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Potency of Red Mud Concrete by Partial Replacement of Cement with and without Hydrated Lime

Takoor. Ankith Singh, Suraj Baraik

Abstract: ***The study was carried out to know the properties of concrete by using red mud as the cementious material in concrete mix. The Bayer procedure for the alumina from Bauxite metallic is described by low vitality talent and it brings approximately the advent of noteworthy measures of resiude like, extra bauxite deposits defined as red mud. Currently red mud is produced almost at equal mass ratio to metallurgical alumina and is disposed into sealed or unsealed artificial impoundments (landfills), leading to important environmental issues.***

In the present study an experimental investigation was conducted on M40 grade red mud concrete to check the workability, strength and durability with and without using hydrated lime. Seven mix trials are taken for this study like 0%, 10%, 20%, 30%, 40%, 50% and 60% of red mud with and without 5% hydrated lime..

Keywords : Bayer process,, hydrated lime, pozzolanic.,red mud, strength.

I. INTRODUCTION

Concrete is one of the most important material in the world to develop cites. The concrete can be prepared by mixing pozzolanic material with suitable quantity of aggregates and water for the specified grade of concrete. The pozzolanic materials generally taken as cement, coarse aggregates of 20mm or 10mm are used and fine aggregates of size less than 4.75mm is used for making concrete mix. The strength is one of the important property of concrete. The strength can be increased or decreased with partial replacement of pozzolanic material with red mud.

Red mud is the waste material which is produced from Bayer's process. Red mud is that the mechanical waste created at some level at intervals the generation of alumina. Hence due to industrial boom the quantity of its production through bayers process vigorously increased causing Earth pollution and dumping it in neary by water bodies causing water pollution.

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Its use as a by product for the concrete production will be noteworthy since tonnes of its production is used for landfilling. It is well enhanced that red mud possess some similar properties of binding exhibited by concrete. As indicated via the analysis of crude material mineral. The main reaction that occurs in the Bayer process can be schematized as follows:

$$2NaOH + Al2O3 .3H2O \rightarrow Na2O.Al2O3 + 4H2O + \text{Red Mud}$$

The above expression represents the production of red mud dust from bayer's process.

II. METHODOLOGY

The fresh properties of concrete like slump cone test and compaction factor test was studied. Hardened properties of concrete like compressive, split tractable, flexural quality was determined. The rate substitution of red mud utilized as 0%, 10%, 20%, 30%, 40%, 50% and 60% as the concrete with 5% hydrated lime. The comparison of results for with and without utilizing hydrated lime was made.

A. Physical properties of research materials

For this study the physical properties of research materials like cement, fine aggregates, coarse aggregates and red mud material were conducted in order to get IS a code specification.

B. Mix Design

For this study a mix design was prepared based on the physical properties of research materials for M40 grade concrete

1:1.52:2.21 at w/c 0.4

C. Batching of materials

Batching is the process of measuring the quantity of materials for this study weight batching is made for all materials for mixing of concrete

D. Mixing of concrete

With the help of measured quantities of materials we need to mix concrete trials for checking the workability, for casting the specimens.

E. Casting of specimens

For this research specimen of cubes, cylinders, prisms were casted to study the strength properties.

Generally cube specimen of 150mmX150mmX150mm, cylinder specimen of 150mm dia and 300mm length and prism specimen of 150mmX150mmX70mm was taken. The specimens were casted with compaction method for the cube, cylinder and prism specimens we need to compact concrete by 3 layers each layer was compacted with 25 number of blows after compaction process id done we need to finish the concrete specimens with cement mortar.

F. Curing of specimens

After casting of cubes we need to demould the specimens and immerse those specimens in curing tank. The curing process is carried out for 7 days and 28 days for with and without hydrated lime case.

G. Strength of concrete

After curing of concrete specimens we need to check the strength of concrete like compressive, split tensile and flexural strength for M40 grade concrete.

III. RESULTS AND ANALYSIS

A Slump cone test

The slump cone test is the one of the most important property of concrete it is generally measured in mm. It is the concrete drop from initial position to final position.

Table-I: Slump cone test

S.no	% Replacement	Without hydrated lime	With 5% hydrated lime
1	0%	24	25
2	10%	26	27
3	20%	28	28
4	30%	30	30
5	40%	31	32
6	50%	34	36
7	60%	38	40

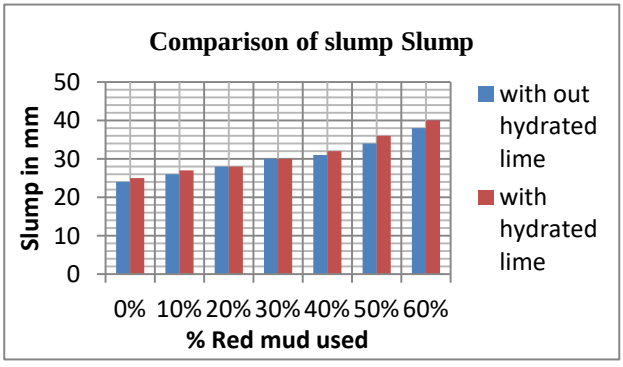


Fig. 1. Comparison of slump cone test

B. Compaction factor test

The value of compaction factor is the ratio of partial compaction concrete weight to the ratio of full compaction concrete weight.

Table- II: Compaction factor test

S.no	% Replacement	Without hydrated lime	With 5% hydrated lime
1	0%	0.86	0.83
2	10%	0.88	0.85
3	20%	0.91	0.88
4	30%	0.93	0.85
5	40%	0.94	0.86
6	50%	0.95	0.86
7	60%	0.95	0.88

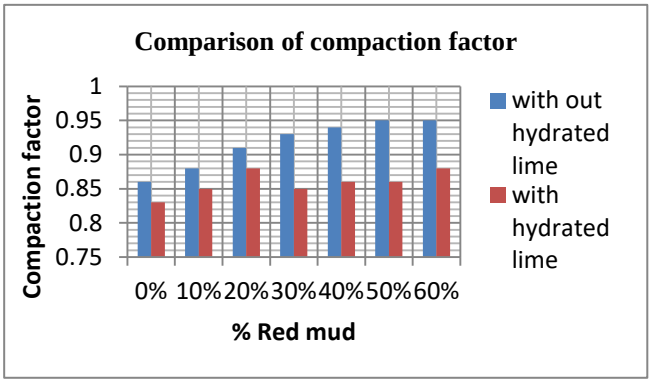


Fig. 2. Comparison of compaction factor test

C. Compressive strength of concrete

In this test the blocks were casted of measurements 150mm× 150mm × 150mm and checked for compressive strength at curing of 7 and 28 days. 3D squares were casted with expanding level of red mud with and without utilizing hydrated lime.

1) Compressive strength of concrete without hydrated lime

Table-III: Compressive strength without hydrated lime

S.no	% Replacement	7 days	28 days
1	0%	39	39.8
2	10%	37.5	38.3
3	20%	34.8	35.6
4	30%	32	33.4
5	40%	29	30.8
6	50%	26	27.5
7	60%	24	40

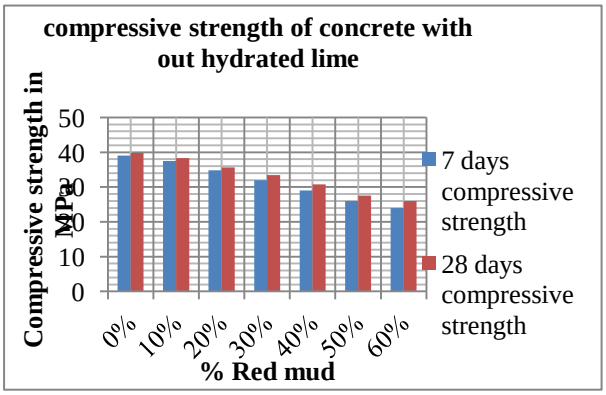


Fig. 3. Comparison of compressive strength without hydrated lime

2) Compressive strength of concrete with hydrated lime

Table IV: Compressive strength with 5% hydrated lime

S.no	% Replacement	7 days	28 days
1	0%	39.5	40.5
2	10%	38.4	39
3	20%	38.2	39
4	30%	34	37.6
5	40%	31	34.5
6	50%	28	31.6
7	60%	26	29

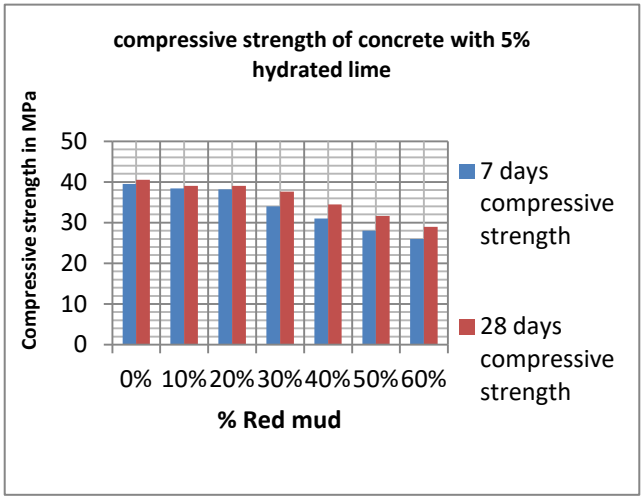


Fig 4: Comparison of compressive strength with hydrated lime

D. SPLIT TENSILE STRENGTH

The concretes compatibility to face up to the pulling force (Tensile Stress) without breaking is referred to as the Tensile Strength of concrete. Its unit is (N/Sqmm or Mpa). The "tensile strength = (2P/πdl) N/mm2". The split check became carried out on cylinders with dimensions 300mm peak and 150mm diameter.

1) Split tensile strength without hydrated lime

Table V: Split tensile strength without hydrated lime

S.no	**% Replacement**	**7 days**	**28 days**
1	0%	2.36	3.8
2	10%	2.48	3.63
3	20%	2.4	3.5
4	30%	2.24	3.3
5	40%	2.18	3.16
6	50%	2.1	3.08
7	60%	2.02	2.98

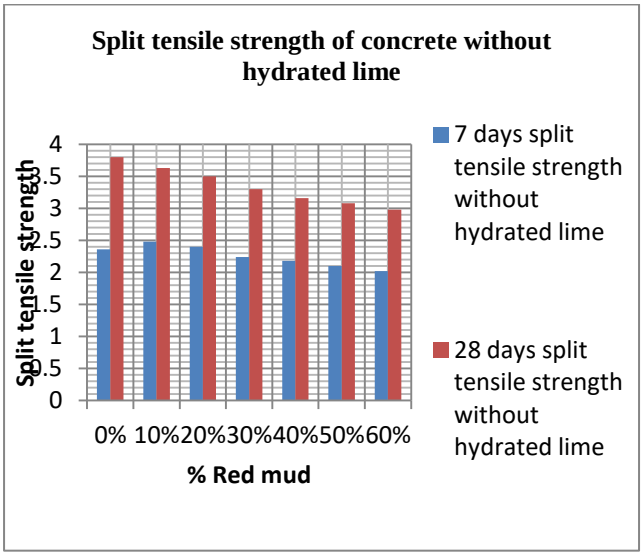


Fig 5: Split tensile strength without hydrated lime

2) Split tensile strength with 5% hydrated lime

Table VI: Split tensile strength without hydrated lime

S.no	% Replacement	7 days	28 days
1	0%	3.82	4.2
2	10%	3.9	4.05
3	20%	3.78	3.92
4	30%	3.56	3.62
5	40%	3.22	3.4
6	50%	3.02	3.2
7	60%	2.6	2.9

E. Flexural strength of concrete

The Flexural strength is an important property of concrete it is also called as modulus of rupture. It is the maximum amount of stress just before the rupture of concrete. For this test square prisms of 100mm×100mm×700mm were used to test on universal testing machine.

1) Flexural strength without hydrated lime

Table VI Flexural strength without hydrated lime

S.no	**% Replacement**	**7 days**	**28 days**
1	0%	5.46	7.12
2	10%	4.84	5.26
3	20%	4.08	4.61
4	30%	3.7	3.91
5	40%	3.02	3.26
6	50%	2.94	3.1
7	60%	2.64	2.8

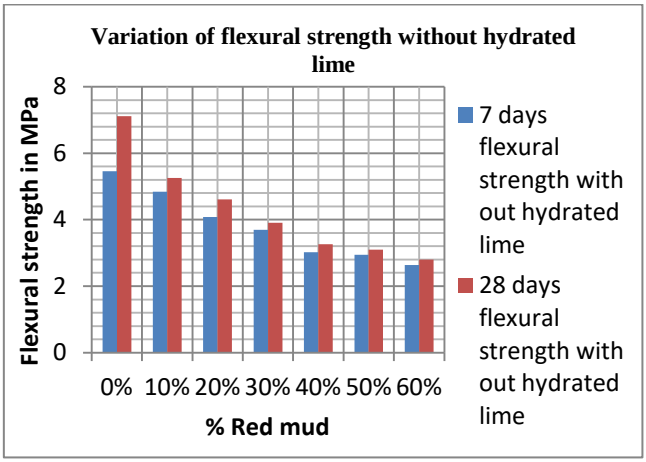


Fig 6: Flexural strength without hydrated lime

2) Flexural strength with 5% hydrated lime

Table VII Flexural strength with 5% hydrated lime

S.no	% Red mud used	7 days	28 days
1	0%	7.86	8.26
2	10%	6.42	6.54
3	20%	5.32	5.82
4	30%	4.3	4.56
5	40%	4.1	4.32
6	50%	3.26	3.62
7	60%	3.02	3.2

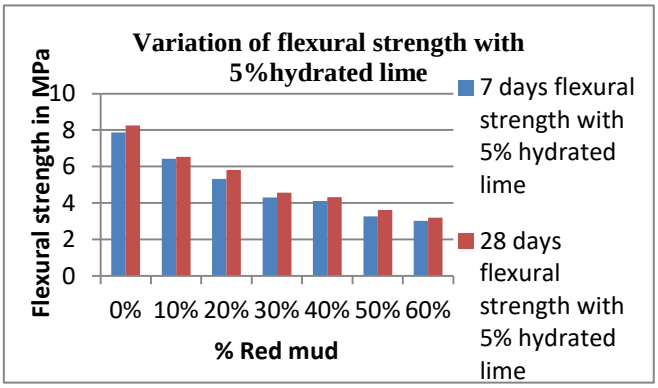
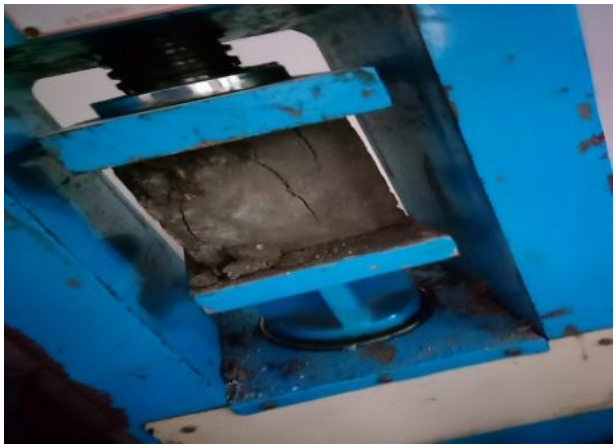


Fig 6: Flexural strength with hydrated lime



IV. CONCLUSION

From the above examination the below conclusions were made

1. The utilization of red mud and hydrated lime as a fractional substitution of concrete gives us an elective source to utilize the loss into a helpful material.
2. The value of slump cone test increases with increasing in the percentage of red mud from 0% to 60% for both with and without utilizing hydrated lime.
3. The value of compaction factor increases with increasing in the percentage of red mud from 0% to 60% for both with and without utilizing hydrated lime.
4. The maximum value of compressive quality was obtained at 10% red mud for 7days and 28 days curing. After 10% the compressive quality of concrete decreases.
5. The optimal value of split and flexibility was observed at 10% red mud for 7days and 28 days curing. After 10% the split tensile of concrete decreases.
6. This trial study obviously shows that legitimate choice of red mud materials, hydrated lime can upgrade the great quality of cement.

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