

EFFECT OF HUMAN HAIR FIBER ON STRENGTH OF CONCRETE

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Abstract: Concrete as one of the most widely used building material. It is composed of three main elements, they are cement, sand and aggregates in which they are bonded together by cement and formed concrete that is in fact a man-made stone. Its compressive strength is acceptable and tensile strength is very low (about ten percentage of compressive strength). Human hair is considered as a waste material in most parts of the world and is a common constituent found in municipal waste streams which cause enormous environmental problems. This is an attempt to find the possibilities of using hair as fibre reinforcement in concrete, thereby forming an alternative way for the safe management of hair waste. Human hair is strong in tension; hence it can be used as a fibre reinforcement material. Hair Fibre, an alternate non-degradable matter, is available in abundance and at a very cheap cost. Present studies have been undertaken to analyses the effect of human hair on plain cement concrete on the basis of compressive, crushing and flexural strengths and cracking control to economize concrete and to reduce environmental problems. Experiments were conducted on concrete cubes with various percentages of human hair fibre i.e. 1%, 2% and 3% by weight of cement. By testing we found that there is an increment in the various properties and strength of concrete by the addition of human hair as fibre reinforcement which makes it suitable for an alternative additive for concrete to enhance its mechanical properties. Also, hair fibre reinforced concrete can be an alternative method for the hair waste management.

IndexTerms–Human Hair (HH), Normal Concrete (NC),Edition (ed),

I. INTRODUCTION

When classification of Materials or substances is done into groups they are classified as Pure Substance and Mixtures. The material most used extensively in many construction projects is classified as Heterogeneous Mixture. Concrete is an all pervading material of construction. Concrete is a versatile material made up of Cement, Coarse Aggregate, Fine aggregate & Water, Most extensively used an extra component these days in concrete is an admixture. Concrete is considered to be inveterate i.e. lasting for a long time if proper mix is chosen and largely depends on curing. Concrete is the most widely used construction material in the world because of its solitary characteristics, such as compressive strength is high, safeguard from fire, easy to cast and low cost when compared with other materials. Its performance in a particular application depends not only on its own quality but also on its correct usage and quality of other materials used along with it.

II. LITERATURE REVIEW

Renju.R.Pillai & Ayothiraman Ramanathan - “An Innovative Technique of Improving the Soil Using Human Hair Fibre” (2012) presented a laboratory scale study on the influences of soil properties with the inclusion of human hair as fibre. Several laboratory tests were carried out such as consistency limit tests, compaction tests and unconfined compression tests. It was seen that maximum dry density initially reduces lightly and optimum moisture content increases marginally due to moisture absorption of hair fibres. Plasticity of soil increased, thereby enhancing engineering properties. Also with addition of 2.0% fibres by weight, the unconfined compressive strength increased up to 2 times that of unreinforced soil. This clearly indicated that the human hair fibre could be used in the improvement of cohesive soils.

Dr. L. B. Zala, et al (2012), The authors reported that compressive strength reduces when replacement of human hair percentage increases when compare to traditional concrete. Replacement of cement with human hair provides maximum compressive strength at 10% replacement but it is lesser than traditional concrete. Flexural strength of beam reduces when replacement of human hair percentage increases when compare to traditional concrete.

Dharani.N et al. (2013), The authors reported that the optimal replacement percentage of cement with human hair is found to be 30% when fibers are not added. On addition of human hair fiber with cement matrix, the compressive strength and split tensile strength decrease with increase in fiber content, however the flexural strength increases with increase in fiber content. When human hair fiber are added, the optimum dosage of Human hair is 20% and optimum Fiber content is 0.4%. Usage of human hair fibers will reduce the segregation, cost of maintenance by reducing the micro cracks and permeability and hence the durability will increase.

Dr. Yaseen Et al (2013) University of salahaddin published a paper on “An Experimental Investigation into the mechanical properties of New Natural Fiber Reinforced Mortar “in 2013. This paper highlights use of human hair fiber (HHF) as reinforced material in cementitious material. Tests were carried to study the influence of fiber content on the compressive strength, splitting tensile strength, flexural strength and load deflection was presented for two w/c ratios (0.6 and 0.7). Energy absorption capacity and ductility factor were improved considerably with the fiber content increased, which makes using the HHF suitable for seismic force resistant structures.

Nila V. M et.al. (April, 2017) According to the test performed it is observed that there is remarkable increment in properties of concrete according to the percentages of hairs by weight of concrete. There was an overall increase of 1 - 12% in the compressive strength of concrete and up to 5% in the flexural strength of concrete test specimens by the addition of hair fibers in different quantities. It is well observed that the maximum increase is noticed in the addition of 2% hair fiber, by weight of concrete, in all the mixes. It is concrete mixes, making the hair fiber reinforced concrete best suitable to u the applications with those concrete mixes. Crack formation and propagation are very much reduced showing that FRC can have its applications in seismic resistant constructions.

III. EXPERIMENTAL PROCEDURE

The procedure followed was:

1. **Weighing of the Materials** : According to the number of specimens to be casted, weight of all the materials were calculated by the ratio given above, and according to that materials i.e. Cement, HH, Coarse Aggregates, Fine Aggregates and water were taken using weighing machine present in the laboratory.



Fig. 1: Showing Human Hairs

The mixing of hair was done in dry cement as shown



Fig 2: Human hairs were mixed in dry cement

IV. DETAILS OF SPECIMEN CASTED:

1st Set of Normal Concrete (N)

Firstly sand and cement were mixed thoroughly till uniform coloured mixture of them was obtained.

After this above prepared mixture were mixed with the required quantity of the coarse aggregates.

Required Amount of water were added then, according to w/c ratio (0.45)

Then the mixture of the cement, sand, coarse aggregates was mixed thoroughly for about 3 minutes to 4 minutes, the pile of these materials so formed was turned 3 times.

2nd Set of Fiber Concrete (HH)

Firstly sand and cement were mixed thoroughly till uniform coloured mixture of them were obtained, and then is mixed with the required quantity of HH fiber

The hairs were cut to least possible size in order to ensure uniform distribution.

Then the HH fiber added mixture were added to the to the required quantity of course aggregates and mixed thoroughly and turned at least for 3 times to ensure uniform & homogeneous mixture

Then the required Amount of water was then added.

Then the mixing was done for about 3 minutes to 4 minutes to ensure proper mix.

After that, the mixture was prepared, and was casted in moulds. Prior to adding mixture we make it sure that our moulds are fixed with nuts and bolts tightly so that there is no space present for the mixture to come out of it while vibrating. Moulds were oiled before adding mixture so that they can easily come out of it while demoulding after 24 hours. Place these moulds in the curing tank maintained at 27 degree Celsius and were then kept in curing tank for 28 days. The specimens were placed over vibrating machine for fully compaction. Use gloves for the safety purpose.

CASTING OF MOULDS

When the whole mixture was ready, it was placed in moulds by tamping with tamping rods at suitable time and then all the moulds were placed on vibration machine to remove all the voids.

DEMOULDING AND CURING

The casted moulds were de-moulded after 24 hours and their weights were measured before curing and they were kept in curing tank for 28 days.

PROPORTION OF SPECIMENS

Table 1

Set No	Type of concrete	Cement (in kg) per m ³	Fine aggregates (in kg) per m ³	Coarse aggregates (in kg) per m ³	Human hair (in kg) per m ³
1	Normal concrete	390.346	1100.90	680.02	
2	Reinforced concrete 1%	390.346	1096.99	680.02	3.903
3	Reinforced concrete 2%	390.346	1093.09	680.02	7.81
4	Reinforced concrete 3%	390.346	1089.19	680.02	11.71

V. RESULTS AND DISCUSSION

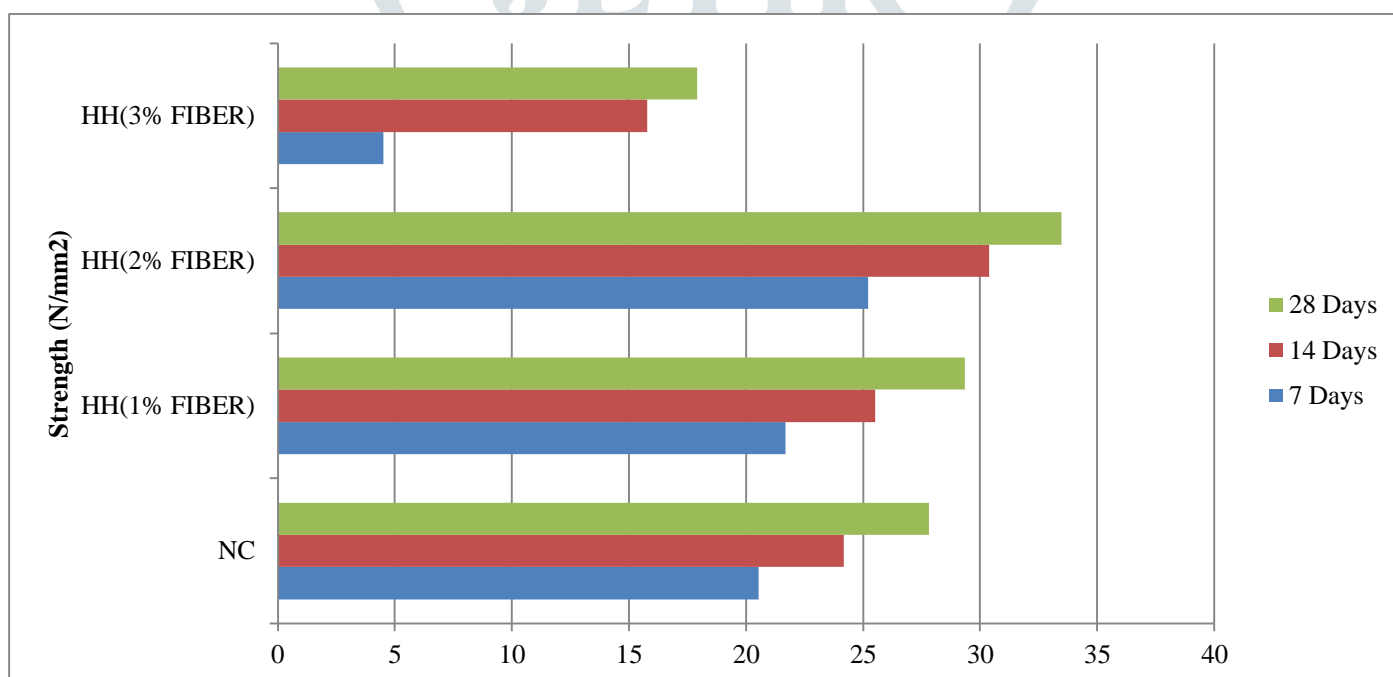
COMPRESSIVE STRENGTH: The compressive strength of concrete is determined by testing the cubes under universal testing machine. The results of compressive strength are shown in the Table 2

Maximum compressive strength occurred at (2% fiber) and it is nearer to the target strength.

Table 2

s. no.	Type of cube	7 days strength [N/MM ²]	14 days strength [N/MM ²]	28 days strength [N/MM ²]
1	Normal concrete	20.544	24.18	27.81
2	HH fiber concrete[HH fiber 1% by the weight of cement]	21.685	25.511	29.34
3	HH fiber concrete[HH fiber 2% by the weight of cement]	25.21	30.378	33.49
4	HH fiber concrete[HH fiber 3% by the weight of cement]	13.41	15.778	17.92

Graph : Showing Strength variations after 28 days of curing



VI. CONCLUSIONS

Based on study carried out to find the structural behavior of hair fiber reinforced concrete in comparison of normal concrete, following conclusions were arrived.

- The optimum dosage level of hair fiber addition was found to be 2%.
- When we tried to add more percentage HH fibre, we found that uniform distribution of human hairs was very difficult and human hairs appear on surface of specimen and after setting gives Harshed Appearance.
- Mixing operation becomes very difficult due to formation of HAIR balls on addition of water.
- Workability considerably decreased after addition of HH FIBERS.
- Setting time of the fiber concrete increased considerably as compared to normal concrete.

REFERENCES

- [1] Human Hair: A Biodegradable Composite Fiber–A Review. https://www.researchgate.net/publication/304904238_Human_Hair_A_Biodegradable_Composite_Fiber-A_Review
- [2] Jain D, Kothari A (2012) Hair Fiber Reinforced Concrete. Research Journal of Recent Sciences 1: 128-133.
- [3] Barone JR (2005) Polyethylene/keratin fiber composites with varying Polyethylene crystallinity. Journal of Composites 36: 1518-1524.
- [4] Ahmad S (2014) Preparation of Eco-Friendly Natural Hair Fiber Reinforced Polymeric Composite (FRPC) Material by using Polypropylene and Fly Ash: A Review. International Journal of Scientific & Engineering Research 5: 969-972.