International Journal of Research in Advent Technology (E-ISSN: 2321-9637) Special Issue
1st International Conference on Advent Trends in Engineering, Science and Technology
"ICATEST 2015", 08 March 2015

Utilization of Rice Husk For Production of Clay Brick

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Abstract:
The investigation presents a parametric experimental study by utilization of rice husk in brick manufacturing. The brick manufacturing material such as clay, fly ash and rice husk was collected from Akola and Gondia districts of Maharashtra, India. Coarse Rice husk was utilized by weight (0 to 5 %) as a brick material. The prepared mixture was compacted and sintering at brick kiln and tested in the laboratory. The observations recorded during the tests shows that bricks with the 2% addition of rice husk to clay ,exhibit a compressive strength of 6.59 MPa which is smaller than the reference clay bricks, satisfying the requirements of IS 1077.
Key words: *Clay brick, Rice husk, Compressive Strength, Water absorption, Density*

1. INTRODUCTION

Burnt clay bricks are most utilizing brick in construction world due to its physical, chemical, mechanical properties. Since the large demand has been placed on building material industry especially in the last decade owing to the increasing population, which causes a chronic shortage of building materials; the civil engineers have been challenged to convert the industrial wastes to useful building and construction materials. The worldwide annual production of bricks is currently about 1391 billion units and the demand for bricks is expected to be continuously rising [1]. Clay fired bricks form the backbone of the construction industry. India is estimated to have over 1, 50,000 brick kilns producing the annual demand 200 billion bricks per year [2]. One of the most common issues for India and other countries for using residue, by-product wastes and raw materials in the production of construction materials such as clay brick. Globally

the estimated quantity of wastes generation was 12 billion tonnes in the year 2002 and about 19 billion tonnes of solid wastes are expected to be generated annually by the year 2025 [3]. Presently in India, about 960 million tonnes of solid waste is being generated annually as by-products during industrial, mining, municipal, agricultural and other processes; of this 350 million tonnes are organic wastes from agricultural sources; 290 million tonnes are inorganic waste of industrial and mining sectors and 4.5 million tonnes are hazardous in nature [4].Disposal of solid waste generated from agricultural and industrial production activity is another serious problem in developing countries like India. The wastes generated from agricultural sources are sugarcane baggase, paddy and wheat straw and husk, wastes of vegetables, food products, tea, oil production, jute fibre, groundnut shell, wooden mill waste, coconut husk, cotton stalk etc[5]; out of these one of the major quantity of rice husk annually generated about 20 million tonnes per year respectively [2]. Researchers incorporate RH and rice husk ash (RHA) for production of construction material such as Ramasamy and Biswas[6] utilized RHA as a cement replacement material. The test results indicated the optimum quantity of RHA increases the mechanical properties of concrete optimum quantity of RHA increases the mechanical properties of concrete. Xu et al.[7] studied the microstructure of RHA from the X-ray diffraction (XRD) analysis and compressive strength test results. It was observed that the optimum combustion temperature for obtaining highly reactive RHA is 600°C. Thus, RHA can partially replace cement as a mineral admixture for construction purpose. Tashima et al. [8] in their research reported

that the addition of RHA enhances the strength and reduces the water absorption of concrete. Gorhan et al. [9] carried out the mineralogical analysis on powdered samples of porous bricks made up with RH by X-ray diffraction (XRD) using Cu Ka radiation. After that, they were characterized thermo gravimetric and differential thermal analysis (TG–DTA). The differential thermal (DTA) and thermo gravimetric (TGA) analyses were performed on powdered samples (<70 mesh) up to 1000°C (5°C/min) in air and concluded that clay and 10% rice husk are the optimum composition for production of clay brick. J. Sutas et al. [10] studied effect between rice husk and rice husk ash to properties of bricks. Comparative adding between rice husk and rice husk ash were varied by 0 -10% by weight. The results showed that more adding rice husk less compressive strength and density of specimens. Otherwise the porosity increases when adding rice husk.

Constituents	**Clay**	**Fly Ash**	**Rice husk**
Silica	12.38%	69.1%	14.66%
SiO2	3.93%	44.9% to 47.6%	0.035%
Al2O3	3.42%	21.9% to 24.3%	--
Fe2O3	--	2.1% to 3.5%	0.006%
CaO	--	0.85% to 1.2%	--
MgO	--	0.20% to 0.60%	0.003%
Sulphur	--	1.2%	0.3%
O	42.37%	--	37.32%
Ca	26.05%		0.06%
C	4.59%	--	41.44%
Pb	7.62%		0.59%
Loss of ignition	--	3.4%	--

Utilizing waste material in construction material lead to conversion of natural resources but will forecast the ways for managing residuals and by-product materials. Continuously researchers made attempts to incorporate residuals and by-product materials in the production of bricks; and provide potential and sustainable solution [11, 12, 13]. In this paper the experimental attempt has been made for utilizing the waste solid rise husk. The main objective of the study is to investigate effect of solid husk with fly ash on the mechanical properties of burnt clay brick at klin level. Bricks are fabricated and characterized for particle size and morphology, density, Chemical composition etc. In particular, the studies focus on the manufacturing process and tests for brick characterization.

2. MATERIAL AND METHODS

In order to measure the structural properties and feasibility of using RH in brick production, the materials and methods are explained in this section. In this study the brick raw materials ex. clay, fly ash obtained locally and rice husk obtained from Gondia, India were used.

2.1 *Characterization of bricks raw material*

2.1.1 *Clay*

Clay is a fine mixture of decompose igneous rock mineral and organic matter. "Clay refers to naturally occurring material composed primarily of fine-grained minerals, which is generally plastic at appropriate water contents and will harden when fired or dried." Technological properties of clay materials mainly depend on their degree of dispersion. Granulometric composition of clay affects the number of properties such as density, compressibility, porosity, etc [14]. The clay material for brick samples is taken from one of the brick manufacturing plant in Akola region in India. Chemical composition of the used clay is given on Table 1, and according to the elemental analysis EDX investigation it was found that montmorillonite, quartz, clinochlore and calcite exist in clay mineral structure given in Table 1.

Table 1. **Chemical composition of *Clay, Fly ash* and *Rice husk***

2.1.2 *Fly Ash*

In India depending on type of soil, fly ash (20-50%) is being used along with clay to produce clay bricks[15]. In this study, 40% fly ash used in each set of bricks. The fly ash was collected in dry state from local thermal power station Paras, India. The chemical composition of the fly ash is given in Table 1.

2.1.3 *Rice husk*

In this study, rice husk obtained from Gondia, India were used. They were initially subjected to pre-treatments such as drying and grinding. Chemical analysis of powder husk was in Table 1.

2.2 *Fabrication of bricks*

The procure raw material; combination of raw material which is clay, fly ash, and rice husk finding the proper combination of raw material. The percentages of flay ash kept 40 % and RH in the brick combination are varied from 0, 1, 2, 3, 4 and 5 by weight. The product is examined by Indian standard of brick IS 1077 [16]. The experiment properties have compressive resistibility, water absorbency and dry density. The sampling combinations are extruded and sintered by local kiln in Akola district. All of samples are transported to Engineering Research Laboratory, Akola for analysis as scheme show in Fig. 1.

Fig. 1 performs the schematic diagram of brick manufacturing. After the raw material procured by clay, the main component is cured for seven days. The RH is added in the curing component which varies percentage of weight from 0, 1, 2, 3, 4 and 5 by weight. Next, the component is mixed and molding by casting, the bricks are cast in sizing of 21 x 10 x 65 cm and kept it for 7 days for setting. For each proportion 3 nos. of bricks prepared. Then, the specimen is sintered in kiln-fired bricks at about 475 ° Celsius for 7 days. The local kiln-fired brick uses the soy sludge, baggase as combustible. Later, the raw brick is analyzed for compressive strength by universal Testing machine, dry density and percentage of water absorption as per Indian standard [17].

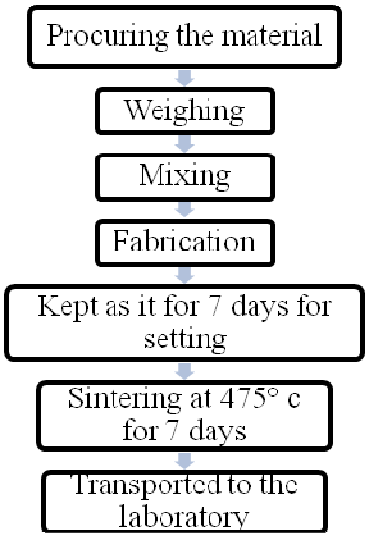
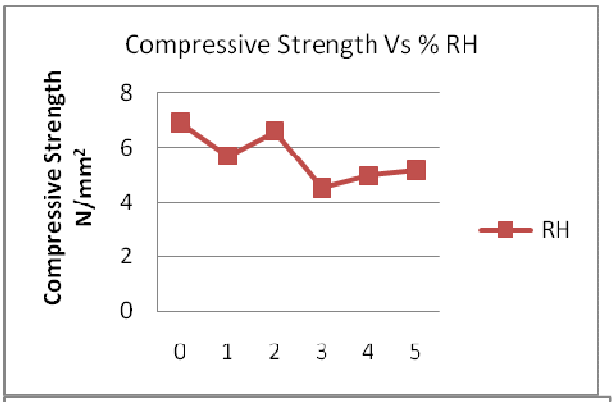


Fig. No.1

3. RESULT AND DISCCUSION

3.1 *Compressive strength*

The compressive strength of brick specimen sintered as the function for different RH with regular brick show in Fig. 2. Increasing percentage of RH decrease the compressive strength with high porosity resulting low dry density. Utilizing RH with increased percentage gives the higher value of 6.59 MPa. Compressive strength obtain maximum at 2 % use of RH in brick and improve their workability properties.



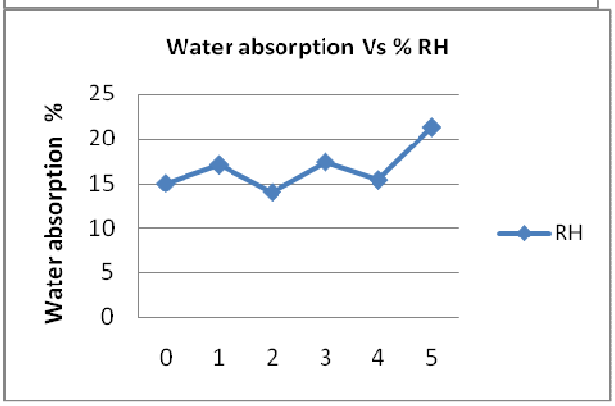


Fig No.2

Fig No.3

3.2 *Water absorption*

The effect of RH to water absorption is show in Fig. 3. The water absorption increase with increase addition of rice husk because high porosity specimens with evaporate of rice husk when burned. The addition of rice husk ash 2% by weight show minimum of water absorption were 14.01 %.

3.3 *Dry Density*

The dry densities of sintered specimen are given in Fig. 4. Compare between specimen without RH and with RH, the brick specimen with add RH has dry density less than traditional and dry density decrease with increase RH addition. Higher RH addition ratio increases the porosity volume and decrease dry density of sintered spacemen.

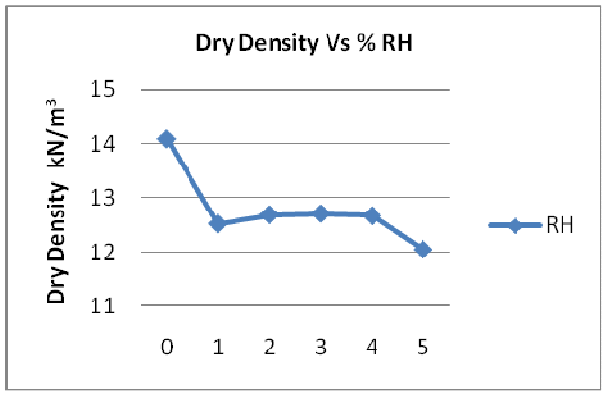


Fig. No. 4

4. CONCLUSIONS

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 2 percent of rice husk by weight increase the compressive strength and lower density. The other percentages decrease the compressive strength and density. Thus, the best composition of brick is 2 percent of rice husk by weight. The 2 percent of rice husk by weight obtain 6.59 MPa of compressive loading and 14.01 percent of water absorption. This ratio component is the proper properties of brick.

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