EXPERIMENTAL INVESTIGATION ON CEMENT CONCRETE WITH VARIYING PERCENTAGE OF COIR FIBRE

Dr.S.S.Jaya aruna[1] Dr.P.R.Dhevasenaa[2]

1-Asst Professor, Dept. of Civil Engineering, Government College of Engg-Srirangam,Trichy -12. Tamil Nadu, India
2-Asst Professor, Dept. of Civil Engineering, Government College of Engg-Srirangam,Trichy -12. Tamil Nadu, India

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Abstract - *This experiment describes the behavioral study of coir fibre in concrete structure. The addition of coir fibre improves various engineering properties of concrete. Coir fibre is available in abundance at the test site, which makes it quite viable as a reinforcement material in concrete. Further, it acts as a new source of income for the coir producer who gets the benefits of the new demand generated by the construction industry. In addition to this, it is an effective method for the disposal of coir mattress waste which will reduce the demand for additional waste disposal infrastructure and decrease the load on existing landfills and incinerators. Moreover the fibres being natural in origin are ecologically sustainable and can bring down the global carbon footprint quite effectively. This research describes experimental studies on the use of coconut fiber to enhance tensile property in concrete, as concrete have less tensile properties. This study aimed at analyzing the variation in strength of coir fiber reinforced concrete at varying fibre contents and to compare it with that of conventional concrete. The various strength aspects analyzed are the flexural, compressive and tensile strength of the coir fiber reinforced concrete at varying percentages (2%,4%,6% by the weight of cement) of fibre.*

***Key Words*:** (Coir Fibre, Fibre Reinforced Concrete, Natural fibre concrete, coconut fibres)

1. INTRODUCTION

A major roadblock towards development of high performance concrete using steel fibres is the high costs involved, availability and also problem of corrosion. Coconut fibre being the most ductile among all natural fibres (Majid Ali et al.,2012) has the potential to be used as a reinforcement material in concrete. It is biodegradable so the impact on environment will be minimal. This is also a way to dispose off the fibres which are derived as waste materials from coir based manufacturing units to produce high strength materials .They are also non-abrasive in nature ,cheap the possibility of coconut-fibre ropes as a vertical reinforcement in mortar-free interlocking structures. This is believed to be a cost-effective solution to earthquake-resistant housing. In the study, coconut fibre is added to concrete and Plain Cement Concrete (PCC) is used as reference to study its effect on flexural, compressive and tensile strength properties. Thus in addition to the enhancement in the physical properties of concrete, it turns out to be a sustainable waste management technique.

The advantages of coconut fibre are: low cost, reasonable specific strength, low density, ease of availability, enhanced energy recovery, biodegradability, and ability to be recycled in nature in a carbon neutral manner, resistance to fungi moth and rot, excellent insulation to sound, flame, moisture and dampness, toughness, durability, resilience.

2 MATERIALS

CEMENT

Portland Pozzolana Cement available in local market is used in this investigation. The cement used has been tested for various properties as per IS: 4031-1988 and found to be confirming to various specifications of IS: 1489-2013

Table -1: Properties of Cement

Sl.No	Test	Value
1	Standard consistency	28%
2	Initial setting time	28 mins
3	Final setting time	600 mins
4	Specific gravity	3.13
5	Fineness test	6%

FINE AGGREGATE

In our investigation we had used river sand which is locally available. The sand is tested and confirming that it is under **Zone II** according to IS-383.

Table -2: Properties of Fine Aggregate

Sl.No	Test	Value
1	Specific Gravity	2.7
2	Fineness Modulus	2.36
3	Water Absorption	1%

COARSE AGGREGATE

In our investigation we had used the aggregate passing through 20mm IS Sieve and retaining on 12.5mm sieve.

Table -3: Properties of Coarse Aggregate

Sl.No	Test	Value
1	Specific gravity	2.83
2	Water absorption	0.5%
3	Impact value	15.32%
4	Crushing value	28.8%

WATER

Potable water available in laboratory with pH value of not less than 6 and conforming to the requirement of IS 456- 2000 was used for mixing concrete and curing the specimens.

COIR FIBRE

Coir fibre is extracted from outer shell of the coconut. The common name, scientific name and plant family of coconut fibre is coir, cocos, nucifera and Arecaceae (palm), respectively. There are two types of coconut fibres, brown fibres extracted from matured coconuts and white fibres extracted from immature coconuts. Brown fibres are thick, strong and have high abrasion resistance. White fibres are Smoother and finer but also weaker. In this experimental investigation, we choose the brown fibres in varying percentages in the concrete mix (2%, 4%, 6% by the weight of cement).

Uniform length of fibers was obtained by using cutting machine. Length of fibers was measured by vernier scale and the diameter by micrometer. Specific gravity and density of coir fibers were determined using pycnometer.

Table -4: Properties of Coir Fibre

Sl.No	Properties	Values
1	Diameter of coir (L)	0.48 mm
2	Length of coir (D)	50 mm
3	Aspect ratio (L/D)	104
4	Specific gravity	1.12
5	Water absorption	98%

Fig -1: Coir Fibre

3. METHODOLOGY

Preparation of Test Specimens

Mix design is the process of selecting suitable ingredients of concrete and determining their relative proportions with the object of producing concrete of certain minimum strength and durability as economically as possible. The Mix proportions for the M32 concrete from the calculations as prescribed in IS10262-2009 is 1: 1.84: 2.35. The mix proportion and quantity of materials required for 1 m^3 of concrete is shown below.

Table -5: Mix Proportions

	Weight of cement kg/m3	Weight of fine aggregate kg/m3	Weight of coarse aggregate kg/m3	Weight of water kg/m3
Weight	438	808.322	1031.63	197
Ratio	1	1.84	2.35	0.45

This experimental work, 150mm X 150mm X 150mm size cubes &150mm diameter, 300mm length cylinders and 500mm x 100mm x100mm prism were cast for the testing of compressive, Split tensile strength and Flexural strength.

CURING

The casted specimens were removed from molds after 24 hours and the specimens were immersed in water tank. After curing the specimens for the period of 7,14and 28 days, the specimens were removed from the water tank, and then allowed to dry under shade.

4 TESTS AND OBSERVATIONS ON CONCRETE

TESTS ON FRESH CONCRETE

SLUMP CONE TEST

Fig -2: Slump cone

Table -6: Slump Values

Sl.no	Percentage of coir fibre	Slump value
1	Conventional concrete	80
2	2%	76
3	4%	65
4	6%	55

COMPACTION FACTOR TEST

Table -7: Compaction factor value

Sl.no	Percentage of coir fibre	Compaction factor value
1	Conventional concrete	0.92

2	2%	0.90
3	4%	0.88
4	6%	0.85

4.1.2. FLOW TABLE TEST

Table -8: Properties of Coir Fibre

Sl.no	Percentage of coir fibre	Flow table %
1	Conventional concrete	29%
2	2%	27%
3	4%	23%
4	6%	20%

TESTS ON HARDENED CONCRETE 4.2.1COMPRESSIVE STRENGTH TEST

Compression test according to IS: 516(1959) is carried out on the cubes. Size of specimen 150 x 150 x 150 mm. The specimens are loaded at a constant strain rate until failure.
The Average of three cubes results of compressive strength of for each 7 days, 14 days and 28 days are as follows.

Table -9: Compressive Strength Test Results

Sl.no	Description	7 days N/mm²	14 days N/mm²	28 days N/mm²
1	Conventional concrete	19.12	26.82	31.12
2	2%	19.5	27.5	31.56
3	4%	21.78	29.33	32.89
4	6%	20.89	28.44	32.20

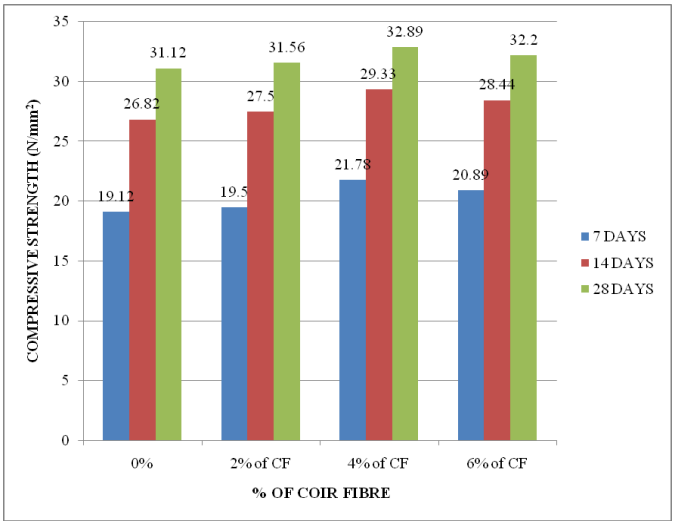

Chart -1: compressive strength

SPLIT TENSILE STRENGTH TEST

After 7 days, 14 days and 28 days curing of concrete cylinder, split tensile strength test carried on each concrete cylinder of each blend. Diameter of Cylinder 150 mm and height 300 mm. Average of three split cylinders is calculated out and graph is plot.

Table -10: Split Tensile Strength Test Results

Sl.no	Description	7 days N/mm²	14 days N/mm²	28 days N/mm²
1	Conventional concrete	1.82	2.36	2.64
2	2%	1.96	2.62	2.88
3	4%	2.15	2.76	3.17
4	6%	2.34	2.9	3.28

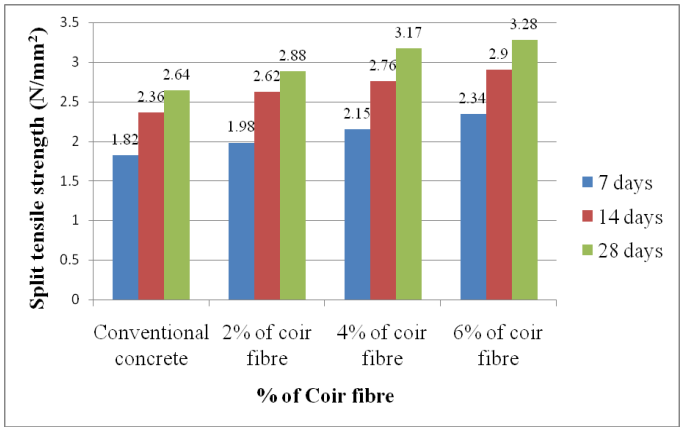

Chart -2: Split Tensile Strength

FLEXURAL STRENGTH TEST

After 7 days,14 days and 28 days curing of concrete cylinder, flexural strength test carried on each concrete cylinder of each blend. Size of specimen 500 x 100 x 100 mm. Average of three split cylinder of each blend is calculated out and graph is plot.

Table -11: Flexural Strength Test Results

Sl.no	Description	7 days N/mm²	14 days N/mm²	28 days N/mm²
1	Conventional concrete	2.72	3.18	3.57
2	2%	2.83	3.25	3.63
3	4%	2.97	3.42	3.68
4	6%	3.14	3.53	3.74

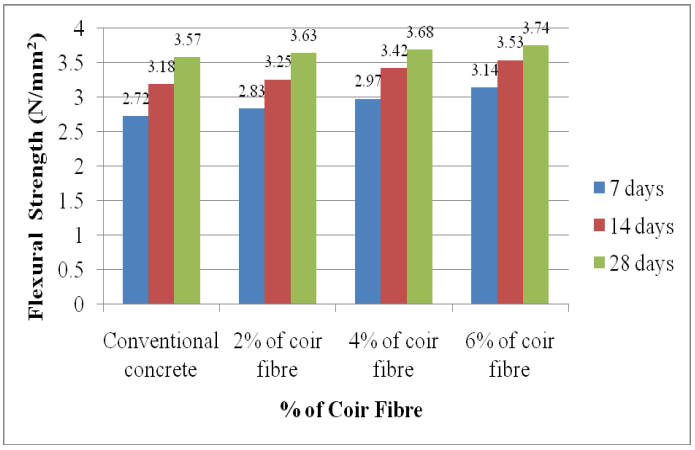

Chart -3: Flexural Strength

5. CONCLUSIONS

- The result of the workability which was done using slump test method was a decrease in workability with increase in percentage of coir fibres.
- Coir fibre addition in the concrete increases the many properties of the concrete such as compression, flexural and split tensile strength.
- Addition of coir fibre increases crack resistance of concrete as well as brittle nature of concrete.
- Increase in compressive strength with a maximum at 6% addition of coir fibre.
- When fibre content is increased there is an increase in flexural and split tensile strength with a maximum at 6% of fibre. However when the fibre content is increased beyond this value, strength gets decrease.

6. REFERENCES

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BIOGRAPHIES

Dr. S.S.Jaya Aruna, an Assistant Professor at Department of Civil Engineering, Government college of Engineering Srirangam, Trichy-12, with an experience of more than 17years in teaching. She has obtained her Ph.D. from Annamalai University in Structural Engineering and has published more than 10 journals.

Dr.P.R.Dhevasenna, an Assistant Professor at Department of Civil Engineering, Government college of Engineering Srirangam, Trichy-12, with a teaching experience of more than 17years. She has obtained her Ph.D. from Annamalai University in Structural Engineering and has published more than 10 journals.