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FABRICATION AND CHARACTERIZATION OF BURNT CLAY BRICKS UTILIZING WASTE SUGARCANE BAGASSE

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Abstract: The main objective of this study is to investigate the utilization potential of bagasse production residues in clay brick. In India annually 90 million tons of bagasse produces and expected increasing percentage in future. The attempt has been made for producing light weight bricks with increasing percentage of baggase by weight. The effects of bagasse addition on the mechanical properties of the bricks were investigated The investigated results shows combination of clay, fly ash and bagasse is light weight and meets compressive strength requirements of IS 1077.

Keywords- Clay Brick, Bagasse, Dry Density, Water Absorption, Compressive Strength

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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. Construction sector is a crucial component of India's development path. It contributed to 8.2% of the Gross Domestic Product (GDP), in 2011-12. 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 [1].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 [2].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 [3].The wastes generated from agricultural sources are sugarcane bagasse, 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 [4]; out of these major quantity of sugarcane baggase and husk annually generated about 90 and 20 million tonnes per year respectively [2]. Reuse of such wastes as a sustainable construction material appears to be viable solution not only to pollution problem but also to the problem of the land-filling and high cost of building materials. Utilizing waste material in construction material lead to conversion of natural resources but will forecast the ways for managing residuals and by-product materials. Many researchers have been made attempts to incorporate residuals and by-product materials in the production of bricks; and provide potential and sustainable solution [5, 6, 7]. In this paper the experimental attempt has been made for utilizing the solid agro-waste for example sugarcane bagasse because these material have properties that’s provide benefit to reduce weight and improve the thermal conductivity [8,9]. The main objective of the study is to investigate effect of solid baggase on the mechanical properties of burnt clay brick at klin level. Bricks are fabricated and characterized for elemental composition, density, water absorption, compressive strength etc. In particular, the studies focus on the manufacturing process and tests for brick characterization.

1. MATERIAL AND METHODS

In order to measure the structural properties and feasibility of using bagasse and rice husk in brick production, the materials and methods are explained in this section. In this study the brick raw materials clay, fly ash, bagasse obtained locally.

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 [10]. The clay material for brick samples is taken from one of the brick manufacturing plant in Akola region in India. Elemental 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, illite and calcite exist in clay mineral structure.

Table 1. Elemental composition

Constituents (%)	Clay	Fly ash	Bagasse
C	8.67	11.30	**58.93**
O	59.75	50.19	**39.87**
Mg	2.12	0.29	**0.41**
Al	5.89	12.40	**0.72**
Si	11.77	24.77	**1.50**
S	0.50	0.03	**0.19**
Ca	0.54	1.03	**0.37**
Pb	**0.0**	**0.0**	**0.0**

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 [11]. 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 elemental composition of the fly ash is given in Table 1.

2.1.3 *Bagasse*

Sugarcane baggase collected from nearby area of Akola, India, Its elemental composition done with the EDX analysis shown in Table 1.

2.2 *Fabrication of bricks*

The procure raw material; combination of raw material which is clay, fly ash and baggase finding the proper combination of raw material. The percentages of flay ash kept 40 % and rice husk and baggase 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 [12]. The experiment properties has 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.

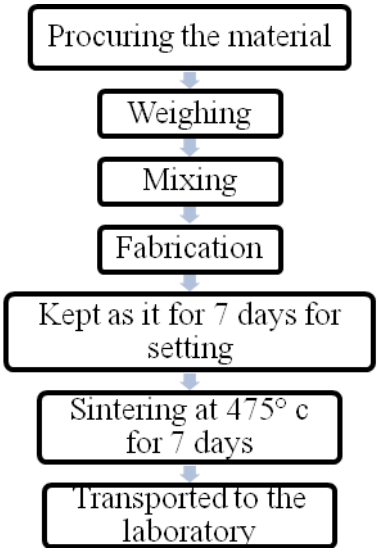

Fig. 1

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 bagasse is added in the curing component which varies percentage of weight from 0, 1, 2, 3, 4, and 5 by weight, respectively. 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. Then, the specimen is sintered in kiln-fired bricks at

about 450 degree 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 Compression Testing machine, dry density and percentage of water absorption as per Indian standard [13] and porosity structure analysis by SEM.

3 RESULT AND DISCCUSION

At least 4 samples were used at each test for all categories and the averages are presented and discussed in this section. Samples were tested for water absorption, apparent dry density and apparent porosity. Compressive strength of the samples was also measured. Convectional brick sample and bagasse addition bricks were investigated with EDX-SEM.

3.1 *Compressive strength*

The compressive strength of brick specimen sintered as the function for different baggase brick with regular brick show in Fig. 2.The strength of bagasse brick occurring more by increasing the amount of waste material in brick. Compressive strength at 2 % use of bagasse in brick were found maximum 7.15 MPa and improve their workability properties. Depending on the increase in residue addition and in porosity content, compressive strength of the samples decreased. Compressive strength of the all series sample is satisfying the standard strength values IS 1077.

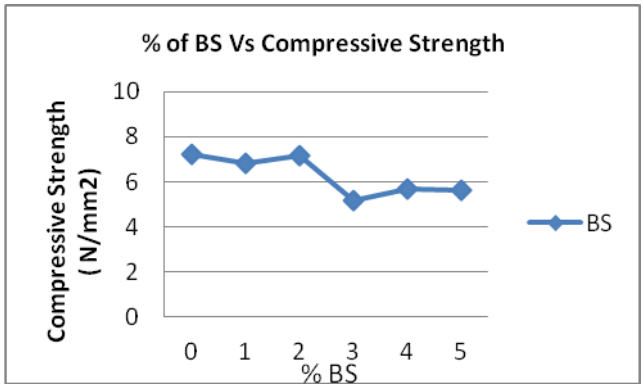

Fig. No. 2

3.2 *Dry Density and Water absorption*

Water absorption, apparent density and apparent porosity were measured by using water absorption method. Fig.no.3 shows that an increase in the amount of bagasse residue brings about a reduction in the clay body density. Water absorption at the use of fig no. 4 but when

the proportion will be increases then the increasing of water absorption found. Additions of 2% of residue water absorption were found 13.4 %.

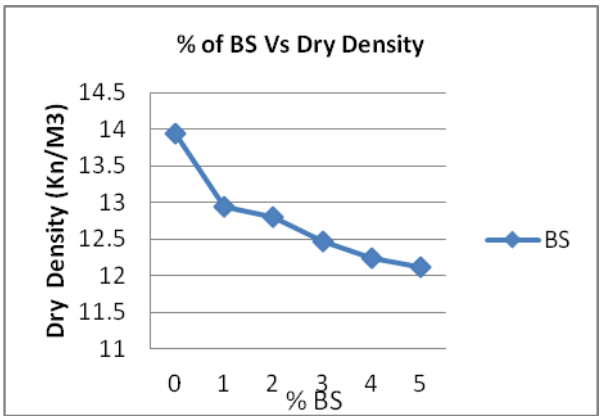

Fig. No.3

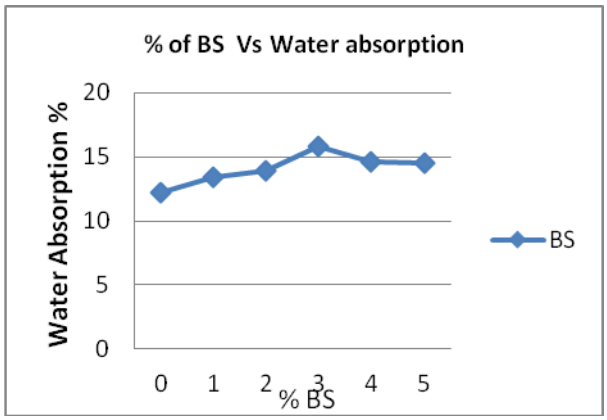

Fig. No.4

3.3 *Micro structure*

Effect of bagasse to micro structure of brick specimens are show in Fig. 6. The Fig. 5 reveals the comparative of micro construction that the traditional brick has porosity less than modified brick. More bagasse adds in component, more porosity increase in the brick matter. The more porosity is acquired by decomposed bagasse in sintering. Unfortunately, the more porosity affects the less product strength. At 10 percents bagasse by weight, the brittle brick decline the compressive strength and decrease the density.

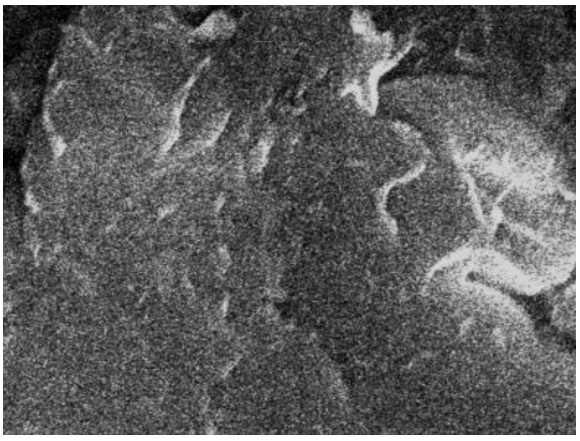

Fig. No. 5

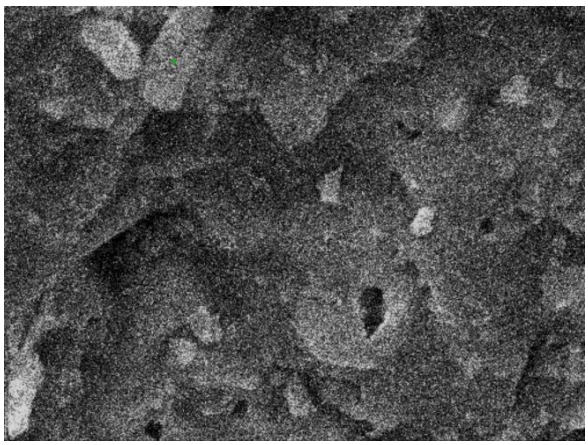

Fig. No. 6

4 CONCLUSION

The physical and mechanical properties of brick samples with bagasse are investigated. The test results show that the bagasse combination with fly ash and clay provides results which can be potentially used in the production of lighter brick material. This composition produces brick which weigh 13 % lesser than of that of the conventional clay. All test result found satisfactorily and within the permissible limit of Indian Standard.

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