Research Paper Engineering

Study on Concrete By Partially Replacement of Silica Fume and Ceramic Tiles

Tanveer Asif Zerdi	Director, Professor Head of Civil Engg Dept, KCT Engineering college, Gulbarga, Karnataka, India.
MD Sajid Ahmed	UG Student Department Of Civil Engineering V.T.U University K.C.T.E.C Gulbarga Karnataka
Nizamuddin Ansari	UG Student Department of Civil Engineering V.T.U University K.C.T.E.C Gulbarga Karnataka
MD K Irfan	UG Student Department of Civil Engineering V.T.U University K.C.T.E.C Gulbarga Karnataka

ABSTRACT

This study investigates the performance of concrete on compressive strength by partially replacing of cement by silica fume, fine aggregate (black sand) by waste ceramic tiles powder, and waste crushed ceramic tiles by coarse aggregate, easily available at construction sites and tiles manufacturing unit as waste debris. The objective of this paper is to examine strength properties of concrete made with silica fume and ceramic tiles. The cement was replaced with silica fume at the rate of 10%, fine aggregate (black sand) replaced by waste ceramic tiles powder at the rate of 15%, coarse aggregates were replaced by waste ceramic tiles at the rate of 30% by weight for design mix of M15. M25, M30 controlled concrete. A total of 48 specimens of size 150mm x150mmx150mm are prepared to determine the cube compressive strength after 3, 7, 21, 28 days of curing. From the study's results it is noticed that, addition of silica fume, waste ceramic tiles positively effect the workability in concrete. Compressive strength decreases with increase in percentage of silica fume beyond 8%, in the concrete prepared by incorporating ceramic tiles powder and ceramic tiles chips.

KEYWORDS Waste crushed tiles, silica fume, fine aggregate (black sand), coarse aggregate, normal concrete, compressive strength.

I. INTRODUCTION

In Europe the amount of wastes in the different production stages of the ceramic industry reached some 3–7% of its global production meaning millions of tons of calcined-clays per year that are just land filled. In this paper, silica fumes which is a by-product of silicon alloy manufacture, disposed ceramic tiles are chosen to partially replace the basic materials of concrete. This investigation study is concentrated mainly on low cost, easily available and high strength materials that possess the properties of concrete has studied that ,10% replacement of cement by silica fume has given excellent strength. The experimental study carried out by Md sajid ahmed, Nizamuddin ansari, Md k irfan and prof Tanveer asif zerdi has revealed that the replacement of, 10% of silica fumes in cement has increased durability property,15% of sand is replaced by powdered ceramics / porcelain. Coarse aggregate has been also replaced by waste ceramic tiles at the rate of 30%,which is increases the workability of concrete. In this study, an attempt has been made to replace cement, sand and coarse aggregates in the same sample. Concrete mix for M15 grade is prepared with a water cement ratio of 0.45,0.50, 0.55 and placed in moulds for cubes of size 150mm x 150mm. In fresh state, slump cone test and compaction factor test have been conducted. Test for compression have been done in hardened state on3, 7,21, and 28 days.

II. INGRADIENTS USED :

A. Cement:

The pozzolana Portland cement of 53 grade whose specific gravity of cement is 2.90, normal consistency of the cement was found as 28% and the initial and final settingtimes were found as 120 min and 240 min respectively was used

B. Silica Fume:

Silica fume is a by product resulting from reduction of high purity quartz with coal or coke and wood chips in an electric arc furnace during the production of silicon metal or Ferro silicon alloys. The specific gravity of silicafume is 2.29.It consist of 0.1 to 1 micron sized fine ,smooth spherical glassy particles with fineness of 20m² /gm.

C. Coarse aggregate:

The coarse aggregate with 20 mm nominal size havingspecific gravity 2.74 was used. The impact value is 20.44%. And the water absorption of the coarse aggregateis 0.38%.

D. Fine aggregate:

Black sand is used as fine aggregate in this experiment.speecific gravity of sand is2.88

E. Crushed Tiles:

Broken tiles were collected from the solid waste ofceramic manufacturing unitand from constuction work. Crushed

them into smallpieces by manually and by using crusher. And separated the coarse material to usethem as partial replacement to the natural **coarseaggregate:**
Specific gravity of the crushed waste tiles is2.28. Impact value of these crushed tiles is 25.81%.

F. Tiles powder*:*
From the crushed waste tiles, powder passed through 4.75 mm IS sieve to use aspartial replacement to the fine aggregate. Specific gravity of tile powder is 2.68.

III. MIX DESIGN
M15 grade of concrete was designed byfollowing the specification given in the IS 10262: 2009.Water – Cement ratio (w/c) was selected as 0.55 based onconducting slump tests for different design trails. Mix proportion obtained for M15 mix is 1: 2.02 : 3.3,M25 is 1:1.76:3,M30is 1:1.51:2.68

IV. TEST RESULTS AND DISCUSSIONS
A. Fresh State
1) Mix Character: Due to superfine nature of SF particles, SF concrete has shown more cohesiveness than standard pozzolana Portland cement concrete. All the mixes have exhibited satisfactory character in relation to segregation and bleeding. But with the increase in percentage of SF, the stickiness in concrete was observed.

2) Workability*:* In all the mix, the compacting factor, i.e, workability increases as percentage of SF is increased from 6%8% till 10%. SF concrete is just as susceptible to poor workmanship as ordinary concrete and all normal site operations should be performed to the optimum requirements

Table 1: Percentages of different mixes

MIX	% of cement		% of fine aggregate		% of coarse aggregate	
	Cement	Silica fume	F.A	tiles Powder	C.A	Crushed tiles
A0	100	00	100	00	100	00
M15	90	10	85	15	70	30
M25	90	10	85	15	70	30
M30	90	10	85	15	70	30

V EXPERIMENTAL PROGRAM
Total 9 type of mixes were prepared by changing percentage of replacement of cement by silica fume, waste crushed tiles and tiles powder in coarse and fine aggregates respectively as shown in Table 1. But we can replace with other materials to some extent. we can replacing the basic materials of concrete to some extent by the waste materials which are locally available like silica fume, waste tiles, demolition building materials, waste marble, by product etc which is a best method of disposing the waste materials. in this experiment we are using, silica fumes which is a by-product of silicon alloy manufacture, disposed ceramic tiles powder and waste ceramic crushed tiles.

MIX	% of cement		% of fine aggregate		% of coarse aggregate	
	Cement	Silica fume	F.A	tiles Powder	C.A	Crushed tiles
A0	100	00	100	00	100	00
M15	90	10	85	15	70	30
M25	90	10	85	15	70	30
M30	90	10	85	15	70	30

SLUMP CONE
Slump is a measure of consistency of fresh concrete. Slump test is a very simple test. Slump cone test was performed on all mixes to assess the replacing materials, replacing materials .workability of concrete for different percentages of replacing materials. Concrete cubes having size of 150 x 150 x 150 mm were prepared for all mixes to test 3 samples of a mix at 3,Compressive strength test is conducted on cubes after 3,7,21 and 28 days curing period, for each mix 3 samples were tested. Compressive strength of each mix is taken as average of the 3 samples 3,7,21, 28 days.

Table 2: Slump values of different concretes

mix	% replacement of fine aggregate	% replacing silica fume	% of coarse aggregate replaced	Slump (mm)
A0	0	0	0	100
M15	15	10	30	92
M25	15	10	30	83
M30	15	10	30	77

Slump cone test was performed on fresh concrete, for all mixes having different percentages of replacing materials which are shown in Table 1. The slump value for different mixes is obtained as follow. Shows slump variation for different mixes. Slump values are not changing when waste crushed tiles are replaced in place of coarse aggregate. But, increase in percentage of tile powder in place of fine aggregate leads to the increase in slump value. From the Fig.1 clearly observe that the workability isincreasing for all mixes at different percentages of replacing materials. There is a huge change in slump value when only tile powder was replaced in place of fine .aggregate. So, here tile powder is acting like admixtures,which are used to produce RMC mix.

B. Compressive Strength:
Compressive strength test was carried out by using compression Testing Machine to find the 3, 7,21 and 28 days compressive strength of the concrete. Samples from each mix were tested and average of these 3 is taken as the average compressive strength of each mix. The compressive strength results are as follows

Table 3: Values of compressive strength of concrete obtained from the tests

Mix	cement content (% of silica fume content)	fine aggregate content(% of ceramic powder content)	coarse aggregate content (% of crushed tiles content)	3days	7days	21days	28days
A0	00	00	00	8.74	14.51	18.70	21.89
M15	10	15	30	7.79	12.65	17.51	19.20
A0′	00	00	00	13.60	21.83	29.52	33.45
M25	10	15	30	11.89	19.35	27.89	31.25
A0″	00	00	00	16.30	25.54	35.43	38.89
M30	10	15	30	15.12	24.57	34.02	36.52

In the Table above table, A0 is the conventional concrete mix.

28days compressive strengths of mixes having 21.89 N/ mm^2 were decreased when silica fume and tile powder and crushed tiles are partially replaced at 10%, 15%, and 30%. compared to the compressive strength of the conventional mix for M15,M25,M30. replacing the cement by silica fume 10%,fine aggregate by waste tile powder 15% and coarse aggregate by waste crushed tile at about 30% are not given a optimum result results are quite satisfactory when percentage. of silica fume ,fine aggregate and coarse aggregate are use at about 8% , 10, 20, for compressive strength.

VI .CONCLUSION

* From the results of compressive strength tests on all the concretes cast by authors it is evident that when silica fume percentage is added to 10% along with (waste ceramic tile powder and chips both these items kept constant) the strength of concrete is decreasing compared to the normal concrete cast by the authors by using normal ingredients.

* Waste tiles powder can be used in place of fine aggregate partially, it increase the workability of concrete but it does not get true slump value when it use in a beyond the limits. There are minor workability when crushed tiles are used in place of coarse aggregate.

* After completion of all experimental programs, we concluded that, High performance concrete produced from cement replacement upto 8% silica fume leads to increase in compressive strength, of concrete. Beyond 8% there is a decrease in compressive strength of concrete. The compressive strength mainly depends on the percentage of silica fume because of its high pozzolanic nature to form more densely packed C-S-H gel. The optimum percentage of replacement of cement by silica fume is 8% and crushed tiles can be used in placed of fine and tiles chips can be used in place of coarse aggregate.

Based on workability test, the following observations were made:

1.concrete making with waste material (silica fume, waste ceramic tiles) results in light weight, economical, reduction in environmental pollution, good quality, high strength, durable and highly compact structure.

2. Increase in tiles powder leads to the increasing in workability of concrete.

3. Tile powder behaving like admixtures, which can be used to produce RMC mix.

REFERENCES:

[1] IS 10262–2009 : Indian Standard "Guidelines for concrete mix design proportioning" – code of practice

[2] Sensale GR., Strength development of concrete with rice husk ash, Cement and Concrete Composites,28(2), 2006, 158-160

[3] Mohammad IqbalKhana and RafatSiddiqueb, Utilization of silica fume in concrete: Review of durability properties, Resources, Conservation and Recycling, 2011,

[4] Dayalan. J, Beulah. M, "Effect of Waste Materials in partial replacement of cement fine aggregate and course aggregate inconcrete", International Journal of Inventive Engineering andsciences, ISSN:2319-9598, Issue-4, March 2014

[5] Zeena Adel Mohammed, "Effect of partial replacement of fine aggregate on some engineering properties of concrete"