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TO STUDY THE EFFECT OF PARTIAL REPLACEMENT OF FINE AGGREGATE BY SILICA

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***Abstract*— Silica fume is a byproduct of the smelting process in the silicon and ferrosilicon industry. It is also known as micro silica, condensed silica fume, volatilized silica or silica dust. It consists of very fine particles of amorphous silica.**

This waste is produced in bulk; we have been looking ways to recycle or dispose of them. Silica being an ingredient in the cement has been used as it enhances the strength properties of cement. It will reduce thermal cracking caused by the heat of cement hydration, improve durability against attack by sulphate and acidic waters, and increase strength.

In this project, we tried to study the extent up to which we could partial replace silica with fine aggregate to make sure it works as an admixture and doesn't have any negative effect over the engineering properties of concrete. So to achieve this replacement in the percentage of 0, 5, 10, 15% with that of fine aggregate is studied whose result obtained are discussed.

Index Terms— different concrete grade, curing, silica, compression test value, fine aggregate.

I. INTRODUCTION

The principal raw materials used in the manufacture of Ordinary Portland Cement are Argillaceous or silicates of alumina in the form of clays and shale's and calcareous or calcium carbonate, in the form of limestone, chalk and marl which is a mixture of clay and calcium carbonate. The ingredients are mixed in the proportion of about two parts of calcareous materials to one part of argillaceous materials and then crushed and ground in ball mills in a dry state or mixed in wet state. Silica is the part of argillaceous materials which is used one part in the mix. The role of silica in the cement is to impart strength properties but still the quantity up to which should be added is question marked. Silica fume is a byproduct of smelting process used. This is a waste by product, whose dumping is big issue as this by product is non biodegradable.

In this report firstly we check out the strength parameters of concrete without any partial replacement and then we check out strength parameter by partial replacement with silica fume by placing cube and cylinder on compression testing machine (CTM).

II. MATERIAL AND METHODS

For this study the various type of materials used in casting the different grade of concrete M30 are: fine aggregate, course aggregate, cement (OPC of grade 43), and water at normal temperature. Before using the material in the design of the mix various test were performed over the materials matching the IS code specification.

For the study 12 cubes in total were casted and mix design were prepared as per IS code. The curing of all the sample at the normal temperature is done. After 24 hours the specimens were removed from the moulds and placed in clean fresh water at a temperature of 270 C. The specimens so cast were tested after 7, 14 and 28 days of curing measured from the time water is added to the dry mix.

1. MIX DESIGN (M_{30})

The mix design was done as per IS code, quantity of various material in their respective proportion is used. Mix design is described below:

SR NO.	MATERIAL	PROPORTION
1	Specific gravity of cement	3.13
2	Specific gravity of coarse aggregates	2.80
3	Specific gravity of fine aggregates	2.35
4	Zone of fine aggregates	II
5	Water absorption of coarse aggregates	0.49%
6	Water absorption of fine aggregates	0.78%

Table 1: Proportion of Material Used

III. RESULT AND DISCUSSION

1. COMPRESSIVE STRENGTH TEST: Total 12 number of test specimens of size 150x 150x 150 mm were prepared for testing the compressive strength concrete in

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which for each grade 3 samples were prepared of same percentage. After completion of their curing period the test were performed whose result are discussed below:

Mix(%)	Average compressive strength after 7 days	Average compressive strength after 14 days	Average compressive strength after 28 days
0	18.11	22.87	26.20
5	19.34	23.40	31.44
10	21	29.65	34.93
15	18.3	26.68	30.20

Table 2: Compressive Test Result

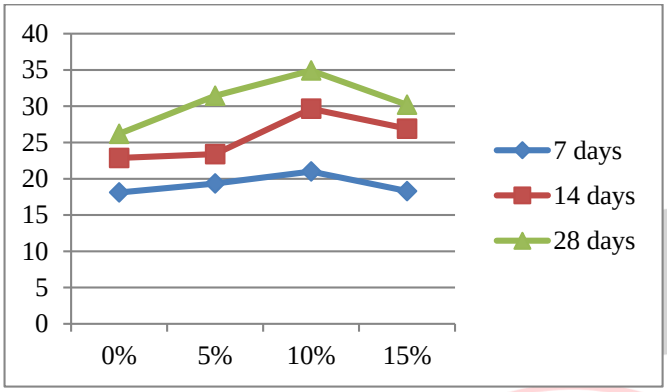

Figure 1: Comparison of compression test according to days

From above result, following information can be concluded:

- After adding 5% silica fume in the mix, there is an increase in the strength observed after performing compression strength test and same observed after testing done on 7 days as compared with the sample prepared without replacement or 0% replacement.
- By adding 10% silica fume, there is large amount of increase in strength after 7, 14 and 28 days respectively. The strength tends to increase with increase percentages of silica fume in the mix and decreases after there is an increase in the percentage of silica fume.

2. SPLIT TENSILE STRENGTH

Test specimens of size 100* 200 mm were prepared for testing the split tensile strength of concrete. The concrete mixes with varying percentages (0%, 5%, 10% and 15%) of silica fume as partial replacement of cement were cast into cylinders for subsequent testing. 12 number of sample were prepared whose result are discussed below:

Mix(%)	Average split tensile strength after 7 days	Average split tensile strength after 14 days	Average split tensile strength after 28 days
0	2.62	3.31	4.71
5	2.84	3.86	4.75
10	3.95	4.13	4.91
15	3.45	3.91	4.65

Table 3: Split Tensile Test

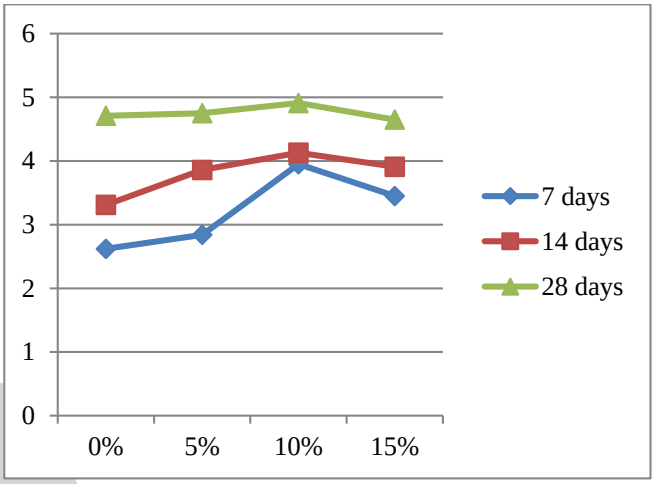

Figure 2: Comparison of STS

From above result, following information can be concluded:

- After adding 5% silica fume in the mix, there is an increase in the strength observed after performing split tensile strength and same observed after testing done on 7 days as compared with the sample prepared without replacement or 0% replacement.
- By adding 10% silica fume, there is large amount of increase in strength after 7, 14 and 28 days respectively. The split tensile strength tends to increase with increase percentages of silica fume in the mix and decreases after there is an increase in the percentage of silica fume.

IV. CONCLUSION

The optimum strength of cube is gained at 10% replacement for all 7, 14 and 28 days respectively. The optimum strength of cylinder is gained at 10% replacement for all 7, 14 and 28 days respectively. Till we replace 10% silica with cement there is increase in the strength but as soon as the percentage is increased the strength starts to fall. There should be balance in the ingredient of the cement for optimum result.

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