International Journal For Recent Developments in Science & Technology
2581-4575
Crossref
A Peer Reviewed Research Journal

AN EXPLORATARY STUDY ON MANUFACTURING OF COST-EFFECTIVE FLOOR TILES BY USING 'COIR PITH'

P.Anusha[1], Bora Janardhanarao[1], B.Naveen[1], P.Sreenivasa Reddy[1], Akhil Reddy[1], T.Sai Krishna[2]

[1]UG students, Department of Civil Engineering, Aditya Engineering College (A), Surampalem
[2]Assistant professor, Department of Civil Engineering, Aditya Engineering College (A), Surampalem

DOI: 10.48047/IJRDST/V04/I07/42

ABSTRACT

A by-product of coir sector, coir pith has been identified as a potential construction material in recent research probe. The following report presents a method to manufacture tiles out of dry coir pith and powdered thermocol. Influence of the source of coir pith, particle size and proportion of mix also has been laid out. Furthermore, microscopic studies were also conducted to compare the trend of breaking strength. The average breaking strength, flexural strength, water absorption, wear, linear thermal expansion obtained for the tiles with optimum mix are 658.55 N, 3.92 N/mm2, 12.19%, 0.93 mm, 5.5 × 10-6 K-1 respectively which are comparable with the values for group III ceramic tiles as per IS 15622: 2006. The bulk density value obtained was 0.996 g/cm3 which shows that it is a light weight material. Even though group III ceramic tiles dominate in strength, coir-pith tiles are inferred to be 34% cheaper than group III ceramic tiles. As the resulting tile properties resemble with properties of wood, subtle changes can be adopted in the procedure to produce a substitute for wood.

1. INTRODUCTION

With limited resources on earth today, to recycle and convert waste materials into beneficial resources is very important. A by-product of coir sector, coir pith has been identified as a potential construction material in recent research probe. The long fiber of coir is extracted from the coconut husk and utilized in the manufacture of brushes, automobile seat and mattress stuffing, drainage pipe filters, twine and other products. Extraction of 1 kg of coir fiber on an average will leave 2 kg of coir pith. A considerable amount of coir pith in the order of 7.5 million tons is produced annually in India and accumulated in the coir industrial yards, causing environmental pollution and disposal problems. Therefore, attempts are being made to covert this waste material into useful products.

1.1.1 Scope

The coir pith, which is available in plenty in Andhra Pradesh, the present study will eliminate the need of costly imports and provide better revenue for coconut farmers. This will also be an environmental friendly solution for management of coir pith, which is considered as a waste by product of coir industry. Thermocol is manufactured by using HFCs, or hydro fluorocarbons, which have negative impacts on the ozone layer and cause global warming. HFCs are less detrimental to the ozone than CFCs, which they replaced in the manufacturing of Thermocol, but their impact on global warming is much more serious. Disposal

International Journal For Recent Developments in Science & Technology
2581-4575
Crossref
A Peer Reviewed Research Journal

of thermocol has been proved to be a challenging task. One of the main re use of thermocol is recycling it by cutting and painting it and turning it into a decorative item. Thermocol is also used to mount drawings and photographs in exhibitions and stalls in fairs. But a majority of them remain buried in the heap of trash in dumping grounds. Previous studies on experiments done on Coir pith field have proved that coir pith can be used to make many versatile construction materials such as building bricks (Natarajan et al., 1995), particle board (Jayadeep et al., 1991).

The product can find a wide variety of applications as listed below:

• Walls in auditoriums where sound proofing is required.
• Floor tiles that will have less water exposure.
• Partition walls
• Wooden door frames, window frames, hand rails that will have less water exposure.

2. LITERATURE REVIEW:

Previous studies on experiments done on Coir pith field have proved that coir pith can be used to make many versatile construction materials such as building bricks (Natarajan et al., 1995), particle board (Jayadeep et al., 1991). From the previous works done in coir pith such as coir pith as a raw material for production of particle board (Ahmed et al., 2016), the water absorption and swelling were least for the board made form largest size particles and phenol formaldehyde resin (Viswanathan et al. 1991), it was inferred that size, moisture content of coir pith will have profound influence on the final product. Trushna et al., 2018 used thinner to dissolve thermocol to use as binding material in cement concrete. The same principal may be adopted to produce binding material in theproduction of tiles, which will also help in reducing the water absorption. Coir pith is also hydrophilic (attracts water) which means that moisture spreads readily over these surfaces. The extensive film of water that is produced gives moist coir the capacity to absorb air and other gases (Rozli et al., 2010)

Attempts have been made to prepare lightweight materials such as particle boards using coir-pith and adhesives. It has been found that high compressive stress is required for making stable particle boards (Jayadeep et al., 1991). Douba et. al., 2015 concluded the improvement in bond strength in polymer concrete using results from IR spectroscopy. Lower transmittance values in FTIR graphs imply higher number of bonds. Rozli et al., 2010 used coir fiber for noise control layer backing and perforated panel which shows that coir pith has sound absorbing characteristics.

3. MATERIALS:

The two major raw materials coir-pith & thermocol, both of which are easily available in a state like Andhra Pradesh. After the procurement of these raw materials it is very necessary to treat it in a proper way. As concluded from the previous works, size of coir pith will play an important role in the mix and strength of the final product. When thinner is used to dissolve thermocol it is very necessary that thermocol has to be powdered to the maximum extent so that least amount of thinner is used.

Coir-pith was collected from two sources (Beypore and Mambetta) to study the influence of the age and condition of coir pith on the mix and final product.

• Coir-pith was dried under sun and sieved to 3 different sizes to study the influence of size on mix & final product.
• Specific Gravity of Coir pith was found to be 1.13.

International Journal For Recent Developments in Science & Technology
2581-4575
Crossref
A Peer Reviewed Research Journal

• Thermocol pieces were collected from segregation yards and shredded to fine powders using sand paper. Fig. 3.1 shows the extent to which thermocol has to be powdered
• Thinner preferably enamel thinner readily available in the market was procured.

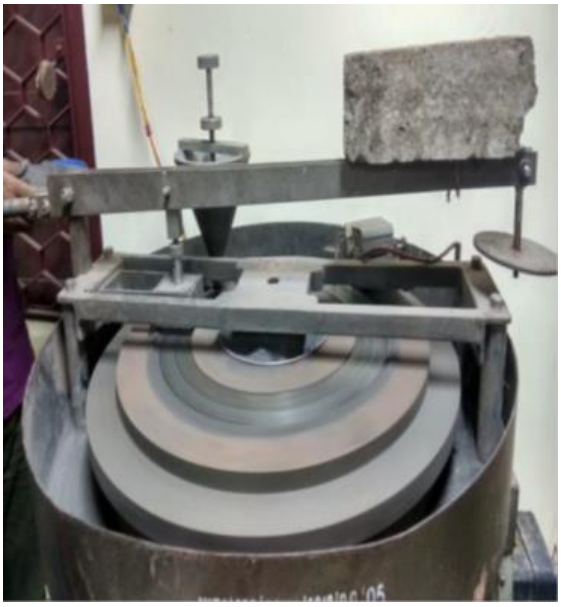
4. EXPERIMENTAL PROGRAMME:

The method consists of simple mixing, filling and loading processes. Mixing was done in a container that can be kept air tight. After adding coir pith and thermocol it was mixed well to make the mixture homogenous to the maximum extent. Further the mixing was continued with subsequent spraying of thinner (about 100ml). The thermocol was dissolved gradually with progress and the mix transformed to dough after complete dissolution of thermocol. For maximal utilisation of the thinner, the container was kept air tight for around 15 minutes.

The dough (Fig. 4.1) was then transferred to a mould (Fig. 4.2) of 15 cm × 15 cm × 20 cm keeping separation plates after each trial mixes. Depending upon the mould height, 3-5 tiles can be produced in a single press. A gradual load of 12 tons in 3 minutes was applied under a CTM. The tiles were further restricted from immediate expansion by a restriction mechanism. After 6 hours, the mould was disassembled and tiles were taken out. Trials were made out from coir pith from two different sources, particle sizes and proportions to study the effect of these on the mix and on the final product.

A coating of touchwood was applied on the tiles. Breaking strength and water absorption tests were conducted on 3 samples of each trial. The tiles were found to be soft just after they were taken out of the mould. The tiles gradually hardened when left in the open air for 24 hours. Upon further drying in sun for 16 days, the tiles hardened and resembled wood.

From the tests conducted on various coir pith tiles with various CP/TC ratio and optimisation, it was inferred that tiles with a CP/TC ratio of 1.56 is expected to have maximum breaking strength while it satisfies all other constraints. In order to verify the trend and to compare with values for group III tiles, further tests were conducted on both tiles (i.e. Coir pith tiles and G-III ceramic tiles). The results of the tests along with the minimum specifications required are shown in Table 8.1 (As per IS 15622: 2006). Detailed calculations have been shown in Appendix E & F.



5.TEST RESULTS & DISCUSSION :

International Journal For Recent Developments in Science & Technology
2581-4575
Crossref
A Peer Reviewed Research Journal

Breaking strength and water absorption tests were performed on 3 samples of each CP/TC ratio

5.1.1 Breaking Strength (IS: 13630)

The apparatus shown in Fig. 2.1 is used to find the breaking strength (S), expressed in Newton, is calculated by means of expression: $S=FLb$

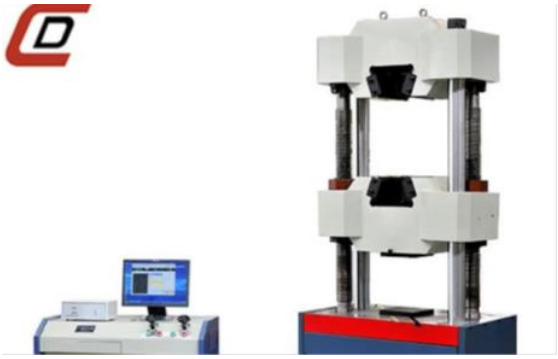
Where

F = Load required to break the tile, in N;

L = Span of the support rods, in mm (see Fig. 2.2);

and

b = width if the tile, in mm.



5.1Water Absorption (IS:13630)

Place the tiles vertically, with no contact between them, in water in the heating water apparatus/water bath as shown in Fig. 5.3 so that there is a depth of 50 mm water above and below the tiles. Maintain the water level of 50 mm above the tiles throughout the test.

Heat the water until boiling and continue to boil for 2 hr. Then remove the source of heat and allow the tiles to cool, chill completely immersed in this water overnight.

For each tile, calculate the water absorption as a percentage of the dry mass using the expression:

$m2-m1m1\times100$

Where

m1 = mass of dry tile; and

m2 = mass of wet tile.

5.2 Influence of Source of Coir Pith

Trials made out of coir pith from different sources have been listed in Table 2. Even though both the coir pith samples were dried for the same duration, the final mix produced by all trials from source 1 resulted in poor mix and the resulting tile had large cracks. While trials from source 2 produced a better mix and tiles with less cracks. It is inferred that tiles made out of coir pith samples from source 1 failed due to the intrusion of moisture to the mix from the fresh coir . Hence it is inferred that the condition, age of the coir pith have profound influence on the overall ease of mixing procedure as well as in the quality of the final product.

6. CONCLUSION

Tiles have been manufactured out of coir-pith and thermocol.

• Breaking strength, water absorption tests were conducted on the tiles as per IS 13630: 2006, which is the IS standards for tests on ceramic tiles.

• From the test results on the tiles it is inferred that the proportion of these ingredients have profound influence on the curing period, breaking strength and water absorption of the final tiles.

• From the test results, it was also observed that the tiles have comparable result values as that for Group III ceramic tiles (as per IS 15622: 2006).

• Bulk density for the coir pith tiles was found to be less than 1 which implies that these tiles are light weight.

• The optimum proportion for obtaining the maximum breaking strength with least curing period is for a CP/TC ratio of 1.56. This implies the tiles will comprise of 39% thermocol content and rest coir pith.

• The optimum tiles were subjected to further more tests as per IS 13630: 2006

and the results were compared with test results on Group III ceramic tiles.

• Even though Group III ceramic tiles slightly dominate in strength parameters, coir pith tiles are expected to be 34% less costly than ceramic tiles.

• The resemblance of the tiles with that of wood (semi-ductile failure) opens an eye for a substitute for wood. If adopted, this can be a rebuttal to the high cost of wood and deforestation.

• The application of these tiles can be extended to wall tiles for rooms designed for acoustic attenuation, as coir pith is a good sound absorbing material (Rozli et al., 2010).

• Coir pith together with thermocol can be used to produce building materials like floor tiles, wall tiles, partition wall, interior door frames, staircase handrails etc. thus increasing the tally in the green building materials.

7. REFERENCES

1. Natarajan, G., 1995. "Commercial Exploitation of Coconut pith problem and prospects". Indian Coconut Journal 9:11.

2. Jayadeep, V., Gothandapani, L., and Sreenarayanan, V, V., 1991. "Particle board from coir pith". TNAU Newsletter, 21(7): 2

3. Ahmed, E., Das,A. K., Hannan, M. O. and Shams,M. I., 2016. "Particleboard from coir pith". In Bangladesh Journal of Scientific and Industrial Research 51(3), pp. 240

4. Trushna D. Patle, Isha P. Khedikar, Kuldeep R. Dabehkar, 2018. "An experimental study on use of waste thermocol and thinner as an admixture in concrete", In International Journal of Engineering and science, Vol.3, No.5, 2018, pp. 110.

5. RozliZulkifli, Zulkarnain and Mohd Jailani Mohd Nor, 2010. "Noise Control Using Coconut Coir Fiber Sound Absorber with Porous Layer Backing and Perforated Panel", In American Journal of Applied Sciences, Vol. 7 (2), 2010. pp. 260-264.

6. Douba, A., Genedy, M., Matteo, E., Stormont, J. and Reda Taha, M. M. "The Significance of Nanoparticles on Bond Strength of Polymer Concrete to Steel", In International Journal of Academic Research, Vol. 6 (1) 2014; pp. 6.

7. Namasivayam, C., Kavitha, D., 2006. "IR, XRD and SEM studies on the mechanism of adsorption of dyes and phenols by coir pith carbon from aqueous phase" In Micro-chemical Journal 82(1), pp.43-48.

8. Ya, S, S., Woo, E, M., Ming, C, W., and Rong-Ming. W., 2003. "WAXD and FTIR spectroscopy studies on phase behaviour of syndiotactic polystyrene/1,1,2,2-tetrachloroethane complexes" in Polymer, 44(18) pp.5293-5302.

9. Bureau of Indian Standards, IS 13630 (Parts 1 to 15): 2006 Indian Standard for Ceramic Tiles-Method of Test, Sampling and basis for acceptance.

10. Bureau of Indian Standards, IS 15622: 2006 Indian Standard for Pressed Ceramic Tiles-Specification.

11. Bureau of Indian Standards, IS 1237: 2012 Cement Concrete flooring tiles-specification.