EXPERIMENTAL INVESTIGATION OF FLOOR TILES USING AGRICULTURAL WASTES AS PARTIAL REPLACEMENT FOR CEMENT

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Abstract: In this study, an attempt has been taken to utilize the wastes produced from agriculture as a partial replacement in the manufacturing of useful construction materials. Proper and efficient disposal of agricultural wastes is being the key factor in solid waste management in most of the Indian States. So various wastes generated through agriculture such as Rice Husk and Straw was utilized suitably in the manufacture of tiles. Different mixes under various levels of replacement of agricultural wastes were prepared to study its behavioural performance. Various tests conducted to study the performance behaviour include Compressive Strength, Water Absorption and Flexural strength in tile specimens. Results indicate that all physical and mechanical properties of tiles fall within BIS standards. Based on the results, it is suggested that we can efficiently replace significant quantity of cement in making floor tiles with Rice husk and Straw ash in appropriate proportions. By replacing cement in making floor tiles would reduce its manufacturing cost as well as selling price and makes it more affordable. Thus, preparation of such cement replaced floor tiles will significantly reflect healthy environmental and economic benefits.

Keywords: **Rice Husk , *Rice Straw,***

1. INTRODUCTION

Building materials have undergone a lot of modification from ancient times till this present 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. Cement is widely used a construction material all over the world and with the upcoming innovations in construction industry, its use has widened. Cement as the major classical binder in construction industry is very expensive. This is because of the phenomenal population growth and urbanization which have triggered high demand for cement for several construction purposes to meet up with the need to expand infrastructures.

The need to connect the gap between demand and high price has warranted the need to investigate the use of cheaper alternative sources of binder as effective strategy to low-cost infrastructure properties that are comparatively adequate. An attempt has been taken to use agricultural waste as a partial replacement for cement. It not only reduces cost, equally helps to mitigate the problem of waste disposal which of great environmental and health concerns. Rice husk and Straw are wastes from agriculture and adapting it for usage in the production of floor tiles by partial replacement of 5%,10% and 15% of cement.

2. AGRO-BASED PRODUCTS

2.1. Rice Husk Ash

[Rice Husk Ash]

Rice husk is an agricultural waste product which is produced in millions of tons. Combustion of rice husk at controlled temperature produces RHA. It consists of non-crystalline silicon dioxide (SiO2) with large surface area and high pozzolanic reactivity. RHA can be used as a partial replacement of cement in conventional concrete to develop its strength and durability properties.

RHA is a perfect substitute of silica fume for making special concrete mixes. It reduces the permeability hence resistance against chloride attack increases. Improves compressive strength, flexural strength and split tensile strength. RHA mixed concrete shows better bond strength as compared to OPC concrete.

Table 1. Properties Of RHA

Particulars	Properties
Colour	Gray
Shape	Irregular
Mineralogy	Non-crystalline
Particle Size	< 45 micron
Specific gravity	2.3
Appearance	Very fine

2.2. Rice Straw

[Rice Straw]

Straw is an agricultural by-product consisting of the dry stalks of cereal plants after the grain and chaff have been removed. Straw is usually gathered and stored in a straw bale, which is a bale, or bundle, of straw tightly bound with twine, wire, or string. Straw bales may be square, rectangular, or round, and can be very large, depending on the type of baler used. In many parts of the world, straw is used to bind clay and concrete. A mixture of clay and straw, known as cob, can be used as a building material. Straw bale construction is gaining popularity as part of passive solar and other renewable projects. Fire resistance is an unexpected property of straw, because when its loose its highly flammable, but when its baled it can provide high fire resistance compared to other construction materials.

3. PROCEDURE FOR FABRICATION

For the objective to be achieved, we need to explore previously done research by doing comprehensive literature review of stuffs related with the concern topic. The method followed to achieve the objectives of the research determines the required data, which intern is a ground to decide on type and method of data collection and their analysis.

Different alternative data collection methods such as experiments, observations and archival records are examined and used when proved suitable. Both preliminary and secondary data are being used for the analysis. The test results were presented in tabular and graphical forms and the analysis and discussions were also made on the research findings both qualitatively and quantitatively. Finally based on the findings, conclusions and recommendations were furnished. So this will be the theme of finding a way through our goal.

3.1. Mix Proportion

The cement mortar mix is prepared with the mix proportion of 1:3. The water cement ratio selected 0.55 is based on the standard consistency of the cement. The ratio is generally varied from 0.3 to 0.5%.

Table 2. Percentage replacement of Rice husk and Straw Ash in mortar

Mix No.	Cement	River sand	Rice husk Ash	Straw Ash
M	100%	100%	0%	0%
M_1	95%	100%	2.5%	2.5%
M_2	90%	100%	5%	5%
M_3	85%	100%	7.5%	7.5%

[Rice husk and Straw Ash]

3.2. Formation of an Tile Specimen

To design an acoustic panel, we made a wooden frame of length 38 cm and breadth 25 cm. Our wooden frame is By-product of Neem wood.

3.3. Casting of specimen

The cement mortar is mixed well in the ratio 1: 3 with water based on the water cement ratio and proper addition of industrial wastes. The mortar is filled in the respective mould. The mould after filling with mortar were placed at a temperature of 27+2o C and 90 % relative humidity for 24 hours.

[Casted Tile Specimen]

4. TEST CONDUCTED

4.1. Compressive Strength Test

Compressive strength is the capacity of material or structure to resist or withstand compression. The Compressive strength of a material is determined by the ability of a material to resist failure in the form of cracks and fissures. In this test, the push

force applied on both the faces of tile specimen and maximum compression the tile bears without failure, is noted.

[Tile under Compressive Strength Test]

4.2. Flexural Strength Test

Flexural testing is used to determine the flex or bending properties of a material. Sometimes referred to as a transverse beam test. It involves placing a sample between two points or supports and initiating a load using a third point or with two points which are respectively call 3-Point Bend and 4-Point Bend testing.

[Tile under Flexure Strength Test]

4.3. Water Absorption Test

It is a test to determine the moisture content absorbed by the tiles as a percentage of its dry weight. The sample is weighed, dried in an oven, then reweighed under standard conditions.

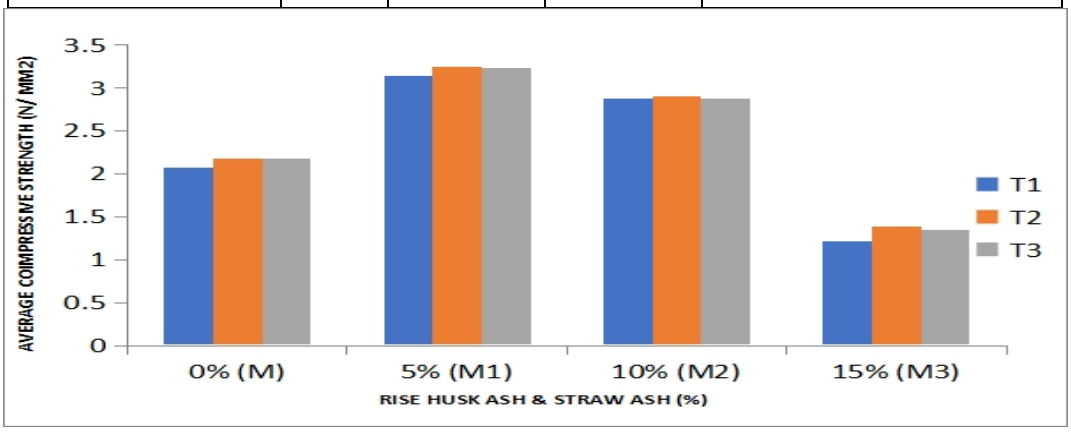
5. RESULTS AND DISCUSSION

In this chapter the results from experimental investigation are presented. The results from the experimental investigation are used to study and compare the strength of cement mortar produced by Rice husk and Straw ash as partial replacement of cement

5.1. Compressive Strength Test:

Table 3. Compressive strength test observations

Mix Proportion	Compressive strength of tiles (N/mm^2)			Average Compressive strength (N/mm^2)
	T_1	T_2	T_3	
0% (M)	2.073	2.178	2.180	2.143
5% (M_1)	3.147	3.248	3.240	3.211
10% (M_2)	2.884	2.900	2.879	2.887
15% (M_3)	1.221	1.387	1.350	1.319



[Comp. Strength for various Percentages of Rice husk & Straw Ash]

5.1.1. Discussion on results:

Conventional Tiles shows better results when compared to 15% but it possess low compressive strength when compared to 15% tiles with partial replacement of cement with Rice husk and Straw ash.

10% of Rice husk and straw ash replaced in cement shows better results when compared to conventional tiles.

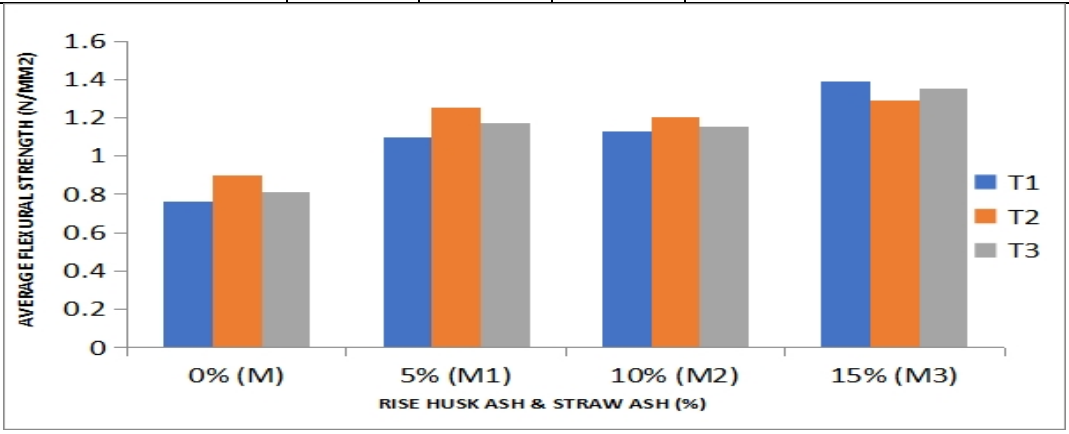
The Average Compressive strength for tiles having 5% of Rice husk and Straw ash shows better results when compared to conventional tiles and tiles with partial replacement of cement with 5%,10% and 15% of Rice husk and Straw ash.

5.2. Flexural Strength Test

Table 4. Flexure Strength Test Observations

Mix Proportion	Flexural strength of tiles (N/mm^2)			Average Flexural strength (N/mm^2)
	T_1	T_2	T_3	

0% (M)	0.76	0.90	0.81	0.82
5% (M_1)	1.10	1.25	1.17	1.17
10% (M_2)	1.13	1.20	1.15	1.16
15% (M_3)	1.39	1.29	1.35	1.34



[Flexural strength for various Percentages of Rice husk and Straw ash]

5.2.1. Discussion on Results:

5% of Rice husk and straw ash replaced in cement shows better results when compared to conventional tiles and tiles with partial replacement of cement with 10% of Rice husk and Straw ash but it possess low flexural strength when compared to 15% tiles with partial replacement of cement with Rice husk and Straw ash.

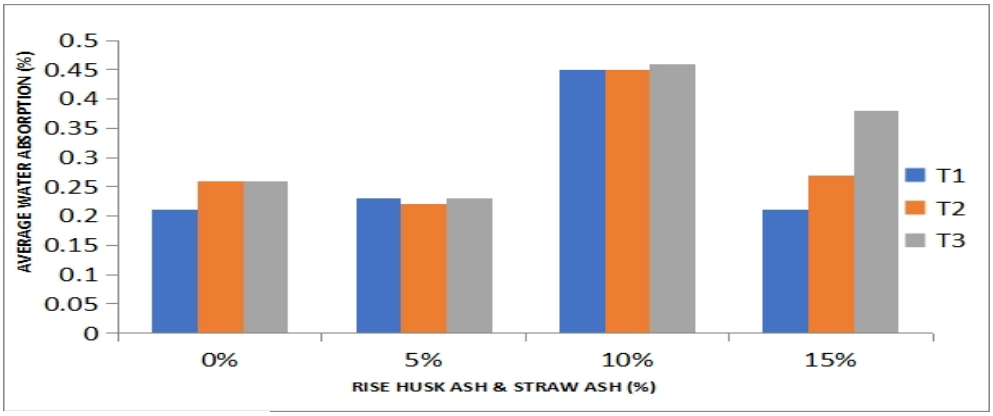
10% of Rice husk and straw ash replaced in cement shows better results when compared to conventional tiles.

The Average Flexural strength for tiles having 15% of Rice husk and Straw ash shows better results when compared to conventional tiles and tiles with partial replacement of cement with 5%,10% and 15% of Rice husk and Straw ash.

5.3. Water Absorption Test

Table 5. Water Absorption of different tile specimen

Proportion	W.A (%) T1	W.A (%) T2	W.A (%) T3	Average W.A (%)
0% (M)	0.21	0.26	0.26	0.24
5% (M_1)	0.23	0.22	0.23	0.22
10% (M_2)	0.45	0.45	0.49	0.46
15% (M_3)	0.21	0.27	0.38	0.28



[Water Absorption for various Percentages of Rice husk & Straw ash]

5.3.1. Discussion on Result:

Percentage of Water absorption for tiles having 5% of Rice husk and Straw ash shows better results when compared to conventional tiles and tiles with partial replacement of cement with 5%,10% and 15% of Rice husk and Straw ash.

15% of Rice husk and straw ash replaced in cement shows better results when compared to 0% and 10%.

Conventional tile possess less water absorption when compared to 10% of Rice husk and straw ash replaced in cement.

6. CONCLUSION

The following conclusions can be drawn from the present study:

1. The experimental work has been devoted to evaluate the Compressive strength, Flexural strength and Water absorption, when cement replacement materials were employed as partial replacement with Rice husk and Straw Ash in the mortar mixes. The following are the conclusions drawn from the investigation.
2. The Average Compressive strength for tiles having 5% of Rice husk and Straw ash shows better results when compared to conventional tiles and tiles with partial replacement of cement with 5%,10% and 15% of Rice husk and Straw ash.
3. The Average Flexural strength for tiles having 15% of Rice husk and Straw ash shows better results when compared to conventional tiles and tiles with partial replacement of cement with 5%,10% and 15% of Rice husk and Straw ash.
4. Percentage of Water absorption for tiles having 5% of Rice husk and Straw ash shows better results when compared to conventional tiles and tiles with partial replacement of cement with 5%,10% and 15% of Rice husk and Straw ash.
5. From our theoretical study, we conclude that replacement of Rice husk and Straw Ash in making floor tiles will be effective if the replacement ratio lies between 5% - 10% comparatively.
6. This study proves that replacement of Rice husk and Straw Ash in floor tiles with similar compressive strength, would be a great benefit in both economic and environmental concern.
7. And further replacement of Rice husk and Straw Ash effectively will indirectly reduce the strength of the low- cost floor tiles.

7. REFERENCES

1. Ashour T. and Wei Wu, 2010, “An experimental study on shrinkage of earth plaster with natural fibres for straw bale buildings”, International Journal of Sustainable Engineering, Volume 3 Issue 4, pp 299-304.
2. Saravanan J, Sridhar M, 2015-Construction Technology, Challenges and Possibilities of Low Carbon Buildings in India‖, International Journal of Civil Engineering (SSRJ-IJCE), Volume 2 Issue 11, pp 6-11.
3. Julian Robinson et.al.,2016, “Determining Moisture levels in straw bale construction”, SCESCM, pp1526-1534.
4. Mangesh V. Madurwar, Rahul V, Ralegaonkar, Sachin A and Mandavgane,2017, “Application of agro-waste for sustainable construction materials: A review” Construction and Building Materials., vol. 38, pp. 872-878.
5. Arturas Lebed and Nerijus Augaitis,2017, “Research of physical properties of straw for building panels”, International Journal of Engineering Science Invention Volume 6, Issue 5, pp 09-14.
6. Ritesh Jadhao and Amrutha Umale,2018, “Review on Low-cost roofing tiles using agricultural and industrial wastes”, IJFEAT Volume 3, Issue 12, pp 33-36.
7. Arun Kumar Sharma et.al.,2018, “A Review on preparation of roof tiles using industrial wastes and fibres”, IJCIET Volume 9, Issue 6, pp 757-764.
8. IS 3978-1967 Indian Standard Code of Practice for Manufacture of Burnt Clay Mangalore Pattern Roofing Tiles.