MANUFACTURING OF BRICKS BY USING COCONUT SHELL CHARCOAL, LIME AND CEMENT

K.P.Ravikumar[1], S.Bharathy[2], T.Durairaj[3], A.Ramachandran[4], R.Sathish[5]

[1]Assistant Professor, [2-5]UG Students
Department of Civil Engineering,
Shivani engineering college, Tiruchirappali - 620009.

***Abstract*: Brick is a composite material made clay, water and fine aggregate. But project are in interest of finding new materials by waste material are coconut shell charcoal, lime and cement which are available naturally cause harmful to the environment. This research deals with partial replacement of sand with charcoal and lime. In order to overcome the harmfulness caused by charcoal, this research is carried out. Naturally charcoal consume more water than other plants. While carrying out this project huge amount of charcoal re cleared. This research will help them. River sand is expensive due to excessive cost of transportation from natural sources. Also large scale depletion of the sources creates environment problem. A substitute or replacement is needed. In order to overcome these difficulties charcoal is used since agriculture waste generated by the industry as accumulated over years. Charcoal gives more strength and durability to the brick when compared with normal brick.**

***Keywords*: Coconut shell charcoal, Lime and Cement.**

1. INTRODUCTION

1.1. GENERAL

A Brick is one of the main materials of a construction work. Bricks are chiefly used for making wall panels. They are the chief constituent of masonry construction. Bricks are used for masonry as it can withstand a large amount of load. Bricks chiefly constitutes of clay, alumina, shale and sand.

In our research we intend to replace the clay partially with coconut shell charcoal, lime and cement are used. These materials are chiefly waste materials and dumped in a large quantity. The usage of these materials is relatively low compared to their wastage. By more usage of these materials, the waste levels are reduced. It can result in more usage of the coconut shell charcoal, lime and cement in bricks.

The bricks are first made by mixing three materials in different ratios. The bricks are made and tested for their strength at various ratios. The ratio levels taken are 1:2:4, 1:1.5:3, 1:1:2. After the tests are made on the bricks, a new set of bricks are made with a composite mixture of coconut shell charcoal, lime and cement partial replacement of clay. This research is done to find a better material that has high strength compared to the normal brick and more light. This also results in use of waste material in the brick which results in higher strength of the brick.

1.2. OBJECTIVES

- Investigate the potential use of coconut shell charcoal, lime and cement as partial replacement of clay bricks.
- Determining the degree of strength improvement in bricks obtained with the addition of coconut shell charcoal, lime and cement.
- Improve the strength of bricks used in construction.
- Increased use of bricks in masonry construction.
- Check the workability of such a bricks and its increased usage over the current conventional bricks.
- Reduce the waste which are chiefly dumped or used in miniscule levels for other works.
- Obtain a new mixtures for the bricks and change its composition.

2. LITERATURERE REVIEW

Sarangapanietal [2002]125 compared the characterization and properties of local low modulus bricks, table moulded bricks and wire cut bricks, mortars and masonry. Leaner mortars such as 1:6:9 cement – soil mortar showed very ductile behaviour which was indicated as the stress strain curve becoming horizontal after reaching a peak strain value. This indicated that the 9 presence of a significant amount of soil gave rise to ductility with low strength mortars. Stress strain characteristics of masonry were examined through prism tests.

Deodhar and Patel [1997]28 presented that under compression; mortar deformed more than brick and expanded laterally causing failure of masonry. With the strength of brick and mortar, the compressive strength of brick masonry was evaluated with

the constants given. It was found that rich mortar does not improved the strength of masonry but for low strength bricks a mortar ratio 1:4 or 1:5 gave considerably high strength.

Choubey [1993]18 had done the experiment with brick masonry specimens for flexural tensile strength. The effect of various parameters such as suction rate, type of sand, mortar grade, joint thickness and slenderness ratio on flexural tensile strength of brick masonry were investigated.

Deodhar and Patel [1996] 27 discussed the strength of brick masonry with respect to the strength of the brick and strength of the mortar. Frog in bonding the brick work, shape and size of frog affect the strength of brick masonry. The mortar joint of size 5mm to 10mm gave the maximum strength. The ratio of cement to sand ratio of 1:6 gave reasonably high compressive strength of brick masonry. For mortars richer than 1:6 ratios, though the increase in strength is considerable, the adhesion of cementing materials is very high compared to the benefit of increase in the crushing strength.

3. MATERIAL USED

There are used for the raw materials following such as,

Coconut shell charcoal

Lime

Cement

3.1. COCONUT SHELL CHARCOAL

Coconut Shell Charcoal is an important product obtained from coconut shell. Coconut Shell charcoal is used widely as domestic and industrial fuel. It is also used by foundries and goldsmiths. Coconut Shell Charcoal is also used to produce activated carbon. Activated Carbon produced from coconut shell has certain specific advantages as the raw material can adsorb certain molecules and because of its density retains good strength and physical properties.

3.1.1. COMPOSITION OF CHARCOAL

Coconut shell is an important raw material used to produce charcoal briquette. And coconut shell charcoal have wide applications in many fields because of its features and advantages. In Malaysia, coconut is the fourth important industrial crop after oil palm, rubber and paddy in terms of total planted area and it is an important export country of coconut products.

3.2. LIME

Lime is a calcium-containing inorganic mineral composed primarily of oxides, and hydroxide, usually calcium oxide and/ or calcium hydroxide. It is also the name for calcium oxide which occurs as a product of coal-seam fires and in altered limestone xenoliths in volcanic ejecta.

3.2.1. COMPOSITION OF LIME

3.2.1.1. CHEMICAL COMPOSITION OF LIMESTONE

Limestone is made up of varying proportions of the following chemicals with calcium and magnesium carbonate being the two major components.

Calcium carbonate	$CaCO_3$
Magnesiumcarbonate	$MgCO_3$
Silica	SiO_2
Alumina	Al_2O_3
Iron oxide	Fe_2O_3
Sulphate	SO_3
Phosphorus	P_2O_5
Potash	K_2O
Soda	Na_2O

The two main impurities are silica and alumina with iron as the third.

For a general purpose lime, a limestone with an SiO_2 content of up to 3.5 % and Al_2O_3 content of up to 2.5 % may be used where purer stone is not available, whereas lime for building or road construction purposes may have an SiO_2 content of up to 10% (perhaps slightly more) and an Al_2O_3 content of 5 %. An Al_2O_3 proportion of greater than 5% will produce a semi-hydraulic or hydraulic lime.

3.2.1.2. PHYSICAL COMPOSITION OF LIME

The color of most lime stones is varying shades of grey and tan. The greyness is caused by the presence of carbonaceous impurities- and the tan by the presence of iron.

It has been found that all lime stones are crystalline but with varying crystal sizes, unit formity, and crystal arrangement. This ret suits in stone with a corresponding variance in density and hardness. For lime production purposes there are two factors related to lime stones' crystal and crystal structure which are of specific interest.

The specific gravities of lime stones range from 2.65-2.75 for high calcium lime stones and 2.75-2.9 for dolomitic lime stones. Chalk has a specific gravity of between 1.4 and 2.

3.3. CEMENT

A Cement is a binder, a substance used for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel together. Cement mixed with fine aggregate produces mortar for masonry, or with sand and gravel, produces concrete.

3.3.1. COMPOSITION OF CEMENT

3.3.1.1. CHEMICAL COMPOSITION OF CEMENT

The raw materials used for the manufacture of cement consist mainly of lime, silica, alumina and iron oxide. These oxides interact with one another in the kiln at high temperature to form more complex compounds. The relative proportions of these oxide compositions are responsible for influencing the various properties of cement; in addition to rate of cooling and fineness of grinding. Table 1.4 shows the approximate oxide composition limits of ordinary Portland cement.

Table 3.1.Approximate Oxide Composition Limits of Ordinary Portland Cement

Oxide	Per cent content
CaO	60–67
SiO2	17–25
Al2O3	3.0–8.0
Fe2O3	0.5–6.0
MgO	0.1–4.0
Alkalies (K2O, Na2O)	0.4–1.3
SO3	1.3–3.0

The identification of the major compounds of cement is largely based on Bogue's equations and hence it is called "Bogue's Compounds". The four compounds usually regarded as major compounds are listed in table 1.2.

Table 3.2. Major compounds of cement

Name of Compound	Formula	Abbreviated Formula
Tricalcium silicate	3 CaO.SiO2	C3S
Dicalcium silicate	2 CaO.SiO2	C2S
Tricalcium aluminate	3 CaO.Al2O3	C3A
Tetracalcium aluminoferrite	4 CaO.Al2O3.Fe2O3	C4AF

It is to be noted that for simplicity's sake abbreviated notations are used. C stands for CaO, S stands for SiO2, A for Al2O3, F for Fe2O3 and H for H2O. The equations suggested by Bogue for calculating the percentages of major compounds are given below.

4. ESTIMATION OF BRICKS

The estimation cost are based on the public work department.

Size of brick (country brick) =225x112.5x75mm

Volume of brick =0.001898 m^3

Weight of coconut shell charcoal in one brick =1.200 kg

Weight of lime in one brick =0.600 kg

Weight of cement in one brick =0.600 kg

Amount of charcoal =3 Rs/1 kg

Amount of lime =5 Rs/1 kg

Amount of cement =9 Rs/1 kg

Cost of brick (1 brick) =8 Rs.

5. MATERIAL TEST

5.1. SPECIFIC GRAVITY OF COCONUT SHELL CHARCOAL

PROCEDURE

Weight of empty pycnometer (W1)

Weight of pycnometer+ charcoal (W2)

Weight of pycnometer+ charcoal+ water (W3)

Weight of pycnometer+ water (W4)

Specific gravity G = W2-W1/((W2-W1)-(W3-W4))

SPECIFIC GRAVITY OF CHARCOAL

S.NO	SPECIFICATION	TRAIL(g)
1.	W1	700
2.	W2	1225
3.	W3	1800
4.	W4	1525

Table.no:6.1

CALCULATION

FORMULA

Specific gravity =W2-W1/((W2-W1)-(W3-W4))

=1225-700/((1225-700)-(1800-1525))

G = 2.10

5.2. SPECIFIC GRAVITY OF LIME

PROCEDURE

Weight of empty pycnometer (W1)

Weight of pycnometer+ lime (W2)

Weight of pycnometer+ lime+ water (W3)

Weight of pycnometer+ water (W4)

Specific gravity G = W2-W1/((W2-W1)-(W3-W4))

SPECIFIC GRAVITY OF LIME (table.no.6.2)

S.NO	SPECIFICATION	TRAIL(g)
1.	W1	700
2.	W2	1225
3.	W3	1820
4.	W4	1525

CALCULATION

FORMULA

Specific gravity =W2-W1/((W2-W1)-(W3-W4))

=1225-700/((1225-700)-(1820-1525))

G = 2.28

6. TEST ON SPECIMEN

6.1. COMPRESSIVE STRENGTH TEST

PROCEDURE

- Place the prepared concrete mix in the wooden brick mould for casting.
- Once it sets, After 24 hours remove the concrete cube from the mould.
- Keep the test specimens submerged underwater for stipulated time.
- As mentioned the specimen must be kept in water for 7 or 14 or 28 days and for every 7 days the water is changed.
- Weight of samples is noted in order to proceed with testing and it must not be less than 8.1Kg.
- Testing specimens are placed in the space between bearing surfaces.
- Care must be taken to prevent the existence of any loose material or grit on the metal plates of machine or specimen.
- The brick are placed on bearing plate and aligned properly with the center of thrust in the testing machine plates.
- The loading must be applied axially on specimen without any shock and increased at the rate of 140kg/sq cm/min. till the specimen collapse.
- Due to the constant application of load, the specimen starts cracking at a point & final breakdown of the specimen must be noted.

6.1.1 COMPRESSIVE STRENGTH IN SAMPLING (1:2:4)

COMPRESSIVE STRENGTH TEST

S.NO	DAYS	COMPRESSIVE STRENGTH (KN)
1.	7 DAYS	120
2.	14 DAYS	140
3.	28 DAYS	190

Table.no:7.1

CALCULATION

Compressive strength =(190/25312.5)x1000
=7.5 N/mm^2

6.1.2 COMPRESSIVE STRENGTH IN SAMPLING (1:1.5:3)

COMPRESSIVE STRENGTH TEST

S.NO	DAYS	COMPRESSIVE STRENGTH (KN)
1.	7 DAYS	140
2.	14 DAYS	160
3.	28 DAYS	220

Table.no:7.2

CALCULATION

Compressive strength =(220/25312.5)x1000
=8.69 N/mm^2

6.1.3COMPRESSIVE STRENGTH IN SAMPLING (1:1:2)

COMPRESSIVE STRENGTH TEST

S.NO	DAYS	COMPRESSIVE STRENGTH (KN)
1.	7 DAYS	190
2.	14 DAYS	225
3.	28 DAYS	240

Table.no:7.3

CALCULATION

Compressive strength =(240/25312.5)x1000
=9.48 N/mm^2

6.2. WATER ABSORPTION TEST

Water absorption test on brick are conducted to determine durability property of bricks such as degree of burning. Quality and behavior of bricks in weathering. A brick with water absorption of less than 7% provides better resistance to damage by freezing.

SAMPLE 1 (1:2:4)

Weight of brick in dry condition W1= 2600g

Weight of brick after immersed in water W2= 2800g

Water absorbed W= (W2-W1/W1) X 100

= (2800-2600/2600) x 100

= 7.69%

SAMPLE 2 (1:1.5:3)

Weight of brick in dry condition W1= 2620g

Weight of brick after immersed in water W2= 2850g

Water absorbed W = (2850-2620/2620) x 100

= 8.77%

SAMPLE 3 (1:1:2)

Weight of brick in dry condition W1= 2650g

Weight of brick after immersed in water W2= 2880g

Water absorbed W= (2880-2650/2650) x 100

= 8.67%

6.3. EFFLORESCENCE TEST

Efflorescence is a whitish crystalline deposit on surface of the bricks. Usually magnesium sulphate, calcium sulphate and carbonate of sodium and potassium are found in efflorescence. The movement of groundwater into the foundations of buildings and by capillary action into brickwork is very often the cause of efflorescence.

6.4. SOUNDNESS TEST

Soundness test of bricks shows the nature of bricks against sudden impact. In this test 2 bricks are chosen randomly and struck with one another. Then sound produced should be clear bell ringing sound and brick should not break. Then it is said to be good brick.

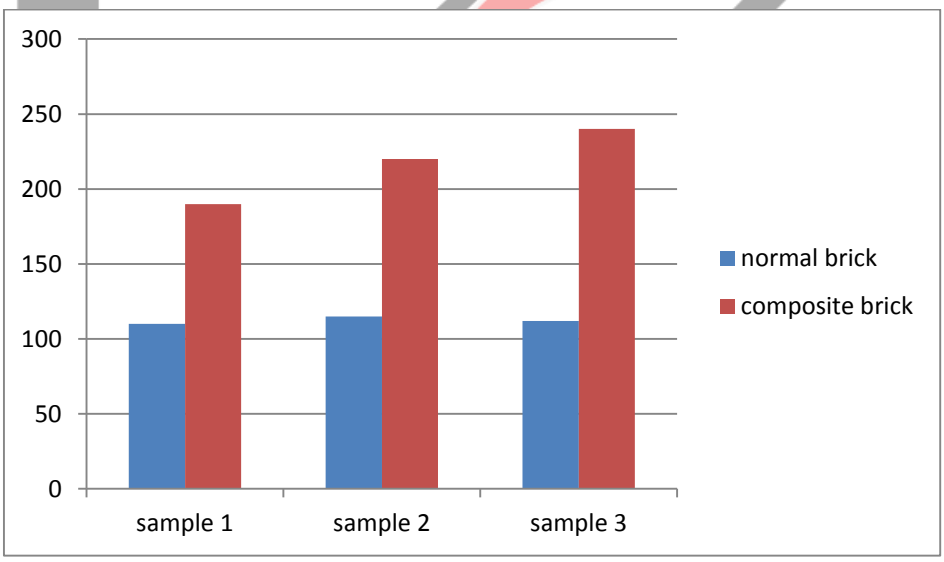
6.5. **HARDNESS TEST**

A good brick should resist scratches against sharp things. So, for this test a sharp tool or finger nail is used to make scratch on brick. If there is no scratch impression on brick then it is said to be hard brick.

7. TEST RESULTS

COMPRESSIVE STREGTH TEST

The composite bricks are made and they are tested for their strength. With the result obtained, a graph is made to represent the strength of the bricks at various ratios.



From the graph above, it can be seen that the composite brick has highest compressive strength than the normal brick. These bricks are lighter and give reasonable strength than the normal brick. This results the better performance of the brick. They are very light in weight due to presence of charcoal.

WATER ABSORPTION TEST

The water absorption test is conducted to know about the pores present in the brick. A brick is weighted in dry condition and the weight is noted. Then the brick is immersed in water for 24 hrs. The brick is taken out and weighted again. The change in weight of brick is calculated. The percentage of water absorbed is calculated by the formula

(W2-W1/W1) X 100

EFFLORESCENCE TEST

The presence of soluble salts in a brick results in the alkali reaction in the brick. The formation of white precipitate in the brick due to reaction with water is proof of the presence of salts in the brick. There is only a little amount of slat in our brick which results in the brick being a good quality brick.

SOUNDNESS TEST

The ringing of the brick when struck with another brick is proof of a good brick. We tested it by striking it with another brick and has a good ringing sound which is proof that the brick is sound.

HARDNESS TEST

The hardness test is made by scratching the surface of the brick by a hard object. If there is no impression left on the brick after scratch is made, then the brick is hard and durable. Our brick has a hard surface, strong and hence has a better structures.

8. CONCLUSION

The following conclusion were obtained upon completion of the research

- There is an increasing compressive strength at low ratio levels.
- The brick weight is less.
- The structure is hard, sound and free from cracks.
- The bricks have a better water absorption ratio than normal bricks.
- The structure of the brick is also more brittle than the normal bricks.
- Compressive strength of brick with replacement is more to referral brick in 7days.
- Our research has shown that the composite mixture of charcoal, lime and cement have more advantages of the normal bricks.

REFERENCES

[1] Aashish kumar parashar, Rinku parashar (2012), “compressive study on compressive strength of bricks made with various materials to clay bricks”, International journal of science and research publication, volume 2, issue 7, July.
[2] American Institute of Architects, Environmental Research Guide, 1998.
[3] History of brick making, Encyclopedia Britannica.
[4] Hudson, Kenneth (1972) Building materials; chap.3: brick and tiles. London: Longman; pp. 28-42. Plumbridge, Andrew; Meulenkamp, Wim (2000), brick work. Architecture and design.
[5] The building brick of sustainability; Chusid, Michael; Miller, Steve.