ORIGINAL RESEARCH PAPER

Volume-7 | Issue-6 | June-2018 | PRINT ISSN No 2277 - 8179

INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

STRENGTH AND BEHAVIOR OF CONCRETE CONTAINS HUMAN HAIR

Engineering

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ABSTRACT

Concrete is the most important component used in the construction industry throughout the world. In the recent years, a lot of research work has improved the two main properties of concrete which are Strength and Durability. The paper presents improvement in compressive strength of concrete by the addition of human hair (0.5%, 1%, 1.5%, 2%, 2.5% and 3%) as fiber. Human hair is considered a waste material and its accumulation with addition of human hair (i.e. 0.5%, 1%, 1.5%, 2%, 2.5% and 3%) increase in the compressive strength was observed at a contents. The concrete attains maximum compressive strength when percentage of human hair is 2%, which has been found as optimum percentage. The strength of concrete at optimum percentage increases up to 31.99N/mm2. It is clear that with addition of 2% human hair in concrete the compressive strength increased by 26.34% to the original strength. Hence, the human hair along with concrete can be used for various Civil Engineering applications.

KEYWORDS

Compressive strength, Human hair fiber, concrete.

1. Introduction

Structural engineering focuses on the infrastructure of the world which include Water works, Sewers, Dams, Power Plants, Transmission Towers/Lines, Railroads, Highways, Bridges, Tunnels, Irrigation Canals, River Navigation, Shipping Canals, Traffic Control, Mass Transit, Airport Runways, Terminals, Industrial Plant Buildings, etc. Therefore, for every construction concrete play an important role. Structure engineer suggest various method to enhance the strength of concrete. In this work author evaluate the behavior of concrete by using wastage human hair as a partial replacement material for cement. Human hair is considered a waste material in most parts of the world and its accumulation in waste streams causes many environmental problems. This study shows that human hair is a highly versatile material with significant potential in several critical areas such as agriculture, medical applications, construction materials, and pollution control. Moreover, these uses are diverse enough for entrepreneurs ranging from unskilled to highly technical individuals and for the wide variety of human hair waste available in different locations. Burning of human hair or the waste piles containing them—a practice observed in many parts of the world—produces foul odor and toxic gases such as ammonia, carbonyl sulphides, hydrogen sulphides, Sulphur dioxide, phenols, nitriles, pyrroles, and pyridines. Open dumps of hair generate hair dust which causes discomfort to people near them and, if inhaled in large amounts, can result in several respiratory problems. Human hair act like a reinforcing material having properties similar to the fiber. Hair is used as a fibre reinforcing material in concrete for the following reasons: It has a high tensile strength which is equal to that of a copper wire with similar diameter. Hair, a non-degradable matter is creating an environmental problem so its use as a fibre reinforcing material can minimize the problem. It is also available in abundance and at a very low cost. It reinforces the mortar and prevents it from spalling. Use of human hair as fibrous material overcome to problem, i.e. avoid the environmental hazards and other is to provide economical way to reinforcing concrete. Experimental and theoretical studies over the past decade have shown that the bond between the reinforcing fiber and the matrix has a significant effect on the performance of a composite material (A.J. Majumbaz, 1975), (Aziz et.al 1981), (Cook, DJ 1978), (Slate, FO 1976) (Swift DG and Smith RBL. 1980), (Racines PG and Pama RP 1978), (Pakotiprapha B et. al 1976)

2. Material and experimental methodology

The material used in present study is briefly described:

i) Human hair

Human hair is a material considered useless in most societies. The unique properties of human hair such as its unique chemical composition, slow degradation rate, high tensile strength, thermal insulation, elastic recovery, scaly surface, and unique interactions with water and oils, along with its sociocultural roles, have led to many diverse uses.

ii) Sand

Sand is a naturally occurring coarser material composed of finely divided rock and mineral particles. It is defined by size, being finer than gravel and coarser than silt. It act as filling material and impart strength to concrete.

iii) Cement

Cement is a binding material which used for construction that sets, hardens and adheres to other materials, and forms a hard mass of specific shape and size.

iv) Aggregate

Aggregate including sand, gravel, crushed stone, slag, or recycled crushed concrete.

v) Water

Water should be free from oil and alkali, such that it did't disintegrate the construction.

2.1 Experimental Plan and Methodology:

Total of 42 experiments were carried out on the several proportions of concrete and human hair to evaluate the compressive strength of concrete. The test performed was compressive strength test as per IS: 516-1959 – Methods of tests for strength of concrete.Table.1 presents the percentage of proportions and designation against the compressive strength.

Table1 Scheme of proportion for laboratory testing.

Property of miv design	Designation
Compressive Strength (N/mm2) (42 mix)	M- 25 + 0%HH(6 Sample) M-25 + 0.5% HH (6 Sample) M-25 + 1%HH (6 Sample) M-25 + 1.5%HH (6 Sample) M-25+ 2%HH (6 Sample) M-25+ 2.5% HH (6 Sample) M-25 + 3% HH (6 Sample)

HH – Human hair percentage (from out of six sample 3 were tested after 7 days and 3 were tested after 28 days)

3. Result and Discussion

Compressive strength tests were carried out on concrete mixed with

o.5%,1% and 1.5%, 2%, 2.5% and 3% human hair as per IS : 516-1959 – Methods of tests for strength of concrete. Six cube of each composition were made out of all three were tested after 7 days and remaining were tested after 28 days. Table 2, showing the average compressive strength of three cube of each composition after 7 and 28 days.

Table.2 Showing average compressive strength of three cube of each composition after 7 and 28 days.

Average compressive strength of three cube of mix	M25 + 0%HH (N/mm²)	M25+ 0.5%HH (N/mm²)	M25+ 1%HH (N/mm²)	M25+ 1.5%HH (N/mm²)	M25+ 2%HH (N/mm²)	M25+ 2.5%HH (N/mm²)	M25+ 3%HH (N/mm²)
After 7 days	17.12	19.85	22.07	23.18	24.29	19.85	15.14
After 28 days	25.32	27.55	29.77	30.88	31.99	27.55	23.1

Fig. Showing average compressive strength of three cube of each composition after 7days, it is clear that the maximum strength attain for the mix with proportion of M25 + 2% HH. The strength after seven days for the mix is 24.29 N/mm². There is an increase in strength up to 42% after 7 days.

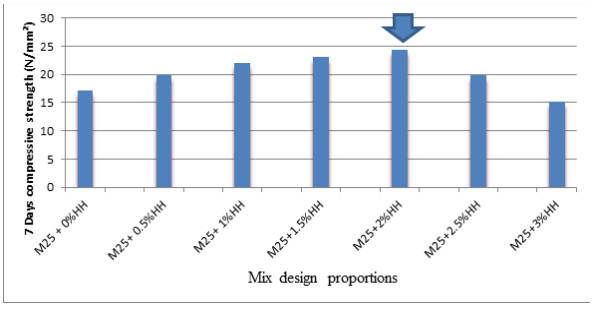

Fig.1 7day's compressive strength

Similarly, the strength after 28 day for all composition show that design mix M25+2%HH show maximum compressive strength as shown in Fig.2. Therefore, the optimum proportion found to be M25+2%HH, which show strength 31.99N/mm². The strength obtained after 28 days for M25+ 0%HH is 25.32 N/mm². It is clear that there is an increase in strength up to 26.34% after addition of 2%human hair to the concrete. This may be because the hair acts reinforcing material, which increases the strength of concrete. Similar results are published by Sarkar, 2012. It is also found that if fiber percentage increases than 2% the strength starts decreasing this may due to excess in human hair percentage segregates the mix and that decreases the strength of concrete.

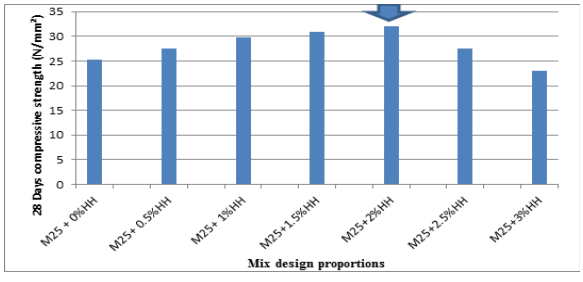

Fig.2. 28day's compressive strength

4. Conclusions

i) Characteristics strength of M25 grade is 25.32N/mm², with addition of 2% human hair compressive strength increases up to 31.99 N/mm². Therefore human hair has reinforcing capacity which increases the compressive strength of concrete.

ii) It can be concluded that waste hair can be effectively used in concrete for various civil engineering applications.

iii) Use of human hair in concrete can reduce the load on environment.

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