Effect of Self Compacting Concrete by Red Mud

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Abstract— Self-compacting concrete (SCC) is an innovative concrete that does not require vibration for placing and compaction. It is able to flow under its own weight, completely filling formwork and achieving full compaction, even in the presence of congested reinforcement. The hardened concrete is dense, homogeneous and has the same engineering properties and durability as traditional vibrated concrete. Due to industrialization there is a huge quantity of red mud created. Red clay is an industrial waste, causing threat to environment. This paper based on experimentation describes the use of Red Mud for construction work, through modified Self Compacting Concrete. Some percentage of cement has been replaced by Red Mud in the concrete. Motive behind this study was to more use of industrial waste and tackle the problem of environmental pollution due to dumping of Red Mud.

Key words: Self-compacting concrete, industrial waste, modified concrete

I. INTRODUCTION

Development of self-compacting concrete (SCC) is a desirable achievement in the construction industry in order to overcome problems associated with cast-in-place concrete. Self-compacting concrete is not affected by the skills of workers, the shape and amount of reinforcing bars or the arrangement of a structure and, due to its high-fluidity and resistance to segregation it can be pumped longer distances (Bartos, 2000). The concept of self-compacting concrete was proposed in 1986 by Professor Hajime Okamura (1997), but the prototype was first developed in 1988 in Japan, by professor Ozawa (1989) at the University of Tokyo. Self-compacting concrete was developed at that time to improve the durability of concrete structures. Since then, various investigations have been carried out and SCC has been used in practical structures in Japan, mainly by large construction companies. Investigations for establishing a rational mix-design method and self-compactability testing methods have been carried out from the viewpoint of making it a standard concrete.

Self-compacting concrete is cast so that no additional inner or outer vibration is necessary for the compaction. It flows like "honey" and has a very smooth surface level after placing. With regard to its composition, self-compacting concrete consists of the same components as conventionally vibrated concrete, which are cement, aggregates, and water, with the addition of chemical and mineral admixtures in different proportions. Usually, the chemical admixtures used are high-range water reducers (superplasticizers) and viscosity-modifying agents, which change the rheological properties of concrete. Mineral admixtures are used as an extra fine material, besides cement, and in some cases, they replace cement. In this study, the cement content was partially replaced with mineral admixtures, e.g. fly ash, slag cement, and silica fume, Red Mud admixtures that improve the flowing and strengthening characteristics of the concrete.

II. EXPERIMENTAL PROCEDURE

A. General:

The aim of this experimentation is to find out the effect of addition of red mud, which is a waste product from the aluminum industries, on the properties of self-compacting concrete containing three admixtures. In this experimentation combinations of admixtures which is taken super plasticizer + VMA.

B. Materials Used:

In the experimentation OPC was used. Locally available sand and coarse aggregates were used. The specific gravity of sand was found to be 2.55 and was Zone II sand. The specific gravity of coarse aggregates used was found to be 2.61. The coarse aggregates were 12mm and downsize. The mix proportion adopted in the experimentation was 1:1:0.5 with a water/binder ratio 0.31. The flyash/cement ratio used was 1:3.5.

The flyash used in the experimentation is pozzocrete 60 was obtained from DIRK INDIA PRIVATE LTD. The chemical composition of flyash is shown in the TABLE- 1

Oxides	Percentages
SiO_2+Al_2O_3+ Fe_2O_2	70 min
SiO_2	35 min
MgO	05 max
SO_3	03 max
Na_2O	1.5 max
Total chlorides	0.05 max

TABLE 1: Chemical composition of flyash

The red mud used in the experimentation was obtained from HINDALCO, Belgaum. The fineness of red mud was found to be 35m^2/gm with particle size of 75 microns and its density is found to be 3gm/cc. The chemical composition of red mud is shown in TABLE- 2**.** (Mauskar2006)

Chemical Composition	Bauxite Residue (%)	Typical values Worldwide (%)
Fe_2O_3	51	30-60
Al_2O_3	15	10-20
CaO	13	2-8
SiO_2	10	3-50
Na_2O	0.20	2-10

TABLE 2: Chemical composition of red mud

A viscosity modifying admixture called GLENIUM STREAM 2 was used to induce the flow without segregation. GLENIUM STREAM 2 is dosed at the rate of 50 to 500ml/100Kg of cementitious material. Other dosages may be recommended in special cases according to specific job site conditions. GLENIUM STREAM 2 consists of a

mixture of water soluble polymers which is absorbed on to the surface of cement granules thereby changing the viscosity of water and influencing the rheological properties of the mix. It also resist the segregation due to aggregation of the polymer chains when the concrete is not moving. GLENIUM STREAM 2 is a chloride free admixture. It should be added to the concrete after all the other components of the mix. This is particularly important in order to obtain maximum efficiency. It is a colorless free flowing liquid and manufactured by BASF Construction Chemicals (India) Pvt. Ltd., Pune.

A high performance concrete Super plasticizer based on modified polycarboxylic ether was used in the experimentation. The trade name of the Super plasticizer is GLENIUMTM SKY 784. It greatly improves the cement dispersion. It is manufactured by BASF Construction Chemicals (India) Pvt. Ltd., Pune. Optimum dosage of GLENIUMTM SKY 784 should be determined in trial mixes. As a guide a dosage range of 300ml to 1200ml per 100kg of cementitiuos material is normally recommended..

III. Experimental Procedure

The cement, sand and coarse aggregates were weighed according to the mix proportion 1:1:0.5. The flyash and cement proportion used in the experimentation was 1:3.5. To this dry mix the required quantity of red mud (0%,1%, 2%, 3%, 4%, 5%, 6%, 7%, 8%, 10%, 12%, 15% and 16%) was added and homogenously mixed. To this dry mix the 33% of water was added and thoroughly mixed. To this the super plasticizer was added at the rate of 700ml/100Kg of cementitious material and mixed intimately. Now the viscosity modifying agent (VMA) was added at the rate of 100ml/100Kg of cementitious material. The entire mix was thoroughly mixed once again. At this stage, almost the concrete was in a flowable state. Now, the flow characteristic experiments for self-compacting concrete like slump flow test, was conducted.

After conducting the flow characteristic experiments the concrete mix was poured in the moulds required for the strength assessment. After pouring the concrete into the moulds, no compaction was given either through vibration or through hand compaction. Even the concrete did not require any finishing operation. After 24 hours of casting, the specimens were demoulded and were transferred to the curing tank wherein they were allowed to cure for 28 days

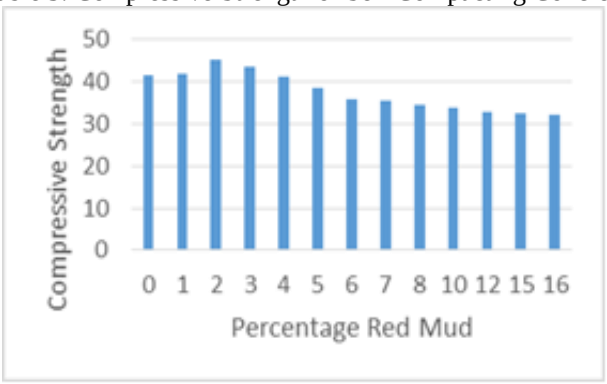
For compressive strength assessment, cubes of size 150mmX150mmX150mm were prepared. After 28 days of curing the specimens were tested for their compressive strengths

IV. Results and Analysis

The following TABLE-3. Gives the overall results of compressive strength of self-compacting concrete containing the combination of admixtures (SP+VMA) for various percentage addition of red mud.

Sr .No	Percentage addition of red mud	Compressive strength (N/mm^2)
1	0	41.49
2	1	42.08
3	2	45.19
4	3	43.56
5	4	41.19
6	5	38.52
7	6	36.01
8	7	35.41
9	8	34.52
10	10	33.74
11	12	32.98
12	15	32.46
13	16	32.28

Table 3: Compressive Strength of Self Compacting Concrete



Graph 1: compressive strength of Self Compacting Concrete

V. Conclusions

1) In India, HINDALCO'S aluminium refinery in Belgaum, Karnatka generates a voluminous quantity of industrial waste in the form Red Mud, almost 400,000 tonnes per annum. This is largely dumped at sites, which are referred to as red mud pounds. The volume of waste generated is large and its alkalinity has the potential to contaminate valuable surface and surface and groundwater resources.
2) So this mix (Red Mud + SCC) should be used for the construction activity it will reduce the problem of environmental pollution at the same time it reduce the cost of the construction and add it makes the concrete high performing from the durability point of view.
3) It has been observed that the compressive strength of self-compacting concrete produced with the combination of admixtures such as (SP+VMA) goes on increasing up to 2% addition of red mud. After 2% addition of red, the compressive strength starts decreasing compacting is the compressive strength of self-compacting concrete produced with (SP+VMA) is maximum when 2% red mud is added. The percentage increase in compressive strength at 2% addition of red mud is + 9.11 thus, it is observed that maximum compressive strength of self-compacting with the combination of admixtures (SP+VMA) may be obtained by adding 2% red mud.
4) The compressive strength of concrete increases with the addition of Red Mud up to 2% then

reduces and comes to no increase at almost 4% addition. So it can be concluded that an addition of 4% Red Mud may be made to SCC without any loss to its compressive strength.

VI. REFERENCES

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