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Temperature Effects on Curing Of Concrete Containing Silica

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Abstract – *In order to evaluate the increased effects of temperature on Concrete, this study along with comparison with normal cured concrete has been made. The silica fume was replaced with the cement and the dosage which gave the maximum strength was used for further addition of silica sand and steel fibers. The steam curing can be used as a effective tool where high early strength is required like road construction etc. In this literature the compressive strength at the age of 3,7 and 28 days was determined and was further compared with normal cured concrete and also split tensile test was also carried out to see the behaviour of concrete cylinder to the tensile effect. All the study was done for M30 grade concrete and for proper mixing of silica fume with cement super plasticiser was used and the water cement ratio was kept to be 0.45. The results obtained through the research work are thus presented in this paper.*

Key Words: ***concrete, mechanical properties, elevated temperature, admixtures, curing method.***

I- INTRODUCTION

The silica fume is discovered from ferrosilicon alloys. It can be either used in slurry from or it can be used in blended form. In any form the appreciable amount of strength can be obtained. The silica fumed concrete is the one which very less times shows the segregation and the problems like bleeding. Silica fume does not generally cause any reduction or increase in setting time. Concretes cured with elevated temperature have been found to have very regular structure in comparison to normal cured concrete. The silica fumed concrete also results in rich mix of the aggregate cement ratio.Silica fume consists concerning of the fine particles together with specific surface as regards six instances over cement due to the fact that its particles are too finer than that of the cement particles. At a typical dosage of 10 % of cement there will be 50000-10000 silica fume grains with that of cement grains.

II- EXPERIMENTAL PROGRAMEES

The Portland pozzolana cement is used in the research work.

Table 1: Shows the various ingredients present in the silica fume

Mineral Name	% present
Sio_2	93-94
Al_2o_3	0.5-2
Fe_2o_3	0.1-0.5
Mgo	0.4-1.6
Na_2o	0.4-0.9
K_2o	0.2-1.0
Cao	0.2-0.6
S	0.2-0.5
C	0.2-1.2
Loi	0.5-2.6

III- COMPRESSIVE STRENGTH

All the results for compressive strength are done on cube of size 150x150x150 mm dimension. And also the temperature of curing was kept to be 60°C and strength at the age of 3,7 and 28 days are determined which is also compared with normal cured concrete and the percentage increase of strength in comparison to normal concrete are also made.

3.1 Results of compressive strength

Table 2: shows the different % in which silica fume, super plasticizer, cement etc are added for the preparation of concrete mix in order to M30 grade concrete.

1	2	3	4	5	6	7	8
Mix1	0	398	730	1245	0	0.45	1.59
Mix2	10	381	730	1245	38.1	0.45	1.52
Mix3	12	365	730	1245	43.8	0.45	1.46
Mix4	14	351	730	1245	49.14	0.45	1.40
Mix5	16	339	730	1245	54.24	0.45	1.35
Mix6	18	323	730	1245	58.14	0.45	1.29
Mix7	20	311	730	1245	62.2	0.45	1.24

Column 1: % mix
Column 2: silica fume in %
Column 3: cement
Column 4: sand

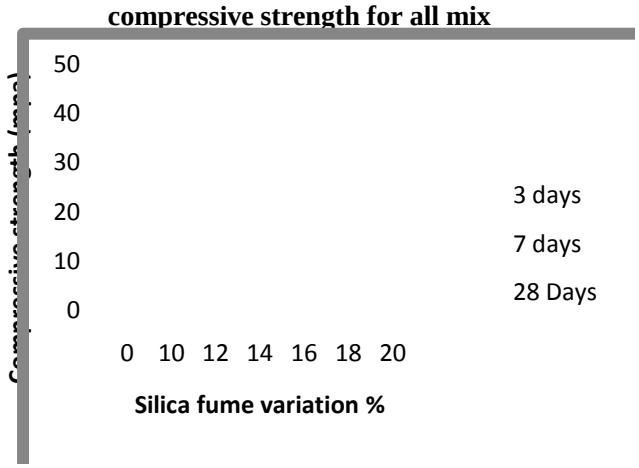
Column 5: Coarse aggregate
Column 6: silica fume in Kg
Column 7: Water-cement ratio
Column 8: Super plasticier

The test results comprises of average of 4 cube samples for all the tests which were carried out in this literature.

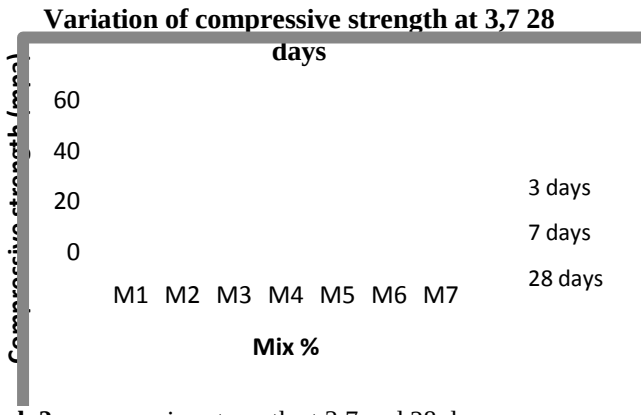
Table 3: Compressive strength for all concrete cube specimen

Mix	Slump (mm)	3 days strength	7 days strength	28 days strength
Mix1	64	22.36	26.58	34.67
Mix2	58	24.56	28.68	36.25
Mix3	56	24.90	29.65	37.58
Mix4	60	28.20	32.69	38.10
Mix5	51	26.52	31.22	37.22
Mix6	52	25.12	29.69	36.98
Mix7	58	24.99	29.32	36.22

On the basis of above results following graph shows the variation of strength at different ages for all mixes.



Graph 1 : Shows the variation for all concrete mixes at the age of 3,7 and 28 days.



Graph 2: compressive strength at 3,7 and 28 days

Table 4: Shows the results of conventional cured concrete

Mix	Slump (mm)	3days strength	7days strength	28 days strength
M1	60	12.20	18.32	30.56
M2	56	14.36	20.54	31.22
M3	55	14.98	21.58	32.58
M4	47	18.55	24.66	33.87
M5	51	16.47	22.55	32.95
M6	60	16.20	22.40	32.78
M7	63	15.77	21.69	32.01

From **Table 3** and **Table 4** the percentage increase in strength of steam cured concrete can be made
Table 5: shows the percentage increase in compressive strength of steam cured concrete in comparison with conventional concrete

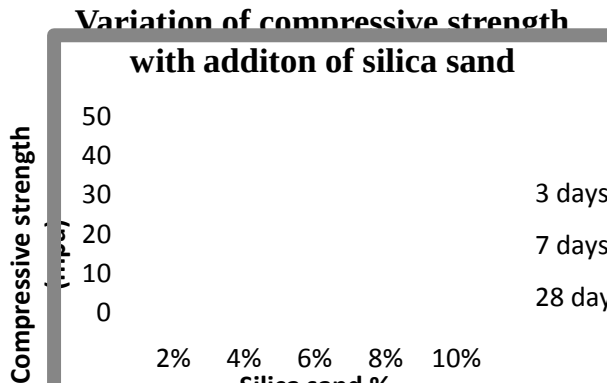
Mix	Increase in strength at 3 days	Increase in strength at 7 days	Increase in strength at 28 days
M1	42.79	30.39	14.32
M2	40.13	33.35	16.54
M3	42.97	31.32	19.58
M4	41.23	29.87	18.54
M5	39.57	28.54	17.02
M6	38.02	27.87	16.54
M7	36.54	25.02	14.21

From above results it is found that 14 % silica fume replacement by weight of cement gives the maximum strength and is further addition of silica sand and steel fibers.

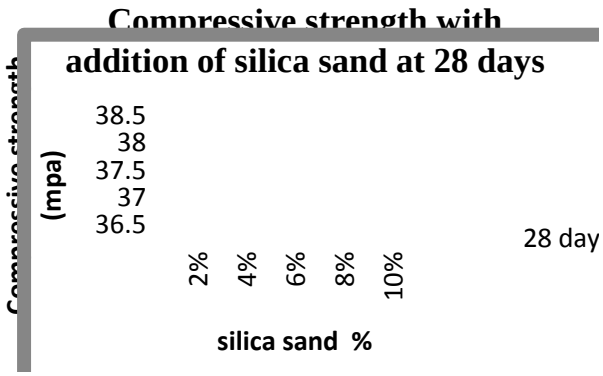
Silica sand is added in proportions (%) as 2, 4, 6,8,10 and silica fume 14 % is also kept constant.

Table 6: shows Variation of compressive strength with addition of silica sand

Mix	% Replacement	3 days strength	7 days strength	28 days strength
Mix8	2	23.45	27.97	37.20
Mix9	4	26.69	29.20	38.15
Mix10	6	25.60	28.30	38.05
Mix11	8	25.43	28.10	37.96
Mix12	10	24.60	27.54	37.55



Graph 3: Shows the variation of compressive strength at 3,7 and 28 days



Graph 4: Variation of compressive strength with addition of silica sand in different percentage for 28 days strength.

From above results it is found that 4% silica sand (silica fume 14% constant) gives the maximum compressive strength and is so selected for steel fibers addition.

3.2. Properties of steel fibers

Table 7: shows the properties of steel fibers

Length (mm)	Diameter (mm)	Aspect ratio
25	0.6	41.67

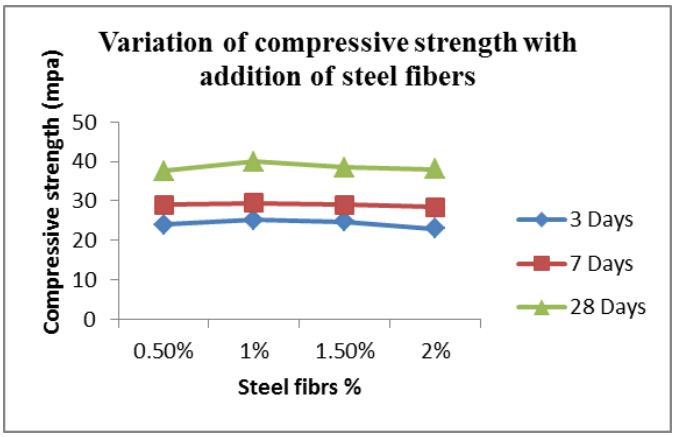
The steel fibers were added in concrete by dry weight of cementations' material

Mix designation	% of fibers added
M13	0.5
M14	1.0
M15	1.5
M16	2.0

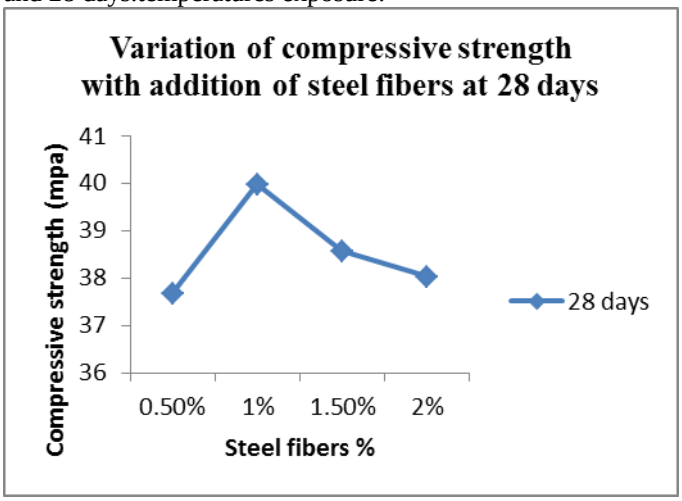
Table 8: shows the proportion in which the steel fibers are added in concrete (here silica fume (14%) and silica sand (4%) is kept constant)

Sr.no	Comp. str.3 Days (mpa)	Comp. str.7 Days (mpa)	Comp. str.28 Days (mpa)
M13	24.02	28.97	37.68
M14	25.22	29.55	39.98
M15	24.69	29.01	38.57
M16	23.00	28.50	38.02

Table 9: compressive strength after addition of steel fibers.



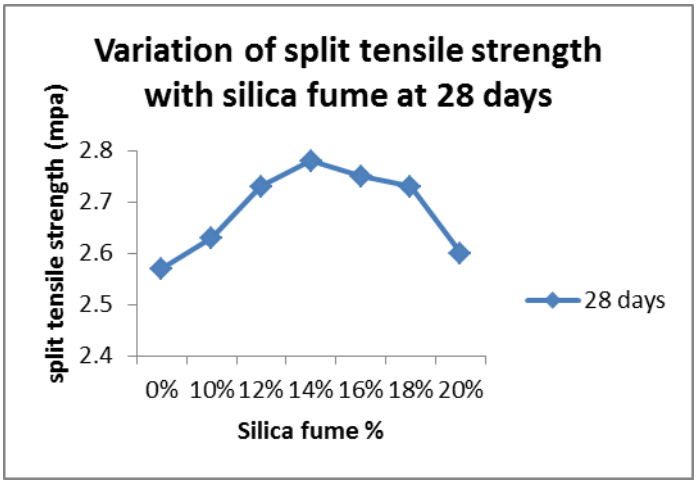
Graph 5: Shows the variation of compressive strength at 3,7 and 28 days.temperatures exposure.



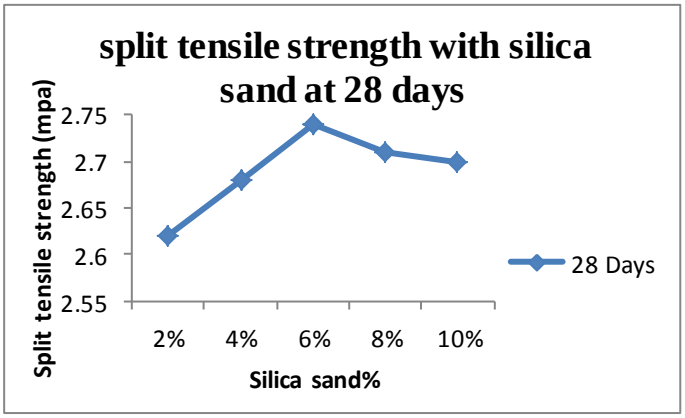
Graph 6: Variation of compressive strength at 28 days

4. SPLIT TENSILE STRENGTH

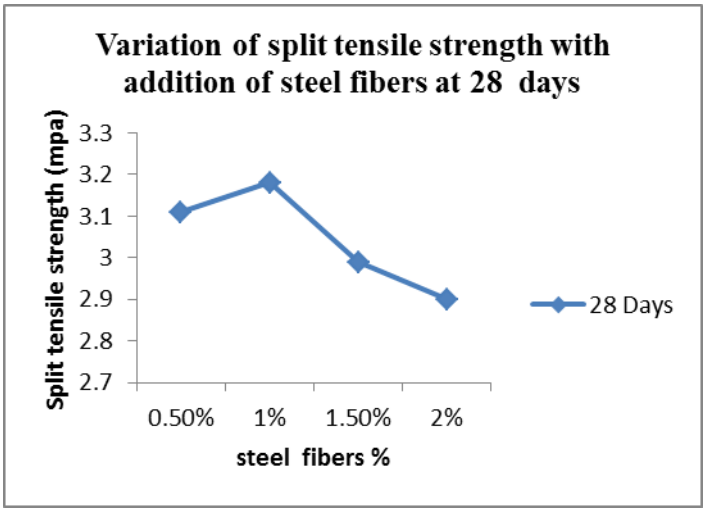
The split tensile test was done on cylinder having 150mm diameter and 300mm length.
As direct tensile test can't be performed on concrete therefore split tensile test is performed on concrete.



Graph 7:Split tensile strength after addition of silica fume



Graph 7: Split tensile strength with addition of silica sand (14% silica fume kept constant) at 28 days.



Graph 8: Split tensile strength at different percentage of steel fibers (14% silica fume and 4% silica sand kept constant) at the age of 28 days

V- CONCLUSION

1. It was found that there was drastic change in compressive strength of steam cured concrete and conventional concrete.

2. The percentage increase of steam cured concrete at 3 days was nearly 42% at 7 days it was 28% and at the age of 28 days it was 14% in comparison to conventional concrete.

3. The 14% silica fume gave the maximum compressive strength and was so selected as the % to be added to concrete for silica sand and steel fibers.

4. It was silicate hydrate reaction which was responsible for higher rate of gain of strength of cement in comparison to normal cured concrete as it taking place at very higher rate.

5. When it comes to split tensile strength the best combination was found to be 14% silica fume+ 4% silica sand+ 1% steel fibers.

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