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Recent innovations in Concrete Reinforced with Human Hair: A Review

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Abstract - *Use of human hair in mortar and concrete is very recent now a days. Human hair is used as natural fiber to enhance the strength characteristic of concrete and mortar. Many studies have been conducted to know human hair concrete performance. These studies show information in this regard. In this paper an effort has been made to review the work already done in the field. The available literature helps the beginner to understand the human hair concrete performance in cement concrete and mortar and start further research in this particular area.*

Key Words: Compressive strength, flexural strength human hair, concrete, mortar.

1. INTRODUCTION

Reuse of recycled or waste materials for the construction of civil structures is an issue of great importance in this century. Addition of waste products in Fibre-reinforced concrete is also very common now days. Fibre-reinforced concrete is concrete containing fibrous material which increases its structural integrity. It contains short discrete fibres that are uniformly distributed and randomly oriented.

Fibres are usually used in concrete to control cracking due to plastic shrinkage and to drying shrinkage. They also reduce the permeability of concrete and thus reduce bleeding of water. Some types of fibres produce greater impact, abrasion and shatter–resistance in concrete. Some commonly used fibres are Steel, Glass, Carbon, Cellulose, Synthetic fibres like Polypropylene, Nylon and Natural fibres like Coir, Hay etc.

Recently there has been a rapid growth in research and innovation in the natural fibre composite (NFC) area [1].

Human hair concrete is great example of such type research and innovations. 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 [8] like burning of human hair or the waste piles congaing them which is respected in many regions of the world produces foul odour and toxic gases such as ammonia carbonyl sulphides hydrogen sulphides, sulphur dioxide, phenols etc. open dumps of hair generate hair dust which causes discomfort to nearby people and if inhaled in large quantities can result in several respiratory problems and death. Oil sweat and other organic matter getting to the hair rot over time and become a source of foul odour and breeding ground for pathogens.

Best way to reduce such problems is to use the waste material as a resource. Human hair concrete is great example of concrete produced from such resources. Used of human hair in concrete not only reduces the waste disposal problem but also, it contributes to the economic system by providing an economic construction material. Human hair has advantage that it is completely biodegradable, renewable and easily available at negligible cost.

2. EARLIER INVESTGATION & SCOPE OF THE STUDY

It is widely recognized that use of natural fibers when used correctly in concrete has many advantages. In similar way when human hair used in correct proportion and manner it give ideal choice of fibers in concrete. Many studies have been conducted to understand the performance characteristic of human hair concrete. In this paper an effort has been made to review the work already done in the field. So that beginner can easily understand most beneficial features of the human hair concrete and start further research in this particular area.

3. NOTEWORTHY CONTRIBUTIONS IN THE FIELD OF CONCRETE USING HUMAN HAIR AS FIBRE

Application of human hair as fibre to mortar and concrete is recent trend and many studies have been conducted to evaluate the performance characteristic of the human hair concrete and mortar [3 to 18]. The brief literature reviews of the latest studies are as follows.

Gautami et al. [3] conducted study on concrete reinforced with human hair. A detailed parametric test series were conducted in the laboratory. Concrete cube beam and cylinder specimen of standard sizes of M40 grade were prepared. Six cube, three beams and three cylinder specimens were casted with various percentages (1%, 1.5 %, 2%, 2.5% and 3%) of human hair by weight of cement. Specimens were tested at curing period of 7 days, 14 days and 28 days respectively. Author reported optimum hair content 1.5 % (by weight of cement) and addition of human hair imparts binding properties and better resistance against cracking.

Ankaiah [4] et.al. Conducted experiment to study the effect the human hair fibre for concrete grade M20 and M25. Concrete cube specimens were conduct in the laboratory with variable hair fibre content (1%,1.5%,2%,2.5%,3% and 3.5%) by wt. of cement. Results were compared with conventional concrete. Study shows significant increase in

strength up to 3%. Beyond 3% addition of fibre content results in decrease in strength.

J. N Akhtara et.al. [5] conducted study to know the effect of human hair fibre on mechanical properties of fly ash hollow block for low height masonry structure .Parametric study was done with variable value of human hair. Author reported increase in compression strength and poissions ratio at hair fibre content 0% to 2%. At 2.5 % hair content there was decreased in compression strength and poission ratio.

Jain D et. al. [6] investigated effect of human hair on flexural strength and compression strength of M20 grade of concrete. Specimens were casted and results were compared with plain concrete. At 2% hair content author reported remarkable increase in compression strength (8.8%) and in flexural strength (5.5%)

Batebi et. al. [7] investigated effect on shrinkage properties when nano hair is used as fibre in concrete . Addition of fibres results in increase in workability and decrease in shrinkage cracks. Author used nano hair of length ranges from 15 mm to 60mm. percentage of human hair content were 0.4%, 0.8% and 1.2%. Results indicated considerable amount of reduction in shrinkage of the human hair concrete.

Nila VM et.al. [8] investigated effect of addition of human hair as fibre in concrete on compressive and flexural strength. Study shows 1to 12 % increase in compressive strength and 5% in flexural strength. Maximum increment in strength is achieved at 2% hair fibre content.

Pawar et.al. [9] investigated the effect of hair fibre and basalt fibre on compressive strength and flexural strength of M40 grade concrete. Initially both fibre were used separately and then combination of hair fibre and basalt fibre were used. Investigation shows increment in flexural and compression strength when both fibre are used separately. Maximum increment in both strength was observed at 1% fibres. There is no increase in strength when fibres are used in combination

Khansaheb [10] conducted study for M20 grade. Author used 0.5% and 1% human hair content with 5% bagaase ash. It was observed that there is significant improvement in compression strength and flexural strength at 28 days.

Ganiron [11] studied performance of human hair as additive in asphalt cement mixture. Human hair were added to asphalt mixture as additive with variable percentage (3% to 12%) by weight of bitumen. Study shows addition of human hair fibres provide good binding and the mixture exhibit superior results to deformation and fatigue.

Jain Alok et.al. [12] reported maximum increases in compressive strength at hair fibre content 2% by weight of cement. Maximum increase in flexural strength was observed at 1.5% to 2% human hair fibre content when compared with conventional concrete and percentage of increase was 5 to 15%.

Agrawal Achal et. al. [13] reported maximum increase in compressive strength (6.29%) and flexural strength (6.82%) at 5% hair fibre content when compared to conventional concrete at the age of 7 days curing . At 28 days curing maximum increase in compressive strength and flexure strength was found 9.81% and 6.95% respectively.

G. Sreevami et.al. [14] investigated high compressive strength and better split tensile strength when human hair fibres added to concrete. Investigation reported the addition of human hair to the concrete not only modifies various properties of concrete like tensile strength compression strength but also enhance the binding properties micro cracking control.

Kumar shantaverayya et.al. [15] reported many advantages as compared to conventional concrete such as modified tensile strength, compressive strength, binding properties, spalling resistance and micro cracking control.

Chinnadurai et.al. [16] investigated study to find effect on compressive strength and splitting tensile strength due to addition of human hair as fibre in concrete . Author reported addition of human hair fibre results in increase in both strength characteristic. The result was similar for both strength and maximum strength were achieved at 3% human hair fibre content by weight of cement.

A. S. Balaji et.al. [17] added human hair fibre to the M20 concrete in which coarse aggregate is partially replaced by plastic coarse aggregate. Author conducted parametric study with variable human hair fibre content (0%, 0.5%, 1%, 1.5%, 2% and 3% by weight of cement) with constant parameter of plastic aggregate (20%). It was observed that maximum compressive strength was found at 2% human hair fibre content at 28 days curing when compared to conventional concrete.

4. SIGNIFICANT OBSERVATIONS ON PERFORMANCE CHARACTERSTICS OF CONCRETE REINFORCED WITH HUMAN HAIR.

Gautami et al. [3] reported optimum hair content 1.5 % (by weight of cement) and addition of human hair imparts binding properties and better resistance against cracking.

A.S. Balaji et. al. [17] observed maximum compressive strength at 2% human hair fibre content. Jain Alok et. al. [12] also reported maximum increases in compressive strength at hair fibre content 2% by weight of cement and maximum increase in flexural strength at 1.5% to 2% human hair fibre content

Chinnadurai et.al. [16] investigated increase in compressive strength and splitting tensile strength at 3% addition of fibre content while B Ankaiah [4] et. al. reprted beyond 3% addition of fibre content results in decrease in strength.

Nila VM et. al. [8] and Jain D et. al. [6] investigated maximum increment in strength is achieved at 2% hair fibre content for both compressive and flexural strength. . While Aggrawal Achal et. al. [13] reported increment in both strengths at 5% hair fibre content.

N Akhtara et. al. [5] reported decreased compressive strength and poissions ratio at 2.5 % hair content.

Batebi et. al. [7] found considerable amount of reduction in shrinkage when nano human hair is used in concrete.

G Sreevami et.al. [14] and Kumar shantaverayya et.al. [15] reported modified tensile strength, compressive strength, binding properties, and micro cracking control.

5. CONCLUSIONS

On the basis of current study reviewed here and significant oservations by various researchers in the field of human hair concrete it was observed that addition of human hairs to the concrete modifies various properties of concrete like tensile strength, compressive strength, binding properties, micro cracking control and also increases spalling resistance. Hence it can be concluded that human hair fibres give ideal choice of fibres in concrete if used in correct proportion and manner and human hair fibre has other advantages like it is completely biodegradable, renewable and easily available at negligible cost.

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