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Parametric study on concrete by partial replacement of fine aggregate with coir fiber

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Abstract – *lack of raw materials and their increased cost is a matter of concern. The reason behind that is increased demand of construction materials like cement, aggregates which are the major ingredients of concrete. Hence the number of researches and experimental investigations are conducting to find the suitable alternative materials for concrete ingredients. In this manner the parametric study was conducted on concrete by partial replacement of natural river sand with coconut fiber as fine aggregate. in this study M20 grade concrete was produced by adding partially the coir fiber with weight of fine aggregate. Total 168 specimens were casted for comparative analysis between conventional concrete, manufactured sand concrete and coir fiber replaced concrete by conducting compressive, split tensile and flexural strength tests at 7 days and 28 days respectively. Workability of concrete was decreased with an increase of fiber fraction, but flexural strength and compressive strength increased with the addition of coir up to some extent. The results and observations attained from this parametric study concludes that, addition of coir fiber increases the crack resistance of concrete, produces the structural light weight material and the suitable alternative partial replacement for natural river sand in order to overcome the lack of that. Hence the coir fiber can be used in construction and can reduce environmental waste by proper utilization. Also the use of coir fiber is cost effective and eco friendly.*

Key Words- *concrete, coir fiber, compressive strength, split tensile strength, flexural strength, natural fiber, light weight matrerial*

1. INTRODUCTION

Concrete, this is a basic construction material. It is used in a wide range across the world. Usage of concrete becomes vast due to the infrastructural development and increased construction activities. As the demand for concrete increased some negative impacts arises like lack of raw materials, continuous extraction of natural river sand leads to its depletion and decreases ground water level, cement manufacturing plants increases co_2 content by production of large quantity of cement. These reasons have generated a lot of concern about environment in the construction field and leads to researches, experimental investigations on alternative solution for concrete ingredients. Large amount of environmental waste generated every year all over the world, coconut fiber is one among such environmental wastes. Coconut fiber is a natural fiber consists of cellulose, lignin, pentosans and ash in varying percentages when dried. Also coconut fiber is locally and economically available. The intention of this parametric study is to spread awareness of use of coconut fiber as partial replaceable alternative ingredient for concrete and construction material. Because till today, byproducts of industries and domestic waste materials have been utilized in concrete widely, but still natural waste utilization is in its immaturity stage. Coconut fiber is an agricultural waste produced in a large quantity every year; hence proper utilization of waste coconut fiber in construction industry will reduces the environmental waste and lead to production of light weight material.

2. MATERIALS

2.1 Cement

Ordinary Portland cement grade 53 confirming to IS 12269-1987 was used as binding agent obtained locally. Selected cement has consists with a normal consistency of 35.2%, specific gravity 2.99 and initial setting time 38 minutes.

2.2 Fine aggregates

Natural river sand was used as fine aggregate, which is confirming to zone II as per IS 383-1970. Sand was air dried and sieved to get rid of foreign materials. Specific gravity of fine aggregate conducted was 2.69 with fineness modulus of 2.83.

Coconut fiber was used as alternative partial replacement agent for natural river sand as fine aggregate. Coir fiber was obtained from local coir industrial plant. Obtained coir fiber was chopped into 1cm, 1.5cm, 2 cm, and 2.5cm and replaced with natural river sand by weight of 2.5%, 5%, and 7.5%.

2.3 Coarse aggregates

20 mm down size crushed granular aggregates gotten from local crusher used as coarse aggregate

confirming to IS 383-1970. Collected coarse aggregates have specific gravity of 2.78.

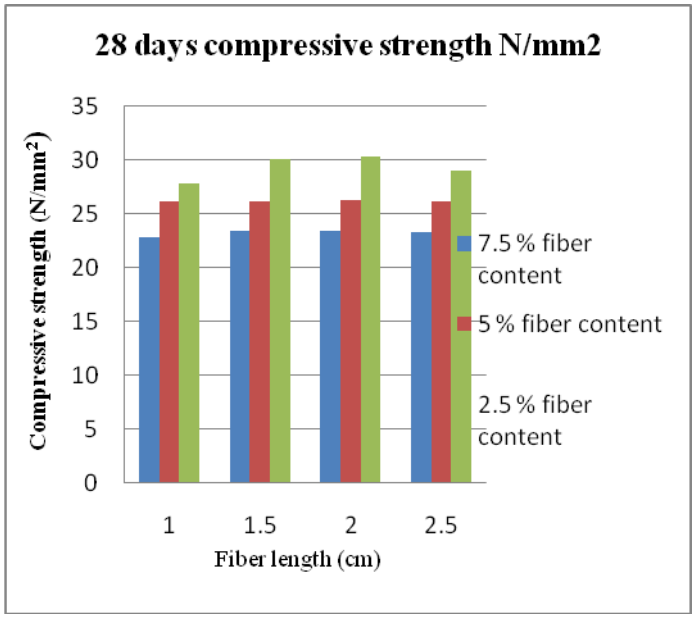
3. METHODOLOGY

M20 grade concrete was designed as per IS 10262-2009 method. 72 cubes, 36 cylinders, 36 beams with addition of varying length and percentage of coir fiber were casted to conduct compression, split tensile and flexural strength test at 7 and 28 days.

Similarly 3 cubes, 3 cylinders, 3 beams with manufactured sand concrete were casted. Meanwhile same numbers of conventional concrete specimens were casted to give the comparative analysis between coir fiber replaced concrete, manufactured sand concrete and conventional concrete by conducting various strength tests.

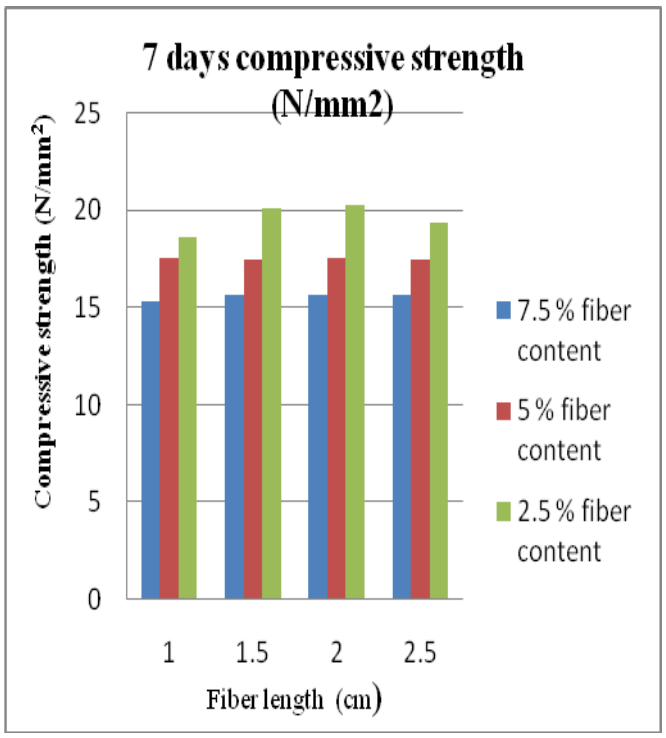
Casted specimens were cured in water tank for 7 and 28 days respectively.

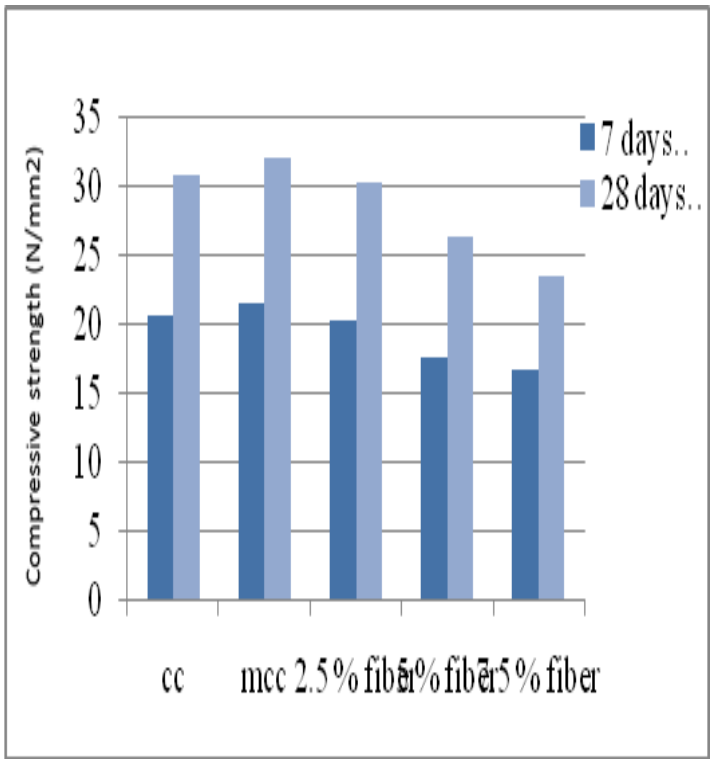
After curing compression, split tensile and flexural strength was conducted at 7 days and 28 days. 3 specimens were tested for each designation and average of three results was taken.

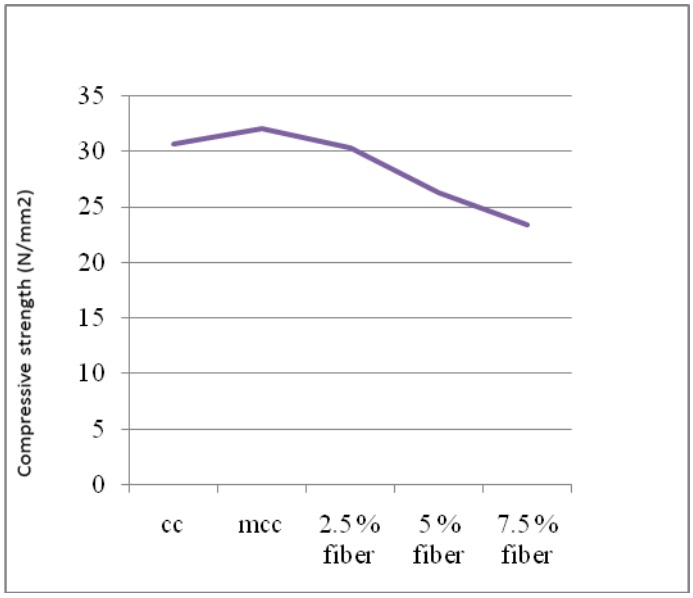


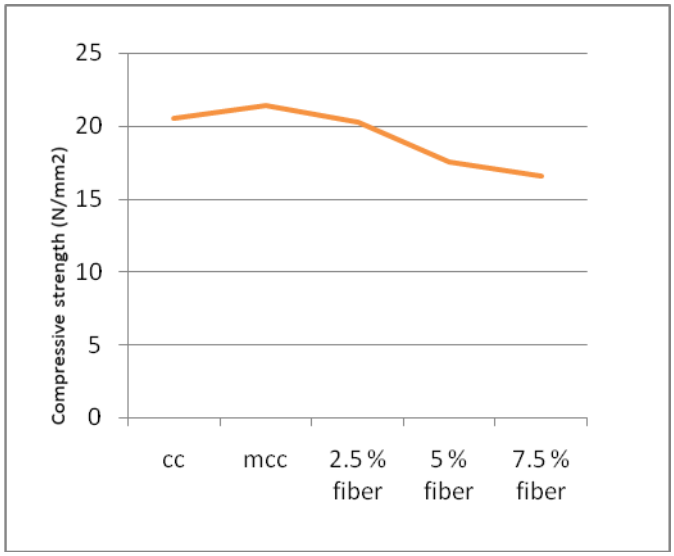
4. RESULTS AND OBSERVATIONS

4.1 Compression strength results

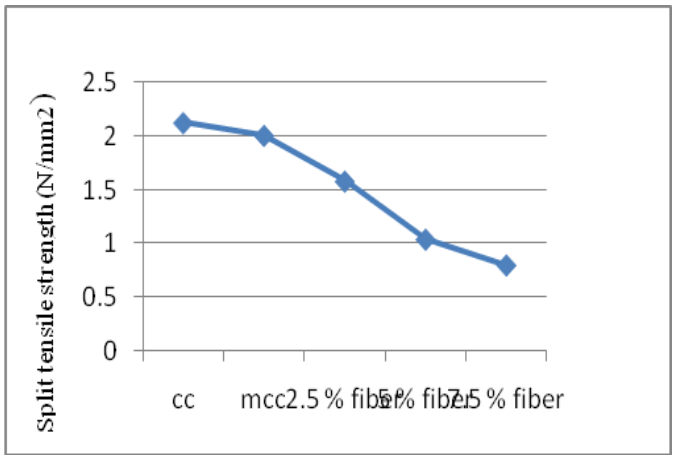




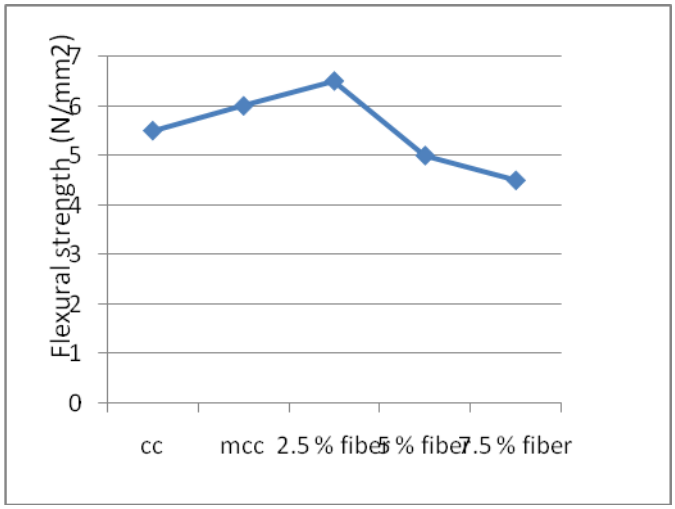




4.2 Split tensile strength results



4.3 Flexural strength results



5. CONCLUSIONS

Coconut fiber being low in density tends to reduce the self-weight of the fiber reinforced concrete hence it can be used as a structural light weight concrete.

By reinforcing the concrete with coconut fibers environmental waste can be reduced and due to vast availability we can achieve economy.

Addition of coir fiber in concrete increases crack resistance property of concrete as well as reduces the brittle nature of concrete.

Flexural strength of concrete increases with addition of 2.5% coir fiber by comparing with normal and manufactured sand replaced concrete.

Hand mixing is very difficult and leads to formation of non-homogeneous mix. So it's better and convenient to replace hand mixing by machine mixing.

Since, 5% and 7% fiber addition doesn't shows favorable results, hence it can be concluded that optimum fiber percentage replacement for concrete is 2.5%.

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