Review Paper: Partial Replacement of Fine Aggregate with GGBFS and Glass Waste in Concrete

Abhineet Kumar Raj[1] Navendu Srivastava[2] Gulshan Sharma[3]
[1,2,3]Department of Civil Engineering
[1,2,3]ABES Institute of Technology, India

Abstract— Ground granular blast furnace slag and glass are non-biodegradable and pursue pozzolanic properties and it needs to proper utilization. Ground granular blast furnace slag and glass are durable, economical, and sustainable option for Portland cement concrete. The study has been taken to the replacement of fine aggregate with ground granular blast furnace slag up to the 60% and Glass waste up to 15% of fine aggregate. Both are replace with fine aggregates together in different-different proportion, and the best result is obtained when fine aggregate is replaced with 50% of ground granular blast furnace slag and 8% replacement with glass waste.
Keywords: GGBFS, Furnace Slag and Glass, Glass Waste

I. INTRODUCTION

Concrete is a mixture of cement, aggregates, water, etc. which are easily available everywhere. In concrete coarse aggregates are bounded together with cement and fine aggregate which fills the space and voids between two aggregate.

The rapid growth of industrialization in the world is giving birth to various kinds of wastes which are very dangerous to our environment. And it needs its proper utilization.

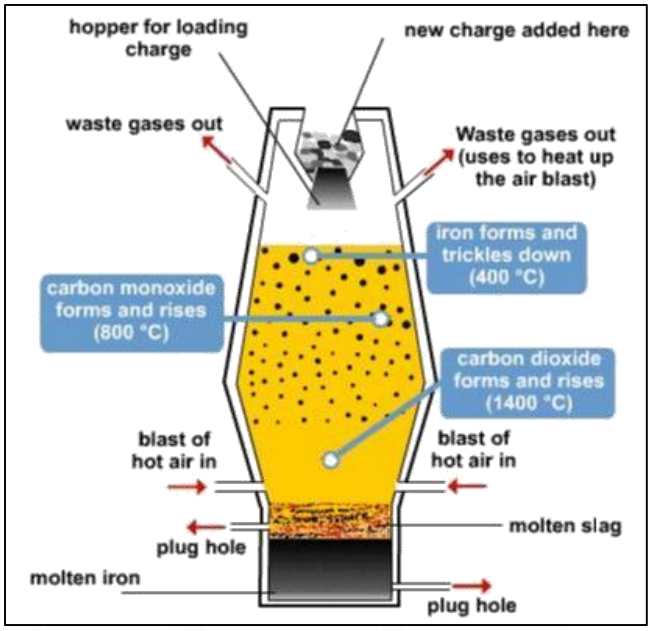
GGBFS is a by-product of iron and steel industry. In blast furnace slag, float to the top of iron and removed. GGBFS is produced through quenching the molten slag in water and then grinding it into fine power form as per requirement.

One of the best ways to utilization of Ground Granulated Blast Furnace Slag and glass waste produced from industry is in replacement of fine aggregate in concrete. Ground Granulated Blast Furnace Slag is produced from iron industry after the removal of molten iron. Slag is a non-metallic inert waste consisting of mainly silicates, alumina silicates and calcium-alumina-silicates.

Whereas Glass is non-biodegradable material produced by melting a mixture of materials such as silica, soda ash, and CaCO3 at high temperature followed by cooling where solidification occurs without crystallization. Glass widely used in our lives through manufactured products such as sheet glass, bottles, glassware, and vacuum tubing. So that a very large amount of glass waste is produced every day and it need its proper utilization.

When ground granular blast furnace slag is replaced with fine aggregate at 40%, 45%, 50%, 55%,and at 60% along with glass waste replacement as 4%, 6%, 8%, 10% and at 12% simultaneously with fine aggregate ,

Then there is decrease in the weight of concrete, increase in strength as compare to conventional concrete, and it becomes more economical.



Manufacture and Constituents of Blast-furnace Slag

II. LITERATURE REVIEW

- MHRD Survey [1][2017]: About 50-100 tons of GGBFS is produced daily from steel and iron industry.
- Gaurav Singh, Souvik Dasa [2] [2015] studied on properties of M25 grade of concrete in which fine aggregate is partially replaced by G.G.B.F.S in increments of 10%. From 0% to, up to 100% of fine aggregate and concluded that at 50% replacement with G.G.B.F.S the mix attained maximum compressive strength and corrosion resistance.
- K.G. Hiraskar and Chetan Patil [3] [2013] Study is based on the replacement of fine aggregate with GGBFS for design mix of M30 grade of concrete, in the increment of 25%. From 0% to, up to 100% of fine aggregate and concluded that at 50% replacement with G.G.B.F.S the mix attained maximum compressive strength.
- Test result of Gaurav Singh, Souvik Dasa[4][2015](M25 grade)

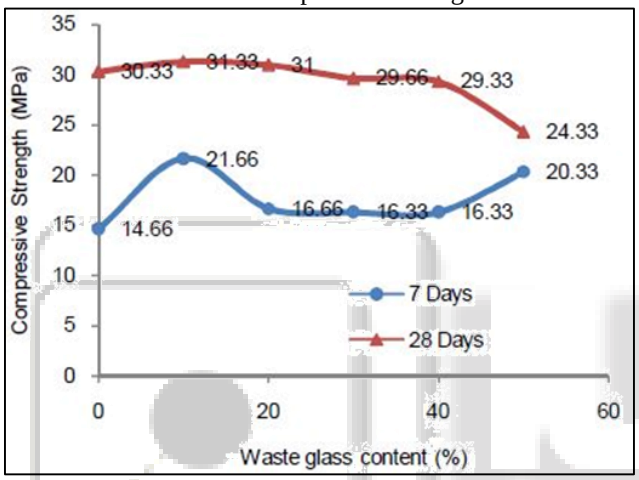
S.No.	Sample No.	GBFS percentage	28 Days Strength(MPa)	90 Days Strength(MPa)
1	G1	0	20.79	22.56
2	G2	10	21.12	23.58
3	G3	20	23.65	26.56
4	G4	30	25.32	30.96
5	G5	40	28.63	36.62
6	G6	50	35.62	40.63
7	G7	60	32.56	38.23
8	G8	70	28.56	34.26
9	G9	80	26.78	32.26
10	G10	90	24.35	30.6
11	G11	100	23.53	27.45

Table 1: Test Results of Normally Cured Specimens

- S.P. Gautam, Vikas Srivastava [5][2012] As per Study the replacement of fine aggregate with glass waste for M25 grade of concrete. The study shows that the replacement of fine aggregate with glass waste at variation of 10% from 0% to 50%. And the best result is achieved when glass waste is 10% replaced with the fine aggregate.
- Test result of S.P. Gautam, Vikas Srivastava[6][2012](M25 grade)

Cube designation	Compressive strength (N/mm^2)		Glass (%)
	7 days	28 days	
I	14.66	30.33	0
II	21.66	31.33	10
III	16.66	31.00	20
IV	16.33	29.66	30
V	16.33	29.33	40
VI	20.33	24.33	50

Table 2: Compressive Strength



- Anu C Abraham, Sindhu P. K [7][2017] The study is based on the partial replacement of fine aggregate with granite powder and Iron powder. Their study shows that how to replace two materials with a single material i.e. replacement of fine aggregate with granite powder and iron powder different- different proportion to achieve the best result among them.

III. NEXT STEP (FURTHER WORK)

Ground granular blast furnace slag and glass waste both are non-biodegradable and pursue pozzolanic properties and these materials are locally available everywhere, so that they need the attention on its proper utilization.

As we know concrete is the second largest thing used in the world, and since both materials are durable, economical and posses good compressive strength so that we can utilize these materials in concrete.

By replacing fine aggregates in concrete with Ground granular blast furnace slag and glass waste simultaneously in different-different proportion we can achieve good compressive strength of concrete. And then we can use them as per our requirement i.e. in building construction, pavement design, and many other places.

As per previous studies when fine aggregate replaced with Ground granular blast furnace slag it gives maximum strength at 50% replacement. So that we can use it at 5% variation of increase and decrease. And as per previous study when fine aggregate is replaced with glass waste the best result is achieved at 10% replacement. So that we can use it at 2% variation of increase and decrease.

Using both material simultaneously we can make set of (50%,6%), (50%,8%), (50%,10%), (50%,12%), (50%,14%) here 50% is the Ground granular blast furnace slag and the second variation is glass waste. Similarly we can make the set of (40%,10%), (45%,10%), (50%,10%), (55%,10%), (60%,10%). Here 10% is the glass waste and the second variation is of Ground granular blast furnace slag. Among these set we can find the best result and we can use as per our requirement.

IV. CONCLUSION

Ground granular blast furnace slag and glass waste both are non-biodegradable and pursue pozzolanic properties, so that it needs its proper utilization to protect the environment. The ground granular blast furnace slag and glass waste are used simultaneously in concrete by replacing fine aggregate in different- different proportion and find the best mix proportion.

REFERENCES

[1] MHRD Survey [2017]
[2] IS 456:2000 for concrete standards.
[3] Gaurav Singh, Souvik Dasa [2] [2015]
[4] K.G. Hiraskar and Chetan Patil [3] [2013]
[5] S.P. Gautam, Vikas Srivastava [5][2012]
[6] Anu C Abraham, Sindhu P. K [7][2017]
[7] Google image
[8] Social media
[9] News papers

