Bricks Manufacturing With Partial Replacement Of Clay With Ggbs

R. Divahar, S. P. Sangeetha, P. S. Aravind Raj, S. Ispara Xavier

Abstract: The advanced technologies has led to increases the amount and the type of waste being generated. In this paper Ground-granulated blast-furnace slag (GGBS or GGBFS) was partially replaced with clay into brick for energy consumption. Granulated blast-furnace slag being waste material obtained from iron slag. Clay, lime and (GGBS) were the materials used to manufacture the bricks in this paper. The present involve gives a detailed description on the experimental investigation on the compressive strength and physical properties of the clay with GGBS brick. Totally 6 different ratios of bricks were investigated such as 0%, 5%,10%,15%,20%,25%,30%. From the results it is obtained that 5% of lime was added constantly to increase the stability and also the increment of 5% of GGBS added in various ratios. The obtained energy consumption was very less compared with conventional burnt clay bricks and calcium silicate bricks. . Sufficient strength was also obtained by molding the bricks at significantly lower pressure compared with calcium silicate bricks. From the results it was found that using GGBS as the main stabilizing agent in Brick production can reduce the cost of energy in the firing process.

Index Terms: GGBS, lime , Clay, Brick, compressive strength

1 INTRODUCTION

Rapid Rapid increasing population and various design methods of constructional technology, in the past centuries, bricks have taken various changes. Fired brick were the most countless types and are place in courses and countless designs known as bonds, and also known as brickwork, and may be laid in various kinds of mortar used to grasp the bricks together to make aim perishable structure. GGBS was observed in the form of powder from iron wastes. This may cause environmental problems and making disposal problems at the disposal sites, this have been changed in to useful resource and used for making bricks. The cost and other properties of the bricks are equalized to the normal bricks. The properties of the manufactured brick have compromised with the normal brick. This study involves the addition of GGBS with clay in the fired bricks.

2 LITERATURE REVIEW

Tejas Ostwal et al [1] investigated experimentally on Strength, Durability, Sustainability and Economic Characteristics of Geo- Polymer Concrete Blocks. The results revealed that geopolymer concrete block develops strength at ambient curing conditions.

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Niragi Dave et al [2]carried out the experimental investigation towards Industrial By- Product Utilization. They concluded that the scientific advancement in recycling and using industrial and agricultural processes for utilizing wastes will lead to a better use of world's resources. Jiping Bai et al [3] conducted an investigation on the unfired clay bricks. They concluded that the lime GGBS can be used as a strengthening agent for LOC soil. J.M Kinuthia et al [4] investigated experimental study on Energy-saving and CO_2 Emission. The results obtained that the technology is an ambitious energy saving technique and will be helpful to reduce CO_2 emission in the environment. Jonathan E Oti [5] carried out the study on the Development of Unfired Clay Building Materials for Sustainable Building Construction. S.K.Malhotra et al [6] conducted an experimental study the development of bricks from granulated blast furnace slag, a by-product of the iron and steel industry. They concluded that the slag- lime sand bricks can be manufactured beneficially in the vicinity of iron and steel plants. Bennet Jose Mathew et al [7] experimentally analysed on the Development of Coal Ash GGBS based geopolymer bricks. Results obtained that the parameter which had the highest influence on strength of the mix was binder percentage. E.Mozaffari et al [8] investigated into the strength development of Wastepaper Sludge Ash blended With Ground Granulated Blast furnace Slag. The kinetics of the hydration reactions and the possible ways of making lime a more effective contributor in activating other phases in the WSA–GGBS system are discussed in this paper. S.C.Pal et al [9] carried out Investigation on hydraulic activity of ground granulated blast furnace slag in concrete. They have proven that the Ground granulated blast furnace slag (GGBFS) being used as an effective partial cement replacement material, is improved several performance characteristics of concrete. Yogendra O. Patil et al [10] conducted an experimental study on GGBS as Partial Replacement of OPC in Cement Concrete. It is observed that the replacement of 20% in cement is possible without balancing the strength with 90 days curing. VinayakAwasare et al [11] analysedthe Strength Characteristics Of GGBS Concrete. .This report shows that tensile strength gives good performance in 20%, 30 % and 40% of replacement which is more than normal plain concrete. SonaliK.Gadpalliwar et al [12] studied the Partial Replacement of Cement by using

GGBS & RHA and Natural Sand by Quarry Sand in Concrete. It is concluded that the maximum strength is achievedwhen natural sand is replacedpartially with 60% quarry sand. M.C.Nataraja et al [13] studied experimentally on Use of Granulated Blast Furnace Slag as Fine Aggregate in Cement Mortar. From this report, it is clear that GGBS sand can be used as an alternative to natural sand from the point of view of strength. Wang Ling et al [14] analysed the Application of Ground Granulated Blast Furnace Slag in High Performance Concrete. The observed results that the GGBFS concrete is more sensitive to curing condition than Portland cement concrete. C.M.Ravikumar et al [15] have conducted Experimental Studies on Strength and Durability of Mortars Containing Pozzolonic Materials. Mortar specimens were tested for compressive strength at age of 3, 7 and 28 days and flexural strength at age of 28 days The objective of the study to analyse the strength of compression on the fired clay brick and also to study the physical properties of bricks.In general the brick will be made up of clay. But in this investigation, a replacement of GGBS in the ratio of 0%,5%,10%,15%,20%,25% has been. The effect of compression strength and the physical properties of the bricks has studied

3 MANUFACTURING PROCESS OF GGBS BRICKS

The blast furnace slag is one of the by-product from the iron manufacturing industry. Clay plays a vital role in brick manufacturing. The clay used for the process and it was collected from brick factory as it was available there itself. Lime is a general term deals to the calcium oxide constituent of a material. Water was collected from the natural pond located near to the brick factory. Fig 1 shows the materials of clay and GGBS.

(a) GGBS

(b) Clay

Fig. 1 *Photo view of Materials used*

3.1 TESTING OF MATERIALS

The following tests were conducted for Clay

TABLE 1

TEST VALUES OF GGBS

SI. NO.	*Tests Conducted*	*Values Obtained*
1	*Specific gravity test*	*2.85*
2	*Fineness test*	*400m^2/kg*
3	*pH value*	*11*
4	*Water solubility*	*100mg/L*
5	*Bulk density (Before Compaction)*	*1000 - 1100 kg/m^3 (loose)*
6	*Bulk density (After Compaction)*	*1200 - 1300kg/m^3*

Table 2

Test values of clay

SI. No.	*Tests Conducted*	*Values Obtained*
1	*Specific gravity test*	*2.66*
2	*Atterberg's limit*	*5.2*
3	*pH value*	*6*
4	*Water absorption test*	*15%*
5	*Bulk density*	*1.1 – 1.6 g/cm3*

3.3 TREATMENT OF MATERIALS

Clay and GGBS are mixed together and soaked in water so that the mixture remains wet for 24 hrs. This step helps soften the mixture which is very useful for manufacture of good quality bricks. Basically the soil particles excavated from the earth are hard which spoils the quality of clay and strength of bricks. In order to overcome this defect the raw materials are soaked in water for one day.

3.4 MIXING OF MATERIALS

The well soaked raw materials are thoroughly mixed with required amount of water in order to obtain the required plasticity of the slit for the moulding of bricks. Fig 2. Shows the mixture of clay and GGBS

(a) GGBS

(b)Clay

Fig 2 *Photo view of Mixture of Materials Used*

3.5 MOULDING OF BRICKS

Brick moulds either made of PVC or steel are used to cut the bricks. In this step a part of the well mixed material mixture is compactively filled into the mould and then the mould is gently removed leaving behind the raw material undisturbed as wet brick

3.6 DRYING OF BRICKS

The moulded bricks were allowed to dry in an open ground under direct sunlight for the period of 7days. During this process the moisture content of the wet bricks gets evaporated due the heat obtained from the sunlight. As the moisture content gets evaporated the brick becomes hard

and gains strength so that it doesn't breaks even after falling from a standard height. Fig.3(a) shows the drying of bricks and Fig.3(b) shows the Bricks are kept before heating.

4 RESULT AND DISCUSION

Table 3
obtained loads at various percentages

Sl. No.	*Percentage replacement*	*Loads obtained (kN)*						*Cumulative Load (kN)*	*Specimen ID*	*Compressive Strength N/mm2*
1	*0%*	*60*	*50*	*60*	*60*	*60*	*50*	*56.7*	*N.B*	*3.27*
2	*5%*	*70*	*90*	*90*	*90*	*90*	*70*	*83.5*	*A*	*4.9*
3	*10%*	*70*	*50*	*70*	*70*	*70*	*70*	*66.7*	*B*	*3.9*
4	*15%*	*50*	*50*	*40*	*50*	*50*	*50*	*48.4*	*C*	*2.9*
5	*20%*	*60*	*59*	*60*	*59*	*60*	*60*	*60*	*D*	*3.5*
6	*25%*	*50*	*60*	*60*	*70*	*60*	*50*	*58.4*	*E*	*3.41*
7	*30%*	*40*	*50*	*50*	*20*	*30*	*40*	*38.4*	*F*	*2.24*

(a) Drying of Bricks (b)Bricks before heating

Fig 3 *Photo view of Drying of Bricks Used*

3.7 TESTING OF SPECIMENS

The specimens taken out from the firing kiln were tested for compression test. The test was conducted in the compressive testing machine. Fig 5 shows The testing of specimen using compression testing machine

Fig.5 *Testing of Specimen*

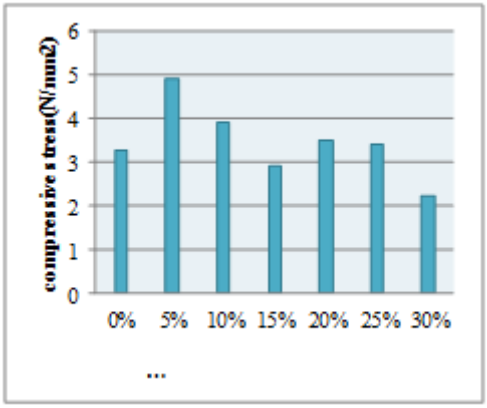

Fig 6. *Percentage Invariants to Compressive Stress*

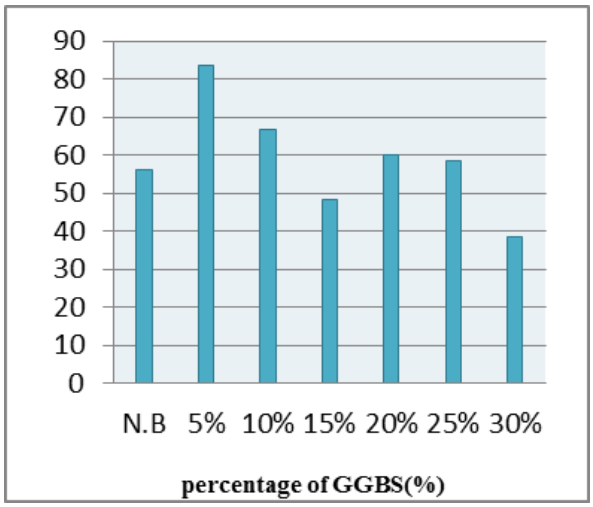

Fig 7. *Percentage Invariants to Load*

5 CONCLUSION

Good quality bricks can be produced from stipulated proportions of slag, lime mixture and sand. The strength characteristics of the unfired bricks tested in this study were improved with the use of lime and GGBS as a binder.

1. The amount of the clay is reduced to 20% of total use. The manufacturing process of the bricks is

simple and does not require any firing or autoclaving, specialized plant or machinery.Therefore, the energy consumption will be much less compared with conventional burnt clay bricks and calcium silicate bricks.

2. Sufficient strength is obtained by moulding the bricks at significantly lower pressure compared to that for calcium silicate bricks.
3. Brick production using GGBS as the main stabilising agent will reduce the energy and cost of the firing process.

Appropriate research and development into new technologies that reduce energy usage and carbon dioxide emissions are vital for sustainable building construction. More significant engagement in the development of new materials will help the construction industry meet global challenges and develop business.

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