Study of concrete prepared using PPC, partially replaced by silica fume

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Abstract: **Considerable efforts are being taken worldwide to utilize local natural wastes and by-products in making concrete as supplementary cementing materials to improve properties(durability, strength). The effects of using silica fume as a replacement for cement has been investigated. This paper summarizes the experimental work of concrete in which Plane Portland cement (OPC) cement were replaced by silica fume (SF). Concrete specimens were prepared with 5%, 10%, 15% and 20% of SF as a replacement of cement weight, The most important mechanical property of concrete is compressive strength and it is evaluated on 150x150x150 mm cubes by The compressive strength is obtained for 28 day strength and results are analysed.**

Keywords: **Silica Fume, Plain Portland cement (P.P.C.), Compressive strength.**

I INTRODUCTION

It was observed and noted that since decade of years that the cost of building materials is currently so high that only corporate organizations, individual, and government can afford to do meaningful construction. Waste can be used as filler material in concrete, admixtures in cement and raw material in cement clinker, or as aggregates in concrete. Ordinary Portland cement (OPC) is acknowledged as the major construction material throughout the world. Due to growing environmental concerns and need to conserve energy and resources, considerable effects have been made worldwide to utilize local natural waste and by-products in making concrete e.g. silica fume as a supplementary cementing materials . The heavy aggregates(coarse and fine) must not react with the cement or contain materials that may adversely affect the strength of concrete made with those aggregates.

The aim of this project is to determine the optimum percentage (0, 5%, 10%,15% and 20%) of silica fume as as a replacement of cement for hardened concrete properties and , to compare the obtained results of the different types of concrete with gravel concrete regarding physical and mechanical properties on the properties of hardened concrete.

II LITERATURE REVIEW

Some of the early researches have examined the use of silica fume (SF) in concrete.

Joshi : observed that reduction in cement content at fixed water cement ratio was not detrimental to fresh and hardened concrete properties and may actually improve performance when silica fume was added as 10% by weight of cement content.

Ray: it is found that compressive strength increased by about 21%, flexural strength by 35% and split tensile strength by 10% when silica fume was added (5-12.5) % with a increment of 2.5% on a high slump concrete.

Ryell and Bickley (1987) :it has been deliberately used for other applications, such as to control potential alkali/aggregate reaction and to make very highstrength concrete.

Khedr and AbouZaid : Silica fume (micro-silica) has been recognized as a pozzolanic admixture that is effective in enhancing the mechanical properties and improving the chemical durability of concrete.

III EXPERIMENTAL PROGRAM

Materials Used: The various material used in the preparation of concrete are cement, sand, cement coarse aggregates, silica fume (SF) and water.

Silica Fume: Silica fume also known as microsilica, has been used as a concrete property enhancing material and as a partial replacement for OPC. Silica fume is a by-product in the production of silicon metal or ferrosilicon alloys. Silica fume is a very reactive pozzolan when used in concrete due to fine particles, large surface area, high silicon dioxide. Silica fume is obtained from BSP India , district- Durg (C.G.).

Table 1 .Typical physical properties of SF.

Property	Value
Appearance	Very fine powder
Colour	Light to dark grey
Mineralogy	Non-crystalline
Odour	Odourless
Specific gravity	2.2

Table 2. Typical chemical composition of SF

Compound	Percentage composition
Calcium oxide (CaO)	0.1
Silicon oxides (SiO2)	96
Aluminum oxide (Al2O3)	0.1
Iron oxide (Fe2O3)	0.6
Magnesium oxide (MgO)	0.2
Sodium oxide (Na2O)	0.1
Potassium oxide (K2O)	0.4
Loss on ignition (LOI)	1.7

Cement: Plain Portland Cement (43 Grades) which is available in market is used.

Fine Aggregate: The natural river sand available in local market which passes through 4.75mm sieve with specific gravity of 2.62. Conforming to Zone II.

Coarse Aggregate: Crushed granite conforming to IS 383 - 1970 is used in this study. Coarse aggregate passing through 20mm and retained on 16 mm sieve and specific gravity 2.82 was used.

Water: Water is an important ingredient of concrete as it actively participated in chemical reaction with cement, clean portable water which is available in our college campus is used.

Mix Proportion: The mixture proportion for the controlled concrete of M25 grade was arrived from the trial mix as per IS 10262-2009.

Table 3. mix proportions

S.no.	mix	Cement (Kg/m^3)	Silica fume (Kg/m^3)	Fine aggregate (Kg/m^3)	Coarse aggregate (Kg/m^3)	Water (Kg/m^3)	w/c ratio
1.	M0	372	0	692	1216	186	0.5
2.	M5	353.4	18.6	692	1216	186	0.5
3.	M10	334.8	37.2	692	1216	186	0.5
4.	M15	316.2	55.8	692	1216	186	0.5
5.	M20	297.6	74.4	692	1216	186	0.5

IV METHODOLOGY:

Replacement levels of PPC by SF of 0, 5%, 10%, 15% and 20 % were choosen for this research work. Batching was carried out by weighing as per calculated amount of each concrete constituent according to the mix ratio of 1:1.86:3.26 and M-25 grade of concrete was adopted. The constituents were then mixed thoroughly until a uniform mix was obtained. Water was then added and the mix was repeated. The fresh concrete mix was then placed in a mould of size 150x150x150 mm, compacted, and left for 24 hr. before testing Compressive specimens were tested at the ages of 7 and 28 days.

V RESULT AND DISCUSSION

Compressive Strength:-

The results of compressive strength presented in Table 4. The test was carried out obtain compressive strength of concrete at the age of 7 and 28 days. The cubes were tested using Compression Testing Machine (CTM) of capacity 2000KN available in structures lab. From Fig1 the compressive strength is up to 22.20 N/mm^2 and 31.12 N/mm^2 at 7 and 28 days. The maximum compressive strength is observed at 10% replacement of silica fume. If higher percentages of ash were used, then compressive strengths decreased. There is a significant the impurities present in SF like alumina , free lime and others.

Table 4. Compressive strength test result of RHA concrete at different ages.

S.NO.	Name of cube sample	Silica fume (%)	Average Ultimate Compressive strength(N/mm^2)	
			(7 days)	(28 days)
1.	M0	0	22.20	31.12
2.	M1	5	23.45	32.30
3.	M2	10	24.75	33.76
4.	M3	15	25.21	34.20
5.	M4	20	24.25	33.30

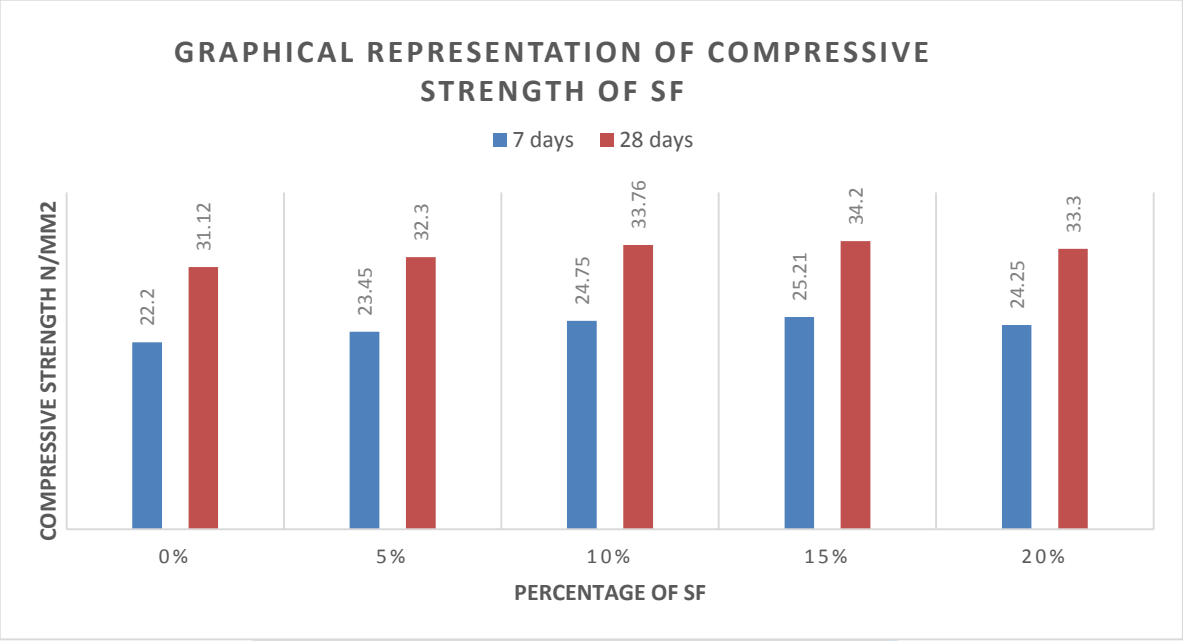

Figure 1. Relationship between compressive strength and different percentage of SF. at age of 7 and 28-days.

VI CONCLUSION

In this study, series of the experiments have been conducted on concrete with the addition of silica fume as partial replacement of PPC. In the SF was used as partial replacement of PPC in different percentage that is 0%, 5%, 10%, 15% and 20% of the dry weight of the cement. the experiments were conducted on M-25 grade of concrete as per relevant IS-code practice based on the test results obtained from this study the following conclusion can be drawn.

1. From the compressive strength test results, it is found that the higher strength is observed for the conventional concrete.
2. There is strength reduction with the addition of SF due to the impurities present in SF like free lime, loss on ignition and other raw minerals.
3. However, the strength attained with the mix of SF complies with the target strength up to a replacement of 10%.
4. When the SF addition is greater than 10%, the strength produced by the concrete gets reduced than the target strength.

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