EFFECT OF ALCCOFINE AND SILICA FUME ON STRENGTH PROPERTIES OF CONCRETE

Ravi Gaba[1], Devinder Sharma[2], Sanjay Sharma[3]

[1]Research Scholar PTU Jalandhar, India
[2]Director/Principal SIRDA Institute of Engineering Technology, Naulakha Sundernagar (H.P), India
[3]Professor & Head NITTTR, Chandigarh

Abstract: *This paper reports result of a study conducted to evaluate the effect of Alccofine and silica fume on the compressive strength, flexure strength and split tensile strength in concrete. Samples of M50 concrete (eg. Cubes, beams and cylinders) were made using calculate the Compressive Strength, Flexure Strength and Split Tensile Strength in Concrete. Concrete samples were prepared and cured for 3 days, 7 days and 28 days for compressive strength and 28 days for flexural and split tensile strength, and tested in the laboratory to destruction to determine their Compressive, flexural and tensile strength properties. When compressive strength of concrete with Alccofine 1206 and silica fume is compared, an increase of 11.11 in 3 days strength, 11.89% in 7 days strength and 16% in 28 days strength is found in Alccofine concrete as compared with silica fume concrete. When Flexural strength of concrete with Alccofine 1206 and silica fume is compared, an increase of 11.11% in 28 days strength is found in Alccofine concrete as compared to silica fume concrete. When Tensile strength of concrete with Alccofine 1206 and silica fume is compared, an increase of 33.93 % in 28 days strength is found in Alccofine concrete as compared to silica fume concrete.*

Keywords: Concrete, Compressive strength. Flexural strength, Tensile strength, Alccofine and Silica fume.

1. INTRODUCTION

Concrete is probably the most common material used in the construction industry in India and most countries of the world. The use of concrete structural elements can be easily found in buildings, highways/bridges, runways, jetties, etc. This has continued to place high demand for concrete materials with the need for research into locally available substitutes for conventional concrete constituent materials like river sand.

Due to rapid growth in concrete technology, high performance concrete is gaining world wide popularity in the construction industry since 1990. Practically high performance concrete is generally characterized by high cement contents and very low water cementitious ratio. Such type of concrete generally suffers from two types of major weaknesses. First one is its difficult to achieve proper workability, and second one is to retain the workability for sufficiently long time with such concrete mixes. To avoid such type of problems, it becomes necessary to use high dosage of high range water reducing agents (HRWR) and resulting cohesive and sticky mixes are equally difficult to place and compact fully and efficiently. It shows that the critical limit for the water content below which high HRWR dosage become not only essential but undesirable, and becomes harmful from durability point of view. Silica Fume and ALCCOFINE is generally proposed against HRWR where high strength, low permeability are necessary requirements. But silica fume is often negated by the increased water and / or admixture dosage for workability of the fresh concrete.

Laboratory tests have shown that the addition of an appropriate amount of silica fume, ALCCOFINE and a high-range water-reducing admixture (HRWRA) to a concrete mixture will greatly increase compressive strength and improve the properties of concrete.

Silica Fume is generally proposed as the appropriate cement extender where high strength, low permeability are the prime requirements. Though silica fume is known to improve durability, its addition in concrete is often negated by the increase water and/or admixture dosage required to improve the workability and handling properties of the fresh concrete.

ALCCOFINE 1203 is a specially processed product based on slag of high glass content with high reactivity obtained through the process of controlled granulation. The raw materials are composed primary of low calcium silicates. The processing with other select ingredients results in controlled particle size distribution (PSD). The computed blain value based on PSD is around 12000cm2/gm and is truly ultra fine. Due to its unique chemistry and ultra fine particle size, ALCCOFINE 1203 provides reduced water demand for a given workability, even up to 70% replacement level as per requirement.

Present study has been under taken because little work has been done on concrete with Alccofine and silica fume.

2. MATERIALS AND METHODS

A high strength concrete casting requires material cement, water, Fine aggregate, coarse aggregate, Alccofine, silica fume and structuro 203.

Ambuja cement PPC has been used in this investigation and was tested according to IS4031-1988. The cement supplied in 50Kg bags was well protected from dampness to avoid lumps. Specific gravity of cement was 3.14. The water used for mixing and curing was free of deleterious materials as per IS: 456-1978. Potable water was used both for preparing concrete specimens as well as for curing purposes.

Fine aggregates used for the study were locally available crushed stone sand which was obtained from crushing of hard stone at the crushing sites. It was tested as per IS: 383-1970. Specific gravity, fines modulus and grading zones of the fine aggregate was 2.66, 2.82 and zone-II respectively. Coarse aggregates used for this study was natural coarse aggregates (angular type of 10mm size). The various properties of the coarse aggregates as per specified in IS: 2386 (part1) -1963. Coarse aggregate of size 10mm and 20mm of specific gravity was 2.60 was confirmed to IS383-1987.

Alccofine 1206 having specific gravity 2.9 was used for this study. Silica fume with specific gravity 2.27 was used for this study. An admixture for mortar or concrete which imparts very high workability was prepared. Sulphonated Naphthalene Formaldehyde condensate CONPLAST SP-430 super plasticizer conforms to IS: 9103-1999. FOSROC Chemicals (India) is the manufacturer of CONPLAST SP430 super plasticizer.

2.1. CONCRETE MIX DESIGN

The mix proportions of M50 grade are given in table1.

2.2. CASTING, CURING AND TESTING

Casting, curing and testing of cubes, beams and cylinders of concrete was done as per relevant Indian Standard specifications IS516:1959. After the concrete mix was prepared as per mix design, concrete was poured in the concrete moulds (of cast iron) which had already been oiled with medium viscosity oil. Concrete was filled in the moulds in three layers and vibrated on the vibrating table each time. The size of cube 150x150x150mm, beam 100x100x500mm and cylinder 100x350mm.cubes for compressive strength testing were cured for 3,7, 28 days. However, beams and cylinders were cured for 28 days.

2.3. COMPRESSIVE STRENGTH TEST

For each set three standard cubes were cast to determine 3-days, 7-days and 28 day compressive strength after curing. Nine cubes were casted to know the compressive strength of concrete. Nine cubes each for cast of alccofine and silica fume were also casted. The size of the cube was as per the IS 10086 – 1982. The size of cube was 150mm x 150mm x 150mm.

Table 1. Mix proportions of M50 grade

Sr. No.	Materials	Quantity kg /m3
1	Cement(PPC)	460
2	Alccofine1206 or Silica Fume	69
3	Sand	800
4	Coarse aggreate10mm	460
5	Coarse aggreate20mm	690
6	Water	145
7	W/C ratio	0.315
8	Super plasticizer(SP430)	9.2

Fig. 1. Compression Testing Machine

Fig. 2. Flexure Testing Machine

Table 2. Compressive Strength of Cubes without Alccofine 1206 & Silica Fume

Samples	3-Days compressive strength (MPa)	7-Days Strength (MPa)	28-Days Strength (MPa)
Cube 1	15.2	18.4	46.8
Cube 2	18.4	21.4	48.8
Cube 3	15.8	19.0	40.8
Mean	16.46	19.6	45.5

Table 3. Compressive Strength of Cubes with SilicaFume

Samples	3-Days compressive strength (MPa)	7-Days Strength (MPa)	28-Days Strength (MPa)
Cube 1	28.0	34.2	53.2
Cube 2	26.0	38.2	50.0
Cube 3	27.6	35.6	51.2
Mean	27.2	36.0	51.5

Table 4. Compressive Strength of cubes with Alccofine1206

Samples	3-Days compressive strength (MPa)	7-Days Strength (MPa)	28-Days Strength (MPa)
Cube 1	32.4	42.8	61.2
Cube 2	28.9	39.6	60.0
Cube 3	30.5	40.2	62.6
Mean	30.6	40.9	61.3

Table 5. Flexural Strength of beams withoutAlccofine1206 and Silica Fume

Samples	28-Days Strength (MPa)
Beam 1	6.2
Beam 2	7.2
Beam 3	6.8
Mean	6.73

Table 6. Flexural Strength of beams with Silica Fume

Samples	28-Days Strength (MPa)
Beam 1	12
Beam 2	9
Beam 3	11.8
Mean	10.93

Table 7. Flexural Strength of beams with Alccofine1206

Samples	28-Days Strength (MPa)
Beam 1	16
Beam 2	12
Beam 3	11.8
Mean	13.27

2.4. FLEXURAL STRENGTH TEST

9 beams are casted for concrete, Alccofine concrete and silica fume concrete.100x100x500 mm cylinders for split tensile strength (28 days) are casted. It is the ability of a beam or slab to resist failure in bending. The flexural strength of concrete is 12 to 20 percent of compressive strength. Flexural strength is useful for field control and acceptance for pavement .but now a day's flexural strength is not used to determine field control; only compressive strength is easy to judge the quality of concrete. To determine the flexural strength of concrete 9 numbers of beams 100 mm were casting. Then it was cured properly. Flexural strength = PL/BD2. Where, P is load. L= Length of Prism. B = Breadth of Prism. D = Breadth of Prism.

2.5. SPLIT TENSILE STRENGTH

9 cylinders are casted for concrete, Alccofine concrete and silica fume concrete.100x300 mm cylinders for split tensile strength (28 days) are casted. After the casting, all the test samples were finished with steel trowel. All the samples were de-moulded after 24 hours and placed in water tank for curing as per IS requirement. All the samples were tested as per the IS-516-1991, methods of test of strength of concrete.

3. RESULTS AND DISCUSSIONS

Compressive strength of mix without Alccofine and silica fume in 3days, 7days and 28 days are much less when compared. There is an increase of 39.48% in 3 days strength ,45.56% in 7 days strength and 11.66% in 28 days strength when silica fume was used.

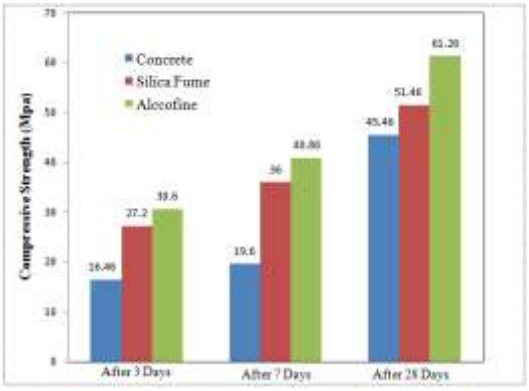

Fig. 3. Compressive strength

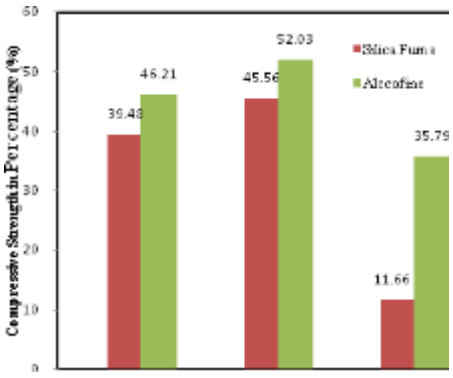

Fig. 4. Comparison of Alccofine and Silica fume Compressive strength in Percentage (%)

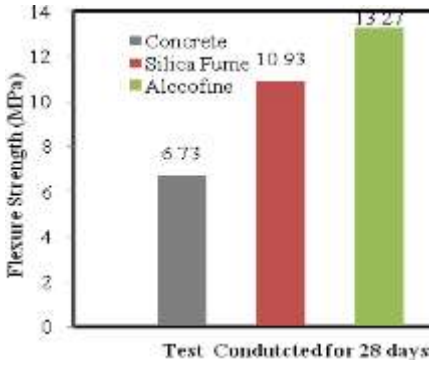

Fig. 5. Flexure strength after 28 days

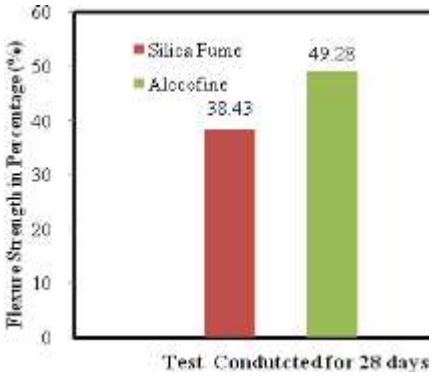

Fig. 6. Comparison of Alccofine and Silica fume Flexure strength in Percentage (%)

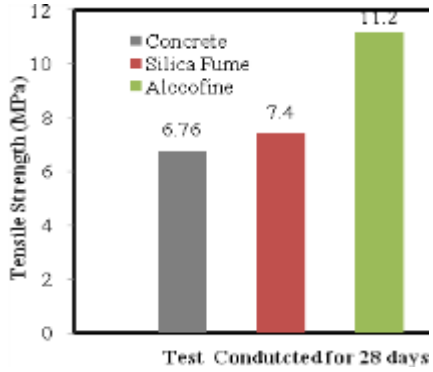

Fig. 7. Tensile strength after 28 days

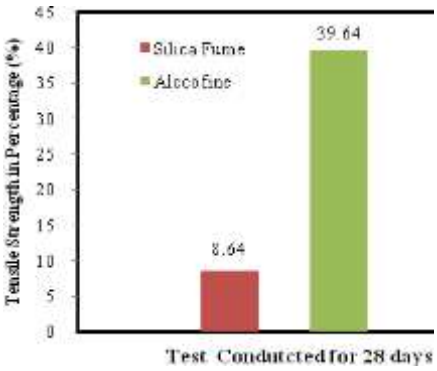

Fig. 8. Comparison of Alccofine and Silica fume Tensile strength in Percentage (%)

Table 8. Tensile Strength of cylinder without Alccofine1206 & Silica Fume

Samples	28-Days Strength (MPa)
Sample 1	6.3
Sample 2	6.8
Sample 3	7.2
Mean	6.76

Table 9. Tensile Strength of cylinder after 28 Days with Silica Fume

Samples	28-Days Strength (MPa)
Sample 1	8.4
Sample 2	7.6
Sample 3	6.2
Mean	7.4

Table 10. Tensile Strength of cylinder after 28 Days with Alccofine

Samples	28-Days Strength (MPa)
Sample 1	10.6
Sample 2	11.2
Sample 3	11.8
Mean	11.2

Similarly there is an increase of 46.21% in 3 days strength, 52,03% in 7 days strength and 25.79% in 28 days strength when Alccofine 1206 is used. When compressive strength in Alccofine 1206 and silica fume is compared, an increase of 11.11 in 3 days strength, 11.89% in 7 days strength and 16% in 28 days strength is found in Alccofine concrete as compared with silica fume concrete. Reason behind this is that Alccofine and silica fume gives denser packing.

Flexural strength of mix without Alccofine and silica fume in 28 days is much less as compared to Alccofine and silica fume when used in concrete. There is an increase of 38.43 % in 28 days strength when silica fume was used. Similarly there is an increase of 49.28% in 28 days strength when Alccofine 1206 is used. When Flexural strength in Alccofine 1206 and silica fume is compared, an increase of 11.11% in 28 days strength is found in Alccofine concrete as compared to silica fume concrete.

Tensile strength of mix without Alccofine and silica fume in 28 days is much less as compared to Alccofine and silica fume when used in concrete. There is an increase of 8.64 % in 28 days strength when silica fume was used. Similarly there is an increase of 39.64 % in 28 days strength when Alccofine 1206 is used. When Tensile strength in Alccofine 1206 and silica fume is compared, an increase of 33.93 % in 28 days strength is found in Alccofine concrete as compared to silica fume concrete.

4. CONCLUSION

The strength of concrete with Alccofine is greater than ordinary concrete. The concrete with Alccofine is found to be more workable than ordinary concrete. Alccofine is easy to use and can be added directly with cement. Ultra fine particles in Alccofine provide better and smooth surface finish. When compressive strength in Alccofine 1206 and silica fume is compared, an increase of 11.11 in 3 days strength, 11.89% in 7 days strength and 16% in 28 days strength is found in Alccofine concrete as compared with silica fume concrete. Reason behind this is that Alccofine and silica fume gives denser packing. When Flexural strength in Alccofine 1206 and silica fume is compared, an increase of 11.11% in 28 days strength is found in Alccofine concrete as compared to silica fume concrete. When Tensile strength in Alccofine 1206 and silica fume is compared, an increase of 33.93 % in 28 days strength is found in Alccofine concrete as compared to silica fume concrete. Thus, more increase in strength is found in Alccofine concrete as compared to silica fume concrete. No doubt, such materials can prove much beneficial in concrete industry.

REFERENCES

[1] Lam L, Wong Y.L. and Poon C.S., " Effect of fly ash and silica fume on compressive and fracture behaviors of concrete", Cement and Concrete research, vol. 28, no. 2, 1988, pp. 271-283

[2] Patel Yatin, Shah BK and Patel PJ, "Effect of Alccofine and Fly ash addition on the durability durability of high performance concrete", ISJRD vol. 1, issue 3, 2013 pp 594-598

[3] Pawar M.S., Saoji A.C., "Study the effect of alccofine in self compacting concrete", vol. 2, issue 6, 2013, pp 05-09

[4] Sellevold EJ., "The function of silica fumes in high strength concrete", Proceedings of International Conference on Utilization of High Strength Concrete, Stavanger, Norway; 1987. p. 39–50.

[5] Mazloom M. et al., " Effect of silica fume on mechanical properties of high-strength concrete", Cement & Concrete Composites, vol. 26, 2004, pp 347–357

[6] Almusallam A.A., "Effect of silica fume on the mechanical properties of low quality coarse aggregate concrete", Cement & Concrete Composites, vol. 26, 2004, pp 891–900.