AN EXPERIMENTAL INVESTIGATION OF CEMENT BY PARTIAL REPLACEMENT OF GROUND GRANULATED BLAST FURNACE SLAG IN CONCRETE

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Abstract **- Concrete manufacturing involves additional cementitious material which results in increase in the production of carbon dioxide gases which results in the damage of the most of layer of earth. The replacement of cement with GGBS in the various percentage. The tests such as compressive were done in Cubes, cylinder and beam. Ground Granulated Blast furnace Slag can recover the stability characteristic of concrete compared to control mix. In the project cement is replaced 0%,10%,20%,30%,40% and 50% of Ground Granulated Blast furnace Slag replaced. The strength of concrete seems to be increased when we replace cement with 30% of GGBS. Beyond that the strength seems decrease.**

Keywords - Ground Granulated Blast Furnace Slag, Compressive strength, Flexural strength, Durability, Cement

I. INTRODUCTION

Concrete is the largest the widely used construction materials. Concrete is usually connected with Portland cement because OPC is the most important element for production of concrete. The claim for concrete as a building substance is onthe argument. In accumulation, the scope of power required to create OPC is only next to steel and aluminum. Slag improves with respect to strength and durability.

II. METHODOLOGY

- Collection of materials
- Initial test on materials
- Mixing of materials
- Filling the cubes
- Curing
- Test on cubes
- Results
- Making the concrete cubes by partially replacing the cement with GGBS in M25 grade.
- Cube samples are prepared in the way different trial GGBS: 5%,10%, 20% ,30%,40% and 50% Replacement for GGBS.

A. Ground granulated blast-furnace slag

Ground granulated blast-furnace slag GGBFS, is a by-product of iron in blast-furnace. It mainly consists of silicate and aluminosilicate of melted calcium that is periodically be removed from the blast furnace.

Table 1: Physical properties of GGBS

Description	Properties
Color:	white
Specific gravity:	2.9
Fineness :	350m2/kg
Bulk density:	1200kg/M3

Table 2: Chemical composition of GGBS

Description	Properties
Calcium oxide:	40%
Silica:	35%
Alumina:	13%
Magnesia:	8%

Table 3: Initial test result of materials

S.no	Materials	Specific Gravity	Fineness modulus
1	Fine aggregate	2.5	4.64
2	Coarse aggregate	2.5	7.08

Table 4: Test result of cement

SI NO	BRAND NAME	TEST ON	RESULT	AS PER CODE IS 12269
1	Coromandel cement	Initial setting time	30 Mins	Not less than 30 mts.
2	Coromandel cement	Final setting time	600 Mins	Not more than 10hr
3	Coromandel cement	Fineness test	9.03 %	Not more than 10%
4	Coromandel cement	consistency	32%	Above 30%

B. Design of Concrete Mix

Mix has been calculate on Indian standard recommended guidelines IS 10262 – 2009. From the mix design, quantity of cement, fine aggregate and water cement ratio are calculated.

Table 5: Detail of mixes

Composition	Mix Designation						
Mix	1	2	3	4	5	6	7
Replacement %	0	5	10	20	30	40	50
Water Cement Ratio	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Cement Kg/m^3	5.4558	5.1830	4.9102	4.3646	3.8191	3.2735	2.7279
GGBS Kg/m^3	0	0.2727	0.5455	1.0911	1.6367	2.1823	2.7279
Fine aggregate	6.2352	6.2352	6.2352	6.2352	6.2352	6.2352	6.2352
Coarse Aggregate	13.25	13.25	13.25	13.25	13.25	13.25	13.25

Figure 1*:* Casting of Cubes

III. RESULTS AND DISCUSSIONS

A. AVERAGE VALUE OF COMPRESSIVE STRENGTHON CUBES

The average compression strength of cubes are tested and expressed in the table 6 below:

Table 6: Average Compressive Strength on Cubes

	7 Days	14 Days	28 Days
NORMAL CONCRETE	17.33N/mm^2	21.33N/mm^2	25N/mm^2
GGBS 5%	17.88N/mm^2	21.33N/mm^2	25.8N/mm^2
10%	18.11N/mm^2	22N/mm^2	26.73N/mm^2
20%	18.44N/mm^2	24.4N/mm^2	27.12N/mm^2
30%	19N/mm^2	25N/mm^2	28.52N/mm^2
40%	14.22N/mm^2	17.21N/mm^2	19.27N/mm^2
50%	12.22N/mm^2	14.21N/mm^2	17.06N/mm^2

Figure 2*:* Compressive Strength Test on Cubes

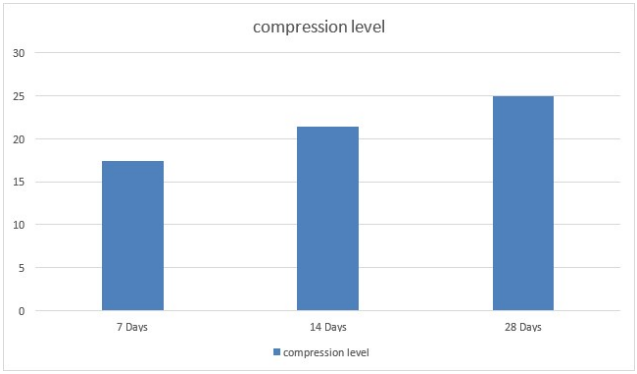

Figure 3*:* 0% of compression test results

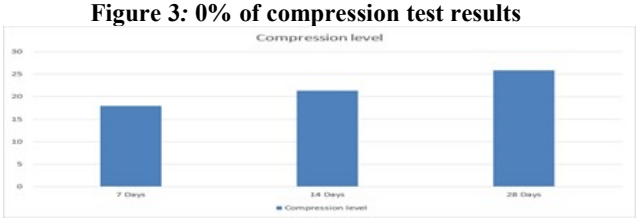

Figure 4*:* 5% of compression test results

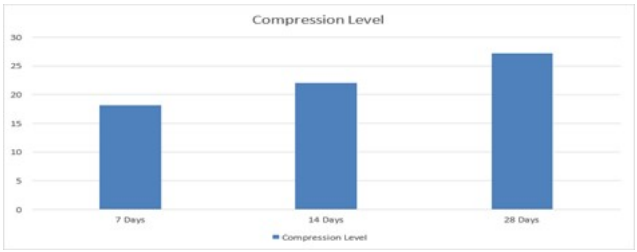

Figure 5*:* 10% of compression test results

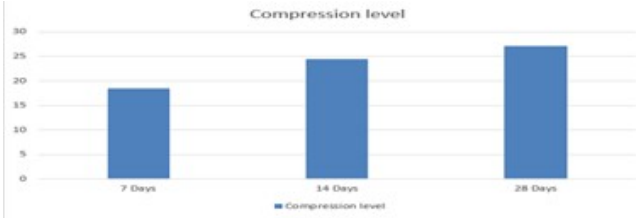

Figure 6*:* 20% of compression test results

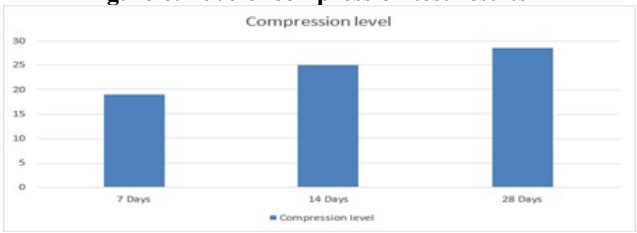

Figure 7*:* 30% of compression test results

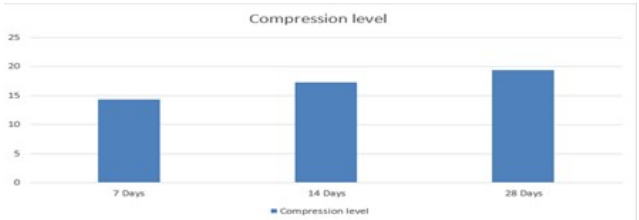

Figure 8*: 40% of compression test results*

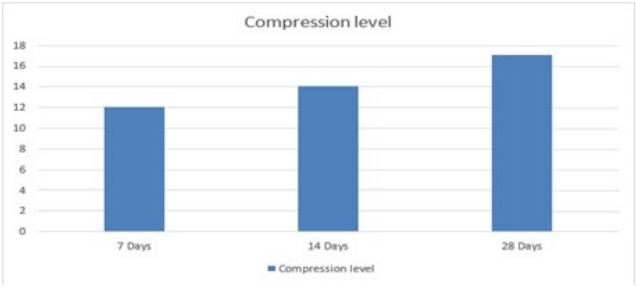

Figure 9*: 50% of compression test results*

Finally, after the replacement of GGBS as 60% and more, there should be no more increasing its strength. Comparing all these 30% replacement having proven valuable strength.

IV. CONCLUSION

- ✓ On replacing cement with GGBS, the maximum compressive strength is obtained in 30% replacement and the value obtained is 28.52N/mm^2 at 28 days curing.
- ✓ Thus, GGBS can be used as a substitute for cement.
- ✓ This replacement of GGBS in the cement reduces the emission of carbon dioxide gases thus helping in giving an ecofriendly environment.

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