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Experimental Investigation on Strength Parameters of M30 Concrete

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Abstract- *A new generation of concrete, Alternative is important in concrete and it should developed of its outstanding strength workability and performance this shows a very promising future in construction application in this paper several possibilities are examined for reducing the price of producing of concrete and to minimize the material like sand and cement of normal concrete. The following types of alternative material were used to produce the concrete; GGBS; COPPER SlAG; OPC grade 53 and natural mineral (gravel). The Results of 28 days of curing light weight aggregate gives the high mechanical properties. When estimated with the conventional concrete. These experimental results demonstrate that the replacement of ground granulated blast furnace aggregate strongly influences the mechanical and durability properties without basic properties of concrete.*

Keywords: *Aggregate Type, Workability, Compressive Strength,*

1. INTRODUCTION

Concrete is a heterogeneous mix of cement, aggregates and water. The global consumption of natural sand is too high due to its extensive use in concrete. The demand for natural sand is quite high in developing countries owing to rapid infrastructural growth which results supply scarcity. To overcome from this crisis, partial replacement of natural sand with copper slag is economic alternative. The concrete industry is constantly looking for supplementary cementitious material with the objective of reducing the solid waste disposal problem. Ground granulated blast furnace slag (GGBS) and copper slag (CS) are among the solid wastes generated by industry. Substantial energy and cost savings can result when industrial by-products are used as partial replacements for the energy- intensive Portland cement. This investigation attempts to study the feasibility of using locally available GGBS and CS as partial replacements for cement and sand in concrete. As seen the cost of construction using concrete is also increasing day by day ,To reduce the cost of the concrete the waste product are used. The recycle of industrial waste has actually environmental and economical. For investigation point of view, the main aim of the project is to investigate utilization of GGBS and COPPER SLUGDGE in partial replacement of cement and fine Aggregate.

M.V. Nagendra- **"ANALYSIS OF STRENGTH CHARACTERISTICS OF GGBS CONCRETE". JUNE 2014;**
This research work focuses on strength characteristics analysis of M20 grade concrete with replacement of cement by GGBS with 20%, 30%, 40% and 50% and compare with plain.

K. S. Al Jabri: **"COPPER SLAG AS FINE AGGREGATE FOR HIGH PERFORMANCE CONCRETE". FEB 2006;** This paper presents results from an experimental investigation carried out to study the potential use of copper slag as fine aggregate on the strength of both normal and high strength concrete.

Santosh Kumar: **"STRENGTH AND DURABILITY STUDIES ON GGBS CONCRETE".OCTOBER 2015**; The present paper focuses on investigating characteristics of M20 and M40 grade concrete with partial replacement of cement with ground granulated blast furnace slag (GGBS) by replacing cement via 30%, 40%, 50%. The cubes, cylinders and prisms are tested for compressive strength.

Arivalagan: **"SUSTAINABLE STUDIES ON CONCRETE WITH GGBS AS A REPLACEMENT MATERIAL IN CEMENT"-OCTOBER 2014;** This research evaluates the strength and strength efficiency factors of hardened concrete, by partially replacing cement by various

percentages of ground granulated blast furnace slag for M35 grade of concrete.

2 MATERIALS

OPC confirming to IS 12269: 1987 (Specification for 53 grade OPC), fine aggregates, coarse aggregates and potable water were used for the control OPC concrete specimens. The specimen of 20% , 40% , 60% was obtained by mixing calculated quantities of cement, fine aggregate, coarse aggregate and . River sand available in Chennai was used as fine aggregates and tested as per IS 2386: Part I: 1963 (Methods of test for aggregates for concrete). In this investigation copper slag ground granulated blast furnaces sludge are used as alternative and test on aggregate are done as per IS 383 - 1970

A. Ordinary Portland cement (OPC)

The basic properties of 53 grade OPC such as consistency, initial setting time, final setting time and specific gravity were given in Table 1. as per IS 4031- methods of physical test for hydraulic cement.

TABLE 1: PROPERTIES OF 53 GRADE ORDINARY PORTLAND CEMENT

EST DETAILS	OBTAINED VALUE	CODAL REQUIREMENT AS PER IS 4031-1998
Fineness of cement	7%	
Consistency	29%	
Initial setting time	30 min	Not less than 30 min
Final setting time	390 min	Not more than 600 min
Specific gravity	3.15	

B. River sand

River sand obtained from local source around Chennai was used as a fine aggregate. The properties of fine aggregate are tabulated in Table 3.2 the test was carried out as per IS 383-specification for fine aggregate from natural source for concrete.

C. Copper slag

Copper slag is a by-product obtained during the refining of copper .Currently tons of copper slag is produced day by day total around **14.98 million tons**

TABLE 2 :PROPERTIES OF FINE AGGREGATE

S. No	Sieve size	Weight retained (gms)	Cumulative(%) passed
1	4.75 mm	16	96.8
2	2.36 mm	22	92.4
3	1.18 mm	131	66.2
4	600 micron	92	47.8
5	300micron	180	11.5
6	150 micron	45	2.8
7	Pan	11	0

From table 1 the soil sample comes under Zone 2 with ref to table 2.

D. Aggregates

In the investigation fine and coarse aggregate used are obtained locally and ,copper slag both are obtained form copper industry. The properties of coarse aggregate are given in Table 3.as per IS 383- Specification for coarse and fine aggregate from natural source for concrete.

TABLE 3: PROPERTIES OF AGGREGATE

S. NO	AGGREGATES TYPE	SPECIFIC GRAVITY
1	Gravel	2.80
2	River sand	2.62
3	Copper slag	3.4
4	GGBS	3.1

3 PREPARATION OF TEST SPECIMENS

Cement, sand and aggregate are weighted separately and mixed together in a dry manner. The amount of water is calculated as per Indian

standard are measured, mixed together thoroughly and this emulsified water should be used for the preparation of concrete. The mixing was done by the hand and precautions were taken to ensure the uniform mixing of ingredients.

The test specimen of size 150 x 150 x150 mm were cast in a mould made of 4mm thick sheet for all concrete specimen. The specimens were DE moulded after 24 hours of casting and cured in water for7, 28 days. To achieve the initial and finial stage strength curing is carried out which helps us to improve the strength of concrete it will be done as per Indian standard.

TABLE 4: MIX DESIGN OF CONCRETE FOR M30

QUANTITY OF MATERIAL REQUIRED FOR M_{30} GRADE OF MIX FOR				
S.no	Cement (kg)	Fine aggregate (Kg)	Coarse aggregate (Kg)	Water (Lit)
1	492.5	836	1156	197

TABLE 5: REPLACEMENT OF COPPER SLAG WITH FINE AGGREGATE

QUANTITY OF MATERIAL REQUIRED FOR M_{30} MIX WITH REPLACEMENT OF % OF COPPER SLAG IN FINE AGGREGATE					
R.E %	Cement Kg	F.A Kg	C.S Kg	C.A Kg	W.E lit
20	492.5	617.2	152.3	1156	197
40	492.5	462.9	308.59	1156	197
60	492.5	308.59	462.9	1156	197

TABLE 6:REPLACEMENT OF GGBS AND COPPER SLAG WITH CEMENT AND FINE AGGREGATE

QUANTITY OF MATERIALOR M_{30} MIX WITH REPLACEMENT % OF C.S IN FA AND GGBS WITH CE						
R.E %	Cement Kg	GGBS Kg	F.A Kg	C.S Kg	C.A Kg	W.A lit
20	492.5		617.2	152.3	1156	197
40	492.5		462.9	308.59	1156	197
60	492.5		308.59	462.9	1156	197

TABLE 7:SLUMP FLOW TEST

CONCRETE	**SLUMP VALUE (mm)**	**TYPES OF SLUMP**
Standard concrete	10	True
20% replacement of C.S with F.A	10	Shear
40% replacement C.S with F.A	25	Shear
60% replacement Of C.S with F.A	30	Shear
20% replacement of GGBS and C.S with cement and sand	20	Shear
40% replacement of GGBS and C.S with cement and sand	40	Shear
60% replacement of GGBS and C.S with cement and sand	60	shear

4 EXPERIMENTAL INVESTIGATION

The aim investigation is to find suitable alternative for conventionally used material in concrete . alternative material is used for the replacement cement and fine content in the concrete . To investigate that those alternative material in concrete should increase the strength and durability of concrete structure. The following investigation on strength were conducted to assess the performance concrete under compression loading .

4.1 Compressive strength tests

The compressive strength tests are carried out as per IS 516-1968 (methods of tests for strength of concrete) to find the influence of high performance concrete on the compressive strength development of cement concrete. The specimens of size 150mm cube were casted with the various types of aggregate. Totally 30 specimens were casted. The test was carried out at the ages of 7 and 28 days tests results are compared with control concrete specimens.

4.2 Water absorption tests

The specimens made with ordinary cement mortar will absorb water to a certain extent. The important parameter that influences the rate of water absorption is the degree of hydration and water-cement ratio . The increases in degree of hydration and decrease in water-cement ratio will certainly reduce the rate of water absorption. In addition of super plasticizer the larger pores are filled with water reducing agent. This feature reduces water absorption. The objectives of this test is to study the water absorption properties due to replacement of different types of aggregate.

5 RESULT & DISCUSSION

The results of the experimental program followed for the determination of strength, durability of Concrete cubes and cylinder are discussed with the results.

5.1 Results for Compressive Strength

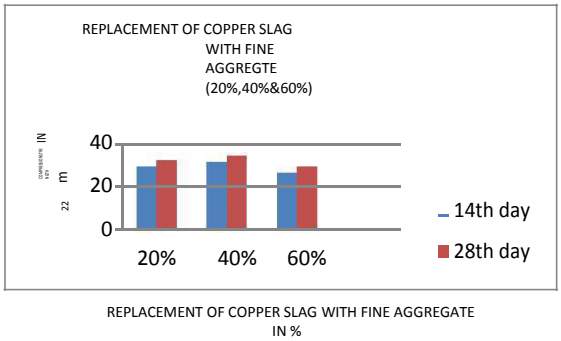

Figure 1: Comparison of Compressive strength for Control Concrete and different types of aggregate

Figure 1 shows Comparison of Compressive strength for Control Concrete and different types of aggregate. In general mix ratio are designed irrespective of types of aggregate used in concrete. In initial stage control concrete offered improved strength of 34 MPa for 40 % of its replacement similarly the copper slag is replaced for 20% , 60%on fine aggregate. Then the gravel gives the moderate strength in the initial stages. It can be concluded that irrespective of type of aggregate 28 days test results revealed similar Compressive strength for for that standard concrete. Whereas marginally improved Compressive strength of the order of 40% for Control concrete.

5.2 Result For GGBS AND COPPER SLAG Tensile Strength

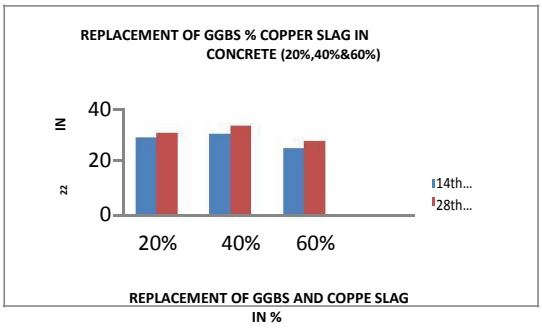

Figure 2 Comparison of compression strength of concrete with with diff %of replacement

Figure 2 shows the Compression strength for standard mortar and different types of aggregate In general mix ratio are designed irrespective of types of aggregate used in concrete. In initial stage control concrete offered improved strength of 29 MPa similarly the copper slag also gives strength of 3.7 MPa . Then the gravel gives the moderate strength in the intilal stages. It can be concluded that irrespective of type of aggregate 28 days test results revealed similar Compressive strength for Gravel, GGBS, COPPER SLAG.

6 CONCLUSION

This paper presents experimental study on high performance concrete using different types of aggregates. The following conclusions are derived based on the analysis.

- Compressive strength of 30MPa was achieved at the age of 14day for concrete using both GGBS and C.S. The strength improvement is similar to the Control Concrete.
- At the finial stage for curing the specimen gives the expected outcome in strength and Performance of Concrete.
- The observation of Compressive strength is in close agreement with the expected

theoretical strength attainment values for M30 Concrete

- The bond strength development of using GGBS & C.S in concrete is comparable with the expected values for control concrete.
- Water absorption percentage obtained for GGBS is nominal but the subsequent strength reduction needs further study.
- The durability up to 40 % improvement in replacement using GGBS & C.S.
- It can be concluded that the strength and durability properties of high performance concrete using different types of aggregate is improved by adequate modification in mixing and curing methods and by appropriate proportion.

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