"EXPERIMENTAL STUDY ON UNFIRED BRICKS PREPARATION BY USING FLY ASH & RICE HULLS"

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ABSTRACT

The amount of rice husk waste generated in India is posing serious threat to the environment and the ecosystem. So utilizing these wastes for productive purposes. This study evaluated the possibility of using rice hush ash (RHA), fly ash (FA) and reinforced clay in producing unfired building bricks. In this underground rice husk ash (URHA), an agricultural byproduct, was used as partial fine aggregate replacement in the mixtures. The solid bricks of 190 x 90 x 90mm in size were prepared in this study. The hardened properties of the brick were investigated including including compressive strength, flexure strength, soundness test, hardness test and water absorption test according to corresponding Indian standards. Forming pressure of 35 Mpa was applied to form the solid bricks in the mold. The test results show that all brick specimen obtained good mechanical properties, which were well conformed to Indian standards. It was definitely proved many potential applications of FA and RHA in the production of unfired building bricks.

1. INTRODUCTION

Bricks have been used as a major building material for a long time. The worldwide annual production of construction bricks is currently 1391 billion units and the demand for bricks is excepted to be continuously rising. There are many different kinds of building bricks in the world. The most of them is conventional bricks that are produced from natural clay with high temperature kiln firing or mainly from ordinary Portland cement(OPC), while the rest minorities are produced from various sources of solid waste materials with or without kiln-fired.

The production of OPC has generated a significant amount of carbon dioxide (CO_2) to the environmental and accounted for around 5% of global man-made co2 emissions. Therefore, the use of OPC needs to be cautious. An effective way of reducing the contribution to greenhouse gas emission is increasing the use of supplementary cementious materials by partially or fully replacing OPC used and producing more environmentally sustainable building materials.

Recently, there are many studies on the use of only FA or RHA in the production of bricks by different methods, mainly by conventional method. However , just few researchers study on the application of combined FA and RHA for producing bricks. Commonly, a mixed FA and other materials have been used for making bricks, similarly with RHA.

MATERIALS AND TERMINOLOGY

The materials used in latex-modified mortars and concrete are the same as those employed in ordinary Portland cement mortar and concrete.

Fly Ash :

Fly ash is manufactured by the burning of coal in an electrostatic precipitator, a by product of industrial coal. The cementitious properties of fly ash were discovered in late 19th century and it has been widely used in cement manufacture for over 100 years. In UK , fly ash is supplied as a separate component for concrete and is added at the concrete at the mixer. It generally replaces between 30 and 40 per cent of the normal Portland cement.

WATER

Almost any natural water that is drinkable and has no pronounced taste or odor can be used as mixing water for making concrete. Some water which may not be suitable for drinking may still be safe for mixing concrete. Pipe born drinking water supplies are generally safe for making concrete. Water of doubtful quality can be simply tested by making two sets of cubes or cylinders of the same mix, one with the doubtful water, and the other set with distilled water, purified water, tap water or other drinkable water of good quality.

RICE HUSK ASH

Rice milling generates a by-product know as husk. This surrounds the paddy grain. During edge of paddy concerning 78% weight is received as rice, broken rice and bran .Rest 22% the load of paddy is received as husk. This husk contains concerning 75% organic volatile matter and also the balance 25% the load of this husk is reborn into ash throughout the firing method, is understood as rice husk ash (RHA). This RHA in turn contains around 85 % - 90 % amorphous silica. So for each one 1000 kgs of paddy processed, regarding 22 kgs of husk is created and once this husk is burnt within the boilers, regarding 55 kgs of RHA is generated

CLAY

Clay is a fine mixture of decompose igneous rock mineral and organic matter. "Clay refers to present material composed primarily of fine-grained minerals, that is mostly plastic at acceptable water contents and can harden once unemployed or dried." Technological properties of clay materials in the main depend upon their degree of dispersion. Granulometric composition of clay affects the amount of properties like density, softness, porosity, etc. The clay material for brick samples will be taken from one of the brick manufacturing plant from Lonere, Raigarh. The constituents present in the clay are silica, quartz (SiO_2), metal oxides (Al_2O_3, MgO) and organic matter.

2. LITERATURE REVIEW

This chapter presents an overview of literatures collected from various journals. The most worthy of them which are relevant to the current study are being reviewed.

UNBURNT BRICK

PROPERTIES OF RICE HUSK,September (2018)

BYSi-Huy Ngo, Thanh-Tam Thi Le

The incorporation of URHA resulted in the reduction in unit weight, compressive strength, UPV, and TC of UBB. However, the adverse trend was obtained with water absorption and porosity of the bricks. Moreover, the inclusion of URHA also contributed to the smooth surfaces of the brick samples.

The use of high URHA content introduced more voids and micro cracks within the brick structure, causing the reduction in mechanical strength and other properties of UBB.

Compared to TCVN 6477, the brick samples produced with 10% URHA had good quality with a compressive strength of above 10 MPa, water absorption of below 10%, UPV values of higher than 1700 m/s, and TC of above 0.99 W/mK. The 20% URHA-bricks can also be used for the production of UBB with the low-quality requirement.

Impact Factor Of Bricks May-2019 by Sudarshan S. Shankare, Priyadarshini R. Patil

The increasing rice husk in product decline the compressive strength because the combusted rice husk replace with the space in the product which effect the density and compressive strength. The 4 percent of rice husk ash by weight has maximum compressive strength and water absorption among the other percentages. The other percentages decrease the compressive strength and water absorption. Thus, the best composition of brick is 4 percent of rice husk ash by weight. The 15 percent of rice husk ash by weight obtain 23 MPa of compressive loading and 18 percent of water absorption. This ratio component nearly matches the proper properties of brick. These bricks are economic than the conventional bricks and have good appearance same as the conventional brick so they can be used for low cost housing

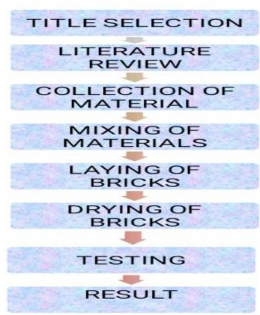
FLY ASH

D.M.J.Sumajouw et al,(2012), The objectives of this paper are to present the results of experimental study and analysis on the behavior and the strength of reinforced green concrete slender columns. The compressive strength of concrete is 70 Mpa.**B.Vijaya Rangan** et al,(2010), A compressive summary of the extensive studies conducted on fly ash based green concrete is presented. These results are utilized to a simple proposed method for the design of green concrete mixtures. The last part of the paper describes the results of the tests conducted on large – scale reinforced green concrete members and illustrates the application of the green concrete in the construction industry.

E.Arioza et al,(2006), Green concretes are the synthetic analogues of natural zeolitic materials. Green materials possess excellent mechanical properties including fire and acid resistance. C class fly ash was activated by 12M sodium hydroxide and sodium silicate solutions. Green concrete pastes were cured at 40℃, 80℃ and 120℃ for 6, 15 and 24 hours respectively. The samples were tested for compressive strength at the ages of 7, 28 and 90 days and the effect of aging was also investigated. After 28 days of curing, the samples were crushed and were extracted using leaching tests.

3. METHODOLOGY AND MIX DESIGN

Methodology is the diagrammatic sequential process of carrying out project.



MATERIALS AND EXPERIMENTAL PROGRAMS

Fly ash, a raw material with a high loss on ignition of 15.9%, was sourced from Neyveli Thermal power plant in Tamilnadu . URHA with a density of 2.07 T/m3, finesses modulus of 2.19, and dry rodded weight of 0.12 T/m3 was obtained as a residual of burning rice husk, the main components of FA are SiO_2 and Al_2O_3, while the major component of URHA is SiO_2. It is also noticed that the quality of URHA is poor with a high loss on ignition of 21.4%. In addition, the FA contained mainly stable crystals of mullite and quartz, whereas, the URHA contained both stable crystals of quartz and cristobaliteay diffraction patterns of FA and URHA, respectively.

MIX DESIGN

VOLUME CALCULATION:

Brick $= L\times B\times H$

$= 0.190\times0.09\times0.09$

$= 1.539\times10^{-3}m^3$

REPLACEMENT OF CLAY WITH 15% OF RHA &15% OF FLY ASH

BRICK 1:**(Cl-70%,Rha-15%,Fa-15%)**

Clay:$70/100\times1.539\times10^{-3}\times1600=1.72$kg

Rha:$15/100\times1.539\times10^{-3}\times125=0.02$kg

Fa:$15/100\times1.539\times10^{-3}\times1300=0.30$kg

REPLACEMENT OF CLAY WITH 30% OF RHA & 30% OF FLY ASH

BRICK 2:**(Cl-50%,Rha-25%,Fa-25%)**

Clay:$50/100\times1.539\times\times10^{-3}\times1600=1.23$kg

Rha:$25/100\times1.539\times\times10^{-3}\times125=0.04$kg

Fa:$25/100\times1.539\times\times10^{-3}\times1300=0.50$kg

MIX PROPORTION FOR BRICK

MATERIAL USED	BRICK 1 (Cl-70%,Rha-15%,Fa-15%) (kg)	BRICK 2 (Cl-50%,Rha-25%,Fa-25%) (kg)
CLAY	1.72	1.23
RICE HUSK ASH	0.02	0.04
FLY ASH	0.30	0.50

4. PROPERTIES OF MATERIALS USED FOR THE STUDY

The material used for this experimental work are cement, sand, water,Fly ash are

Sand: Locally available sand zone III with specific gravity 2.63, fineness modulus 3.10, conforming to I.S. –383-1970

Water: Potable water was used for the experimentation.

Fly ash: Specific gravity of FA is 2.58.Fly ash is composed of the mineral portion of coal.Particles are glassy, spherical ‘all bearing’finer than cement particles. Sizes of particles are 0.1µ-150µ.It is a pozzolanic material which reacts with free lime in the presence of water. The fly ash is produced from maize products power plant. This plant is located near kathwala in Ahmadabad district is Gujarat state.

Clay : Clay is a fine mixture of decompose igneous rock mineral and organic matter. "Clay refers to present material composed primarily of fine-grained minerals, that is mostly plastic at acceptable water contents and can harden once unemployed or dried."

FLY ASH

Flyash is taken from VIJYAWADA

THERMAL POWER STATION,VIJYAWADA in Andhra Pradesh .

5. EXPERIMENTAL WORK

This chapter presents the details of development of the process of making fly ash and clay RHA based unburnt brick. In 2001, very little knowledge and know how of making of fly ash based unburnt brick were available in the published literature. Due to this lack of information, the study began based on limited available literature on green pastes and mortars.

EXPERIMENTAL INVESTIGATION

FLY ASH

In the present experimental work, low calcium, Class F (American Society for Testing and Materials 2001) dry fly ash obtained from the power plant, Mettur was used as the base material. Three different batches of fly ash were used; the first batch was obtained in the middle of 2001, the second batch arrived in the middle of 2003, and the last batch was obtained in 2004. The chemical composition of fly ash from all batches, as determined by X – Ray Fluorescence (XRF) analysis, It can be seen from table 4.1, that the three batches of fly ash contained a very low percentage of carbon.

RICE HUSK ASH

Rice milling generates a by-product know as husk. This surrounds the paddy grain. During edge of paddy concerning 78% weight is received as rice, broken rice and bran .Rest 22% the load of paddy is received as husk. This husk contains concerning 75% organic volatile matter and also the balance 25% the load of this husk is reborn into ash throughout the firing method, is understood as rice husk ash (RHA). This RHA in turn contains around 85 % - 90 % amorphous silica. So for each one 1000 kgs of paddy processed, regarding 22 kgs of husk is created and once this husk is burnt within the boilers, regarding 55 kgs of RHA is generated. India is a major rice producing country and also the husk generated throughout it is usually used as fuel within the boilers for processing padding, manufacturing energy through direct combustion and / or by chemical process about 20 million tonnes of RHA is produced annually. This RHA is great environment threat causing damage to the land and surrounding area in which it is dumped. Lots of ways that area unit being thought of for disposing them by creating business use of this RHA.

SIEVE ANALYSIS This is the name given to the operation of dividing a sample of RHA into various fractions each consisting of particles of the same size. The sieve analysis is conducted to determine the particle size distribution in a sample of RHA, which we call gradation.

PROCEDURE

i. The shaking shall be done with a varied motion, backward sand forwards, left to right, circular clockwise and anti-clockwise, and with frequent jarring, so that the material is kept moving over the sieve surface in frequently changing directions.

ii. Material shall not be forced through the sieve by hand pressure. Lumps of fine material, if present, may be broken by gentle pressure with fingers against the sid Light brushing with a fine camel hair brush may be used on the 150-micron and 75-micron IS Sieves to prevent RHA of powder and blinding of apertures.

iii. On completion of sieving, the material retained on each sieve, together with any material cleaned fro Light brushing with a fine camel hair brush may be used on the 150-micron and 75-micron IS Sieves to prevent RHA of powder and blinding of apertures.

iv. On completion of sieving, the material retained on each sieve, together with any material cleaned from the mesh, shall be weighed.

Table – Sieve analysis of RHA

Fineness modulus= **(Cumulative Percentage Of Weight Retained/100. = 4.38**

CLAY

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24 hrs wetted and cured

Fig. curing of clay

TEST ON BRICK

Fig. Drying of brick

COMPRESSIVE TEST

IS Sieve	Weight Retained gms	Cumulative Weight Retained gms	% Retained	% Passing
4.75mm	35	35	3.5	96.5
2.36mm	235	270	32	73
1.18mm	320	590	59	41
600µm	189	779	79.9	22.1
300µm	135	914	91.4	8.6
150µm	56	970	96	3
60µm	17	987	98.7	1.3
Pan	13	1000	100.0	0

Take three random bricks samples and immerse them in water for 24 hours at room temperature. After twenty four hours, take them out, permit them to empty and so clean the excess water. Now, fill their frogs (and the other voids) by a layer of normal one: 1 mortar (1 half cement and 1 half sand).Store these bricks under damp sacks for 24 hours (to allow setting of mortar). Place the bricks in water for seven days. (This is to allow the mortar to harden). Take the bricks out of the water, allow the water to drain and remove the surplus water. When surface dry, every brick is tested for compressive strength singly. Place the brick flat-wise, with frog end facing upward, between two plywood sheets. Brick therefore adjusted between the laminate sheets is placed on the bed of compressive strength of bricks testing machine and cargo is applied axially and at an identical rate of a hundred and forty kg/cm2/minute. (This is very important). Note the load at which the brick fails (gets broken). This load (P) is divided by cross-sectional area (A) of the brick gives the compressive strength (Co).

Compressive strength = Maximum load / Area of the specimen

= P/A

Where,

P -Maximum load (N)

A - Area of the specimen (mm^2)

The arithmetic mean of the compressive strength of bricks values of all the three bricks shall be taken as the compressive strength of that lot of bricks represented by the test samples.

Table compressive test analysis

COMPRESSIVE STRENGTH

BRICK	14DAYS
BRICK 1 (Cl-70%,Rha-15%,Fa-15%) (kg)	23
BRICK 2 (Cl-50%,Rha-25%,Fa-25%) (kg)	36
BRICK 3 (Red clay brick)	21

Fig. compressive test analysis

WATER ABSORPTION TEST

Take three whole bricks randomly. Dry these samples to a continuing weight by inserting them in an exceedingly airy kitchen appliance at 110° C +- 5°C. This could take forty eight hours or longer. The specimens are weighed individually after cooling. The dry, weighed samples are then immersed in water, at room temperature, for 24 hours. After 24 hours the samples are taken out. Each sample is wiped dry and weighed individually within three minutes after it is taken out from the water. Absorption value is calculated by the simple relationship. Water absorption = {[W2 – W1] / W1} x 100

Where,

W1 = Weight of dry brick (kg)

W2 = Weight of wet brick after immersion for 24 hours. (kg)

The average of three values for the three samples shall be taken as the water absorption of the brick. It shall be within the specified limits for the classification of the bricks.

Table 5.3 water absorption test analysis

BRICK	%
BRICK 1 (Cl-70%,Rha-15%,Fa-15%)	9.3

(kg)	
BRICK 2 (Cl-50%,Rha-25%,Fa-25%) (kg)	16.2
BRICK 3 (red clay brick)	13

EFFLORESCENCE TEST

Take three bricks at randomly. Place every brick on finish during a separate shallow flat bottom dish containing H2O. Note that depth of immersion of bricks mustn't be but a pair of.5 cm in every case. Keep the on top of dishes (containing water and bricks) during a heat (18°C to 30°C) area that has adequate Ventilation. The water from the dishes will be lost due to absorption by bricks and subsequent evaporation). Add recent amount of water once the bricks seem having dried. At the top of the second drying, every brick is determined for efflorescence; that's a look of any white patch of salt on the surface of the brick. The efflorescence is reported only by qualitative words as follows:

Serious- Salt deposition is all round and quite heavy and increases with repeated wetting and drying. Powdering of salt is prominent.

Heavy- Salt deposits cowl quite 50% of the extent. The tendency to powder is absent.

Moderate- Salt deposits cover 10-50 percent surface area. The salt forms thin layers without showing any tendency to peel off in flakes or become powdery.

Slight- Salt covers the area of but 10% and forms solely an awfully skinny sticky layer. Nil- There is seen no deposit of any salt even once recurrent wetting.

Table 5.4 Efflorescence test

Sr. No.	Rice Husk Ash (%)	Nill	Sight
1	**15%**	✓	_
2	**25%**	_	✓
3	**0%**		

HARDNESS TEST

In this test a scratch is made on brick surface with steel rod (any hard material can be used) which was difficult to imply the bricks or blocks were hard. This shows the brick possess high quality.

Sl.NO	BRICK	RESULT
1	**BRICK 1** (Cl-70%,Rha-15%,Fa-15%) (kg)	NO IMPLY
2	**BRICK 2** (Cl-50%,Rha-25%,Fa-25%) (kg)	NO IMPLY
3	**BRICK 3** (Red clay brick)	NO IMPLY

SOUNDNESS TEST

The soundness test is also done in the field. After the manufacturing of the brick are allowed to dry in air for 2days.Then the bricks are made to hit each other the ring sound produced during the process, which denotes the quality of the brick that it is good. Good quality bricks produce the clear ringing sound. In our project both fly ash bricks and plastic sand bricks clear ringing sound produced.

BRICK	RESULT
BRICK 1 (Cl-70%,Rha-15%,Fa-15%) (kg)	RING SOUND PRODUCED
BRICK 2 (Cl-50%,Rha-25%,Fa-25%) (kg)	RING SOUND PRODUCED
BRICK 3(red clay brick)	RING SOUND PRODUCED

RAW MATERIALS	PRICE/KG
Rice husk ash (rha)	8
Fly ash(fa)	1.3
Clay	1.8

Cost estimation :

BRICK 1:(Cl-70%,Rha-15%,Fa-15%)

Rice husk: (0.02kg) = 8*0.02 =0.16 Rs.

Fly ash:(0.30kg) = 1.3*0.30 =0.39 Rs.

clay:(1.72kg) =1.8*1.72 =3.096 RS.

Cost of Brick 1:(Cl-70%,Rha-15%,Fa-15%)

=Rs 3.646/brick

BRICK 2:(Cl-50%,Rha-25%,Fa-25%)

Rice husk: (0.04) = 8*0.04 = 0.32Rs.

Fly ash:(0.50) =1.3*0.50. = 0.65Rs.

Clay(1.23) =1.8*1.23. = 2.214Rs.

Cost of BRICK 2:(Cl-50%,Rha-25%,Fa-25%)=Rs.3.18/

brick 3:(Red clay brick)

Cost of BRICK 3(Red clay brick) =Rs.5.50/brick

6. CONCLUSION:

The various waste that are currently recycled in bricks manufacturing for enhance the performance in terms of making more environmental and economical bricks either consume energy resource nor emits gases to design the green building. Bricks are manufactured with partially replacement of clay by Rice Husk Ash(RHA) and FlyAsh(FA) with 30% and 50% respectively. The increasing rice husk in product decline the compressive strength because the combusted rice husk replace with space in the product which effects the density and compressive strength. The 50% of rice husk ash and fly ash by weight obtain 36N/mm^2 compressive strength and 16.2 % of water absorption . this properties nearly equal to the standard brick. This brick are economic and environment friendly than the conventional brick. Hence it can be used for low cost and green building.