REPLACEMENT OF CEMENT WITH SILICA FUME WITH ADDITION OF JUTE FIBER

Abstract - *The concrete is widely used construction material in the world. In conventional concrete, micro-cracks develop before structure is loaded because of drying shrinkage and other causes of volume change. When the structure is loaded, the micro cracks open up and propagate because of development of such micro-cracks, results in inelastic deformation in concrete. It has been recognized that the addition of small, closely spaced and uniformly dispersed fibers to the concrete would act as crack arrester and would substantially improve its compressive and split tensile strength properties. In this research, Natural available Jute fibers is being used in concrete. Thereby, the mechanical properties such as compressive strength, split-tensile strength were determined for M35 grade concrete and by varying percentage of fiber content from 0%,1%,2%, 3%,4%and 5% by volume of cement and 10% Cement is replaced by silica fume. The optimum length of fiber 5-10mm.. The mechanical properties such as compressive strength and split tensile strength with % Jute fiber were compared with conventional concrete properties of M35 grade. From the results it is observed that increasing % of fiber in concrete increases the compressive and split tensile strength of concrete.*

Keywords: *Concrete, Jute fiber, silica fume,Compressive Strength, Split-Tensile Strength*

1.INTRODUCTION

The concrete is a cement based material, Concrete is one of the most versatile building materials, with about two Billion tons of utilization worldwide during each year. Concrete is widely used in all types of infrastructural applications because it offers considerable strength. It can be cast to fit any structural shape in building. The advantages of using concrete include high compressive strength and good fire resistance for low maintenance and long service life. The

disadvantage of using concrete poor tensile strength, low strain of fracture and formwork requirement. The major disadvantage of concrete develops micro cracks during curing. It is the rapid propagation of these micro cracks under applied stress that is responsible for the low tensile strength of the material concrete is the most widely used construction material in the world. The production of Ordinary Portland cement, which is the binder material in concrete, is a highly energy-intensive process, and it is the most expensive and non-eco-friendly component in a concrete mixture. Mechanical properties of the concrete. To achieve this, engineers are looking for new generation of concrete.

2.MATERIALS AND METHODOLOGY

2.1Cement

It is very fine powder with adhesive properties The basic tests were carried out in accordance with relevant IS codes. Cement can be described as a crystalline compound of calcium silicates and other calcium compounds having hydraulic properties . The four major compounds that constitute cement are Tri calcium silicate(C_3S), Di calcium silicate (C_2S), Tri calcium aluminates (C_3A), Tetra calcium alumina ferrite (C_4AF) . Tri calcium silicate and di calcium silicate are the major contributes to the strength of cement together constituting about 70 % of cement. When mixed With the water for the chemical reaction take place and is referred to as ‘Hydration of Cement’. The products of this exothermic reaction are C-S-H and $Ca(OH)_2$. Calcium hydroxide has lower surface area and hence can not contribute much to the strength of

concrete. Fresh OPC 0f 43 grade conforming to Indian standard IS 8112 cement at 28 days tested as Ordinary Portland Cement (ACC Cement) of 43 grade used for preparing concrete specimens.

The properties of cement is used are given in the table.

Grade of Cement	Specific Gravity	Fineness sieve analysis	Standard Consistency	Initial setting time of cement (Min)	Final setting time of cement (Min)
43	3.12	6%	33%	32	408

Table no – 1 Properties of Ordinary Portland Cement

2.2 Silica fume

Silica fume is also called as micro silica and Silica fume, also known as micro silica is an amorphous (non-crystalline) polymorph of silicon dioxide, silica. It is an ultrafine powder collected as a by-product of the silicon and ferrosilicon alloy Silica Fume is a waste material that is products during the production of silicon and silicon alloy.

S.No	Properties	Value
1	Specific Gravity	2.25
2	Particle size (avg.)	0.1
3	Bulk Density	2.247 mg/m^3
4	SiO_2	93.38%
5	CaO	0.67%
6	Al_2O_3	0.15%
7	Fe_2O_3	0.21%
8	MgO	0.10%
9	SO_3	0.37%
10	Loss of ignition	1.46%

Table No – 2 Chemical Properties of Silica fume

2.3 Jute Fiber

Jute is the most affordable natural fibers. There are plenty of renewable resources obtainable from the plant kingdom, and a vast resource for different-diffrent natural fiber such as. Jute, Banana, Coir, *etc.* which are abundantly available in many parts of world. However, there are still a number of other vegetable fiber which have not been used as textile fiber. From the plant kingdom, one of the abundant sources of strong natural fiber of Jute.

S.No	Composition	Amount %
1	Cellulose	58-63
2	Hemi-Cellulose	20-24
3	Lignin	17
4	Fat and wax	0.3
5	Water soluble material	1.2

Table - 3 Chemical Composition of Jute fiber

S.No	Physical properties	Value
1	Ultimate jute length	1.5-4mm
2	Ultimate diameter of jute	0.015-0.002mm
3	Jute fiber length	150-300 cm
4	Jute color	Whit, yellow grey, brown
5	Strength of jute	3.5-5G/Den
6	Specific gravity	1.48
7	Dimension stability of jute	Good on Avg.

Table - 4 Physical Properties of Jute fiber

2.4 Aggregates

There are two types of aggregates mainly depending upon their size i.e. The sand is used as fine aggregate is used in the concrete. Various tests were conducted to determine the properties of fine aggregate the particle size distribution of fine aggregate as determined by a sieve analysis. The tests were done according to IS: 2386 (Part-1) –1963. Fine aggregate is

that aggregate which passed through the 4.75 mm sieve. Fine aggregate property is maintain to produce the maximum size of aggregate b/w 4.75mm,2.36mm, 1.18mm, 600 micron, 300 micron,150 micron, 75 micron, Pan

S.No.	Properties	Value
1	Specific Gravity	2.6
2	Water Absorption	0.82%
3	Zone	II

Table – 5 Fine Aggregate

Coarse Aggregates are commonly considered inert filler, which accounts for 60 to 80 % of the volume and 70 to 85 percentage of the weight of concrete. Maximum size of aggregate affects such as workability and strength of concrete. In this study the natural coarse aggregates are used, which was bought from the nearby quarry. Aggregates of 20 mm passed and 12.5 mm retained size were chosen for the experiment which is clean and free from deleterious materials. The following shows the tests conducted order to determine the properties of this aggregate.

S.No	Properties	Value
1	Specific Gravity	2.65
2	Water Absorption	0.3
3	Type	Crushed stone
4	Impact Value	12.97

Table No – 6 Coarse Aggregate

2.5 Methodology

The mix design for the M35 grade of concrete was carried out based on the guidelines given in IS 10262-2009 and IS 456-2000. The target slump was selected as 100 and water cement ratio of 0.5 was kept constant. After many trials, based on strength and workability, the final mix proportion for shown the given table. Slump Test values determined from the experimental results are given below.

s.no	Material	Quantity
1	Cement	394.00kg/m^3
2	Water	197 L or kg/m^3
3	F.Aggregate	687.356kg/m^3
4	C.Aggregate	1170.368kg/m^3
5	W.C.Ratio	0.50

Table No – 7 Mix Proportion

3. RESULT AND DISCUSSION

3.1Slump Test

Slump Test values determined from the experimental results are given below

S.No.	Mix	Jute fiber	Silica Fume	Value of Slump
1	M0	0%	0%	82mm
2	M1	1%	10%	73mm
3	M2	2%	10%	71mm
4	M3	3%	10%	68mm
5	M4	4%	10%	61mm
6	M5	5%	10%	62mm

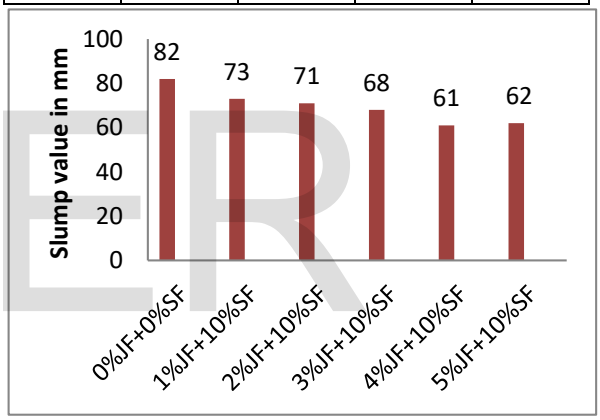


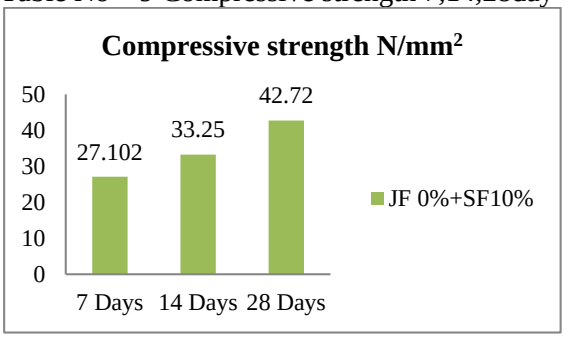
Table No – 8 Value of Slump Test

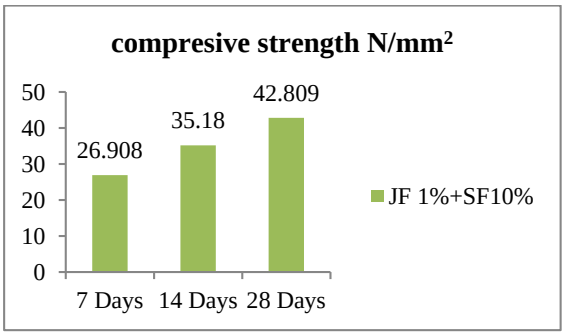
Graph for slump test

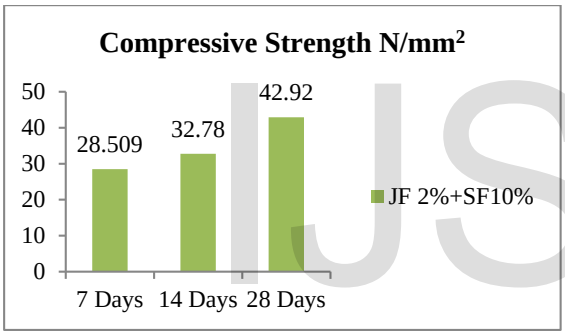
3.2 Compression Strength

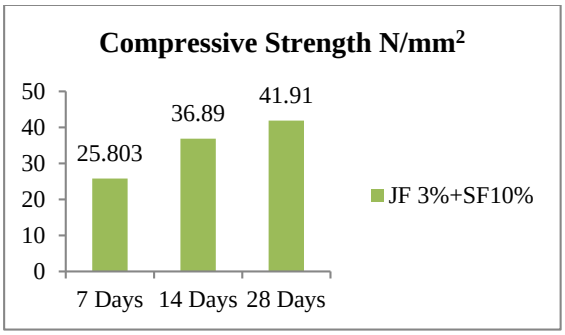
Compressive strength of concrete is conducted as perIS:516 - 1959 for testing the concrete cube specimens with different contents of silica fume addition of Jute fibers for different periods of day such as 7,14, 28, days. The results of compressive strength test for different curing periods are as shown in Table and graph.

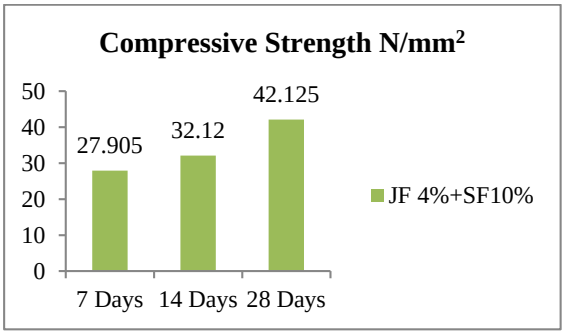
Table No – 9 Compressive strength 7,14,28day



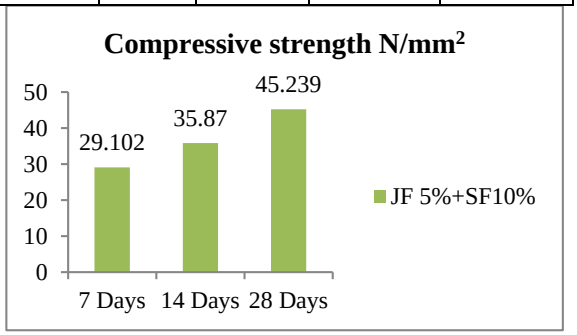








%of Jute Fiber	Silica fume	Compressive Strength N/mm^2		
		7 Days	14 Days	28 Days
0%	0%	27.102	33.250	42.720
1%	10%	26.908	35.180	42.809
2%	10%	28.509	32.780	42.920
3%	10%	25.803	36.890	41.910
4%	10%	27.905	32.120	42.125
5%	10%	29.102	35.870	45.239

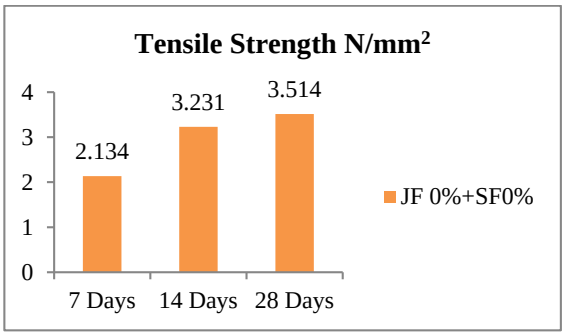


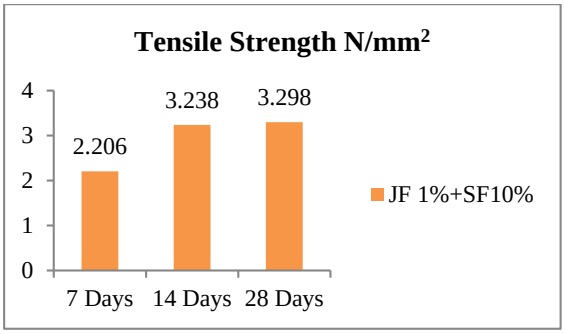
3.3 Tensile Strength

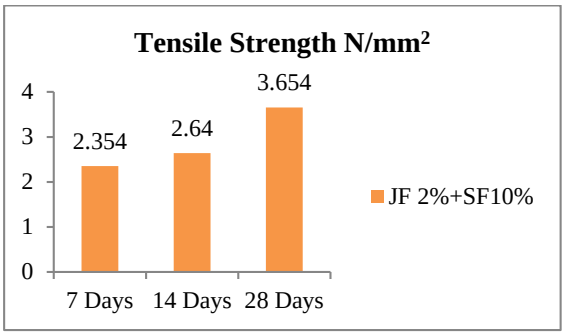
Tensile strength of concrete is conducted as per IS: 5816 - 1999 for testing the concrete cylinder specimens with different contents of silica fume addition of Jute fibers for different days such as 7, 14,28, days.

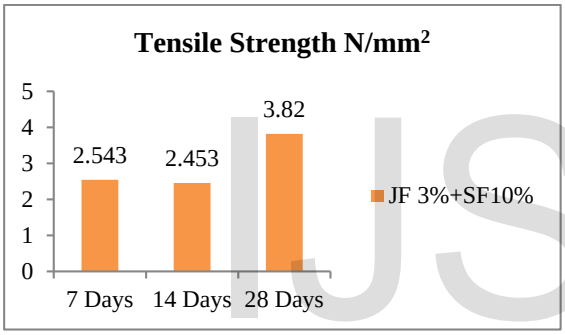
%of Jute Fiber	Silica fume	Tensile Strength N/mm^2		
		7 Days	14 Days	28 Days
0%	0%	2.134	3.231	3.541
1%	10%	2.206	3.238	3.298
2%	10%	2.354	2.640	3.654
3%	10%	2.543	2.453	3.820
4%	10%	2.612	3.421	3.981
5%	10%	2.890	2.398	3.821

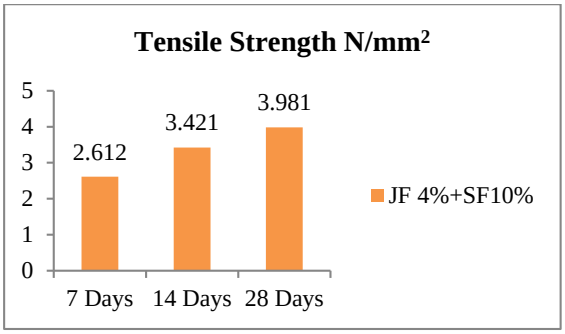
Table no – 10 Tensile Strength for 7,14,28 Days

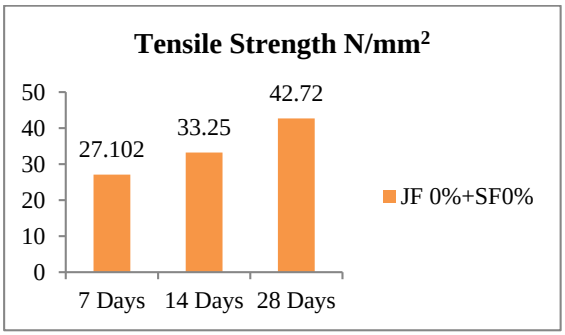












4.CONCLUSION

- The test results shows that 0%,1%,2%,3%,4% and 5% of addition of Jute fiber With replacement of cement with 10% silica fume shows the increasing in compressive and tensile Strength.
- For a constant w/c ratio i.e 0.5 increase the content of jute fiber, the workability of concrete decrease.
- The compressive strength and Tensile is been increased From 45.239 N/mm^2 and 3.981 N/mm^2 for 5% to 45.239 N/mm^2 and 3.981 N/mm2 for 4 % Jute fiber.
- It has been observed that the workability of concrete decreases with the addition Jute fibers with normal concrete.
- The compressive strength of specimens gradually increased with the increase percentage of Jute fiber in concrete.

5. SCOPE FOR FUTURE RESEARCH

A detailed study of the microstructure at specific intervals throughout a year can give a very good idea about the reactions taking place in the concrete. Looking at the price of the Jute fiber new methods can be designed for its production at a low cost.

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