To Study Effect of Cotton Fiber on Strength and Durability of Concrete using Mineral Admixture

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Abstract— This paper presents Split tensile strength and Durability characteristics of M20 grade concrete with use of cotton fiber and mineral admixture. Silica fume is used as mineral admixture in replacement of cement which effects on performance of concrete. Past few years, fibers and mineral admixtures are utilized to improve the performance of concrete. Super plasticizer is used to maintain the workability of concrete which is based on Sulphonated naphthalene polymers. Silica fume can be utilized to improve strength and durability properties of concrete. The Split tensile strength of cylinders determined at 7 and 28 days and Durability of concrete cubes at 56 days. Cotton fiber added by the weight of concrete and Silica fume in replacement of cement improves strength properties of concrete.

Key words: Cotton fiber, Silica fume, Conflow-SP, Split tensile strength, Sulphate attack test, Chloride attack test

I. INTRODUCTION

Cotton fiber is one of the specially processed products. Large amount of cotton wastes accumulated from countries that cause certain serious environmental problems and health hazards. Cotton fiber used as light weight construction materials in building industry.

Silica fume is very effective in mechanical properties of concrete. Utilization of silica fume as industrial product because it becomes attractive alternative to disposal due to increase environmental awareness and hazardous effects. Conflow-SP (Super Plasticizer) used to satisfy or maintain the workability of concrete which effected by mineral admixture.

This paper reports the results of an experimental investigation of Split tensile strength of concrete cylinders and durability of concrete cubes. Addition of cotton fiber varies from 0.2% to 0.5% and Silica fume 3% to 12% in replacement of cement improves property of concrete. The Split tensile strength determined 7 and 28 days and also minimum loss in weight and compressive strength of cubes for sulphate attack, chloride attack determined at 56 days.

II. EXPERIMENTAL PROGRAM

Experimental Program has been designed to provide results of Cotton fiber and mineral admixture with super plasticizer. To study effect of cotton fibers and silica fume as mineral admixture on the strength and durability of concrete have been studied in this investigation.

A. Material Used:

1) Cement:

Ordinary Portland Cement 53 grade (J. K. Laxmi Cement) have used in investigation was tested according to IS 4031:1988. It confirmed to IS 12269:1987.

Sr. No.	Properties	Value	As per IS:12269-1976
1	Specific Gravity	3.15	3.15
2	Normal Consistency	31%	30-35%
3	Initial Setting Time	39	>30
4	Final Setting Time	240	<600
5	Compressive Strength	29 (3 days)	>27
		40 (7 days)	>37
		54.9 (28 days)	>53

Table 1: Property of OPC 53 Grades

2) Fine and Course Aggregate:-

Fine aggregates sand is provided with maximum size of 4.75mm. Specific gravity of Fine aggregate is 2.60 and Fineness Modulus 2.9 with grading zone II. Coarse aggregate is 20mm size of used. Specific Gravity of Course aggregate is 2.62 and Fineness Modulus of coarse aggregate is 7.02.

3) Cotton Fiber:-

Cotton fiber brought to use in building industry as light weight construction material. Physical Properties of Cotton Fiber is given in Table.2.

Sr. No	Physical Properties	
1	Length	30mm
2	Dia.	0.2mm
3	Density	1.54g/cm^3
4	Water absorption	0.97%

Table 2: Physical Properties of Cotton Fiber

4) Silica Fume:-

Silica fume as mineral admixture used in concrete which is a highly pozzolanic material and its use have significant influence on mechanical properties of concrete.

Sr. No	Physical Properties	
1	Pozz, Activity index	88
2	Particle size	< 1µm
3	Specific Surface	18
4	Bulk Density	650

Table 3: Physical Properties of Silica Fume

Sr. No	Chemical Properties	
1	Sio2	90.2%
2	Moisture content	0.55%
3	Available alkali	1.52%
4	LOI	1.80%

Table 4: Chemical Properties of Silica Fume

5) Conflow-SP:-

Conflow-SP (Super plasticizer) which is maintains the workability of concrete. Use of Super plasticizer in concrete which production of very workable concrete and significantly influence on performance of concrete.

B. Mix Design:-

Cotton fiber 0.2%, 0.3%, 0.4%, 0.5% and Silica fume 3%, 6%,9%,12% . Conflow-SP will be constant 0.9% by the wt. of cement.

Material	Volume (Kg/m^3)
Cement	383
F.A.	546
C.A.	1212.4
Water	191.50
Conflow-SP	1.72
Proportion Ratio	(1:1.42:3.16)

Table 5: Mix Design of M20

C. Experimental Process:-

Combine and individual addition of cotton fiber and silica fume with different 25 mixes in this experimental work. The Specimen of standard cylinders (150mmX300mm) for Split tensile strength and also cubes (150X150X150mm) used for Sulphate attack and Chloride attack test. The binder ratio adopted was 0.50 concrete cylinders were cast for split tensile strength and cubes were cast for durability. Cylinders have tested for Split tensile strength after 7 and 28 days of normal water curing at atmospheric temperature. Cube specimens for durability have cure 28 days after 28 days curing cubes were taken out and allowed for drying 24 hours and weight are taken. For sulphate attack test 5% dilute Na_2SO_4 and for chloride attack test 5% dilute NaCl used. The cubes were to be immersed in both solutions for period of 28 days. After 28 days the specimen were taken out from acid solution. The minimum loss of weight and compressive strength of cube specimen due to sulphate attack and chloride attack was determined.

III. Results Obtained

The result of maximum Split tensile strength is given in Table 7 and also minimum loss in weight and compressive strength for sulphate attack test and chloride attack test is given in Table 8. The test was carried out conforming to IS: 516 – 1959 to obtain Split tensile strength.

Mix No.	Mix	Cotton Fiber (%)	Silica Fume (%)	Conflow-SP
1	C0S0	0%	0%	0.9%
2	C0.2S0	0.2%	0%	0.9%
3	C0.3S0	0.3%	0%	0.9%
4	C0.4S0	0.4%	0%	0.9%
5	C0.5S0	0.5%	0%	0.9%
6	C0S3	0%	3%	0.9%
7	C0S6	0%	6%	0.9%
8	C0S9	0%	9%	0.9%
9	C0S12	0%	12%	0.9%
10	C0.2S3	0.2%	3%	0.9%
11	C0.2S6	0.2%	6%	0.9%
12	C0.2S9	0.2%	9%	0.9%
13	C0.2S12	0.2%	12%	0.9%
14	C0.3S3	0.3%	3%	0.9%
15	C0.3S6	0.3%	6%	0.9%
16	C0.3S9	0.3%	9%	0.9%
17	C0.3S12	0.3%	12%	0.9%
18	C0.4S3	0.4%	3%	0.9%
19	C0.4S6	0.4%	6%	0.9%
20	C0.4S9	0.4%	9%	0.9%
21	C0.4S12	0.4%	12%	0.9%
22	C0.5S3	0.5%	3%	0.9%
23	C0.5S6	0.5%	6%	0.9%
24	C0.5S9	0.5%	9%	0.9%
25	C0.5S12	0.5%	12%	0.9%

Table 6: Optimum Dosages of Cotton Fiber and Silica Fume

Mix	Split tensile strength	
	7 Days	28 Days
C0S0	2.50 MPa	3.45 Mpa
C0.4S0	2.67 MPa	3.77 Mpa
C0S9	2.88 MPa	4.03Mpa
C0.3S6	2.79 MPa	3.96 Mpa

Table: 7 Maximum strength at 7and 28 Days

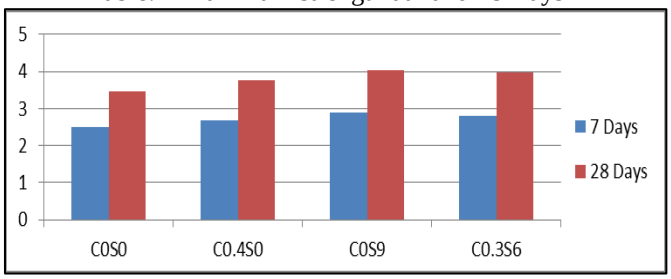

Fig. 1: Result of Split tensile strength

Mix	Sulphate Attack Test		Chloride Attack Test	
	Loss in wt. (%)	Loss in strength (%)	Loss in wt. (%)	Loss in strength (%)
C0S0	3.51	6.05	3.10	5.80
C0.4S0	2.10	3.14	1.66	2.68
C0S9	2.22	3.64	0.98	2.43
C0.3S6	2.05	2.82	1.93	2.62
C0.3S9	2.20	3.15	1.21	2.11

Table 8: Minimum losses in Weight and Compressive strength at 56 Days

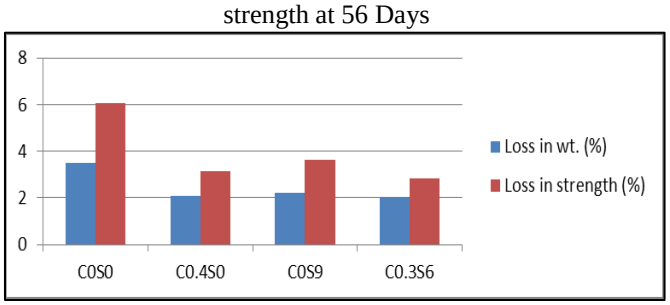

Fig. 2: Result of Sulphate attack

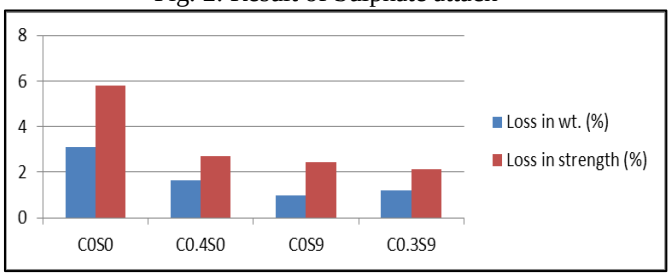

Fig. 3: Result for Chloride attack

IV. Conclusions

– In this study, Addition of only Cotton fiber 0.4% increase maximum Split tensile strength 6.80%

and 9.27% higher than normal concrete at 7 and 28 days.

- Addition of only Silica fume 9% increase Split tensile strength 15.20% and 16.81% higher than normal concrete at 7 and 28 days.
- Combine addition of Cotton fiber 0.3% & Silica fume 6% increase maximum Split tensile strength 11.60% and 14.78% in compare to the normal concrete at 7 and 28days.
- Minimum loss in weight 2.10% and compressive strength 3.14% by Sulphate attack test when addition of only cotton fiber 0.4% in M20 concrete at 56 days.
- Minimum loss in weight 2.22% and compressive strength 3.64% by Sulphate attack test when addition of only silica fume 9% in M20 concrete at 56 days.
- Minimum loss in weight 2.05% and compressive strength 2.82% by Sulphate attack test when combine addition of cotton fiber 0.3% and silica fume 6% in M20 concrete at 56 days.
- Minimum loss in weight 1.16% and compressive strength 2.68% by Chloride attack test when addition of only cotton fiber 0.4% in M20 concrete at 56 days.
- Minimum loss in weight 0.98% and compressive strength 2.43% by Chloride attack test when addition of only silica fume 9% in M20 concrete at 56 days.
- Minimum loss in weight 1.21% and compressive strength 2.11% by Chloride attack test when combine addition of cotton fiber 0.3% and silica fume 9% in M20 concrete at 56 days.

REFERENCES

[1] Algin, H.M. and Turgut, P.2008, "Cotton and Lime stone powder wastes as brick material, construction and building materials", 22(8): 1074-1080.
[2] T. Alomatri, I. M. Low, "Synthesis and characterization Properties in Cotton Fiber-Reinforced Geo-polymer composites", Journal of Asian Ceramic Societies, Vol.1, PP-30-34. (March 2013)
[3] Lewis, R. C. Hasbi, S. A., Use of Silica Fume Concrete: Selective case studies, Indian Concrete Journal, (Oct.2001)
[4] Nabil, M. and Al-Akharas. (2005), "Investigation of the effect of metakaolin (MK) replacement of cement on the durability of concrete to sulphate attack".
[5] Yogendra V, Langan BW, Haque M and Ward MA Silica on High Strength Concrete, ACI Material Journal, No.2, 84(1987)124-129.
[6] Ramasamy, V.; Biswas,s. "Mechanical properties and durability of rise husk ash concrete" International Journal of Applied Engineering Research December 1, 2008.
[7] Ghugal, Y. M., (2003), Effect of Steel Fiber on Various Strength of Concrete, Indian Concrete Institute of Journal,4(3),pp.23-29.
[8] Bhanja S. and Sengupta B. (2005), "Influence of Silica Fume on Tensile Strength of Concrete" Cement and Concrete Research,35,pp.743-747.
[9] Dinakar P, Babu K G and Manu Santhanam (2008), " Durability properties of high volume fly ash self-compacting concretes", Cement & concrete composites, Vol.30, pp. 880-886.
[10] Mohammad Iqbal Khana and rafat Siddiquieb, "Utilization of silica fume in concrete" Review of durability properties" Resources, Conservation and recycling, 2011, 57, 30-35.
[11] Shannag, M. J., Hussein A. Shaia (2003), "Sulphate resistance of high performance concrete, cement and concrete composites, 25, 363-369.
[12] Wee, T.H., Suryavanshi A.K., Wong S.F., "Rahman A.K.(2000), Sulphate resistance of concrete containing mineral admixtures", ACI material Journal, 97, 536-549.
[13] Khadilkar, S.A., and Kulkarni V.R., "Engineered fly ash based blended cement for durable concrete: A review, Indian concrete journal", April 2003, 1009-1021.

