Kautilya International Journal of Engineering, Science and Management
Volume - 1 July 2019

Effects of GGBFS and KSPS on Compressive strength of concrete

Priyanka Mandal
Department of Civil Engineering,
Arya College of Engineering and Research
Jaipur, India
Priyankamandal017@gmail.com

Abstract— There is a lot of investigations are reported on Ground-granulated blast-furnace slag and stone based powder individually but the study reported in the paper presents experimental work on combined use of Ground-granulated blast-furnace slag and Kota stone powder slurry in concrete. This study can be used for the process of creating smart infrastructures which will be prove helpful to increase their strength so that it can be sustainable. The main objective of the present study is to determine compressive strength of the concrete containing GGBFS and Kota stone powder slurry. The experimental program consists of preparing concrete mixes with GGBFS as a partial replacement of cement (20%, 30% & 40%) and Kota stone powder slurry partially replaced with sand (10%, 15% & 20%). The performance of the concrete mixes for compressive strength at the age of 7, 28 and 56 days are investigated.

Keywords—GGBFS, Kota stone powder slurry, Compressive strength.

I. INTRODUCTION

Ground-granulated blast-furnace slag and Kota stone powder slurry both are waste materials from different industries. During the processing of Cutting, finishing and polishing of stones a large amount of waste in the form of stone slurry and powder is generated similarly GGBFS is obtained by quenching molten iron slag from a blast furnace in water or stream, to produce a glassy, granular product that is then dried and ground into a fine powder. GGBFS is used to make durable concrete structures in combination with ordinary Portland cement or other pozzolanic materials. GGBFS has been widely used for its superiority in concrete durability The main aim of this study is to investigate combined use of Ground-granulated blast-furnace slag and Kota stone powder slurry in study has been chosen as M40, as it offers good number of applications in the construction industry, ranging from PQC to buildings concrete.

II. PROPERTIES OF MATERIALS

A. Ground-granulated blast-furnace slag

The Chemical and Physical properties of GGBFS in the present paper is taken as as per manufacturer which is shown in table 1 and table 2

B. Kota stone powder slurry

The Chemical and Physical properties of Kota stone powder slurry in the present paper is taken as per manufacturer which is shown in table 1 and table 2

C. Cement

The cement used in present study is of OPC-43 grade

Table-1 Chemical Properties of Materials (as per manufacturer)

S.No.	Chemical Properties	Cement	GGBFS	Kota Stone Powder slurry
1.	Cao	62-67%	30-34%	38-42%
2.	SiO_2	17-25%	30-36%	20-25%
3.	Al_2O_3	3-8%	18-25%	2-4%
4.	Fe2O3	3-4%	0.8-3.0%	-
5.	SO_3	1-3%	0.1-0.4%	-
6.	MgO	0.1-3%	6-10 %	1.5-2.5%

Table-2 Chemical Properties of Materials (as per manufacturer)

S.No.	Physical Properties	Cement	GGBFS	Kota Stone Powder slurry
1.	Specific gravity	3.15	2.9	2.5
2.	Shape texture	Irregular	Irregular	Irregular
3.	D_{50}	25 micron	7 micron	230 micron
4.	Colour	Grey	Grey	White

III. CONTROL MIX

Control mix was designed as per IS 10262:2009. Mix proportions of control mix M-40 grade and the typical computations are given below:

Table-3 Mix Proportion for Control Mix (M40 Grade)

S.No	Materials	Quantities in Kg/m^3
1.	Cement (OPC-43)	363
2.	Coarse aggregate	1148.9
3.	Fine aggregate	902.75
4.	Water	132 litre
5.	Super-plasticizer	2.54
6.	W/C Ratio	0.363

IV. TEST ON CONCRETE

1. Slump
2. Compressive Strength

All materials and strength of samples were tested as per IS 516:1959. Specimens for compressive strength, flexure strength and splitting tensile strength of concrete were tested at different ages. At the time of testing, specimens were tested in ―wet‖ condition, i.e. removed from water pond, surface water wiped off by the cloth with any projecting fines removed and tested, still in ―wet‖ form.

In this study, minimum three specimens were tested at each selected age. The tests for Compressive strength of cube specimens size 150 mm x 150 mm x 150 mm were prepared and tested.

V. RESULTS

1. Slump

The Slump test results of control mix and concrete prepared with 20%, 30% and 40% replacement of cement by Ground granulated blast-furnace slag and 10%, 15% and 20% replacement of fine aggregate by Kota stone powder slurry are presented in Table-4.

Table- 4 Slump Variation of Specimens

GGBFS	Kota Stone Powder Slurry			
	0%	10%	15%	20%
20%	63	61	60	58
30%	65	62	61	60
40%	69	66	65	63
0% (Control)	58			

From table-4 it is observed that the slump decreased with addition of the Kota Stone powder slurry in the mix.

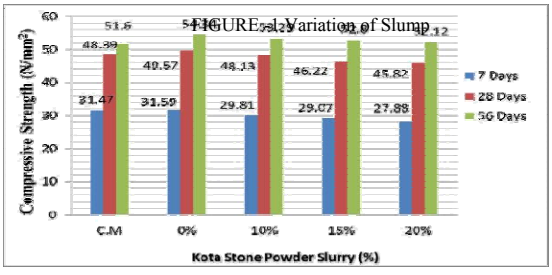
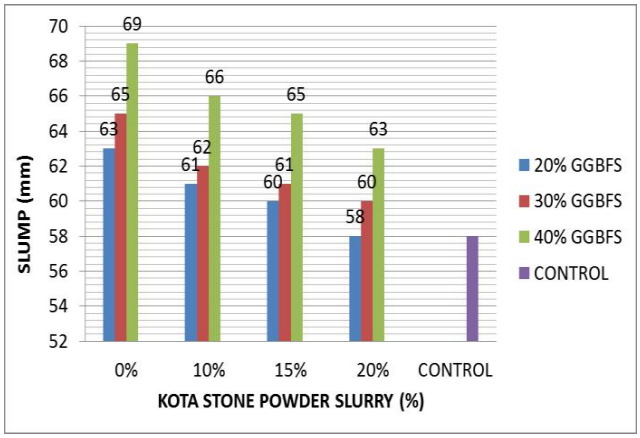


FIGURE-1 Variation of Slump



It is observed from Fig. 1, that with addition of GGBFS, slump increased and it decreased with addition of the Kota Stone powder slurry in the mix.

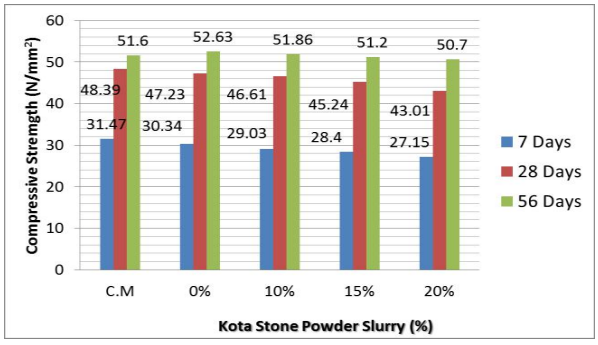
2. Compressive strength

The Compressive strength results of concrete specimens with 40% replacement of cement by Ground granulated blast-furnace slag and 10%, 15% and 20% replacement of fine aggregate by Kota stone powder slurry at the ages of 7, 28 and 56 days are presented in Table-5 and Fig. 2

Table -5 Compressive Strength of Specimens with 40% GGBFS and KSPS

OPC+GGBFS	SAND+KSPS	COMPRESSIVE STRENGTH (N/mm^2)		
		7 DAYS	28 DAYS	56 DAYS
100+0	100+0	31.47	48.39	51.6
60+40	100+0	31.59	49.57	54.34
	90+10	29.81	48.13	53.29
	85+15	29.07	46.22	52.8
	80+20	27.88	45.82	52.12

Figure-2 Variation in Compressive Strength of Concrete with 40% GGBFS



In Fig. 2, the first set of bars shows the compressive strength without GGBFS (Control) and all the other sets of bars shows the compressive strength with 40% GGBFS. When the second set of bars which is with 40 % GGBFS and sand as fine aggregate is compared with the first set (without GGBFS), it is observed that there is a marginal increase in compressive strength with addition of GGBFS, the compressive strength increased (at all ages). But, the strength is observed to decrease with addition of the Kota Stone powder slurry. The mixes with Fine aggregate partially replaced by Kota stone powder slurry ranging from 10% to 20% reduces the compressive strength 5% to 12% at the age of 7 days and 0.5% to 6% at the age of 28 days. But all the values of compressive strength increased 3% to 1 % at the age of 56 days.

The Compressive strength results of concrete specimens with 30% replacement of cement by Ground granulated blast-furnace slag and 10%,15% and 20% replacement of fine aggregate by Kota stone powder slurry at the age of 7, 28 and 56 days are presented in Table 6

Table-6 Compressive Strength of Specimens with 30% GGBFS and KSPS

OPC+GGBFS	SAND+KSPS	COMPRESSIVE STRENGTH (N/mm^2)		
		7 DAYS	28 DAYS	56 DAYS
100+0	100+0	31.47	48.39	51.6
70+30	100+0	30.34	47.23	52.63
	90+10	29.03	46.61	51.86
	85+15	28.40	45.24	51.2
	80+20	27.15	43.01	50.7

Figure-3 Variation in Compressive Strength of Concrete with 30% GGBFS

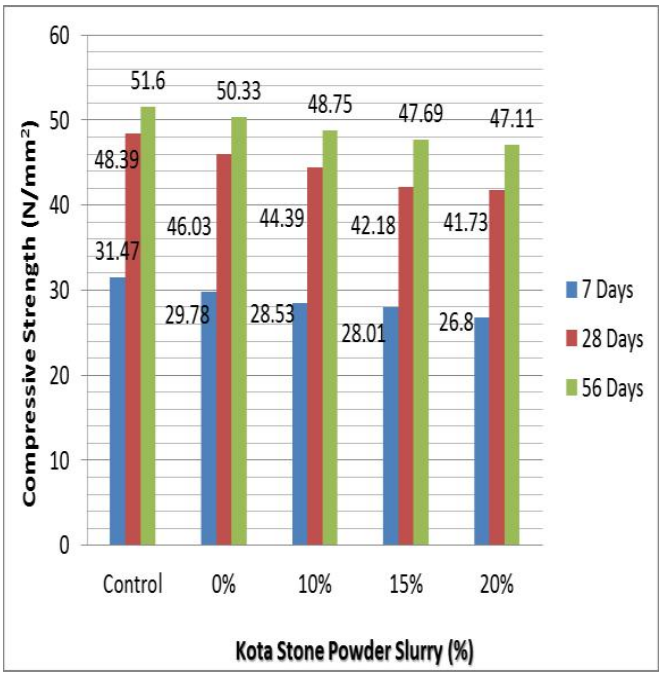
In Fig. 3, the first set of bars shows the compressive strength without GGBFS (Control) and all the other sets of bars shows the compressive strength with 30% GGBBFS. When the second set of bars which is with 30 % GGBFS and sand as fine aggregate is compared with the first set (without GGBFS), it is observed that there is a decrement in compressive strength with addition of GGBFS, the compressive strength decreased at the ages of 7 and 28 days, increased at the age of 56 days. But, the strength is observed to decrease with addition of the Kota Stone powder slurry. The mixes with Fine aggregate partially replaced by Kota stone powder slurry ranging from 10% to 20% reduces the compressive strength 4% to 10% at the age of 7 days, 1% to 9% at the age of 28 days and reduction of 1.5% to 3% at the age of 56 days.

The Compressive strength results of concrete specimens with 20% replacement of cement by Ground granulated blast furnace slag and 10%, 15% and 20% replacement of fin aggregate by Kota stone powder slurry at the age of 7, 28 and 56 days are presented in Table 7 and Fig. 4

Table -7 Compressive Strength of Specimens with 20% GGBFS and KSPS

OPC+GGBFS	SAND+KSPS	COMPRESSIVE STRENGTH (N/mm^2)		
		7 DAYS	28 DAYS	56 DAYS
100+0	100+0	31.47	48.39	51.6
80+20	100+0	29.78	46.03	50.33
	90+10	28.53	44.39	48.75
	85+15	28.01	42.18	47.69
	80+20	26.8	41.73	47.11

Figure-4 Variation in Compressive Strength of Concrete with 20% GGBFS



In Fig. 4, the first set of bars shows the compressive strength without GGBFS (Control) and all the other sets of bars shows the compressive strength with 20% GGBBFS. When the second set of bars which is with 20 % GGBFS and sand as fine aggregate is compared with the first set (without GGBFS), it is observed that there is a decrement in compressive strength with addition of GGBFS, the compressive strength decreased at the ages of 7, 28 days and 56 days. The strength is observed to decrease with addition of the Kota Stone powder slurry. The mixes with Fine aggregate partially replaced by Kota stone powder slurry ranging from 10% to 20% reduces the compressive strength 4% to 9% at the age of 7 days, 3% to 9% at the age of 28 days and reduction of 3% to 6% at the age of 56 days.

VI. CONCLUSIONS

By evaluating the test results of Slump, Compressive Strength, Flexural Strength and Splitting Tensile Strength, following conclusions have been drawn-

Slump Values
The Value of slump increases with increase of GGBS content in the mix, but it slightly reduces with increase in the content of Kota stone powder.

Compressive Strength
Even by reducing cement content by 40% and replacing it by GGBFS, the compressive strength of M 40 Grade concrete does not decrease (at the age of 56 days) and it is observed to be almost similar to the control concrete (without GGBFS).
In the mixes with 40% GGBFS, if fine aggregate is partially replaced by Kota stone slurry powder in the range 10% to 20%, then also, compressive strength does not decrease (hardly variation of 1 to 3% was observed at the age of 56 days). At the age of 7 days and 28 days, the compressive strength of concrete with cement replaced by GGBFS by 40% is observed to be lesser than the control mix (without GGBFS).

References

[1] Jain Aman, Majumder Rohan (2016) ,―Strength, Permeability and Carbonation properties of Concrete containing Kota Stone Slurry‖ International Journal of Advance Research and Innovation Volume 4, Issue 4 (2016) 735-739 ISSN 2347 – 3258

[2] Kumar Santosh, G.V.Rama Rao, Markandeya Raju (2015),‖ Strength and Durability Studies on GGBS Concrete‖ SSRG International Journal of Civil Engineering (SSRG-IJCE) – volume 2 Issue 10 October 2015

[3] Chaithra, Pramod, Chandrashekar (2015),‖An Experimental Study on Partial Replacement of Cement by GGBS and Natural Sand by Quarry Sand in Concrete‖ International Journal of Engineering Research & Technology (IJERT) ISSN: 2278-0181 Vol. 4 Issue 05, May-2015

[4] Singh kushwah Raj P, Sharma Chand Ishwar, Chaurasia (2015),‖ Utilization of Marble Slurry In Cement Concrete Replacing Fine Aggregate‖ American Journal of Engineering Research (AJER) e-ISSN : 2320-0847 p-ISSN : 2320-0936 Volume-04, Issue-1, pp-55-58

[5] Upadhyay Siddharth, Jamnu (2014) ―Effect on Compressive strength of High Performance Concrete Incorporating Ground-granulated blast-furnace slag and Fly Ash‖ International Journal Of Innovative Research & Development, ISSN 2278 –0211, volume 3, issue 2,pp.124-128, February 2014.

[6] Arivalagam (2014),‖ Sustainable Studies on Concrete with GGB As a Replacement material in Cement‖Jordan Journal of Civ Engineering,Volume8, No. 3, 2014

[7] Krishnamoorthy, Aswini (2015),‖Strength and Corrosion Resistance Properties of GGBS Concrete Containing Quarry Dust as Fine Aggregate‖ International Journal of Structural and Civil Engineering Research Vol. 4, No. 2, May 2015