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EFFECTS OF PLASTIC AND EGG SHELL WASTE MATERIALS ON THE PHYSICAL AND STRENGTH PROPERTIES OF ROOF TILES

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Abstract - *Human activities often generate solid wastes such as plastics and egg shell wastes. Disposal of these wastes is usually a problem. The aim of this study was to investigate the feasibility of using plastic and egg shell wastes together with clay in the production of roof tiles. The waste was collected from kitchens and waste disposal facilities. The materials were cleaned and dried; and plastics were shredded while egg shells were crushed. Waste materials were then mixed with clay in different proportions. Compressive strength tests were carried out to determine the suitability of using such solid wastes in making roof tiles. Crushed egg shells passing through the 1.2 mm sieve and shredded plastics with an average diameter of to 1 to 2 mm were used. The compressive strength of the roof tiles was tested using a universal testing machine. The Increasing the quantity of plastics and egg shells resulted in elevated water absorption, while larger quantities of clay resulted in reduced water absorption. Increasing the quantity of egg shells and plastics resulted in reduced density. With the presence of plastics, It is concluded that egg shells can be used as filler material in the manufacture of the roof tiles. The study has established that use of plastic and egg shell wastes in the manufacture of roof tiles is a viable waste reduction option. However, further studies are necessary to establish the chemical interactions involved in roof tiles production systems where household and industrial wastes such as plastics and egg shells are used.*

Key Words: Plastics, Egg shells, Clay, Roof tiles, compressive strength

1. INTRODUCTION

Roof tiles are designed mainly to keep out water penetrating into the structural members and are traditionally made from locally available materials. Apart from traditional materials, some modern materials are also used in some clay tiles and it gives a water proof glaze in tiles. Also the usage of materials such as egg shells, plastics etc are also being used in the tiles ,which is easily available in local and also gives good aesthetic conditions.

2. PROFILES OF ROOF TILES

2.1 Flat Tiles

It is the simplest type, which are laid in regular overlapping rows. Flat roof tiles are usually made of clay but also be made of stone, wood , plastic, concrete or solar cells.

2.2 Imbrex and Tegula

It is an ancient Roman pattern of curved and flat tiles that makes rain channels on a roof.

2.3 Roman Tiles

It is flat in the middle, with a concave curve at one end and convex curve at the other, to allow interlocking.

2.4 Pantiles

It is with an S-shaped profile, allowing adjacent tile to interlock. These result in a ridged pattern resembling a ploughed field.

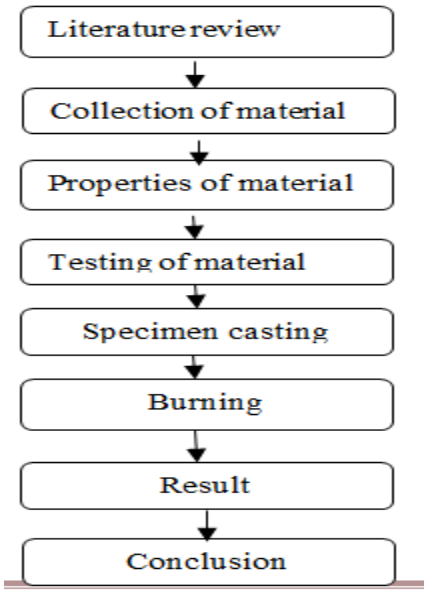
2.5 Mission or Barrel Tiles

It is semi-cylindrical tiles laid in alternating columns of convex and concave tiles. Originally they were made, by forming clay around a curved surface. Today barrel tiles are mass produced from clay, metal, concrete or plastic.

2.6 Interlocking Roof Tiles

It is similar to pan tiles with side and top locking to improve protection from water and wind.

3. METHODOLOGY



4. MATERIALS:

The following materials were used in our research.

- Clay soil
- Eggshell powder
- Plastic powder
- Water

4.1Clay

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.

4.2Eggshell

The egg shells were obtained from poultry farmers, hotels, mesh; the ware subjected to through cleaning involving soaking in water for 24 hours allowing easy removal of dirt and membranes during cleaning. The major component of egg shells being calcium carbonate makes them very important material. The egg shells are resistant to water penetration making it combination with plastics suitable for their use.Egg shells were first put in boiling water for 5-10 minutes to remove the membrane and then sun dried for 3-4 days and then some were pounded using a motor and pestle and others crushed using a million machine the pounded eggshells are sieved. The egg shells were used to increase the bulk and reduce on the use of other materials.

4.3 Plastic

Plastic is a strong material and it is resistant to both chemical and physical attacks making it hard to disintegrate it is also resistant to the penetration of water which is why it is considered one of the major threats to the fertility of our soils. This is made it a suitable component in this material since it increases on the water penetration resistant of the material. Plastics also increase the bonding in the composite material. Plastics were mainly used as fill materials to increase the bulk and reduce on the use of other material like clay and egg shells.

4.4Water

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

Advantages of roof tiles

Classy style

Roof tiles are quite a sight to see. They can transform your house in to wonderful masterpiece with beauty they provide. There are variety of tile colours to choose from in order to deliver the perfect look.

Endurance

Roof tiles have a long life expectancy. They are known to last for 50 years, but have lasted longer.

Protection

Tile roofs offer protection against insect boring and rotting, which also helps to promote further longevity.

Provide safety

Tile roofs are made from fire resistant material. They are known to prevent a fire from starting on the home as well as a fire spreading from the neighbor's home to yours.

Disadvantages of roof tiles

Delicate

It is not recommended to walk on the tile due to the possibility of it breaking. Roof tile is known to be long lasting, but it is wise to have a professional do any service are repair because they are trained to walk on the tile properly.

Heavy

Tile is known to be heavy. Proper reinforcement needs to be made because of the weight of the roof. Proper ventilation also needs to be installed because of the excessive heat in the summer. This is a major drawback of getting a tile roof.

Maintenance

The tile last for a long period of a time, there is some maintenance required if one has a tile roof. Every 20 years the materials where it is laid have to be replaced to avoid

your roof from caving in. one of the biggest problems with tile roofs is the underlayment paper and the proper ventilation.

5. TESTING ON ROOF TILES:

5.1Water absorption test

Water absorption test is the measurement of moisture quantity that roofing tile may absorb. If water absorption is too high, the tile may suffer from cracking which is not desirable.so, this test reflects the suitability of the tile for application; roofing tile need to have substantially low absorption capacity, especially in environments subjected to rainfall, freezing, and thawing cycles. Water absorption is expressed as a percent by weight of water against the dry weight of the individual tiles. Various codes around the world have established a method for water absorption test such American Standard for Testing materials and Indian Standard for testing materials and Indian standard. As perASTMC373, typicalwater absorption non-porous tiles is 0.1-0.5% while the porous products can exhibit water absorption in the range 9-15%

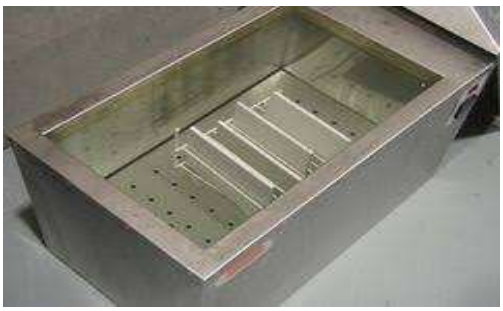


Fig.1 water absorption

Table-1: Water absorption test

Particulars	**Dry weight (W1)**	**Wet weight (W2)**	**Water absorption (W2-W1)/W1(%)**
Control tiles	800g	1000g	25%
25%plastic tiles	600g	800g	33%
25%egg shell tiles	800g	1000g	25%
15%plastic+10%egg shell tiles	700g	900g	29%
5%plastic+ 20%Eggshell tiles	800g	1000g	25%

5.2 UNCONFINED COMPRESSIVE TEST

The unconfined compression test is a special form of a tri-axial test which the confining pressure is zero. The test can e conducted only on clay soil which can stand without confinement. The test is generally performed on intact (non-fissured), saturated clay specimens. Although the test can be conducted in tri axial test apparatus as a u-u test, it is more convenient to perform in an unconfined compressive testing machine. The confined compressive strength test is conducted on black cotton soil as per IS2720 part 10-(1973) for the various percentages as 0%,10%,15%,20%.,

There are two types of machines. They are

1. Machine with a spring.
2. Machine with a proving ring.

In this test, we are using the machine with proving ring. In this type of the unconfined compression testing machine. A proving ring is used to measure the compressive forces.

Table-2: Unconfined Compressive Strength

SL .NO	Percentage of eggshell and plastic powder(%)	Unconfined Compressive Strength(N/mm^2)
1	0	0.08
2	10	0.073
3	15	0.125
4	20	0.120

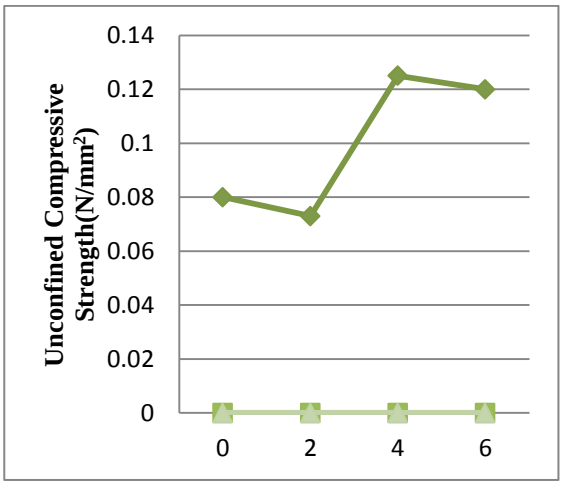


Chart -1: Unconfined compressive Strength

5.3 Flexural strength test

Flexural strength of clay also known a modulus of rupture or bend strength is a material property defined as the stress in a material just before it yields in a flexure test. The transverse bending test is most frequently employed, in which a specimen having either a circular or rectangular cross-section is bent until failure or yielding using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of yield

Flexural strength test is done as per IS: 516:1959. Prisms are tests for flexure in Universal Testing machine of capacity 500 KN. The bearing surfaces of the supporting and loading rollers are wiped clean before loading. The clay tiles are placed in the machine in such a manner that the load is applied to the upper most surface along the two lines spaced. The axis of the specimen is aligned with the axis of the loading device. The maximum load applied to the specimen during test is noted.

$$\text{Flexural Strength} = \frac{PL}{b \times d \times d} \ (\text{N/mm}^2)$$

Where,

P= Maximum load in newton applied to the specimen

L= Length of the beam specimen in mm

D= Depth of the beam specimen in mm

Table- 3: Flexural strength test

S.NO	Percentage of eggshell and plastic powder(%)	Flexural Strength(N/m^2)	
		7days	14 days
1	0	7.98	8.23
2	10	7.56	8.03
3	15	7.47	7.97
4	20	7.13	7.85

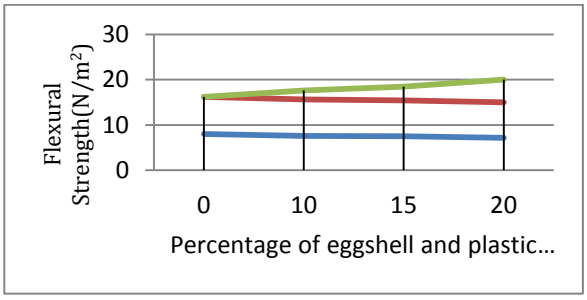


Chart-2: Flexural Strength

5.4 Liquid limit

Liquid limit is defined as "The moisture content at which soil changes from liquid state plastic state".

The water content at which soil has such small shear strength that it flows to a close a groove of standard width when jarred in a special manner. The liquid limit, it is the water content at which soil changes from the liquid state to plastic state. It is the minimum moisture content at which soil flows upon a application of very small shear force. Liquid limit –the water content, in percent, of a soil at the arbitrarily defined boundary between the semi liquid and plastic states.

Fig -2: Liquid limit

It is the water content of the soil between the liquid limit state and plastic state of soil .It can be defined as the minimum water content at which the soil, through in liquid state ,shows shearing strength against flowing. it is measured by the casagrande's apparatus and is denoted by WI

5.5 PLASTIC LIMIT

Take 20g of soil passing 40sieve in to a dish. Add water and mix it thoroughly. Prepare several ellipsoidal _shape soil masses by quizzing the soil with your hand. Put the soil in rolling device, and roll the soil until the thread reaches 3.2 mm. continue rolling until the thread crumbles

into several pieces. Determine the moisture content of about 6g of the crumbled soil.

Fig-3 :Plastic limit

The limit lies between the plastic and semi- solid state of the soil .It is determined by rolling out a thread of soil surface which is non porous, it is the minimum water content at which the soil just begins to crumble while rolling into a thread of approximately 3mm diameter. plastic limit is denoted by wP.

6. CONCLUSIONS

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 prove 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 1% river sand with agricultural wastes (eggshells, plastic powder etc.) effectively, it will indirectly reduce the demand for clay and reduce the manufacturing cost of clay roof tiles, which induce the conversion of huts in slum areas into tiled houses. Thus, both economic and environmental benefits occurs in this manner if the manufacturing of roof tiles is made in large scale.

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