

Experimental Investigation of Concrete by Red Mud as Replacement of Cement and Using Strengthening Admixture

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ABSTRACT: Red mud is an industrial waste material generated during production of alumina from bauxite by Bayer process. These industrial wastes hold some heavy aim of the paper is to investigate the possibility of partially replacing Portland cement in concrete by red mud and evaluating its compressive and splitting tensile strength. The test results revealed that 15% of cement can be optimally replaced by red mud beyond which compressive strength, split tensile and flexural strength starts decreasing.so adding the admixture the harden concrete strength it will be increase two fold strength.

KEYWORDS: Red mud, Admixture(WL), workability, Bayer process, compressive strength, split tensile strength, flexural strength

I. INTRODUCTION

Concrete is the primary construction material used around the world and most widely used in all types of civil engineering works and it is a manmade product, essentially consisting of cement, aggregate, water and admixtures. Concrete in spite of being the most popular and most economical construction material has major shortcomings in terms of embedded energy and is also one of the major causes of greenhouse gas effect. However, the production of cement of leads to the dissipation of significant amount of carbon dioxide and greenhouse gas emission. One ton of Portland cement clinker production creates one ton of carbon dioxide and other greenhouse gases. To reduce the emission of carbon dioxide concerning the production of cement, we must reduce the usage of cement, and therefore the demand of Portland cement. Therefore, there is a need to look for alternate types of material the carbon dioxide emissions associated with the manufacturing of Portland cement can be reduced significantly by reducing the production of current clinker. In this project loss in production of Portland cement can be overcome the increased use of red mud in different percentages super plasticizers.

Red mud is the largest amount of industrial waste generated during the production of alumina. Depending on the amount of bauxite and the type process during the production of each 1-ton alumina 1.2 to 1.3 –ton dry red mud is generated. Because of the complex physical-chemical properties of red mud it is very challenging task for the designers to find out the economical utilization and safe disposal of red mud. Disposal of this waste was the first major problem encountered by the alumina industry after the adoption of the Bayer process.

The conventional method of disposal of the red mud in ponds has often adverse environmental impacts as during monsoons the waste may be carried by run off to the surface water courses and as a result of leaching may cause contamination of ground water .further disposal of large quantities of red mud dumped, poses increasing problems of

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storage occupying a lot space over the years many attempts have been made to find a use for red mud but none have proven to be economically satisfactory. In this paper the attempt is made to check the effectiveness of red mud at 0%, 10%, 15%, 20%, over Portland cement by partial replacement of cement in concrete.

II. OBJECTIVE

- To find the optimum replacement of cement by red mud
- To find the compressive strength, split tensile strength and flexural strength of red mud used concrete and conventional concrete.
- To compare the compressive strength, split tensile strength and flexural strength of the red mud concrete with the conventional concrete.
- To identify various industrial wastes suitable for utilization in cement manufacture
- To examine the constraints related to utilization of industrial waste.
- Current demand of cement is far in excess of production and is rapidly increasing.

By keeping the above objectives in mind the aims of present works is to check the suitability and utilization of neutralized red mud as a partial replacement of Portland cement in concrete.

III. RED MUD

Red mud is composed of a mixture of solid and metallic oxide-bearing impurities, and presents one of the aluminium industry's most important disposal problems the red mud caused by the oxidized iron present which can make up to 60% of the mass of the red mud. In addition to iron the other dominant include silica unaltered residual aluminium, and titanium oxide. Red mud cannot be disposed of easily. As a waste product of the Bayer process the mud is highly basic with a pH ranging from 10 to 13. The following is the composition of the dry red mud of MALCO (Madras Aluminium Company Limited)

TABLE 1.1 COMPOSITION OF RED MUD

S.NO	COMPONENTS	WEIGHT %
1.	Al ₂ O ₃	20-22
2.	Fe ₂ O ₃	40-45
3.	SiO ₂	12-15
4.	TiO ₂	1.8-2.0
5.	CaO	1.0-2.0
6.	Na ₂ O	4-5

TABLE 1.2 Characteristics of red mud

S.NO	CHARACTERISTICS	VALUES
1.	Specific gravity	2.83
2.	pH	10-13

IV. ADMIXTURE

Conplast WL is a dark brown liquid based on lignosulphonates which mixes readily with water and therefore disperses evenly. Conplast (WL) waterproofs by improving the quality of the concrete or mortar. It reduces the water demand for required workability and minimizes segregation and bleeding. Thus it is more efficient compared to traditional powder water proofers as its use results in two fold improvement of concrete or mortar.

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ADMIXTURE



FIGURE 1 CONPLAST WL

V. CONCRETE MIX

The physical properties of blended cement (Portland cement replaced by 0%, 10%, 15%, 20%) with constant water ratio concrete design mix of grade M₂₀ was prepared and design mix was studied for compressive.

CONCRETE DESIGN MIX PROPORTIONS

Cement	Fine aggregate	Coarse aggregate	Water content
1	1.68	2.76	0.45

VI. COMPRESSION STRENGTH TEST

Out of many test applied to the concrete this is the at most important which gives an idea about all the characteristics of concrete. By this single test one judge that whether concreting has been done properly or not. For cube test two types of specimens either cubes of 15cm × 15 cm × 15 cm or 10 cm × 10 cm × 10 cm depending upon the size of aggregate are used. For most of the works cubical moulds of size 15 cm × 15 cm × 15 cm are commonly used.

This concrete is poured in the mould and tempered properly so as not to have any voids. After 24 hours these moulds are removed and test specimens are put in water for curing. The top surface of this specimen should be made even and smooth.

These specimens are tested by compression testing machine after 7 days curing or 28 days curing. Load should be applied gradually at the rate of 140 kg/cm² per minute till the specimens fails. Load at the failure divided by area of specimen gives the compressive strength of concrete.

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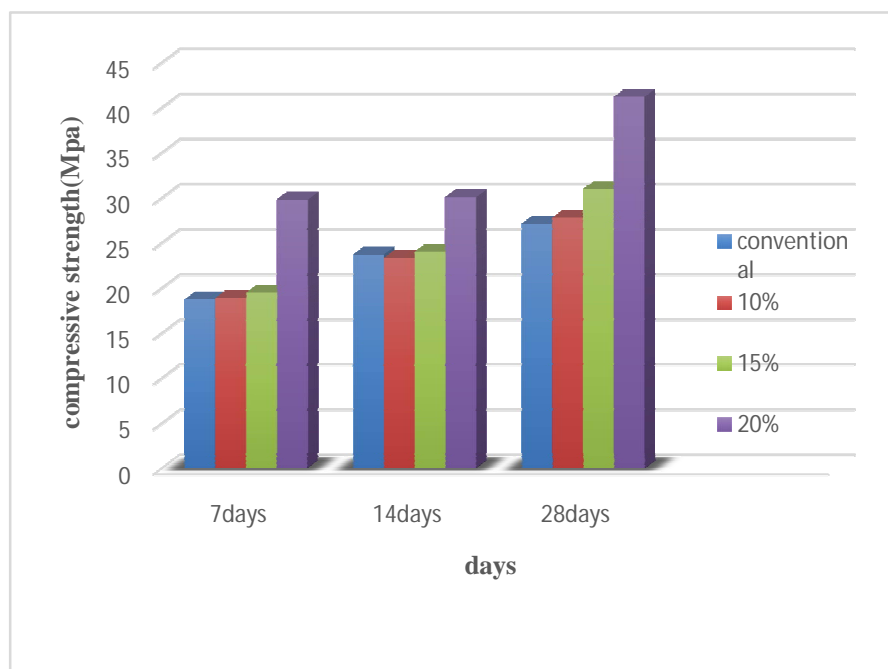
VII. TENSILE STRENGTH TEST

It is the standard test to determine the tensile strength of concrete in an indirect way. This test could be performed in accordance with IS: 5816-1970.

A standard test cylinder of concrete specimen (300 mm × 150 mm diameter) is placed horizontally between the loading surfaces of compression testing machine. The compression load is applied diametrically and uniformly along the length of cylinder until the failure of the cylinder along the vertical diameter. To allow the uniform distribution of this applied load and to reduce the magnitude of the high compressive stresses near the points of application of this load strips of plywood are placed between the specimen and loading plants of the testing machine. Concrete cylinders split into two halves along this vertical plane due to indirect tensile stress generated by Poisson's effect.

VIII. FLEXURAL STRENGTH TEST

Flexural strength also known as modules of rupture bend strength or fracture strength a mechanical parameter for brittle material is defined as a materials ability to resist deformation under load the transverse bending test is most frequently employed in which a specimen having either a circular or rectangular cross-section is bent until fracture or yielding using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture. It is measured in terms of stress here given the symbol σ



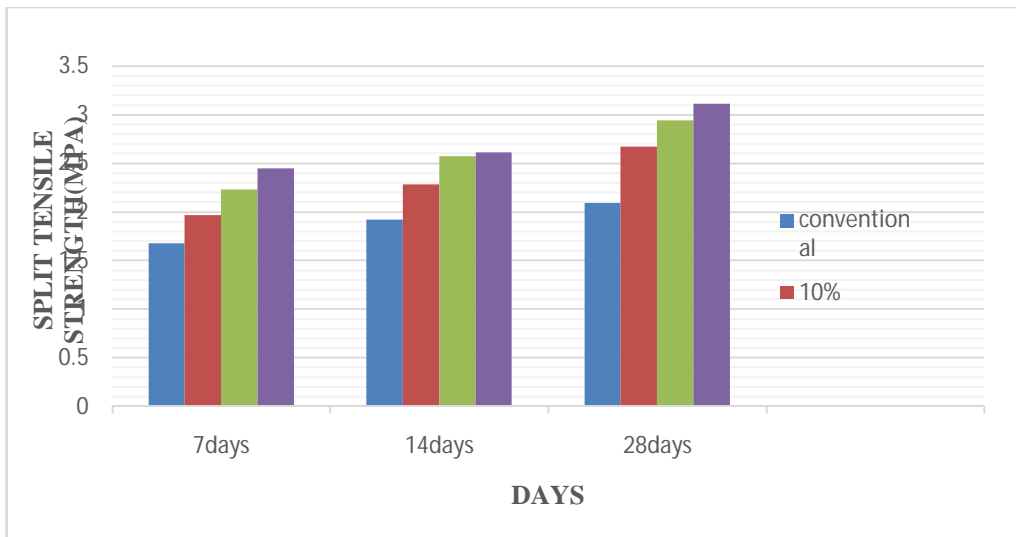
GRAPH 1 COMPRESSIVE STRENGTH

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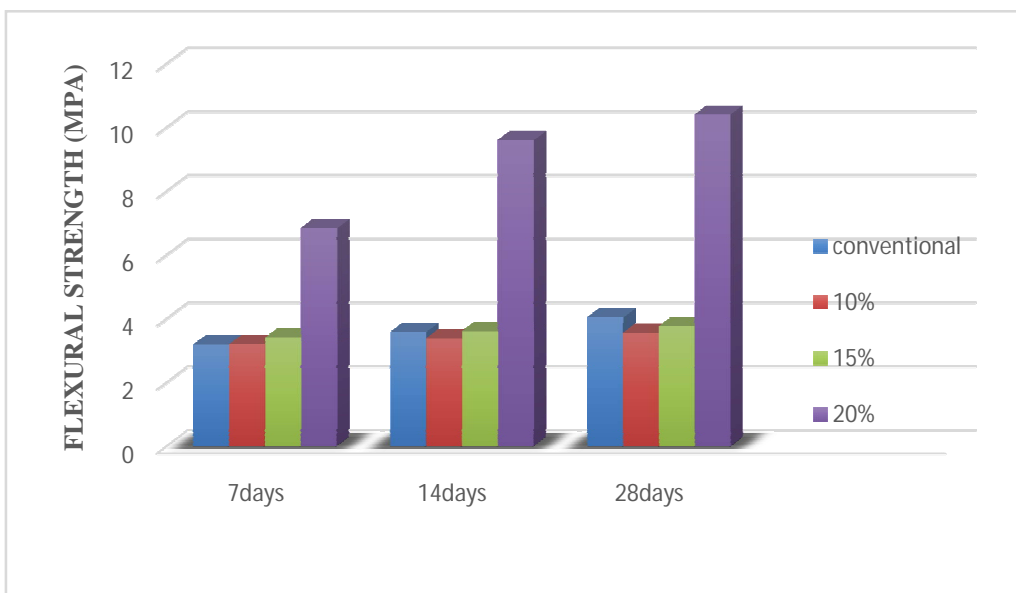
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GRAPH 2



GRAPH 3

IX. CONCLUSION

- In the present experimental study, effort has been put to check the feasibility of red mud use in cement mortar.
- It is observed that 20% replacement of the red mud for cement is possible from compressive strength, split tensile strength, flexural strength.
- Strength result of 20% of red mud replacement concrete shows two fold strength increased in the M₂₀ grade of concrete.
- The addition of admixture (conplast WL) for M₂₀ grade concrete increases the workability.

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- Water absorption of concrete increases with increased percentage of red mud.
- Increased percentage of red mud increases the water absorption and decreases the strength of concrete.

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