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STUDY ON UTILIZATION OF NATURAL FIBRE AS A COMPOSITE MATERIAL IN CEMENT MORTAR TILES

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Abstract *: In order to optimize the cost of construction, engineers have always been on the lookout for efficient which require minimum maintenance and labour to install. Fibre has potential as a raw material for the production of flooring materials like carpet and tiles. The main objective is produce cost effective flooring tiles without compromising their quality by replacing cement up to 15% using natural fibre. On the basis of pervious results, a composite with a fibre volume of 12% was considered to be the optimum composite. A comparison of material cost indicated that this composite tile was substantially cheaper than the ordinary cement concrete tile. The experimental investigations uptill now have concluded the use of coconut fibres in composite cement tiles by replacing some percentage of cement with coir fibre. The project associated with partial replacement of cement with natural fibre for the production of cement flooring tiles. The various tests are performs as per the Indian standard specifications for tiles. Fibres proves to be a better replacement for cement considering in natural availability. The tiles are easy to manufacture and install. The fibre composite cement tiles are compared with the normal tiles and result obtained. These types of tiles reduce the cost and waste generated, easily recycle the wastes and reuse them in innovative way by modern techniques*.

Key words: *Cement mortar tiles, coir fibre cost effective , high strength, flooring tiles.*

1.INTRODUCTION

Coconut fibre has potential as a raw material for the production of flooring material like carpet and tiles. The main objective is to produce cost effective flooring tiles without compromising their quality be replacing cement up to 15% using natural fibre. On the basis of the previous results, a composite with a fibre volume of 10% was considered to be the optimum composite. The project associate with partial replacement of cement with natural fibre for the production of cement flooring tiles .Coconut tree, coconut and coconut fibres research for different purposes. There is huge difference in some properties, for example , diameter of coconut fibres is approximately same and magnitudes of tensile strength are quite different. Coconut fibre is extracted from the outer shell of a coconut. The common name, scientific name and plant family of coconut fibre is Coir, Cocos nucifera and Arecasa (Palm), respectively. Coconut cultivation is concentrated in the tropical belts of Asia and East Africa.There are two types of coconut fibres, brown fibre extracted from matured coconuts and white fibres extracted from immature coconuts. Coconut fibres are stiff and tough and have low thermal conductivity Coconut fibres are commercial available in three forms, namely bristle (long fibres), mattress (relatively short) and decorticated (mixed fibres).

1.1 Natural fibre :Natural reinforcing materials can be obtained at low levels of energy using local manpower and technology. Utilization of natural fibres as a form of concrete enhancement is of particular interest to less developed regions where conventional construction materials are not readily are too expensive.

1.2 Coconut fibre-Coir or coconut fibre, is a natural fibre extracted from the outer husk of coconut and used in products such has floor mats, doormats, brushes and mattresses. Coir is fibrous material found between the hard, internal shell and the outer coat of a coconut Coir fibre is one of the natural fibres abundantly available in tropical regions, and is extracted from the husk of coconut fruit. Coir is stiff coarse fibre and is being found between the husk and the outer shell of a coconut. It is a fibre abundantly available in India the second highest in the world after Philippines. The individual fibre cells are narrow and hollow, with thick wall made of

cellulose. There are two varieties of coir (i) brown coir extracted from a varieties ripe coconut which contains more lignin and less cellulose and are stronger but less flexible. (ii) White coir extracted from coconut before they are ripe, which are white or light brown in colour and are smoother and finer, but also weaker. these general advantages and the rich availability of the material in the South Indian tropics, Coir has found desirable applications in the field of construction with the advent of light-weight concrete technology. The cheap availability of the raw material can also reduce the production costs and hence the housing expenditure on roofing, which is otherwise the most expensive part in building construction, can be considerably truncated. The main objectives of the study are to develop coir fibre reinforced cement concrete roof tiles and to seek its pros and cons as a roofing material based on standard specifications. The structural behaviour and strength characteristic of coir fibre reinforced tile were compared with Cement Concrete roofing tiles. Main objectives of the present situation.

Previous study on coconut fibre

Cook et.al. (1978**)** reported the use of randomly distributed coir fibre reinforced cement composites as low cost materials for roofing sheets. The studied parameters were fibre lengths, fibre volumes and casting pressure. They concluded that the optimum composite was a composite with a fibre length of 3.75 cm, a fibre volume fraction of 7.5 % and cast at a pressure of 1.67 MPa. Cost comparison revealed that this composite was substantially cheaper than the locally available roofing materials. Further study on the strength the research output of Ramaswamy et.al. (1983**)** revels that, natural fibres such as, coir and bamboo can be used with advantage in concrete, in a manner similar to other fibres. It was also observed that, improvement in impact strength of over 25%. Bo Johansson **(**1995) has presented a simple method to produce a roofing material with cement as the binding agent. The properties of coir fibre are discussed by Ramakrishna et.al. (2005) studied the durability of natural fibres and the effect of corroded fibres on the strength of mortar. Coir fibres were found to retain higher percentages of their initial strength than all other fibres after the specified exposure in the various mediums. To improve the cracking flexural stress further study of Li et. al. (2006): on coir mesh reinforced mortar using non –woven coir mesh matting. The results indicate that the addition of coir mesh to mortar significantly improves the composite post cracking flexural stress, toughness, ductility, and toughness index, compared to plain materials. Sivaraja.M. et al. (2009**)** studied the durability of natural fibre concrete composites using mechanical strength and micro structural properties and concluded that, natural fibres enhance the strength and flexural performance of concrete. It was found that, at all the curing ages, both the natural fibres such as coir and sugarcane fibres enhance all the three mechanical strength properties such as compressive strength, split tensile strength, modulus of rupture and flexural performance. Though the natural fibres enhance the strength properties at earlier curing ages, the rate of increments are lower than conventional concrete specimen at later curing**.** Ali (2010) They are reported to be ductile and energy absorbent material and also have the potential to be used in composites for different purposes and as reinforcement in composites for non-structural components. Cost comparison revealed that this composite was substantially cheaper than the locally available roofing materials. Further study is on the strength after replacing cement with coir fibre Abdullah et.al. (2011) reports the effect of natural fibre content on the physical and mechanical properties as well as fracture behaviour of composite cement reinforced with coconut fibre. It was observed that the composite reinforced with 9 wt. % of coconut fibre demonstrated the highest strength of modulus of rupture and compressive strength. Indian Plywood Industries Research & Training Institute and Coir Board, Bangalore explains the procedure adopted for treated coir sheets. (2015) Darsana Pa Ruby Abraham: In the present study, only 10% replacement of cement was possible. But the percentage can be increased with mechanization of the manufacturing process. Properties like breaking load and ductility were improved with the addition of fibres**.** From the difference in cracking pattern of tiles which used coir fibre and those without coir fibre it was observed that the cracks more sharp in the latter. This can be justified because of the presence coir fibres in the roofing tile it a cracking pattern with less sharpness and this physical observation lead to this conclusion**.** Saravanan J (2017): from their experimental study , they conclude that replacement of river sand in making roof tiles will effective if the replacement ratio lies below 7%. %. Mrs. Saranya, Mythily K(2018): reported that the matrix cracking occurred close to fibres as a result of internal tensile stresses generated by volume changes in the fibres. Savasana et al(2019**):** reported that the matrix cracking occurred close to fibres as a result of internal tensile stresses generated by volume changes in the fibres. Chand Madduru b (2020): When adding 0.6% coconut and 1.2% coconut with aqueous water cement ratio of 0.40. The compression strength test yields the good results.

2.MOTIVATION

Scope of study to identify the effect of adding the varying the percentage of coir fibre with cement in cement mortar tiles and studying its strength.

3.PROBLEM STATEMENT

The high self weight , less flexural strength and higher cost of cement mortar tiles.

By addressing this problem we are replacing some percentage of cement with coir fibre to make it light weight and to increase in its flexural strength and making it cost effective.

4. METHODOLOGY

Experimental analysis was used to find optimum percentage of cement and coir. In order to replace cement with natural fibres (Coir), initial studies were conducted to finalise the % replacement of cement with fibres. After finalising the same, tile specimens were prepared using specially prepared mould size 300X300X20 mm .Tests were conducted as per Indian standard specifications for tiles.

5. MATERIAL PROPERTIES

5.1 Cement: Properties of 33,43,and 53 grades of ordinary Portland cements such as fineness, setting times, soundness, expansions, compressive strength based on Indian, American and Eurocodes. Ordinary Portland cement (OPC) is the most widely used cement in the world for producing concrete, mortar, stucco, and non-specially grouts. Ordinary Portland cement (O.P.C.53) : Shree cement

5.2 Sand: Crushed sand Sand consist of natural sand or any crushed stone particles that are ¼ or smaller. This product is often referred to as ¼ minus as it refers to the size, or grading, of this particular crush sand.

5.3 Natural fibre : Natural fibres are fibres that are produced by plants, animals, and geological processes. They can be used as a component of composite materials, where the orientation of fibres impacts the properties. Natural fibres can also be matted into sheets to make the paper or felt. Coir fibre-coir or coconut fibre, is a natural fibre extracted from the outer husk of coconut and used in products such as floor mats, doormats, brushes and mattresses. Coir is the fibrous material found between the hard, internal shell and the outer coat of a coconut. Other uses of brown coir (made from rip coconut) are in upholstery padding, sacking and horticulture. White coir harvested from unrip coconuts, is used for making finer brushes, string, rope and finishing nets. It has the advantage if not sinking, so can be used in long length on deep water without the added weight dragging down boats and buoys.

6.EXPERIMENTAL INVESTIGATION :

6.1 Casting of tile specimen: As per calculation we take the measurement of the items. Then we divided the material Into four groups as per their percentages variation (i.e 10%, 12%, 15% & normal tile). After that the respective material was mixed homogenous with the water/cement ratio of 0.4 Then we filled the material in mould of size (300*300*20 mm), then we used the table vibration for the better compaction of tiles. Such like we make around 12 tiles for each proportion So, for four variation 12*4 = 48 no of tiles were made. Then tiles were kept for curing in the pond for 28 days Then the following test were performed on the tiles after curing (i.e Abrasion, flexure, Water absorption)

6.2 DEMOULDING AND CURING: Once the mix is ready, is poured into the clean and oiled moulds, which are vibrated by vibrating machine in two layers .the surface of mortar is then given a smooth finish, and the moulds are let loose (demoulded) . These specimens were allowed to remain in tiles for the first 24 hour, at ambient condition. After that these were placed in the tank at the ambient temperature for curing. Tiles were placed water for 28 days.

6.3 TESTING OF SPECIMEN

6.3.1 FLEXURAL TEST Select the 10 tiles as a representative, to the lot of tiles manufactured. Soaked tiles in water for 24 hrs at a temperature of 27℃ ± 2℃

Fig 1. Flexural test on tiles

Table 1 Flexural test on tiles

Sr.No.	% of tiles	Dimentions of tile L*B*t (mm)	Breaking load point P (N)	Flexural strength (f) N/mm^2	Average flexural strength N/mm^2
1.	10%	300X300X20	4.04	15.15	
2.		300X300X20	4.02	15.08	15.25
3.		300X300X20	4.08	15.03	
4.	12%	300X300X20	5.5	20.63	
5.		300X300X20	5.8	21.75	20.25

6.		300X300X20	4.9	18.38	
7.	15%	300X300X20	3.4	12.75	
8.		300X300X20	3.2	12	12.37
9.		300X300X20	3.3	12.38	
10.	N	300X300X20	3.8	14.25	14.25

RESULT: The average flexural strength of tiles (12%) = 20.25 12% has more flexural strength as compare to 10%,15% and normal tiles

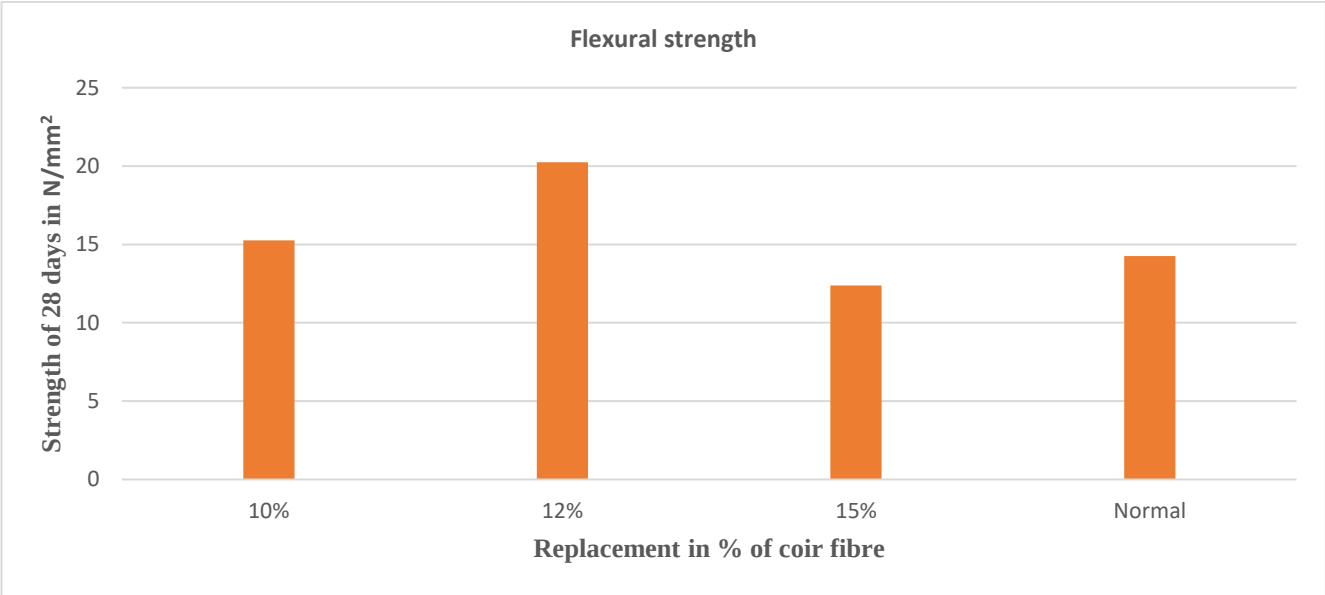

Fig.2 Graph of flexural strength of tiles

6.3.2 ABRASION TEST:

Table.2 Abrasion test result of cement mortar tile

Sr.No.	% OF TILES	Initial thikness t1 (mm)	Final thikness t2 (mm)	Wear in thikness t=t1-t2 (mm)	Initial weight W1 (kg)	Final weight W2 (kg)	Wear in thikness from weight
1.	10%	20	19.3	0.7	197	191	6
2.		20	19.5	0.5	184	181	3
3.		20	19.4	0.4	195	192	3
4.	12%	24	23.6	0.4	249	242	5
5.		24	23.7	0.3	226	222	4
6.		24	23.8	0.2	224	223	2

7.	15%	19	18	1	172	160	12
8.		19	18.3	0.7	213	208	5
9.		19	18.1	0.9	167	158	9
10.	N	26	25.8	0.2	259	255	4

RESULT:

(1) The average loss in thickness due to wear and tear of tile is (10%) = 0.53mm

(2) The average loss in thickness due to wear and tear of tile is (12%) = 0.3mm

(3) The average loss in thickness due to wear and tear of tile is (15%) = 0.86mm

(4) The average loss in thickness due to wear and tear of tile is (N) = 0.2mm

Fig.3 Abrasion test on tiles

6.3.3 WATER ABSORPTION TEST

Table.3 Water absorption results of cement mortar tiles

Sr No	% OF TILES	Weight W1 (Kg)	Weight W2 (Kg)	Water absorption in %
1	10%	5.960	6.140	3.02%
2	12%	5.240	5.380	2.67%
3	15%	4.930	5.300	7.50%
4	N	4.88	5.240	7.37%

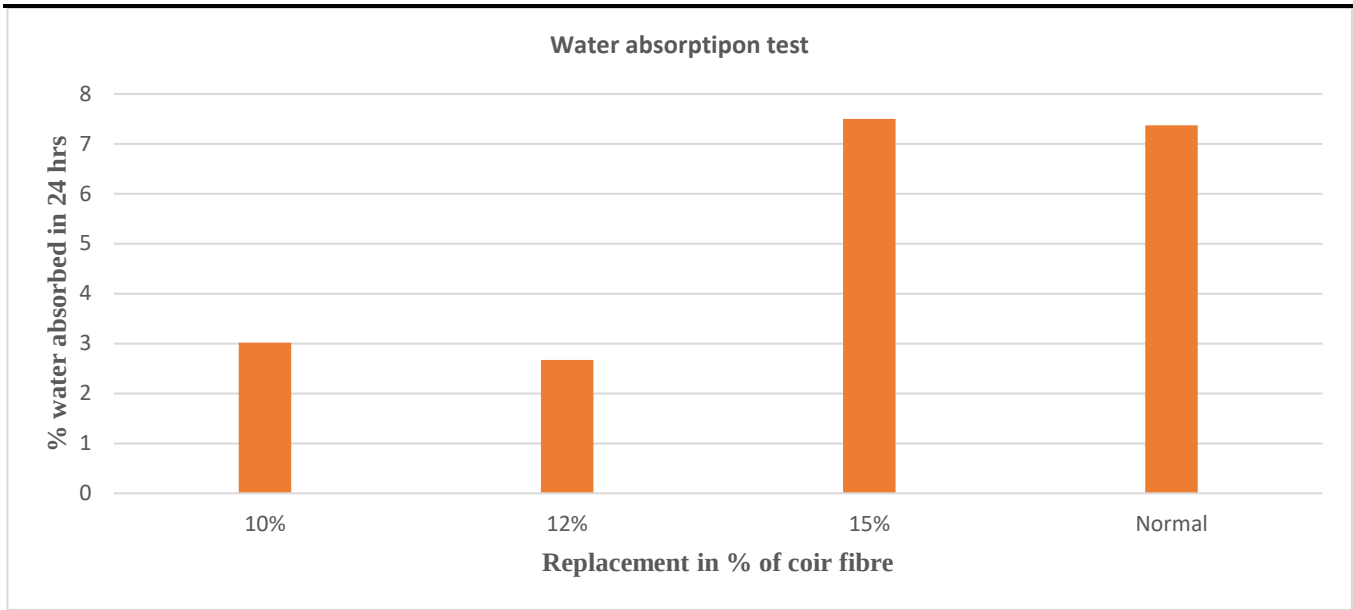

Fig.4 Graph of water absorption test on tiles

6.3.3 ESTIMATION

1. Detail estimate of 100 normal tile.
   - Rate of one bag cement = 350/-
   - Rate of cement per kg = 7/- • Rate of sand per brass = 13000/-
   - Rate of sand per kg 6.7/- as per volume of tiles 0.58 kg cement and 2.8kg sand with wastage used for one tile.
   - Cost one tile = 23/-

2. Detail estimate of 12% replacement of 100 fibre tile.
   - Rate of one bag cement = 350/-
   - Rate of cement per kg = 7/- • Rate of sand per brass = 13000/-
   - Rate of sand per kg 6.7/- as per volume of tiles 0.51 kg cement and 2.8kg sand with wastage used for one tile.
   - Rate of coconut fibre per kg = 2/- per Kg
   - Cost of one tile = 21/-
   - The calculation of 100 tiles, so coir fibre tiles is save in 7 kg cement.

CONCLUSION

- An eco-friendly product was developed using locally available material.
- In the present study, only 12% replacement of cement was found to have greater strength of 20.25 N/mm^2 than other variation and normal tiles. But the percentage can be increased with mechanization of the manufacturing process.
- Addition of more fibres will result in reduction in self-weight and cost. Properties like breaking load and ductility were improved with the addition of fibres . From the difference in cracking pattern of tiles which used coir fibre and those without coir fibre it was observed that the cracks are more sharp in the latter.
- This can be justified because of the presence coir fibres in the roofing tile it has shown a cracking pattern with less sharpness and this physical observation lead to this conclusion.

FUTURE SCOPE

- One of the best future fibre used in road pavement by replacing of cement.
- Coir fibre used in fly ash brick, concrete block
- Adding admixture with coir fibre to increase strength and better quality tile
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