iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** III **Month of publication:** March 2023

DOI: https://doi.org/10.22214/ijraset.2023.49435

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue III Mar 2023- Available at www.ijraset.com

Properties of High volume GGBFS and High Volume Flyash Concrete: A Brief Review

Sachin J. Pandhare[1], Dr. Mrs. Geetha K. Jayaraj[2]
[1]*PG Student of ME Construction Engineering and Management, Department of Civil Engineering, Shivajirao S Jondhle College of Engineering and Technology, Asangaon, Dist Thane, Maharashtra, India*
[2]*Principal, Shivajirao S. Jondhle College of Engineering &Technology, Asangaon, Dist Thane, Maharashtra, India*

Abstract: In India, the annual production of GGBS is 15 million tons and only 55% of GGBS is used in the construction industry. It is therefore important to increase the use of industrial waste on a larger scale for environmental benefits in the concrete industry. Numerous studies have been performed on these SCMs to evaluate the properties of his GGBS-containing concrete in fresh and cured states. Using by-products of the slag industry to higher replacement levels for cement could significantly reduce the price of concrete. Paving economical and environmentally friendly concrete Green house gas (GHG) emissions are effectively reduced by 47.5% by using GGBS as a cement substitute. India is the largest producer of fly ash. In one year he produces more than 112 million tons of fly ash. 60-70% of the fly ash is consumed and the rest is spread over the ground. This is because the government encourages the use of his 100% fly ash to avoid landfills and create a greener environment.
Keywords: GGBFS, Fly ash, Durability, Concrete.

I. INTRODUCTION

The effects of GGBS and Flyash on concrete produce characteristics that make it both fresh and hardened, including workability, a reduction in fresh concrete bleeding, a reduction in hydration heat, long-term strength, corrosion resistance, reduced porosity, and permeability, among others. In order to create durable and sustainable concrete, different durability properties of high-volume ground-granulated blast-furnace slag (GGBFS) and Flyash mixtures were evaluated in this review paper.

II. CEMENTITIUS MATERIAL

A. Ground Granulated Blast Furnace Slag (GGBFS)

Ground-granulated blast-furnace slag (GGBFS) is produced by quenching molten iron slag from a blast furnace in water or steam to create a glassy, granular product that is then dried and ground into a fine powder. GGBFS has a specific gravity of approximately 2.81 g/cm3. The Blaine specific surface area of the GGBFS is approximately 4250 cm2/g. based on ASTM C 989.GGBFS that was used was a fragment in category 80. Since GGBS contains much less calcium than cement, it will take longer for GGBS concrete to gain strength of concrete.

B. Fly ash

Fly ash can be added to Portland cement concrete to enhance performance. Fly ash, which is primarily generated by coal-fired power plants, is one of the more well-known pozzolanic materials. The specific gravity of fly ash is 2.14.Fly ash comes in two distinct varieties, Class C and Class F. In this study, Class F fly ash is used as a cement substitute.

III. LITERATURE REVIEW

A. A. Elahi,et,al(2010)[1]

research was done on the mechanical and durability characteristics of concretes produced with additional cementitious materials. Silica fume, fly ash, and powdered, granulated blast-furnace slag were used in SCM. Fly ash up to 40%, silica fume up to 15%, and GGBS up to a level of 70% were used to substitute Portland cement. As a consequence of the experiment, silica fume produced the best results. The finest ternary mixes to prevent chloride diffusion include silica fume and ground granulated blast-furnace slag/fly ash. ageing causes all mixtures' air conductance to decrease. With Sage, all of the mixtures had less sorptivity (the ability to absorb water). The barrier to chloride diffusion in every mix using cement substitutes was at least three times higher than in the control mix. The resistivity of the FA and GGBS mixtures was raised by the inclusion of Silica Flume.

B. A. H. L. Swaroop, et al.(2013) [2]

Effect of OPC substitution with flyash and ggbs was researched. Each Flyash and GGBS concrete has been completed and evaluated for properties like weight compressive strength and durability, replacing 20 and 40% of OPC, respectively. The compressive strength of concrete made with Flyash and GGBS is found to be greater than that of the control blend. In comparison to GGBS concrete, the resilience of flyash concrete is consistently higher. 40% Flyash mix weight reduction is greater than all mixes when specimens are cured in sea water. In comparison to other mixtures, GGBS mixes had good durability characteristics. Strength was found to decline when 40% flyash was used, so it is advised that OPC replacement be done with flyash between 20 and 40% but not more than that.

C. Gengying Li & Xiaohua Zhao.(2003) [3]

GGBS and Flyash concrete were researched. attain significant compressive strength early. Additionally, long-term tensile strength growth was noted. Concrete made with GGBS and Flyash has great resistance to assault. The control blend experiences weight change before the GGBS and flyash mixes. Large volume flyash concrete hydrates more slowly than GGBFS concrete.

D. Hosam El-Din H. Seleem,et,al(2010) [4]

In this paper examined concrete's ability to withstand seawater using a mixture of metakaolin(MK), silica flume(SF), and Ground granulated blast furnace slag(GGBFS) mixes. For periods of 3, 6, and 12 months, all samples were maintained in seawater conditions.

Testing was done on compressive strength, permeability, and resistance to chloride entry. All pozzolanic concrete mixtures have strong compressive strengths regardless of age. All pozzolanic compounds have been found to decrease the permeability of concrete.

The best substance for blocking chloride infiltration is silica dust. The metakaolin combination, however, performs less well in blocking chloride penetration. Additionally, GGBS were discovered to be less porous than other pozzolanic materials. Mixture contains GGBS, which decreases in intensity from 5.3% after three months to about 3.0% after twelve. Based on test results, cement-SF was the most efficient material for seawater resistance.

E. K. Suvarna Latha (2012) [5]

Studied Replacement of Large Volume GGBS and Flyash increases strength and efficiency. Blend design was completed by substituting GGBS for OPC and 0%, 10%, 20%, 30%, 40%, 50%, 60%, and 70% for Flyash. M20, M40, and M60 concrete was used for this repair.

Compressive strength tests were performed on concrete made of GGBFS and Flyash. Compressive strength discovered additional strength that replaced GGBS by up to 40% before it started to decline. Same incremental potency up to 40% Flyash GGBS replacement, after which it starts to decline. Flyash and GGBS strength are compared, and GGBS blend strength is greater than Flyash mix strength for 28, 90, and 180 days. Reactive silica is present in GGBS and HVFA, which results in increased strength. The empirical formulation of Bolomey is used to forecast the GGBS and HVFA strength efficiency factors in concrete mixtures. The "k" factor of the GGBS's strength efficiency is much greater than the "k" factor of Flyash.

F. P. Ganesh and A. Ramachandra Murthy (2019) [6]

Ultra high-performance concrete (UHPC) with a large volume of GGBS, studied mechanical properties such as compressive strength, indirect tensile strength (split tension and flexural), direct tensile strength (uniaxial tension), fracture properties, and durability properties are found.

The percentages of cement that can be replaced by GGBS are 0, 20, 40, 60, and 80%. For all mixtures, the water-binder (Cement+GGBS) ratio is held constant at 0.17. due to the large amount of GGBS. Flextural strength and workability both show incremental progress.

When GGBS replacement is done up to 40%, the strength of the direct and indirect tensile characteristics is seen to increase. In the durability study, it was found that UHPC with a large volume of GGBS mixes had superior RCPT and water sorptivity resistance to chloride ingress and water absorption. RCPT number is very low as GGBS percentage increases. When compared to control mix, it is seen that the microstructure of UHPC mix with a large volume of GGBS is extremely dense.

G. P. Nath and P. Sarker (2011) [7]

studied supplemental cementitious materials used in concrete to lower cement production's carbon dioxide emissions. Additionally, it can improve the concrete's enhanced properties. Once Flyash has been replaced in part, there has been a gradual increase in strength up until day 56. If the w/b ratio is changed, Flyash concrete shrinks less during drying than Control Mix concrete. Additionally, the majority of the shrinkage happens up to 56 days after the specimen was cast. The sorptivity of fly ash concretes was lower than that of the control concrete. Flyash concrete exhibits improved resilience to chloride ion penetration at 28 and 180 days.

H. Poonkuzhali. R & Priya Rachel. P (2016) [8]

According to studies, adding flyash has numerous advantages, including a decrease in hydration heat, resistance to corrosion, sulphate attack, alkali-silica reaction, acid attack, a decrease in cement consumption, and a decline in permeability. Reduced mix power is seen as the flyash percentage rises when compared to the control mix. Manufactured sand can be used as a substitute for river sand because its characteristics are identical to those of river sand.

I. P. Priya Rachel (2019) [9]

research on the compressive, tensile, and bending strengths of concrete made with HVFA and GGBFS in proportions of 30%, 40%, and 50% by cement weight. Sand is also entirely displaced by M. sand. According to studies, GGBS blends need more water to cement than Flyash mixtures do. According to research, the slow pozzolonic reaction accounts for the increase in specimen strength as the curing time grows. As the percentage of Flyash rises, split tensile strength falls, but when the percentage of GGBFS rises, split tensile strength rises. Tensile strength in the GGBFS and Flyash Split improved at day 56 as opposed to day 28. Flexural strength improves as the percentage of GGBFS rises, but it falls as flyash content rises. In comparison to Flyash blends, GGBFS mixes have higher sorptivity. As the proportion of flyash and GGBFS rises, RCPT falls. Both Flyash and GGBFS mixtures have very low water permeability. Comparing partial cement substitution with GGBFS with M. sand to conventional mixes helped increase compressive strength.

J. Rafat Siddique (2004) [10]

Class F flyash was used to substitute studied concrete in three different percentages (40%, 45%, and 50%). Flyash content rises as a proportion. Compressive strength was discovered to be lower than the control blend. Additionally, as the percentage of flyash increases, split tensile strength, flexural strength, and elasticity modules were found to decline. Concrete's compressive strength is closely correlated with its abrasion resistance. As concrete ages, abrasion resistance was discovered to increase.

IV. DISCUSSION

supplemental cementitious elements to be taken into account. Up to 40% of SCM Flyash and 70% of GGBS could be substituted. The compressive strength of concrete made with Flyash and GGBS is found to be greater than that of the control blend. In comparison to GGBS concrete, the resilience of flyash concrete is consistently higher. Concrete made with GGBS and fly ash has great resistance to sulfuric acid attack. According to research, the slow pozzolonic reaction accounts for the increase in specimen strength as the curing time grows. Great endurance is attained as GGBS percentage rises. Less RCPT is a very low number. Flyash has many advantages, including a decrease in hydration heat and corrosion protection.

V. CONCLUSION

Following a review of recent research rework, it is discovered that GGBFS and Flyash can both be used in high volume with cement replacement to some extent. Both GGBFS and Flyash improve the fresh, hardened, and durability properties of concrete. These mixtures are also very cost effective and environmentally friendly.

REFERENCES

[1] Elahi a, P.A.M. Basheer b,*, S.V. Nanukuttan b, Q.U.Z. Khan a.” Mechanical and durability properties of high-performance concretes containing supplementary cementitious materials”, Elsevier, Construction and Building Materials 24 (2010) pp no 292–299.

[2] A.H.L.Swaroop, K.Venkateswararao, Prof P Kodandaramarao. “Durability Studies On Concrete With Fly Ash & Ggbs”, International Journal of Engineering Research and Applications (IJERA), Vol. 3, Issue 4, Jul-Aug 2013, pp.285-289.

[3] Gengying Li & Xiaohua Zhao. “Properties of concrete incorporating fly ash and ground granulated blast-furnace slag”Elsevier, Cement & Concrete Composites 25 (2003) pp no. 293–299.

[4] Hosam El-Din H. Seleem a, Alaa M. Rashad a, Basil A. El-Sabbagh b “Durability and strength evaluation of high-performance concrete in marine structures”, Elsevier Construction and Building Materials 24 (2010) pp no 878–884.
[5] K. Suvarna Latha, M V Seshagiri Rao, Srinivasa Reddy. V, “Estimation of GGBS and HVFA Strength Efficiencies in Concrete with Age” , International Journal of Engineering and Advanced Technology (IJEAT) ISSN: 2249 – 8958, Volume-2, Issue-2, December 2012.pp no 221-225.
[6] P. Ganesh a, A. Ramachandra Murthy,” Tensile behaviour and durability aspects of sustainable ultra-high performance concrete incorporated with GGBS as cementitious material” , Elsevier Construction and Building Materials 197 (2019) pp no 667–680.
[7] P. Nath1a, P. Sarker1b, “Effect of Fly Ash on the Durability Properties of High Strength Concrete”, Elsevier Procedia Engineering 14 (2011) pp no. 1149–1156.
[8] Poonkuzhali. R & Priya Rachel. P. “Experimental Investigation on High Volume FlyAsh Concrete using Manufactured Sand”, International Journal of Engineering Research & Technology (IJERT), Vol. 5 Issue 02, (February-2016) pp no.427-429.
[9] P. Priya Rachel, “Experimental Investigation on Strength and Durability of Concrete using High Volume Flyash, GGBS and M-Sand” , International Journal for Research in Applied Science & Engineering Technology (IJRASET), Volume 7 Issue III, (2019) pp no 396-403.
[10] Rafat Siddique, “Performance characteristics of high-volume Class F fly ash concrete”, Cement and Concrete Research 34 (2004) pp no 487–493.