Use of Waste Plastic and Human Hair as Composite Material in Cement Concrete Construction

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Abstract— Aim of study is examine the effect on compressive strength of concrete by use of waste plastic and human hair as composite fiber reinforced material. The above plastic waste and human hair are mixed with cement concrete in various proportions (0.1%to 2%) and test specimens were casted (cubes and prisms) the study the behavior of plastic mixed concrete in axial compression. Study of human hair and plastic fiber is taken because of its excellent attributes which are available in low cost as compare to other fiber. At 5% optimum modifier content, the strength of the modified concrete was found to be 1.2 times greater than the plain concrete. By using Plastic waste and human hair as modifier, we can reduce the quantity of cement and sand by their weight, hence decreasing the overall cost of construction. The experimental finding in all tested sample will encourage the future researches in direction of long term of performance to extending thick chip for economical type of fiber use n structural application and reduced the environmental problem. By testing we found that there is an increment in the various properties and strength of concrete by the addition of human hair as fiber reinforcement which makes it suitable for an alternative additive for concrete to enhance its mechanical properties.

Key words: Waste Plastic, Human Hair, Compressive Strength; Cement Concrete, Fiber Reinforced Concrete

I. INTRODUCTION

The concrete is one of the most widely used construction material in developed and developing countries. The performance of concrete depends on its ingredients; it is well known that plain concrete is brittle and weak in tension. The major advantage of fiber reinforcement concrete is to transform a brittle concrete into a ductile material. Adding fibers in concrete can arrest micro crack which causes gradual failure. The fibers from cheap or waste materials may be used for manufacturing of structural units with cement mortar composites have a great potential for developing countries like India.

A. Why Waste Plastic and Hair as A Fiber?

This type of fiber has a high tensile strength which is equal to that of all tensile material with the same diameter. Hair and Waste Plastic are non-degradable matter is creating an environmental problem, so its use as a fiber reinforcing material can minimize the problem. It was help to control cracking due to both plastic shrinkage and drying shrinkage also it reinforces the mortar and prevents it from breaking.

II. MATERIAL USED

The material used for this experiment work are Portland Pozzolana Cement (PPC) 53 grade, River sand, Coarse aggregate, water, waste plastic fiber, waste human hair.

A. Cement

In this work, Portland Pozzolana Cement is used of Ambuja brand and 53 Grade is used. The properties of cement are tabulated in Table 1.

Sr. No.	Property	Values Obtained
1.	Specific Gravity	3.13
2.	Fineness	4%
3.	Standard Consistency	31%
4.	Intial Setting Time	30 minutes
5.	Final Setting Time	260 minutes
6.	Compressive Strength	54 MPa

Table 1: Properties of Cement

B. Aggregates

Fine Aggregate used in this project is natural river sand and Coarse Aggregate used in this project is well graded angular crushed stones. The properties of Aggregate are in table 2 and 3.

Sr. No.	Property	Results
1.	Specific Gravity	2.65
2.	Particle Size	4.75µm
3.	Fineness Modulus	2.7

Table 2: Properties of Fine Aggregate

Sr. No.	Property	Results
1.	Specific Gravity	2.73
2.	Particle Size	20 mm
3.	Fineness Modulus	4.6

Table 3: Properties of Coarse Aggregate

C. Water

Potable, Fresh, Colourless and clean municipal tap water, which is free from organic matter, is used in this project work.

D. Waste Plastic

In this work, Polypropylene ball is used in the experiment which made by the waste plastic as shown in Fig 1.

Fig. 1: Polypropylene Ball

E. Waste Human Hair

In this work waste Human hair is used which is of 30 µm long and diameter is 17 to 180 µm as shown in Fig 2.

Fig. 2: Waste Human Hair

III. METHODOLOGY

To study effect of composite material on compressive as well as tensile strength of concrete the experimental study was done. On this study some of the mix proportions were decided for addition of human hair and waste plastic in plain concrete are 0%, 1.5%, 3%, 4.5%, and 6% by the weight of cement and the strength was compared for 7, 14, 28 days curing period. For this experiment M20 grade of concrete is used. Mix proportions for per cubic meter concrete as in show in table 4. Quantity required for one cube and beam as shown in table 5 & 6.

Cement (kg)	Fine Aggregate(Kg)	Coarse Aggregate(kg)	Water (litter)
423.6	663.46	1187.06	186

Table 4: Mix Proportions For Per Cubic Meter Concrete

% of Hair and Waste Plastic	Cement (Kg)	Fine Aggregate (Kg)	Coarse Aggregate (Kg)	Fiber (gram)
0%	1.33	2.9	4.54	-
1.5%	1.313	2.9	4.54	20
3%	1.290	2.9	4.54	40
4.5%	1.273	2.9	4.54	60
6.0%	1.253	2.9	4.54	80

Table 5: Quantity Required For One Cube

% of Hair and Waste Plastic	Cement (Kg)	Fine Aggregate (Kg)	Coarse Aggregate (Kg)	Fiber (gram)
0%	1.975	4.30	6.71	-
1.5%	1.954	4.30	6.71	30
3.0%	1.915	4.30	6.71	60
4.5%	1.885	4.30	6.71	90
6.0%	1.855	4.30	6.71	120

Table 6: Quantity Required For One Beam

IV. EXPERIMENTAL STUDY

A. Compressive Strength

Most common test on hardened concrete is compressive strength test and it measures the ability of concrete to resist static load which tends to crush it. The compressive strength gives a good and clear indication that how the strengthen is varies with the increases of fiber volume dosage rate in the test specimen with 150*150*150mm size. The testing shown in Fig 3.

The compressive strength of concrete can be calculated using following formula.

$$fc = \frac{P * 1000}{A}$$

Where,
fc = Compressive strength of concrete (MPa)
P = Maximum load applied to the specimen in (KN)
A = Cross sectional area of the specimen (mm^2)

Fig. 3: Compression Test

B. Flexural Test

Flexural strength of a concrete is measure of its ability to resist bending and it's expressed in term of modulus of rupture. Concrete specimens for flexural strength test were with c/s of 100*100*500 mm. The specimen was subjected to bending by applying concentrated loading at its centre of prism. Figure 4 shows the setup of concrete beam specimen. The test was carried out under computer-controlled conditions, which is measure the load and deflections of concrete beam specimen. As an accurate load/deformation curves can be plotted to obtain the result of the concrete with the computer software.
The flexural strength of concrete can be calculated using the following formula.

$$fcf = \frac{PL * 1000}{B * D * D}$$

Where,
fcf = Flexural Strength of Concrete (MPa)
P = Maximum load applied to concrete
L = Length of specimen in mm
B = Width of the specimen in mm
D = Depth of the specimen in mm

Fig. 4: Flexural Test

V. RESULT AND DISCUSSION

A. Compressive Strength Test

For the compressive test, cube specimens of dimensions 150*150*150 mm were casted M20 grade of concrete with 1.5%, 3%, 4.5% & 6%of composite of human hair and waste plastic fibers with the replacement of cement. It is observed from the graph that the compressive strength of cube of 7 days increases up to 3% fiber content there after the strength is decreases at 4.5% & 6% of fiber content as shown in table no 7

Sr. No.	% of Hair and Waste Plastic	Average Compressive Strength (N/mm^2)		
		7 Days	14 Days	28 Days
1.	0%	12.38	18.91	22.45
2.	1.5%	17.908	21.45	25.26
3.	3.0%	17.424	20.58	24.88
4.	4.5%	12.804	19.032	21.83
5	6.0%	12.694	14.43	20.45

Table 7: Compressive Strength (N/Mm2)

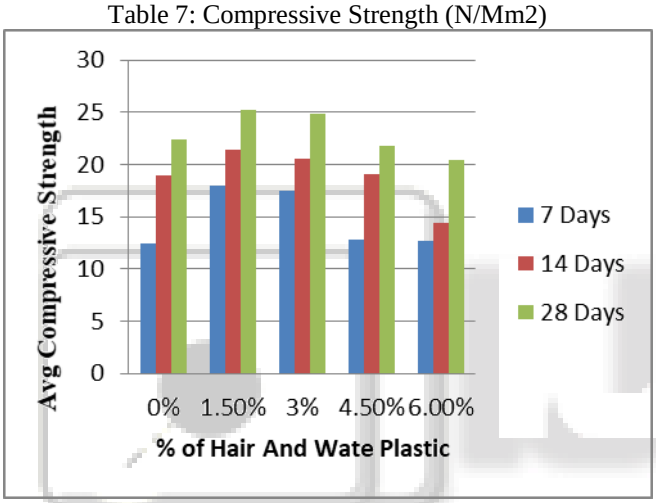

Fig. 5: Average Compressive Strength

B. Flexural Strength Test

The test was carried out under computer controlled condition, which measures the load and deflection of concrete beam specimens for the flexural strength. The specimens are subjected to bending, using point load until it fails. It is observed form the graph that the flexural strength was increased up to 3% fiber content there after the strength decreases at 4.5% and 6% fiber content as shown in table no. 8.

Sr. No.	% of Hair and Waste Plastic	Average Flexural Strength (N/mm^2)		
		7 Days	14 Days	28 Days
1.	0%	1.90	2.4	3.06
2.	1.5%	2.15	3.015	4.25
3.	3.0%	2.045	2.98	4.09
4.	4.5%	2.0	2.25	2.78
5.	6.0%	1.7	1.98	2.5

Table No. 8: Average Flexural Strength

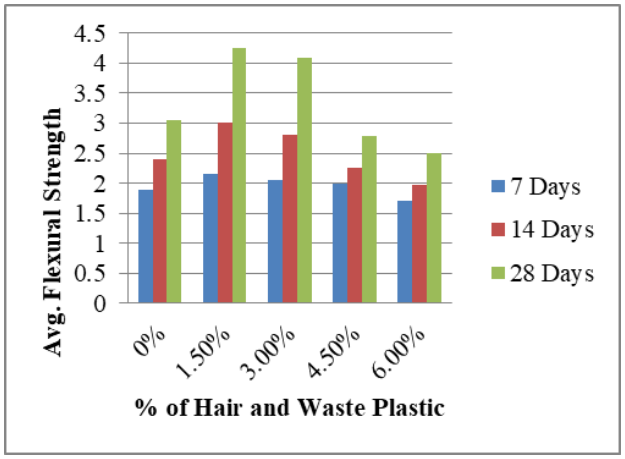

Fig. 6: Average Flexural Strength

VI. CONCLUSION

Based on the Experimental result, the following conclusions were drawn.

1) The use of waste plastic and human hair fiber improved compressive strength and flexural strength.
2) Addition of Fiber improves ductility of concrete and its post cracking load carrying capacity.
3) Increases the cube compressive strength of concrete by 40%, by adding the 1.5% and 3% composite fiber material.
4) The increases the flexural strength of concrete specimen in 28 days to extend to 13.15% by adding 1.5% of composite material.
5) The most important contribution of fiber reinforcement in concrete in not to strength but to the flexural toughness of material.

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