Impact Factor (SJIF): 3.632

International Journal of Advance Research in Engineering, Science & Technology

e-ISSN: 2393-9877, p-ISSN: 2394-2444

Volume 3, Issue 5, May-2016

Experimental Investigation on Concrete Using Processed GGBFS & Manufactured Sand

Mustufa H. Gandhi[1]
PG student of M.E.(Structural Engineering)

Prof. Abhay V. Nakum[2]
Assistant Professor

Abstract - *The aim of this Study is to evaluate the performance of concrete containing materials such as Processed GGBFS & Manufactured Sand when partially replaced by cement & fine sand respectively. This study investigates the performance of concrete mixture containing Processed GGBFS & Manufactured Sand in terms of Compressive strength and Split Tensile Strength at the age of 7, 28 and 56 days. Result show that concrete incorporating Processed GGBFFS and Manufactured Sand had higher compressive strength and processed GGBFS enhances the durability of concrete.*

Keywords: Processed GGBFS, Manufactured Sand, Compressive Strength, Split Tensile Strength, Durability.

I. INTRODUCTION

The main cause of concern is the non-renewable nature of natural sand and the corresponding increase demand of construction industry. The resources of sand are exhausting very rapidly. So it is a need of the time to find some substitute to natural river sand. The artificial sand produced by proper machines can be a better substitute to river sand. The sand must be of proper gradation (it should have particles ranging from 150 microns to 4.75 mm in proper proportion). River sand in many parts of the country is not graded properly and has excessive silt and organic impurities and these can be detrimental to durability of steel in concrete. Whereas manufactured sand has no silt or organic impurities. The main disadvantage of using manufactured sand in concrete is that the workability of concrete decreases with increasing proportion of manufactured sand.

II. EXPERIMENTAL PROGRAM

Experimental program has been planned to provide sufficient information for ascertaining the quality of Processed GGBFS and Manufactured Sand. To evaluate the behavior of concrete, both compressive strength and split tensile strength have been studied in this investigation.

A. MATERIAL

a) CEMENT

Ordinary Portland cement-53 grade available in local market was used in investigation. The cement was tested according to IS 4031: 1988. It confirmed to IS 12269: 1987. Its Properties is given in Table 1.

Sr. No.	Properties	Value	As per IS:12269-1976
1	Specific Garvity	3.10	3.15
2	Normal Consistency	31%	30%-35%
3	Initial Setting Time	36	>30
4	Final Setting Time	450	<600
5	Fineness(%passing 90 IS sieve)	3%	<10%

6	Soundness(mm)	1.2	<10
7	Compressive Strength(3 days)	39	>27
8	Compressive Strength(7 days)	40	>37
9	Compressive Strength(28 days)	57	>53

Table. 1 :Properties Of Opc - 53 Grades Used

b) FINE AGGREGATE

Natural sand as per IS: 383-1987 was used. Locally available River sand having bulk density 1860 kg/m3 was used. The properties of fine aggregate are shown in Table 2- Properties Of Fine Aggregate.

Sr. No.	Property	Result
1	Specific Gravity	2.63
2	Fineness Modulus	3.63
3	Grading Zone	Zone 2
4	Water Absorption	0.6

c) MANUFACTURED SAND

M-sand is crushed aggregates produced from hard rock which is cubically shaped with grounded edges, washed and graded with consistency to be used as a substitute of river sand. Manufactured sand is defined as a purpose made crushed fine aggregate produced from a suitable source material. Production generally involves crushing, screening and possibly washing. The properties of Manufactured Sand are shown in Table 3.

Sr. No.	Property	Result
1	Specific Gravity	3.96
2	Fineness Modulus	2.65
3	Grading Zone	Zone 2
4	Water Absorption	1.2

d) COARSE AGGREGATE

Crushed aggregate confirming to IS: 383-1987 was used. Aggregates of size 20 mm and 10 mm of specific gravity 2.86 and fineness modulus 7.28 for 20 mm and 6.30 for 10 mm were used.

e) PROCESSED GGBFS

ALCCOFINE is a specially processed product based on slag of high glass content with high reactivity obtained through the process of controlled granulation. ALCCOFINE use in project conforming to ASTM C989-99. Physical & Chemical Properties of Alccofine is given in Table 4.

Physical Properties		
Fineness (cm^2/gm)		>12000
Specific Gravity		2.9
Bulk Density		600.700 kg/m^3
Particle Size Distribution	d10	1.5 micron
	d50	5 micron
	d90	9 micron
Chemical Properties		
CaO		30-34
SO_3		0.1-0.4
SiO_2		30-36
Al_2O_3		18-25
Fe_2O_3		0.8-3
MgO		6-10

Table 4 – Physical & Chemical Properties Of Alccofine

B. MIX PROPORTION

In concrete mix design first find out optimum dosage of Processed GGBFS(Alccofine) and Manufactured Sand, in which maximum strength is achieved. Alccofine varies from 0% to 12% and manufactured sand is replaced to fine aggregate by 30% & 40%. Finally optimum dosages of processed GGBFS(alccofine) and manufactured sand are 8% and 30% respectively.

Mix proportion of M50 grade as per trial and error and with the help of reference is found out and is shown in below table

Sr. No.	Material	Quantity(kg/m^3)
1	Total Binder	485.71 Kg
2	Water	170 Liter
3	Fine Aggregate	607.95 Kg
4	Coarse Aggregate(20mm)	697.44 Kg
5	Coarse Aggregate(10mm)	464.96 Kg
6	w/b ratio	0.35

Table 5 – Final Quantity Of Concrete in $1m^3$

C. EXPERIMENTAL PROCESS

The specimen of standard cube of (150mm x 150mm x 150mm) standard was used to determine the compressive strength. Three specimens were tested for 7 & 28 days with each proportion of Processed GGBFS(Alccofine) and Manufactured Sand replacement. The concrete was filled in different layers and each layer was compacted. The specimens were demoulded after 24 hrs, cured in water for 7, 28 & 56 days, and then tested for its compressive and split tensile strength as per Indian and ASTM Standards.

D. TEST METHODS

a) COMPRESSIVE STRENGTH

Concrete cubes of 150 X 150 X 150 mm dimensions were cast for compressive strength. They were tested for compressive strength after 7, 28 and 56 days of water curing. The compressive strength of concrete was determined according to Indian Standarrd 516:1959. For each age, three specimens were tested and the mean value of these measurements is reported.

b) SPLIT TENSILE STRENGTH

The most commonly used tests for estimating the tensile strength of concrete are the split tensile test and the third-point flexural loading test. In the splitting tension test a 150 mm x 300 mm concrete cylinder is subjected to compression loads along the two axial lines which are diametrically opposite. The load is applied continuously at a constant rate within the splitting tension stress until the specimen fails. The compressive stress produces a transverse tensile stress, which is uniform along the vertical diameter. Split tensile strength of concrete cylinder is measured in N/mm2.

The split tensile strength of the cylinder specimen is calculated using the following formula:

Split Tensile Strength = $2P/\Pi LD$
Split tensile strength fsp = N/mm2
Where, P = Load at failure in N
L = Length of the Specimen in mm (300 mm)
D = Diameter of the Specimen in mm (150mm)

III. RESULT AND DISCUSSION

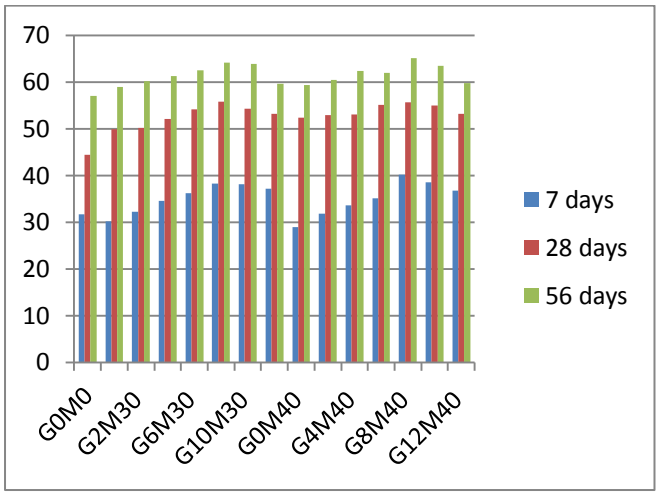
A) COMPRESSIVE STRENGTH RESULTS:

The results of compressive strength were presented in Table 6. The test was carried out conforming to IS 516-1959 to obtain compressive strength of concrete at the age of 7, 28 and 56 days. The cubes were tested using Compression Testing Machine

(CTM) of capacity 2000KN. In this study cement is replaced by processed GGBFS by 0, 2, 4, 6, 8, 10, 12% and simultaneously fine sand is replaced by manufactured sand by 30 and 40%.The maximum compressive strength is observed at 8% replacement of cement by processed GGBFS and 30% replacement of fine sand by manufactured sand. There is a significant improvement in the compressive strength of concrete because of the high pozzolanic nature of the processed GGBFS and its void filling ability.

Cube Specimen	7 days (N/mm^2)	28 days (N/mm^2)	56 days (N/mm^2)
G0M0	31.68	44.42	56.96
G0M30	30.10	49.96	58.87
G2M30	32.20	50.21	60.12
G4M30	34.56	52.15	61.25
G6M30	36.26	54.10	62.54
G8M30	38.20	55.84	65.13
G10M30	38.12	54.22	63.92
G12M30	37.10	53.23	59.67
G0M40	27.44	52.37	59.38
G2M40	31.76	52.96	60.45
G4M40	33.54	53.06	62.38
G6M40	35.07	55.07	61.95
G8M40	40.20	55.64	64.13
G10M40	38.47	54.96	63.48
G12M40	36.72	53.12	59.78

Table 6 – Compressive Strength Test Results

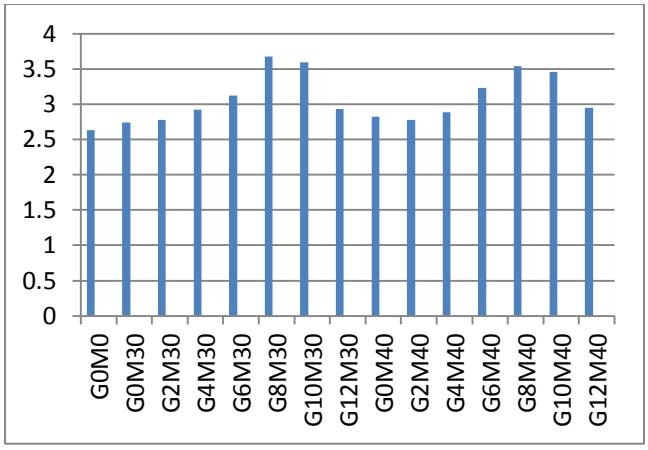


B) SPLIT TENSILE STRENGTH RESULTS:

The most commonly used test for estimating the tensile strength of concrete is the split tensile test. In the splitting tension test a 150mm*300mm concrete cylinder is subjected to compression loads along the two axial lines which are diametrically opposite. The load is applied continuosly at a constant rate within the splitting tension stress until the spcimrn fails. The compressive stress produces a transverse tensile stress, which is uniform along the vertical diameter. Split tensile strength of concrete cylinder is measured in N/mm^2.

Cube Specimen	28 days (N/mm^2)
G0M0	2.63
G0M30	2.74
G2M30	2.78
G4M30	2.92
G6M30	3.12
G8M30	3.68
G10M30	3.59
G12M30	2.93
G0M40	2.82
G2M40	2.78
G4M40	2.89
G6M40	3.23
G8M40	3.54
G10M40	3.46
G12M40	2.95

Table 7 – Split Tensile Strength Test Results of 28 days



IV. CONCULUSIONS

In this study, the effect of processed GGBFS as supplementary cementing materials and filling materials on the strength of concrete was investigated. From the results obtained in this study, the following conclusion can be drawn:

- We concluded that compressive strength achieved by using processed GGBFS(8%) and M-sand(30%) is maximum. The alccofine has particle size smaller than cement so its help to reduce voids so indirectly increasing the strength of concrete.
- In split tensile strength also we get maximum strength of $3.68 N/mm^2$ in G8M30 mix.
- So we can say that optimum mix is 8% of processed GGBFS and 30% of manufactured sand in which we get maximum strength in both compressive as well as split tensile strength test.

REFERENCES

1. O. Cabrera, H. Donza, High strength concrete with crushed fine aggregate, XXVIII Jornadas Sul-Americanas de Engenharia Estrutural San Carlos, Brazil, vol. 5, 1997, pp. 2099–2107.

2. Li Beixing, Wang Jiliang, Zhou Mingkai. Effect of limestone fines content in manufactured sand on durability of low- and high-strength concretes. Construct Building Mater 2009;23(8):2846–50

3. P.M.Shanmugavadivu and R.Malathy (2011)"Durability Properties of Concrete with Natural sand and Manufactured sand" International Conference on Science and Engineering

4. M. G. Shaikh and S. A. Daimi (2011) "Durability studies of concrete made by using artificial sand with dust and natural sand" International Journal of Earth Sciences and Engineering Volume 04, pp 823-825

5. Nimitha. Vijayaraghavan and Dr. A.S. Wayal (2013) " Effects of Manufactured sand on compressive strength and workability of concrete" International Journal of Structural and Civil Engineering Research Volume 02, pp 228-232

6. IS 383-1970 – IS specification for coarse and fine aggregate from natural sources of concrete

7. "Indian Standard Plain and Reinforced Concrete - Code of Practice". IS 456 :2000,Bureau of Indian Standards, New Delhi

8. IS: 5816-1999, Splitting Tensile Strength of Concrete – Method of Test, First Revision, Bureau of Indian Standards, New Delhi.

9. IS: 1199-1959, Indian Standard methods of sampling and analysis of concrete, *Bureau of Indian Standards*, New Delhi, India.

10. IS: 516-1959, Indian Standard code of practice-methods of test for strength of concrete, *Bureau of Indian Standards*, New Delhi, India.