Experimental investigation on bricks using various ashes

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Abstract **:** A brick is a block of ceramic material used in masonry construction usually laid using various kinds of mortar. A brick is a rectangular block baked by the sun or in a kiln until hard and used as a building and paving material. Bricks are used where strength, low water porosity or acid resistance are needed. Brick is durable, permanent, opaque and sound absorbing. **Bricks are usually used in the construction to form a bonded structure to increase its stability and strength.** The bricks are used in the construction works such as exterior and interior wall construction , flooring , paving , compound walls etc.,Bricks may be made by using three materials. They are bricks made of clay burned or fired to hardness , brick made of cementitious materials and adobe bricks. The clay from which burned brick is made technically known as "Hydrated Silicate of Alumina" (Al_2O_3. $2SiO_2$. $2H_2O$). Brick making consumes larger amount of clay which leads to top soil removal and land degradation. Large areas of lands are destroyed due to collection of soil from a depth of about 1 to 2 m from agricultural land. In order to reduce the degradation of the cultivating land we should use the alternative material for the manufacturing of bricks.The government of Tamil Nadu has declared to vanish the complete growth of those Prosopis juliflora tree. The ash obtained from Prosopis juliflora tree contains more amount of magnesium when compared to ordinary good brick earth. Hence, In this project we replace the red soil by *prosopis juliflora* ash, and also by groundnut shell and coconut fiber ash to find the compressive strength, hardness, water absorption, unit weight, efflorescence test.

Keywords: Red soil, Prosopis juliflora ash, Groundnut shell ash, coconut fiber ash.

1. INTRODUCTION

India's present housing shortage is estimated to be high as 1.9 million as per 2011 and out of these shortage 1.2 million units are in rural area and 0.7 million units in urban areas. The government of India has targeted the year 2020 for providing housing for all. Such large housing construction activities require huge amount of money. The conventional brick making requires large quantity of red and clay soil. These soils are most suitable for cultivation such as rice, cotton etc., for the manufacturing of the production coast and also there is a great demand for these soils at present. Due to continuous sage of red and clay soils in brick manufacturing reduces the cultivating lands vastly. In order to reduce the degradation of the cultivating land we should use the alternative material for the manufacturing of bricks. The alternative bricks were made with Prosopis juliflora, coconut fibre, groundnut shell ash.

2. MATERIAL PREPARATION

Material collection/ data collection is the basic and important step in any project. The material that is used in a project should not cause any damage to the environment. Following materials which are used in this project were collected before starting the work.

2.1. RED SOIL

Red soil is the main source for doing our project. The soil was collected from Oddanchadram. The main function of red soil is which is best for good plasticity. So the red soil were collected bulky and were used in this project. The texture of red soil varies from sand to clay, the majority being loam. Their other characteristics include porous and friable structure, absence of lime, kankar and free carbonates, and small quantities of soluble salts. Their chemical composition include non-soluble material 90.47%, iron 9.18%,aluminium 9.97%, organic mater 1.01%, oxygen 40.94%, silicate 15.12%, carbon 5.25%. However significant regional differences are observed in the chemical composition. In general these soils are deficient in lime, magnesia, phosphates, nitrogen, humus and potash. Intense leaching is a menace to these soils. In the uplands, they are thin, poor and gravelly, sandy, or stony and porous, light-colored soils 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, pulse, tobacco, jowar, linseed, millet, potatoes and fruits. These are also characterized by stunted forest growth and are suited to dry farming.

2.2 PROSOPIS JULIFLORA ASH

Prosopis juliflora ash is the residue powder left after the combustion of wood, such as burning wood in a home fireplace or an industrial power plant. Prosopis Juliflora Ash from the biomass power plant unit in the state of TamilNadu, India was selected to evaluate its suitability as ash for OPC replacement. The Wood Ash (WA) was obtained from open field burning with average temperature being 700C. The material was dried and carefully homogenized. An adequate wood ash particle size was obtained by mixing wood ash and cement together for a fixed amount of time.

2.3 COCONUT FIBER ASH

Coconut fiber is extracted from the outer shell of a coconut. The common name, scientific name and plant family of coconut fiber is Coir, Cocos nucifera and Arecaceae (Palm), respectively. There are two types of coconut fibers, brown fiber extracted from matured coconuts and white fibers extracted from immature coconuts. Brown fibers are thick, strong and have high abrasion resistance. White fibers are smoother and finer, but also weaker. Coconut fibers are commercial available in three forms, namely bristle (long fibers), mattress (relatively short) and decorticated (mixed fibers). These different types of fibers have different uses depending upon the requirement. In engineering, brown fibers are mostly used. There are many general advantages of coconut fibers e.g. they are moth-proof, resistant to fungi and rot, provide excellent insulation against temperature and sound, not easily combustible, flame-retardant, unaffected by moisture and dampness, tough and durable, resilient, springs back to shape even after constant use, totally static free and easy to clean.

2.4 GROUNDNUT SHELL ASH

The possible use of agricultural waste (such as Groundnut Shell Ash - GSA) will considerably reduce the cost of construction and as well as reduce or eliminate the environmental hazards caused by such waste. Groundnut shell is an agricultural waste obtained from milling of groundnut. Nigeria contributes about 7 percent of world groundnut production which makes Nigeria the 3rd largest producer of groundnut in the world. In 2002, about 2,699,000 Mt of groundnut were produced in about 2,783,000 Hectares of Land. Meanwhile, the ash from groundnut shell has been categorized under pozzolana (Alabadan et.al, 2006), with about 8.66% Calcium Oxide (CaO), 1.93% Iron Oxide (Fe2 O 3), 6.12% Magnesium Oxide (MgO), 15.92% Silicon Oxide (SiO2), and 6.73% Aluminum Oxide (Al2O3). The utilization of this pozzola as a replacement for traditional stabilizers will go a long way in actualizing the dreams of most developing countries of scouting for cheap and readily available construction materials. Groundnut shell ash has been used in concrete as a partial replacement material for cement with a measure of success achieved (Alabadan et al., 2005). Problematic soils such as expansive soils are normally encountered in foundation engineering.

3. PROCEDURE

The following procedure is used in manufacturing of bricks,

- Mixing
- Moulding
- Drying and Burning

3.1 MIXING

After weighing each material, it is allowed to mix by manual mixing based on the percentage of Prosopis juliflora ash, Groundnut shell ash and Coconut fiber ash is to be added with the soil.

3.2MOULDING

Moulding of the bricks into the proper shape and size can be done manually with the hands or it can be done with the help of machines. Hand moulding can take more time as compare to the machine moulding. Hand moulding is employed when the cheap labour available to us and less numbers of bricksare required to be manufactured and machine moulding can be employed when the labour is costly and the large numbers of bricks are required. Machine moulding is more accurate then the hand moulding.

3.2.1HAND MOULDING

It is again can be done in the following two manners:

- Moulding on the ground
- Moulding on the table

In hand moulding on the ground following instruments are used

- Mould
- Pallet
- Strike
- Clay

Mould of the size about 10 to 12% greater dimensions than the standard brick size for the allowance of the shrinkage of the brick, is used which can be made either of the seasoned wood or with the steel plates and the angle. Pallet is used to in-script the frog in the bricks. Frog is necessary for the proper bonding of the bricks and for the advertisement of the manufacturer. Strike is used to strike off the excess clay from the top of the mould after it is filled with the brick.

Following procedure is followed to carry the moulding of the bricks on the ground

First of all a dried plane ground is chosen on which dry sand is sprinkled to check the adherence of the brick clay to the ground. Mould with the pallet is put on the ground. Clay is taken in limps in hands and it is slashed on the mould with force so that every corner of the mould is filled with the clay. Excess of clay is struck off with the strike which can be wooden or wired. Mould is turned upside down and it is removed leaving the moulded brick in its place. It is kept at near place and whole procedure is followed again.

HAND MOULDING ON THE TABLE

Here the moulding is done on the table which is generally of the size 2m* 1m. It may take somewhat longer time than the ground moulding.

3.2.2 MACHINE MOULDING

As the name suggests, machine moulding is carried out with the help of a machine. It produces them in faster rate and in a better shape than that in the hand moulding. Bricks should have standard characteristics if they are to be used in construction. For example, contractors may buy bricks from several different sources for one project, the bricks must be the same size or there will be problems matching the construction of different sections of the building. The size of our mould is 220X105X80mm.

3.3 DRYING AND BURNING

The moulded bricks are grouped and separated based on the proportion of Prosopis juliflora ash, Groundnut shell ash and Coconut fiber ash added with the soil. And it is allowed to dry in an open atmosphere. When mixed with water, the clay minerals give a plastic mass that can be shaped by pressure to form a brick. At economically practical temperatures ranging between 1000◦ to 1200◦ C, the clay particles can be fused into a cohesive mass of great compressive strength. Controlled evaporation of the free water surrounding the particles in plastic clay minimizes excessive shrinkage and defects in the structure of bricks.

4. TEST FOR BRICKS

The following tests are recommended for determining the suitability of brick for construction work:

- Compressive strength test
- Water absorption test
- Efflorescence test
- Hardness test
- Size ,Shape and Colour test
- Soundness test
- Structure test

4.1 COMPRESSIVE STRENGTH TEST

This test is done to know the compressive strength of brick. It is also called crushing strenth of brick. Generally two or three bricks are taken to laboratory for testing. In this test a brick specimen is put in crushing machine and applied pressure till it breaks. The ultimate pressure at which brick is crushed is taken into account. And the specimens are tested one by one and average is taken as the bricks compressive/ crushing strenth.

Compressive strength= Load/Area

4.2 WATER ABSORPTION TEST

In this test the bricks are weighed in dry condition and let them immersed in fresh water for 24 hours. After 24 hours of immersion these are transfer out from water and wipe out with cloth. Then the bricks are weighed in wet condition. The difference between the weights is the water abosrbed by the bricks. The percentage of water absorption is the calculated: The less water absorbed by brick the greater its quality, good quality brick does not absorb more than 21% water of its own weight.

Water absorption=(Wet weight – Dry weight)/(Dry weight) X 100

4.3 EFFLORESCENCE TEST

This is due to the presence of soluble salts (such as Sulphates of sodium and potassium). About 3 no's of bricks are placed in a tray of water about 25mm depth (end side of the bricks inside water) in a well ventilated room and they are allowed to absorb the water completely. When the bricks appear to be dry, they are examinate for florescence marks.

4.3.1 PROCEDURE

- A shallow flat bottom dish containing sufficient distilled water to completely saturate the specimens is used for the test. The ends of the bricks are placed in the dish, the depth of immersion in water being 25mm.
- 2 The whole arrangement is placed in a warm (between 20ºC and 30ºC) well ventilated room until all the dish is absorbed by the specimens and the surplus water evaporates.
- 3 The dish containing the brick is covered with a suitable glass cylinder so that the excessive evaporation from the dish may not occur.
- 4 When the water has been absorbed and brick appears to be dry, a similar quantity of water is placed in the dish and it is allowed to evaporate as before. Examine the bricks for efflorescence after the evaporation and the results are reported

4.3.2 REPORTS

- Nil- When there is no preciptable deposits on the surface of the bricks after testing.
- Slight- When not more than 10% of surface is covered with a thin deposits of salts.
- Moderate- When there is moderate deposits covering atleast 50% of surface with thin deposits of salts.
- Heavy- When there is heavy deposits of salts covering more than 60% of surface accompanied by powdering and flanking of the surface.
- Serious- When there is heavier deposits of salts on surface accompanied.

4.4 UNIT WEIGHT TEST

- The dimensions of the brick is measured accurately and the volume is calculated(V)
- The dry weight of the brick is taken as mass (M).

Calculation

The bulk density is calculated as mass per unit volume

Bulk density =

4.5 HARDNESS TEST

In this test, a scratch was made on brick surfaces. This test was carried out for all the two proportions of brick. While the scratch was made with the help of finger nail on the bricks, very light impression was left on the brick shows that the brick is sufficiently hard.

4.6 SHAPE AND SIZE

In this test bricks are closely inspected for its size and it should be truly rectangular with sharp edges. For this purpose, bricks are selected at random and they are stacked lengthwise, along the width and along the height.

4.7 STRUCTURE TEST

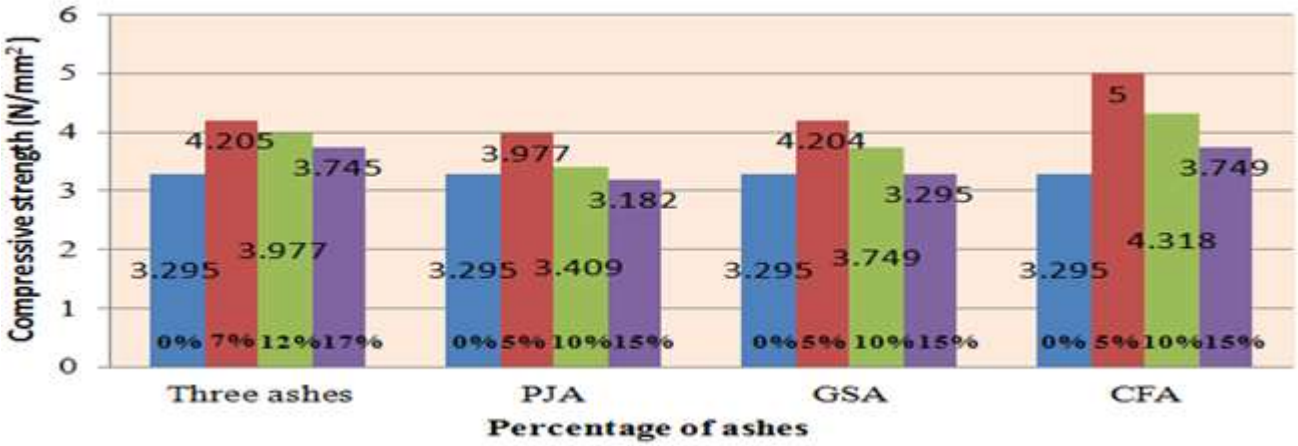
A brick is broken and its structure is examined. It should be homogeneous, compact and free from any defects such as holes, lumps etc.,

5. RESULT AND DISCUSSION

5.1 COMPRESSIVE STRENGTH TEST

S.NO	FOR ALL ASHES		PJA		GSA		CFA	
	%	COMPRESSIVE STRENGTH (N/mm^2)	%	COMPRESSIVE STRENGTH (N/mm^2)	%	COMPRESSIVE STRENGTH (N/mm^2)	%	COMPRESSIVE STRENGTH (N/mm^2)
1.	0	3.295	0	3.295	0	3.295	0	3.295
2.	7	4.205	5	3.977	5	4.204	5	5
3.	12	3.977	10	3.409	10	3.749	10	4.318
4	17	3.745	15	3.182	15	3.295	15	3.749

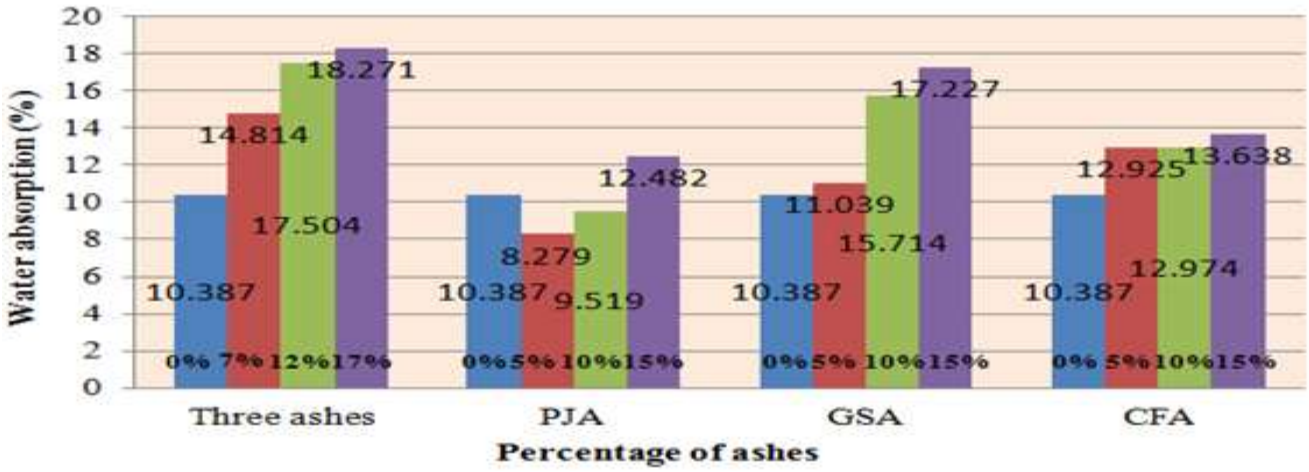
COMPRESSIVE STRENGTH TEST GRAPH



5.2 WATER ABSORPTION TEST

S.NO	FOR ALL ASHES		PJA		GSA		CFA	
	%	WATER ABSORPTION (%)	%	WATER ABSORPTION (%)	%	WATER ABSORPTION (%)	%	WATER ABSORPTION (%)
1.	0	10.387	0	10.387	0	10.387	0	10.387
2.	7	14.814	5	8.279	5	11.039	5	12.925
3.	12	17.504	10	9.519	10	15.714	10	12.974
4	17	18.271	15	12.482	15	17.227	15	13.638

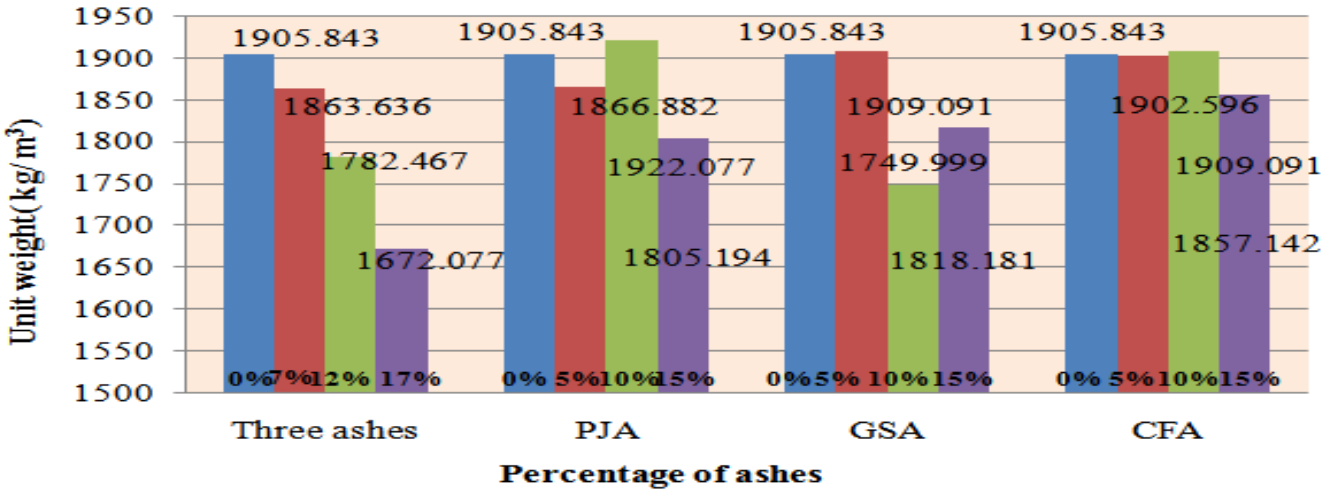
WATER ABSORPTION TEST GRAPH



5.3 UNIT WEIGHT TEST

S.NO	FOR ALL ASHES		PJA		GSA		CFA	
	%	UNIT WEIGHT (Kg/m^3)	%	UNIT WEIGHT (Kg/m^3)	%	UNIT WEIGHT (Kg/m^3)	%	UNIT WEIGHT (Kg/m^3)
1.	0	1905.843	0	1905.843	0	1905.843	0	1905.843
2.	7	1863.636	5	1866.882	5	1909.091	5	1902.596
3.	12	1782.467	10	1922.077	10	1749.999	10	1909.091
4	17	1672.077	15	1805.194	15	1818.181	15	1857.142

UNIT WEIGHT TEST GRAPH



CONCLUSION

Based on experimental investigations concerning compressive strength ,water absorption and unit weight test of the brick, the following results were obtained,

- Compressive strength decreases on increase in percentage of all ashes.
- The maximum compressive strength of brick obtained is 5 N/mm^2 and this strength is achieved by 5% of replacement of red soil by CFA.
- The water absorption for all the bricks are increases with increase in percentage of ashes.
- The minimum water absorption of brick obtained is 8.279 % and this is achieved by replacing 5% of red soil by PJA.
- The maximum unit weight of brick obtained is 1909.091kg/ m^3 and this is achieved by replacing 5% of red soil by GSA.
- By using these various ashes certain quantity of clay from agricultural land will be saved which is eco-friendly.
- So based on results , our brick is suitable for constructing non load bearing walls in framed structures , compound walls and buildings in water logging areas .

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