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An Experimental Study on Low Cost Roofing Tiles by Using Agricultural Wastes

Jayasree J[1], Manjula Bai K[2], Y Hemanthkumar[3] , P Lakshmidevi[4], C Lathasree[5], E, Nandini[6],C Saikiran[7].

[1] *Assistant Professor in Civil Engineering Dept. Sanskrithi School of engineering.*
[2]*Assistant Professor in Civil Engineering Dept. Sanskrithi School of engineering.*
[3] *Studying Final Year in Sanskrithi School of engineer.*
[4] *Studying Final Year in Sanskrithi School of engineer.*
[5]*Studying Final Year in Sanskrithi School of engineer.*
[6]*Studying Final Year in Sanskrithi School of engineer.*
[7]*Studying Final Year in Sanskrithi School of engineer.*
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A B S T R A C T

The scenario of living in huts in slum areas is becoming very difficult day by day due to vast change in climate. Replacing the ordinary huts and conventional poor class roofs with much efficient alternate roof cover is being the most required. On the other side, proper and efficient disposal of agricultural wastes is being the key factor in solid waste management in most of the Indian States . Having both the problems in a single line, in this project we are preparing and evaluating the performance of low cost roofing tiles using agricultural wastes as raw material. The material that are used to prepare roofing tiles are clay, redsoil, river sand. The physical properties of these materials like specific gravity and sieve analysis were determined. The project focus on the partial replacement of river sand with corncob powder and ricehusk. General mix proportions for a conventional roofing tile in the percentage 35% : 35% : 30% of clay : redsoil : river sand. In the mix proportion the sand is replaced in the percentage of 5%, 10%, 15%, 20%. The sand is also replaced with the combination of corncob and ricehusk ash with constant 5% of corncob &ricehusk ash in 5%, 10%, 15%, 20%. The physical properties like water absorption & compressive strength of roofing tile were determine. The test results are compared with the standard values

Keywords: River sand, Red soil, Clay, Rice husk ash, Corncob powder, Compressive strength, Water absrotion.

1. Introduction

Large scale industrialization due to urbanization has caused a greater impact of the construction materials. This resulted the over consumption of natural resources which in turn depleted it as well. So the replacement of conventional materials using alternative waste materials that achieve sustainability in the environment should be promoted. Local materials like soil, stone etc. are often used which require a lot of maintenance and are not always resistant to climatic condition like heavy rain or snow fall. The roof is the covering provided on top most part of the building that protects from various climatic variations. The right material must be used in order to obtain the proper covering using a roof. Thus the demand and high cost relation must be considered and the researches to use cheaper alternative sources should be aimed. These agricultural wastes include such as corncob and rice husk. To produce a low cost roofing tile using rice husk, corn cob by replacing river sand. To promote the economic wellbeing to the present and future population. Effective waste management to achieve a healthy environment.

2. Literature Review

Mr. Omatola had investigated on **"Experimental study on the compressive strength and water absorption of roofing tile by partial replacement of river sand with RHA and corncob".** The RHA is obtained by burning the rice husk at between 500-800 celsius, since the sum of Sio2,Al2o3 and Fe2o3 is 79.23%, For Strength River sand was partially replaced with 7%, 14%, 21%, 27% by weight and 5% of corn cob was partially replaced in the production of clay tile. Compressive strength and water absorption test was conducted after burning the tile for 3 hours and then cooling. Based on the test conducted, it can concluded that RHA is a good pozzolana and Corn cob makes the bond of particles stronger and develop other properties. It was concluded that 7% of RHA is used for better peroformance and 5 % of corncob powder. More than that can't be acceptable and the strength will be reduced.

Mr.Malhorta and mehta(1999) had studied on **"Feasibility of using Rice husk ash".** The Feasibility of using Rice husk ash, a finely grounded waste product from the Rice mill industry, as partial replacement for river sand in production of roofing tiles. Usage of 7%, 14%, 21%,27% of RHA as partial replacement of river sand can give different values. After Preparing the roofing tile burns it a day and then cooled before tested. The compressive strength for 7 % ,14%,21%27% gives 0.23 N/mm2, 0.19, 0.14, 0.11, N/mm2 and water absorption test contain 42%, 45%, 50%, 58%. The test results shows us more than 14% of RHA usage will highly effective and it will effect the strength of the low cost roof tiles. Thus both the economical and environmental benefits occurs at the percentage of 7% and 14% Rice husk ash and it can be followed for an making of low cost roofing tiles

3. OBJECTIVES

- To Collect the raw materials like Rice husk ash, Corncob powder, River sand, Red soil, Clay.
- To Conduct the River sand tests like Specific gravity, Sieve analysis.
- To Conduct the Red soil tests like Specific gravity, Sieve analysis .
- To Conduct the Clay tests like Specific gravity, Sieve analysis .
- To Conduct the tests for replacement materials such as Rice husk ash and Corncob powder like Specific gravity, Sieve analysis.
- To use 5%, 10%, 15%, 20% of corncob powder in the replacement of river *sand* in the production of roofing clay tile.
- To use 5%, 10%, 15%, 20% of rice husk ash and 5% constant corncob powder .
- To compare the cost of conventional roofing clay tile with partial replacement of river sand by rice husk ash and corncob powder.

4. METHODOLOGY

A. Materials

The following materials were used in our project.

- Fine aggregates
- Red soil
- Clay
- Corncob
- Rice husk ash (RHA)
- Water

1.Fine aggregates

In the present work, the mixes were prepared using locally available river sand free from silt, organic matter and passing through 4.75mm sieve. The sand used was confining to Zone 2 of IS 383 – 1970. The composition of sand is highly variable, depending on the local rock sources and conditions.

2.Red soil

Red soils are highly leached soils of thehumid tropics having a high content of sesquioxides.Low natural fertility is the main limiting factor for good crop production on these soils and they are frequently acidic and deficient in all essential nutrients, especially N, P, K, Ca, Mg, S, Zn, B, and Cu. Adequate applications of lime and fertilizers are important strategies for replenishing soil fertility and improving crop yields on these soils. Adequate applications of lime and fertilizers are importantstrategies for replenishing soil fertility and improving crop yields on these soils.

3.Clay

Clay has the smallest particle size of any soiltype, with individual particles being so small that they can only be viewed by an electron microscope.This feature plays a large part in clay's smooth texture, because the individual particles are too small to create a rough surface in the clay.Because of the small particle size of clay soils, the structure of clay-heavysoil tends to be very dense.Clay contains very littleorganic material; you often need to add amendments if you wish to grow plants in clay-heavy soil.

4.Corncob

Corn cobs, the core of corn ears, are very absorbent. They have been used to make inexpensive smoking pipes, and to transport various materials. Ground corn cobs makes an effective blasting media, are friendly to the environment, and delicate while maintaining abrasive capacity.Corncobs are increasingly being used as a low-cost environmentally friendly insulation material for houses.In this study, corncob powder has been used as a filler material replaced partially with fine aggregate.

5.Rice husk ash

Rice Husk Ash is an Rice milling industry generates a lot of rice husk during milling of paddy which comes from the fields. This rice husk is mostly used as a fuel in the boilers for processing of paddy. Rice husk is also used as a fuel for power generation. Rice husk ash (RHA) is about 25% by weight of rice husk when burnt in.

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Potable tap water was used for mixing andcuring of specimens. The water reacts with the clay and sand, which bonds the other components together, creating a solid like material.

B. Mixing Procedure

The Default mixing ratios followed in the plan was:

River sand	**Red soil**	**Clay**
30%	35%	35%

In the above normal mixing ratio, we have altered the river sand ingredient intitially with Corncob powder to find out the optimum replacement ratio and then with rice husk as partial replacements.

All the mixing was done in weight basis, as follows:

Table 1: Standard roof tile – mixing ratio

STANDARD ROOF TILES			
S.NO	**MATERIAL**	**PERCENTAGE (%)**	**WEIGHT**
1.	River Sand	30%	0.750 kg
2.	Red Soil	35%	0.875 kg
3.	Clay	35%	0.875 kg
Total		100%	2.5kg

Table 2: 5% Corn tile – mixing ratio

1st MIX : 5 % OF CORNCOB POWDER			
S.NO	**MATERIAL**	**PERCENTAGE(%)**	**WEIGHT**
1.	River Sand	25%	0.625 kg
2.	Corncob	5%	0.125 kg
3.	Clay	35%	0.875 kg
4.	Red soil	35%	0.875 kg
Total		100%	2.5 kg

Table 3: 10% Corn tile – mixing ratio

2nd MIX : 10 % OF CORNCOB POWDER			
S.NO	**MATERIAL**	**PERCENTAGE(%)**	**WEIGHT**
1.	River Sand	10%	0.500 kg
2.	Corncob	10%	0.250 kg
3.	Clay	35%	0.875 kg
4.	Red soil	35%	0.875 kg
Total		100%	2.5 kg

Table 4 :15% Corn tile – mixing ratio

3rd MIX : 15 % OF CORNCOB POWDER			
S.NO	**MATERIAL**	**PERCENTAGE(%)**	**WEIGHT**
1.	River Sand	15%	0.375 kg
2.	Corncob	15%	0.375 kg
3.	Clay	35%	0.875 kg
4.	Red soil	35%	0.875 kg
Total		100%	2.5 kg

Table 5 :20% corn tile – mixing ratio

4th MIX : 20 % OF CORNCOB POWDER			
S.NO	**MATERIAL**	**PERCENTAGE(%)**	**WEIGHT**
1.	River Sand	10%	0.250 kg
2.	Corncob	20%	0.500 kg
3.	Clay	35%	0.875 kg
4.	Red soil	35%	0.875 kg
Total		100%	2.5 kg

Table 6 :5% corn + 5% RHA tile – mixing ratio

1stMIX : 5 % OF CORNCOB POWDER + 5% RHA			
S.NO	**MATERIAL**	**PERCENTAGE(%)**	**WEIGHT**
1.	River Sand	30%	0.750 kg
2.	Corncob	5%	0.125 kg
3.	Rice husk ash	5%	0.125 kg
4.	Red soil	30%	0.750 kg
5.	Clay	30%	0.750 kg
Total		100%	2.5 kg

Table 7 :5% corn + 10% RHA tile – mixing ratio

2nd MIX : 5% of Corncob powder + 10% RHA			
S.no	**Materials**	**Percentage(%)**	**Weight**
1.	River Sand	25%	0.625 kg
2.	Corncob	5%	0.125 kg
3.	Rice husk ash	10%	0.250 kg
4.	Red soil	30%	0.750 kg
5..	Clay	30%	0.750 kg
Total		100%	2.5 kg

Table 8 :5% corn + 15% RHA tile - mixing ratio

3rdMIX : 5% of corncob powder + 15% RHA			
S.no	**Materials**	**Percentage(%)**	**Weight**
1.	River Sand	20%	0.500 kg
2.	Corncob	5%	0.125 kg
3.	Rice husk ash	15%	0.375 kg
4.	Red soil	30%	0.750 kg
5.	Clay	30%	0.750 kg
Total		100%	2.5 kg

Table 9 :5% corn + 20% RHA tile - mixing ratio

4thMIX : 5% of corncob powder + 20% RHA			
S.no	**Materials**	**Percentage(%)**	**Weight**
1.	River Sand	15%	0.375 kg
2.	Corncob	5%	0.125 kg
3.	Rice husk ash	20%	0.500 kg
4.	Red soil	30%	0.750 kg
5.	Clay	30%	0.750 kg
Total		100%	2.5 kg

Fig 1 : Casting the Tiles

Fig 2 : Compression test of tiles

C. Testing of specimens

Two test have been made for low cost roof tiles. This test are made to find out the water absorption capacity of low cost roof tiles and ultimate strength of the low cost roofing tiles.

i Water Absorption Test.

ii Compressive Strength Test

Water Absorption Test

The tiles were dipped in a tray of water for 24 hours for determining the water absorption capacity.

Tiles	**Dry weight**	**Wet weight**	**Water absorption**
Standard tile	1.892 gms	2.219gms	20%
5% corncob	1.237 gms	1.426 gms	15%
10% corncob	1.154 gms	1.396 gms	21%
15% corncob	1.054 gms	1.243 gms	18%
20% corncob	0.187 gms	0.980 gms	20%
5% corn+ 5%RHA	1.348 gms	1.645 gms	22%
5%corn+10%RHA	1.114 gms	1.347 gms	21%
5%corn+15%RHA	1.092 gms	1.310 gms	20%
5%corn+20%RHA	0.900 gms	1.08 gms	20%

Compressive Strength Test

Compressive strength or compression strength is the capacity of a material or structure to withstand loads tending to reduce size, as opposed to tensile strength, which withstands loads tending to elongate. In other words, compressive strength resists compression, whereas tensile strength resists tension. In this study and shear strength of roof tiles can be analyzed independently.

Tiles	**Weight (After burnt)**	**Load**	**Compressive Strength(N/MM^2)**
Standard tile	1.892 gms	8.6 KN	0.20
5% corncob	1.237 gms	9.6 KN	0.23
10% corncob	1.154 gms	9.13 KN	0.22
15% corncob	1.054 gms	8.5 KN	0.20
20% corncob	0.187 gms	7.69 KN	0.18
5% corn+ 5%RHA	1.348 gms	9.4 KN	0.22
5%corn+10%RHA	1.114 gms	8.17 KN	0.197
5%corn+15%RHA	1.092 gms	7.88 KN	0.19
5%corn+20%RHA	0.900 gms	7.59 KN	0.18

From the above table, we can estimate the effectiveness of replacement of river sand in making roof tiles with alternate materials.

5.CONCLUSIONS

From the test results, the following conclusions can be drawn : From our experimental study, we conclude that replacement of Rice husk ash in making roof tiles will be light effective if the replacement ratio lies below 5%. This study prove that 5% replacement of Rice husk ash in roof tiles with similar compressive strength, it would be a great benefit in both economic and environmental concern. And further replacement of Rice husk ash at the percentage of (5%, 10% and 15%) effectively, it will indirectly reduce the strength of the low cost roof tiles. Thus, both economic and environmental benefits occur at the percentage of 5%Rice husk ash and it can be followed for a making of low cost roofing tiles.

6. REFERENCES

- IS 3978-1967 Indian Standard Code of Practice for Manufacture of Burnt Clay Ma ngalore Pattern Roofing Tiles. YaningZung, A.E. Ghaly, Bingxi Li, ―Physical Proiperties of Corn Residues‖, American Journal of Biochemistry and Biotechnology, Aug, 2012. ISSN 1553-3468.
- Saravanan J, Sridhar M, ―Construction Technology, Challenges and Possibilities of Low Carbon Buildings in India‖, International Journal of Civil Engineering (SSRJIJCE), Vol 2 Issue 11, November 2015. ISSN 2348-8352.
- Saravanan J, Sridhar M, Vinitha Judith J, ―Effective Utilization of Vinyl Flex Banners – A Solid Waste Management Perspective‖, International Journal of Applied Engineering Research, Vol 10, No 38 (2015). ISSN 0973-4562.
- Saravanan J, Sridhar M, ―Flex Crete: Low Cost Concrete Using Old Vinyl Banners as Partial Replacement of Coarse Aggregate – Solid Waste Management Perspective‖, International Journal of Engineering Trends and Technology (SSRJ-IJETT), Volume 30 Number 4, December 2015. ISSN 2231-5381.
- Gunasekaran. K et al, ―Mechanical and bond properties of coconut shell concrete‖ (2011), construction and building materials 25 92-98. 9.K.Gunasekaran, P.S.Kumar, - ―Lightweight concrete mixdesign using coconut shell aggregate‖ Proceedings of International Conference on Advances in Concrete and Construction, ICACC- 2008 ,7- 9 February, 2008, Hyderabad, India pp. 450-459