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Review Article

STUDY ON STRENGTH AND BEHAVIOUR OF RED MUD BRICKS

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ABSTRACT

Red mud is the waste product generated by bayer's process in the aluminium industry. Extraction of aluminium from bauxite is called as bayer's process. Enormous quantity of red mud is generated worldwide every year posing a very serious environmental problem. Further, disposal of large quantities of red mud dumped, poses increasing problems of storage occupying a lot of space. Hence, at present an important problem of aluminium industries is the disposal of red mud. There is an effective way of utilizing red mud to make bricks. The bricks are manufactured with various proportions of red mud(5%, 10%, 15%, 20% and 25%) in the laboratory and compared with the ordinary conventional bricks and tested for its various properties. It was observed that 15% replacement had shown more strength. The utilisation of red mud is of great significance from the point of view of resource conservation and sustainability of the aluminium industry.

INTRODUCTION

Fired clay bricks remain one of the most enduring building materials known to the world wide building industry. Bricks have an excellent fire rating, it is weather-proof and has really good acoustic properties and is almost soundproof, and best of all it amount to only about 10 per cent of the total cost of a typical residential building. Homebuyers will almost always prefer to buy a house constructed out of clay brick as it does not deteriorate over time and has a higher resale value.

Manufacturing of bricks consists of the following steps.

- Preparation of brick clay
- Moulding of bricks
- Air drying of bricks
- Burning of bricks

TESTS PERFORMED

Compressive Strength of Brick

To determine the compressive strength of brick specimens prepared and verify the strength requirements as stipulated in the IS code. Remove unevenness observed in the bed faces to provide two smooth parallel faces by grinding. Immerse in water at room temperature for 24 hours. Remove the specimen and drain out any surplus moisture at room temperature. Fill the frog and all voids in the bed faces flush with cement mortar (1 cement, 1 clean coarse sand of grade 3 mm and down). Store it under the damp jute bags for 24 hours filled by immersion in clean water for 3 days. Remove and wipe out any traces of moisture. Place the specimen with flat faces horizontal and mortar filled face facing upwards between plates of the testing machine. Apply load axially at a uniform rate of 14 (140 kg/cm^2) per minute till failure occurs and note maximum load at failure (Rai, *et al*., 2012; Glenister and Thornber, 1985). The load at failure is maximum load at which

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the specimen fails to produce any further increase in the indicator reading on the testing machine (Tables 1-6 and Fig. 1).

Water Absorption Test

To determine the percentage of water absorption of brick specimen prepared and to verify the strength requirements as stipulated in the IS code. Dry the specimen in a ventilated oven at a temperature of 105°C to 115°C till it attains substantially constant mass. Cool the specimen to room temperature and obtain its weight (M1) specimen too warm to touch

Table 1. Compressive strength of conventional brick

S. No	Size (mm)	Class of Brick	Compressive strength (N/mm²)	Avg. (N/mm²)
1.	190 × 90 mm	First Class	10.55	10.52
2.	190 × 90 m		10.49	
3.	190 × 90 mm		10.52	
1.	190 × 90 mm	Second Class	6.9	7.01
2.	190 × 90 mm		7.01	
3.	190 × 90 mm		7.12	

Table 2. Compressive strength of brick with 5% red mud

S. No	Size (mm)	Class of Brick	Compressive strength (N/mm²)	Avg. (N/mm²)
1.	190 × 90 mm	First Class	10.76	10.76
2.	190 × 90 mm		10.79	
3.	190 × 90 mm		10.73	
1.	190 × 90 mm	Second Class	7.12	7.36
2.	190 × 90 mm		7.60	
3.	190 × 90 mm		7.36	

Table 3. Compressive strength of brick with 10% red mud

S. No	Size (mm)	Class of Brick	Compressive strength (N/mm²)	Avg. (N/mm²)
1.	190 × 90 mm	First Class	11.11	11.11
2.	190 × 90 mm		10.51	
3.	190 × 90 mm		11.71	
1.	190 × 90 mm	Second Class	8.13	7.72
2.	190 × 90 mm		7.31	
3.	190 × 90 mm		7.72	

Table 4. Compressive strength of brick with 15% red mud

S. No	Size (mm)	Class of Brick	Compressive strength (N/mm²)	Avg. (N/mm²)
1.	190 × 90 mm	First Class	11.45	11.23
2.	190 × 90 mm		11.01	
3.	190 × 90 mm		11.23	
1.	190 × 90 mm	Second Class	8.19	8.19
2.	190 × 90 mm		8.56	
3.	190 × 90 mm		7.82	

Table 5 Compressive strength of brick with 20% red mud

S. No	Size (mm)	Class of Brick	Compressive strength (N/mm²)	Avg. (N/mm²)
1.	190 × 90 mm	First Class	11.65	11.34
2.	190 × 90 mm		11.34	
3.	190 × 90 mm		11.03	
1.	190 × 90 mm	Second Class	8.30	8.30
2.	190 × 90 mm		7.95	
3.	190 × 90 mm		8.65	

Table 6. Compressive strength of brick with 25% red mud

S. No	Size (mm)	Class of Brick	Compressive strength (N/mm²)	Avg. (N/mm²)
1.	190 × 90 mm	First Class	12.14	11.34
2.	190 × 90 mm		11.34	
3.	190 × 90 mm		10.54	
1.	190 × 90 mm	Second Class	8.35	8.42
2.	190 × 90 mm		8.42	
3.	190 × 90 mm		8.49	

Fig. 1 Compressive strength of conventional bricks

shall not be used for this purpose. Immerse completely dried specimen in clean water at a temperature of 27 ± 2°C for 24 hours. Remove the specimen and wipe out any traces of water with damp cloth and weigh the specimen after it has been removed from water (M2) (Tables 7-13).

RESULTS AND DISCUSSION

Comparison of Compressive Strength

The comparison of compressive strength of conventional brick vs. Red mud brick is shown in the below graph and the % increase is shown in the Table 14 and Fig. 2.

Comparison of Water Absorption

The comparison of Water absorption of conventional brick vs. Red mud brick is shown in the below graph and the % increase is shown in the Fig. 3.

Table 7. Water absorption of conventional brick

S. No	Class of Brick	Water Absorption %	Avg. %
1.	First Class	10.26	10.26
2.		10.28	
3.		10.25	
1.	Second Class	18.74	18.75
2.		18.76	
3.		18.75	

Table 8. Water absorption of brick with 5% red mud

S. No	Class of Brick	Water Absorption %	Avg. %
1.	First Class	10.13	10.15
2.		10.17	
3.		10.15	
1.	Second Class	18.66	18.66
2.		18.69	
3.		18.63	

Table 9. Water absorption of brick with 10% red mud

S. No	Class of Brick	Water Absorption %	Avg. %
1.	First Class	10.10	10.10
2.		10.11	
3.		10.09	
1.	Second Class	18.54	18.54
2.		18.55	
3.		18.54	

Table 10. Water absorption of brick with 15% red mud

S. No	Class of Brick	Water Absorption %	Avg. %
1.	First Class	10.06	10.08
2.		10.08	
3.		10.08	
1.	Second Class	18.41	18.41
2.		18.40	
3.		18.43	

Table 11. Water absorption of brick with 20% red mud

S. No	Class of Brick	Water Absorption %	Avg. %
1.	First Class	10.08	10.08
2.		10.08	
3.		10.07	
1.	Second Class	18.35	18.36
2.		18.36	
3.		18.36	

Table 12. Water absorption of brick with 25% red mud

S. No	Class of Brick	Water Absorption %	Avg. %
1.	First Class	10.06	10.07
2.		10.08	
3.		10.07	
1.	Second Class	18.35	18.36
2.		18.36	
3.		18.36	

Table 13. Efflorescence test on bricks

Percentage of clay replaced with Red Mud	Efflorescence	
	I Class Brick	II Class Brick
0 (Conventional Brick)	Slight	Moderate
5	Slight	Moderate
10	Slight	Moderate
15	Slight	Slight
20	Slight	Slight
25	Slight	Slight
Permissible Limit	Slight	Moderate

Table 14. Percentage increase of compressive strength

% of Red Mud	Compressive Strength Of First class brick	% increase of Compressive Strength of First class brick
0	10.52	-
5	10.76	5
10	11.11	7
15	11.23	2.4
20	11.34	2.2
25	11.34	0
% of Red Mud	**Compressive Strength of Second class brick**	**% increase of Compressive Strength of second class brick**
0	7.01	-
5	7.36	7
10	7.72	7.2
15	8.19	9.4
20	8.30	2.2
25	8.42	2.4

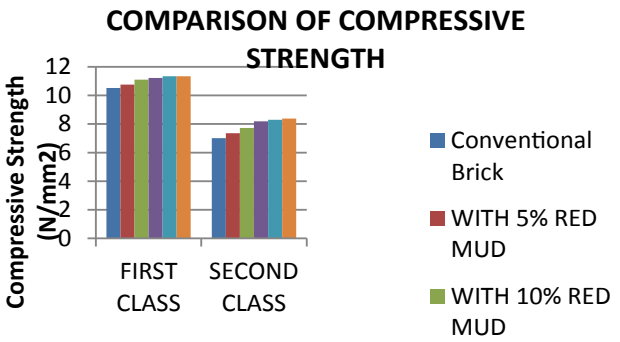

Fig. 2 Comparison of compressive strength.

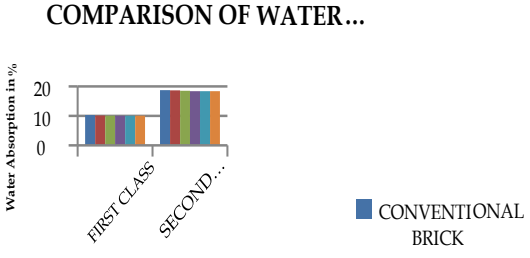

Fig. 3 Comparison of water absorption.

CONCLUSION

This study was conducted to evaluate the effect of using red mud as the ingredients of bricks composites and also give an idea for using these materials within specific range. The result obtained in this project shows that there is great potential for using the red mud in bricks (Red mud Project; Virotec, 2003; Brunori, *et al*., 2005).

The Second class bricks with 10% to 15% of partial replacement of red mud were within the prescribed limit for compressive strength.

The manufactured bricks (both I and II class) were within the prescribed limit for water absorption test (Wanchao, *et al*., 2009).

Both I and II class bricks showed slight efflorescence which was well within the permissible limits.

IS CODES

- IS 1077: 1997 Common burnt clay building bricks.
- IS 2117: 1991 Guide for manufacture of hand-made common burnt clay building bricks.
- IS3495: 1992 Part I to III Methods of test for burnt-clay building bricks.

REFERENCES

Brunori, C., Cremisini, C., Massanisso, P., Pinto, V. and Torricelli, L. (2005). Reuse of a treated red mud bauxite waste: studies on environmental compatibility. *Journal of Hazardous Materials.* 117 : 55-63.

Glenister, DJ. and Thornber, MR. (1985). Alkalinity of red mud and its applications for management of acid wastes. *Chemica.* 85 : 100-113.

Rai, S., Wasewar, K.L., Mukhopadhyay, J., Chang Kyoo, Y. and Uslu, H. (2012). Neutralization and utilization of red mud for its better waste management. *Arch. Environ. Sci.* 6 : 13-33.

Red mud Project. http: //www.redmud.org/ Characteristics.html

Virotec. (2003). Dealing with red mud-By-product of the Bayer process for refining aluminium. *Materials World.* 11 : 22-24.

Wanchao, L., Jiakuan, Y. and Bo, X. (2009). Application of Bayer red mud for iron recovery and building material production from alumosilicate residues. *Journal of Hazardous Materials.* 161 : 474-478.