N.Vamsi Mohan, Prof.P.V.V.Satyanarayana, Dr.K.Srinivasa Rao / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 2, Issue 5, September- October 2012, pp.1906-1910

Performance Of Rice Husk Ash Bricks

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ABSTRACT

In this study, rice husk ash has been utilized for the preparation of bricks in partial and full replacement of clay. Engineering properties like compressive strength, water absorption and size and shape have been studied. From the studies, it is observed that optimum proportion for (RHA + Clay) bricks was observed as 30% RHA and 70% Clay (Maximum of 30% RHA) as the bricks exhibited high compressive strength and low brick weight. In full replacement of clay with 40% RHA, 40% Lime and 20% gypsum and 50% RHA, 30% lime and 20% gypsum gives more strength (41 kg/ cm^2) when compared to all other possible proportions after 28 days curing period.

INTRODUCTION

Shelter is a basic human need and owning a house becomes a life long struggle as majority of Indians find housing costs prohibitively expensive. This problem becomes even more acute when considering the low income families who accounts for about 60-70% of Indian population. This brings out the need to reduce the cost of the housing and make it affordable for the booming population. Burnt clay bricks are being used extensively and the most important building material in construction industry. In India the building industry consumes about 20000 million bricks and 27% of the total natural energy consumption for their production. In addition to this, Clay bricks available in certain region are poor in quality and have lower compressive strength, higher water absorption, high efflorescence, higher wastage during transportation and handling, uneven surface etc., which have forced engineers to look for better materials capable of reducing the cost of construction.

In this contest search for an alternative building material to clay bricks, various government agencies and research institutions have repeatedly recommended the use of waste materials such as flyash, Rise husk ash (RHA), Ground

* Former PG Student, Department of Civil Engineering, Andhra University, Visakhapatnam-530 003.
** Faculty, Department of Civil Engineering, Andhra University, Visakhapatnam-530 003. granular blast furnace slag (GGBS) etc., as an alternative building material in making bricks, blocks and tiles etc. Logically the unlimited use of clay is harmful to the society,

as all the conventional clay bricks depend on good quality clay available from agriculture fields. Presuming a weight of 3 kg per brick, the total clay taken out from agriculture lands per year for such brick works out to over 300 million tonnes. The use of flyash and other industrial wastes for making bricks is ecologically advantageous since apart from saving precious top agriculture soil, it meets the social objective of disposing Industrial wastes otherwise are pollutants and nuisance.

Rice husk ash is obtained by burning rice husk. Physical properties of RHA are greatly affected by burning conditions. When the combustion is incomplete, large amount of unburnt carbon is found in the ash. When combustion is completed, grey to whitish ash is obtained. The amorphous content depends on burning temperature and holding time. Optimum properties can be obtained when rice husks are burnt at 500 - 700° C and held for short time, this temperature at which the husk is being burnt is less then that required for formation of clinkers in cement manufacturing process, the resulting ash can be used as a replacement of cement in concrete. The Rice Husk ash used in plain cement concrete often achieves economy and cost savings and imparts specific engineering properties to finished products. The chemical composition of RHA produced by utilizing the fluidized bed type furnace is reported to be SiO_2 (80- 95%), K_2O (1-2%) and un-burnt carbon (3-18%). The pozzolanic activity of rice husk ash is effective in improving the strength.

METHODOLOGY:

The experimental program is divided in to two parts

1. Partial replacement of clay by RHA.
   Rice husk ash is mixed with clay in different proportions ranging from 10-80%, and the basic properties of bricks like compressive strength and water absorption.
2. Fully replacement of clay by waste material from the different industries like RHA, gypsum and lime.

In this work, three waste products (Rice Husk Ash, Lime and Gypsum) utilized in building construction have been considered to see the impact also on the economy of the building construction by using these waste material. Rice husk ash is taken from four different places. These places are Jammu, Narayanapuram, padalapata which are near to Vizianagaram and

gypsum is collected from Corommendal fertilizers Pvt. Ltd, Visakhapatnam.

RESULTS AND DISCUSSIONS:

All the above tests are conducted as per IS: 2720 (part: 10) - 1991

Fig.1 and Table 1 show compressive strengths of bricks cast with different rice husk ash and clay proportions.

Table No: 1 Compressive strength of bricks cast with different rice husk ash and clay proportions

Designation	RHA + clay clayclayClay	RHA- 1	RHA - 2	RHA - 3	RHA- 4
1	10%+90%	46	44	46	42
2	20%+80%	45	42	44	40
3	30%+70%	39	37	41	37
4	40%+60%	36	34	33	31
5	50%+50%	30	32	27	28
6	60%+40%	26	28	20	20
7	70%+30%	20	22	18	16
8	80%+20%	16	17	12	14

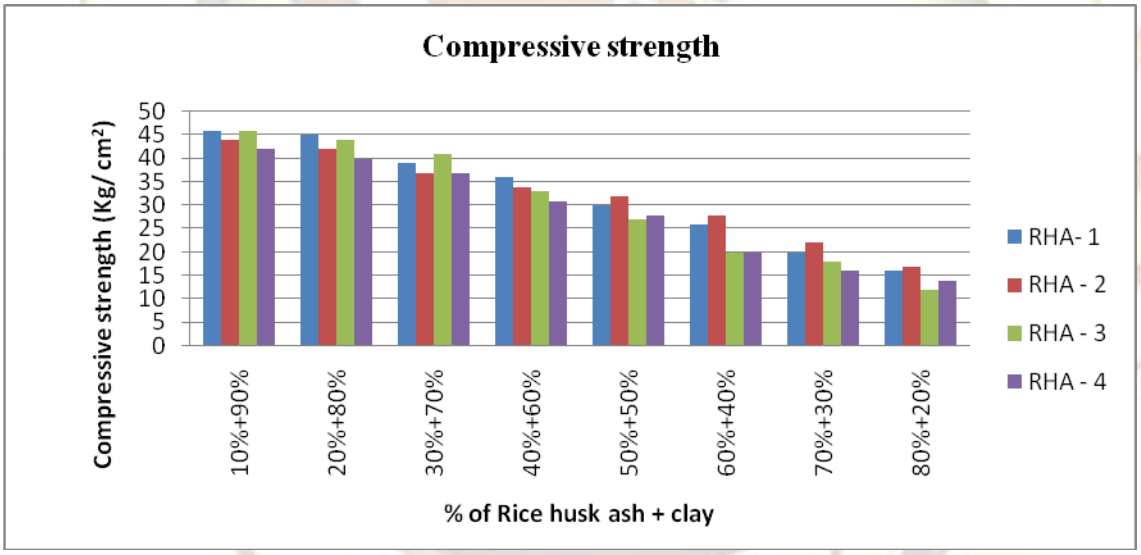

Fig.1 Compressive strengths (kg/ cm^2) of bricks cast with different rice husk ash and Clay proportions

Table 2 Chemical composition of the RHA

Type of RHA	CaO (%)	SiO_2
RHA – 1	11.3	75.77
RHA – 2	8.8	81.72
RHA – 3	10.0	73.2
RHA – 4	7.5	76.0

Table no: 3

S.no	RHA + CLAY	WEIGHT gms	ABSORPTION	STRUCTURE	SHAPE AND SIZE	SOUNDNESS
1	10%+90%	1880	15.56%	homogenous	Rectangular with sharp edges 19x9x9	Clear and ringing sound
2	20%+80%	1860	15.94%	Homogenous		
3	30%+70%	1800	16.30%	Homogenous		
4	40%+60%	1760	18.31%	Small lumps		
5	50%+50%	1700	20.73%	Homogenous		
6	60%+40%	1616	21.02%	Homogenous		
7	70%+30%	1590	21.62%	Small lumps		No sound
8	80%+20%	1540	21.84%	Small lumps		No sound

At 10% RHA the compressive strength is 42-46 kg/cm^2, at 20% it is 40-45 kg/cm^2, at 30% it is 37-40 kg/cm^2 and at 40% it is 31-36 kg/cm^2. So, from the above mentioned values by increasing the percentage of RHA the compressive strength decreases.

By addition of RHA upto 40% the strength is slightly decreasing and all the values are above 35 kg/cm^2 (As per IS: 1077-1975). Beyond 40% RHA the compressive strengths are drastically decreasing and are lies below 35kg/cm^2. At lower percentages of RHA, the clay characteristics are very much dominating than the RHA's characteristics, so the bonding between the materials is very high. While the RHA percentage increases RHA characteristics predominate, the bonding between the clay particle and the RHA particles is weak. The compressive strength values are somewhat similar for all other RHA's as the chemical properties (lime content & silica content) of all the RHA's are almost similar.

Due to the addition of RHA the weight of the brick reduced at higher the percentage of RHA, the weight of the brick reduced considerably. As the weight of the brick reduces considerable so as the weight of the super structure and the weight which falls on the soil reduces. Therefore from the first part (partial) it can conclude that the optimum percentage for RHA+ Clay bricks is 30% RHA + 70% Clay (Maximum of 30% RHA). Table no 4 and Fig no 2 shows the varieties of compressive strengths with respect to time.

Table 4 Compressive strength (kg/cm^2) of Full replacement of clay by RHA + Lime + gypsum

Designation	RHA + Lime + Gypsum	7 days	28 days
1	80% + 20% 0%	22	28
2	70% + 20% + 10%	24	31
3	60% + 20% + 20%	29	36
4	50% + 20% + 30%	28	28
5	70% + 30% + 0%	30	36
6	60% + 30% + 10%	33	39
7	50% + 30% + 20%	34	41
8	60% + 40% + 0%	30	38
9	50% + 40% +10%	32	39
10	40 % + 40% +20%	31	41

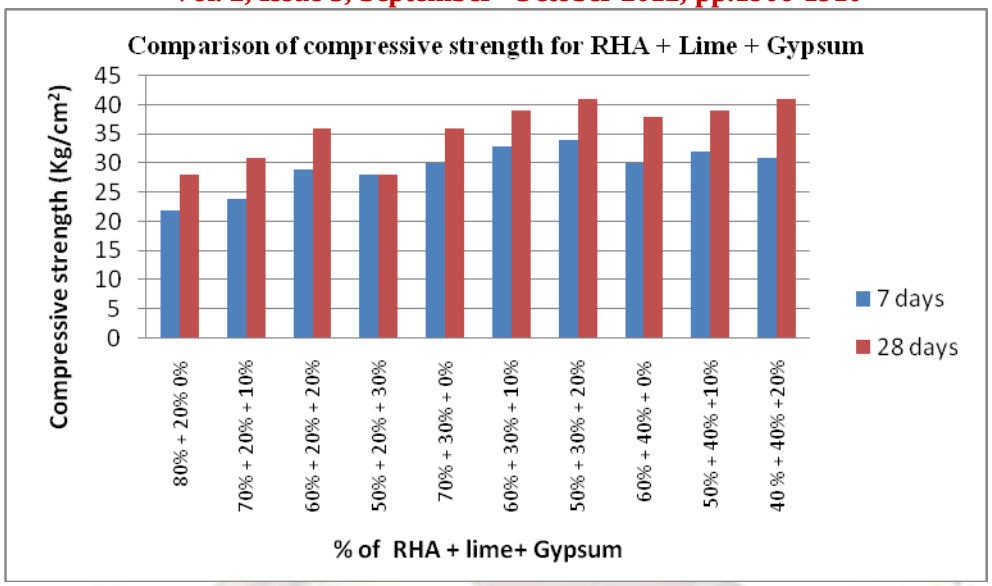

Fig: 2 Comparison of compressive strength for RHA + Lime + Gypsum

Table 5

S.no	RHA + Lime + gypsum	weight	Absorption	Structure	shape & size	Soundness
1	80% + 20% 0%	2200 gms	16.8 %	Small lumps	Rectangular with sharp edges, 19 x 9 x 9	Clear and ringing sound
2	70% +20%+10%	2254 gms	16.5 %	Small lumps		
3	60%+20%+20%	2265 gms	16.1 %	Homogenous		
4	50% +20%+30%	2290 gms	15.9 %	Homogenous		
5	70% +30%+0%	2258 gms	17.6 %	Homogenous		
6	60% +30%+10%	2297 gms	17.3 %	Homogenous		
7	50% +30%+20%	2310 gms	16.9 %	Homogenous		No sound
8	60% +40%+0%	2123 gms	16.7 %	Homogenous		No sound
9	50% +40%+10%	2146 gms	16.4 %	Homogenous		No sound
10	40% +40%+20%	2180 gms	16.2%	Homogenous		No sound

In order to improve the strength of the brick, lime is added in the above composition. Here by increasing the lime content the compressive strength increases. From the above table it is seen that the lime is kept constant at 20%, 30% and 40% and the percentages of RHA and Gypsum are varied. At 60% RHA + 30% lime + 10% Gypsum, the 7 days strength is 33Kg/ cm^2 and 28 days strength is 39 Kg/cm^2, at 50% RHA + 30 % lime +20% gypsum 7 days strength is 34 kg/cm^2 and 28 days strength is 41 Kg/cm^2, at 60% RHA +40 % lime + 0% gypsum the 7 days strength is 30 kg/cm^2 and 28 days strength is 38 kg/cm^2, at 50% RHA +40% lime + 10% gypsum the 7 days strength is 32 kg/cm^2 and 28 days strength is 39 kg/cm^2, at 40 % RHA + 40% lime +20% gypsum at 7 days strength is 31 kg/cm^2 and 28 days strength is 41 kg/cm^2. The ultimate strength is very good and the compressive strength is above 35 kg/cm^2. From the above results it can conclude that the 50% RHA +30% lime+ 20% gypsum is the optimum percentage.

Positive aspects of RHA bricks in building construction

1. The RHA-clay bricks offer strengths at par with conventional clay bricks and in some cases even they give higher strength (around 100 kg/cm^2) as compared to a strength of 40-50 kg/cm^2 in case of burnt clay Bricks when fineness of RHA increases.
2. RHA – clay bricks have very low water absorption of 12-15%.
3. RHA bricks can be of good quality with sharp edges, controlled dimensions and offer a plain and even finish. They are resistant to wear and tear which makes

them suitable for the internal and external uses. Plastering over brick can be avoided thus achieving further economy.

4. The bonding with mortar and plaster is much greater or better in the case of RHA bricks.
5. RHA bricks can be made in different sizes or shapes, so these can be used in building construction.
6. Bulk utilization of RHA helps in solving the pollution problem.
7. RHA proved to be quite economical when produced in the vicinity if thermal power plants.
8. These bricks are very easy to produce as they manufacturing, process is simple and machinery required is easily available.
9.

Conclusions:

1. By the addition of RHA upto 40% to clay, the strength gradually decreased and beyond the addition of 40% RHA the compressive strengths decreased rapidly.
2. Optimum proportion for (RHA + Clay) bricks was observed as 30% RHA and 70% Clay (Maximum of 30% RHA) as the bricks exhibited high compressive strength and low brick weight.
3. As the percentage of RHA increased, water absorption of RHA-Clay bricks also increased.
4. In full replacement of clay with 40% RHA, 40% Lime and 20% gypsum and 50% RHA, 30% lime and 20% gypsum gives more strength (41 kg/ cm^2) when compared to all other possible proportions after 28 days curing period. 50% RHA, 30% lime and 20% gypsum is optimum proportion due to its light weight at that proportion.
5. As the percentage of lime and gypsum increased, water absorption of RHA+ Lime+ Gypsum bricks decreased.

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