IJPRSE
Progressive Research
International Journal of Progressive Research in Science and Engineering
Volume-1, Issue-9, December-2020
www.ijprse.com

Experimental Analysis Partially Replacement of Cement, Sand by GGBFS and Foundry Sand

Karan Singh Norake[1], Lavina Talawale[2]

[1]*Dept. of Structural Engineering, Shiv Kumar Singh Inst. of Technology and Science, Indore, India.*

Corresponding Author: karansinghnorake99@gmail.com

Abstract: - Use of recycled waste foundry sand in concrete can be useful for environmental protection and economical terms. Recycle of foundry sand as replacement of fine aggregate are the Materials for the future. Foundry sand is a group of materials that can vary significantly in composition. The advantages of using foundry sand for mechanical properties. The most important benefit is reduced natural fine aggregate. This increases strength and reduces permeability. Globally, the concrete industry consumes large quantities of natural resources, which are becoming insufficient to meet the increasing demands. At the same time, large number of using natural sand and other structures have reached the end of their service life and are being demolished, resulting in generation of demolished concrete or sand. In other side Ground, granulated blast furnace slag (GGBFS), a by-product of the steel manufacturing industry, being used as an effective partial cement replacement material, has already been proven to improve several performance characteristics of concrete. The reactivity of GGBFS has been found to depend on the properties of slag, which vary with the source of slag, type of raw material used, method and the rate of cooling. The present work aims at bringing out a novel relationship between the Hydraulic Index (HI) of slag at 7 and 28 days (HI7 and HI28) and the influencing properties of slag, namely, glass content, fineness and chemical composition by employing multiple regression analysis on 37 slag samples from various sources. HI7 and HI28, thus obtained, have been mapped onto a Slag Activity Index (SAI) plot, giving an indication of the ranges of strength. Over all we get good result and showing in result discussion.

Key Words: — ***Cement, Sand, GGBFS.***

I. INTRODUCTION

The reuse of the like waste material found by industries for example glass powder is one of the important issues in many countries due to the increment in solid waste in the environment. The waste glass is considered as an important solid waste that can be found in the majority of world's countries and is being not much affected by weather conditions and its existence leading to environmental problem Caijun et al (2007). Thus, the suitable solutions must be found to overcome this problem.

In Australia, GGBFS has been in use since the mid-sixties1, 2, and 3. Currently, the use of granulated slag that is then ground for use as a supplementary cementitious material is in high demand. Approximately GBFS is further processed into various valued added products, including blended cements manufactured by the major cement producers in Australia as well as being used as a direct addition into concrete4.

Historically slag was utilized in the production of high slag blends for marine and sulphate resistance in major civil works for it is in these applications that the long-term properties of slag cements are ideal.

In recent years, slag use as a supplementary cementitious material in concrete has significantly increased in Australia for general concrete production. This has been both as blended cements in concrete (following AS3972) 5 and as a direct addition into a concrete mix as a supplementary cementitious material (following AS3582.2)6. In addition, sustainability requirements for concrete have also driven the use of GGBFS.

The formation of GGBFS is not direct. The by-product of iron manufacturing is a molten slag and molten iron. The molten slag consists of alumina and silica, also with the certain amount of oxides. This slag is later granulated by cooling it. For this, it is allowed to pass through a high-pressure water get. This result in quenching of the particles which results in granules of size lesser than 5mm in diameter.

The formation of GGBFS is not direct. The by-product of iron manufacturing is a molten slag and molten iron. The molten slag consists of alumina and silica, also with the certain amount of oxides. This slag is later granulated by cooling it. For this, it is allowed to pass through a high-pressure water get. This result in quenching of the particles which results in granules of size lesser than 5mm in diameter. In the concrete manufacturing plant, the GGBFS can be added along with the Portland cement, water and aggregates. The normal ratio of the mixture remains the same. The studies show that the GGBFS can be replaced from 30 to 85 % of the cement weight. Most of the instances we replace 40 to 50%.

II. MIX DESIGN M-30 GRADE

Concrete mix proportioning guidelines according to IS CODE 10262-2009.

International Journal of Progressive Research in Science and Engineering
Volume-1, Issue-9, December-2020
www.ijprse.com

A. A-1 Design a concrete mix for M-30 grade of concrete with the following data:-

a) Grade designation	:M30
b) Type of cement	:OPC 43
c) Maximum nominal size of aggregate	:20mm
d) Minimum cement content	:320Kg/m3
e) Maximum water-cement ratio	:0.45
f) Workability	:100mm(Slump)
g) Exposure condition	:Severe
h) Method of concrete placing	:by Hand
i) Degree of supervision	:Good
j) Type of aggregate	: Crushed angular aggregate
k) Maximum cement content	: 450kg/m3

III. RESULTS AND DISCUSSIONS

Concrete is required to be tested in both fresh and hardened states. Fresh concrete is tested for workability to determine its capacity for satisfactory placing. The analysis of fresh concrete is required to judge the stability that is to identify segregation of the concrete mix, uniformity in mixing and to determine the proportions of the ingredients of concrete actually used. The testing of hardened concrete specimens is required for checking the quality and compliance with the specifications.

To estimate the compressive strength of cement concrete and changes ingredient concrete mixture cubes are prepared. The test procedure for cement and mix sand concrete cubes is same. Compressive strength / flexural test or modular of rupture test has given following results.

A. Procedure for Compression Test of Concrete

- Clean the mould and coat the inside lightly with form oil, then place on a clean, level and firm surface, i.e. the steel plate. Collect a sample.
- Fill 1/2 the volume of the mould with concrete then compact by rodding 25 times. Cube may also be compacted by vibrating using a vibrating table.
- Fill the cone to overflowing and rod 25 times into the top of the first layer, then top up the mould until overflowing.
- Level off the top with the steel float and clean any concrete from around the mould.
- Cap, clearly tag the cylinder and put it in a cool dry place to set for at least 24 hours.
- After the mould is removed the cylinder is sent to the laboratory where it is cured and crushed to test compressive strength.

Fig.1. Preparing of cubes in laboratory and mixing of concrete

Fig.2. Moulded of cubes in laboratory

B. Comparisons between average value of compressive strength with different condition

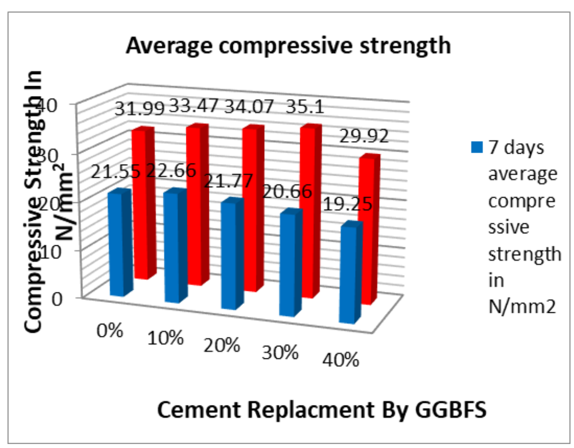

Fig.3. Average Compressive Strength for 7,28days Cement Replacement by GGBFS on Different Percentage

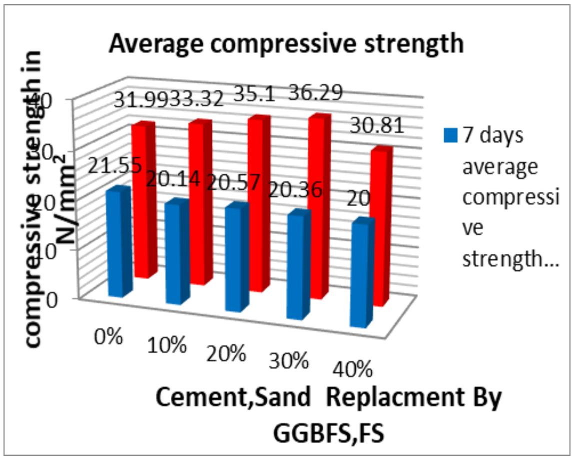

Fig.4. Average Compressive Strength for 7,28days Cement, Sand Replacement by GGBFS, FS on Different Percentage

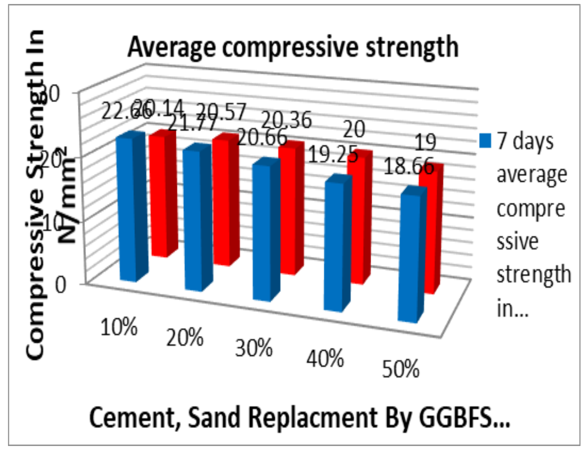

Fig.7. Average Compressive Strength for 7 days Cement and sand Replacement By GGBFS, FS On Different Percentage

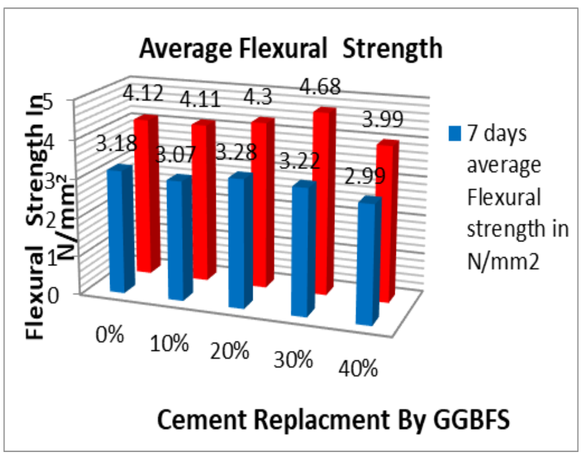

Fig.5. Average Flexural Strength for 7,28days Cement Replacement by GGBFS on Different Percentage

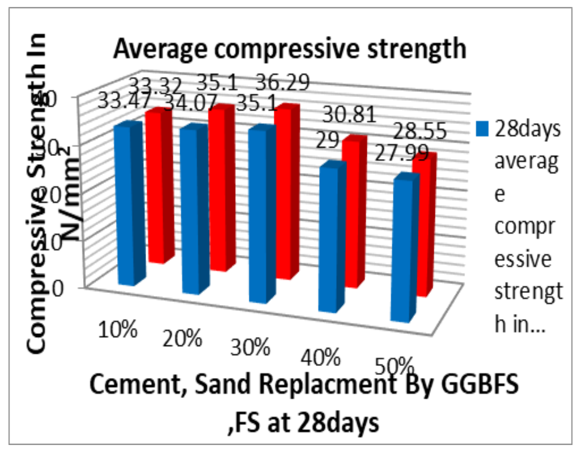

Fig.8. Average Compressive Strength for 28 days Cement and sand Replacement By GGBFS, FS On Different Percentage

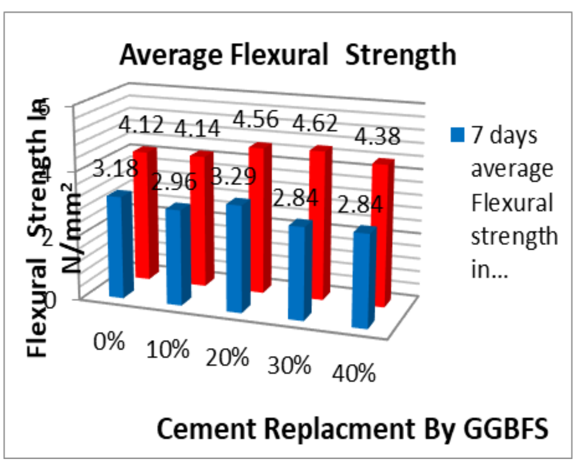

Fig.6. Average Flexural Strength for 7,28days Cement, Sand Replacement by GGBFS, FS on Different Percentage

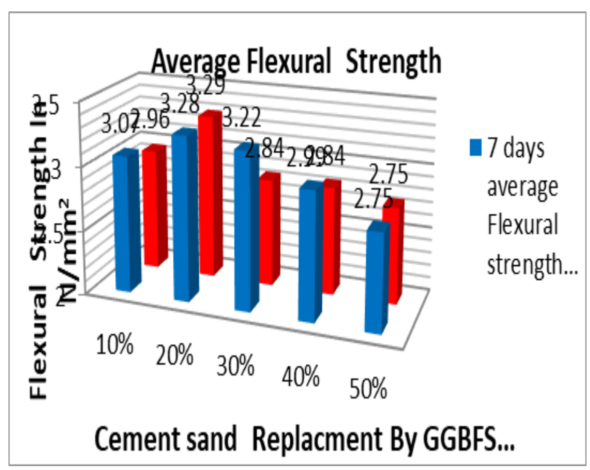

Fig.9. Average Flexural Strength for 7 days Cement and sand Replacement By GGBFS, FS On Different Percentage

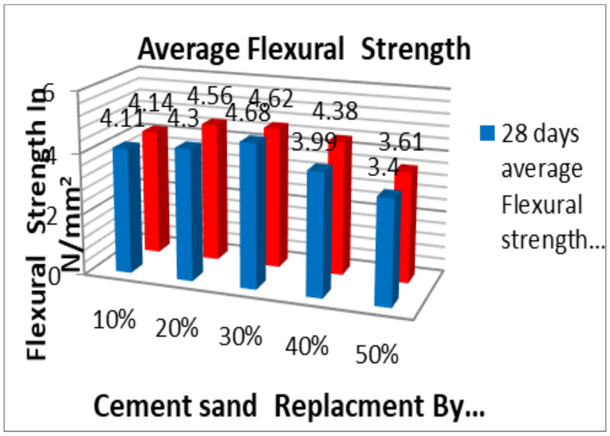

Fig.10. Average Flexural Strength for 28 days Cement and sand Replacement By GGBFS, FS On Different Percentage

IV. Conclusion And Future Scopes

The strength of concrete is determined by using Flexural test and strength test of M30 concrete. Compressive strength, Flexural strength, Split tensile strength and Alkalinity test of concrete mixes made , sand replacement by FS at 10%,20%,30%40% and 50% , have determined at 7 & 28 days. The compressive and flexural strength have determined of 0%, 10%, 20%, 30% and 40% and 50% GGBFS as waste cement replacement in concrete M30 concrete. Results shows that the increase compressive strength of the cement is high as compare to M30 cement concrete. The compressive &flexural strength also determine for M30.

A. *On the basis of the results obtained conclusions can be drawn*

- The mixes of different percentage have increases with cement resulting in higher compressive strength in the concrete mix. In addition, gives different result but in (when we partially replacement of cement by GGBFS its gives different result but at fix percentage) gives good result.
- Same as when sand partially replacement by foundry sand we get good result at fix amount percentage.
- The results clear indicate the compressive strength of the 28 days material is higher as compare to 7 days material. We can say that age of concert.
- Figure shows that the M30 with concrete with when we are mixing the GGBFS dust as cement from 0% to 30% compressive strength for the 7 & 28 days gives good result but 20 % also achieve the good result. Than after 40% and 50% of cement replacement gives bad or decreasing of strength the results clear indicate the strength of the Sample-3, 30% is higher than the 10%, 20%, 40% and 50%.
- Same as in partially replacement of sand by foundry sand, On Figure shows that the M30 with concrete with when we are mixing the foundry sand as sand from 0% to 30% compressive strength for the 7 & 28 days gives good result but 20 % also achieve the good result. Than after 40% and 50% of cement replacement gives bad or decreasing of strength the results clear indicate the strength of the Sample-3, 30% is higher than the 10%, 20%, 40% and 50%.
- In also Figure shows that the M30 material beams tested in flexural test for the 7 & 28 days material. The results clear indicate the strength of the 28 days material is higher as compare to 7 days material.
- If we talk about beam cases it’s not follow compressive strength of cubes. like that when we increasing percentage of replacement in both condition (cement and sand) maximum value on 20% percentage of replacement otherwise failure in the condition 30% ,40% and 50%
- Over all if we changes ingredient of concrete at various percentage, so we adopted 30% of replacement on both condition.

B. *Future Scope*

From this research, there are few recommendations to improve, to extend and to explore the usage of GGBFS or FS, sand and Cement replacement with different waste.

- Determine the durability of concrete with using waste material. If Anywhere we can maintain the partly replacement of sand and cement so we get the good result.
- Add chemical activator into waste glass powder concrete mix for determine the compatibility by observing the compressive strength of the concrete.
- We can Using waste material 15%, 25% with sand replacement gives good result.
- We also used FS at 15%,20% with sand replacement gives good result
- We can Using waste granite dust with basalt stone 15%, 25% with sand replacement gives good result.
- GGBFS in concrete increases the strength and durability of the concrete structure.

- It reduces voids in concrete hence reducing permeability
- GGBFS gives a workable mix.
- It possesses good pump able and compaction characteristics
- The structure made of GGBFS constituents help in increasing sulphate attack resistance.
- The penetration of chloride can be decreased.
- The heat of hydration is less compared to conventional mix hydration.
- The alkali-silica reaction is resisted highly.
- These make the concrete more chemically stable
- Gives good surface finish and improves aesthetics
- Waste glass aggregate may be used with GLP.
- Now the current research the ordinary Portland cement was used. Further, its automatic properties can be compared by using different cement.
- While soda lime glass presents a high alkali contented, utilize of ground waste glass as cement replacement in mortar, improved resistance to ASR.
- Replacement of cement with waste glass powder in different water cement ratio.
- Use of GSW as sand replacement and cement replacement need to be studied with different mix, different curing conditions. Also the other parameters like tensile strength, abrasion of the concrete needs to be evaluated.

REFERENCES

[1]. Divya.M.R1, Shanmuga priya.S2, Anukarthika.B3 Experimental Investigation on concrete with replacement of Fine Aggregates by Foundry Sand and Cement by Cow dung ash, International Journal of Innovative Research in Science, Engineering and Technology, ISSN(Online): 2319-8753, ISSN (Print): 2347-6710.

[2]. Dsouza, V., 2017. Evaluation of Strength Properties of Concrete by Partial Replacement of Natural Sand with Foundry Sand. Evaluation.

[3]. SaritaChandrakanth and Ajay.A.Hamane, "Partial Replacement of Waste Foundry Sand and Recycled Aggregate in Concrete", International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 4 Issue V, May 2016, 98 ISSN: 2321-9653.

[4]. Carey, P.R. and Sturtz, G., 1995. Sand binder system. IV. Urethane binders. Foundry Manage. Technol. (USA), 123(6), pp.25-29.

[5]. Celik, T. and Marar, K., 1996. Effects of crushed stone dust on some properties of concrete. Cement and Concrete research, 26(7), pp.1121-1130.

[6]. Colombo, P., Brusatin, G., Bernardo, E. and Scarinci, G., 2003. Inertization and reuse of waste materials by vitrification and fabrication of glass-based products. Current Opinion in Solid State and Materials Science, 7(3), pp.225-239.

[7]. Cyr, M., Coutand, M. and Clastres, P., 2007. Technological and environmental behavior of sewage sludge ash (SSA) in cement-based materials. Cement and Concrete Research, 37(8), pp.1278-1289.

[8]. D.A.R. Dolage, M.G.S. Dias, C.T.Ariyawansa, Offshore sand as a fine aggregate for concrete, Production 3 (2013) 813–825.

[9]. Dayton, E.A., Whitacre, S.D., Dungan, R.S. and Basta, N.T., 2010. Characterization of physical and chemical properties of spent foundry sands pertinent to beneficial use in manufactured soils. Plant and soil, 329(1-2), pp.27-33.

[10]. Deng, A. and Tikalsky, P., 2006. Metallic characterization of foundry by-products per waste streams and leaching protocols. Journal of Environmental Engineering, 132(6), pp.586-595.

[11]. Deng, A. and Tikalsky, P.J., 2008. Geotechnical and leaching properties of flowable fill incorporating waste foundry sand. Waste Management, 28(11), pp.2161-2170.