

Combined effect of GGBFS and KSPS on Compressive Strength of ConcreteAnil Sharma¹, Sayed Imran Ali², Arvind Singh Gaur³^{1, 2, 3}Department of Civil Engineering, Arya College of Engineering and Research, Jaipur, IndiaE-Mail: sayedimranali24@gmail.com, anilsharma2701@gmail.com, eng.arvindgaur@gmail.com**Abstract**

A large number of studies have been reported on dry granular and powders granite slag based on rock, but the study presented in this paper presents experiments on the use of a combination of granular furnace and coal powders in concrete. The main objective of this study is to determine the compressive strength of concrete containing GGBFS. And powder Kota. 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 concrete mixes for compressive strength at the age of 7, 28 and 56 days is investigated.

Keywords: GGBFS, Kota stone powder slurry, Compressive strength.**Introduction**

Blast furnace slag and kota rock flour are waste materials from various industries. In the processing of stones, sizing and polishing of stones, a large amount of waste in the form of stone sludge is produced and the dust is produced in a similar manner. GGBFS is prepared by cooled pure iron from an explosion furnace to a water or a stream to obtain a grain product and a glass that is then dried and attached to a crushed powder. GGBFS is used to construct strong concrete structures combined with Portland cement or other pozzolanic materials. GGBFS became widely used because of its superior concrete durability. The main objective of this study is to investigate the combined use of ground blast furnace slag and Kota sludge in the study chosen as the M40, as it offers a variety of applications in the construction industry, starting with PQC on concrete buildings.

Properties Of Materials**A. Ground-granulated blast-furnace slag**

The Chemical and Physical properties of GGBFS in the present paper is taken 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 ₂ O ₃	3-8%	18-25%	2-4%
4.	Fe ₂ O ₃	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.	D50	25 micron	7 micron	230 micron
4.	Colour	Grey	Grey	White

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 liter
5.	Super-plasticizer	2.54
6.	W/C Ratio	0.363

Test on Concrete

1. Slump
2. Compressive Strength

All materials and strength of samples were tested as per IS 516:1959. The samples were tested for compressive strength, flexural strength and fracture strength of the concrete at various 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 compressive strength tests of 150 mm × 150 mm × 150 mm cubes samples were prepared and tested.

Results

1. Slump

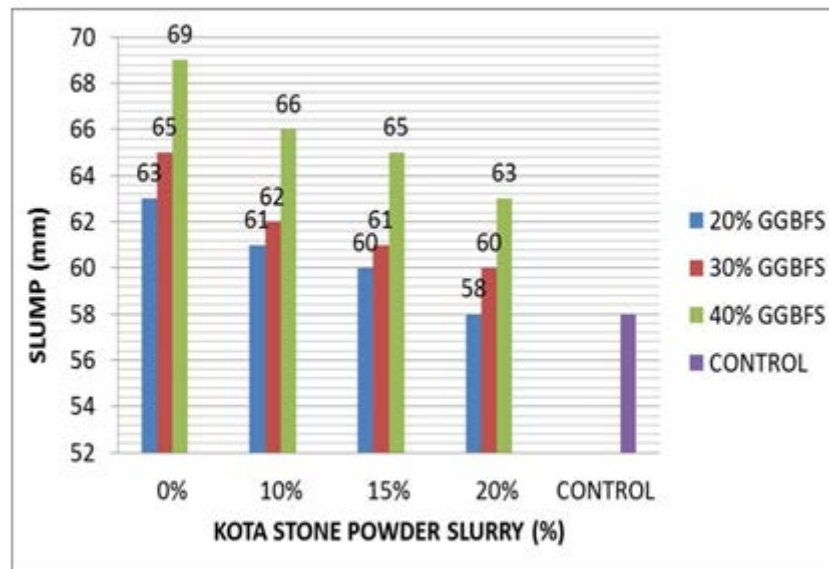
The results of the test of the impact strength of the control mixture and the concrete obtained by replacing the cement with 20%, 30% and 40% of the blast furnace slag and 10%, 15% and 20% replacement of crushed seeds with Kuta stone, in Table 4 is presented.

Table- 4 Slump Variation of Specimens

GGBF S	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.

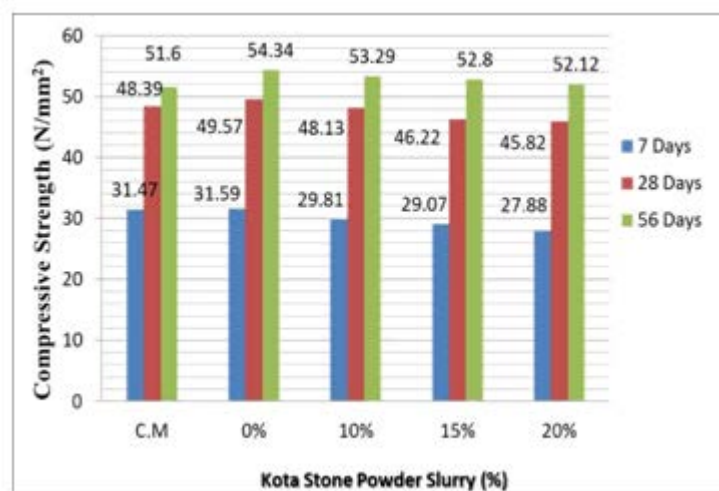
2. Compressive strength

The compressive strength results of concrete samples are presented with a 40% replacement of the cement by sand slag and a 10%, 15% and 20% aggregate replacement by Kota Stone Dust by mud at 7, 28 and 56 days in Table 5 and 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

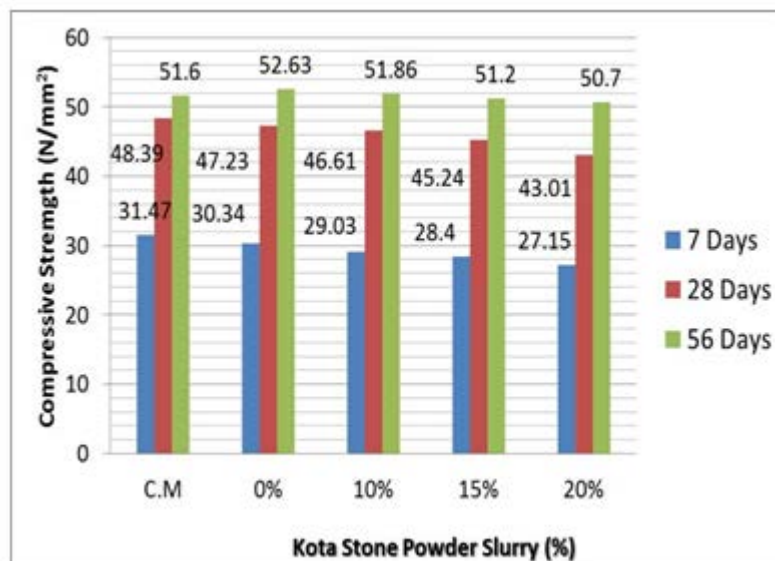
compressive strength with addition of GGBFS, the compressive strength increased (at all ages). But, the strength is observed to decrease with addition of the Kota Stone powder slurry. The mixture with crushed grains, which partially replaces the Kota powder rock in the range of 10% to 20%, reduces compressive strength at 7 days and 5 to 6% at 28 days of age. But all the values of compressive strength increased 3% to 1 % at the age of 56 days.

The results of the compressive strength of concrete samples with 30% cement replacement by milled granulated blast furnace slag and 10%, 15% and 20% fine dust removal rate by Kota stone powder are presented. the ages of 7, 28 and 56 days 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% GGBFS. 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

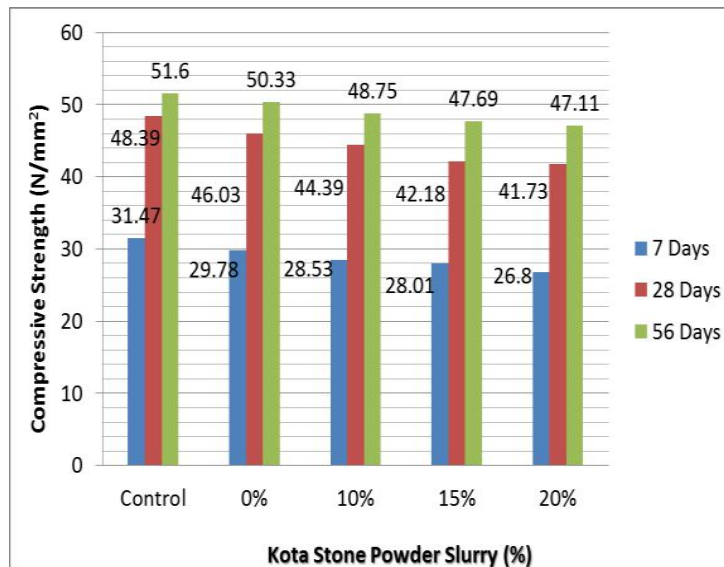
aggregate partially replaced by Kota stone powder slurry ranging from 10% to 20% reduces the compressive strength 4% to 10% at the age of 7 days, 1% to 9% at the age of 28 days and reduction of 1.5% to 3% at the age of 56 days.

We present the results of compressive strength of concrete samples with 20% replacement of cement by milled granulated blast furnace slag and 10%, 15% and 20% aggregate of fine aggregates by Kota Stone Powder at 7 and 28 days in Table 7 and in fig 4

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

OPC+GGBFS	SAND+KSPS	COMPRESSIVE STRENGTH (N/mm ²)		
		7 DAY S	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% GGBFS. 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.

Conclusions

In the evaluation of the results of installation tests, compressive strength, flexural strength and tensile strength, the following results were obtained.

Slump Values

The amount of decay increases with increasing content of GGBS in the mixture, but with a slight increase in the amount of powder of castor kota, its amount is reduced.

Compressive Strength

Even if the cement content is reduced by 40% and replaced by GGBFS, the compressive strength of concrete M 40 will not be reduced to 56 days, and it will be observed near the GGBFS control cement.

In a mixture with 40% GGBFS, if the small amount of sodium starch powder is replaced by about 10% to 20%, its compression strength is not reduced (hardly a change of 1-3% at the age of 56 days). At 7 days and 28 days, the compressive strength of concrete to cement, replaced by GGBFS by 40%, is less than the control mixture (without GGBFS).

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