International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 12 | Dec 2018 www.irjet.net p-ISSN: 2395-0072

Experimental Investigation of Effect of Neutralized Bauxite Waste (Neutralized Red Mud) on Concrete

Sanket Bajirao Sutar [1], D.N.Mudgal [2], A.V.Karvekar [3]

[1]P.G. Student, Department of Construction and Management , AMGOI, Wathar Tarf Vadgaon, Kolhapur, Maharashtra, India.
[2]Director of AMGOI, Wathar Tarf Vadgaon Kolhapur, Maharashtra, India
[3]Asst. Prof. Department of Construction and Management, AMGOI, Wathar Tarf Vadgaon Kolhapur, Maharashtra, India.

Abstract - *The aim of this work to investigate the experimental utilisation of Neutralized Red Mud in plain cement concrete. For assessing the strength characteristics of the aluminum red mud, experiments have been conducted under laboratory condition. The Portland cement is replaced by 15%,20% and 25% Neutralized Red Mud in M20 concrete. The optimum percentage is find out by taking compressive test, split-up tensile test and flexural test. Finally economy analysis is done for optimum percentage. This paper gives another promising direction for the proper utilization of red mud.*

Key Words: **Neutralized Red Mud (NRM), Normal Concrete(C), 15% Replaced NRM (R-15), 20% Replaced NRM (R-20) , 25% replaced NRM (R-25).**

1. INTRODUCTION

Red mud is an industrial waste which is produce during the production of Alumina in the Bayer's process .It is generally dumped as non value byproduct due to which it is dumped in open natural environment. Due to high alkaline in nature it enhances land infertility. Presence of oxide contains creates ill effect on wealth [4]. But a breakthrough was made when MALCO discovered that red mud could be tried as an alternative for the Low Grade Bauxite (LGB) which the cement industries used for its cement production. An idea struck as why not try Red Mud in cement industries instead of Bauxite as the composition of both are almost similar. It's quite possible as the cement industries were on the look out to make up for the deficiency of Alumina, in their raw materials namely Lime stone for Cement production. Red mud is the industrial waste generated during the production of alumina. According to the grade of raw material bauxite and the production process of alumina, red mud can be divided into Bayer red mud and Sintering red mud Based on present technologies, there is 0.8~ 1.76 t red mud generated by each 1t alumina produced. It is reported that, there are up to 3 million tons of red mud produced by China's largest three alumina production bases. [1]

So to keep environmental also economical balance through partial replacement to cement this project work has focused.

2. MATERIALS

2.1. Materials Used

2.1.1. Cement

Ordinary Portland cement of 43 grade was used in this study. The cement was tested according to IS: 12269-1987.Different test were carried out on the cement to ensure that it confirms to the requirements of the IS: 12269-1987specifications. Cement is a binder, a substance used in construction that sets and hardens and can bind other materials together.

2.1.2. Fine Aggregates

It is the aggregate most of which passes 4.75 mm IS sieve and contains only so much coarser as is permitted by specification. According to source fine aggregate may be described as: For the present investigation, locally available river sand (coarse sand) conforming to Grading

Zone II of IS 383:1970 was used as fine aggregate.

2.1.3. Coarse Aggregates

Hard crushed granite stone, coarse aggregates confirming to graded aggregate of size, 10mm as per IS:383-1970 was used in the study According to size coarse aggregate is described as graded aggregate of its nominal size.

2.1.4. 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.

2.1.5. Red Mud

Red mud is composed of a mixture of solid and metallic oxide-bearing impurities, and presents one of the aluminum 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, unbleached residual aluminum, 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 specific gravity is 2.64. For the present dissertation work, the red mud is procured from, the Hindustan Aluminum CO. (HINDALCO), an aluminum manufacturing unit, situated at about 4 KM from Belgaum City (Karnataka). Waste soil (byproduct of HINDALCO factory) popularly known as the red mud is dumped on the sides of artificial ponds which have now formed hillocks occupying a lot of space. A considerable expenditure is involved in maintaining these sites and disposal of the waste. An attempt is made in the present investigation, to explore the possibilities of using red mud (neutralized) in M20 grade concrete, as partial replacement of ordinary Portland cement.

2.2 Properties of Material

2.2.1. DENSITY

Dry Density of Red Mud =1.93 gm/cm3

2.2.2. CHEMICAL PROPERTIES OF RED MUD:

Table No. 2.2.2: Chemical Properties of Red Mud

Oxides	Red Mud (%)	Properties
Calcium (CaO)	5.75	Imparts strength
Silicates (SiO_2)	31.4	Imparts strength
Aluminates (Al_2O_3)	2.11	Imparts quick setting properties
Iron (Fe_2O_3)	50.89	Imparts strength
Sodium (Na_2O)	0.74	--------

2.2.3. Geotechnical Properties of Red Mud

Table No.2.2.3: Geotechnical Properties of Red Mud

Property	Value
Grain Size distribution	Clayey
Specific Gravity	2.70
Moisture Content	10.35 %
Liquid Limit	32.25 %
Plastic Limit	26.50 %
Shrinkage Limit	30.51 %
Bulk Density	2.129 gm/cm^3

3. NEUTRALISATION PROCESS OF RED MUD

3.1. Aim of Neutralization

It is found from digital pH meter, that the pH of red mud procured from site is alkaline in nature with pH values of 11.80 and above.

Commercially available of normality 32N Hydrochloric acid has been firstly diluted to 1N Hydrochloric acid for our neutralization process. It enriches the silicon oxide and content of red mud; it also eliminates harmful sodium oxides.

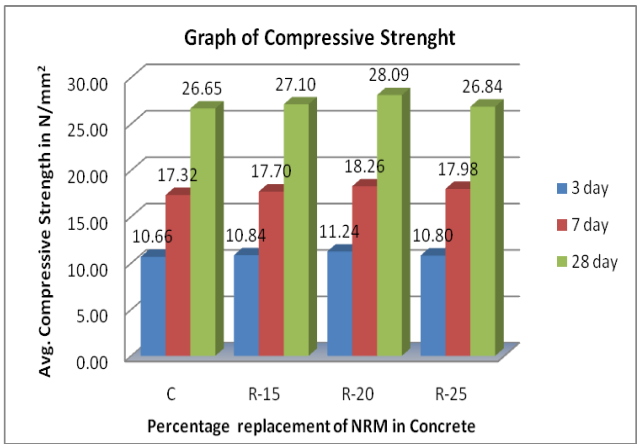
3.2. Neutralization of Red Mud- Experimental Procedure.

About 10 Kg of red mud was mixed with 20 liters of tap water in aluminum container, and is stirred continuously for about half an hour to make the solution homogeneous. The acid was mixed slowly in the solution till pH value of solution became 7.0.

4 RESULTS AND ANALYSIS

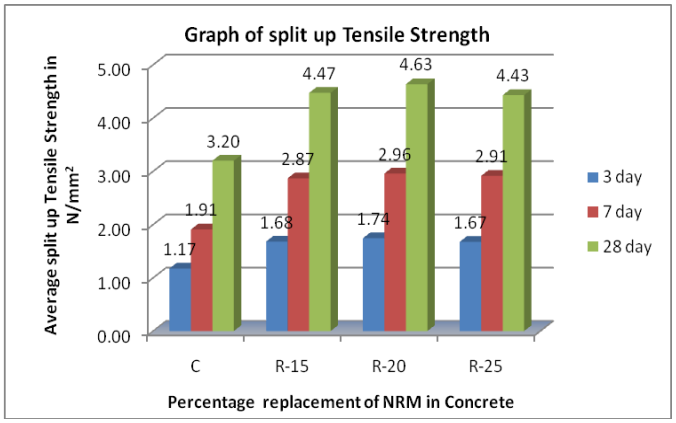
4.1 Avg. Compressive Strength in N/mm2

Replacement of cement by Red mud (%)	C	R-15	R-20	R-25
3 day	10.66	10.84	11.24	10.80
7 day	17.32	17.70	18.26	17.98
28 day	26.65	27.10	28.09	26.84



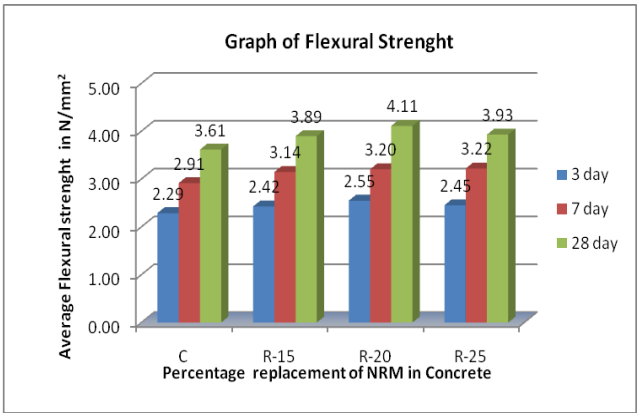
4.2 Average split up Tensile Strength in N/mm2

Cylinder	C	R-15	R-20	R-25
3 day	1.17	1.68	1.74	1.67
7 day	1.91	2.87	2.96	2.91
28 day	3.20	4.47	4.63	4.43



4.3 Average Flexural strength in N/mm2

Beam	C	R-15	R-20	R-25
3 day	2.29	2.42	2.55	2.45
7 day	2.91	3.14	3.20	3.22
28 day	3.61	3.89	4.11	3.93



5. Result and Discussion:

5.1 Effect of NRM Replacement on Consistency

It is observed that with the increase in neutralized red mud in the mix, the water required for standard consistency also decreases& this decrease water requirement shows almost linear relationship with standard consistency.

5.2. Effect of NRM on Initial and Final Setting Time.

It is observed that increase in percentage replacement increases setting time. Thus it acts as retarder.

5.3. Strength Comparison for the Effect of NRM on M20 Grade Concrete.

- The effect of replacement of cement by neutralized red mud has been studied on design mix concrete of grade M20. The water-cement ratio 0.5 is kept constant for different percentage replacement of cement by neutralized red mud.

- It is interesting to note that the particular variation in average compressive strength of cement concrete with different proportions of neutralized red mud in place of cement. It is observed that the average compressive strength increases with increase in neutralized red mud content up to 20% replacement.
- For M 20 Concrete Mix Flexural strength and split tensile strength goes on increasing as the replacement of cement by NRM increases up to 20%.
- For M20 grade Conventional Concrete the 28 days target strength is 26.60 N/mm2 from actual Mix Design we get 23.65N/mm2 after 28 days for conventional concrete (0% replacement) and 28.09N/mm2 for NRM concrete (20% replacement) and 26.84 N/mm2 for NRM Concrete (25% replacement). Hence from the available results and graphs for the experimental work we can say that the optimum use of NRM in Concrete as a replacement of cement is up to 20%.

5.4. Economical Comparison

Grade of Concrete	M20
Conventional Concrete	Rs. 3905/- per cu.m.
NRM (20% replacement)	Rs.3505/- per cu.m.
Difference	Rs.400/- per cu.m.
% Economy Achieved	10.24%

Economical Comparison is made between conventional concrete and the NRM concrete. We can say that 20% replacement of cement by NRM is possible.

From the above made comparison we can say that the optimum replacement by NRM is up to 20% with addition of strength gaining Admixtures, if strength gaining Admixtures is added in concrete the optimum replacement may be up to 20% and 25% replacement by NRM.

CONCLUSIONS

As per available results and analysis we can put forth that, in Concrete mix designs of M20 there is a gradually increase in the Compressive Strength, Flexural Strength and Spilt Tensile Strength with the increase in the percentage replacement of cement by NRM upto 20 % replacement.

Then after the Strengths are decreases as the percentage replacement of cement by NRM increases. The decrease in the strength is might be due to the finer size of Red Mud which increases the density of mix.

Though there more Compressive Strength, Flexural Strength and Spilt Tensile Strength for 25% replacement NRM Concrete than conventional concrete, for keeping factor of safety and higher strength we have suggested optimum percentage of NRM should be 20% of cement weight in kg.

ACKNOWLEDGEMENT

I am highly indebted to Dr. D.N. Mudgal sir and Prof. A. V. Karvekar Sir for their guidance and constant supervision as well as for providing necessary information regarding the project & also for their support in completing the project.

I would like to express my gratitude towards my parents & colleague for their kind co-operation and encouragement which help me in completion of this project.

I would like to express my special gratitude and thanks to industry persons for giving me such attention and time.

REFERENCES

P. Syam Sai (2017): Strength Properties Of Concrete By Using Red Mud As A Replacement Of Cement With Hydrated Lime: PG Scholar, Department of Civil Engineering, Vasireddy Venkatadri Institute of Technology, Guntur, Andhra Pradesh, India: International Journal of Civil Engineering and Technology (IJCIET)

P.Ashok, M.P.Sureshkumar (2010) : " Experimental Studies On Concrete Utilising Red Mud As A Partial Replacement Of Cement With Hydrated Lime": P.G Student, Dept of Civil Engineering, K.S.Rangasamy College of Technology, Tiruchengode, Anna University, India.: www.iosrjournals.org

Kiran Kumar M S1, Harish K S2, Ramesha M3, Manjunath G Tontanal4 (2017):" Experimental Study On Utilization Of Red Mud And Used Foundry Sand In Cement Concrete": Assistant Professor, Civil Engineering Department, Jain Institute of Technology, Davanagere, Karnataka State, India: International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395 -0056 Volume: 04 Issue: 06 | June -2017 www.irjet.net p-ISSN: 2395-0072.

Er.Vedpal Nain, Er.Mohd. Usman, Er. Ayay Kumar, Er. Sanjay Sangwan (2015) have done a thesis on "Properties of Red Mud Admixed Concrete": Er.Vedpal Nain, Er.Mohd. Usman, Er. Ayay Kumar, Er. Sanjay Sangwan[4] (2015) have done a thesis on "Properties of Red Mud Admixed Concrete": www.ijraset.com Volume 3 Issue XII, December 2015IC Value: 13.98

Mohammed Qadeer, Mohammed Naseer Uddin, Mohammed Zarar Ali , Mohammed Abdul Malik , Mohammed Armaan Mehdi Khan [5] (2017): "MUD Concrete": B-tech students at Lords Institute of Engineering and Technology Jawaharlal Nehru Technology University Hyderabad Kukatpally, Hyderabad-500085, Telangana, India: SSRG International Journal of Civil Engineering (SSRG-IJCE) – volume 4 Issue 4 – April 2017

D. V. Ribeiro; M. R. Morelli (2012) Has Done A Thesis on" Use of Red Mud as Addition for Portland Cement Mortars". Tsakiridis, P.E.; Agatzini-Leonardou, S.; Oustadakis, P. Red mud addition in the raw meal for the production of Portland cement clinker. Journal of Hazardous Material, v. 116, n. 1-2, p. 103-110, 2004.

BIOGRAPHIES

P.G. Student, Department of Construction and Management, AMGOI, Wathar Tarf Vadgaon, Kolhapur, Maharashtra, India.

Director of AMGOI, Wathar Tarf Vadgaon, Kolhapur, Maharashtra, India.

Asst. Prof. Department of Construction and Management, AMGOI, Wathar Tarf Vadgaon Kolhapur, Maharashtra, India.