POTENTIAL USE OF BAUXITE ORE (RED MUD) IN PAVER BLOCKS

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Abstract - *Red mud is a waste material generated by the Bayer process widely used to produce alumina from bauxite throughout the world. The project aims to say the possibility of replacing the Portland cement with red mud. Because it negatively affects the environment. To solve this problem, Portland cement was replaced up to 20% red mud by the weight of cement. And evaluating its compressive strength of red mud paver blocks. This project examines the effects of red mud on the properties of hardened paver blocks. The test results show that how its compressive strength becomes equivalent to normal paver block without red mud content, it is concluded that the optimum percentage of the replacement of cement by weight is found to be. By this percentage replacement, we can have 15% strength is equal to the strength of a normal paver tile.*

Key Words: Bayer process, Compressive strength, Water absorption, Red mud.

1. INTRODUCTION

Aluminum is a lightweight, high-strength, and recyclable structural metal. It plays an important role in social progress and has a vital contribution in transportation, food, and beverage packaging, infrastructure, building and construction, electronics and electrification, aerospace, and defense. It is the third abundant element in the earth's crust and is not found in the free state but combined form with other compounds. The commercially mined aluminum ore is bauxite, as it has the highest content of alumina with minerals like silica, iron oxide, and other impurities in minor or trace amounts. The primary aluminum production process consists of three stages: Mining of bauxite, followed by refining of bauxite to alumina by the Bayer process, and finally smelting of alumina to aluminum. In the Bayer process, the insoluble product generated after bauxite digestion with sodium hydroxide at elevated temperature and pressure to produce alumina is known as red mud or bauxite residue. The waste product derives its color and name from its iron oxide content. As the bauxite has been subjected to sodium hydroxide treatment, the red mud is highly caustic with a pH in the range of 10.5-12.5. Bauxite posing a very serious and alarming environmental problem. About 1 tonne of alumina is produced from 3 tonnes of bauxite and about 1 tonne of Aluminum is produced from 2 tonnes of alumina. Depending on the raw material processed, 1-2.5 tonnes of red mud is generated per tonne of alumina produced.

2. MATERIALS AND METHODS

2.1 Materials

2.1.1 Fine aggregate

Natural sand obtained from local river sources is used as fine aggregate. Before mixing, the sand was air-dried and free from foreign material. The grading of fine aggregate conforms to Zone III of IS 383–1970[6]. The physical properties are tabulated in Table-1 which conforms to IS 2386-1&3[7].

Table-1: Physical Properties of Fine Aggregates

Physical Properties	Test Result
Size	4.75mm
Specific Gravity	2.76
Water Absorption	0.80%

2.1.2 Coarse aggregate

Crushed granite of size 10mm was used as coarse aggregate. The physical properties of coarse aggregate are tabulated in Table-2 which conforms to IS 2386-1, 3&4[7].

Table-2: Physical Properties of Coarse Aggregates

Physical Properties	Test Result
Size	10mm
Specific Gravity	2.87
Water Absorption	0.12%
Aggregate Impact Value	11.01%

2.1.3 Cement

53Grade OPC conforming to IS: 12269–1987[8] was used. The physical properties are tabulated in Table-3.

Table-3: Physical Properties of Cement

Properties	Specific Gravity	Fineness
Value	3.15	$325 m^2/kg$

2.1.4 Water

Potable water was used for concreting and curing process as specified in IS: 456–2000[9].

2.1.5 Red mud

The red mud is one of the major solid wastes coming from the Bayer process of alumina production. For the present work, it was collected from MALCO, at Mettur, Tamilnadu. The physical and chemical properties are tabulated in Table-4 and Table-5.

Table-4: Physical Properties of Red mud

Properties	Specific Gravity	Fineness	PH
Value	2.51	$3000\ cm^2/kg$	10.5 to 12.5

Table-5: Chemical Properties of Red mud

Ingredients	Red Mud In%
Fe2O3	38.3
Al2O3	21.6
SiO2	11.4
CaO	1.47
Na2O	6.87

2.2 Methodology

A Paver block with a Characteristic strength of 40 MPa was designed. Four mixes were prepared by replacing 10%, 15%, 20%, and 25% weight of cement by Red Mud, and one Normal paver block was prepared as a control mix without any replacement for cement. To study the strength comparison of Normal paver block–Red Mud Paver block and control mix, the mix proportions of Normal Paver–Red Mud Pavers are shown in Table-6.

Table-6: Mix Proportion of Normal and Red Mud Paver block

Materials	Normal Paver	10%	15%	20%	25%
RM (kg)	0	0.63	0.945	1.26	1.57
Cement (kg)	6.3	5.67	5.35	5.04	4.75
FA (kg)	11.21	11.21	11.21	11.21	11.21
CA (kg)	7.9	7.9	7.9	7.9	7.9
H2O (lit)	2.55	2.55	2.55	2.55	2.55

2.1.3 Preparation and testing of the specimen

15 specimens were prepared and Paver of size 120mm x 240mm x 80mm were cast and cured in water. After 24 hours of curing 3 paver block specimens were taken out and tested for water absorption test and also after 7 days of curing, 12 paver block specimens were taken out and tested for compressive strength.

Fig -1: Compression test

Fig -2: Water absorption test

One control specimen of the Normal paver block was cast to compare the results of the Red Mud Paver which was partially replaced by Red mud with Cement. The testing set up for compression and water absorption tests is shown in Fig-1 and Fig-2.

3. RESULTS AND DISCUSSIONS

3.1 Compressive strength

The compressive strength result of Normal – Red mud paver mixes with 10%, 15%, 20%, and 25% Red mud replacement with Cement were compared with the control mix in Chart-1.
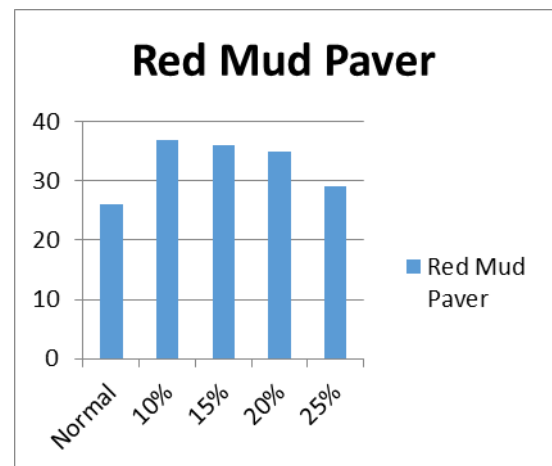

Chart -1: Comparison of compressive strength for a different proportion of Red Mud

From Chart-1, it is observed that the compressive strength is increased by 94.5%, 91.9%,89.4%, and 74% upon addition of 10%,15%,20%, and 25% of Red Mud on 7 days curing respectively.

3.2 Water absorption test

The water absorption test result of Normal – Red mud paver mixes with 10%, 15%, 20%, and 25% Red mud replacement with Cement in Table.7.

Table-7: Result of water absorption test

% of Red Mud	Wet Weight Ww (kg)	Dry Weight Wd (kg)	W Percent (%)
Normal	5.7680	5.5780	3.4062
10%	5.7540	5.5780	3.1552
15%	5.7940	5.6000	3.4642
20%	5.7050	5.5000	3.7272
25%	5.6320	5.4120	4.0650

4. CONCLUSIONS

From experimental work, it was found that an increase in red mud content decreases the compressive strength of the paver block.

The optimum percentage of the replacement of cement by weight is found to be 25%. By this replacement results got are nearly equal to the results of the controlled Paver block.

Paver block prepared by using red mud is suitable in ornamental works and gives an aesthetically pleasing appearance.

The workability of the paver block may get affected by an increase of red mud but it can be improved by adding superplasticizers.

REFERENCES

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