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PARTIAL REPLACEMENT OF CEMENT BY USING SILICA FUME AND FINE AGGREGATE BY USING STEEL SLAG

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Abstract — *In generally the modern construction would leads to the demand for cement that provides maximizing the production of cement. So the cement manufacture creates lot of pollution to the environment. In that situation we need provide alternate replacement product in that project so we use the silica fume partially in the cement. Due to demand of sand reducing over exploration of natural quarries and to reduce the use of the by products from different. In additional we are adding another substance of steel slag to the corresponding concrete mix. So the correct choice is steel slag to use partially in the fine aggregates. This can be achieved with the help of chemical admixtures and supplementary cementations materials like silica fumes, fly ash, granulated blast furnace slag and steel slag etc. these days the waste materials of industries is on its way to increase day by day due to strict environmental policies.*

Keywords*-component; steel slag , silica fume, water.*

I. INTRODUCTION

As a construction material, concrete is the largest production of all other materials. Aggregate are the important constituents in concrete. As 75% of concrete is composed of aggregates it is imperative that we look to the maximize the use of waste as aggregate input in concrete making. Steel slag is generated as a melt at about 1600ºc during steel making form hot metal in the amount of 15%-20% per equivalent unit of steel. Practically all steel slag are air cooled, but the current technology of steel production cannot always provide its immediate cooling. which can influence its quality. These days the waste materials of industries is on its way to increase day by day due strict environmental policies and these Waste material generally includes fly ash, silica fume, ground granulated blast furnace slag steel slag which can be used as supplementary cementations materials and hence they can be utilized not only to improve properties of concrete but also to prevent pollution.

MATERIAL

SILICA FUME

Silica fume consist of spherical particles with primary silica particles in the size range of 0.002-1.0m(average particle size 0.15m) and a specific surface area of typically 17 to 30 m/g. the chemical and physical properties of this inorganic product are different as compared to other amorphous and crystalline silica, and it should not be confused with fumed silica also known as phylogenic silica.

STEEL SLAG

The composition and properties of steel –making slag depend on the kind of steel –making process and /or on the type of steel. Steel slag are mostly formed in the process of re melting steel scrap. This is called black slag.

OBJECTIVES

- To increase the strength of concrete by using silica fume and steel slag.
- To reduce the pollution caused by the excess manufacturing of cement.
- To minimize the usage of natural sand (river sand) and to create the friendly concrete.

II. TESTING OF RAW MATERIALS

Fineness test

The fineness of the materials to be calculated by 0.15 micron sieve. The retained silica fume content weight is noted. The fineness value was calculated. Fineness of other materials is to be determined. So same procedure is repeated for other materials.

Specific gravity test

Specific gravity of silica fume is made use of in design calculations of mixes. With the specific gravity of each constituent known, its weight can be converted into solid volume. Specific gravity of other materials is to be determined. So same procedure is repeated for other materials.

Bulk density test

Bulk density of silica fume is made use of in design calculations of mixes. With the Bulk density of each constituent known, its weight can be converted into solid volume . Same procedure is repeated for other materials.

III. MIXING PROPORTION

The design mix proportion is done in below

SAMPLE	STEEL SLAG	SILICA FUME	WATER RATIO
1	10%	5%	0.45%
2	20%	10%	0.45%
3	30%	15%	0.45%

EXPERIMENTAL PROCESS

There are four different operations are involved in the process of manufacturing of concrete:

1. Preparation of concrete
2. Molding
3. Curing
4. Remolding

IV. TESTS ON CONCRETE

As per IS 516: 1959, the following laboratory tests are conducted on concrete.

1. Compressive strength test
2. Tensile strength test
3. Flow table test

And also some of the site tests are also conducted on bricks.

1. Slump cone test
2. Workability test

COMPRESSIVE STRENGTH TEST

The compressive strength test was conducted on specimens different percentage replacement of fine aggregate using steel slag and replacement of cement using silica fume. There are 3 different mixed eighth 10, 20. 30, and 10, 20, 30, percentage replacement of cement using silica fume.

Table 5.1 compressive strength of normal concrete cube 7days

GRADE	SAMPLE	WEIGHT (Kg)	ULTIMATE STRENGTH (Kg)	COMPRESSIVE STRENGTH (N/mm^2)
M20	I	8.904	530	23.556
	II	9.034	510	22.667
	III	9.020	630	28
	Average	8.986	556.67	24.741

Average compressive strength = 24.741 N/mm^2

Table 5.2 compressive strength of 28 days

GRADE	SAMPLE	WEIGHT (Kg)	ULTIMATE STRENGTH (Kg)	COMPRESSIVE STRENGTH (N/mm^2)
M20	I	8.700	630	28
	II	8.491	810	36
	III	8.662	700	31.11
	Average	8.617	713.33	31.70

Average compressive strength = 31.70 N/mm^2

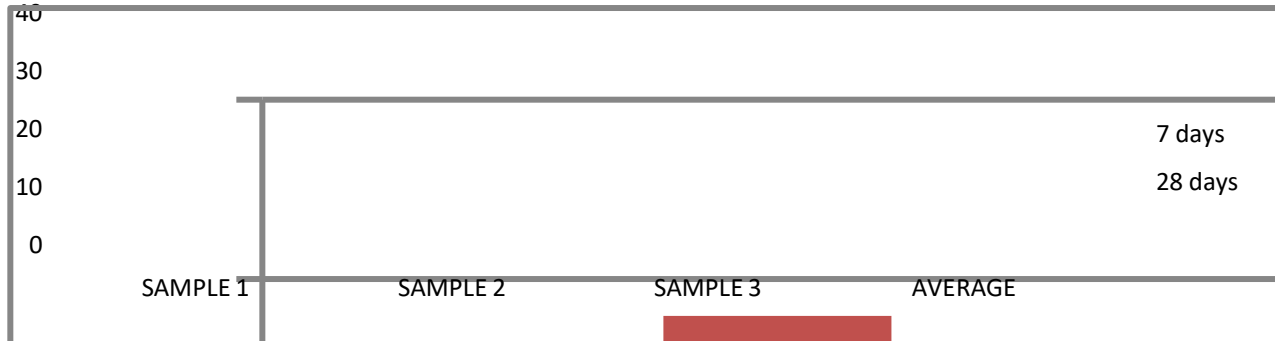


Table 5.3 compressive strength of silica fume 5%,10%,15%and steel slag 10%,20%,30% (7 days)

SAMPLE	PERCENT (%)	WEIGHT (KG)	ULTIMATE STRENTH (KN)	COMPRESSIVE STRENGTH (N/mm^2)
1	Silica fume-5% Steel slag-10%	8.511	655	29.11
2		8.515	650	28.88
3		8.769	640	28.44
Average		**8.595**	**648.33**	**28.81**
1	Silica fume-10% Steel slag-20%	8.673	720	32
2		8.330	650	28.88
3		8.502	540	24
Average		**8.501**	**636.66**	**28.296**
1	Silica fume-15% Steel slag-30%	8.234	630	28
2		8.630	430	19.11
3		8.553	520	23.11
Average		**8.472**	**526.66**	**23.40**

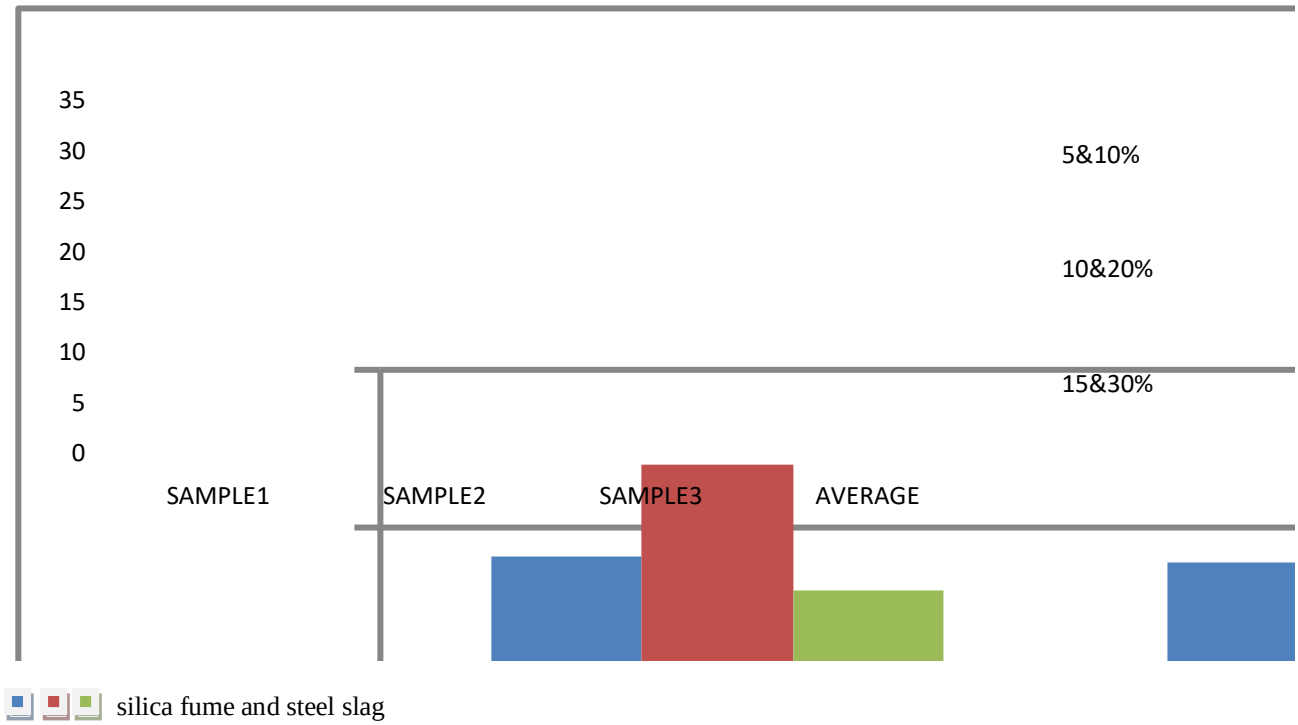
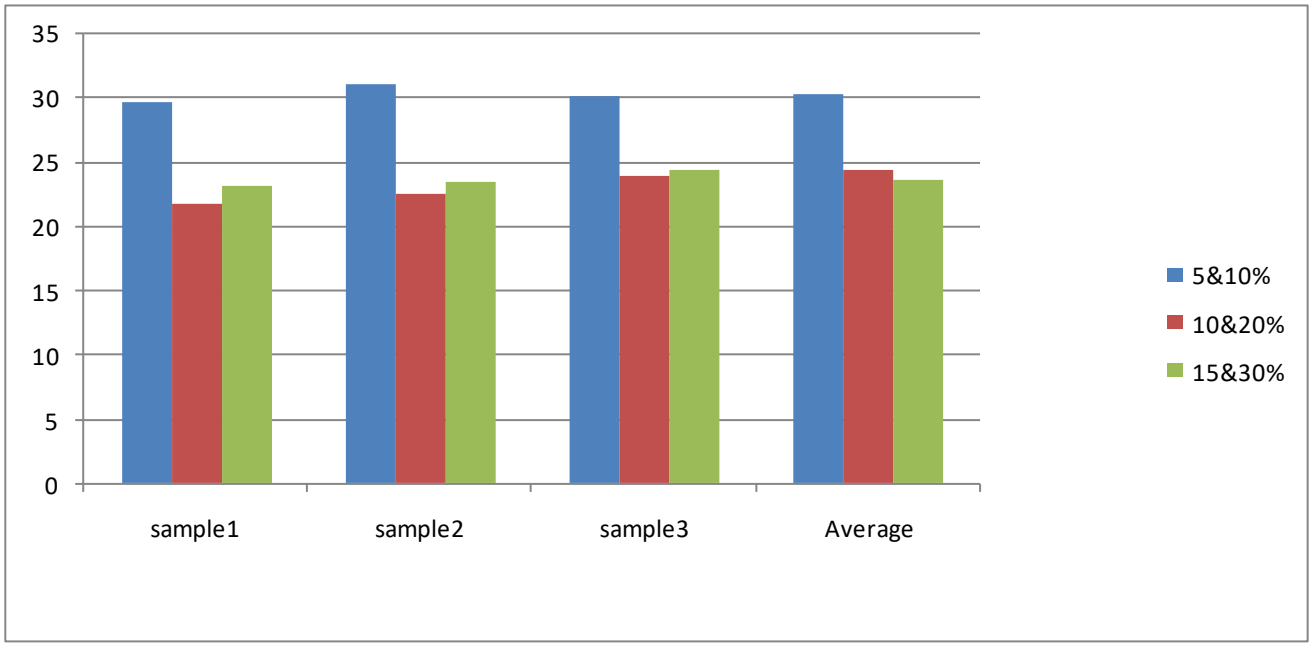


Table 5.4 compressive strength of silica fume 5%,10%,15%and steel slag 10%,20%,30% (28 days)

SAMPLE	PERCENT (%)	WEIGHT (KG)	ULTIMATE STRENTH (KN)	COMPRESSIVE STRENGTH (N/mm^2)
1	Silica fume-5% Steel slag-10%	8.508	670	29.71
2		8.348	700	31.11
3		8.438	680	30.222
Average		8.431	683.33	30.37
1	Silica fume-10% Steel slag-20%	8.235	490	21.777
2		8.378	620	22.556
3		8.494	540	24
Average		8.369	550	24.44
1	Silica fume-15% Steel slag-30%	8.285	520	23.11
2		8.197	530	23.556
3		8.514	550	24.444
Average		8.332	533.33	23.70



silica fume and steel slag

V. CONCLUSION

Based on present study the following conclusions were derived. The compressive strength of mortar and concrete containing steel slag and silica fume up to 30 percent is found to be comparable with the strength of corresponding control mortar mix with super plasticizer on slag. The compressive strength of mortar and concrete containing induction steel slag greater 30 percent is found to be lower than the corresponding control mortar mix containing no slag. The slump of concrete containing inducting steel and silica fume up to 30 percent is found to be greater compared to all other mixes. Hence it may be concluded that the slag fines can be used as aggregate in concrete and silica fume can be used as cement. The replacement ratio of the fine slag shall be limited to 30 percent and replacement ratio of the silica fume shall be limited to 15 percent. However, more durability studies are to be conducted for the evaluation of the performance of concrete containing fine induction furnace slag.

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