

Analysis on Red Mud Waste in the Field of Construction

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Introduction

Red mud will be waste material formed by the Bayer procedure that is usually utilized in alumina production from bauxite in the whole world. The red mud disposal is not as simple as it is produced in large quantities and alkaline in nature. The red mud will be directly disposed of on land or in a pond that negatively affects the environment [1-2]. The goal of the current survey was to observe the possibility of red mud usage in the construction field. The utilization of industrial waste instead of conventional raw material will support to reduce environmental pollution. Red mud may also use for brick manufacturing, water treatment, concrete production, dam construction, and road construction as an embankment landfill. Cement is partially replaced by red mud in concrete and the workability and strength properties of concrete are determined [3-4].

Around 3 tons of bauxite produced 1 ton of alumina and around 2 tons of alumina produced 1-ton Aluminum. Production of 1 ton of alumina generated 1-2.5 tons of red mud which depends on the raw material utilized.

Production of Red Mud

Aluminum is 3rd abundant component in earth's crust that establishes about 7.3% by mass. After steel aluminum is world's second most utilized metal. These days, the aluminum products demand is gradually increased yearly due to it has numerous advantages that create it distinctive from all. It might give strength of steel, whereas forming flexibility, alloys, recyclable, durability, & numerous advantages. [5]

ABSTRACT

Red mud is a waste material generated at aluminum refinery in the whole world. It is produced in alumina production from bauxite in the Bayer procedure. The production of red mud depends on the raw material processed, generally, 1-2.5 tons of red mud will be produced from 3-5 tons of bauxite to produce 1 ton of alumina. Most alumina refineries have the problem of disposal of red mud as it has high PH and alkaline in nature. The red mud will be prepared as semi-dry or dry material in bauxite mines. The untreated red mud has high PH (usually 11-13) that plant development will be difficult and this poses very disturbing & serious environmental issues. After many studies of a research paper, it has been found that the red mud has cementation properties that may use as cementation material.

Keywords: Red Mud, Compressive Strength (CS), Split Tensile Strength (STS), flexural strength (FS)

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The metallic aluminum will be not discovered in nature, it produced from bauxite which occurs in form of silicates or hydrated oxides with many mixture of iron oxide, titanium, silica, aluminum silicates & additional impurities in insignificant amounts.

The principal aluminum will be produced from bauxite through two stages. In initial stage alumina will be generated by wet chemical, caustic leach model (Bayer procedure). In 2nd stage, aluminum will be generated from alumina by Hall-Heroult procedure [6]. The red bauxite sludge or residue is formed in Bayer process as a by-product named red mud. Bauxite residue contains iron oxide up to 60% which makes it red. Around 90 million tons of red mud being formed globally each year.

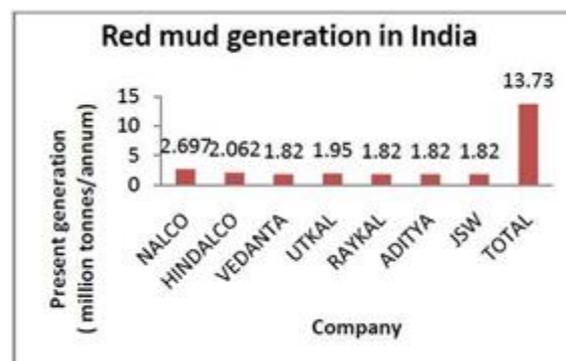


Figure 1: Generation of red mud in India, Source [1]

Table 1: Bauxite Production in different countries, Source [1]

Country	Mine production (X10 ⁶ tons)		Reserves (X10 ⁶ tons)
	2013	2014	
Australia	81.1	81.0	6.50
Brazil	32.5	32.5	2.60
China	46.0	47.0	0.83
Greece	2.1	2.1	0.60
Guinea	18.8	19.3	7.40
Guyana	1.71	1.8	0.85
India	15.4	19.0	0.54
Indonesia	55.7	0.5	1.00
Jamaica	9.44	9.8	2.00
Kazakhstan	5.44	5.5	0.16
Russia	5.32	5.3	0.20
Suriname	2.7	2.7	0.58
Venezuela	2.16	2.20	0.32
Vietnam	0.25	1.00	2.10
Other	4.57	4.76	2.40
World total	283.00	234.0	28.00

Properties of Red Mud

The physical properties of red mud shown in below table

Table 2: Red mud's physical properties, Source [2]

Property	Value
Fineness	1000-3000 cm ² /gm
pH	10.5 to 12.5 (Alkaline)
Specific gravity	2.51

The Chemical properties of red mud

The chemical properties of red mud have represented in Table 1. The red mud has no cementations properties; however, whereas mixed with water & cement it displays cementations properties. The silica presence enhances strength properties of red mud.

Table 3: Red mud chemical composition, Source [3]

Composition	Percentage
Fe ₂ O ₃	30% - 60%
Na ₂ O	2% - 10%
SiO ₂	10% - 20%
TiO ₂	Trace - 25%
Al ₂ O ₃	10% - 20%
CaO	2% - 8%

Table 4: Indian red muds chemical composition, Source [3]

Company	Al ₂ O ₃ %	Fe ₂ O ₃ %	SiO ₂ %	TiO ₂ %	Na ₂ O %	CaO %	LOI %
HINDALCO, Muri	19-21	44-46	5-7	17-19	3-4	1-2	12-14
BALCO, Korba	18-21	35-37	6-7	17-19	5-6	2-3	11-14
NALCO, Metturdam	18-22	40-46	12-16	3-4	4-5	1-3	11-15
HINDALCO, Renukoot	17-19	35-36	7-9	14-16	5-6	3-5	10-12
NALCO, Damonjodi	17-20	48-54	4-6	3-4	3-5	1-2	10-14
HINDALCO, Belgum	17-20	44-47	7-9	8-11	3-5	1-3	10-14

Literature Survey

MahinSha O B and his companions studied on RED MUD CONCRETE. In this research work, incomplete replacement of Portland cement by red mud is carried out 5% to 25% of Portland cement at an interval of 5% in concrete. The concrete workability increments with incrementing the percent of red mud and 20% partial cement replacement by red mud are the optimum dose, Source [7-8].

Mr. Ramesh R. Rathod and his companions studied on an assessment of Red Mud Concrete properties. Portland cement's partial replacement was carried out up to 40% Red Mud by cement weight at an interval of 5% [9-10]. Strength properties are evaluated by performing CS and STS tests on a concrete cast for each replacement after curing of 28 days. CS and STS of concrete decrease as an increase in red mud content, 25% cement replacement by red mud is the optimum percentage at this replacement outcomes have nearly equal to outcomes of controlled concrete, Source [11-12]. Companions studied on finding Optimum Possibility of

partial replacement of cement by red mud in concrete[13]. The objective of the research will be to discover the probability of partial replacement of Portland cement by red mud in concrete and assessing its CS & STS. This survey studies the red mud effect on hardened concrete properties & contrasts with conventional concrete. The test result shows that 15% of cement might be replaced by red mud beyond that CS, STS, & FS start decreasing [14].

Experimental work

The goal of present survey will be to calculate red mud utilization in construction. The numerous simulation works are carried out to investigate the workability and strength factors of red mud concrete generated by replacing cement with red mud. The materials like cement, red mud, lime, coarse aggregate, superplasticizers, & fine aggregate have been utilized in investigational work. The materials have been composed & properties of the material have been surveyed as per standards stated in IS codes. Mix design is done for several concrete grades as per IS 10262:2009. The cubes and cylinders were casted and various tests like compaction factor & slump cone examination are utilized to find out workability and Compression tests, Split Tensile Test and Flexural Test are used to discover strength properties. The examples have tested at 7 and 28 days age of diverse proportions of red mud with or without hydrated lime.

Result and Discussion

The following are the results of various experimental works carried out on red mud concrete. The chemical composition and characteristics of red mud are varying according to place. So that there is variation in test results.

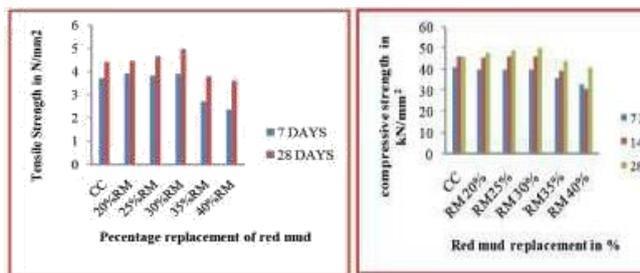


Figure 2: Results of tensile strength test, Source[4]
Figure 3: Results of CS test, Source [4]

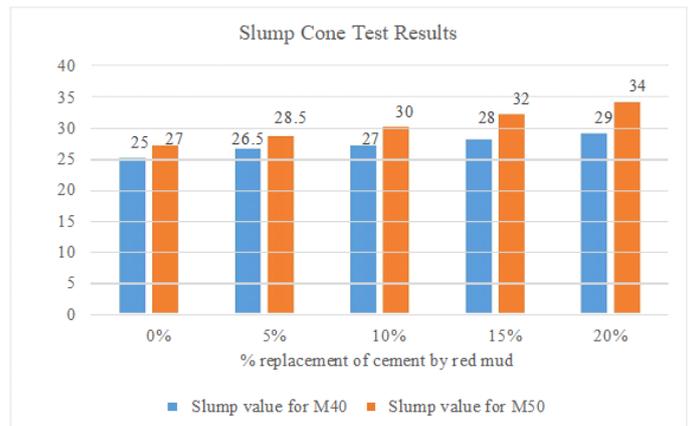


Figure 4: Results of Slump cone test, Source [2]

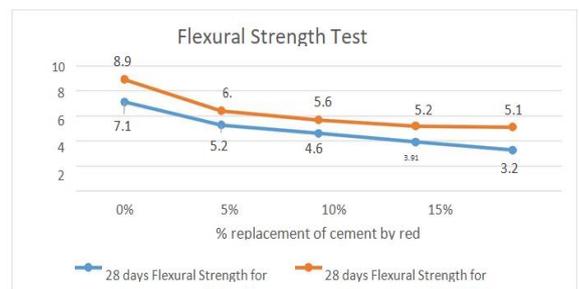


Figure 5: Results of FS test result, Source [2]

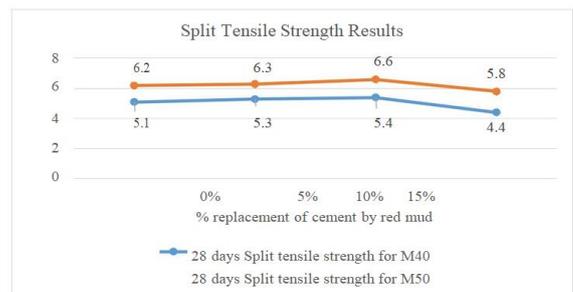


Figure 6: Results of STS, Source [2]

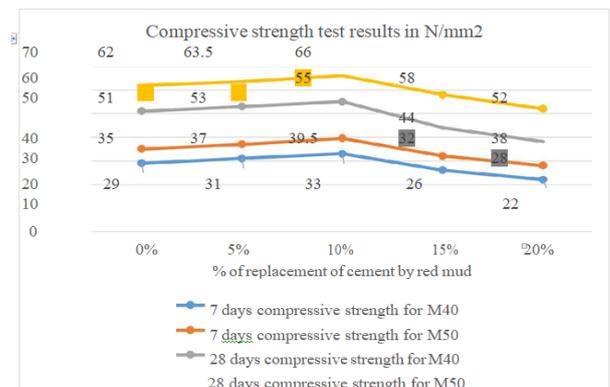


Figure 7: Results of CS, Source [2]

Conclusion

From this review the subsequent conclusions are:
The slump value will be incremented with enhance red mud percentage in concrete. Because to enhance in red mud leads to a reduction in the number of cement outcomes in increment in concrete workability.

For a good grade of bauxite, the strength properties of concrete increased as an increase in red mud percentage. But for a lower grade of bauxite strength properties are increased up to 10 % replacement.

Future Scope

The review will help to discover the effect of addition and cement replacement by industrial waste which provides reuse of industrial waste in concrete mix and helps in reducing the amount of industrial waste for disposal. It also helps in producing cheap concrete.

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