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Experimental Studies on Strength Properties of Concrete with Partial Replacement of Cement by GGBS

Amaresh Kumar Singh[1], Mithun Kumar Rana[2], Pushpendra Kumar Kushwaha[3]
[1]*M. Tech. Research Scholar, Civil Department, RKDF College of Engineering, Bhopal (M. P.), India*
[2]*Assistant Professor, Civil Department, RKDF College of Engineering, Bhopal (M. P.), India*
[3]*Assistant Professor, Civil Department, RKDF College of Engineering, Bhopal (M. P.), India*

Abstract: ***Countries like India and China are facing problem of pollution due to large construction works in recent times. Ordinary Portland cement which is used in Concrete releases plethora of carbon dioxide (CO2) in atmosphere during manufacturing. This paper presents an experimental study of compressive and flexural strength of concrete prepared with Ordinary Portland Cement, partially replaced by ground granulated blast furnace slag in different proportions varying from 0% to 50% of GGBS Concrete for M25 and M40 grade of concrete at room temperature for 7 ,14 and 28 day respectively. From the experiment I was found that Compressive strength and Flexural strength of GGBS concrete increased at 40 % of GGBS and further addition of GGBS, concrete showed marginal decrease in compressive and flexural strength.***
Keywords: Cement, Natural Sand, GGBS and Aggregate, Portland cement, Geo polymer

I. INTRODUCTION FLY GGBS

A. Ground Granulated blast Furnace Slag

Ground granulated blast furnace slag (GGBS) is a byproduct of iron industry. Iron ore, coke and limestone are fed into the furnace to produce iron, and the resulting flowing slag floats above the molten iron at a temperature of about 1500ºC to 1600ºC. The melted slag has content 30-40% silicon dioxide (SiO2) and approximately 40% calcium oxide (CaO), which is close to the chemical configuration of OPC.

II. LITERATURE REVIEW

A. Literature Review

GGBS in five separate ratios to make geopolymer concrete mixes. Geopolymer concrete with a higher proportion of GGBS (slag) has a higher compressive strength. In just 14 days, 90 percent of compressive strength was reached. Ganapati Naidu et al., 2012.

The effect of NaOH concentration on the strength of geopolymer concrete based on GGBS and BRHA was investigated (Gokulanathan V et al. Nov 2013). The tests were carried out with different molar concentrations of sodium hydroxide (NaOH) such as 5M, 8M, 11M, and black rice husk ash being substituted at 10%, 20%, and 30% of total binder content, respectively.

Binding ingredients include ground granulated blast furnace slag (GGBS), palm oil fuel ash (POFA), and fly ash. The optimum amount of GGBS, low calcium fly-ash, and POFA with processed sand (M-sand) to achieve maximal compressive strength of geopolymer mortar was determined through an experimental investigation (Islam Azizul et al. Dec 2013).

High strength alkali activated binder was produced by alkali activation of binary mix of ground granulated blast furnace slag (GGBS) and palm oil fuel ash (POFA) at ambient temperature (MoslihAmerSalih et al. June 2020).

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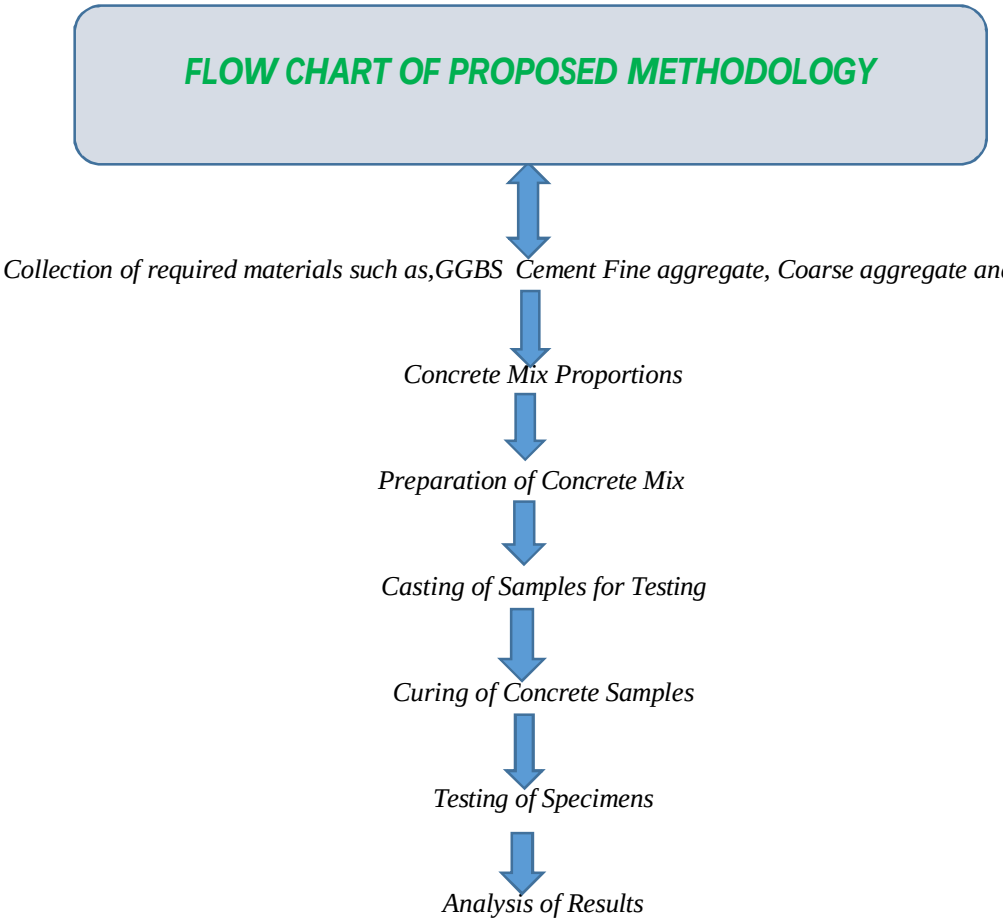
III. OBJECTIVE

A. The objectives of this study are:
B. To make a concrete without using cement (i.e. Geopolymer concrete).
C. To develop a mix proportioning process to manufacture GGBS based Geopolymer concrete.
D. To identify and study the effect of some of the salient parameters such as Compressive strength and flexile strength of geopolymer concrete (GGBS)
E. To find the optimum percentage of GGBS to get maximum strength

IV. MATERIALS AND METHODOLOGY

A. Material
1) Cement
2) Fine aggregate
3) Coarse aggregate
4) Water
5) Admixtures
6) GGBS



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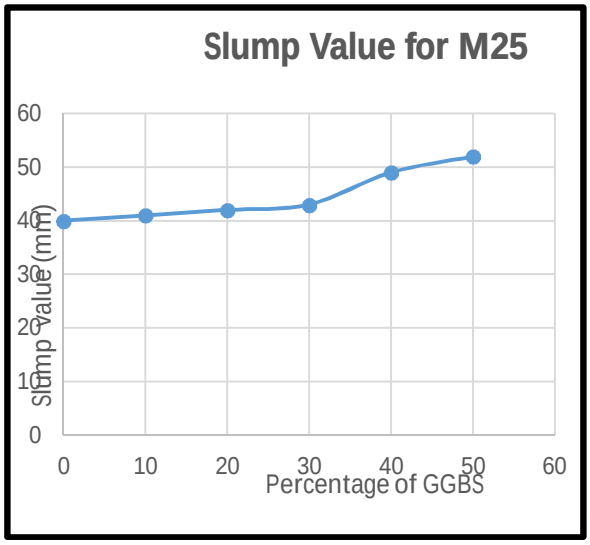
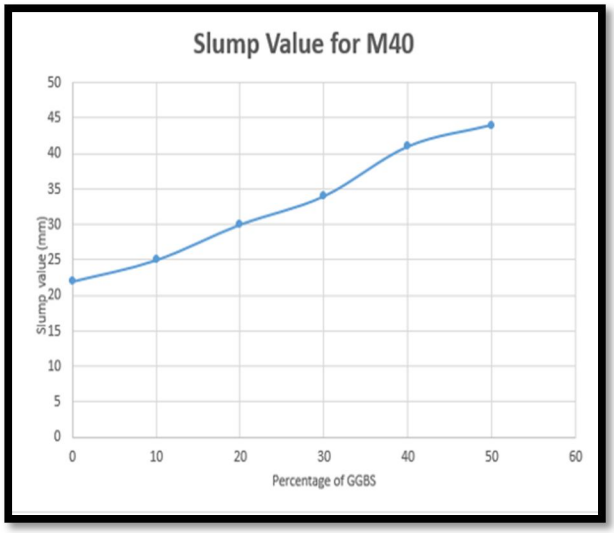
V. EXPERIMENTAL RESULT

A. *Workability test Results*





B. *Compressive Strength Test Results*

To study the effect of variation of percentage of GGBS on compressive strength of geo polymer concrete, standard cube specimens of dimension 150×150×150 mmwere prepared and tested in accordance with IS specifications. The percentage of GGBS used in geopolymer was 0 to 50 %. All the specimens were cured in direct sun light then tested for compressive strength.

Compressive Strength of concrete for M40 after 7,14,28 day

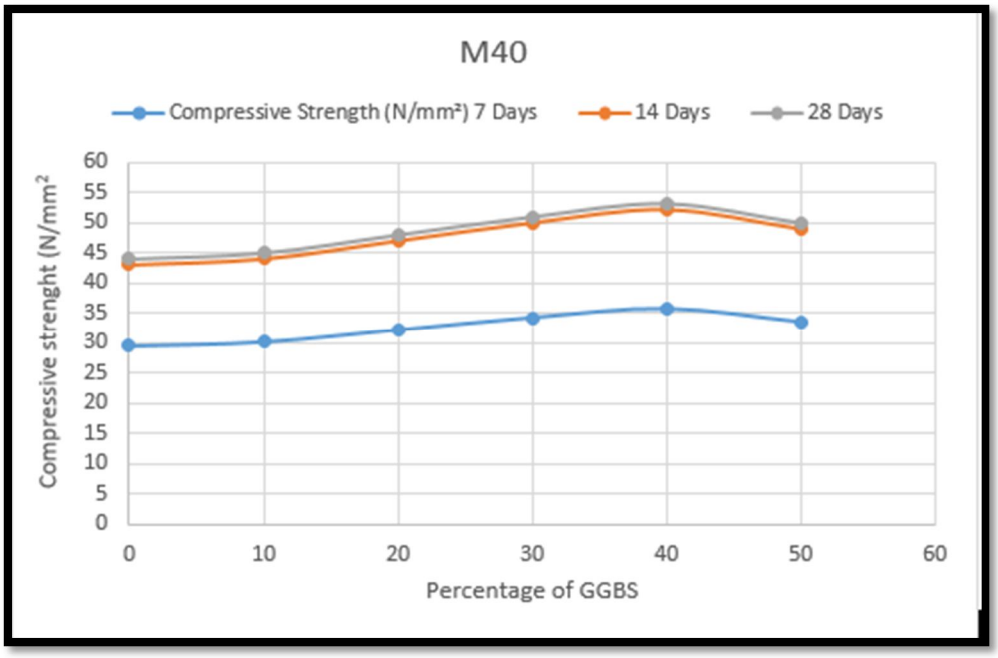


Figure Compressive Strength of concrete for M40 after 7,14,28 day

Compressive strength of GGBS based GPC increased with increase percentage of GGBS. The GGBS based GPC mixes developed compressive strength in the range of 16.58MPa to 24MPa in 7days, for GGS varying from 0to50% respectively. It achieved strength ranging from 21.9MPa to 32.12MPa at the age of 14 days; at the age of 28 days strength obtained is 25MPa to 36.42MPa for M25. .For M25 Maximum Compressive strength Value is 36.45MPa and 53.2 MPa for M40

VI. CONCLUSION

Conclusions from experimental study carried out on GGBS based GPC are listed below-

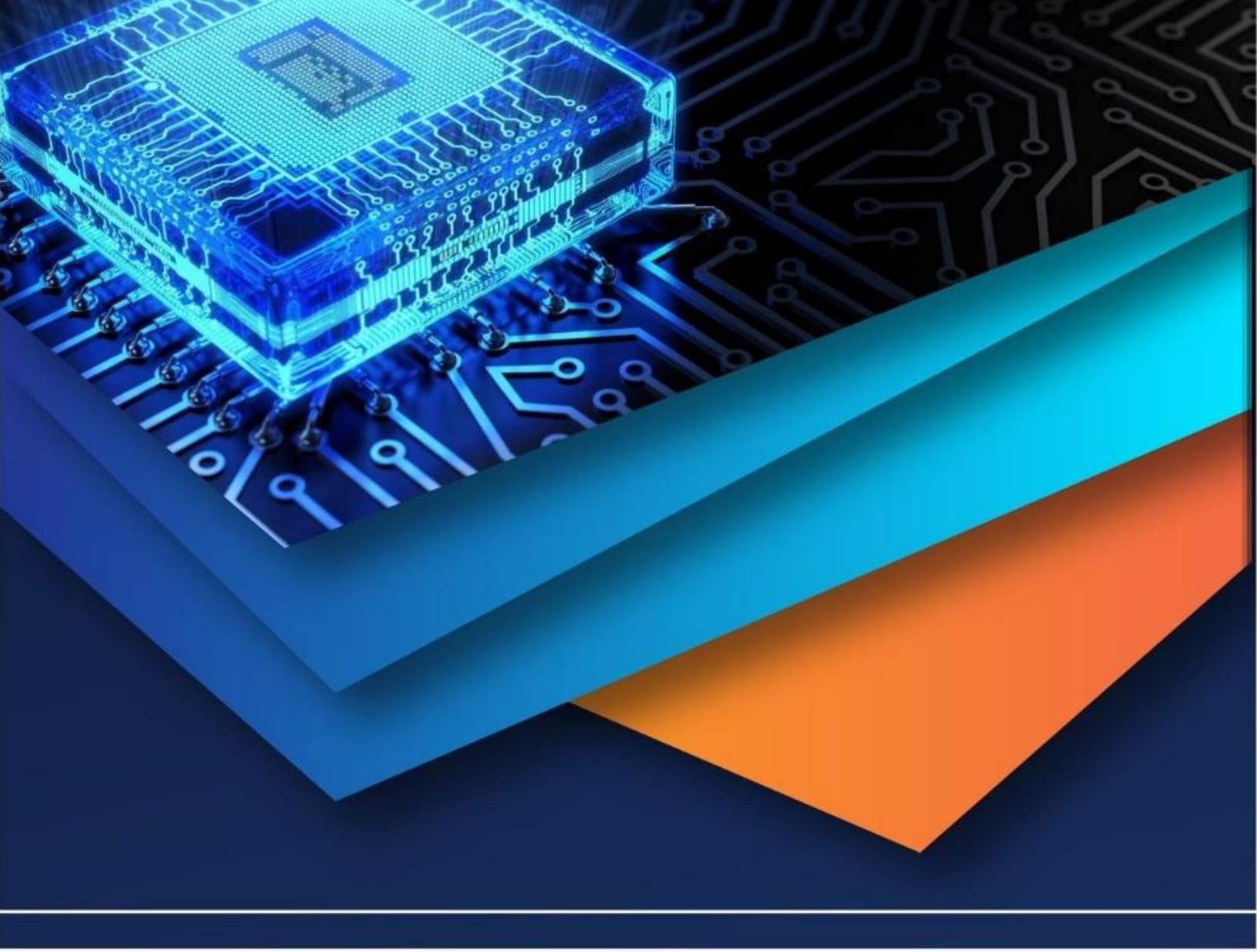
1) GGBS based GPC can be produced using technology and equipment's used for the manufacturing of conventional concrete.

2) GGBS based geo polymer concrete is very less workable. Workability of GPC mix decreased with increase of percentage of GGBS .

3) Compressive strength of GGBS based GPC increased with increase percentage of GGBS. The GGBS based GPC mixes developed compressive strength in the range of 16.58MPa to 24MPa in 7days, for GGS varying from 0 to 50% respectively. It achieved strength ranging from 21.9MPa to 32.12MPa at the age of 14 days; at the age of 28 days strength obtained is 25MPa to 36.42MPa for M25. .For M25 Maximum Compressive strength Value is 36.45MPa and 53.2 MPa for M40

REFERENCES

[1] Alwis Deva Kirupa J. P. and Sakthieswaran N. (Nov 2015), "Strength and stability characteristics of GGBS and red mud based geopolymer concrete incorporated with hybrid fibers" ICJ pp 66-72.
[2] Bonder D., Lynsdale C.J., Milestone Neil B., Hassani N. and Ramezanianpour A.A. (Nov 2010), "Effect of type, form and dosage os activators on strength of alkali-activated natural pozzolans" Cement and Concrete Composites 33, pp 251-260.
[3] C. S. Maneesh Kumar, G Manimaran and S Prasanth (May 2015), "An Experimental Investigation on GGBS and fly ash Based geopolymer Concrete With Replacement of Sand by Quarry Dust" IJERA vol 5, pp 91-95.
[4] Cheng, T. W. and J. P. Chiu, "Fire-resistant Geopolymer Produced by Granulated Blast Furnace Slag" Minerals Engineering □□(3), 2003, pp. 205-210.
[5] Davidovits J. (1994), "Properties of Geopolymer Concrete" published in proceedings first International Conferemnce on Alkaline Cements and Concretes, Scientific, Research Institute on Binder and Materials, Kiev state university, Kiev, Ukraine, pp 131-149.
[6] Deb ParthaSarathi , NathPradip, Kumar SarkerPrabir (May 2014), "The effects of ground granulated blast-furnace slag blending with fly ash and activator content on the workability and strength properties of geopolymer concrete cured at ambient temperature" Materials and Design 62, pp 32-39.
[7] Fernandez-Jimenez A., Garcia-Lodeiro, I. and Palomo A. (2007), "Durability of AlkaliActivated Fly Ash Cementitious Materials", J Mater Sci, 42, pp 3055-3065.
[8] Glukhosky V.D. (1981), "Slag alkali concrete produced from fine aggregates" Kiev: VishchaShkolay.
[9] GokhanGorhan and GokhanKurklu (Nov 2013), "The Influence of NaOH Solution on the Properties of Fly Ash Based Geopolymer Mortar Cured at Different Temperatures" ELSEVIER, Composites: Part B 58, pp 371-377.
[10] Gokulanathan V., PrasannaVenkatesan R. and Pazhani K.C., (Nov 2013), "Effect of NaOH Concentration on Strength of GGBS and BRHA Based Geopolymer Concrete" RECENT SCIENCE PUBLICATIONS ARCHIVES
[11] Hardjito D., Wallah S.E., SumajouwDody M.J. and Rangan B.V. (Dec 2014), "Technical paper On the Development of Fly Ash Based Geopolymer Concrete" ACI materials Journal V.101, no. 6, pp 467-472.
[12] Hilbig H. and Buchwald A. (Sep 2006), "The Effect of Activator Concentration on Reaction, Degree and Structure Formation of Alkali Activated Ground Granulated Blast Furnace Slag" J Mater Sci 41, pp 6488-6491.
[13] Indian standard code of practice, Method of sampling and analysis of concrete IS: 1199- 1959, Reaffirmed 2004, BIS New Delhi, India.
[14] Indian standard code of practice, Methods of Test for strength of concrete, IS: 516-1959, Reaffirmed 2004, BIS New Delhi, India.
[15] Indian standard code of practice, splitting tensile strength of concrete- method of test IS: 5816-1999, Reaffirmed 2004, BIS New Delhi, India
[16] Islam Azizul, Johnson Alengaram U., ZamitJumaatMohd., Ibnul Bashar Iftekhair, AlamgirKabir S. M. (Dec 2013)), "The development of compressive strength of ground granulated blast furnace slag-palm oil fuel ash-fly ash based geopolymer mortar" Materials and Design 56, pp 833-841.
[17] Joshi S.V. and Kadu M.S.(Oct 2012), "Role of Alkaline Activator in Development of Ecofriendly fly ash based Geopolymer Concrete" International Journal of Environmental Science and Development, vol 3, pp 417-421.
[18] Khale, Divya, Chaudhary and Rubina (2007), "Mechanism of Geopolymerization and Factors Influencing Its Development: A Review" J Mater Sci 42, pp.729-746.



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