"Experimental Studies on Strength Properties of M20 and M30 Concrete with Partial Replacement of Cement by Red Mud"

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ABTRACTS

Extensive amounts of waste materials and by-products are generated by human, industrial and commercial activities. It has become difficult to handle huge amount of waste which leads to environmental problems. Rapid utilization of natural resources, generation of huge amount of industrial wastes and environmental pollution needs new solution for sustainable economic development. If the industrial wastes are used in production of cement, concrete and in some other construction materials as a replacement to conventional materials then the manufacturing /project cost will be reduced and reduces the land fill area .One of the major challenges before the processing and manufacturing industries is disposal of the residual waste products. Red mud are one of the major waste products of any aluminum industry. The main objective of the study to solves this disposal problem red mud is used in manufacturing of concrete. In this work the cement is replaced at the proportions 0%, 5%, 10%, 15%, 20% red mud and a constant 5% hydrated lime is used in M20 and M30 concrete and evaluating its compressive and splitting tensile strength of red mud concrete.

Keywords: Red mud, Hydrated Lime, Compressive Strength Test, Split tensile Strength test.

I INTRODUCTION TO RED MUD CONCRETE

Due to the rapid industrialization, a huge quantity of waste products is discharged into the atmosphere, which causes the environmental hazards. The wastes thus discharged can be used in construction as a replacement material for conventional materials, when utilized in a good way. The waste material generated as a byproduct of Bayer's process from aluminum industry is called red mud. Since it is a highly caustic chemical substance, which causes contamination of ground water leading to health hazards, it should be dispersed in a proper way. The disposal of such materials is a major problem to these industries. Red mud is a solid - waste generated at the Aluminum plants all over the world. In Western countries, about 35 million tons of red mud is produced yearly. Because of the complex physico-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 red mud in

ponds has of tenadverse environmental impacts as during monsoons, the waste may be carried by run-off to the surface water courses and as a result leaching may cause contamination of ground water: Further disposal of large quantities of Red mud dumped, poses increasing problems of storage occupying a lot of space. Over the years, many attempts have been made to find a use for red mud, but none have proven to be economically satisfactory. Red mud is a caustic by-product of the Bayer process of bauxite refining to produce alumina. This material is considered hazardous according to the Environmental Protection Agency (EPA). Every year, millions of tons of this hazardous material is produced around the world. In order to manage this industrial waste, several researches have been conducted to investigate the possibility of utilizing red mud as a useful construction material. This paper presents a review of some of the previous studies conducted on the effective utilization of red mud in construction processes.

Red mud

II LITERATURE REVIEW

Literature review on applications of red mud as construction material

Kalkan (2006) examined the effects of red mud on the unconfined compressive strength, hydraulic conductivity, and swelling percentage of compacted clay liners as a hydraulic barrier. The test results showed that compacted clay samples containing red mud and cement–red mud additives had a high compressive strength and decreases the hydraulic conductivity and swelling percentage as compared to natural clay samples.

Rana & Sa the (2015) were cast Mortar cubes ,They used cement with varying percentages of replacement of red mud with the addition of lime. The authors followed the same procedure for silica to find the optimum red mud replacement with addition of either lime or silica. First, mortar cubes were cast with varying percentages replacement of red mud. The red mud fractions in the mortar were 0%, 10%, 15%, 20% and 25% with the addition of lime by weight of red mud of 0%, 4%, 8% and 12%

III **OBJECTIVE**

- To find out the mechanical properties of control concrete of M-20 and M-30grade at various percentage of Red mud as a partial replacement of cement at 7 day ,14 day and 28 days tests are conducted.
- To find the optimum % of replacement of cement by Red mud by imparting better strength and durability properties.
- The objective of this study is to search alternatives material which can fully or partially replaced naturally available material in construction.

IV **EXPERIMENTAL SETUP AND** METHODOLOGY

4.1 MATERIALS USED

4.1.1 Cement

Portland slag cement of Konark brand available in the local market was used in the present studies. The physical properties of PSC obtained from the experimental investigation were confirmed to IS: 455-1989.

4.1.2 Coarse Aggregate

The coarse aggregate used were 20 mm and 10 mm down size and collected from Quarry near Bhopal .

4.1.3 Fine Aggregate

Natural river sand has been collected from Koel River, Rourkela, Orissa and conforming to the Zone-III as per IS-383-1970

4.1.4 Red mud

Red mud consists of a mixture of stable and steel oxide-bearing impurities, and gives one of the alumimium organizations most quintessential disposal problems. The red shade is due to the fact of the oxidized iron gift, which may want to make up to 60% of the mass of the red mud.

Red mud

4.1.5 Hydrated lime

Pure hydrated lime energy is popularly known as calcium hydroxide or slaked lime. The managed slacking of quicklime with water provides us white dry energy then they launched warmth of response is captured and the more slaking water is evaporated.

HYDRATED LIME

4.1.6 Super plasticizer (conplast sp430)

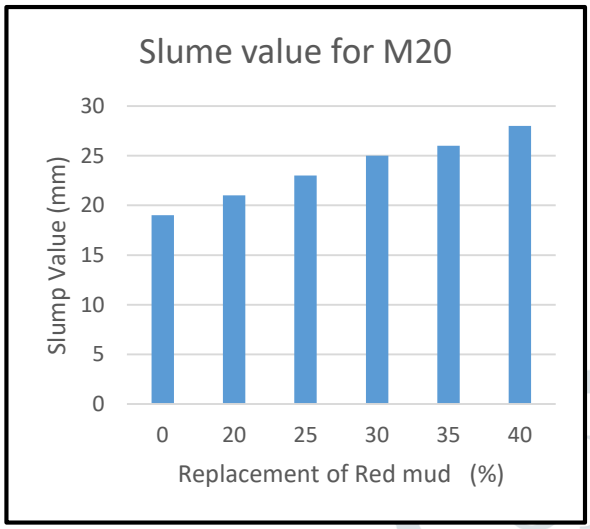
Conplast SP430 is a super plasticizing admixture. Conplast SP430 is a Sulphonated naphthalene polymer based admixture and is supplied as a brown liquid instantly assorted in water. Conplast SP430 has been manufactured to give high water reductions unto 25% without loss of workability and produce high quality concrete of reduced permeability.

V RESULTS AND DISCUSSION

5.1 SLUMP CONE TEST RESULTS

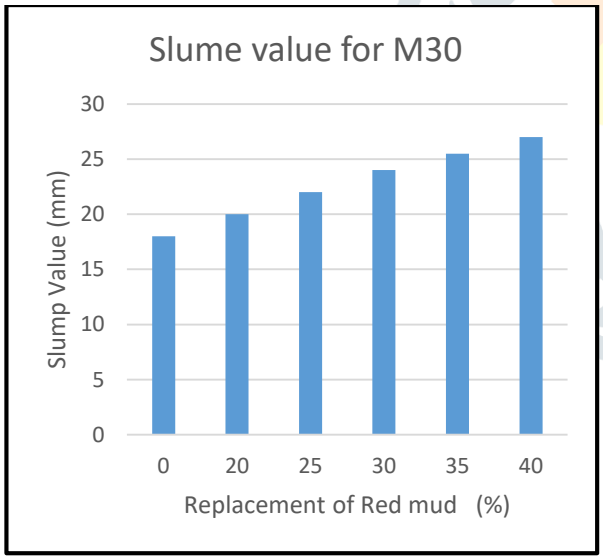
From the slump test results it was It was observed that as the quantity of Red mud increases as 0 %, 20 %, 25 %, 35 %, and 40% of the concrete mix slump quality may also increase. The increase in concrete workability is due to Red mud's low water absorption characteristics. This increase in workability can have a beneficial effect on concrete in the sense that it mixes with low water to cement ratios, the concrete can be manufactured with better workability, higher strength than traditional concrete.

5.1.1 Workability of Concrete with Varying Proportion of Red mud for M20



Workability of Concrete with Varying Proportion of Red mud for M20

5.1.2 Workability of Concrete with Varying Proportion of Red mud for M30

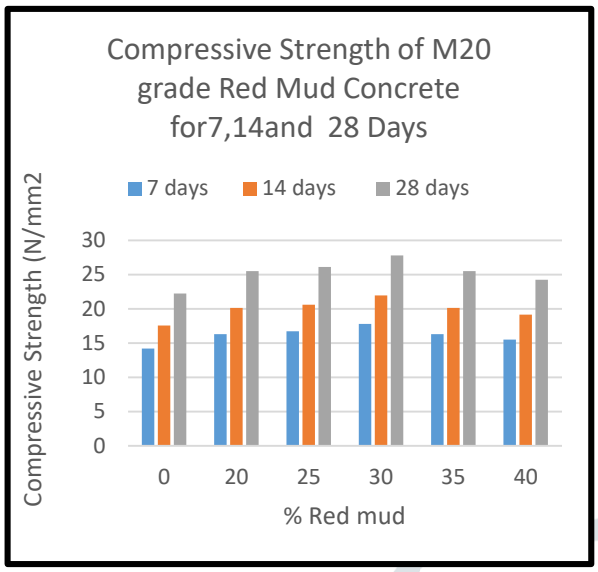


Workability of Concrete with Varying Proportion of Red mud for M30

5.2 COMPRESSIVE STRENGTH TEST RESULTS

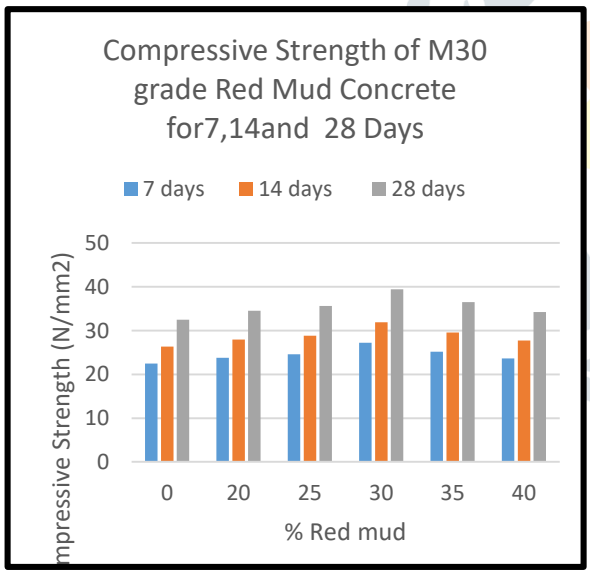
From the Graph , it is concluded that at 30% replacement of red mud with concrete achieved higher compressive strength. Till 30% replacement the compressive strength increases with increasing red mud content. Increase in the replacement of cement with hydrated lime leads to decreasing in its strength up to 15 to 18%

5.2.1 Variation of compressive strength after7,14 28 days curing for M20



Variation of compressive strength after7,14 28 days curing for M20

5.2.2 Variation of compressive strength after7,14 28 days curing for M30

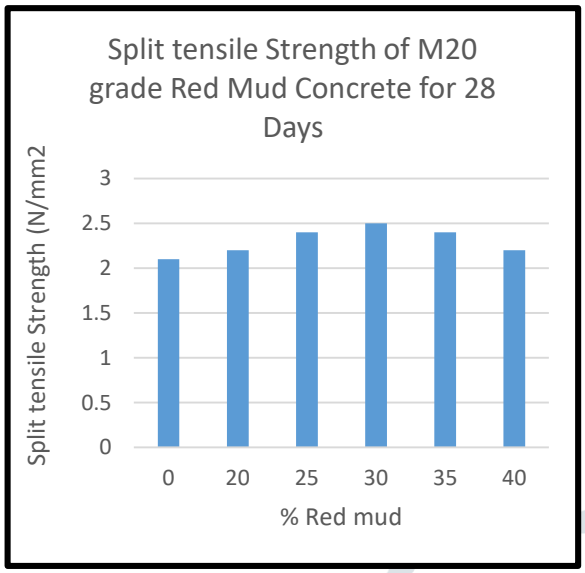


Variation of compressive strength after7,14 28 days curing for M30

5.3 SPLIT TENSILE STRENGTH TEST RESULT

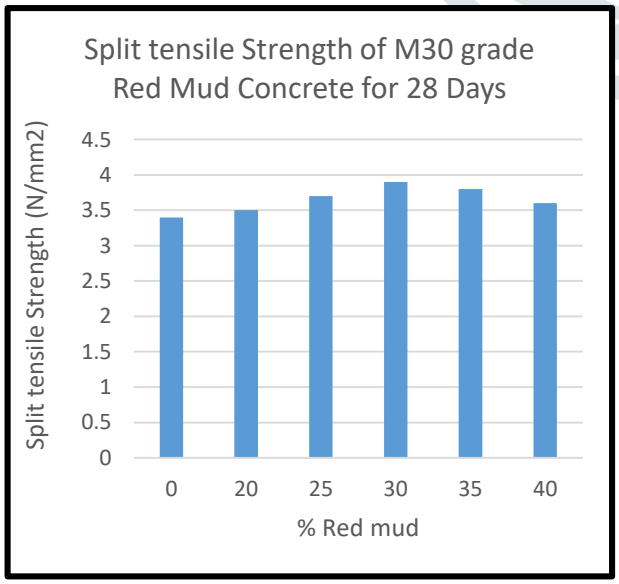
From experiment the split tensile strength of M20 and M30 grade red mud concrete results are observed at 28 days. Split tensile strength is higher at the replacement of 30% for both M20 and M30 grade of red mud concrete as shown in the table and graph. After 30% replacement the split tensile strength decreases with increasing replacement of red mud with concrete as shown in tables. .From the experiment The maximum value of Split tensile strength M20 concrete is2.5 N/mm2at 28 day and In similar way for M30 concrete is 3.9 N/mm2.

5.3.1 Variation of Split Tensile Strength after 28 days curing for M20



Variation of Split Tensile Strength after7,14 28 days curing for M20

5.3.2 Variation of Split Tensile Strength after 28 days curing for M30

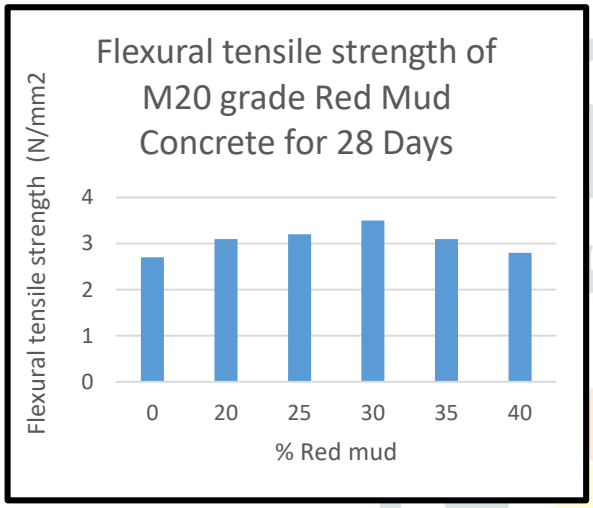


Variation of Split Tensile Strength after 28 days curing for M30

5.4 Flexural Strength Test Results

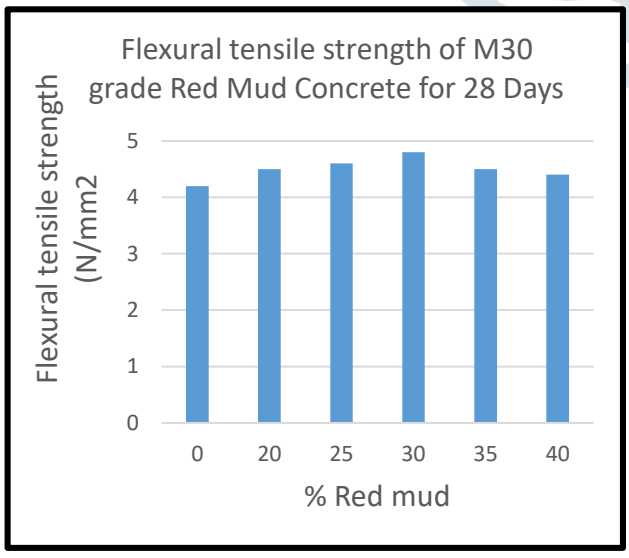
From Experiment it was observed that the Flexural strength of M20 and M30 grade red mud at 28 days. Flexuraltensile strength is increasing up to the replacement of 30% for both M20 and M30 grade of red mud concrete as shownin the tables. After 30% replacement the Flexural tensile strength decreases with increasing replacement of red mudwith concrete as shown in tables.The maximum value of Flexuraltensile strength for M20 concrete is 3.5 N/mm2at 28 day and in similar for M30 concrete is 4.8 N/mm2

5.4.1 Variation of Flexural Strength after 28 days curing for M20



Variation of Flexural Strength after 28 days curing for M20

5.4.2 Variation of Flexural Strength after 28 days curing for M30



Variation of Flexural Strength after 28 days curing for M30

VI CONCLUSION

- As we increase the percentage of Red mud workability of concrete also increases for M-20 and M-30
- The compressive strength results represents that as the percentage of Red mud increases compressive strength(7 days,14days,28days)also increases upto 30% of Red mud & 5% of Hydrated Lime and after that it decreases for M-20 and M-30.The maximum value of compressive strength for M20 concrete is 27.82 N/mm2 And for M30 concrete is 39.4 N/mm2
- The split tensile strength results represents that as the percentage of Red mud increases split tensile strength(28days) also increases upto 30% of Red mud & 5% of Hydrated Lime and after that it decreases for M-20 and M-30.experiment The maximum value of Split tensile strength M20 concrete is2.5 N/mm2at 28 day and In similar way for M30 concrete is 3.9 N/mm2.
- The flexural strength results represents that as the percentage of Red mud increases flexural strength(28days) also increases upto 30 % of Red mud& 5% of Hydrated Lime and after that it decreases for M-20 and M-30..The maximum value of Flexuraltensile strength for M20 concrete is 3.5 N/mm2at 28 day and in similar for M30 concrete is 4.8 N/mm2

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