iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** III **Month of publication:** March 2019

DOI: http://doi.org/10.22214/ijraset.2019.3305

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 6.887
Volume 7 Issue III, Mar 2019- Available at www.ijraset.com

Use of Aluminium Industry Waste in Concrete and Study the Effect on Strength of Concrete

Shubham Kognole[1], Abhijeet Gorwade[2], Shubham Bajaj[3], Vasant Bandgar[4], Minal Gidd[5]
[1, 2, 3, 4, 5]*Department of civil engineering, Vishveshwarya technical campus, Patgaon, Miraj. India*

Abstract: ***The reduction of the use of Portland cement on replacing it by supplementary materials, especially if these are by-products of industrial processes or recycled materials is one of the basic steps towards the achievement of concrete sustainability. Several industrial by-products are commonly used as cement replacement materials due to availability and price.***
Among them, the most common are fly ash, G.G.B.S. and silica fumes. Many efforts are being made globally to find suitable uses for red mud so that the alumina industry may end up with no residue at all.
During the past decades, considerable work has been done by a lot of researchers to develop various economic ways for the utilization of red mud as a raw material for the production of range of products, But use in concrete resulting utilization of red mud in large quantity.
Keywords: G.G.B.S. Ground granulated blast furnace slag, Red mud, Disposal, residue, sustainability..

I. INTRODUCTION

Aluminium metal is commercially produced from bauxite ore. Aluminium is a light weight, high strength and recyclable metal. It plays an important role in the social progress and has a pivotal contribution in transportation, food and beverage packaging, building and construction, electronics and defense. It is the third abundant element in the earth's crust and is not found in the free state but in combined form with other compounds.

There are also various processes (i.e. sinter process, combined process, nepheline process), but the Bayer process is most commonly used for aluminium production. As the first step in the process. Bauxite particles are washed, crushed and milled at high temperature and pressure.

This is followed by "digestion" using caustic soda, which produces a sodium aluminate solution and undissolved bauxite residue that contains aluminium, iron, silicon and titanium among others. This highly caustic product, commonly known as "Red Mud" is transferred to residue ponds.

The global average of bauxite residue generated per ton of alumina is between 1 and 1.5 ton; it is estimated that over 150 million ton of bauxite residue are produced annually 3-4 million ton in India alone, and the majority of this waste is being landfilled. Concrete production has a tremendous impact in the environment because of consumption of natural resources and production of greenhouse gases. CO2 emissions related to concrete production can be estimated 700 to 1000 kg of CO2 are produced for each ton of clinker just for the production of Portland cement.

Hence, construction industry needs to be sustainable one.The experimental tests were carried out to obtain the mechanical properties and behavior red mud used concrete.

The comparisons of mechanical properties and behavior include the workability, compressive strength, tensile strength, flexural strength. Effect of increase in red mud percentage by wieght of cement and at same time reducing the same quantity of cement was studied. Observation for 7 & 28 days curing as well as exposure period were recorded and presented in the form of tables and graph.

II. METHODOLOGY

A. Material Used

1) *Cement:* Penna Cement: Ordinary Portland cement (53 Grade) was used conforming to Indian Standard Specifications IS 8112: 1989 (Reaffirmed 2005). The cement was tested as per Indian Standard Specifications IS 4031: 1988. The physical properties of cement are shown in table 2
2) *Red Mud:* Red mud used in this study has been procured from Hindalco Industries Limited, Belgum, Karnataka, India. The physical properties of red mud are: pH varying between 10 to 12.5 (alkaline in nature). Specific gravity was observed to be between 2.5 to 3.5. The chemical properties are shown in table 1. red mud is neutralized with HCL before its use.

Component	Percentage
Fe_2O_3	26.40
Al_2O_3	26.24
TiO_2	22.10
Na_2O	4.20
SiO_2	6.55
CaO	3.50
LOI	10.88

Table 1 : Chemical composition of red mud produced in India

3) *Coarse Aggregate:* Locally available crushed angular aggregates of 20 mm nominal size has been used in the study. Physical properties of coarse aggregate are shown in table 2
4) *Fine Aggregate:* Locally available crushed angular coarse sand with a maximum size of 4.75 mm was used in the study. Physical properties of coarse sand are given in table 2
5) *Water:* Tap water available in the laboratory was used for both mixing the ingredients and curing of the specimens.

Physical Properties of Material Used

Material / Properties	Red Mud	Fine Aggregate	Coarse Aggregate
Specific Gravity	2.72	2.69	2.9
Fineness modulus	-	2.13	5.51
Water absorption	-	0.137	0.028

Table2 Physical Properties of Material.

B. Mix Design

The proportions for M20 grade and 0.45water cement ratio concrete mixes are in the ratio 1:1.51:2.76 where 1 part is cement, 1.51 parts is sand and 2.76 parts is coarse aggregates. Cement is replaced by red mud at various replacement levels varies from 10% to 25% in the interval of 5% by weight of cement. The proportion of mix design are as given in table.3

Red Mud in %Material / (In Kg)	10	15	20	25
Cement	395.1	373.15	351.2	329.25
Red Mud	43.9	65.85	87.8	109.75
Coarse Aggregate	1212	1212	1212	1212
Fine Aggregate	661.7	661.7	661.7	661.7
Water	197	197	197	197

Table3 Proportion of Material

C. Methodology

Various steps involved in carrying out this work are as given below,

1) Concrete mix design for both M20 grade were prepared.
2) Specimens with different percentage of Red mud content replacing cement [i.e.10%, 15%, 20%, 25%.)] were prepared.
3) A total of 24Nos. of Cubes, 12 Nos. of Beam and 12 Nos. of Cylinders are cast.
4) The slump was taken in the range of 55 mm to 75 mm for all the concrete mixes.
5) All the 24 cubes were cast in 150mmx150mmx150mm size mound and are well vibrated under vibrating machine in to 3 layers and the cubes were de-molded after 24 hours and are transferred to curing tank.
6) The cubes were tested 7 and 28 days of curing under Compression Testing Machine so as to determine the Average Compressive Strength.
7) The Beams were tested for 28 days of curing under Universal Testing Machine so as to determine the Average Flexural Strength.
8) The Cylinders were tested for 28 days of curing under Compression Testing Machine so as to determine the Average Split Tensile Strength.

D. Results

1) *Compressive strength for M20 Concrete:* In this point the comparison of compressive strength of various sets of concrete were made by the results obtained after the 7 & 28 days curing of cubes in fresh water.

Table 4 result of compressive strength

Red mud Replaced	10%		15%		20%		25%	
	7day	28day	7day	28day	7day	28day	7day	28day
1.	14.66	21.88	16.13	24.07	15.86	23.68	15.46	23.07
2.	15.20	22.69	17.33	25.86	15.56	23.22	14.22	21.22
3.	15.56	23.22	17.20	25.67	15.42	23.01	13.64	20.36
Average	15.14	22.60	16.88	25.20	15.61	23.30	14.44	21.55

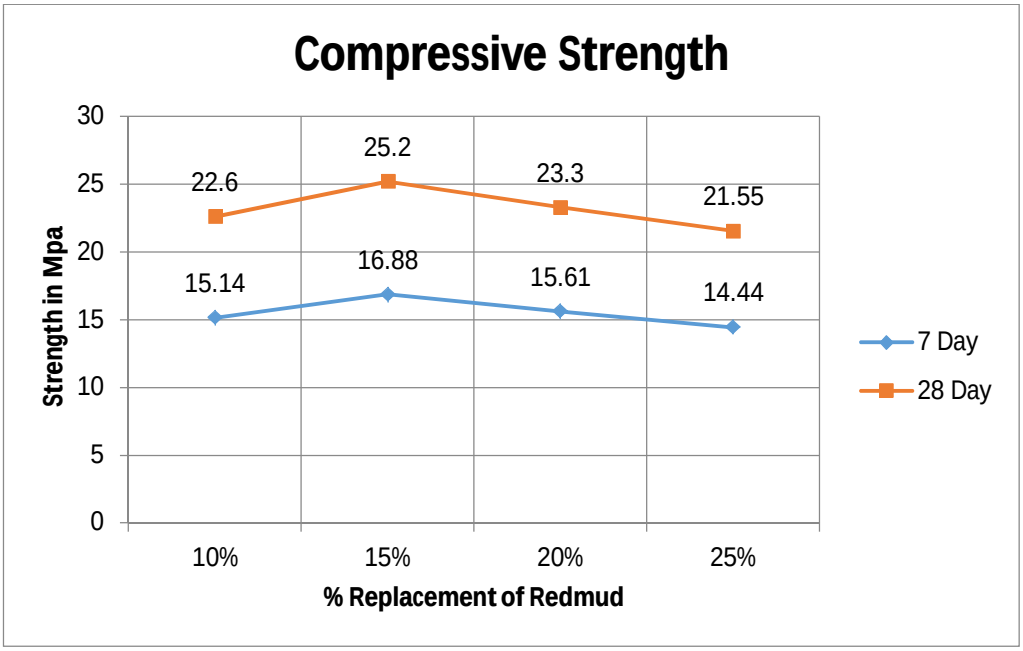


Chart 1 compressive strength

2) *Split Tensile test for M20 Concrete:* In this point the comparison of Split Tensile testof various sets of concrete were made by the results obtained after the 7 and 28days curing of cubes in fresh water.

Table 5 Split Tensile Test Results

Red mud Replaced	10%		15%		20%		25%	
	7day	28day	7day	28day	7day	28day	7day	28day
1.	1.53	2.28	1.56	2.33	1.49	2.22	1.42	2.12
2.	1.70	2.54	1.77	2.64	1.41	2.10	1.37	2.04
3.	1.85	2.77	2.04	3.05	1.34	2.00	1.29	1.92
Average	1.69	2.53	1.79	2.67	1.41	2.11	1.36	2.03

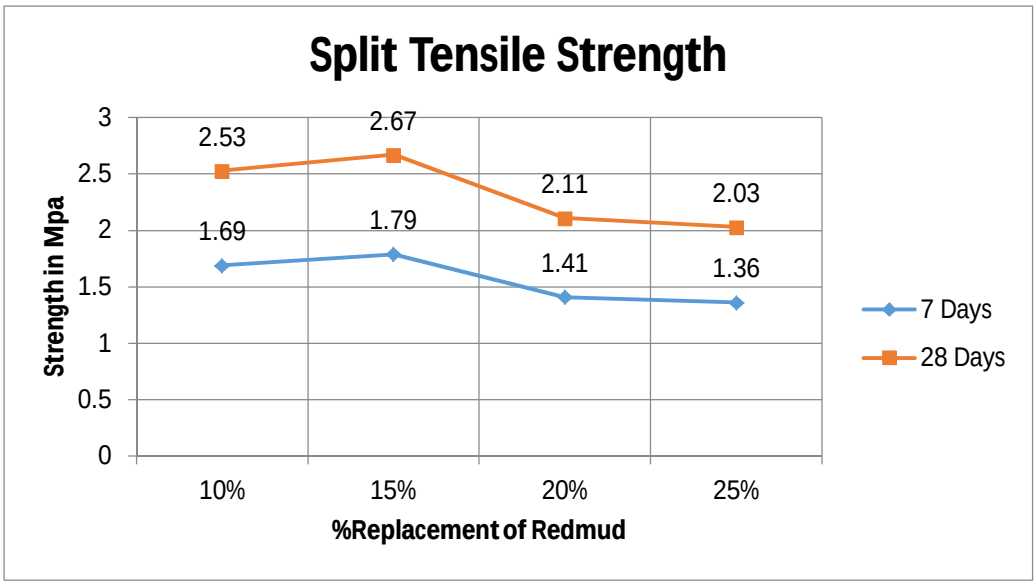


Chart 2 Split Tensile Test

3) *Flexural strength for M20 Concrete Beam :* In this point the comparison of Flexural strength of various sets of concrete were made by the results obtained after the 7 and 28 days curing of cubes in fresh water.

Red mud Replaced	**10%**		**15%**		**20%**		**25%**	
	7day	28day	7day	28day	7day	28day	7day	28day
1.	4.12	6.15	4.30	6.42	4.35	6.49	3.89	5.81
2.	4.27	6.38	4.55	6.79	4.44	6.63	3.68	5.50
3.	4.40	6.57	4.64	6.93	4.16	6.21	3.77	5.63
Average	4.26	6.36	4.50	6.71	4.31	6.44	3.78	5.64

Table 6 Flexural Test Results

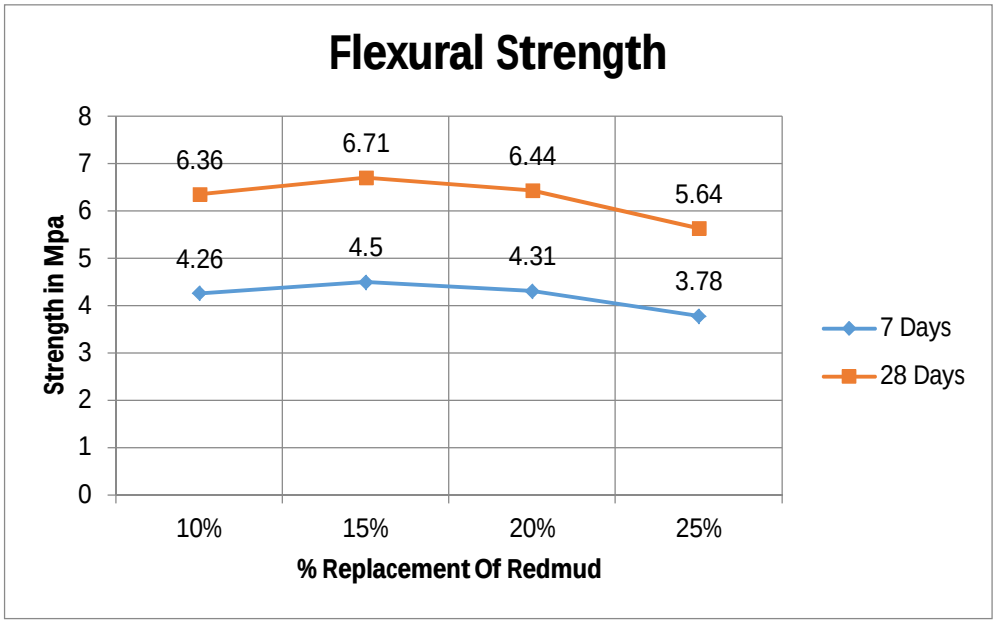


Chart 3 Flexural Strength

III. CONCLUSION

The results of this research work seem to justify the following conclusions:

A. The M20 grade of concrete increased with increasing content of Red Mud up to 15% replacement than after compressive strength decreasing with increasing content of Red Mud. In Compressive Strength, Splitting Tensile Strength, Flexural Strength and durability, Optimum result are obtain by using Red Mud content of 15%.
B. From the experimental work, it was observed that increase in content of red mud decreases compressive strength and splitting tensile strength and flexural strength.
C. It may leads to better waste management and energy savings in terms of carbon reduction.
D. It can lead to transform the construction industry into sustainable one.
E. Red mud can be used as the partial replacement of cement in structural and nonstructural works.
F. Concrete prepared by using red mud is suitable in ornamental works and gives aesthetically pleasant appearance.

1) Suggetions and Recommendation

a) It is better to improve workability by using admixtures instead of adding extra water which will reduce strength.
b) Loading should be applied carefully while testing of specimens.
c) Proper neutralisation of Red mud gives good strength.

2) Futere Scope

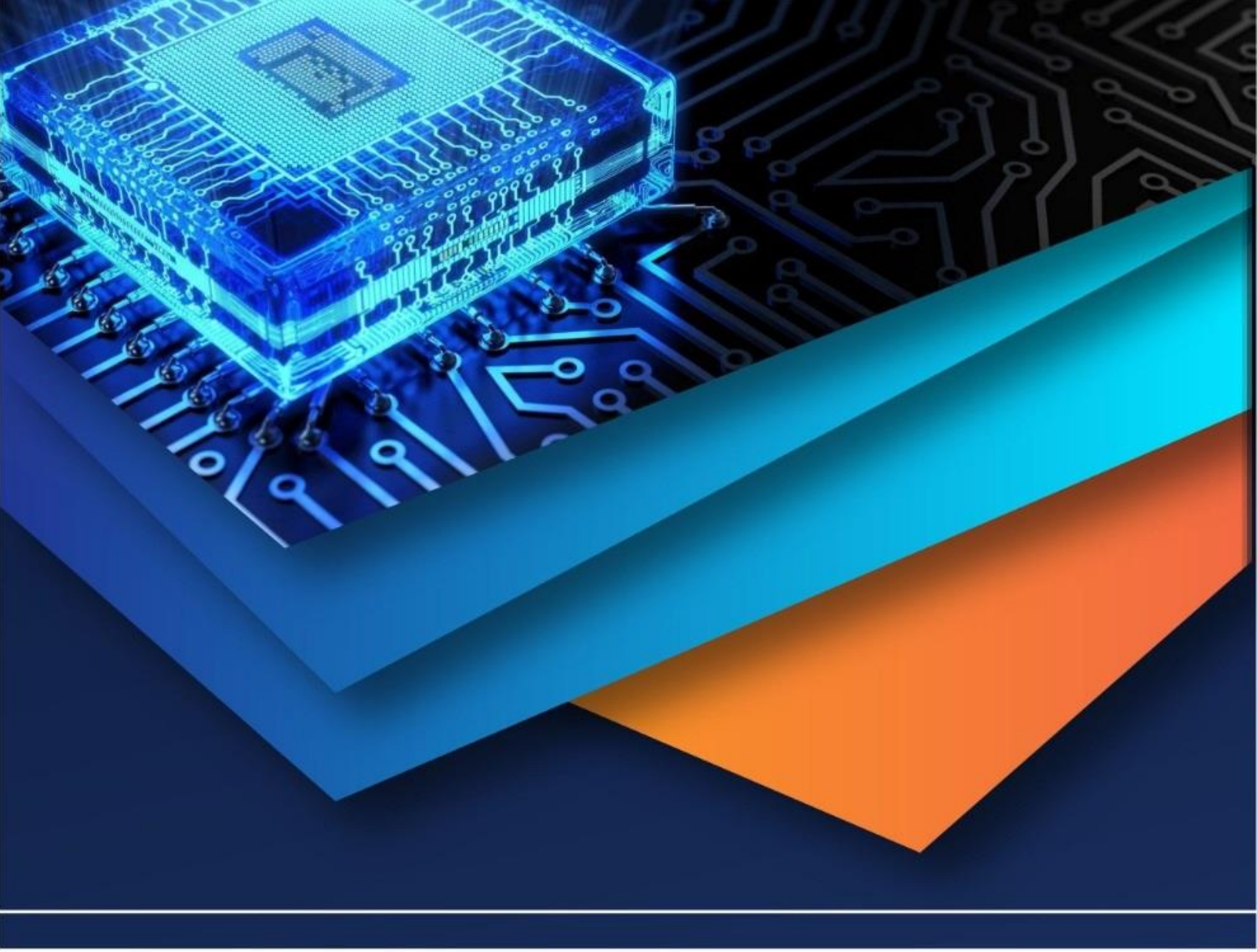
a) Proper and easy neutralisation techniques for red mud before use it as binder material.
b) Other properties like water permeability test, durability test need to conduct and examined in further studies.
c) To study the effect of redmud properties on reinforcement of concrete.

IV. ACKNOWLEDGMENT

This research was supported by , Prof Minal Gidd, Prof. A.A. Mahajan , and V. G. Awasare . VTC patgaion, miraj. We are thankful to our colleagues from Civil Department, who provided expertise that greatly assisted the research.
We have to express out -appreciation to the Prof. Minal Gidd for shearing their pearls of wisdom with us during the course of research.

REFERENCES

[1] D. V. Ribeiro and M. R. Morelli “Use of Redmud as addition of ordinary Portland cement”(2011) Department of Materials Engineering / Federal University of São Carlos Rodovia Washington Luis, Km 235. 13565-905. São Carlos/SP, Brazil.
[2] Ramesh R. Rathod , Nagesh T.Suryawanshi ,Pravin D. Memade ; Evaluation of the properties of Red Mud Concrete(2016),Civil Engg. dept.,S.B.Patil College of Engineering Indapur/Pune Universiyt,India.
[3] P. Tharani,B. Ajay Adithiya, K. Murali ; Experimental Study on Concrete with Bauxite Residue as Partial Replacement of Cement (2017),Department of Civil Engineering,SNS College of Technology, Coimbatore-35, India.
[4] Mr. P. Ajay Kumar, Mr. M. Jayaraman ; study and Analysis of Concrete Strength Parameters Using Redmud as a Partial Replacement Binder Content with or Without Hydrated Lime (May 2017).
[5] K.Deepika1, S.Ananthakumar, R.Mariadoss, J.Nanthagopal, V.Saravanakuma ; Experimental Investigation of Concrete by Red Mud as Replacement of Cement and Using Strengthening Admixture (March 2017)Assistant Professor, Department of Civil Engineering, Sir Issac Newton College of Engineering and Technology, Nagapattinam, India.
[6] P.Ashok, M.P.Sureshkumar ; Experimental Studies On Concrete Utilising Red Mud As A Partial Replacement Of Cement With Hydrated Lime (2017),P.G Student, Dept of Civil Engineering, K.S.Rangasamy College of Technology, Tiruchengode, Anna University, India.



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY