

An Informative Review of Coir Fiber:- Its Properties and Applications in Construction Industry

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Abstract— Traditional Methods are still adopted in rural areas to construct houses. India has coastline of 7,516.6 km (4,671 miles). Coconut Plantation is common at this vast coastline. Making use of Coir which is a byproduct from coconut can be used for construction which is locally available and will make affordable, green, sustainable, durable etc Construction for the needy population of rural areas. This paper addresses a review on the applications of byproduct of coconut coir fiber and its various forms used in construction and civil work. Coir is abundantly available across in tropical regions of India, as well as it also has religious importance in urban areas. The major emphasis of this research paper would be to give an overview of Coir and its application in different forms and techniques of civil work. The paper also aims to make aware of waste Coir and its application in civil works and construction. This Paper is an informative research for the readers to know about coir fibers and its application in construction industry.

Keywords—Coir, Fiber, Construction, coconut

I. INTRODUCTION

India is the second most populous and 7th largest country in the world. Due to Increasing Population the need for alternative methods and materials should be practiced. One third of the population in India lives below poverty line. The demand and shortage of housing is more than 18.78 million homes at the start of which 95% EWS (Economically Weaker Sections) and LIG (Low Income Group) segments. Approximately the estimated shortage will be 30 million by 2022. The increasing gap in demand and supply in the supply of affordable housing is major concern for the growth of Informal settlements leading encroachments of lands. Hence it is important for everyone to concentrate on Policy making and programmes for Affordable construction for The Poor and needy people. Conventional construction materials are Cement (OPC or PPC), Reinforcement Steel, Coarse and Fine aggregates.. Depleting limestone reserves and high price of steel, efforts has to been made to introduce naturally local and affordable materials. Cheaper materials like straw, bamboo, fibers, earth etc. to be used as construction materials However this method and materials are old practices in India . This paper aims to study properties, applications of Coir Fiber with respect to Sustainability of the structure and affordability of the improvised material.

II. COIR

A. Coir:- A by product from Coconut

Coir or Coconut is a Natural fiber form the coconut husk. It is the fibrous materials found inside the shell and on the outer coat.

B. Chemical Properties of Coir

Water Soluble	5.25%
Pectin and Related Compounds	3.30%
Hemi- Cellulose	0.25%
Cellulose	43.44%
Lignin	45.88%
Ash	2.22%

Coir is Tougher and stiffer compared to other natural fibers as it consists of higher percentage of Lignin (45.88%).

C. Physical Properties of Coir

Ultimate Length	0.6 mm
Diameter / Width	16 Micron
Single Fiber	
Length	6 to 8 Inches

Density	1.4 g/cc
Tenacity	10g/tex
Breaking Elongation	30%
Moisture gain at 65 pH	10.5%
Swelling In Water	5% in Diameter

D. Production of Coir

Coir is majorly produce in states/UTs of India are Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Odisha, Assam, Gujarat, West Bengal, Madhya Pradesh, Jammu and Kashmir, Lakshadweep, Andaman and Nicobar, Pondicherry, Maharashtra and Goa. About 60% of the total production is contributed by Kerala itself.



Fig.1 Process of COIR fiber extraction from husk
Source (Dhandhanian VA, 2014)

E. Annular Export of Coir in India

Year	Quantity in Tonnes	Value in Lacs
1970-71	52211	1387.34
1980-81	28610	2544.66
1990-91	27926	4832.85

2000-01	57493	31366.22
2012-13	5965100	357900.13

F. Annular Export of Coir in India

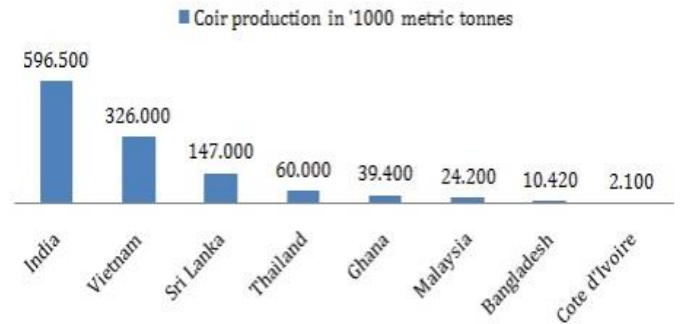


Fig. 2

G. Coir Forms and their Availability

Coir fibers are available in various forms based on market need such as for household uses, for Commercial uses including light weight boards in Acoustics works etc. Some availability is mentioned below:-

- Coir Mats
- Coir Cement Boards
- Coir blocks
- Coir Sheets
- Coir grid/nets
- Random Distributed Ropes

III. PROBLEMS IN CURRENT CONSTRUCTION METHODS

The desired quality work is not achieved due to the lack of adequate quality building material with increasing demands and huge amount of construction in different fields of civil works. Consequently, failure occurs in the creation of different fields in different ways. It is possible to list such failures as below:

- Concrete failure due to insufficient tensile strength and flexural resistance.
- Lack of landfill due to landslides.
- To regulate soil surface erosion in any construction with the highest soil surface.
- To solve the use of expensive geotextiles of chemical fibers in road subgrades.
- The deterioration of the embankments and the base due to the low capacity of the bearing
- Replacing existing expensive material for Reinforcement such as steel.
- A new composite is needed to replace the current expensive and insufficient building material
- Need alternatives for expensive building materials that are both thermal and sound insulating.
- Need an alternative to build lowcost paver blocks by reducing the content of cement and making it Lightweight.

A. Applications of Coir Fiber in Construction Industry



Fig.3

Thermal Insulation by Coir Fiber :- Kerala state coir organization constrained makes different coir items for warm protection that are accessible on location www.coircraft.com, items, for example, coir needle felts-these are cushions made by interlocking coir fiber through needling; these felts cushions can be utilized for minimal effort acoustic control, air and water filtration, warm protection and furthermore for soil disintegration control; the sizes accessible are 60 x 40 and 90 x 45; thickness of felts is 174 kg/m³ what's more, heat limit is 2600 J/kgK which fluctuates for various coir based protection items.

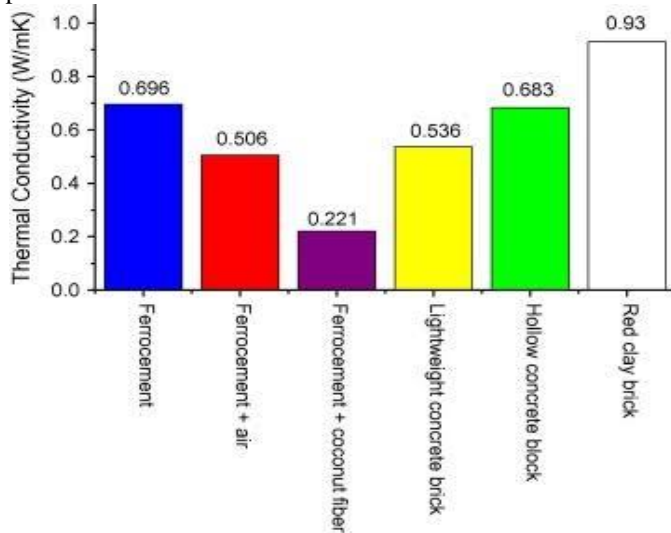


Fig.3 (R.Alavez-Ramirez, 2012)

Coir Fibre Reinforced Concrete (CFRC):- Coir fiber plays a imperative job in solid innovation, for example, different examinations states that it expands the different quality parameters like modulus of flexibility, compressive quality, relating strain, compressive durability, parting elasticity, modulus of burst, flexural durability, thickness confronted increase too decrement in contrast with plain concrete.



(a) Static failure (b) Impact failure

Fig.4 Source:- (Wanjie Wang, 2017)

Light weight cement boards (CCB): Generally two kinds of coir sheets are accessible in showcase specifically

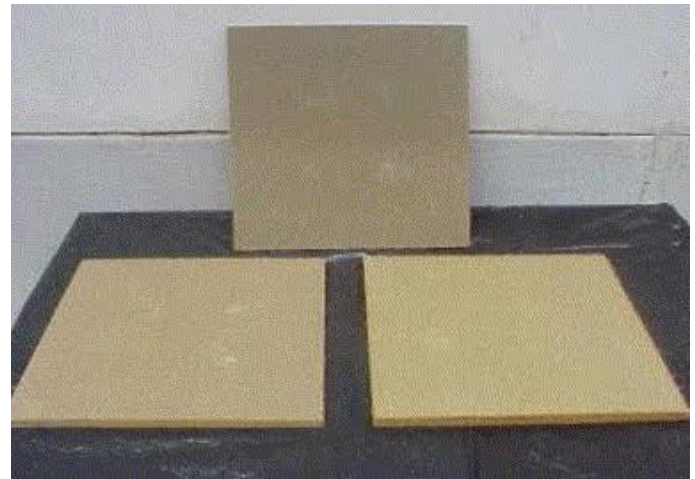


Fig.5 Source:- (C.Asasutjarit, 2007)

- Three layered wood-coir-wood board with thickness going 650-800 kg/m³.
- Single homogenous layer coir fiber concrete sheets with thickness 800-1200 kg/m³ essential properties as development material are water absorption 32%, thickness expanding 4.2%, heat conductivity-0.090 W/mK, modulus of break 8.3 kg/cm² regions of development application can be stated below

Coir Dimension Boards	Density (kg/m ³)	Applications
1'' x 2' x 4'	800-1200	External Walls / Flooring

1" x 2' x 4'	650	Ceilings / Partitions
3/8" x 2' x 3'	650-800	Roofing
3/8" x 2' x 4'	800	Furniture Components

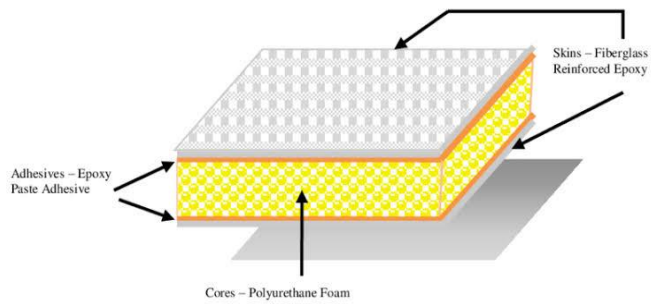


Fig.8

Fiber Reinforced cement hollow blocks: - Manufacturing cost of can be reduced due addition of coir fibers. Blocks casted using coir fibers are light weight.

Coir Soil Cement Blocks: - High Decrease in thermal conductivity is seen due to addition of coir fiber.



Fig.6



Fig.9

IV. SUMMARY OF COIR FORM, ROLE AND ITS APPLICATIONS

Soil Stabilisation in sub-grade:- Coir fiber is mainly used in road constructions at Kerala, Tamil Nadu and other states. Due to addition of fiber it holds soil mass and it results in shear strength.



Fig.7 A Road constructed using Coir Fiber in Kerala

Coir Fiber and its Role	Form	Application
Reinforcement in Concrete	Distributed manner and Rope	Casting of CFRC (Coir Fiber Reinforced Concrete)
Reinforcement member in Highway sub grade	Randomly distributed manner, grids and mats	Used in reinforcing increases CBR value
Reinforcement in footing	Randomly distributed, grids and mats	Increase of 2 to 3 times of SBC
Light weight and sound proofing Building	Randomly distributed manner	Used in Light weight hollow concrete blocks which are cost effective and earthquake

Composite Foam Panels: - Coir fibers are used in polyurethane foam panels. About 5-15% decrease its weight and to increase mechanical properties.

Material		resistant To increase flexural strength and tensile strength of CCB coir fibers are been used
Reinforcement in poly-urethane foam	Randomly distributed manner	Used in casting foams which makes them light weight and heat absorbing due to coir fiber. Used in false ceiling
Reinforcement and Insulator in composites	Randomly distributed manner	Casting of soil cement blocks. Used in construction of FRP-CFRC composite column having more flexural and axial strength compared to cement column.

V. CONCLUSION AND FINDINGS

- From above study we can easily figure out the useable applications of coir fiber in civil work domains.
- Coir fiber can be easily adopted and used in civil work. It also has future scope in sustainable and green development.
- Coir Fibers has ability to replace reinforced concrete structure. Improved adoptions should be worked out in coming days.

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