RESEARCH ARTICLE OPEN ACCESS

Laboratory Investigation Of Partial Replacement Of Coarse Aggregate By Plastic Chips And Cement By Human Hair

A.S.Balaji[1] and D.Mohan Kumar[2].
[1](M.Tech structural engineering Student, department of civil engineering, Prist university, thanjavur)
[2](M.tech structural engineering student, department of civil engineering, S.R.M university, chennai)

ABSTRACT
The use of plastic is increasing day by day, although steps were taken to reduce its consumption. The suitability of recycled plastics as coarse aggregate in concrete and its advantage are discussed here. Experimental investigation was done using M20 mix and tests were carried out as per recommended procedures by relevant codes. As 100% replacement of natural coarse aggregate (NCA) with plastic coarse aggregate (PCA) is not feasible, partial replacement were examined. And also Hair is used as a fibred reinforcing material in concrete as partial replacement of cement. It has a high tensile strength which is equal to that of a copper wire with similar diameter. It is also available in abundance and at a very low cost. Tests were conducted to determine the properties of plastic aggregate and human hair such as density, specific gravity and crushing value. Experiments were conducted on concrete cubes with various percentages of human hair i.e. 0%, 0.5%, 1%, 1.5%, 2%, and 3% by weight of cement and with constant percentage of plastic aggregate as 20%.
Key word: human hair, plastic coarse aggregate, compressive strength, split tensile strength.

I. INTRODUCTION

Big attention is being focused on the environment and safeguarding of natural resources and recycling of wastes materials. One of the new waste materials used in the concrete industry is recycled plastic. For solving the disposal of large amount of recycled plastic material, reuse of plastic in concrete industry is considered as the most feasible application. Recycled plastic can be used as coarse aggregate in concrete. There are many recycling plants across the world, but as plastics are recycled they lose their strength with the number of recycling. So these plastics will end up as earth fill. In this circumstance instead of recycling it repeatedly, if it is utilized to prepare aggregates for concrete, it will be a boom to the construction industry.

Plastics collected from the disposal area were sorted to get the superior one. These were crushed into small particle and washed to remove the foreign particles. Then it was heated at a particular temperature so that the necessary brittleness was obtained. After extrusion the molten plastic was cooled down and collected in boulders of 100 mm size approximately. These plastic boulders were crushed down to the size of aggregates.Praveen Mathew, Shibi Varghese, Thomas Paul, Eldho Varghese suggested that percentage replacement of 22% NCA with PCA was found to be of superior concrete compressive strength. In the current investigation the effects on the properties of concrete when added with constant 20% recycled plastic aggregate with different human hair percentage are studied.

Since concrete is weak in tension hence some measures must be adopted to overcome this deficiency. Human hair is strong in tension; hence it can be used as a fibre reinforcement material. Hair Fibre (HF) an alternate non-degradable matter is available in abundance and at a very cheap cost. It also creates environmental problem for its decompositions. the human hair should be replaced with cement with various percentage.

The specimen for both the test is made in the following manner: i. Compression test: Three cubes are made for M-2O with 0%, 0.5%, 1%, 1.5%, 2%, and 3% hair by weight of cement and 20% plastic aggregate by weight of course aggregate. ii. Tensile Strength test: three cubes is made for each M-2O with 0%, 0.5%, 1%, 1.5%, 2%, and 3% hair by weight of cement. and 20% plastic aggregate by weight of course aggregate.

II. EXPERIMENTAL PROGRAM

2.1 MATERIALS

2.1.1 Cement: In this experimental investigation Pozzolona Portland cement of 43 grade is used The properties of Cement are as follows:

TABLE 2.1.1. PROPERTIES OF CEMENT

S.No	Property	Value
1.	Specific Gravity	3.21
2.	Initial Setting Time	43min
3.	Final setting Time	240min

4.	Standard Consistency	28.7%
5.	Fineness	98.50

2.1.2 Fine Aggregate: Clean River sand is used as fine aggregate. The size of it is less than 2.36 mm. The specific gravity and fineness modulus of this fine aggregate where found to be 2.66 and 2.56 respectively. The percentage of passing is within the limits as per IS: 383-1970 [9].

2.1.3 Course Aggregate: The coarse aggregate used here is 20mm in size, crushed angular shape and free from dust. The specific gravity and fineness modulus of this fine aggregate where found to be 2.6 and 2.98 respectively and the impact value was found to be 12%. The percentage of passing is within the limits as per IS: 383-1970.

2.1.4 Plastic Course Aggregate: A recycled plastic was used to replace coarse aggregates for making concrete specimens. These aggregates were available in there different size as shown in table 2.1.4.

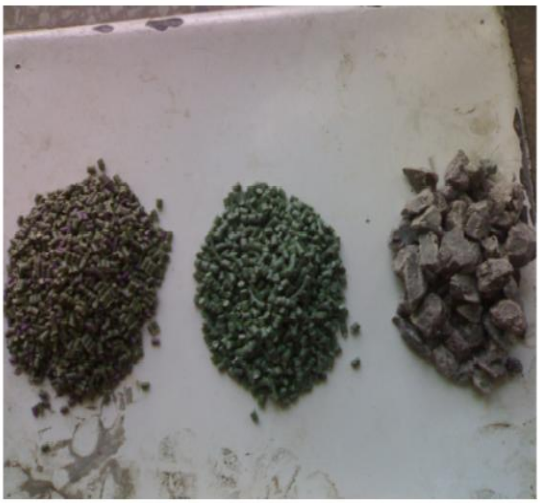


Fig 2.1.4 - plastic aggregate

TABLE 2.1.4 PROPERTIES OF PLASTIC AGGREGATE:

S.No	Properties	Values
1.	Density	385.9
2.	Shape Of The Particals	Granular Of A Board Distribution Dimension With Varying Length Of(0.15-12) mm And Width Of (0.15-4)Mm.
3.	Colour	Different Colours
4.	Water Absorption 24hr (%)	0.02

2.1.5 Human Hair:

A human hair was used to partially replaced by a cement for making concrete specimens. These aggregates were available in there different size as shown in table 2.1.5.

fig 2.1.5 - human hair used as a fibre

Table 2.1.5 Properties of Human Hair:

Sl.No	Properties	Values
1.	Cross-section	Circular
2.	Diameter	18-100µm
3.	Elongation	1.6 times its dry length
4.	Length	6-50mm
5.	Specific gravity	Nil

2.2.MIX PROPORTION

Mix design is carried out as per Indian Standard Code Method (IS 10262 – 2009) for concreting the test specimen. The grade of concrete which we adopted is M20 with the water cement ratio of 0.45.

2.3. specimen preparation

Concrete cubes specimens (150 mm x 150 mm x150mm) were casted for computing compressive strength. The cylindrical specimens (diameter- 150 mm and length- 300 mm) were casted to determine spilt tensile strength of concrete. All the specimens were cured for a period of 28 days before test. Total
twenty four specimens for each test were casted.

2.4.specimen testing method

The compression and split tension tests were carried in compression testing machine of capacity 2000 KN. The specimen for both the test is made in the following manner: I. Compression test: Three cubes are made for each M-20 with 0%, 0.5%, 1%, 1.5%, 2%, and 3% hair by weight of cement and 20% plastic aggregate by weight of coarse aggregate. II. tension test: Three cubes are made for each M-20 with 0%, 0.5%, 1%, 1.5%, 2%, and 3% hair by

weight of cement and 20% plastic aggregate by weight of coarse aggregate.

III. RESULT AND DISCUSSION

After a detailed study we have obtained the following results for compression, split tensile strength.

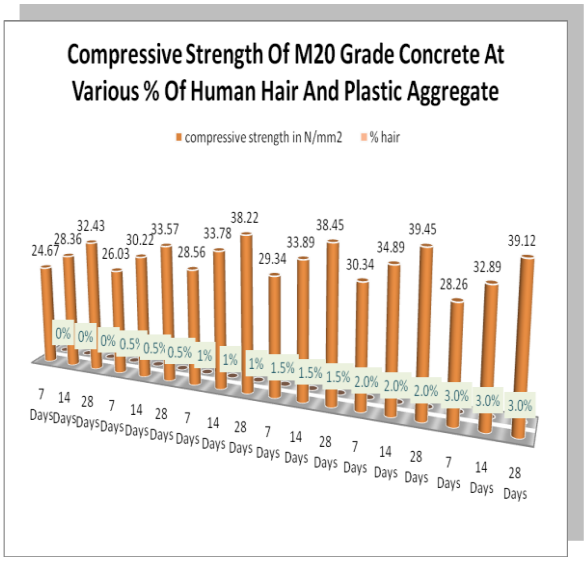
3.1 COMPRESSIVE STRENGTH

The compressive strength for different percentage of human hair added to concrete were tested at the end of 28days using compressive strength testing machine as shown in plate 4.1. The percentage of human hair were taken as 1%, 1.5%, 2%, 2.5%, 3%. three cubes of each percentage of human hair are casted and the average of three test results is taken for the accuracy of the results. the concrete cubes were cured at room temperature. The values of compressive strength obtained are tabulated in table 4.2 and fig 4.2. It is clear from the fig that with the addition of plastic and human hair.

Fig 3.1 compression testing machine.

Table 3.1: Result Obtained For Compressive Strength By Adding Human Hair And Plastic Aggregate

S.No	No of days	% hair	% plastic	Compressive strength in N/mm²
1	7	0%	0%	24.67
2	14	0%		28.36
3	28	0%		32.43
4	7	0.5%	20%	26.03
5	14	0.5%		30.22
6	28	0.5%		33.57
7	7	1%	20%	28.56
8	14	1%		33.78
9	28	1%		38.22
10	7	1.5%	20%	29.34
11	14	1.5%		33.89
12	28	1.5%		38.45
13	7	2.0%	20%	30.34
14	14	2.0%		34.89
15	28	2.0%		39.45
16	7	3.0%	20%	28.26
17	14	3.0%		32.89
18	28	3.0%		39.12



3.2 SPLIT TENSILE STRENGTH:

The split tensile strength for different percentage of human hair added to concrete were tested at the end of 28 days using compressive strength testing machine as shown in plate 4.3. The percentage of human hair was taken as 1%, 1.5%, 2%, 2.5%, 3%. Three cubes of each percentage of human hair are casted. the concrete cubes were cured at room temperature. The values of split tensile strength obtained are tabulated in table 4.3 and fig

4.3. It is clear from the fig that with the addition of plastic and human hair.

Fig 3.2 tensile testing machine

Table 3.2 Result Obtained For Split Tensile Strength By Adding Human Hair And Plastic Aggregate.

S.No	No of days	% hair	% plastic	Split tensile strength in N/mm²
1	28	0%	0%	3.243
2	28	0.5%	20%	3.357
3	28	1%	20%	3.822
4	28	1.5%	20%	3.845
5	28	2.0%	20%	3.945
6	28	3.0%	20%	3.912

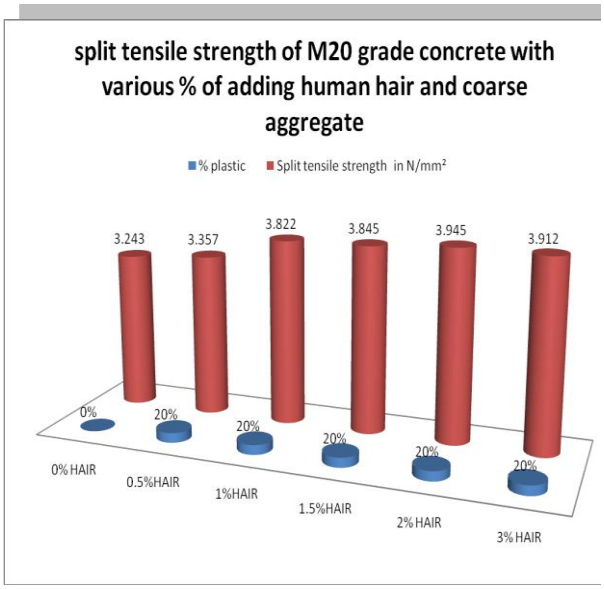


Fig 3.1.2 compression test specimens after test

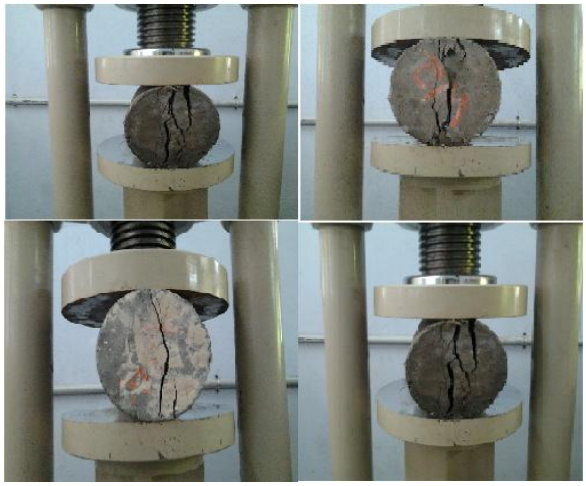


Fig 3.1.3 tensile test specimens after test

IV. CONCLUSIONS

Following are the conclusions can be made based upon the studies made by various researchers:

1. Plastics can be used to replace some of the aggregates in a concrete mixture. This contributes to reducing the unit weight of the concrete. This is useful in applications requiring non bearing lightweight concrete.
2. Introduction of plastics in concrete tends to make concrete ductile, hence increasing the ability of concrete to significantly deform before failure. This characteristic makes the concrete useful in situations where it will be subjected to harsh weather such as expansion and contraction, or freeze and thaw.
3. The inclusion of plastic aggregates in the concrete of the building under investigation has been shown to be advantageous from an energy point of view. The use of plastic aggregates helped the interior cooler, when the outside temperature is raised, as compared to the corresponding conventional concrete.
4. Better split tensile strength was achieved with the addition of the human hair in concrete. The strength has increased when compared to that of the conventional concrete specimen.

5. When M-20 concrete on 28day strength with 2.0% hair is compared with the conventional concrete, it is found that there is an maximum increase of 7.02 N/mm² in compressive strength.
6. While testing control cement concrete cube the spalling of concrete was observed. However, the failure mode of fiber concrete was bulging in transverse direction.

REFERENCE

[1] Jain D. And Kothari A, Hair Fibre Reinforced Concrete, *Research Journal Of Recent Sciences Vol. 1(ISC-2011), 128-133 (2012)*

[2] Yadollah Batebi, Alireza Mirzagoltabar, Seyed Mostafa Shabanian And Sara Fateri, "Experimental Investigation Of Shrinkage Of Nano Hair Reinforced Concrete", *Iranica Journal Of Energy & Environment 4 (1) Special Issue On Nanotechnology: 68-72, 2013*

[3] R. Lakshmi And S. Nagan Investigations On Durability Characteristics Of E-Plastic Waste, *Incorporated Concrete Asian Journal Of Civil Engineering (Building And Housing) Vol. 12, No. 6 (2011).*

[4] T. Senthil Vadivel And M. Doddurani, An Experimental Study On Mechanical Properties Of Waste Plastic Fiber Reinforced Concrete, *International Journal Of Emerging Trends In Engineering And Development Issue 3, Vol.2 (March 2013).*

[5] M. Elzafraney1,P. Soroushian And M. Deru, Development Of Energy-Efficient Concrete Buildings Using Recycled Plastic Aggregate, *10.1061/_Asce_1076-0431_2005.*

[6] Tsung-Yueh,Yuen-Yeunchen,Chao-Lung Hwang(2006), "Properties Of Hpc With Recycled Aggregates", Cement And Concrete Research,*Vol:36,Pp943-950.*

[7] Amnon Katz (2003),"Properties of concrete made with recycled aggregate from partially hydrated old concrete", *Cement and Concrete Research*,vol 33,pp 703-711.

[8] Ahmed S., Ghani F. and Hasan M., Use of Waste Human Hair as Fibre Reinforcement in Concrete, *IEI Journal, Volume **91** FEB, Page no 43, (**2011**)*

[9] Is 456-2000 Specifications For Plain And Reinforced Concrete.

[10] Is 10262:2009recommended Guidelines For Concrete Mix Design, Bis. New Delhi, India, 2009.

[11] Is: 383-1970,Specification For Coarse And Fine Aggregates From Natural Sources For Concrete (Second Revision).