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Controlling Environmental Issues by Using Natural Wastage in Concrete

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ABSTRACT

A conducive environment plays an instrumental role to live healthy, upgraded lifestyle but many harmful prospects like green house effect, rise in temperature, climate changes etc. are increasing only due to deforestation and rise of artificial or man-made wastage such as non-degradable garbage. Natural human hair and sugarcane ash, are the Non-degradable garbage and responsible majorly for harmful environmental issues. Therefore, there is a need to solve this major problem to benefit humanity. The Present experimental study is based on making the utilization of such non-degradable garbage as fibrous material in different percentages in concrete. These composite materials provide better strength to structures in very cheap cost. These unique experimental findings on concrete mitigate environmental problems to large extent, which contribute in direct and positive impact to improve lifecycle of livings beings on this planet.

Keywords: Non-degradable wastages, Natural Human Hair, Sugarcane Fibers, Compressive Strength of Concrete, Flexural Strength, Split Tensile Strength etc.

1. Introduction

Environment is the surrounding in which we are living. In other words survival of life entirely depends on the environment, directly or indirectly. This includes the life of all living component like animals, plants and non living component like soil, air water, which support directly to the survival of life. Unfortunately, it is going to be polluted very fast because of use in large quantity of fossil fuel and carbon emissions; consequently non-degradable substances, harmful chemical etc. are increasing tremendously and continuously proving to be a big threat to the humanity. The need to mitigate this problem is becoming a huge challenge.

Utilizing the Non-degradable garbage can solve this problem to large extent, that too in concrete as reinforcing material save environment as well as cost. As Its constitutional composition increase the mechanical properties of concrete such as Compressive Strength, Flexural Strength, and Split Tensile Strength etc.

2. Fibers as an important concrete ingredient

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Concrete is a composite material produced by mixing the binding material such as cement, different sizes of aggregates and water, possessing low tensile strength, limited ductility and little resistance to cracks. Internal micro cracks are inherently present in concrete. Its poor tensile strength is due to the propagation of such micro cracks, which eventually leading to brittle fracture of the concrete. Fibers have the properties to prevent cracking, improve the tensile strength and ductility substantially. Fibers like human hair and sugarcane are acting as good reinforcing agents in concrete.

This is because, natural human hair are strong in tension or have great tensile strength almost equal to that of a copper wire with same diameter, whereas sugarcane fibers have great reinforcing properties which help to improve many concrete attributes as well. It is an alternate non-degradable matter is available in abundance and at a very cheap cost.

In present conditions the non-decompositions of these materials create lots of environmental problems. To mitigate such problems these fibers can be used as a reinforcement material in concrete to covert normal concrete to fiber reinforced concrete, which saves good amount of cost as well.

Enlisted the benefits of fiber as concrete ingredient:

[1]Fibers help to make earthquake resistance structure and they provide better ductility and stiffness.

[2]Fibers are added in concrete by dissolved in water & it taken by weight of binding material.

[3]Natural Horse hair fiber helps to improve tensile & flexural strength of concrete. Density of concrete does not depend on horse hair fiber. However, by increasing the fiber percentage, density reduces slightly.

[4] Human Hairs help to improve chemical and biological properties of soil. Consequently, Load bearing capacity of soil can be increased by using human hair.

3. Objective and Scope

The main objective of this study is to protect environment from non-degradable wastages widespread allover, which are increasing day by day and polluting surroundings profusely.

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By using these wastages in concrete not only increase its strength but also make it better construction material economically with reduced cost. These also contribute to mitigate and control environmental issues, which is like a boon to the humanity in long run.

4. Experimental Work

4.1 Materials and their Properties

Many types of material are used in this work to produced fiber reinforced concrete, discussed below:

Cement:

In this experimental work Ordinary Portland Cement of 53-grade and 3.14 of specific gravity, is used as binding material with as per IS code 12269:1989.

Aggregates:

Aggregates are used in concrete to achieve strength and remove air voids. There are two types of aggregates- Fine aggregates (<4.75 mm size and 2.63 specific gravity) which help to remove voids and coarse aggregates (4.75 – 20 mm size and 2.74 specific gravity) which help to achieve strength.

Reinforced Materials:

The various studies show that the fibrous strength adds to tensile strength of concrete. Use of fibers reduces the need of steel bars to maintain the required strength and provide the better tensile strength and ductility to structures. Here natural human hair (NHH) and sugarcane fibers (SCF) are used in different percentages (0.25% and 0.5%) by weight of binding materials and aggregates, and different important parameters related to these fibers are given in table I. Fibers are described by aspect ratio which is nothing but ratio of length to its diameter and typical aspect ratio range lies 200 to 300.

Table I Some Parameters of Reinf. Materials

Reinforced Material	Parameters	Average values
NHHF & SCF	Diameter range	50 μm – 100 μm
	Length of Fiber	10mm – 30mm

4.2 Preparation of Specimens

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In this investigation, IS code 10262:2009 is used for preparing M30 concrete mix, with standard water cement ratio of 0.42 to prepare standard sizes of 100 x 100 x 100 mm cubical specimens, 500 x 100 x 100 mm prisms and 100 x 200 mm cylindrical specimens for compressive strength test, flexural strength test and split tensile strength test respectively. All discussed materials were mixed with each other in drum type mixing machine with standard quantity of water and fibers which are added in different percentages (0.25% and 0.5%) with manual distribution. After proper mixing of all materials and fibers, FRC mix put in cubical, prism and cylindrical moulds in three different layers. Machine vibrator is also used to remove voids from moulds so that it can be filled properly with concrete mix. After 24-hours, moulds were de-molded and kept it in water tank for 28-days of curing period as per IS Standard.

4.3 Testing of Specimen

Mechanical properties of FRC were found under monotonic load by compression testing, flexural and split tensile testing as shown in fig I, are as follows:

Compression Test:

This test is used to find compressive strength (N/mm^2) of concrete by applied axial load on cubical samples by universal testing machine of 2000 kN capacity. Ultimate compressive strength of specimen is the value of uni-axial compressive stress reached when the material fails completely under applied load.

Flexural Strength Test:

This test is conducted on flexural strength testing machine under Centre-point loading or three-point loading, to find tensile strength or flexural strength of concrete beams or prisms with the help of mathematical equation named as 'Bending Equation'. It also defined as the stress in a material or specimen just before it yields in a flexure test.

Split Tensile Strength:

This test is conducted on cylindrically shaped specimens by transverse loading on universal testing machine to find split tensile strength in which specimen is subjected to a controlled tension until failure.

5. Results and Discussion

After a detailed investigation and findings on fiber reinforced concrete as shown in table II, the non-degradable substances are used as fibrous material to increase concrete attributes and

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protect environment. it is found that Compressive strength of FRC samples are increase from 0.25% human hair and 0.25% sugarcane samples to 17.8% and 9.7% respectively, and from 0.50% human hair and 0.50% sugarcane samples increased to 12.9% and 5.7% respectively, when it compared with control specimen results.

Table II Test Results with or without fiber

Specimens Details	**Compressive Strength (N/mm^2)**		**Flexural Strength (N/mm^2)**		**Tensile Strength (N/mm^2)**	
	HHF	SCF	HHF	SCF	HHF	SCF
Control	**39.6**	**39.6**	**6.48**	**6.48**	**6.26**	**6.26**
With 0.25% Fibers	**46.7**	**43.5**	**8.01**	**7.60**	**7.67**	**7.26**
With 0.50% Fibers	**44.7**	**41.9**	**8.49**	**7.78**	**7.93**	**7.41**

Similarly, flexural strength of 0.25% human hair & sugarcane fibers and 0.50% human hair & sugarcane fibers increased from 23.7% & 16.9% to 31.1% & 18.7% respectively. And split tensile strength of 0.25% human hair & sugarcane fibers and 0.50% human hair & sugarcane fibers increased 22.5% & 15.9% and 26.7% & 18.4% respectively. There is also found that different specimens with human hair and sugarcane fiber were more stretchable and stiffer as compared to control specimens and crack propagation changed to ductile from brittle manner in FRC samples as shown in fig I.

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Fig. I Different Testing and Crack Propagation

6. Conclusion

Natural Human Hair fibers and Sugarcane fibers are provided to achieve great improvement in concrete properties and help to make it ductile material. There is a great increment in human hair FRC samples attributes as compared to sugarcane samples but when both types of samples combine with control, give excellent result. Overall, with addition of 0.50% fibers in concrete provided great results. So according to experimental findings, both the natural fibers can use in concrete to enhance its properties. This study found duel benefit of use of natural fibers in concrete in which first is concrete can improve its attributes and gain more strength in very low cost and second is harmful environmental issues which born from non-degradable garbage or wastage, can reduce easily in beneficial way.

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