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EXPERIMENTAL INVESTIGATION ON ECOFRIENDLY BRICK MADE BY CNSL CORE BINDER RESIN

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Abstract— Clay bricks are widely used in construction. About 20-30% of pollution in environment is created by kilns. Various harmful gases like Co_2, CH_4,$NO_2$are liberated. To avoid this issue bricks are manufactured without burning. The entire construction industry is in search of a suitable and effective the waste product that would considerably minimize the use of clay bricks and ultimately reduces the construction cost. A latest innovation that is revolutionizing the way we think about bricks. The country can gain a lot by utilization of "ECO-FRIENDLY BRICK MADE BY CNSL CORE BINDER RESIN" resulting in conservation of natural resources as well as protection of environment. We use available sand which is an alternate solution for clay bricks. When you make a clay brick the time and energy used right from mixing the clay to baking it in the kiln and taking into account the firewood used for that, you will see that the un-burnt available sand brick is far more energy-efficient. CNSL (cashew nut shell liquid) core binder resin is mixed with the available sand to form bricks. , the waste which is extracted from power plant is also used as an admixture to form available sand bricks. By this way deforestation, pollution and need for clay is minimized. They are also cheaper than conventional bricks.

Key words: Available sand, clay, brick, pollution, CNSL resin

I. INTRODUCTION

A brick is a block or a single unit of kneaded clay used in masonry construction. Burnt clay bricks are the most numerous types and are laid in courses and numerous patterns known as bonds, collectively known as brickwork, and may be laid in various kinds of mortar to hold the bricks together to make a durable structure. Bricks are produced in numerous classes, types, materials, and sizes which vary with region and time period, and are produced in bulk quantities. Two most basic categories of brick are burnt and un-burnt brick. Burnt bricks are one of the longest lasting and strongest building materials sometimes referred to as artificial stone and have been used since circa 5000 BC. Air dried bricks have a history older than burnt bricks, are known by the synonyms mud brick and adobe, and have an additional ingredient of a mechanical binder such as straw.

Burnt bricks lead to deforestation and pollution. To avoid more consumption of clay and protect the earth surface environment, searching other materials for replacing clay in high compressive un-burnt bricks production can be prompted to achieve the sustainable development of natural resources as well as the protection of environment.

A. Nature of Pollution Caused By Clay Bricks

Clay bricks are manufactured by baking the kneaded clay in kilns. For baking wood is used as a major fuel. Due to this deforestation is increased. During the baking process of bricks various harmful gases are liberated such as carbon di oxide, nitrogen, methane which causes the air pollution.

B. Advantages of ECO-FRIENDLY BRICK MADE BY CNSL CORE BINDER RESIN

1. ECO-FRIENDLY BRICK MADE BY CNSL CORE BINDER RESIN are eco-friendly compared to normal clay bricks.
2. Deforestation and need for clay are minimized by adopting this type of bricks.
3. Pollution to environment is completely reduced by this un-burnt bricks.
4. Time and energy used for manufacturing bricks is considerably reduced compared to normal clay bricks.
5. Cost of those bricks is also low.

C. CNSL Core Binder Resin

The major producing countries of Cashew are Tanzania, India, Mozambique, Srilanka, Kenya, Madagascar, Thailand, Malaysia, Indonesia, Nigeria, Senegal, Malawi and Angola. World Bank data

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estimates that 97% of production is from wild trees and only 3% is from established plantations (Rosengarten, 1984). Gibbon et al (1981) reported that many trees are found growing wild and that the plant germinates poorly, those that are cultivated are propagated by seed which are planted at a rate of 2-3 per hole due to poor germination rates. Cashews, as with other tree nuts, are a good source of antioxidants. Alkyl phenols, in particular, are abundant in cashews. Cashews are also a source of dietary trace minerals copper, manganese, magnesium and phosphorus.

Table 1 : Global Production and Trade Patterns

COUNTIRES	PRODUCTION in (%)
Vietnam	28.9
Nigera	19.5
India	15.7
Brazil	5.3
Coted'ivoire	9.1

II. OBJECTIVE

- Main objective is to reduce the usage of clay and to make use of available sand and .
- To avoid burning of bricks in kilns.
- Thereby to reduce deforestation and pollution.
- To determine the most suitable mix in terms of weight of used materials as , , CNSL core binder resin.
- To design optimum mix of brick.
- To study the mechanical behavior of brick by using available sand.

III. EXPERIMENTAL PROGRAMME

The following are the some materials used in the un-burnt bricks made by core binder resin on available sand. Normally ECO-FRIENDLY BRICK MADE BY CNSL CORE BINDER RESIN consist of available sand as major ingredient, small amount of in addition to than here some materials are added these are and CNSL core binder resin.

1) AVAILABLE SAND

Available sand is any of a group of soils that develop in a warm, temperate, moist climate under deciduous or mixed forests and that have thin organic and organic-mineral layers overlying a yellowish-brown leached layer resting on an illuvial (see illuviation) red layer. Available sands generally form from iron-rich sedimentary rock. They are usually poor growing soils, low in nutrients and humus and difficult to cultivate.

Available sands denote the second largest soil group of India covering an area of about 6.1 lakhs sq. km (18.6% of India's area) over the Peninsula from Tamil Nadu in the south to Bundelkhand in the north and Rajmahal hills in the east to Kachchh in the west. They surround the black soils on their south, east and north.This soil, also known as the omnibus group, have been developed over Archaean granite, gneiss and other crystalline rocks, the sedimentaries of the Cuddapah and Vindhayan basins and mixed Dharwarian group of rocks. Their colour is mainly due to ferric oxides occurring as thin coatings on the soil particles while the iron oxide occurs as haematite or as hydrous ferric oxide, the colour is red and when it occurs in the hydrate form as limonite the soil gets a yellow colour. Ordinarily the surface soils are red while the horizon below gets yellowish colour. In general these soils are deficient in , magnesia, phosphates, nitrogen, humus and potash. Intense leaching is a menace to these soils.

On the uplands, they are thin, poor and gravelly, sandy, or stony and porous, light-coloavailable sands on which food crops like bajra can be grown. But on the lower plains and valleys they are rich, deep, dark colored fertile loam on which, under irrigation, can produce excellent crops like cotton, wheat, pulses, tobacco, jowar, linseed, millet, potatoes and fruits. These are also characterized by stunted forest growth and are suited to dry farming.

Table 2 :Chemical Compositions of Available sand

Non-soluble material	90.47%
Iron	3.61%
Aluminium	2.92%
Organic matter	1.01%
Magnesium	0.70%
Carbon-Di-oxide	0.30%
Potash	0.24%
Soda	0.12%
Phosphorus	0.09%
Nitrogen	0.08%

2) CNSL CORE BINDER RESIN

- Cashew nutshell liquid (CNSL) or cashew shell oilis a natural resin with a yellowish sheen found in the honeycomb structure of the cashew nutshell, and is a byproduct of processing cashew nuts. It is a raw material of multiple uses in developing drugs, antioxidants, fungicides, etc. It is used in tropical folk medicine and for anti-termite treatment of timber. Its composition varies depending on how it is processed. Cold, solvent extracted CNSL is mostly composed of anacardic acids (70%),cardol (18%) and cardanol (5%).
- Heating CNSL decarboxylates the anacardic acids, producing a technical grade of CNSL that is rich in cardanol. Distillation of this material gives distilled, technical CNSL containing 78% cardanol and 8% cardol (cardol has one more hydroxyl group than cardanol). This process also reduces the degree of thermal polymerization of the unsaturated alkyl-phenols present in cashew nutshell liquid.

3) Properties of CNSL Core Binder Resin

Table 3 :Physicochemical Properties

Moisture	7.2%
Oil	49.1%
Protein	36.3%
Crude fiber	3.2%
Carbohydrate	1.4%

Table 4 : Mineral Composition

Mineral composition	**Values(mg/100g)**
Magnesium (Mg)	19.3
Calcium (Ca)	21.5
Sodium (Na)	8.2
Zinc(Zn)	0.8
Iron(Fe)	0.6
Potassium(K)	27.5
Phosphorus(P)	14.0

IV. METHODS FOR MAKING BRICK

1) Mixing

- Fixing of all proportions are weighed in proper ratio(i.e cotton waste, quarry dust, , fly ash)
- To clean the surface without any dirt, for mixing of all materials in proper proportions.
- Then the proper mix has done using trowel.
- Various mixing proportion of this both is given below.
- 10-15% of water is added to mixed proportion.

2) Casting of brick

- The modular brick samples of size 210mm x 100mm x 80mm were cast in lab by hand molding, the mixed proportion is forced in the mould in such a way that it fills all the corners of mould.
- Then proper compacting had done.
- The surplus mix was removed either by frame with wire and the top surface was leveled.
- Finally the mould is lifted up and raw bricks are left on the ground.

3) Drying

- Above process is repeated till sufficient raw bricks are ready when such bricks become sufficient dry for 2 days in sunlight.
- Then it is kept in oven for 24 hours at a temperature of about 15°C.

V. TESTING OF BRICKS

The test was carried out to find out the following properties of bricks they are; compression, water absorption, efflorescence. A standard test procedure is followed for each test strength performance is studied.

1) COMPRESSION TEST PROCEDURE:

Place the specimen in the compression-testing machine. The green button is pressed to start the electronic motor. When the load is applied gradually, the piston is lifted up along with the lower plate and thus the specimen application of the load should be 300KN per minute and can be controlled by load rete control knob. Ultimate load is noted for each specimen. The release valve is operated and the piston is allowed to go down. The values are tabulated and calculations are done.

2) CALCULATION:

$$\textbf{Compressive strength} = \frac{maximum\ load\ at\ failure(N)}{average\ area\ of\ bed\ face(mm)}$$

3) WATER ABSORPTION TEST

Dry the casted specimen under sun till it attains substantially constant mass. Cool the specimen to room temperature. Weigh the specimen to get its dry weight (M_1).

Immerse completely dried specimen in clean water at a temperature of 27 f 2ºC for 24 hours. Remove the specimen and wipe out any traces of water with a damp cloth and weigh the specimen. Complete the weighing 3 minutes after, the specimen has been removed from water (M_2).

Water absorption, percent by mass, after 24 hours immersion in cold water is given by the following formula:

$((M_2-M_1)/M_1) \times 100$

Where, M_1 = Weight of the brick at time 0

M_2 = Weight of the brick after 24 hours

4) Is specification

When tested as above, the average water absorption shall not be more than 20% by weight up to class 125 and 15% by weight for higher class.

5) EFFLORSCENCE TEST

Place the end of the bricks in the dish, the depth of immersion in water being 25mm. place the whole arrangement in a warm(for example, 20 to 30°C) well ventilated room until all the water containing the brick with suitable glass cylinder so that excessive evaporation from the dish may not occur. When the water has been absorbed and bricks appear to be dry, place similar quantity water in the dish and allow it to evaporate as before. Examine the bricks for efflorescence after the second evaporation and report the result.

VI. TEST RESULTS AND DISCUSSION

A.Result

In this chapter, the experimental results are presented and discussed. The parameters considered are as follows:

- Bricks specification
- Ratio of water to resin,by mass
- Mixing
- Demoulding
- Drying

VII.EXPERIMENTAL RESULT

Table 5 : Compressive Strength of Normal Brick

Brick sample	Load in (N x 10^3)	Stress in (N/mm^2)
Normal brick	75	3.75

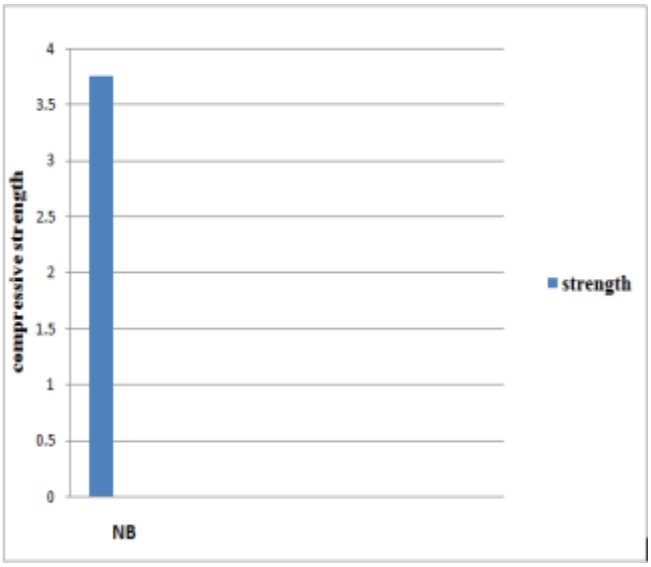

Figure 1 : compressive strength of normal brick

Table 6 : Compressive Strength Of Resin Mixed Brick

Brick sample	Load In N x 10^3	Stress in (N/mm^2)
Sample 1	56.34	2.82
Sample 2	62.78	3.14
Sample 3	74.34	3.72
Sample 4	82.99	4.15

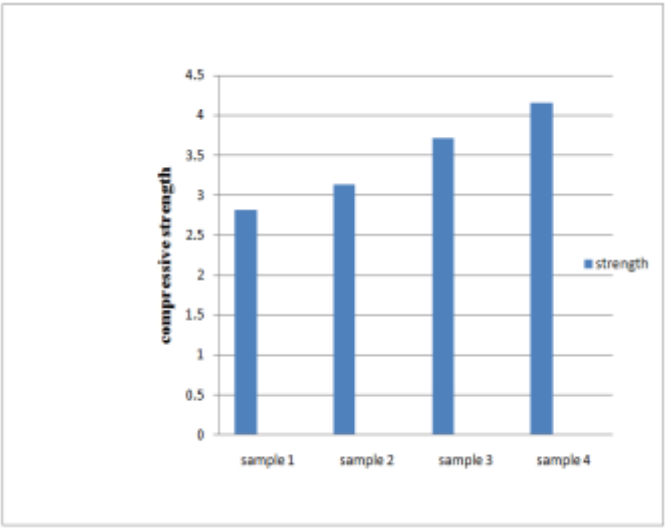

Figure 2 : compressive strength of resin mixed brick

VIII. WATER ABORPTION TEST RESULT

Table 7 : Water Absorption Test Of Bricks

% Added	At 0 min (M2)	After 24 hours (M2)
200ml	3.349kg	3.679kg
250ml	3.431kg	3.791kg
300ml	3.645kg	3.985kg
350ml	3.903kg	4.233kg

Water absorption = (3.679-3.349)/ (3.349 ×100)

= 9.85%

Water absorption = (3.791-3.431)/ (3.431 ×100)

= 10.5 %

Water absorption = (3.985-3.645)/ (3.645 ×100)

= 9.33 %

Water absorption = (4.233-3.903)/ (3.903 ×100)

= 8.45 %

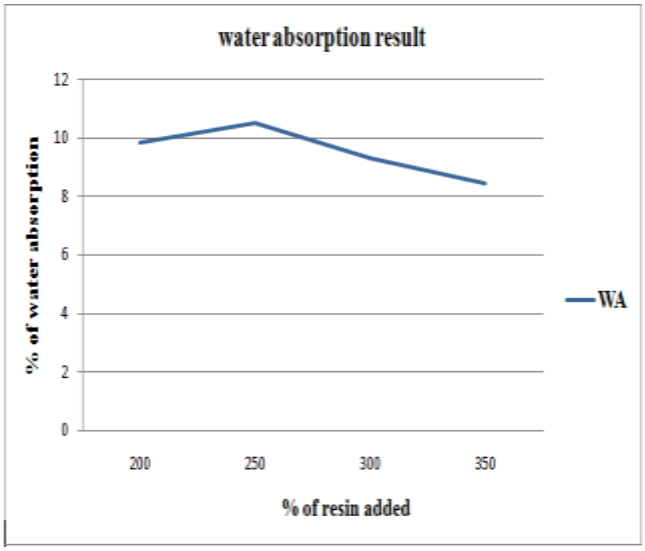

Figure 3 : Water Absorption Test Of Brick

IX. EFFLORESCENCE TEST RESULT

- Efflorescence Test on Bricks. Efflorescence is a whitish crystalline deposit on surface of the bricks.
- Usually magnesium sulphate, calcium sulphate and carbonate of sodium and potassium are found inefflorescence for normal brick
- The efflorescence results, brick comes under the NIL type. That is "NIL-when there is no perceptible deposit of efflorescence".

X. CONCLUSION

- The test results shows that the resin,combination provide results, which are of potential for this combination to be used in the production of lighter and economical new brick material.
- The observations during the tests show that the effect of 10 – 30% resin with and exhibit 86.6 % capacity by allowing lower labouring cost than the normal bricks.

XI. FURTHER SCOPE

- The performed test presented in this paper constitute only a first step research on , and resin combination to be used as brick materials and the further test are possibly needed prior to use the new bricks as construction material.
- Further test may be required such as water absorption coefficient, thermal conductivity, soundness as well as mechanical test on brick/mortar combination.
- The variation in the mechanical strength of these bricks containing a higher percentage replacement of resin when they are saturated with water is another research area need to be investigated.
- This further information on the new brick would allow proposing this composite as new building material.

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