

STRENGTH PROPERTIES OF CONCRETE BY USING RED MUD AS A REPLACEMENT OF CEMENT

Palak R Patel¹, Prof. Jitendra B Suthar²

¹Department of civil Engineering, L.J.I.E.T Ahmedabad, Gujarat

²Applied mechanics Department, Government Engineering College Palanpur, Gujarat

Abstract— This research was conducted to study the characteristics of concrete using red mud to replace cement in concrete. The Bayer process, which produces alumina in bauxite ores, features low energy efficiency and produces significant amounts of highly alkaline bauxite residues such as dust, also known as red clay. Currently, red mud is produced in almost the same mass ratio as metallurgical alumina and is placed in an enclosed or unsealed artificial reservoir (landfill), causing significant environmental problems. It is composed of oxides of iron, titanium, aluminum and silica and is contained with some trace elements. The presence of alumina and iron oxide in the red mud complements the deficiency of the same ingredients in the limestone, the main raw material for cement production. The presence of soda in red mud when used in clinker production neutralizes the sulfur content of pet coke used in clinker-cured cement production and adds curing properties to cement. Based on economic considerations as well as environmental issues, there has been a tremendous worldwide effort to address red mud management issues - use, storage and disposal. Other routes of using red mud are known to some extent, but they have not proven economically viable or commercially feasible.

Experiments were conducted under laboratory conditions to evaluate the strength characteristics of aluminum red mud. Project work focuses on the suitability of the red mud that has been obtained for construction. The five test groups consisted of 0%, 10%, 20%, 30% and 40% of the red clay substitute percentages. This paper points out another promising direction for the proper use of red mud.

Keywords— Cement, Red mud, compressive strength

I. INTRODUCTION

Bayer's alumina production process uses caustic and bauxite as a major raw material for alumina production, producing red mud that has virtually no industrial application, and is generally discarded as a nonconforming product in the backyard of the alumina refinery. Red mud yard. The red mud that was produced for several years lay in the yard with no use. You need about 3.0 acres of huge space to store red mud and floods. However, a breakthrough was made when MALCO discovered that red clay could be tried as an alternative to Low Grade Bauxite (LGA) that the cement industry used to produce cement. The idea is not to try red mud in the cement industry, not bauxite. They are both very similar. This is possible because the cement industry is carefully sighted to fill the alumina deficiency in raw materials for cement production, the Lime stone.

Red clay is an industrial waste generated during the alumina production process. Depending on the grade of raw bauxite and the production process of alumina, red clay can be divided into Bayer red clay and sintered red clay. There are 0.8-1.76 tonnes of red mud per ton of alumina produced based on current technology. Red mud produced in China's three largest alumina production bases (Guizhou, Shandong and Henan) has been reported to reach 3 million tons. The main reactions taking place in the Bayer process (conversion from bauxite to sodium aluminate) can be illustrated as follows:

1.1. Bayer Process

The Bayer process is used to purify bauxite and refine alumina (alumina), the precursor of aluminum, as you can see. Generally, depending on the quality of ore, 1.9 to 3.6 tons of bauxite is required to produce one ton of alumina. The Bayer process is a cycle process and is often called the Bayer cycle.

1.2. Sinter Process

Firing is a heat treatment at or below the melting temperature of the main constituent material that transforms metal or ceramic powders (or powder compacts) into bulk materials, which in most cases contain residual porosity. The process of sintering results in certain physical and chemical changes in the material.

II. PROPERTIES OF RED MUD

A. Physical Properties of Red Mud

The following are the physical properties of the mud powder.

Generally fineness of red mud is varies between 1000-3000cm²/gm.

Its pH is varies in between 10.5 to 12.5 hence alkaline in nature

Specific gravity of red mud is found to be 2.51

B. Chemical Properties of Red Mud

The chemical properties of red clay are shown in the table below. There is no cementity because the ratio of CaO is variable, but when reacting with water and cement, cement properties are shown. We have also added an optimized ratio of lime (5%) to improve this property.

C. Composition of Red Mud and its Properties

Red mud contains about 65% to 70%. Solids with residues as moisture are thixotropic substances that exhibit shear thinning action, that is, the apparent viscosity decreases with increasing shear rate. The following is a composition of dry red mud.

Table 1 Composition of red mud

COMPONENTS	Al ₂ O ₃	Fe ₂ O ₃	SiO ₂	TiO ₂	CaO	Na ₂ O
WEIGHT %	20-22	40-45	12-15	1.8-2.0	1-2	4-5

III. MATERIALS

A. Materials

Cement

Ordinary Portland Cement of Ultratech brand of 53 grade confirming to IS: 12269-1987 was used in the present study. The properties of cement are shown in Table 2.

Table 2: Properties of Cement

Sr. No	Property	Result
1.	Normal Consistency	32%
2.	Initial Setting time	45 mins
3.	Specific Gravity	3.15
4.	Fineness of cement	5%

Fine Aggregate

Natural sand as per IS: 383-1987 was used. Locally available River sand having bulk density 1860 kg/m³ was used. The properties of fine aggregate are shown in Tab 3.

Table 3: Properties of fine aggregate

Sr. No	Property	Result
1.	Specific Gravity	2.57
2.	Fineness modulus	2.28
3.	Grading zone	II

Coarse Aggregate

Crushed aggregate confirming to IS: 383-1987 was used. Aggregates of size 20mm and 12.5 mm of specific gravity 2.74 and fineness modulus 7.20 were used.

IV. TEST RESULTS

Totally 30 cube (30 nos for M30) of size 150 mm x 150 mm x 150 mm and were cast to study the compressive strength of red mud concrete. Standard cast iron moulds were used for casting the test specimens. Results obtained are shown in table 4.

Table 4: Compressive Strength Results

S.no	% red mud used	7 days compressive strength for M30 grade	28 days compressive strength for M30 grade
1	0%	19.22	40.36
2	10%	20.25	42.38
3	20%	21.63	43.62
4	30%	18.61	39.85
5	40%	17.86	37.70

V. CONCLUSIONS

- The compressive strength of M30 for 28 days at 0%,10%,20%,30%,40% is 40.36 kN/m²,42.38 kN/m²,43.62 kN/m² ,39.85 kN/m² , 37.70 kN/m² respectively,

- It is feasible to replace red mud powder up to 20% for M-30 grade concrete.
- The optimum value of the compressive strength of red mud concrete for 7 days curing was observed at 20% red mud replacement. And also for 28 days compressive strength observed at 20% red mud replacement.

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