CONSTANT REPLACEMENT OF CEMENT WITH RED MUD AND PARTIAL REPLACEMENT OF SAND WITH M. SAND IN CONCRETE

THANGAMANI K
Assistant professor Civil Department
KG Reddy College of engineering and technology, India

Abstract: ***Concrete in spite of being the most popular and most economical construction material has major shortcomings in terms of embedded energy and is also one of the major causes of greenhouse gas effect. In this project is to use red mud and M. sand as a replacement of cement and sand in building construction in order to reduce the cost of construction for the development of rural areas. The purpose of carrying out this development program is to reduce the release of CO2 gas from concrete.***

The main objectives of the project are; the use of industrial wastes in place of conventional raw materials will help to decrease the environmental pollution and also conserve our natural resources. The development of alternate low-cost and ecologically suitable building materials from agricultural and industrial wastes is an economic necessity. To identify various industrial wastes suitable for utilization in cement manufacture. To examine the constraints related to utilization of industrial waste

Current demand of cement is far in excess of production and is rapidly increasing In this project we have done a comparative study on the red mud and m. sand as concrete ingredients and have discussed about the properties and their chemical composition and how it enhances the mechanical properties of concrete i.e., increases the compressive strength, and tensile strength of concrete based on several research papers.

Key words: manufactured sand,compaction, split tensile test,compaction, vee-bee consistometere

I. INTRODUCTION

Concrete is the primary construction material used around the world and most widely used in all types of civil engineering works and it is a man-made product, essentially consisting of cement, aggregates, water and admixtures. Concrete inspite of being the most popular and most economical construction material has major shortcomings in terms of embedded energy and is also one of the major causes of greenhouse gas effect. However, the production of cement leads to the dissipation of significant amount of carbon dioxide, & greenhouse gas emission. One ton of Portland cement clinker production creates one ton of carbon dioxide and other greenhouse gases. To reduce the emission of carbon dioxide concerning the production of cement, we must reduce the usage of cement. Therefore, there is a need to look for alternate types of materials. The carbon dioxide emissions associated with the manufacturing of Portland cement can be reduced significantly by reducing the production of current clinker. In this project loss in production of Portland cement can be overcome by the increased use of red mud in different percentages with hydrated lime.

Concrete is a composite material composed of gravels or crushed stones (coarse aggregate), sand (fine aggregate) and hydrated cement. It has been in use for over a century in all construction works. A variety of new materials in the field of concrete technology have been developed during the past with the ongoing demand of construction industries to meet the functional, strength, economical and durability requirements.

II. MATERIALS AND MATERIAL PROPERTIES

The materials used in this experimental study includes cement, red mud, fine aggregates (sand and m. sand), coarse aggregates and water.

Cement

Ordinary Portland cement of 53 grade confirming to IS: 10262-2009 was used. 53 Grade OPC provides high strength and durability to structures because of its optimum particle size distribution and superior crystallized structure. Being a high strength cement, it provides numerous advantages wherever concrete for special high strength application is required, such as in the construction of skyscrapers, bridges, flyovers, chimneys, runways, concrete roads and other heavy load bearing structures. Not only is this grade of cement stronger than other grades / types, it is also more durable. Further, by substituting lower grade cement with OPC 53, overall savings can be obtained through reduced quantity of cement that would be required to be used. A savings of 8-10% can be achieved with the use of 53 Grade OPC in place of any other grade.

Red Mud

The Red mud used for the replacement of cement was brought from nearby nursery. The red mud is obtained from manufacturing of alumina from bauxite ore by Bayer's process. The characteristics of Red mud depend on the nature of the bauxite ore used. The principal means of refining bauxite en route to alumina. The resulting alumina is the raw material for producing aluminum by the Hall–Harold process. A typical bauxite plant produces one to two times as much red mud as alumina. This ratio is dependent on the type of bauxite used in the refining process and the extraction conditions.

Red mud is composed of a mixture of solid and metallic oxides. The red colour arises from iron oxides, which comprise up to 60% of the mass. The mud is highly basic with a pH ranging from 10 to 13. In addition to iron, the other dominant components include silica, unleashed residual alumina, and titanium oxide.

Many studies have been conducted to develop uses of red mud. An estimated 2 to 3 million tones are used annually in the production of cement, road construction and as a source for iron. Potential applications include the production of low cost concrete, application to sandy soils to improve phosphorus cycling, amelioration of soil acidity, landfill capping and carbon sequestrate

Manufactured Sand:

Natural or River sand are weathered and worn out particles of rocks and are of various grades or sizes depending upon the amount of wearing. Now-a-days good sand is not readily available, it is transported from a long distance. Those resources are also exhausting very rapidly. So it is a need of the time to find some substitute to natural river sand. The artificial sand produced by proper machines can be a better substitute to river sand. The sand must be of proper gradation (it should have particles from 150 microns to 4.75mm in proper proportion). When fine particles are in proper proportion, the sand will have fewer voids. The cement quantity required will be less. Such sand will be more economical. Demand for manufactured fine aggregates for making concrete is increasing day by day as river sand cannot meet the rising demand of construction sector. Natural river sand takes millions of years to form and is not repleneshible. Because of its limited supply, the cost of Natural River sand has sky rocketed and its consistent supply cannot be guaranteed. Under this circumstances use of manufactured sand becomes inevitable. River sand in many parts of the country is not graded properly and has excessive silt and organic impurities and these can be detrimental to durability of steel in concrete whereas manufactured sand has no silt or organic impurities.

However, many people in India have doubts about quality of concrete / mortars when manufactured or artificial sand are used. Manufactured sand have been regularly used to make quality concrete for decades in India and abroad

III. METHODOLOGY

Tests on fresh concrete

i) Slump Cone Test

Slump test is the most commonly used method of measuring consistency of concrete which can be employed either in laboratory or at site of work. It is not a suitable method for very wet or very dry concrete. It does not measure all factors contributing to workability, nor is it always representative of the placability of the concrete.

The pattern of slump indicates the characteristic of concrete in addition to the slump value. If the concrete slumps evenly it is called true slump. If one half of the cone slides down, it is called shear slump. In case of a shear slump, the slump value is measured as the difference in height between the height of the mould and the average value of the subsidence.

ii) Compacting Factor Test

The compacting factor test is designed primarily for use in the laboratory but it can also be used in the field. It is more precise and sensitive than the slump test and is particularly useful for concrete mixes of very low workability as are normally used when concrete is to be compacted by vibration. The method applies to plain and air- entrained

concrete, made with lightweight, normal weight or heavy aggregates having a nominal maximum size of 40 mm or less but not to aerated concrete orno- fines concrete.

The compacting factor, CF can be calculated as follows

The compaction factor = weight of partially compacted concrete/weight of fully compacted concrete.

This is a good laboratory test to measure indirectly the workability of concrete. This test consists of a vibrating table, a metal pot, a sheet metal cone, a standard iron rod. The vibrator table (C) is 380 mm long and 260 mm wide and is supported on rubber shock absorbers at a height of about 305 mm above floor level. The table is mounted on a base (K) which rests on three rubber feet and is equipped with an electrically operated vibrometer mounted under it, operating on either 65 or 220 volts three phase, 50 cycles alternating current. A sheet metal cone (B) open at both ends is placed in the metal pot (A) and the metal pot is fixed on to the vibrator table by means of two wing-nuts (H). The sheet metal cone is 30 cm high and its bottom diameter is 20 cm and top diameter 10 cm. A swivel arm 61 holder (M) is fixed to the base and, into this is telescoped another swivel arm (N) with funnel (D) and guide-sleeve (E). The swivel arm can be readily detached from the vibrator table. The graduated rod (J) is fixed on to the swivel arm and at the end of the graduated arm _8. glass disc records the slump of concrete after rod is 20 mm in (C) is screwed. The division of the scale on the rod bf the concrete cone in centimetres and the volume vibration of the cone in the pot. The standard iron diameter and 500 mm in length

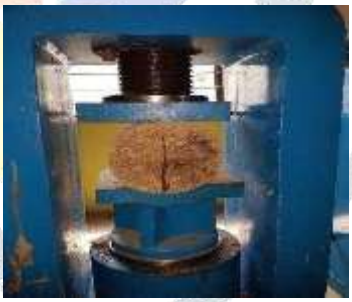

Tests on hardened concrete

iii) Compression Test

The test method covers determination of compressive strength of cubic concrete specimens. It consists of applying a compressive axial load to molded cubes at a rate which is within a prescribed range until failure occurs.


Split Tensile Test

This method covers the determination of the splitting tensile strength of cylindrical concrete specimens.

IV). MIX PROPORTIONS:

The following table shows the concrete mix proportions. With constant water ratio concrete design mix of grade M40 was prepared and design mix was studied for compressive strength.

Concrete design mix proportions.

CEMENT	FINE AGGREGATE	COARSE AGGREGATE	W/C RATIO
1	1.65	2.92	0.40

PERCENTAGE REPLACEMENT:

The following table shows the percentage of red mud used in the mix with the constant water cement ratio of 0.40.

Replacement of red mud and m. sand

S. No	CEMENT		FINE AGGREGATES		COARSE AGGREGATES
	CEMEN T	RED MUD	NATURAL SAND	MANUFAC TURED SAND	
1	100%	0%	100%	0%	100%

2	50%	50%	90%	10%	100%
3	50%	50%	80%	20%	100%
4	50%	50%	70%	30%	100%
5	50%	50%	60%	40%	100%
6	50%	50%	50%	50%	100%

V. RESULTS AND DISCUSSION

Slump Cone Test

S. No.	% replacement of natural sand by manufactured Sand	Slump Value	Slump Type
CC	0%	58 mm	True
1.	10%	45 mm	True
2.	20%	51 mm	True
3.	30%	74 mm	True
4.	40%	63 mm	True
5.	50%	49 mm	True

Compacting Factor Test

S. No.	% replacement of natural sand by manufactured sand	Compacting Factor (Wp/Wf)
CC	0%	0.784
1.	10%	0.829
2.	20%	0.842
3.	30%	0.861
4.	40%	0.837
5.	50%	0.825

Vee Bee Consistometer Test

S. No.	% replacement of natural sand by manufactured sand	Vee Bee Degree (seconds)
CC	0%	30
1.	10%	32
2.	20%	35
3.	30%	38

4.	40%	34
5.	50%	36

Compression Test

Sample	7 days	21 days	28 days
CC	27 Mpa	32 Mpa	40.7 Mpa
1.	25.56 Mpa	34.1 Mpa	42.65 Mpa
2.	25.92 Mpa	34.59 Mpa	43.24 Mpa
3.	26.34 Mpa	35.12 Mpa	43.89 Mpa
4.	25.48 Mpa	33.97 Mpa	42.47 Mpa
5.	23.52 Mpa	31.36 Mpa	39.20 Mpa

Split Tensile Test

Sample	7 days	21 days	28 days
CC	1.89 Mpa	2.52 Mpa	3.15 Mpa
1.	1.91 Mpa	2.54 Mpa	3.18 Mpa
2.	2.62 Mpa	3.48 Mpa	4.36 Mpa
3.	2.68 Mpa	3.58 Mpa	4.47 Mpa
4.	2.47 Mpa	3.29 Mpa	4.12 Mpa
5.	2.43 Mpa	3.24 Mpa	4.05 Mpa

VI. CONCLUSION

From the tests carried out it has been observed that cement on being partially replaced with red mud and sand with manufactured sand can be used in concrete for the development of rural areas and proves to be economical. On the basis of literature survey, it is evident that red mud serves as a good binder material and has proved to be a good cementations material. Red mud reduces the capillary pores of concrete. Thus for the purpose of economical construction red mud has proved to be effective in all aspects. Manufactured sand has been proved to have more strength than the natural sand.

- Optimum percentage of the replacement of manufactured sand by weight is found to be 30%.
- We can use the mixture of red mud and cement for non-structural work and manufactured sand in structural works. There is a future scope for the use of red mud and manufactured sand concrete in structural point of view.
- Used for road construction as an embankment, landfills is an alternative option with a high potential for large volume reuse.

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