Study on Strength Properties of Coir Fiber Reinforced Concrete

Md Zahoor[1], M. Mounika[2]
[1, 2]Assistant Professor, Dept of Civil Engineering
[1, 2] Holy Mary Institute of Technology & Science, Bogaram (T.S) – 501 301, India

Abstract- *The rising cost of construction material is increasing day by day. The reason for increase in cost is high demand of concrete and scarcity of the aggregate material. Hence the concrete technologists are researching on alternative materials in the construction areas. In this study, M 30 grade of concrete was produced by adding coconut fiber (coir). Twenty five cylinders were casted and their split tensile strength and workability's were evaluated at 7, 14 and 28 days. The workability and tensile strength of concrete increased to some extent as the coir increased. Concrete produced by 1%, 2%, 3%, 4% & 5% addition attained 28 days tensile strength of 2.68, 2.90, 3.11, 3.25, 2.33 respectively. These results showed that Coir Fiber Concrete can be used in reinforced concrete construction. Its utilization is eco-friendly.*

Keywords- Split Tensile Strength, Workability, Waste Utilization, Agricultural Waste, Coir.

I. INTRODUCTION

Concrete is world's most widely used construction material. The utilization of concrete is increasing at a higher rate due to development in infrastructure and construction activities all around the world.However there are some negative impacts of more production of concrete like continuous extensive extraction of aggregate from natural resources will lead to its depletion and ecological imbalance. Researchers are using agricultural and industrial waste to improve the strength properties of concrete and to lead sustainable development. This environmental reason has generated a lot of concern in the construction world. The use of sugarcane bagasse, wooden chips, plastic waste, textile waste, polyethylene, rice husk ash, rubber tyres, vegetable fibers, paper and pulp industry waste, groundnut shell, waste glass, broken bricks are some examples of replacing aggregates in concrete.The coconut fiber, termed as coir, when dried contains cellulose, lignin and ash in varying percentage. In Asia, the construction industry is yet to realize the advantages of light weight concrete in high rise buildings. Coconut fibers are not commonly used in construction industry and are often dumped as agricultural waste. The aim of this research is to determining its tensile strength and workability. Until now, Industrial by products and domestic wastes has been utilized in concrete, but the use of agricultural waste in concrete is in its infancy stage. Coconut fiber is an agricultural waste. The materials are proportioned by their weights. The water cement ratio is obtained by conducting various workability tests. The obtained results are compared with that of conventional mix. Tests are as per the specified procedure of Indian Standard Codes.

II. MATERIALS AND METHOD

The raw materials used in this experimentation were locally available and these included Ordinary Portland Cement (O.P.C) as binding agent, river sand as fine aggregate, crushed granite and coconut fiber as additional ingredient of concrete. Potable tap water was used for mixing and curing throughout the entire investigation. The permissible and tolerance limits of water were checked as per the I.S 456-2000.

Cement: Ordinary Portland cement grade 53, conforming to I.S 12269-1987 was used. Cement must develop appropriate strength. It must represent the appropriate rheological behavior.

S.No	Physical Property	Test Results
01	Standard Consistency	29.5%
02	Fineness of Cement %	7.2%
03	Specific Gravity	3.15
04	Initial Setting Time	45 minutes.
05	Final Setting Time	260 minutes

Fine Aggregates: River sand was used as the fine aggregate, conforming to Zone-II as per I.S 383- 1970.The sand was air dried and sieved to remove any foreign material, prior to mixing.

S.No	Physical Property	Test Results
01	Specific Gravity	2.6
02	Fineness Modulus	2.83
03	Bulk Density(kg/m^3)	1600

Coarse Aggregates: Coarse aggregate consists of 50% of self weight of concrete and 70% of volume of concrete.

S.No	Physical Property	Test Results
01	Specific Gravity	2.7
02	Fineness Modulus	2.73
03	Bulk Modulus(kg/m^3)	1650
04	Water Absorption	0.25

Coconut Fiber: Coconut fibers were collected from temples in the city to analyze the properties. The physical properties of Coir are shown below.

S. No	Physical Property	Test Results
01	Specific Gravity	0.89
02	Water Absorption (%)	10
03	Bulk Density(kg/m^3)	1725
04	Aspect Ratio	105

III. PREPARATION OF SPECIMENS

Concrete Mix Design: M-20 grade of concrete was designed by I.S 10262-2009 method. The natural coarse aggregates used were crushed granite. The test results were analyzed and compared with theoretical values, obtained from various codes. Coir was added during mixing in varying percentages.

Batching and Mixing: Weigh Batching was practiced with the help of electronic weigh balance. Batching was done as per the mix proportions. Mixing was done in tilting mixer. It was mixed for 2- 3 minutes, after addition of water.

Placing and Compaction: Cylinders are cleaned and oiled to prevent the formation of bond between concrete and moulds. Place the fresh concrete in cubes in 3 layers, tamping each layer 25 times. The entrapped air in concrete is removed by table vibrator. Anything kept on the table gets vibrated.

Demoulding: After placing fresh concrete in moulds, it was allowed to set for 24 hours. It was marked with some permanent identification mark i.e. A1, A2, A3, etc. Concrete cylinders are now kept in curing tank for 7, 14 and 28 days. After 28 days, concrete cylinders were removed from curing tank to conduct tests on hardened concrete.

IV. RESULTS AND DISCUSSION

Split Tensile Strength:

Split Tensile strength is defined as resistance of concrete to radial loading. Cylinders were placed in Universal Testing Machine (U.T.M), and load was applied. The readings on dial gauge were recorded and tensile strength was calculated. The results of tensile strength are shown in Table 01.

Calculations: Tensile Strength = $2P/(\pi dl)$

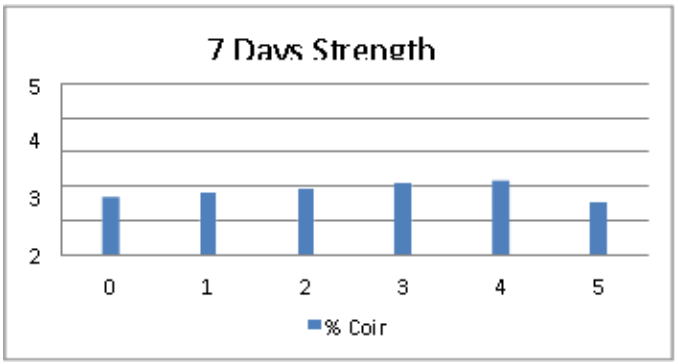
Table 01. Tensile Strength of Coconut Fiber Concrete (N/mm^2)

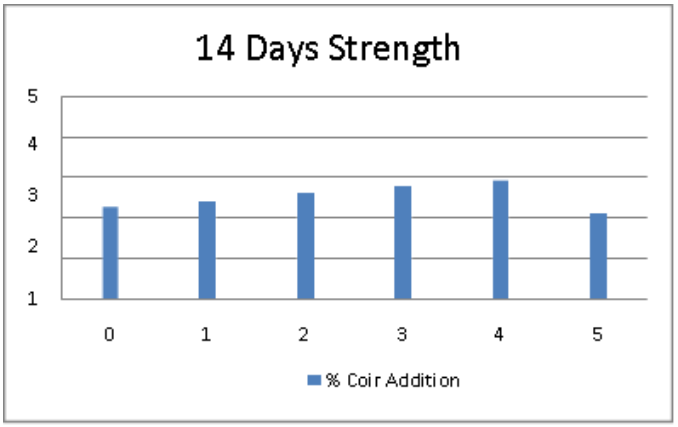
Curing Days	0%	1%	2%	3%	4%	5%
07	1.86	1.94	1.84	2.55	2.53	1.98
14	2.41	2.65	2.98	2.12	2.12	2.78
28	2.76	2.88	2.04	3.88	3.38	2.61

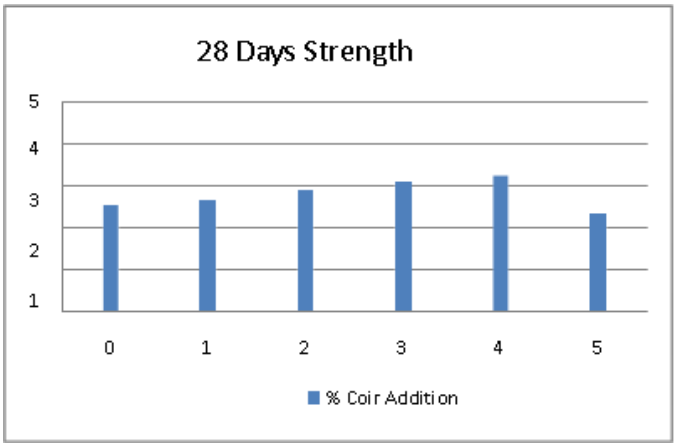
Workability: The results of workability determination are shown in table 02. It is observed that as percentage of coir increased, the workability in terms of slump (mm) and compaction factor increased.

Workability	0%	1%	2%	3%	4%	5%
Slump (mm)	84	62	71	78	76	79
Compaction Factor Value	0.920	0.924	0.912	0.940	0.974	0.902

Bar Charts: The bar charts are drawn for Tensile strength results. These are drawn between tensile strength and percentage addition of coconut fiber at 7, 14 and 28 days to observe the variation of results.







V. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that

- Increase in percentage addition by coir increased tensile strength. But, if coir added is 5%, then strength decreases.
- Coconut Fiber increased the slump value and compaction factor value of Concrete.

The following recommendations are made at the end of the study.

- Effect of different admixtures can be studied on Coir Fiber Concrete
- Evaluating Bond Strength of Coir Fiber Concrete
- Coconut Coir- Cement compatibility

REFERENCES

[1] M.Ali,B, Nolot and N. Chouw, April 2009, " Behaviour of coconut fibre and rope reinforced concrete members with debounding length .Annual Australian Earthquake Engineering Society Conference, "New Castle Earthquake Dec.11-13. Paper 04

[2] Majid Ali. ,11 July 2011, " Coconut Fibre – A Versatile Material and its application in Engineering - .Journal of Civil Eng.& Const. Tech. Vol.2(9), pp.189-197, 2 Sept. 2011

[3] Noor Md, SadiqulHasan, Habiburrahman, Mdshiblee and MdSaiful Islam, 2012, "The use of Coconut Fibre in the production of Structural Lightweight Concrete"- Journal of Applied Sciences 12(9):839, 2012.

[4] Shetty M.S," Concrete Technology Theory and Practice"(1991),3rd edition, S.Chand Company Limited, New Delhi.

[5] British Standard Institutions, BS 8110 – Part1, The structural use of concrete, BSI, London 1997.

[6] ManinderKaur and Manpreet Kaur, 2012, "A review of utilization of Coconut coir as coarse aggregate in concrete", International Journal of Applied Engineering Research, 7, pp 05-09

[7] Yaw Osei, 2013, "Experimental Assessment on coconut coir as aggregate in concrete", International Journal of Engineering Science Research, 05, pp 07-11

[8] K.U.Rogo, 2010, "Exploratory study of coconut coir as coarse aggregate in concrete", Journal of engineering and applied sciences, 02, pp 19-24.

[9] I.S 10262-2009:"Recommended guidelines for concrete mix design", 2009

[10] I.S 12269-1987:"Specifications for 53 grade Ordinary Portland Cement", 1987

[11] I.S 383-1970:"Specifications for coarse and fine aggregates", 1970

[12] I.S 456-2000 "Indian Standard: Plain and Reinforced Cement Concrete" Code of practice.

[13] Improvement in the Strength of Concrete by using Industrial and Agriculture waste.-Pravin V Domke[1], IOSR Journal of Engineering, April. 2012, Vol.2(4) pp.755-759.

[14] Ghassan Subhi Jameel, "Study The Effect of Addition of Wast Plastic on Compressive and Tensile Strengths of Structural Lightweight Concrete Containing Broken Bricks as a coarse Aggregate", International Journal of Civil Engineering & Technology (IJCIET), Volume 4, Issue 2, 2013, pp. 415 - 432, ISSN Print: 0976 – 6308, ISSN Online: 0976 – 6316.

[15] Dewanshu Ahlawat and L.G.Kalurkar, "Coconut Shell as Partial Replacement of Coarse Aggregate", International Journal of Civil Engineering & Technology (IJCIET), Volume 4, Issue 6, 2013, pp. 12 - 16, ISSN Print: 0976 – 6308, ISSN Online: 0976 – 6316.

[16] Riyaz Khan and Prof.S.B.Shinde, "Effect of Unprocessed Steel Slag on the Strength of Concrete When used as Fine Aggregate", International Journal of Civil Engineering & Technology (IJCIET), Volume 4, Issue 2, 2013, pp. 231 - 239, ISSN Print: 0976 – 6308, ISSN Online: 0976 – 6316.