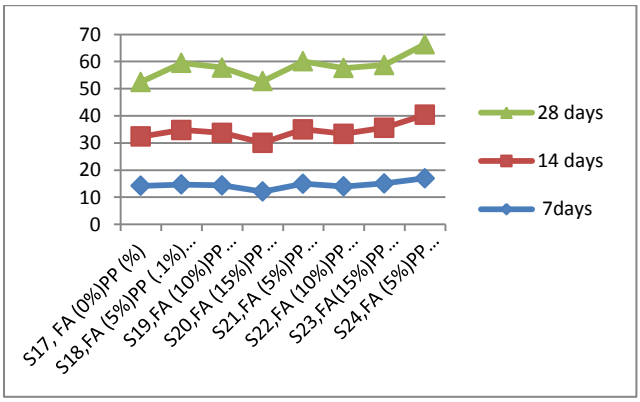
FOR M-15

The maximum 28 day compressive strength of cube obtained was 15.3 N/mm², for a mix with polypropylene of 0.1% is found to be 19.7N/mm², an increase in strength over polypropylene concrete is 28.75%.



FOR M-20

The maximum 28 day compressive strength of cube obtained was 20.1 N/mm², for a mix with polypropylene of 0.1% is found to be 26.0N/mm², an increase in strength over polypropylene concrete is 29.35%.



It has been seen during experiments that as the percentage of polypropylene increases the compressive strength increases initially, on further increase in its percentage reduces its compressive strength.

V- RECOMMENDATIONS

Compressive strength, of polypropylene based (fine aggregate is replaced by different percentage of polypropylene as 0.1% and 0.2%) concrete specimens were higher than the Control Mix and polypropylene concrete specimens at all the ages.

VI-SCOPE FOR FURTHER STUDY

1. In this investigation the work can be carried out by using higher grades of concrete.
2. Fly ash based fiber reinforced concrete shows a better performance than ordinary concrete, so it has a future scope in various type of construction works.
3. In this investigation to increase the strength of concrete other than fly ash fibers may be used
4. In this investigation 20mm down size aggregate have been used. Further work can be carried out by using 10mm aggregate size.

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