

Optimization of agricultural waste in roofing tiles

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Abstract— *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 have prepared and evaluated the performance of low cost roofing tiles using agricultural wastes as raw material. Based on the results, it is suggested that we can efficiently replace significant quantity of river sand in making roofing tiles with the corn cob powder and rice husk powder in appropriate proportions which gave compressive strength as similar as before replacement. By replacing the river sand in making roofing tiles would reduce its manufacturing cost as well as selling price and makes it more affordable. Thus preparation of such sand replaced roof tiles will significantly reflect healthy environmental and economic benefits^[2].*

Keywords— *Roofing tiles, Corn cob, Rice husk, Partial sand replacement, Compressive strength.*

I. INTRODUCTION

Building materials have undergone a lot of modification from ancient times till this present technology era. With everyone seeking for affordable and comfortable houses to live in, every scientist and engineer is working hard to develop and optimize new building materials that would be durable and cost effective. Building materials range from roofing sheet, block, concrete, gravel, sand, clay, stone, cement, roofing tiles, steel, fine aggregate, coarse aggregate, laterite among others.

Materials used for roof cladding in building have evolved over time. A number of them have been deployed for specific reasons such as: building type, weather condition, availability, cost, durability, and weight, among others. Common ones in use are: metal, asphalt, wood, ceramic, polymers and quite recently concrete has been explored as a suitable material and found to be useful.

Cement as the major classical binder in construction industry is very expensive. This is because of phenomenal population growth and urbanization which have triggered high demand of cement for several construction purposes to meet up with the need to expand infrastructures (Otuoze, et.al 2012). Therefore the need to connect the gap between demand and high price has warranted the need to investigate the use of cheaper alternative sources^[3].

II. OBJECTIVE

1. To produce low cost roofing tiles.
2. To reuse the agricultural waste in production of low cost tiles, as there is no proper channel for the disposal of agricultural waste.
3. To compare the obtained result with standards for low cost roof tiles.

III. Literature review

1. Author: Mrs.K.SaranyaM.E.,Mythily.K

[1]

Replacement of Rice husk ash in making roof tiles will be light effective if the replacement ratio lies below 7%. This study prove that 7% 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 (14%, 21%, 28%, 35% and 42%) effectively, it will indirectly reduce the strength of the low cost roof tiles.

2. Author: Saravanan J, Imthiyasahamed S, Muniyasamy X, Muthu Ganesh P, Rawther Ibrahim Ali Sait^[2]

Replacement of river sand in making roof tiles will be effective if the replacement ratio lies below 5%. For example, if future study prove that 2% replacement of river sand in roof tiles with similar compressive strength, it would be a great benefit in both economic and environmental concern. If we replace 1% river sand with agricultural wastes (Corncob, Rice husk, etc.) effectively, it will indirectly reduce the demand for river sand and reduce the manufacturing cost of clay roof tiles, which induce the conversion of huts in slum areas into tiled houses.

3. Author: Unmesh Tayade, Priyanka Tupe, Shradha Lonikar^[3]

Replacement of Rice husk ash in making roof tiles will be light effective if the replacement ratio lies between 5% - 10%. This study prove that 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 (14%, 21%, 28%, 35% and 42%) effectively, it will indirectly reduce the strength of the low cost roof tiles.

4. Author: Zainordin Firdaus Zulkefli, Dr. Mohd Remy Rozainy Mohd Arif Zainolandnorhayati Osman^[4]

The strength test show, the average maximum pressure will increase as a percentage of the waste increased. Through the water absorption test shows the average percentage of water absorption for rice husk and palm fibre is less than 7%, with the tiles produced in accordance placed on the bathroom wall. The water absorption increase when the waste is increase. Lastly for anti slip test, the pendulum value increase when the waste value increase.

5. Author: Momoh Omuya RAHEEM, Hassan Suleiman OTUOZE P., And Usman ABDULHAFIZ^[5]

The result of TBS shows that 5% to 25% RHA proportions in the tiles is above 0% RHA (control) showing that hydration of RHA has provided binding strength to the tiles. A further increase of 30% RHA accounts for excessive fines beyond what is need and caused a decrease in the result of TBS as a result of low particle bonding which reduces the mechanical strength. However, 15% RHA proved to be the most optimal result for TBS of RHA roof tiles. TBS result also, decreased in value with increasing firing temperature because of disintegration and breaking of particles contact bonds due to excessive temperature. All the tiles produced met the minimum TBS requirement of (0.182N/mm²) of [14], 15% RHA at 900°C provided the best result.

III. MATERIAL AND METHODS

3.1 Materials used

Fine Aggregate, Corn cob, Red Soil, Clay, Rice Husk, Water

3.2 Testing of materials:

3.2.1 Specific Gravity Test

➤ Results for Specific gravity test on Materials

Table No. 3.1. Specific gravity of materials

Sr. No	Material	Specific gravity
1.	Red soil	2.29
2.	M-Sand	2.57
3.	Clay	2.10
4.	Rice husk ash	2.3
5.	Corn cob	1.9
	Average	2.232

3.2.2. Results for Particle size Distribution test on Sand

Table No. 3.2. Sand

IS Sieve	Weight retained (gm)	Cumulative weight retained (gm)	Cumulative % retained	Cumulative % passed
10	0	0	0	100
4.75	28.5	28.5	2.85	97.15
2.36	64.5	93	9.3	90.7
1.18	109	202	20.2	79.8
0.6	290	492	49.2	50.8
0.3	366.9	858.9	85.89	14.11
0.15	126	984.9	98.49	1.51
0.075	12.6	997.5	99.75	0.25
Pan	2.5	1000	100	0

Finess modules = 2.6

∴ The sand is medium sand

3.3. Mix Ratio:

1) Mix design for Rice Husk

Rice Husk mix				
Material	7%	14%	20%	25%

M-Sand	43	36%	30%	25%
Red soil	23	23%	23%	23%
Clay	27	27%	27%	27%

2) Mix Design For Corncob

Corncob mix				
Material	7%	14%	20%	25%
M-Sand	43	36%	30%	25%
Red soil	23	23%	23%	23%
Clay	27	27%	27%	27%

3.4. Mix design: Specimen size

Density = 2.232*1000
 = 2232 kg/m³

Volume of mould

Length = 8"

Width = 8"

Thickness = 1"

Mass = Volume * Density
 = (0.2032*0.2032*0.0254) * (2232)
 = 2.34 ~ 2.5 kg

Total weight = 2.5 kg (8" * 8" * 1)

3.5 Tests on roofing tiles:

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. The tests are:

1. Water Absorption Test.
2. Compressive Strength Test.

SUMMARY

In this project we are preparing and evaluating the performance of low cost roofing tiles using agricultural waste as a raw material. We are replacing quantity of sand in making roofing tiles with corn cub and rice husk ash in appropriate proportion. Replacement ratios are 7% , 14% , 20% and 25%.

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