Concrete Using Red-Mud and Iron-Ore Slickens

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Abstract— Basic Factor Is Keeping Environment Away From Pollution As Much As Possible, Which Is Directly Connected To Humans. Sustainable Development Plays An Important Role In Present Scenario Of Construction. But Before Doing Any Kind Of Development The Factor Like Environmental Consciousness And Protection Of Natural Resources Must Be Kept In Mind. For That In This Study We Have Utilized Waste Materials Which Help Us To Get Greener & Cleaner Environment. In This Study We Have Focused On the Strength Aspects of Concrete for that We Are Replacing Ordinary Portland Cement By Red Mud And In The Same Mix Fine Aggregate Are Replaced By Iron Ore Slickens. Opc In The Red Mud Is Replaced By Red Mud At 1%,2%,3%,4% And For Each Red Mud Replacement Level 10%,20%,30%,40%Of Send Is Replaced By Iron Ore Slickens.

Key words: Red-Mud, Iron-Ore Slickens

I. INTRODUCTION

As we know now a day's many changes have taken place in conventional concrete, Concrete is the most utilized man-made construction material on the earth. The demand for concrete as a construction material has increased as the demand for infrastructure development has increased. However, the environment gets polluted by utilization of cement and raw materials (limestone) also get reduced. The manufacturing of ordinary Portland cement (OPC) requires the large quantities of fuel to be burned as well as the decomposition of limestone, resulting in significant emissions of CO2.

For the manufacturing of a ton of OPC, nearly one ton of CO2 is produced, depending on the production process adopted. Cement plants have been reported to emit up to 1.5 billion tons of CO2 into the atmosphere annually.

As such, replacement of cement in concrete by red mud and partially replacing sand by iron ore slickens by different percentage so it could increase the strength of conventional concrete, because red mud and iron ore tailing are the waste which comes out from aluminum production plant & iron production plant. These have already caused ecological unevenness in their respective regions and appear as the main source of environmental hazards.

Aluminum is a light weight, high strength and recyclable metal. It plays a major role in social progress and has a pivotal contribution in food, transportation, beverage packaging, building construction and infrastructure, electronics and electrification, defense and aerospace. It is the third plentiful element in the earth's crust and is not found in the free state but in combined form with other compounds. The commercially excavated aluminum ore is bauxite, as it has the highest content of alumina with minerals like iron oxide, silica and other impurities in small or trace amount. The primary process of aluminum production consists of three stages: Mining of bauxite, followed by cleanse of bauxite to alumina by the Bayer process and finally fusion of alumina to aluminum. In the Bayer process, the indissoluble product generated after bauxite digestion with sodium hydroxide at raised temperature and pressure to manufacture alumina is known as red mud or bauxite residue. The waste product was given its color and name from its iron oxide content. As the bauxite has been undergo to sodium hydroxide treatment, the red mud is highly corrosive with a pH in the range of 10.5-12.5. Bauxite posing a very hazardous and alarming environmental problem.

The increasing demand for heavy construction material like iron and steel and ample reserve of iron ore in India has effected in the foundation of many iron ore mining companies. The residue left after extraction of concerted iron from iron ore is in the form of slurry. This form the iron ore slickens (IOS) and the same is disposed of in the region of plant as waste material over large area of valuable land leading to water &land pollution. The production of IOS waste is about 18 million tons per annum in India. The safe disposal of large quantities of iron ore slickens is surely a difficult task and a matter of environmental concern, reuse of IOS eliminates/reduces the disposal problem.

II. OBJECTIVE

The objective of the study was:

1) To find the strength properties of concrete for 7, 28 days.
2) Partial replacement of cemantanious material with red mud.
3) Partial replacement of iron ore slickens with the conventional sand.

III. METHODOLOGY

The experimental investigation were conducted at concrete tasting lab in ntpc singrauli

The process involved that the following steps are conducting the feasibility study on compressive strength of red mud and iron slickens concrete.

1) Identification of raw materials such as red mud, iron ore slickens, fine aggregate, course aggregate.
2) Analysis of physical and chemical properties of red mud, iron ore slickens and physical properties of fine aggregate and course aggregate.
3) Making of concrete by replacing cement by red mud and fine aggregate by iron ore slickens in various percentages till a desired compressive strength and workability achieved.

A. Identification of Raw Materials:

1) Red Mud:

The red mud to be used was produced from Renukoot Alumina, Hindalco Industries Limited,, Renukoot, Uttar Pradesh The conservative method of disposal of red mud in ponds has frequently adverse environmental impacts as during rainy seasons, the waste may be carried by run-off to

the surface water courses and as a result of leaching may cause pollution of ground water: more disposal of large quantities of Red mud dumped, poses rising problems of storage occupying a lot of space.

Red Mud is generated during the process for alumina production. Depending on the raw material processed, 1–2.5 tons of red mud is produced per ton of alumina produced. In India, about 4.71 million tons per annum of red mud is produced which is 6.25% of world's total digestion with sodium hydroxide at elevated pressure and temperature. It is a mixture of components originally present in the main mineral bauxite and of compounds introduced or formed during the Bayer process. It is disposed as slurry having a solid attentiveness in the range of 10-30%, pH in the range of 10-13 and high ionic strength.

2) Iron Ore Slicknes:

Iron ore slickens which was used were collected from Bhilai Steel Plant, SAIL Chhattisgarh.

The conventional method of disposing iron ore waste in the area has often unfavorable environmental impacts as during monsoons, the waste may be carried by run-off to the surface water and as a result of percolate may cause contamination of ground water. More disposals of large quantities of iron ore waste poses increasing problems of storage occupying a lot of space.

Particle shape	Spherical
Density	14.5 kn/m3
Specific gravity	3.21
Colour	Dark tan (Brown)
Maximum dry density	1.71 gm/cc

Table 1: Physical Properties of IOS

S.No.	Properties of material	Coarse aggregate	Remark
1	Type	Crushed	-
2	Shape	Angular	-
3	Maximum size	20mm	
4	Specific gravity	-	IS:2386(PartIII)-1963
5	Impact value	-	IS:2386(Part IV)-1963
6	Fineness modulus	-	IS:2386(Part III)-1963

Table 2: Physical Properties of Coarse Aggregates

S.No.	Properties of material	fine aggregate	Remark
1	Type	Natural	-
2	Shape	Spherical	-
3	Maximum size	4.75mm	
4	Specific gravity	2.65	IS:2386(PartIII)-1963
5	Impact value	-	-
6	Fineness modulus	2.9	IS:2386(Part III)-1963

Table 3: Physical Properties of Fine Aggregates

B. Experimental Procedure Adopted:

The size of the cube was 15cm×15cm×15cm, the optimized mix design was developed. The mixing was done by the portable concrete mixer for concrete. All the test cubes were kept at room temperature for 24 hours and then remolded. These were then placed in the water curing tank. In this study 17 concrete mix proportions were made .The first mix was a controlled mix (without red mud and IOS) and the remaining 16 mixtures contained red mud and IOS. The controlled mix was designed for M30 grade. IS 10262-1982 guidelines were followed to design the mix. Cementations material in the mixture was replaced with red mud at 1%, 2%, 3% and 4%. For every red mud substitute level, 10%, 20%, 30% and 40% of regular sand was replaced with Iron Ore Slickens (IOS).

Mix Designation	Description
NC	without red mud and iron ore slickens
1RM10IOS	1% red mud + 10% iron ore slickens
2RM10IOS	2% red mud + 10% iron ore slickens
3RM10IOS	3% red mud + 10% iron ore slickens
4RM10IOS	4% red mud + 10% iron ore slickens
1RM20IOS	1% red mud + 20% iron ore slickens
2RM20IOS	2% red mud + 20% iron ore slickens
3RM20IOS	3% red mud + 20% iron ore slickens
4RM20IOS	4% red mud + 20% iron ore slickens
1RM30IOS	1% red mud + 30% iron ore slickens
2RM30IOS	2% red mud + 30% iron ore slickens
3RM30IOS	3% red mud + 30% iron ore slickens
4RM30IOS	4% red mud + 30% iron ore slickens
1RM40IOS	1% red mud + 40% iron ore slickens
2RM40IOS	2% red mud + 40% iron ore slickens
3RM40IOS	3% red mud + 40% iron ore slickens
4RM40IOS	4% red mud + 40% iron ore slickens

Table 4: Concrete Mix Designation

The compressive strength was tested at 7 and 28 days.

IV. SCOPE

Concrete is prepared by partially replacing cementations material by red mud and in the same mix partially replacing sand by iron ore slickens. Cementations material in the mixture was replaced with RM (red mud) at 1%, 2%, 3% and 4%. For each red mud replacement level, 10%, 20%, 30%, 40% of regular sand was replaced with Iron Ore slickens.

The concrete properties studied included the compressive strength workability.

V. RESULTS

All the concrete mixtures were made up with the controlled mix as well as with RM and IOS to check the compressive strength at 7 and 28 days after curing .Every mix which had been replaced with RM and IOS has achieved higher strengths as compared to the normal concrete mix. At 28-days, the control normal concrete mixture (0% RM, 0% IOS) achieved a compressive strength of 39.4 MPa. The mix with 2% RM along with 30% IOS achieved the highest strengths. The mixes which had 2% Red mud had relatively more strengths as compared to other mixes at 28 days.

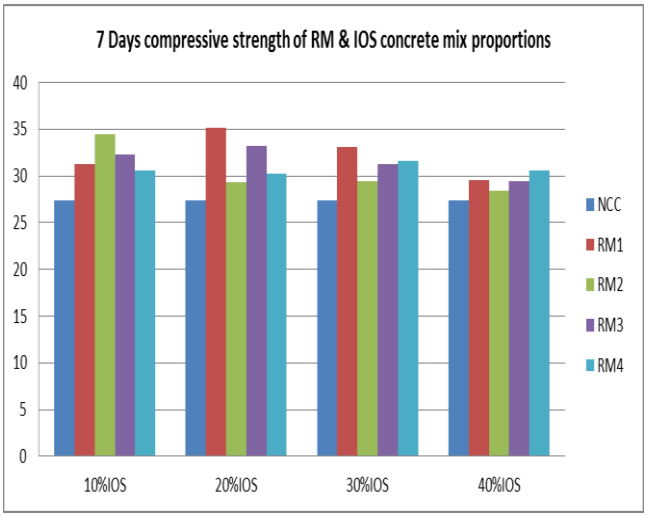

Fig. 1: Graph 1. 7 days compressive strength

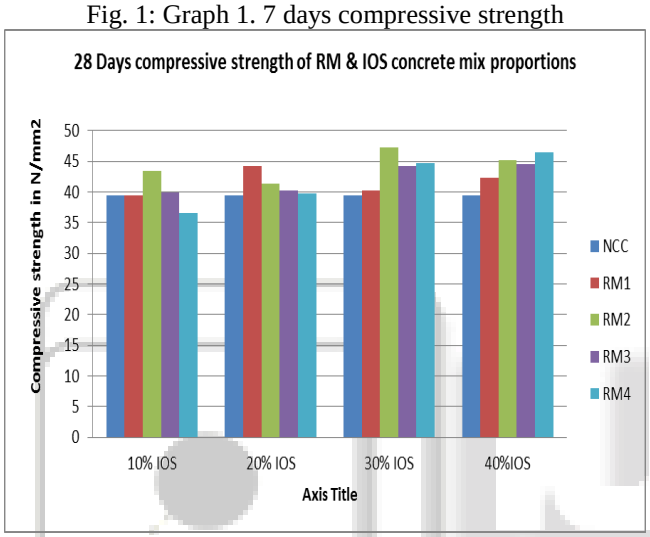

Fig. 2: Graph 2. 28 days compressive strength

VI. CONCLUSION

In India, HINDALCO'S aluminum refinery in Renukoot, Uttar Pradesh generates a voluminous quantity of industrial waste in the form Red Mud, approximately 400,000 tonnes per annum. This is largely dumped at sites, which are known as red mud pounds. The volume of waste generated is large and its alkalinity has the potential to pollute valuable surface and groundwater resources.

1) The compressive strength achieved for all the mix is more than the control mix
2) So this mix (Red Mud + IOS) should be used for the construction activity it will reduce the problem of environmental pollution as well as it will decrease the cost of the construction and add it makes the high performance concrete from the durability point of view.
3) It has been observed that the compressive strength of concrete produced with the combination of RM & IOS goes on increasing. But The maximum compressive strength and split tensile strength was achieved at 2% RM with 30% IOS
4) The compressive strength of concrete increases with the addition of Red Mud up to 2% & iron ore slickens 30% then reduces and but higher than normal concrete mix.
5) The optimum strength for each test was achieved at 2% RM for every IOS replacement level

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