



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 11, Issue 1, January 2022

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.569

9940 572 462

6381 907 438

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Review on GGBS as Partial Replacement of Cement in Concrete

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ABSTRACT:- Concrete is the most widely used construction material in civil engineering industry because of its high structural strength and stability. The concrete industry is constantly looking for supplementary cementitious material with the objective of reducing the solid waste disposal problem. The production of cement releases large amount of carbon dioxide gas into the atmosphere, a major contribution of greenhouse effect and the global warming. To overcome these problems there is a need of cost effective, alternative and innovative materials. In this project a comprehensive effort is made to partially replace the cement by ground granulate blast furnace slag (GGBS) as an alternative in combination with concrete admixture, for concrete ingredients which shall lead to global sustainable development and lowest possible environment impact and will also reduce cost of construction as well.

I. INTRODUCTION

Concrete is a heterogeneous mixture of cement, aggregates and water. The global consumption of cement is too high due to its extensive use in concrete. The demand for cement is quite high in developing countries owing to rapid infrastructural growth which results in supply scarcity and produce environmental of cement. The concrete industry is constantly looking for supplementary cementitious material with the objective of reducing the solid waste disposal problem. To overcome from this crisis, partial replacement of cement with GGBS is an economic alternative. Ground granulated blast furnace slag (GGBS) is 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 as partial replacements for cement and sand in concrete. In this research we prepared specimen of cubes for compressive strength test. Three samples for each set of percentage have been taken for conducting test and average of results are taken. The samples were tested at the age of 3 days, 7 days, 28 days and 56 days.

1.2 Aims and Objectives:- The main aim of this study is to study the performance of concrete on replacement of cement with ground granulated blast furnace slag.

- To replace the cement in concrete with GGBS by 30 percent and 40 percent.
- Comparison of the results.

1.3 SCOPE:-From structural point of view. GGBS replacement enhances lower heat of hydration, higher durability and higher resistance to sulphate and chloride attack when compared with normal ordinary concrete. On the other hand, it also contributes to environmental protection because it minimizes the use of cement during the production of concrete. GGBS can be used to make durable concrete structures in combination with ordinary Portland cement and/or other pozzolanic materials.

It can be used in structures to avoid cracks due hydration process like water retaining structures which should be leakage proof.

It can be used in areas where steel industrial waste disposal is a major problem.

It can be also used in hot country where there is problem of rapid reduction of setting time.



II. LITERATURE REVIEW

O. Ettu, O. M. Ibearuglem, J. C. Ezeh, and U. C. Anya Department of Civil Engineering, Federal University Of Technology, Owerri, Nigeria carried out the study on the suitability of using Laterite as sole Fine Aggregate in Structural Concrete.

This study investigates the suitability of laterite as sole fine aggregate in place of sand, and specifically seeks to determine whether laterized concrete would satisfy the minimum compressive strength requirement of BS 8110 (1997) for use in reinforced concrete works, which is 25 N/mm²

Compressive cube strength and saturated dry (SSD) bulk density tests were conducted in conformity with BS 1881: part 115 (1986). Batching was by weight. Forty mix ratios of water: cement: laterite: granite were used. The Scheffe Simplex Optimization design method aimed at achieving the minimum target strength of 25N/mm² specified by BS 8110(1997) was employed as a guide for choosing the mix ratios.

Laterized concrete has a lower unit weight than traditional concrete, it would be more suitable for use in communities with problematic soils that have poor or unreliable bearing capacities. Moreover, the prevalence of laterite in most communities also means the use laterized concrete would greatly contribute toward the provision of low cost housing units for the rapidly increasing population in major urban cities.

The results show that the average SSD density of the laterized concrete(concrete with laterite as sole fine aggregate) is approximately 2328 Kg/m³ or 22.81 KN/m³. This value is reasonably lower than the average value of 24KN/m³ for traditional concrete produced with cement, sand, and granite. Thus, laterized concrete would produce structural members with lower self-weight than traditional concrete. Also, a good number of the mix ratios had compressive cube strengths higher than or very close to the 25N/mm² bench mark of BS 8110.

2.2

Olubisi A. Ige Department Of Civil Engineering, Osun State Polytechnic, Iree carried out a study on performance of lateritic concrete under environmental harsh condition.

This study, which studies the performance of lateritic concrete under environmental harsh condition, form part of the efforts aimed at fully intergrating laterized concrete for structural use in construction works. This was done by subjecting laterized concrete to varying temperatures, chemicals such as magnesium sulphate(Mg₂SO₄) and alternate wetting and drying, while still varying laterite-sharp sand ratio as fine aggregate.

Batching of materials was done by weight using semi-automatic scale at the 20kg range. The manual method of mixing, using shovels and trowels, was adopted while the mix ratio used was 1:2:4. The sand-laterite ratio used as fine aggregate were 0, 10, 20, 30, and 40%, this was to ascertain the range of combination that will give optimum compressive strength. The Mixing was done such that the dry components were mixed until a satisfactory uniform color was obtained with desired water being added gradually to the mixed dry components and thorough mixing done to give a workable concrete. The moulds(150 x 150 x 150)mm³ were used in casting the cubes.

After each cube had been subjected to the desired conditions, their crushing loads were determined using the AveryDenilson Testing Machine.

The influence of high temperature, chemical and alternating wet and dry condition on the compressive strength of laterized concrete has been investigated. It was found that for laterized concrete mix 1:2:4 and curing age of 28 days, with laterite fine aggregate ratio variation as a factor, 20% replacement of fine aggregate by laterite had a reasonable compressive strength for temperature applications up to 100°C where as plain concrete and other percentage replacement suffered a reduction.

2.3

K. Muthusamy, N. W. Kamaruzaman, Mohamed A. Ismail and A. M. A. Budiea carried out a study on the durability performance of concrete containing laterite aggregates.

In their study they observed that the use of 20 to 30% of laterite aggregates, as partial replacement for coarse aggregate content on the durability performance of this concrete is unknown. As such the acid resistance and water absorption of concrete consisting of various percentage of laterite aggregates, integrated as partial replacement of coarse aggregates were prepared in the form of cubes (150 x 150 x 150mm). After water curing for 28 days, the specimens were tested for the determination of compressive strength and durability against acid attack and water absorption.



Material used in this study were ordinary Portland cement, granite aggregates, laterite aggregates, super plasticizer and tap water.

A single batch of Ordinary Portland Cement(OPC0 , that conforms to ASTM C150(2012), was used as a binder for producing the concrete specimens.

Acid Resistance Test

The durability of the concrete against acid attack was investigated using a similar experimental approach to that of Awal(1998) and the durability test was carried out by immersing the cubes in 5% Hydrochloric Acid Solution(HCL) for 1800h. The pH of the solution was maintained at about 2 throughout the immersion period. Moreover, the durability performance of both the plain and laterite concrete mixes was determined by measuring the loss of mass and the reduction in compressive strength.

The results show that the slump value decreases with increasing percentage of laterite. This result indicates that the concrete becomes less workable as the amount added laterite aggregates increases. Therefore, a larger amount of water is needed in order to make the mixes more workable. The workability of the laterite concrete mix is reduced probably as result of the higher rate of water absorption of these aggregates, which have higher porosity, compared to their granite counterparts.

Losses of mass and strength are clear indicators of acidic attack(Zivica and Bajza,2001)

2.4

S. Pavia and E. Condren carried out the study on Durability of OPC versus GGBS Concrete on Exposure to Silage Effluent

Concrete used to build silage silos undergoes severe chemical attack over its lifetime. This damage invariably costs a lot of money to repair and, hence, research is needed in order to find a more durable concrete in this environment.

In order to compare the durability OPC and GGBD mortars, samples of different mix proportions were exposed to silage effluent. There 28-day cycles of effluent exposure were repeated over a 4-month period. In order to determine the rate of deterioration following each cycle, the mortars were tested for permeability, capillary suction, water absorption and mass loss. Durability test by salt crystallization and compressive tests were also carried out.

This paper has evidenced that PC composites incorporating GGBS are more durable than those made with PC alone in aggressive environments under the action of acids and salts such as those produced by silage and that durability increased with increasing amount of GGBS. GGBs Mixes showed the smallest progressive rise in permeability, water absorption and capillary suction as a result of silage immersion and salt cycling, as well as the smallest mass and compressive strength loss. Therefore, a more durable concrete mix for agricultural use in silos can be specified by incorporating GGBS as a partial substitute for OPC.

2.5 Sonali K. Gadpalliwar, R. S. Deotale, Abhijeet R. Narde carried out the study on the partial Replacement of Cement by GGBS & RHA and Natural Sand by Quarry Sand In Concrete.

The M40 mix proportion is designed as per guidelines, according to the Indian Standard Recommended Method IS 10262-2009. The total binder content was 400Kg/m³, fine aggregate is taken 668.9525 Kg/m³, coarse aggregate is taken 1301.122 Kg/m³. The super plasticizer content was varied to maintain a slump of 60 mm for all mixtures. This research is carried out in three phase, in first phase mix of M40 grade concrete with replacement of 0%,15%,30%,45%,60%,&5%,90% and 100% of quarry sand with natural sand is carried out to determine the optimum percentage of replacement at which maximum compressive strength is achieved. In second phase, cement is partially replaced with GGBS by 10%, 20% and 30%. Concrete acquires maximum increase in compressive strength at 60% quarry sand replaced by natural sand for M40 grade of concrete. This mix is named as critical mix. Good compressive strength is obtained when 22.5% GGBS + 7.5% RHA is replaced with cement and natural sand is replaced by 60% quarry sand.

Durability test carried out in the investigation through acid attack test and chloride test with 1% sulphuric acid and 3% hydrochloric revealed that 22.5% GGBS + 7.5% RHA replaced with cement and 60% sand replaced with natural sand in concrete is more durable in terms of durability factors than control mix.



Methodology And Design Of Experimental Setup:-

The following flow chart shows the methodology or the process we'd be following in the project.

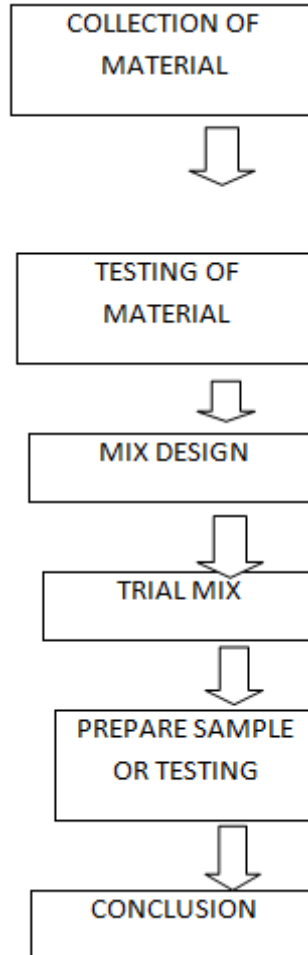


Figure 1: The Flow Chart of Methodology

Collection of material and testing of materials

For making concrete and project required material will be collected nearby sources. Collected material will be tested by following guidelines or codes-

Table 1: For Cement

Sr. No.	Test	Test Method/ IS Code for testing
1	Consistency Of Cement	IS: 4031 (pt-4) :1988
2	Finesses	IS: 4031 (pt-2) :1988
3	Initial And Final Setting Time	IS: 4031 (pt-5) :1988
4	Destiny Of Cement	IS: 4031 (pt-11) :1988
5	Compressive strength	IS: 4031 (pt-6) :1988

Table 2: For aggregates course and fine

Sr. No.	Test	Test Method/ IS Code for testing
1	Sieve Analysis	Is 2386 (pt-1): 1963
2	Specific Gravity	Is 2386 (pt-1): 1963
3	Water Absorption	Is 2386 (pt-1): 1963
4	Bulk Density	Is 2386 (pt-1): 1963
5	Flakiness Index(Course)	Is 2386 (pt-1): 1963
6	Elongation Index (Course)	Is 2386 (pt-1): 1963
7	Crushing Value (Course)	Is 2386 (pt-4): 1963
8	Impact Value	Is 2386 (pt-4): 1963
9	Material Finer Than 75 μ	Is 2386 (pt-2): 1963

GGBS-bs 6699-1992 SPECIFICATION OF ggbs USE WITH ORDINARY Portland cement

Mix design

By studying the property of materials test results conducted on in, the mix design will be prepared as per following codes-

IS 10262-2009 recommended guidelines for concrete mix designs.

Is 456-2000 code of practice for plain and reinforced cement concrete.

Trial Mix

The purpose of concrete trial mixes is to enable you to check that the strength, workability, density and other properties of concrete. Trails mixes are often undertaken when new materials or admixture are to be used. Trials are also undertaken when setting up batch data, trial mixes can help you maximize all materials in mixes.

Preparing sample for test

Placing

Concrete is placed in the molds using a trowel in three layers of approximately equal depth and is remixed in the mixing pan with a shovel to prevent segregation during the molding of specimens.

The trowel is moved around the top edge of the mold as the concrete is discharged in order to ensure a symmetrical distribution of the concrete and to minimize segregation of course aggregate within the mold.

Roding (Compaction)

Compaction is the removal of air from fresh concrete. Proper Compaction results in concrete with an increased density which is stronger and more durable. Concrete is placed in the mold, in three layers of approximately equal valume. Each layer is compacted with 25 strokes with the rounded end of the rod. The strokes are distributed uniformly over the cross section of the mold and for each upper layer.

Curing

Curing means to cover the concrete with a layer of water, so it stays moist. BY keeping concrete moist, the bond between the paste and the aggregates get stronger. Concrete doesn't harden properly if it is left to dry out. Curing is done just after finishing the concrete surface, as soon as it will not be damaged. The longer concrete is cured, the sufficiently is less likely to crack. The specimens are removed from the molds 24 hours after casting. Specimens are placed immediately in water after removal from the molds to prevent loss of moisture from specimens.

Testing

Testing will be performed on cubes with three, seven, twenty eight and fifty six days of curing. Concrete mixes containing 50% GGBS and 100% quarry sand replacement level were cast before subjected to water curing for 3, 7, 28, 56 days compressive strength test. The results will be compiled in tabular form with each property represented on a graph to show variance as mix design changes.

For compressive strength we will use IS 516:1959.

Conclusion

As per the test results, calculations will be done and graphs would be plotted and according to that conclusion would be given.



Month Wise schedule

Oct. 2021

In Oct. testing of material such as cement aggregate and GGBS will be done. By studying test results the mix design will be finalized.

Nov. 2021

First week of Nov. trial mixes will be conducted and casting of cubes will be done before second week. Curing of 3 days, 7 days and 28 days cubes will be done. Testing of cubes will be done and test results shall be compiled and data received shall be organized to reflect the need of the study, calculation and graphs shall be conducted, this phase is subject to availability of test apparatus and dates available for use of testing apparatus.

Dec. 2021

All result data compiled and calculated shall be represented as a formal report along with the conclusion gathered from the results.

REFERENCES

1. The suitability of Using Laterite as Sole Aggregate in Structural Concrete L. O. Ettu, O. M. Ibearugbulem, J. C. Ezech, and U. C. Anya Department Of Civil Engineering, Federal University Of Technology, Owerri, Nigeria.
2. Performance of lateritic concrete under environmental harsh condition Olubisi A. Ige Department of Civil Engineering, Osun State Polytechnic, Iree.
3. Durability performance of Concrete Containing Laterite Aggregates K. Muthusamy, N. W. Kamaruzaman, Mohamed A. Ismail, and A. M. A. Budiea.
4. The potential of Laterite as Fine Aggregate In Foamed Concrete Production Funso Falade, Department of Civil Engineering and Environmental Engineering, University Of Lagos, Akoka, Lagos, Nigeria.
5. Partial replacement of natural river sand with crushed rock sand in concrete production
6. Department Of Civil, Conctruction and Environmental Engineering,
7. Jomo Kenyatta University of Agriculture & Technolgy.
8. Concrete Mix Desing- Dr. M. C. Nataraja Professor of Civil Engineering.
9. IS 516 (1959) Methods of test for strength of concret.



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