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RED MUD CONCRETE

[1]Mahin Sha O B, [2]Remya C P, [3]Salja P A, [4]Shifal K S

[1] *UG student, Department of Civil Engineering, Mar Athanasius College of Engineering, Kerala, India,*
[2] *UG Student, Department of Civil Engineering, Mar Athanasius College of Engineering, Kerala, India,*
[3] *UG Student, Department of Civil Engineering, Mar Athanasius College of Engineering, Kerala, India,*
[4] *UG Student, Department of Civil Engineering, Mar Athanasius College of Engineering, Kerala, India.*

Abstract - *Rapid industrialization leads to the maximum discharge of waste products which in turn causing the environmental hazards. These wastes can be a substitute for conventional material, when utilized in a best way. Red Mud is a waste generated by the aluminum industry (an average of 3million tons per year) in a Bayer's process and its disposal is a major problem for these industries as this is highly caustic and causes ground water contamination, leading to health hazards. By taking cementatious behavior of the red mud into account, an experiment was carried out to partially replace the cement by red mud in concrete for different percentages and also its effects on the strength and other properties of the concrete.*

Key Words: *Red Mud, Compressive Strength, Tensile strength, Slump, industrial waste etc.*

1. INTRODUCTION

Red mud; a solid- waste generated at the Aluminum plants all over the world .In Western countries, about 35 million tons of red mud are 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 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 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 .In this paper the attempt is made to check the effectiveness of red mud at 5%,10%,15%,20%,25% over Portland cement by partial replacement of cement in concrete.

2. OBJECTIVES OF THE STUDY

Basically this paper is based on the dissertation work carried out to overcome the problems created due exhaustion and obsolescence of raw material required for manufacturing of conventional building material and also minimize the thrust of Indusial waste on the environment by utilizing the same in the Construction Industry.

Some other objectives are;

- The use of industrial wastes in place of conventional raw materials will help to decrease the environmental pollution and also conserve our natural resources.
- The development of alternate low-cost and ecologically suitable building materials from agricultural and industrial wastes is an economic necessity.
- 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 work is to check the suitability and utilization of neutralized red mud as a partial replacement of Portland cement in concrete.

3. MATERIALS USED

3.1 Cement

Ordinary Portland Cement (53 Grade) confirming to IS: 269-1976 was used throughout the investigation. Different tests were performed on the cement to ensure that it confirms to the requirements of the IS specifications. The physical properties of the cement were determined as per IS: 4031-1968 and are presented in Table:1

Table -1: Physical Properties of 53 Grade Cement

S.no	Characteristics	Values
1	Standard Consistency	53
2	Fineness of cement as retained on 90 micron sieve	3 %
3	Initial Setting Time	30 mints
4	Specific Gravity	3.15
5	7days compressive strength	37 Mpa

Table -2: Chemical Properties of Cement

S.no	Components	Weight
1	Lime(CaO)	63%
2	Silica(SiO_2)	22%
3	Alumina(Al_2O_3)	6%
4	Iron oxide(Fe_2O_3)	3%
5	Magnesium oxide(MgO)	2.5%
6	Sulphur trioxide & loss of ignition(SO_3)	1.5%
7	Alkalies	0.5%

3.2 Aggregates

The maximum size of coarse aggregate from stone crusher used for this investigation is 20 mm and specific gravity is 2.74. M Sand is used as fine aggregate in mix of having a nominal maximum size of 4.75 mm. The specific gravity of fine aggregate is 2.73.

3.3 Water

Fresh and clean water is used for casting and curing of specimen. The water is relatively free from organic matters, silt, oil, sugar, chloride and acidic material as per requirements of Indian standard. Combining water with a cementitious material forms a cement paste by the process of hydration. A cement paste glues the aggregate together fills voids within it, and makes floor freely.

3.4 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 colour is 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 particles include silica, unleached 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- 3: Composition of Red Mud

Componenets	Weight %
Al_2O_3	20-22
Fe_2O_3	40-45
SiO_2	12-15
TiO_2	1.8-2.0
CaO	1.0-2.0
Na_2O	4-5

Particle Size : less than 44 microns
Appearance & Odor : Red, Earthy odor, slight pungent

4. CONCRETE MIX

The physical properties of blended cement (Portland cement replaced by 0%, 5%, 10%, 15%, 20% & 25%) With constant water ratio concrete design mix of grade M25 was prepared and design mix was studied for Compressive.

Table -4: Concrete Design Mix Proportions

Cement	Fine Aggregate	Coarse Aggregate	Water Content
1	1.59	2.72	0.45

5. RESULTS AND DISCUSSION

Test results for workability of red mud concrete mixes for M25 Grade.

5.1 Slump Cone Test

A slump test is a method used to determine the consistency of concrete. The consistency, or stiffness, indicates how much water has been used in the mix. The stiffness of the concrete mix should be matched to the requirements for the finished product.

Graph shows the slump test results for replacement percentage which falls in the slump range.

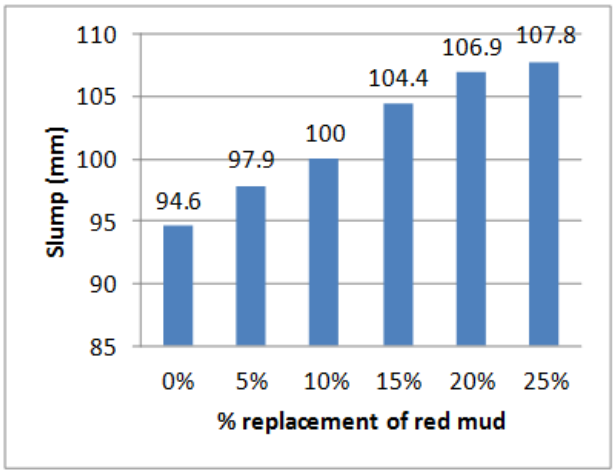

Chart -1: Slump

The workability of the concrete seems to be increasing as the percentage of red mud increasing in the mix.

Fig 1: Slump Test

5.2 Compressive Strength Test

Mechanical test measuring the maximum amount of compressive load a material can bear before fracturing. The test piece, usually in the form of a cube, prism, or cylinder, is compressed between the platens of a compression-testing machine by a gradually applied load. Brittle materials such as rock, brick, cast iron, and concrete may exhibit great compressive strengths; but ultimately they fracture. The crushing strength of concrete determined by breaking cubes and cylinders.

Fig 2: compressive strength test

Graph shows the 28 days compressive strength of red mud concrete cubes & cylinders

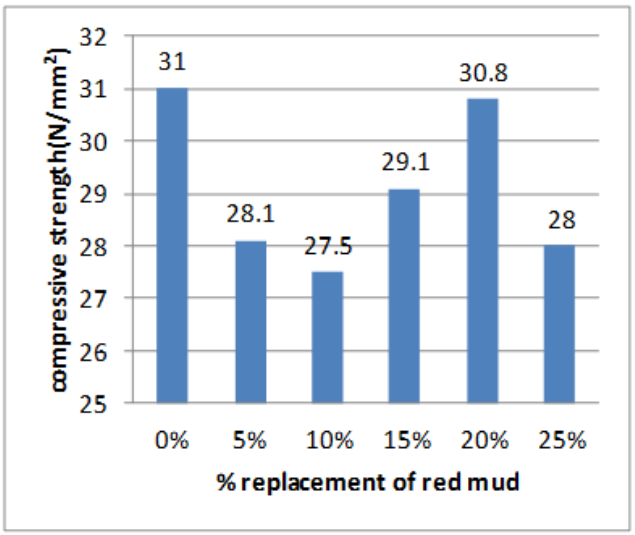

Chart -2: Compressive strength

5.3 Splitting Tensile Strength

The tensile strength is one of the basic and important properties of the concrete. The concrete is not usually expected to resist the direct tension because of its low tensile strength and brittle nature. However, the determination of tensile strength of concrete is necessary to determine the load at which the concrete members may crack. The cracking is a form of tension failure. This test method covers the determination of the splitting tensile strength of cylindrical concrete specimens.

Graph shows the 28 days split tensile strength of red mud concrete cylinders.

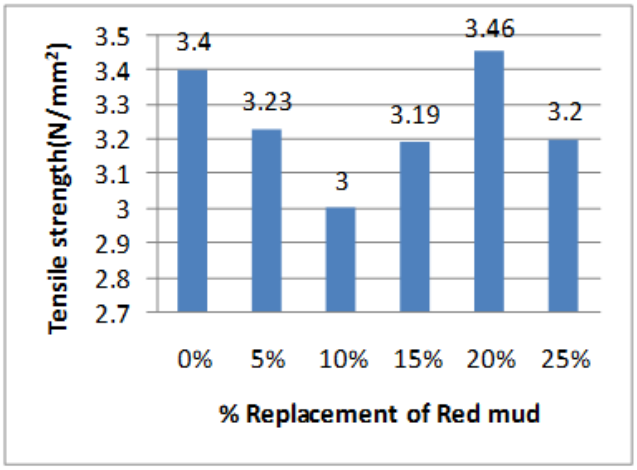

Chart -3: Splitting tensile strength

6. CONCLUSION

From this experimental study following points can be drawn:

- For each percentage replacement up to 20% the compressive strength values of the red mud concrete coincides with that of conventional concrete. But beyond 20% there is reduction in the strength of conventional concrete.
- From the experimental work it was found that increase in red mud content(greater than 20%) decreases the compressive strength as well as tensile strength of concrete.
- Optimum percentage of the replacement of cement by weight is found to be 20%. By this replacement results got are nearly equal to the results of conventional concrete.
- We use mixture of red mud and cement for non-structural work. There is a future scope for the use of red mud concrete in structural point of view.
- Concrete prepared by using red mud is suitable in ornamental works and gives aesthetically pleasant appearance.
- Used for road construction as an embankment landfill is an attractive option with a high potential for large volume reuse.

The above results show that the optimum utilization of Red mud in concrete is 20% as a partial replacement of cement. This study concludes that Red mud can be innovative supplementary cementitious materials but judicious decision must be taken by expert engineers.

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REFERENCES

[1]Ramesh R.Rathod, Nagesh T.Suryawanshi, Pravin D. Memade,Evaluation of the properties of Red Mud concrete ,*IOSR journal of mechanical and civil engineering(*IOSR-JMCE),ISSN:2278-1684, PP:31-34.

[2]Kiran.k.shetty,Gopinatha Nayak ,Rahul shetty.k.,Self compacting concrete using Red mud and used foundary sand, IJRET : *International journal of research in engineering and technology* , Eissn:2319-1163|PISSN :2321:7308

[3]Premchand, Rakesh Kumar, J.P. Srivastava, ―Utilization of iron values of red mud for metallurgical applications‖, Environmental and Waste Management (ISSN: 0971-9407), pp. 108-119, 1998.

[4]Harekrushna sutar,Subash Chandra Misra,Santhosh Kumar Sahoo et.al(2014),Progress of Red Mud utilization :an overview,*American chemical science journal,*4(3),255-279,2014.

[5]IS 456:2000, *Indian Standard Plain and Reinforced concrete-code of practise,* Fourth Revision, Bureau of Indian Standards, New Delhi.

[6]Shetty M.S, *Concrete Technology,* Illustrative EDITION, S. Chand & company ltd. 2005, New Delhi.

[7] Suchita Rai, K.L. Wasewar, J. Mukhopadhyay, Chang Kyoo Yoo, Hasan Uslu, ―Neutralization and utilization of red mud for its better waste management‖ ARCH. ENVIRON. SCI,volume 6,pp. 13-33, 2012

[8]Prasad N Bishetti,Leeladhar Pammar,(2014),Experimental study on utilization of industrial waste in concrete,*International journal of technical research and applications* e-ISSN:2320-8163,VOLUME2,ISSUE 4(July-Aug 2014),pp,49-52

[9] Sneha Samal, Ajoy K. Ray, Amitava Bandopadhyay, ―Proposal for resources, utilization and processes of red mud in India‖, International Journal of Mineral Processing, volume 118 pp. 43–55, 2013.

[10] Daniel Véras Ribeiro, João António Labrincha, Marcio Raymundo Morelli,― Potential Use of Natural Red Mud as Pozzolan for Portland Cement‖ 2010