JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

MANUFACTURING OF AGRO WASTE TILES

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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. Effective and adequate recycling of agricultural wastes are a key factor in waste disposal in most of the world. Replacing the ordinary tiles and conventional poor class tiles with much efficient alternate and made of agricultural waste is being the most required. 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 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 agro waste tiles with the corn cob powder and rice husk powder in appropriate propositions which gave compressive strength as similar as before replacement. The experimental tiles were studied and their compressive strength, water absorption, drying shrinkage and bulk density were determined. Thus, preparation of such replaced tiles will significantly reflect economic benefits and healthy environment. Thus, preparation of such agro waste tiles will significantly reflect healthy environmental and economic benefits.

CHAPTER 1 INTRODUCTION

Agro waste, also known as agricultural waste, refers to the by-products generated during various agricultural activities. These by-products often include crop residues, husks, straw, and other organic materials that are left behind after harvesting or processing crops. Instead of letting these materials go to waste, they can be repurposed and used in various applications. One innovative and sustainable way to utilize agro waste is in the production of tiles. By incorporating agro waste into tile manufacturing, we can contribute to environmental sustainability, reduce waste, and create eco-friendly building materials. the utilization of agro waste in tile manufacturing represents a sustainable and eco- friendly approach to address environmental concerns, reduce waste, and create innovative building materials. This practice aligns with the principles of a circular economy, promoting resource efficiency and contributing to a more sustainable future in the construction industry. Effective and adequate recycling of agricultural wastes are a key factor in waste disposal in the majority of the world. 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. In this project we have prepared and evaluated the performance of low- cost tiles using agricultural wastes as raw material. The experimental tiles were studied and their compressive strength, water absorption, drying shrinkage and bulk density were determined. Thus, preparation of such replaced tiles will significantly reflect economic benefits and healthy environment. Manufacturing tiles using agro waste is an innovative and sustainable approach that harnesses the potential of agricultural byproducts to create eco-friendly building materials. This method not only reduces environmental impact but also provides a cost-effective

solution for both the construction industry and agricultural sector. In this process,

various types of agro waste, such as rice husks, sugarcane bagasse, or coconut shells, are transformed into durable and aesthetically pleasing tiles through a combination of natural processes and modern technology. This approach not only addresses the problem of waste disposal but also contributes to a greener and more sustainable future in the construction industry.

1.1 OBJECTIVE

To determine the properties of the Replacement Material (Rice husk Ash) and (Sugarcane bagasse). comparing of the strength of Conventional and Replacement Tiles. deriving the cost of the Replacement Material. To compare the obtained result with standards for Agro Waste tiles. Decrease the burden on landfills by diverting agro waste from disposal sites, thereby contributing to more sustainable waste management practices. Minimize the environmental impact of agricultural waste by repurposing agro waste materials into valuable products, such as tiles.

1.2 SCOPE:

- **To control industrial solid waste.**
- **To utilize agricultural solid waste.**
- **To reduce the manufacturing cost of conventional tile by replacing low-cost materials.**
- **To promote environmental sustainability**

1.3 LITERATURE REVIEW:

Kannan. July 2022, 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.

Saravanan. march 2017, 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 propositions 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.

Zainordin Firdaus Zulkefli, in general of 80% the human activities is located in the building. Buildings

constructed should be in line with full functions and optimum safety features. Aspects to be emphasized is the slip on the floor of the building. The selection of tiles must have anti-slip characteristics and achieve standard strength stress. This study is conducted to develop anti-slip tiles modification using agricultural waste. The material used is agricultural waste such rice husks, palm fibre and saw dusk mixed into the clay and then baked at a temperature of 900-1185 C °. Agricultural waste mixture ratio is 5%, 10% and 15%. The samples of tiles are produced for experiments. The results of agricultural waste tiles show that the strength is higher than standard strength, the water absorption less than standard tiles and pendulum value test is exceeds 36.

Kumar P R. march 2020, This technical review paper highlights the research work pertaining to the role of agricultural wastes, such as vegetable fibres, coconut shell, palm oil clinkers, and rice husk ash, in construction industry. Fibres are converted into strands and pulp form. Mainly, it is used in light weight concreting due to its engineering properties. Agricultural wastes are utilized to minimize the environmental pollution as well. It is regarded as an economically viable alternative. Coconut shell is broken and utilized as an aggregate in the construction of flooring tiles. Rice husk ash is utilized as an optimum replacement of cement. In this view it can be concluded that for the replacement of aggregates, rice husk ash, coconut shell and jute fibres can be adopted. This will help to minimize the agricultural wastes and promote environmental sustainability.

Waghmare Vaman Bhaskar. may 2022, 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 propositions 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.

Myrian Aparecida S. 2015, In Brazil, the sugarcane industry generates large amounts of sugarcane bagasse ash, and a key issue is to find a proper use of this solid waste material. The aim of this study is to determine the chemical, physical and mineralogical characteristics of a sugarcane bagasse ash sample from south- eastern Brazil, and to investigate its use in the production of ceramic floor tile. The sample of this waste material was analyzed regarding chemical composition, mineralogical analysis, particle size distribution, morphology, particle density, and organic matter. Floor tile pieces containing up to 2.5 wt% sugarcane bagasse ash waste as a partial replacement of quartz were prepared by uniaxial pressing and sintered at 1190°C. The following technological properties were determined using standard procedures: flexural strength, apparent density, linear shrinkage, and water absorption. The experimental results indicated that the sugarcane

bagasse ash waste is rich in quartz particles, and has potential to be used as an alternative raw material for the production of ceramic floor tile.

M.A.S. Schettino October. 2016, In this work, the effect of sugarcane bagasse ash waste on the densification behavior of vitrified floor tiles was investigated. Four tile formulations containing up to 5 wt. % of sugarcane bagasse ash waste as a replacement of quartz were prepared. The floor tile manufacturing route consisted of the following steps: powder preparation by the dry process, uniaxial pressing, and firing at temperatures between 1190 ºC and 1250 ºC using a fast- firing cycle. The densification was measured by three parameters: linear shrinkage, water absorption, and flexural strength. The microstructure was evaluated by XRD and SEM. The experimental results indicated that the densification behavior of floor tile formulations was influenced by both the amount of sugarcane bagasse ash waste and the maximum firing temperature. Microstructural variation occurred during firing. However, the use of sugarcane bagasse ash waste had little effect on phase

evolution during the fast-firing cycle. An optimum amount of sugarcane bagasse ash waste (up to 2.5 wt. %) for the replacement of quartz allowed for the highest quality production of floor tile materials.

Agbede Olufemi. June 2016, This research deals with the effects of using rice husk ash (RHA) as a partial weight of cement replacement in concrete roof tile production. The work is based on an experimental study of roof tiles produced with ordinary Portland cement (OPC) and 5 %,10 %, 15 % , 20 % and 25 % (OPC) replaced by RHA. The rice husk ash used was produced by open air burning the rice husk. The tests which were performed evaluate the performance of this material were: specific gravity normal consistency, setting time, compressive

strength, rupture strength and water absorption. The results show that addition of RHA show better results for 10 % replacement level than OPC at 28 days.

Jagruti Bhatt. November 2022, Roof tiles are designed mainly to stay out rain, and are traditionally made up of locally available materials such as terracotta or slate. Modern materials like concrete and plastic are also used and some clay tiles have a waterproof glaze. On the opposite side, proper and efficient disposal of agricultural wastes is being the key think about solid waste management in most of the Indian States. Replacing the standard huts and conventional poor class roofs with much efficient alternate roof cover is being the most required. The paper suggest that we will efficiently replace significant quantity of river sand in making roofing tiles with the corn cob powder and rice husk powder in appropriate propositions was as similar as before replacement which gave compressive strength. The reviewed literature highlight about green roof, benefits and low cost roofing tiles using agricultural wastes as staple.

Kukuh Kurniawan D. Rice husk ash (RHA) is very rich in the content of silica (SiO_2) or known as silica dioxide. The content of silica (SiO_2) in RHA reaches about 90%. This study was to investigate the characteristics of clay tile which was added RHA originating from burning brick. Addition of RHA on clay tile is 0%, 2.5%, 5% and 7.5% by weight of clay. The results of seepage test, all of clay tile obtained no leakage or water droplets at the location in the water soak. The addition of 7.5% RHA resulted in an absorption of up to 18%, and addition of 5% and 2.5% RHA is 14.8% and 14.8% in absorption test. Maximum flexural load was obtained by increasing the RHA by 7.5% which is average of 68.75kg, for the addition of 5% RHA and 2.5% is 65kg and 66.25kg. And clay tile without RHA produces 60kg bending load.

CHAPTER 2 MATERIAL USED

2.1 CLAY:

Clay has the smallest particle size of any soil type, 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-heavy soil tends to be very dense. Clay contains very little organic material; you often need to add amendments if you wish to grow plants in clay-heavy soil.

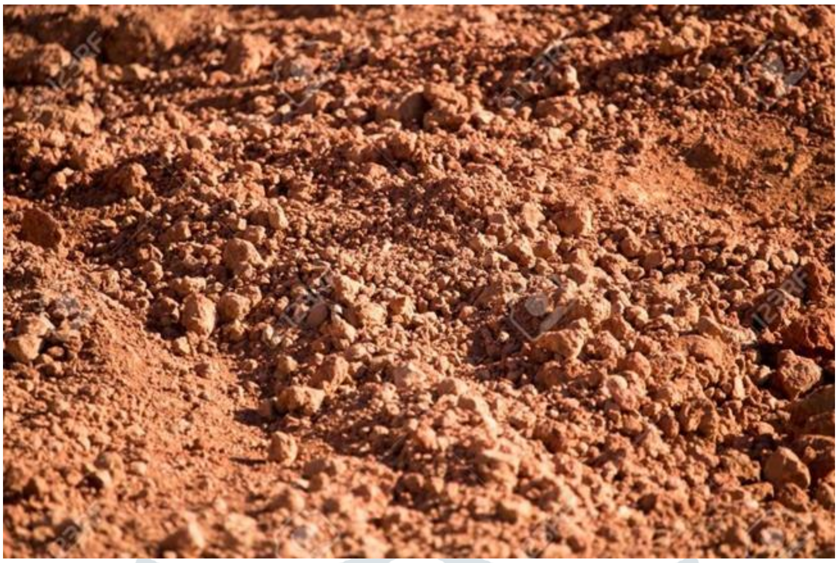

Fig: 2.1 clay

2.2 FINE AGGREGATE:

Fine aggregate, often known as sand, is a crucial component in concrete and construction. Its properties include particle size, shape, and texture, which impact the workability, strength, durability of concrete. Fine aggregates should ideally have a mix of sizes and shapes to enhance the packing density within the concrete mixture. Smooth, rounded particles are generally preferred for better workability,

while angular particles can contribute to higher strength due to increased interlocking within the mix. The granular size of fine sand is so fine that they can pass by a 4.75mm sieve.

Fig: 2.2 Fine aggregate

2.3 RICE HUSK ASH:

Rice Husk Ash (RHA), a waste from firing process of clay products, has no proper usage. For this study, roof tile specimens were manufactured by replacing clay with different RHA percentages (i.e., 0%, 5%, 10%, 15% and 20%) in an industrial scale plant, so as to determine the effect of waste RHA from a brick firing process on structural, thermal properties and run off qualities of clay roof tiles. For 10% replacement of clay with RHA, transverse breaking load was increased by 45.97% indicating higher ductility compared with that of the conventional tiles. Bulk density is reduced with the percentage of RHA added, promising a light-weight roof tile, a favorable tile for a roofing material. Collected runoff coming along the 10% RHA mixed clay roof tiles has a pH value of 7.22 and total solid concentration of118.67 mg/L, indicating RHA mixed roof clay tile will not

cause any severe impact on the runoff. Hence this harvested runoff can still be utilized

for non-potable activities while enhancing the strength and thermal properties of clay roof tiles.

Fig: 2.3 Rice Husk Ash

2.4 SUGARCANE BAGASSE:

The representative sample of sugarcane bagasse ash waste in form of powder was collected in sugarcane plant from south-eastern Brazil. The waste sample was subjected to drying in an oven for 24 hours at 110 °C. Floor tile compositions containing up to 2.5 wt.% of sugarcane bagasse ash waste as a partial substitute of quartz were prepared. Kaolin, albite, and quartz commercial were used. The compositions were mixed, homogenized, and granulated. The moisture content was adjusted to 7 wt.%. The compositions were pressed into rectangular pieces (11.50 cm x 2.54 cm) at 50 MPa, dried at 110 ºC for 24 h, and then fired in air at 1190 ºC. The following technological properties of floor tile pieces were determined according to standardized procedures: linear shrinkage (ASTM C326),

apparent density (ASTM C373), water absorption (ASTM C373), and flexural strength (ASTM C674).

Fig: 2.4 sugarcane bagasse

2.5 WATER:

Potable tap water was used for mixing and curing of specimens. The water reacts with the clay and sand, which bonds the other components together, creating a solid like material. Water has several important physical properties. Although these properties are familiar because of the omnipresence of water, most of the physical properties of water are quite a typical. Given the low molar mass of its constituent molecules, water has unusually large values of viscosity, surface tension, heat of vaporization, and entropy of vaporization, all of which can be ascribed to the extensive hydrogen bonding interactions present in liquid water.

Fig: 2.4 water

CHAPTER – 3 METHODOLOGY

3.1 GENERAL:

In this chapter we are going to discussed about the process of low-cost tiles using agro waste.

3.2 METHODOLOGY:

TOPIC SELECTION

LITERATURE REVIEW

COLLECTION OF MATERIAL

CASTING & PREPERATION

TESTING OF SPECIMEN

RESULT AND DECUSSION

CONCLUDION

fig 3.1 methodology

CHAPTER 4 MATERIAL TESTING

4.1 SIEVE ANALYSIS

Sieve analysis is an index number which represents the mean size of the particles in sand. It is calculated by performing sieve analysis with standard sieves. The cumulative percentage retained on each sieve is added and subtracted by 100 gives the value of the fine aggregate.

SAMPLE PREPARATION

Take a sample of fine aggregate in pan and placed it in dry oven at a temperature 100-110°C. After drying take the sample and note down its weight.

PROCEDURE

- **Take the sieve and arrange them in descending order with the largest sieve on top.**
- **If mechanical shaker is using then put the ordered sieves in position and pour the sample in the top sieve and then close it with sieve plate.**
- **Then switch on the machine and shaking of sieves should be done atleast 5 minutes.**
- **After sieving, record the sample weights retained on each sieve.**
- **Then find the cumulative weight retained.**
- **Finally determine the cumulative percentage retained on each sieve.**
- **Add all the cumulative percentage values and divide with 100 then we will get the value of fineness modulus**

Fig 4.1 Sieves

4.2 LIQUID LIMIT PROCEDURE

- **About 120 gm of air-dried soil from thoroughly mixed portion of material passing 425 micron I.S sieve is to be obtained.**

• Distilled water is mixed to the soil thus obtained in a mixing disc to form uniform 1 2 paste. The paste shall have a consistency that would require 30 to 35 drops of cup to cause closer of standard groove for sufficient length.

• A portion of the paste is placed in the cup of LIQUID LIMIT device and spread into portion with few strokes of spatula.

• Trim it to a depth of 1cm at the point of maximum thickness and return excess of soil to the dish.

• The soil in the cup shall be divided by the firm strokes of the grooving tool along the diameter through the centre line of the follower so that clean sharp groove of proper dimension is formed.

• Lift and drop the cup by turning crank at the rate of two revolutions per second until the two halves of soil cake come in contact with each other for a length of about 1 cm by flow only.

• The number of blows required to cause the groove close for about 1 cm shall be recorded.

• representative portion (15gm) of soil is taken from the cup for water content determination by oven drying.

• Repeat the test with different moisture contents at least three more times for blows between 10 and 40.

Fig 4.2 Liquid Limit

4.3 PLASTIC LIMIT

PROCEDURE

•Take about 20gm of thoroughly mixed portion of the material passing through 425 micron I.S. sieve obtained in accordance with I.S. 2720 (part 1).

•Mix it thoroughly with distilled water in the evaporating dish till the soil mass becomes plastic enough to be easily molded with fingers.

•Allow it to season for sufficient time (for 24 hrs) to allow water to permeate throughout the soil mass

•Take about 10gms of this plastic soil mass and roll it between fingers and glass plate with just sufficient pressure to roll the mass into a threaded of uniform diameter throughout its length. The rate of rolling shall be between 60 and 90 strokes per minute.

•Continue rolling till you get a threaded of 3 mm diameter.

•Kneed the soil together to a uniform mass and reroll.

•Continue the process until the thread crumbles when the diameter is 3 mm.

•Collect the pieces of the crumbled thread in air tight container for moisture content determination.
•Repeat the test to at least 3 times and take the average of the results calculated to the nearest whole number.

CHAPTER – 5 DESIGN MIX

5.1 MIXING PROCEDURE

Roof tiles are made as per the recommendations provided in IS 3978- 1967. The mixing ratios were adopted from the local roof tile manufacturing plant located nearby Poonamallee, Chennai.
The default mixing ratios followed in the plant was:

Fine Aggregate : Red soil Clay :: 40:60 DENSITY :
Wet Clay : 1760 Kg/m3 Red soil : 1680 Kg/m3

In the above normal mixing ratio, we have altered the red soil ingredient initially with Rice husk Ash to find out the optimum replacement ratio and ingredient Sugarcane Bagasse husk as partial replacements

Table 1: CONTROL TILE – MIXING RATIO

Control Tiles / Normal Tiles 6 x 6 (Inches)		
FINE AGGREGATE	40%	600grm
CLAY	60%	950grm

Table 5.1: Control Tile – Mixing Ratio

Table 2: 5% RHA Tile + 5%SBH Tile – Mixing Ratio

5% RHA Tile + 5% SBH Tile 6 x 6 (Inches)		
FINE AGGREGATE	50%	785gram
CLAY	40%	600gram
RHA	5%	25gram
SBH	5%	25gram

Table 5.2: 5% RHA Tile + 5%SBH Tile – Mixing Ratio

Table 3: 10% RHA + 10% SBH Tiles – Mixing Ratio

10% RHA + 10% SBH 6 x 6 (Inches)		
RED SOIL	40%	600gram
CLAY	40%	600gram
RHS	10%	50gram
SBH	10%	50gram

Table 5.3: 10% RHA + 10% SBH Tiles – Mixing Ratio

CHAPTER – 6

EXPRIMENTAL WORK

6.1 GENERAL

The specimens were casted according to the mix ratio by the following equipment and curing were made at the outside of the lab.

6.2 SAMPLE PREPARATION

Materials were collected and mixed with proper proportions. A required quantity of Red soil Clay, Rice husk ash, Sugarcane bagasse. The whole materials are mixed thoroughly by designed proportional amount of water.

Fig 6.1: Sugarcane bagasse

Fig 6.2: Sieving

6.3 MOULDING AND DEMOULDING:

After the mixing of ingredients is over, the concrete is poured into a mould of dimensions 300 mm x 300mm x 20mm. After final setting time (24 hours) the concrete is removed from the mould.

Fig 6.3: Moulding and Demoulding

6.4 CURING:

The process of immersing the prepared concrete blocks into the water is called as curing of concrete blocks. Curing plays an important role on strength development and durability of concrete. The specimen get tested by compression testing machine. Prepared concrete block is cured in 28th day till the concrete specimen gets its strength. Strength of concrete block is directly proportional to the curing of concrete which means if the curing day is extended the strength of the concrete is also increased. Properly cured concrete has an adequate amount of moisture for continued hydration and development of strength, volume stability, and resistance to freezing.

6.5 WATER ABSORPTION TEST

- **Dry the chosen tiles in an oven at a temperature of 105 ° to 110 °C until they gain constant weight and then cool and weigh (W1).**
- **After getting cool, submerge the dry specimen fully in clean water at 27±2°C for 24 hours.**

- **Take out each specimen, cleanse the surface water cautiously with a damp cloth and weigh the specimen closer to a gram (W2) within 3 minutes as soon as the specimen is taken out from the tank.**
- **Percentage of water absorption is calculated with the following equation:**

W = ((W2-W1)/W1)*100

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

6.5.1 WATER ABSORPTION OF TILE CALCULATION:

- **Sample 1 :**

- **Normal Tiles**

W= ((W2-W1)/W1)*100 W = ((700-450)/450)*100 W = 20%

- **Sample 2 :**

5% RHA + 5% SBH Tile W=((W2-W1)/W1)*100 W =((460-350)/350)*100 W = 31%

- **Sample 3 :**

10% RHA + 10% SBH Tile W= ((M2-M1)/M1)*100
W =((450-350)/350)*100 => 28%

6.5.1 WATER ABSORPTION TEST ON TILE

PARTICALS	DRY WEIGHT	WET WEIGHT	WATER ABSORPTION
Normal tile	350	280	20%
5% RHA + 5% SBH Tiles	460	350	31%
10% RHA + 10% SBH Tiles	450	350	28%

Table 6.1: Water Absorption Test on Tile

6.6 COMPRESSIVE STRENGTH OF THE TILE

Tile 6 x 6 Inches	Compressive Strength of the Tile in KN	Average Compressive Strength LOAD IN N/cm2

Normal tiles S1 42.5KN 3.15N/cm2
S2 54.6KN
5% RHA Tile
+ 5% SBH S1 8.20KN 0.210N/cm2
S2 6.78KN
10% RHA S1 20.15KN 0.325N/cm2
S2 19.45KN
+ 10% SBH

Table 6.2: Compressive Strength of the Tile

GRAPH FOR COMPRESSIVE STRENGTH OF THE TILE

Graph 6.1: Compressive Strength of The Tile

CHAPTER – 7

RESULT AND CONCLUSION

7.1 RESULT

The loads of the tiles of various mixing ratios. The water absorption of control tiles were determined as 25% and for SBH and RHA tiles as 25% which showed that there is no difference in water absorption characteristics of control and other tiles.

7.2 CONCLUSION

- **From our experimental study, we conclude that replacement of clay in making roof tiles will be effective if the replacement ratio lies below 5%.**
- **For example, if future study proves that 2% replacement of clay in roof tiles with similar compressive strength, it would be a great benefit in both economic and environmental concern.**
- **If we replace 10% clay with agricultural wastes (Sugarcane bagasse husk, Rice husk, etc.)**
- **Thus, a both economic and environmental benefit occurs in this**

manner if the manufacturing of tiles using agricultural waste is made in large scale.

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