International Journal of Civil Engineering and Technology (IJCIET)
Volume 9, Issue 1, January 2018, pp. 416–422, Article ID: IJCIET_09_01_040
Available online at http://http://www.iaeme.com/ijciet/issues.asp?JType=IJCIET&VType=9&IType=1
ISSN Print: 0976-6308 and ISSN Online: 0976-6316

STUDY ON PROPERTIES OF NATURAL FIBRE REINFORCED CONCRETE MADE WITH COCONUT SHELLS AND COIR FIBRE

P. Purnachandra Sai
Assistant Professor, Department of Civil Engineering,
Marri Laxman Reddy Institute of Technology & Management, Hyderabad, India

K. Murali
Head of the Department, Department of Civil Engineering,
Marri Laxman Reddy Institute of Technology & Management, Hyderabad, India

G Sravan Kumar
PG Student, Department of Civil Engineering,
Marri Laxman Reddy Institute of Technology & Management, Hyderabad, India

K Varun Teja
Research Scholar, Scale, VIT University, Vellore, India

ABSTRACT

Utilisation of agricultural waste material in concrete enhances the properties of concrete. To study this phenomenon concrete made of fly ash, coconut fibre and coir fibre for M40 was done and evaluated. Cement is substituted with fly ash by 10%, 20%, and 30%.Coir fibres is include by weight of the binder in the proportions about 0%, 1%, 1.5%, 2%, 2.5%, 3%. Coconut shells are replaced in the place of coarse aggregate. The breadth of coconut fibre will vary from 0.25 to 1.0 cm. The present study has illustrated that addition of coconut fibre and coir fibre to concrete enhances the properties of concrete.

Key words: Coconut Fibre, Coir Fibre, Compressive Strength, Fly Ash, Workability.

Cite this Article: P. Purnachandra Sai, K. Murali, G Sravan Kumar, K Varun Teja, Study on Properties of Natural Fibre Reinforced Concrete Made with Coconut Shells and Coir Fibre. *International Journal of Civil Engineering and Technology,* 9(1), 2018, pp. 416-422.
http://www.iaeme.com/IJCIET/issues.asp?JType=IJCIET&VType=9&IType=1

1. INTRODUCTION

1.1. Natural Fibres in concrete

The use of natural fibres in concrete is suggested since distinctive types of these fibres are available locally and are ample [14]. The idea of using such fibres to enhance the strength and

durability of brittle materials is new; for example, straw and horsehair are used to make bricks and plaster [15]. Natural fibres that are suitable for reinforced concrete and are readily available can be classified as shown in Fig 1.

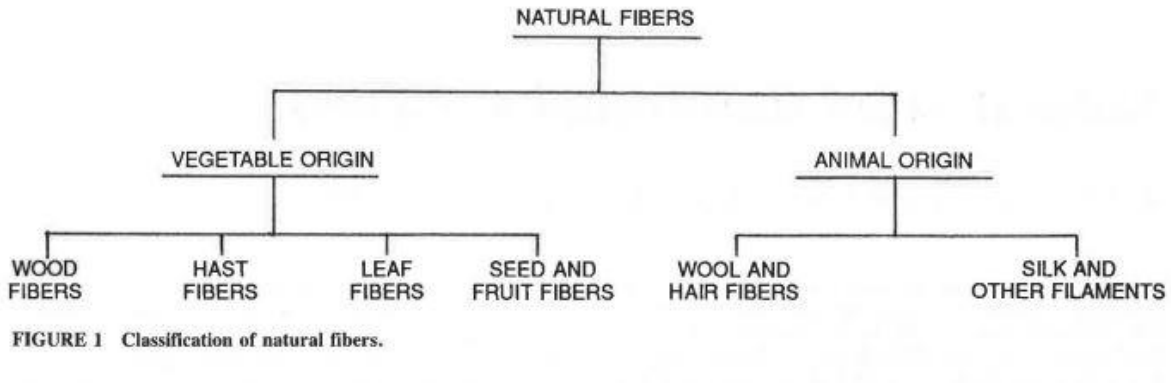


Figure 1 Classification of natural fibres.

1.2. Fly ash

Flyash, which is a by-product of the combustion coal in the thermal plants. It is removed by the dust collection system as fine particle dregs from the incineration gases before they are quitted into the atmosphere [1]. Fly ash accounts for about 9% of the cement mix in concrete. Water absorption, the coefficient of water and chloride diffusion coefficient was less in fly ash concrete. Fly ash can be used in a significant amount as replacement material of cement in concrete. It can be added to a quantity of 10% to about 35% by weight of cement. It will be very beneficial in reducing CO2 emission during production of cement, preventing the global warming [1]

1.3. Coir Fibre

India has a vast coastline with coconut palms and producing more than 2/3rd of the world production of coir and its products[4]. Not more than 28 percent of the coconut husks are utilised in the coir industry, the rest being used as a fuel or as a waste material in rural areas [2]. The development in coir sector accounts towards the development agenda regarding the creation of environment-friendly products, its application for domestic use along with the usage in housing, building, agriculture, horticulture, and infrastructure production are significant. The world population is becoming more and more conscious about the need of preserving the nature with an increasing number of people opting for environment-friendly products. Coir fibre is the opportunity to promote the coir usage as an admixture in building materials.

1.4. Coconut fibre

Coconut plays a significant role in the agricultural economy of India. The coconut is known to be a rich source of raw material for various products. The nut is the most active material with its nut oil being widely used for eatable and manufacturing. The coconut shell is the raw material for the coir production [16]. Coconut fibres attained from coconut husk, belongs to the family of palm fibres, and are available in large quantities in the tropical regions of the world, most especially in Africa, Asia and southern America. In Ghana, they are available in large quantities in the southern part of the country [1].

2. LITERATURE REVIEW

R. Naga Lakshmi, 2013 conducted an experimental study to assess the strength characteristics of concrete of M25 grade with partial replacement of cement with flyash and coconut shell in coarse aggregates. Results from the test indicates that compressive strength, split tensile strength and flexural strength of the concrete reduced with increasing proportion of the coconut shell replacement.

Majid Ali et al., 2009 coconut fibres and cord ferroconcrete beam below dynamic loading in earthquake-prone region, properties of CFRC structural members is investigated. Natural fibre (coconut fibre) of length 7.5 cm and 3 percent by weight of cement are accustomed in preparing CFRC beams. A fibre of diameter 1cm and durability of 7.8 MPa is due to reinforcement.

Alida Abdullah, 2011 conducted an experiment in which had taken cement and sand with 1:1 ratio and 0.55 as a water-cement ratio. Used coconut fibres as reinforcement in the concrete mix and replaced with the composition of sand by weight 3%, 6%, 9%, 12%, 15% respectively for 7, 14 and 28 days. Reported that density of mix reduced with increase in fibre. Moisture content gave maximum value at 3% fibre content, and a similar trend occurs at 14 and 28 days. observered that water absorption increased with increasing fibre content in the mixture.

3. MATERIALS AND PROPERTIES

3.1. Materials

3.1.1. Cement

OPC 53 grade which is available in the market is used. The coarse aggregates of 20mm and 12mm from the nearby quarry and the fine aggregate of zone-II are used. Conplast 430 superplasticiser is used.

Table 1 Properties of Cement

S No	PROPERTY		VALUE
1	Specific Gravity of cement		3.15
2	Fineness of the cement		8.56 %
3	Soundness Test(Le-Chatlier)		3.8 mm
4	Setting Time	Initial	180 min
		Final	240 min

3.1.2. Fly ash

Properties of fly ash are shown below in Table 2. As per the literature, 10% fly ash is continuously taken for all the mixes.

Table 2 Physical properties of flyash

PARAMETERS	FLY ASH
Bulk Density (gm/cc)	0.9-1.3
Specific Gravity	1.6-2.6
Plasticity	Lower or non-plastic
Shrinkage Limit (Vol stability)	Higher
Free Swell Index	Very low
Porosity (per cent)	30-65
Surface Area (m2 / kg)	500-5000
Lime reactivity (MPa)	1-8

3.1.3. Coarse Aggregate

Locally available stonework, sieved with a 20 mm sieve, was used as coarse aggregate. It was then washed to clear dirt and dust and kept under dry surface conditions. Coarse aggregates are tested as per IS: 383-1970. Table no.2 illustrates the properties of the coarse aggregate used.

Table 3 Properties of Coarse Aggregate

S No	PROPERTY	VALUE
1	Specific gravity	2.8
2	Water absorption	0.2%
3	Fineness modulus	7.3

3.1.4. Fine Aggregate

Sand which is locally available and conforming to zone -2 of IS 383-1970 was used as fine aggregate. Fine aggregate taken was clean, inert and free from organic matter, silt and clay. Properties are tabulated in the below Table no.3.

Table 4 Properties of Fine Aggregates

S No	PROPERTY	VALUE
1	Specific gravity	2.65
2	Water absorption	4.16%
3	Fineness modulus	2.69

3.1.5. Chemical Admixture

Super Plasticizer Conplast SP-430 was used to obtain better workability for the mix of chosen w/c ratio of 0.48. The specific gravity was varying from 1.220 to 1.225 at 30^{o}C in the lack of chloride. The air entrained in the mix is nearly taken as 1%. The various physical properties of Conplast SP-430 are as listed in Table 5.

Table 5 Properties of Conplast SP-430

S. No.	Description	Property
1	Appearance	Brown liquid
2	Specific Gravity (BSEN 934-2)	1.2 @ 22°C + 2.2°C
3	Water-soluble chloride (BSEN 934-2)	-
4	Alkali content (BSEN 934-2)	Typically less than 53 g. Na_2O equivalent/ litre of admixture

3.1.6. Coir fibre and coconut shells

For this study, locally available coir fibre and coconut shells are used.

4. MIX DESIGN

As per IS 456-2000 the mix proportioning was done for M40.

400 : 660 : 1368 : 160

1 : 1.65 : 2.92: 0.4

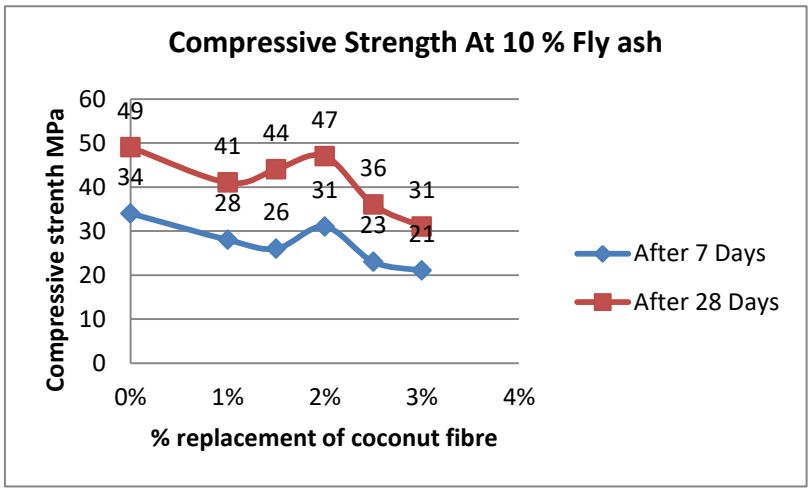
5. RESULTS AND DISCUSSIONS

5.1. Compressive Strength

Compressive strength of concrete made with coir fibre by keeping fly ash 10% constant for all mixes given in table no.6

Table 6 Compressive strength of Coir fibre reinforced concrete

Coir Fibre (%)	Compressive strength (Mpa)	
	7 days	28 days
0 %	34	49
1 %	28	41
1.50 %	26	44
2.0 %	31	47
2.5 %	23	36
3.0 %	21	31



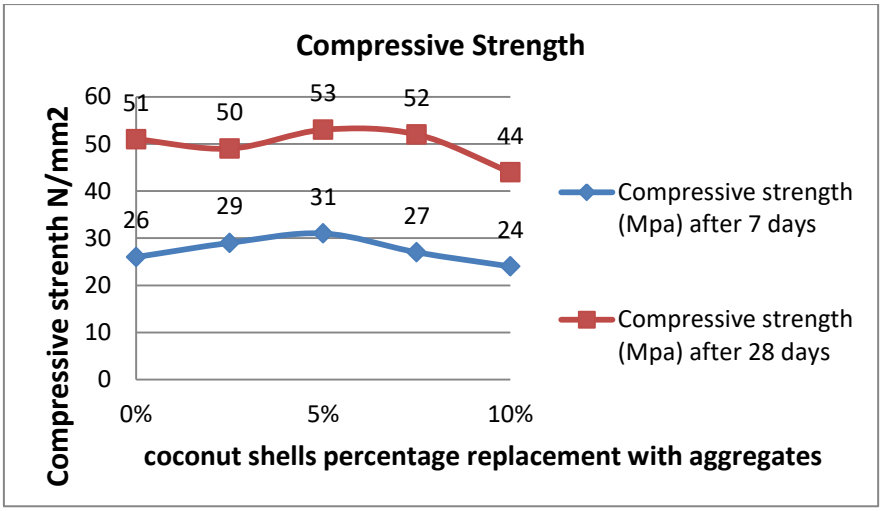
Graph 1 Showing Compressive strength of Coir fibre reinforced concrete

The above test results show that compressive strength of concrete gradually decreases with increase in coir fibre content except at 2% level the strength tends to increase.

Compressive strength of concrete made with 10% Flyash, 2% coir fibre and replacing coconut shells with coarse aggregate is given in the table no 7

Table 7 Compressive strength of partial replacement of coarse aggregate

% replacement of coarse aggregate	Compressive strength at the age of MPa	
	7 Days	28 Days
0 %	26	51
2.5 %	29	50
5 %	31	53
7.5 %	27	52
10 %	24	44



Graph 2 Showing Compressive strength of Coir fibre reinforced concrete

The above test results show that compressive strength of concrete is linearly varying with an increase in coir fibre content.

6. CONCLUSIONS

- Usage of coir fibre is not at all recommended since it reduces the strength of concrete with an increase in content.
- Compressive strength increases with increase in coconut shells as a partial replacement of coarse aggregate
- 5% is the optimum percentage replacement as per the experimental results.

REFERENCES

[1] Nagalakhsmi R., 2013, Experimental study on strength characteristics on M25 concrete with partial replacement of cement with flyash and coarse aggregate with coconut-shell international journal of scientific & engineering research, 4(1), 2229-5518

[2] Alida Abdullah, Shamsul Bahrain Jamaluddin, Mazlee Mohd Noor and Kamarudin Hassan 2011. Composite cement reinforced coconut fibre: physical and mechanical properties and behaviour, Australian journal of basic and applied

[3] Vajje Sandeepani and Murthy Krishna N.R. 2013. Study on addition of the natural fibres into concrete, international journal of science and technology research, 2277-8616

[4] Ruben Sahaya J., Bhaskar G. 2014, Experimental study of coir fibre as concrete reinforcement material increment based composites, international journal of research and application, 2248-9622

[5] Harle Shrikant and Dhawale Vaibhav 2014. comparison of different natural fibre reinforced concrete: review, an international journal of engineering science & research technology, 3(2), 2277-9655

[6] Anju Mary Ealis, Rajeev A P, Sivadutt S, Life John and Anju Paul 2014. Improvement of strength of concrete with partial replacement of coarse aggregate with coconut shell and coirfibres, IOSR Journal of mechanical and civil engineering, 2278-1684

[7] Khatri Shubha 2014. Impact of coconut fibre & polypropylene woven fibre including admixture on concrete mix, international journal of scientific & engineering research, 2229-5518

[8] Elizabeth Chinenye Okere, strength properties of coconut fibre ash concrete, Journal of research in architecture and civil engineering

[9] Valley, P.P. and Kwan, AlanS.K, Use of coconut fibre as an enhancement of concrete, Journal of Engineering and Technology 3, Pages 54-73. 2009.

[10] K., Mohan Raja Saravana, Jayabalan P., and Rajaraman A., 2012 Properties of Fly Ash Based Coconut Fibre Composite, American journal of engineering and applied sciences, 5(1):29-32, 1941-7020

[11] J.M.Crow, The Concrete Conundrum,2006, available at www.chemistryworld.com

[12] A. short and W.Kinniburgh, Lightweight Concrete, Applied Science Publishers, London

[13] Daniel Y.O, 2013, Experimental Assessment on Coconut Shell as aggregate in concrete, International Journal of Engineering Science Invention, Vol.2, Issue 5, pp 07-11

[14] Maninder Kaur, Manpreet Kaur,(2012), A review on utilisation of coconut shell as coarse aggregate in mass concrete, International Journal of Applied Engineering Research, Vol. 7, No.11, pp 05-08

[15] Kulkarni V.P, Kumar .S, (2013), Comparative study on coconut shell aggregate with conventional concrete, Vol.2, Issue 12, pp 67-70.

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

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

[18] Kabiru Usman Rogo, Selah Abu-Bakr, the Exploratory study of coconutshell as aggregate in concrete production, JournalofEngineering and Applied Sciences, Vol.2, Dec 2010.

[19] Gunasekaran K, Kumar P.S, Laxmipathy M, Mechanical and Bond properties of Coconut Shell Concrete, Construction and Building Material (20 11), pp 92-96.

[20] Utsev, J.T, Taku, J.K,2012, Coconut shell ash as partial replacement of ordinary Portland cement in concrete production, International Journal of Scientific and Technology Research, Vol.1, Issue 8, September 2012, pp 86-89.

[21] I.S 10262-1982:Recommended guidelines for concrete mix design, 1982

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

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

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

[25] S P Jagadish, Dr. K R Dinesh, Dr. A Thimmana Gouda and Shivasharanayya Swamy, Fabrication and Investigation of Tensile and Bending–Mechanical and Oxidative Biodegradation Properties of Hybrid Natural Fibre Reinforced Bio-Composites. International Journal of Mechanical Engineering and Technology, 8(1), 2017, pp. 01–14.

[26] Pankaj Giri, V. Charan Kumar, V. Jayakumar and G. Bharathiraja, Some Studies on Mechanical Properties of Natural Fibre Polymer Composites with Fibre Surface Treatments, International Journal of Mechanical Engineering and Technology 8(12), 2017, pp. 1113–1120