Study on Development of Light Weight Foamed Bricks using Red Mud

S. Sharmila[1] N. Surya[2] S. Divya[3]
[1,2,3]Assistant Professor
[1,2,3]Department of Civil Engineering
[1,2,3]Paavai college of Engineering, Namakkal, India

Abstract— In construction industry, brick is one of the major building materials. Conventionally for making brick, top layer of Fertile Soil (FS) is dug out and used as primary raw material. In order to prevent the fertile soil degradation and to overcome the present day demand for the brick an attempt were made to manufacture brick using different waste material. In our project we use Industrial and mining waste material for developing sustainable construction material to make brick. In view of this, an experimental investigation is carried out in combination of Waste/dump Soil during Magnesite Exploration (WSME) with ordinary Red Soil (RS) to develop an alternative brick.

Key words: Red Mud, Fly ash, Eco- friendly, Economical, Light weight

I. INTRODUCTION

Red Mud is the industrial waste generated during the production of alumina. Presence of Alumina and Iron oxide in Red Mud compensates the deficiency of the same components in limestone which is the primary raw material for cement production. Presence of soda in the Red Mud which when used in clinker production neutralizes the sulphur content in the pet coke that is used for burning clinker enroot cement production and adds to the cement's setting characteristics. Red Mud generated in the form of thick concentrated slurry in the Bayer's process was pumped to the Red Mud pond containing about 500 to 600 gpl of solids by high energy positive displacement pumps. MALCO discovered that Red Mud could be tried as an alternative for the Low Grade Bauxite (LGB) which the cement industries used for cement production. Over the years, many attempts have been made to find a use of Red Mud, but 2 none have proven to be economically satisfactory. These attempts were based mainly on the use of Red Mud as a partial substitute for clay in the production of bricks and other ceramic products .To overcome these problems there is a need of cost effective, alternative and innovative materials. In present study, Red Mud is used for the development of bricks. Replacing natural raw materials in brick with wastes may offer a much sought after opportunity to mitigate today's waste management problems.

Red Mud is usually discharged as highly alkaline slurry (pH 10-13.5) with 15-40% solids, which is pumped away for suitable disposal. Its chemical and mineralogical composition may change temporarily, depending on the source of bauxite and on the technological processing conditions. Due to its strong alkalinity (Na2O + NaOH = 2.0 – 20.0 wt. (%)), the conditions in which it can be discarded are restricted to minimize environmental problems such as soil contamination and groundwater pollution.

A pH of 8.9 was obtained at 25–50%of Red Mud and50–75% fly ash with water and temperature of 11000C. Alternatively 50% of Red Mud can be mixed with 50% of fly ash with water at temperature of 12000C to get a pH of about 8.4[1]. The Red Mud-clay composites have been formulated as 80%-20%, 70%-30%, 60%-40%, 50%-50% and fired at sintering temperatures of 800ºC, 900ºC and 1100ºC. Generally, mechanical strengths (modulus of rupture) increased with higher sintering temperature[2]. mechanical strengths (modulus of rupture) increased with higher sintering temperature[3]. It is found from the study that a Red Mud brick shows better performance than ordinary brick. As Red Mud bricks are eco-friendly & economical they protect the environment[4]. Compressive strength of Red Mud bricks are more as compound to ordinary bricks. Water absorption is also more but within limit, change is size and weight losses of Red Mud brick are negligible in case of Red Mud bricks[5]. The sintering temperature of bricks with high replacing ratio of fly ash was about 1050ºC, which is 50–100ºC higher than that of clay bricks[6].

II. MATERIALS AND THEIR PROPERTIES

A. *Red Mud (RM)*

The Red Mud has been collected from MALCO (Madras aluminium company), Mettur. It is found that the Red Mud possessed similar properties of clay after conducting various tests.

Fig. 2.1: Red Mud

Colour	Red
Odour	Earthy Odour, Slight Pungent
Size	Less Than 600µ
Density	2.7 G/Cm^3
Specific Gravity	2.85-2.97

Table 2.1: Physical Properties of Red Mud

Red Mud as such containing about 65% to 70% Solids with the remaining as moisture is a thixotropic substance which exhibits shear thinning behavior i.e., when the shear rate is increased, the apparent viscosity decreases.

B. *Fly Ash (FA)*

About 72 % of power generated in India is from Thermal Power Stations. It has been estimated that about 30 million tonnes of fly ash is produced per year by 60 Thermal plants located in different parts of the country. The common environmental pollution problems created by disposal of fly ash, besides air and water pollution are wastages of large

tracts of land which otherwise could be utilized for useful purposes. FA which has pozzolanic properties creates serious environmental pollution problems is being utilized for production of building materials The FA for the present investigation was procured from mettur Thermal power plant. The specific gravity of fly ash was 2.08. In all the samples, fraction finer than 2µ was maintained as 7.7%. Its LL, PL, and PI were 15%, 15%, and 0% respectively. The OMC and MDD were 45% and 800 kg/m3 respectively.

Fig. 2.2: Fly ash

C. Foaming Agent

The containments holding foaming agent must be kept airtight and under temperatures not exceeding 25°C. Once diluted in 40 parts of potable water, the emulsion must be used soonest. The weight of the foam should be minimum 80 g/l, the containment should be as close as possible to 10 Litres in volume, to check the weight (density) of the foam. Under no circumstances must the foaming agent be brought in contact with any oil, fat, chemical or other material that might harm its function (Oil has an influence on the surface-tension of water).

S. No	Red Mud (in g)	Fly Ash (in g)	Foaming Agent (in ml)	Water (in ml)
1	1000	--	7.5	250
2	900	100	7.5	250
3	800	200	7.5	250
4	700	300	7.5	250
5	600	400	7.5	250
6	500	500	7.5	250

Table 2.2: Mix Proportion of Bricks

III. TESTS AND RESULTS

A. Water Absorption Test

Water absorption test is used to find out the water absorption ratio. Because the brick, which are absorbing more water cannot be used in water logging area or exterior walls which is open to sky. The bricks from all the proportion were tested. The following steps were followed to find out the water absorption ratio.

First all the bricks were weighed in an electronic weighing machine. This weight was noted as W1

After that the bricks were immersed in water for 24 hours. it were taken out and wiped with cloths. Then the bricks were weighed. This weight was noted as W2

Then the water absorption ratio was calculated by this formula ((W2-W1)/ W1)X100

S. No	Proportion (%)	Dry weight, W1 (kg)	Wet weight, W2 (kg)	Average water Absorption (%)
1.	100RM	1.87	2.26	19.56
		1.80	2.13	
		1.84	2.20	
2.	90RM +10FA	1.92	2.31	19.20
		1.95	2.32	
		1.91	2.26	
3.	80RM +20FA	1.91	2.27	18.90
		1.88	2.24	
		1.90	2.26	
4.	70RM +30FA	1.83	2.15	17.47
		1.81	2.13	
		1.84	2.16	
5.	60RM +40FA	1.91	2.23	16.37
		1.88	2.17	
		1.90	2.11	
6.	50RM +50FA	1.82	2.08	14.27
		1.87	2.14	
		1.84	2.1	

Table 3.1: Water Absorption Value of Bricks

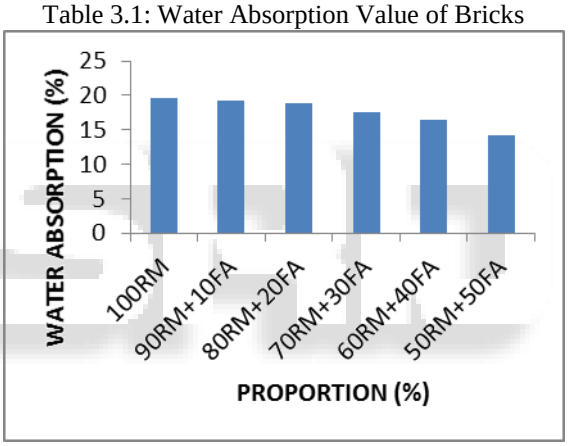

Fig. 3.1: Water Absorption Ratio at Different Proportions

B. Compressive Test

It is the main and important test. This test only decides the strength of the brick. This test was carried out by a compression testing machine. While testing the brick great care must be taken.

The following steps were followed for compression testing.

1) First the irregularities in the surface were removed.
2) The brick was placed centrally on the bottom plate of the compression testing machine.
3) Then the upper plate of the compression testing machine was lowered down up to the brick to hold tightly without any movement.
4) Then the load was applied axially at a uniform rate
5) When the load is applied the pointer in testing machine moves up gradually, the point where the pointer gets down is taken as ultimate load of brick. Note down the divisions and calculate the load applied (i.e. 1division= 5KN)
6) Three bricks from same proportion were tested every time.
7) And compressive strength is calculated by using the formula.

Compressive strength
= Load/ Surface Area

S.No	Proportion	Load (N) X10^3	Surface area (mm^2)	Compressive strength (N/mm^2)	Average Compressive strength (N/ mm^2)
1.	100RM	670	17100	3.918	3.96
		685	17100	4.01	
		675	17100	3.95	
2.	90RM +10FA	680	17100	3.98	4.02
		610	17100	4.15	
		670.5	17100	3.92	
3.	80RM +20FA	705	17100	4.12	4.09
		675	17100	3.95	
		720	17100	4.21	
4.	70RM +30FA	715	17100	4.18	4.20
		730	17100	4.27	
		711.5	17100	4.16	
5.	60RM +40FA	825	17100	4.82	4.73
		810	17100	4.73	
		795	17100	4.65	
6.	50RM +50FA	870	17100	5.09	5.17
		885	17100	5.17	
		900	17100	5.26	

Table 3.2: Compressive Strength of Bricks

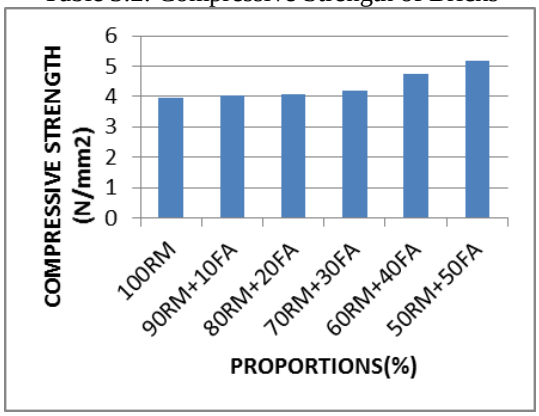

Fig. 3.2: Compressive Strength of Bricks at Different Proportion

IV. CONCLUSION

The brick is manufactured by using 100% of Red Mud. Then the Red Mud is replaced by 10%, 20%, 30%, 40% and 50 % of fly ash. When the Red Mud is replaced by fly ash and foaming agent the weight of the brick is reduced and weight of the bricks varies between 24 – 28% compared to the conventional bricks, the compressive strength of the brick is tend to increase and the water absorption is decreased. When 50% of Red Mud is replaced by fly ash the compressive strength of the brick is 5.1 N/mm2 and the water absorption is 14.37%, Thus it comes under third class bricks. From the experimental investigation it came to know that the Red Mud can be used in construction field as the development of light weight foamed brick, Utilisation of waste may also place a role in minimizing the cost of materials

REFERENCES

[1] D. Dodoo-Arhin, D. S Konadu, " Fabrication and Characterisation of Ghanaian Bauxite Red Mud-Clay Composite Bricks for Construction Applications", American Journal of Materials Science 2013, 3(5): 110-119 DOI: 10.5923/j.materials.20130305.02

[2] Manoj Bhaskar, Salim Akhtar, Geeta Batham, "Development of the Bricks from Red Mud by Industrial Waste (Red Mud), International Journal of Emerging Science and Engineering (IJESE) ISSN: 2319–6378, Volume-2, Issue-4, February 2014

[3] Harekrushna Sutar[1*], Subash Chandra Mishra[1],"Progress of Red Mud Utilization: An Overview", American Chemical Science Journal 4(3): 255-279, 2014

[4] Indian Standard Code IS 1077 : 1992 (Reaffirmed 2002)- Common Burnt Clay Building Bricks – Specification

[5] Indian Standard Code IS 3495 (Parts 1 to 4) : 1992 (Reaffirmed 2002) - Methods of Tests of Burnt Clay Building Bricks. Part 1 Determination of Compressive Strength, Part 2 Determination of Water Absorption, Part 3 Determination of Efflorescence, Part 4 Determination of Warpage

[6] Suchita Rai,[1,2] Dilip H. Lataye, "An Alternative to Clay in Building Materials: Red Mud Sintering Using Fly Ash via Taguchi's Methodology", Advances in Materials Science and Engineering Volume 2013, Article ID 757923, 7 pages

[7] Mamta Rajgor, Jayeshkumar Pitroda, "Stone Sludge: Economical Solution for Manufacturing of Bricks", International Journal of Innovative Technology and Exploring Engineering (IJITEE) ISSN: 2278-3075, Volume-2, Issue-5, April 2013

[8] Kute,"Reduce consumption of soil in bricks by adding fly ash", Journal of Building and Environment,Vol. 7, June 2007.

[9] Ebenezer Annan[1], Benjamin Agyei-Tuffour[1], "Physico-Mechanical Properties of Bauxiteresidue-Clay Bricks", VOL. 7, NO. 12, DECEMBER 2012 ISSN 1819-6608 ARPN Journal of Engineering and Applied Sciences

[10] Tabin Rushad S[1], Abhishek Kumar[2], "Experimental Studies on Lime-Soil-Fly Ash Bricks" , International Journal Of Civil And Structural Engineering Volume 1, No 4, 2011

