Comparative Analysis of Slag Sand with Partial Replacement to Fine Aggregate

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***Abstract* –Slag is considered as one of the waste materials which can have a promising future in construction industry as partial or full substitute of conventional sand. For each ton of steel production, about 2.2 tonnes of slag is generated. In this paper, Slag is used as a partial replacement to fine aggregate with 30,40 and 50% respectively. Cubes and Cylinders were casted and compressive and tensile testing were noted after 7 and 28 days testing. The Cylinders casted has more tensile strength such that it has wide application in RCC work as steel requirement will be less due to good strength of slag sand used in cement. For this project, Steel Slag was used whish was available from Kalika Steel, Jalna, Maharashtra. This Project was successfully completed under the guidance of CSK RMC Plant, PUNE.**

***Keywords* – Slag sand, Partial substitute, Tensile and Compressive Test, Kalika Steel, CSK RMC Plant.**

I. INTRODUCTION

The Concrete Industry is very large consumer of natural resources like sand, gravel, crushed rock, etc as building material. Environmental restrictions of sand extraction from river beds have resulted in search for alternative sources of fine aggregate, particularly near the larger metropolitan areas. The recent controversy in India over sand mining has put spotlight on the need to substitute the natural fine aggregates. Slag sand is being used as an alternative to fine aggregate which in turn leads to effective utilization of industrial by-products. In order to reduce the accumulation of steel slag and also to provide an alternative material for sand and cement an approach has been done to investigate the use of steel slag in concrete for the partial replacement of sand and cement. Many researchers have already found it possible to use slag as a concrete aggregate, because slag has similar particle size characteristics likely to that of sand. Fine grained powder of steel slag can be used as a supplementary cementing material to concrete and in cement clinker production. Although there are many studies that have been reported by investigators from other countries on the use of slag in cement concrete, not much research has been carried out in India concerning the incorporation of steel slag in concrete.

II. MATERIALS AND METHODS

The raw materials used in this research were cement, fine aggregate and coarse aggregate, steel slag, admixtures and water. The cement used was Ordinary Portland Cement from CSK Plant, Pune. Fine aggregate and coarse aggregate was also available from the premises of CSK RMC Plant. Slag sand was sponsored from the KALIKA STEEL Plant, Jalna, Maharashtra and final raw material i.e water, normal drinking water was used for work. The physical properties of coarse fine aggregate and steel slag were determined.

TABLE 2.1

Physical Properties

	C.A	Sand	Steel Slag
Fineness Modulus	7.73	3.96	4.508
Specific Gravity	2.75	2.65	3.72
Water Absorption	0.609	1.2	4.72

The Ordinary Portland Cement Concrete was M20.

Water Cement ratio for the mix proportion is 0.47

Example Preparation

The materials utilized for making cement are OPC 53 review concrete, coarse sand of size 20 mm, fine sand of size 10 mm, water cement proportion 0.47. In this solid we utilize steel slag as a substitute of fine aggregate in different sum control stage (0%), 30%, 40% and 50%.

Curing

Curing intends to cover the solid so it remains wet. By keeping solid damp, the bond between the glue and the total gets more grounded in order to advance solidifying of cement.To help diminish water misfortune, promptly subsequent to demoulding of examples they were put in curing tank containing consumable water for appropriate curing until testing for a time of 7 dys and 28 days respectively.

Test Specimens

The 24 numbers of (150*150*150) mm estimate block (cubes), 24 numbers of (150*300) mm measure chamber (cylinders) were threw for review.

Quality Test

The accompanying are the test directed for assessing the quality of concrete

- Compressive quality test
- Split tensile quality test

Compressive Strength of Cube:

It is characterized as the most extreme compressive load that can take by the solid per unit zone. The blocks were tried for their 7 and 28 days quality in the compressive testing machine which has the limit of 2000 tons. Load is connected at a uniform rate until the examples fizzle. Stack at disappointment is noted.

Compressive strength og concrete = LOAD / AREA

Split Tensile Strength of Cylinder:

A chamber of determined measurement is made to bomb under strain by applying compressive load over the width is named as part elastically of the solid. The barrets were tried for their 7 and 28 days in the compressive testing machine. Quality decided in the part test is accepted to be nearer to the genuine elasticity of cement.

Split tensile strength of concrete = 2P / 3.14LD

Where,

P = compressive load on the cylinder

L = length of cylinder

D = diameter of cylinder

III. OBJECTIVE OF THE WORK

Slag sand is used in the work with partial replacement to fine aggregate with 0%, 30%, 40% and 50% respectively thus increases the strength of concrete.

Thus, for the future use in RCC work where steel requirement will be less as the strength provided by the concrete would be sufficient.

Thus, economical to use as compared to convensional sand the by-product of steel from steel manufacturing industries were usually dumped as a waste material, but can be used as a slag in manufacturing the cement.

Leaching of cement is minimized with the use of slag sand.

IV. RESULTS AND DISCUSSION

A. Compressive Strength of Concrete (CUBE)

GRADE: M20

TABLE 4.1 NORMAL (CUBES)

	DAYS	STRENGTH (N/mm2)
Concrete 0%	7	31.18
	28	41.02

TABLE 4.2
CONCRETE WITH 30 % REPLACEMENT OF FINE AGGREGATE BY STEEL SLAG

	DAYS	STRENGTH (N/mm2)
Concrete 30%	7	32.93
	28	39.83

TABLE 4.3
CONCRETE WITH 40% REPLACEMENT OF FINE AGGREGATE BY STEEL SLAG

	DAYS	STRENGTH (N/mm2)
Concrete 40%	7	30.64
	28	50.94

TABLE 4.4

CONCRETE WITH 50% REPLACEMENT OF FINE AGGREGATE BY STEEL SLAG

	DAYS	STRENGTH (N/mm2)
Concrete50%	7	14.26
	28	22.35

B. Split Tensile Strength of Concrete (CYLINDER)

GRADE: M20

TABLE 4.5. NORMAL CONCRETE

	DAYS	STRENGTH
Concrete 0%	7	15.6
	28	20.3

TABLE 4.6
CONCRETE WITH 30% REPLACEMENT OF F.A. BY STEEL SLAG

	DAYS	STRENGTH
Concrete 30%	7	31.43
	28	38.76

TABLE 4.7
CONCRETE WITH 40% REPLACEMENT OF SAND BY STEEL SLAG

	DAYS	STRENGTH
CONCRETE 40%	7	35.65
	28	57.5

TABLE 4.8
CONCRETE WITH 50% REPLACEMNT OF SAND BY STEEL SLAG

	DAYS	STRENGTH
CONCRETE 50%	7	15.65
	28	23.5

V. CONCLUSION

- The Compressive strength of Cubes is increased with the partial replacement of fine aggregate up to 40% replace by weight of sand and further any partial replacement of sand with slag sand lead to a decrease in compressive strength.
- Thus, optimum value obtained is at 40% replacement.
- The split tensile strength of Cylinders is increased with the partial replacement of fine aggregate up to 40% replace by weight of sand and further any partial replacement of sand with slag sand lead to a decrease in tensile strength.
- We have put forth a simple step to minimize the cost of steel in RCC work by utilization of slag sand to cast cylinders.
- We have also stepped into a aim of saving the environmental pollution due to the dumping of wastes in form of slag and irregular mining for river sand; being our main objective as Civil Engineers.

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