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Study on the Performance of Treated and Non Treated Coir Fibres and Sugarcane Bagasse Fibres in Concrete

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Abstract - *Concrete is a basic material used for a lot of engineering projects. This project describes experimental studies on the use of coir fibre and sugarcane bagasse fibre as enhancement of concrete. The addition of coir and sugarcane bagasse fibers can significantly improve many of the engineering properties of the concrete. Use of natural fibres in civil engineering construction practice is often advantageous as they are locally available, cheap, biodegradable, and eco-friendly. The study comprises of the comparative statement of compressive properties, tensile properties and temperature effect of alkali treated and untreated coir fiber reinforced concrete and sugarcane bagasse fibre reinforced with conventional concrete based on experiments performed in the laboratory.*

Key Words: **Concrete, Coir fiber, Sugarcane bagasse fibre, Compressive strength, Split-tensile strength, Elevated temperatures**

1. INTRODUCTION

Concrete has been well known as a low-cost building material with high compressive strength. Though high in compressive strength, concrete is quite brittle with a tensile strength of only 10% of its compressive strength. Under normal conditions, most concrete structures are subjected to a range of temperature no more severe than that imposed by ambient environmental conditions. Concrete is a composite material whose constituents have different properties and also depends on moisture and porosity.

In recent years, research and development of fibres and matrix materials and fabrication process related to construction industry have grown rapidly. Their advantages over other construction materials are their high tensile strength to weight ratio, ability to be moulded into various shapes and potential resistance to environmental conditions, resulting in potentially low maintenance cost. These properties make FRC composite a good alternative for innovative construction.

Natural fibres have a potential to be used as a reinforcement material in concrete. In this study coir fibres and sugarcane bagasse fibres are used in concrete. These are biodegradable, so the impact on the environment will be minimal. This is also a way to dispose of the fibres which are derived from waste materials. They are also non-abrasive in nature , cheap and easily available.

Exposure of concrete to elevated temperature affects its mechanical and physical properties. Elements could distort and displace under certain conditions. Temperature effects produce dimensional changes, loss of structural integrity, the release of moisture and gases resulting from the migration of free water could adversely affect plant operations and safety. A complete understanding of the behaviour of concrete under elevated temperature after a thermal excursion is essential for reliable design evaluations and assessments. The properties of concrete changes with respect to time and the environment to which it is exposed, an assessment of the effects of concrete is also important in performing safety evaluations. The study comprises of the comparative statement of compressive properties, tensile properties and temperature effect of alkali treated and untreated coir fibre reinforced concrete and sugarcane bagasse fibre reinforced with conventional concrete based on experiments performed in the laboratory.

The main objectives are:

- To compare the compressive strength of concrete after the addition of treated and non-treated coir fibres and sugarcane bagasse fibres
- To compare the split tensile strength of concrete after the addition of treated and non-treated coir fibres and sugarcane bagasse fibres
- To compare the strength of concrete after the addition of treated and non-treated coir fibres and sugarcane bagasse fibres at elevated temperatures

2. METHODOLOGY

The scheme of the project work is given as follows:

- Basic tests of cement, coarse aggregate and fine aggregate were conducted.
- Collection of materials
- Reviewing of the journal papers related to my area of study.

- According to IS codes mix proportion was obtained. The grade of concrete was M_{30}.
- Alkali treatment of coir fibres and sugarcane bagasse fibres were done using NaOH solution.
- Concrete specimens of standard size cubes, and cylinders were casted with and without fibres. Both treated and non treated coir and sugarcane bagasse fibres were used while casting the specimens.
- The casted specimens were allowed for water curing.
- The mechanical properties such as compressive strength, split tensile strength were conducted at room temperature and at elevated temperatures.
- Water absorption were carried out on the casted specimens.
- The obtained results were then analyzed and a detailed report was prepared.

3. MATERIALS AND PROPERTIES

3.1 Cement

The cement used for this project work is Zuari 53-grade ordinary portland cement. The various physical properties of cement used are tabulated in Table 1.

Table -1 Properties of Cement

Sl. No	Property	Values
1	Specific Gravity	3.15
2	Fineness	6.56%
3	Standard Consistency	33%
4	Initial Setting Time	65 min

3.2 Fine Aggregate

Manufactured sand was used for this project. The specific gravity of sand used in this project is2.63. The various properties of sand are tabulated in Table 2.

Table -2 Properties of Fine Aggregates

Sl. No	Property	Values
1	Specific Gravity	2.64
2	Water Absorption	0.87%
3	Fineness Modulus	3.89

3.3 Coarse Aggregate

The crushed aggregate of nominal size 20mm is usedas coarse aggregate. The various properties of coarse aggregate are presented in Table 3.

Table -3 Properties of Coarse Aggregates

Sl. No	Property	Values
1	Specific Gravity	2.7
2	Water Absorption	0.43
3	Finess Modulus	10.95

3.4 Coir Fiber

Natural fibres like coir fibres can be used as an alternative reinforcement to absorb tension as concrete is weak in tension. The husk consists of coir fibre. It is immersed in water for 6 to 9 months; then the fibre is extracted by beating it manually using a mallet or by mechanical extractor machine.

Fig -1 Coir Fibre

3.5 Sugarcane Bagasse Fibre

Sugarcane bagasse fibre is natural fibre obtained from sugarcane after extracting the juice. It is an abundant waste fibrous tissue. After extracting juice from the sugarcane, the remaining pulp is known as bagasse. Sugarcane bagasse roughly consists of cellulose, hemicellulose and lignin.

Fig -2 Sugarcane Bagasse fibre

4. EXPERIMENTAL INVESTIGATION AND RESULTS

The final mix proportion obtained is 1: 1.89: 2.9. The water to cement ratio is 0.50. Cubes and cylinders are casted. Cube of size 150mm are casted to test compressive strength and water absorption. Split tensile strength was tested in cylinder of diameter 150mm and length 300mm.

Totally a 5 set of concrete mixes are prepared by changing the fibers say, plain cement concrete(PCC), coir fibre reinforced concrete(CFRC),treated coir fibre reinforced concrete(TCFRC), sugarcane bagasse fibre reinforced concrete (SFRC),treated sugarcane bagasse fibre reinforced concrete (TSFRC).

4.1 Compressive Strength Test

The cube specimen was tested for compression test at the end of 7 and 28 days. The specimen is placed in the machine in such a manner that the load is applied to the opposite sides of the cubes as cast. An average of 3 values is taken as the result. Compressive strength is calculated and tabulated in the Table 4.

Table -4 Compressive Strength Results

Type	Compressive Strength (N/mm²)	
	7 Day	28 Day
PCC	30.81	37.04
CFRC	22.81	25.92
TCFRC	29.48	35.11
SFRC	22.67	29.03
TSFRC	25.48	30.37

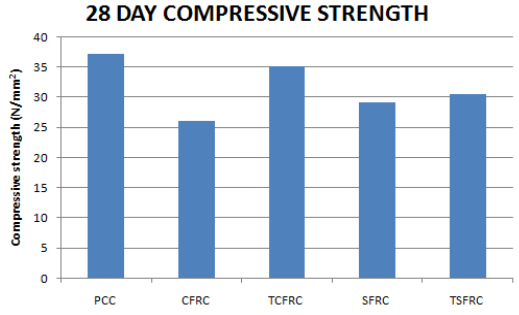

***Chart* -1** Compressive strength

4.2 Split Tensile Strength Test

Placing a cylindrical specimen horizontally between the loading surfaces of a compression-testing machine and the load is applied till the cylinder failed along the vertical diameter. The mean tensile strength is calculated and tabulated in Table 5.

Table -5 Split Tensile Strength Results

Type	Split Tensile Strength (N/mm²)	
	7 Day	28 Day
PCC	2.17	2.64
CFRC	2.50	2.97
TCFRC	2.87	3.44
SFRC	1.88	2.69
TSFRC	2.36	3.11

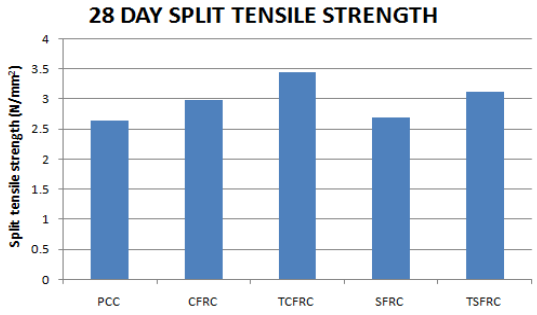

Chart -2 Compressive strength

4.3 Water Absorption Test

Water absorption tests were conducted on cubes of size 150mm. The average values of the obtained results are tabulated in the table 6.

Table -*6* Water Absorption Test Results

Type	% of water absorption
PCC	0.719
CFRC	1.058
TCFRC	0.882
SFRC	3.693
TSFRC	2.097

4.4 Fire Resistance Test

Compression tests were conducted on cube specimens of size 150mm which were heated at 100^{0}C, 200^{0}C and 300^{0}C and air cooled. The results are tabulated in Table 7.

Table -7 WATER ABSORPTION TEST RESULTS

Type of Specimen	Compressive Strength at 100^{0}C (N/mm^2)	Compressive Strength at 200^{0}C (N/mm^2)	Compressive Strength at 300^{0}C (N/mm^2)
CFRC	27.56	35.56	32
TCFRC	35.56	38.67	37.83
SFRC	31.11	32.22	25.56
TSFRC	31.11	37.33	35.56

5. CONCLUSIONS

From the experimental studies conducted the following conclusions are obtained:

- From the results obtained from the compression test, it is observed that there is no improvement in strength with the addition of coir fibres and sugarcane bagasse fibres whether treated or non-treated in comparison with plain cement concrete. There is 26.17% increase in compressive strength for treated coir fibre reinforced concrete than coir fibre reinforced concrete. Also 4.41% increase in compressive strength was obtained for treated sugarcane bagasse fibre reinforced concrete than sugarcane bagasse fibre reinforced concrete.
- From the results obtained from the split tensile test, it is observed that there is an improvement in tensile strength with the addition of coir fibres and sugarcane bagasse fibres whether treated or non-treated in comparison with plain cement concrete. There is 13.66% increase in split tensile strength for treated coir fibre reinforced concrete than coir fibre reinforced concrete. Also, 13.50% increase in split tensile strength was obtained for treated sugarcane bagasse fibre reinforced concrete than sugarcane bagasse fibre reinforced concrete.
- Water absorption has a notable increase with the addition of both fibres. But sugarcane baggase fibre reinforced concrete absorbs more percentage of water. Treated fibres, coir and sugarcane bagasse fibre reinforced concrete, showed a decrease in percentage water absorption when compared with non-treated ones.
- On exposure to elevated temperatures there is an increase in compressive strength for 100^{0}C and 200^{0}C. But beyond 300^{0}C there is a decrease in compressive strength.

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