COMPARISION OF COMPRESSIVE STRENGTH OF CONCRETE WITH CARBON NANO TUBE AND WITH SILICA FUME WITH REPLACEMENT BY WEIGHT OF CEMENT

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Abstract: Concrete is very important material in construction point of view. Concrete is homogeneous material consists of cement, sand and aggregate and water in some definite proportion. High-performance concrete is a term used to describe concrete with special properties not attributed to normal concrete. High-performance means that the concrete has one or more of the following properties that is low shrinkage, low permeability, or high strength. For extremely high impact strength, Concrete mix designs replacing cement by using (0.001%, 0.005%, 0.01%, 0.05 and 0.1%) CNT along with silica fume with (3%, 6%, and 9%) in M40 grade concrete. Experiments will be performed to check the properties and optimum % of CNT and silica fume such as compressive strengtth of concrete and the results were compared with normal concrete.

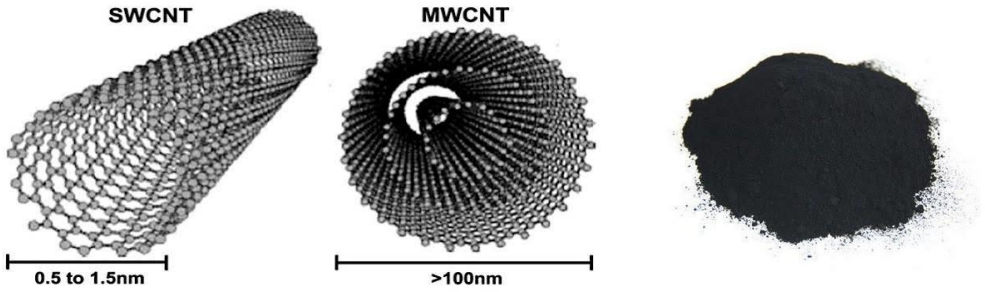
Index Terms **-Concrete, Carbon nano tube, Silica fume, Strength, Workability.**

I. INTRODUCTION

Concrete is very important, very strong and versatile material in construction point of view. Concrete is the one of the most artificial material which is used all over the world in various construction projects of highways, dams, bridges, buildings ect. Strength and durability of concrete is most essential criteria to check. Concrete is made up of basic component like Coarse aggregate, Fine aggregate, cement and water. Cement usually in powder form act as a binding agent when mixed with water and aggregate. Aggregate occupies most of the volume in concrete and is the stuff material that binds the cement paste coats and bind together. Water chemically reacts with cement to produce the desired properties of concrete. Mixing water is the quantity of water that comes in contact with cement, impacts slump of concrete and is used to determine the (w/c) of the concrete mixture. Strength and durability of concrete is controlled by its water cement ratio. Water absorbed by aggregates is excluded from mixing water.

Carbon nano tube: Sumio Iijima in 1991 in Japan NEC was first discovered the presence of carbon nanotubes

CNT is the black graphite powder manufactured by heating carbon particles in rice mill. CNT is stronger than steel. CNT must be found to fill void in concrete to get high increase in compressive, tensile and flexure strength of concrete. Additions with proportion of silica fume by mass of cement, increase strength of concrete. To high of a concentration of CNT decrease strength of concrete. Single graphene rolled available. Single Walled Carbon Nanotubes are defined as one dimensional, cylindrically shaped allotropes of carbon that have a high surface area and aspect ratio (length to diameter ratio). They are made of one-atom-thick nano carbon sheets and are members of the fullerene family. Multi-walled nanotubes consist of multiple rolled layers of graphene. The interlayer distance in multi-walled nanotubes is close to the distance between graphene layers in graphite, approximately 3.4 Å.



Silica Fume: Silica fume is a by-product of the ferrosilicon industry, is a highly pozzolanic material that is used to enhance mechanical and durability properties of concrete. Material composed of at least 85% ultra-fine, amorphous non-crystalline (glassy) spherical silicon dioxide (SiO2) particles. It is produced as a by-product of silicon metal or ferrosilicon alloys by reduction of high quality of quartz in a submerged –arc electric furnace heated to 20000C with coal coke and wood chips as fuel. The effect of silica fume can be experienced by two mechanisms-the pozzolana reactions and the micro filler effect.

II. OBJECTIVES

- To evaluate its fresh properties and hardening properties of cnt/silica fume concrete compare with normal concrete.
- To find the optimum percentage of CNT and silica fume.
- To check the Durability of CNT/cement composite with silica fume

III. LITERATURE REVIEW

[3]H.K. Kim, I.W. Nam, H.K. Lee, investigated mechanical and electrical property of cement composites with CNT and silica fume. Amount of CNT and silica fume is in % by wt. of cement, 0%, 0.15%,0.3% and 0%,10%,20%,30% respectively. Surface morphology and microstructure is investigated by SEM images. CNT cement composite without silica fume results insignificant results on strength and small amount of silica fume added than compressive strength is increase.
More amount of the silica fume with CNT cement composite decrease in strength

[8]Sanjeev Kumar,PrabirKolay, Sunil Malla,and Sanjay Mishra. Investigated various cement –CNT composites are prepared by replacing 0.5%,0.75%,1.0%. Different test such as compressive, tensile strength, flexural strength, and freezing and thawing resistance on CNT composite were conducted. Cylindrical specimen of approximately 15.8* 31.6 mm and beam specimen 20*20*80mm. Specimen tested at 7,28,60,90,180 days of curing with CNT 30 min and 240 min sonicated time. As per results compression and flexural strength were increase At 0.05% CNT added to the cement with control mix.

[7]S. Alrekabi1, A. Cundy2, Raymond L.D. Whitby3, A. Lampropoulos1, I. Savina4 investigated the study on multiwall carbon nanotube and USF on microstructure of cementitous composite has been study. USF used to enhanced dispersion of MWNT .percentage of CNT and USF by wt. of cement is 0%,0.025% and 0%,10% respectively. Microstructure investigated by SEM images. As per that results micro silica is better perform with CNT cement composite to reduce agglomeration effect compare to 0% silica with CNT cement composite .silica fume improve the interfacial interaction between CNT and matrix..

[6]María del Carmen Camacho, Oscar Galao, Francisco Javier Baeza, Emilio Zornoza and Pedro Garcés Change in Mechanical property of cement based mortar due to addition of CNT particles and corrosion of embedded steel rebar in CNT cement paste are mansion. Bending strength, compression strength, porosity and density of mortar were determine related to CNT dosage(0%,0.1%,0.2%,0.3%,0.4%,0.5%) As per graph bending strength at 28 days curing is higher compare to 7 days curing with optimum 0.05% optimum CNT content. In compression strength also same as bending strength. Corrosion potential is decrease in 0.05% and higher in the 0% CNT

[2]Dr. B.VIDIVELLI1, B.ASHWINI2 In present study CNT as 0.15 to 2% by wt. of cement or water integrating on strength characteristics and durability of the concrete. Tensile, compressive strength, durability and bending test have been conducted even cement have different type of shape inside the structure still voids are present. There by nano tubes are used to fill the observed at nano scale. Addition of small amount of CNT (1%) increase the mechanical property of samples. oxidized MWNT shows the best results which increase both compressive (+25 n/mm2) and flexural strength (+8 n/mm2) compare to without CNT sample.

[3]Lakhbir Singh1, *Arjun Kumar1, Anil Singh2 This study is an experimental on the nature of silica fume and its influence on the property of fresh concrete. The partial replacement of cement by silica fume the strength of the concrete has been studied. Silica fume were used to replace 0% to 15% of cement by wt. of increment 5%. Strength of the concrete increase rapidly as we increase silica fume content. The optimum value of silica fume is 10% silica fume with compare to other in compression test and split tensile strength test after adding 10% of silica fume strength is decreased. Test was performed at 7, 14, and 28 days with and without silica fume.

[1]Arnon Chaipanich, RattiyakornRianyoi, Thanongsak Nochaiya This paper report the carbon nano tube on compressive strength and flexural strength of portland cement silica fume carbon nano tube cement mortar. Percentage of MCNT (produce by Chemical vapour deposition) is taken up to 1% and % of silica fume is taken 10%.sample tested at 28 days curing. Water to binder ratio is 0.5 same in all the mortar mix. Silica fume also gave a high compressive strength but when adding carbon nano tube also increase in strength. In that case optimum CNT % is 0.5. it is shown that strength of CNT mortar with SF is depends upon the dispersion of CNT particles in concrete.

IV. MATERIAL AND METHODOLOGY:

Fine Aggregate:The naturally available river sand used as fine aggregate. The properties of FA were determined by conducting tests as per IS 2386 (Part- I).

Table 1 Physical Properties of Fine Aggregate

Properties.	**Sand**
Sieve analysis	Zone II
Fineness modulus.	3.01
Specific Gravity.	2.67
Water Absorption.	1.1
Bulk Density.	1332 (Loose) 1615.66(Compacted)

Coarse aggregate: Crushed coarse aggregate conforming to IS 383-1987 was used in study. Coarse aggregate of size 20mm and10 mm were used. Properties of aggregate extremely affect on properties of concrete such as strength, durability and economy. Good grading of aggregates is required to satisfy the needs of gap grading that result in to fewer voids, ultimately increasing the strength of concrete with the same materials

Table 2 Physical Properties of Course Aggregate

Properties	**20mm**	**10mm**
Specific Gravity	2.81	2.78
Water Absorption	0.97	0.91
Aggregate Impact Value	14.35	11.19
Aggregate Crushing Value	17.37	12.81
Aggregate Abrasion Value	17.40	13.36
Flakiness Index	10.70	12.74
Elongation Index	12.34	11.96

Table 4 Mix Proportion for M40 Grade of Concrete

Water	**Cement**	**Sand**	**Aggregate. Proportions as per table 2 of IS 383**	
			0.60	**0.40**
			(20mm)	**(10mm)**
160.425	433.58	663.42	764.5749	509.716648
0.37	1	1.53	1.7634	1.1756

RESULTS

Workability:

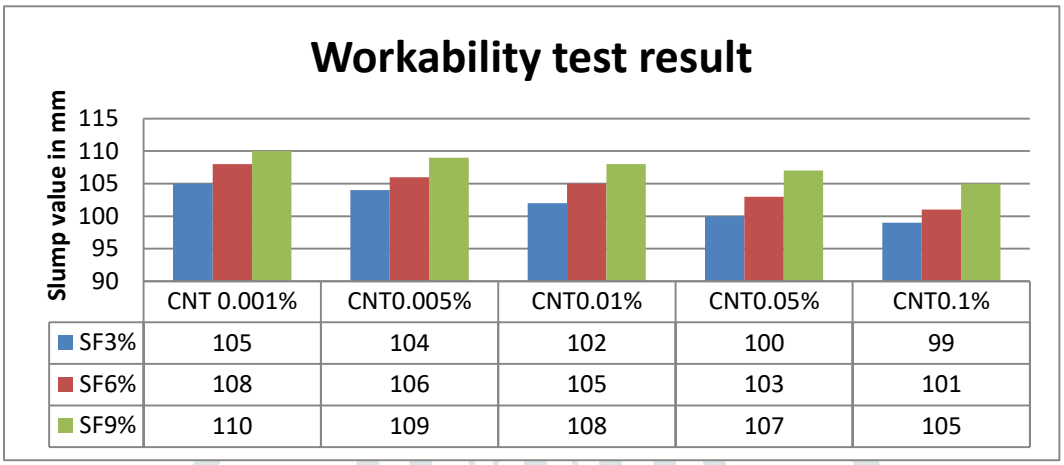
- The concrete slump test measures the Workability of fresh concrete before it sets.
- It is performed to check the workability of freshly made concrete, and therefore the ease with which concrete flows.
- It can also be used as an indicator of an improperly mixed batch.
- The slump test is used for the measurement of a property of fresh concrete as per IS: 1199 - 1959.

Table 5 Slump Test Results

Variations	**Slump Value (in mm)**
	M40 Grade
S_0CNT_0	**95**
$S_3CNT_{0.001}$	**105**
$S_3CNT_{0.005}$	**104**
$S_3CNT_{0.01}$	**102**
$S_3CNT_{0.05}$	**100**
$S_3CNT_{0.1}$	**99**
$S_6CNT_{0.001}$	**108**
$S_6CNT_{0.005}$	**106**
$S_6CNT_{0.01}$	**105**
$S_6CNT_{0.05}$	**103**
$S_6CNT_{0.1}$	**101**
$S_9CNT_{0.001}$	**110**

$S_9CNT_{0.005}$	109
$S_9CNT_{0.01}$	108
$S_9CNT_{0.05}$	107
$S_9CNT_{0.1}$	105

Fig. 2 Slump Values Comparison



Compressive Strength Test:

- Determination of compressive strength of concrete using by cube where size of cube specimen is 150×150×150 mm and this test was performed on a 2000 KN capacity compression testing machine.
- Bureau of Indian Standards suggests that the compressive strength of concrete be considered as the basis for determining all properties and studying response of concrete. As such more emphasis was given on this test. The compressive strength of concrete was evaluated at the age of 3 days, 7 days and 28 days.
- The compressive strength of cube specimen is calculated by using the following formula:

$$\sigma = P/A$$

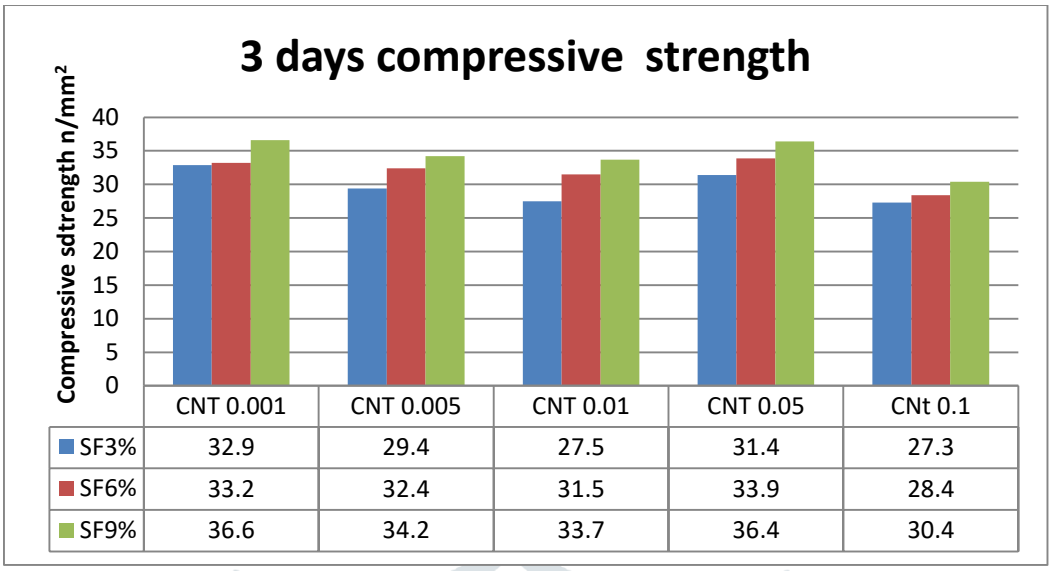
Where, P = failure load

A = cross sectional area of cube in mm

Table 6 Compressive Strength Test Result

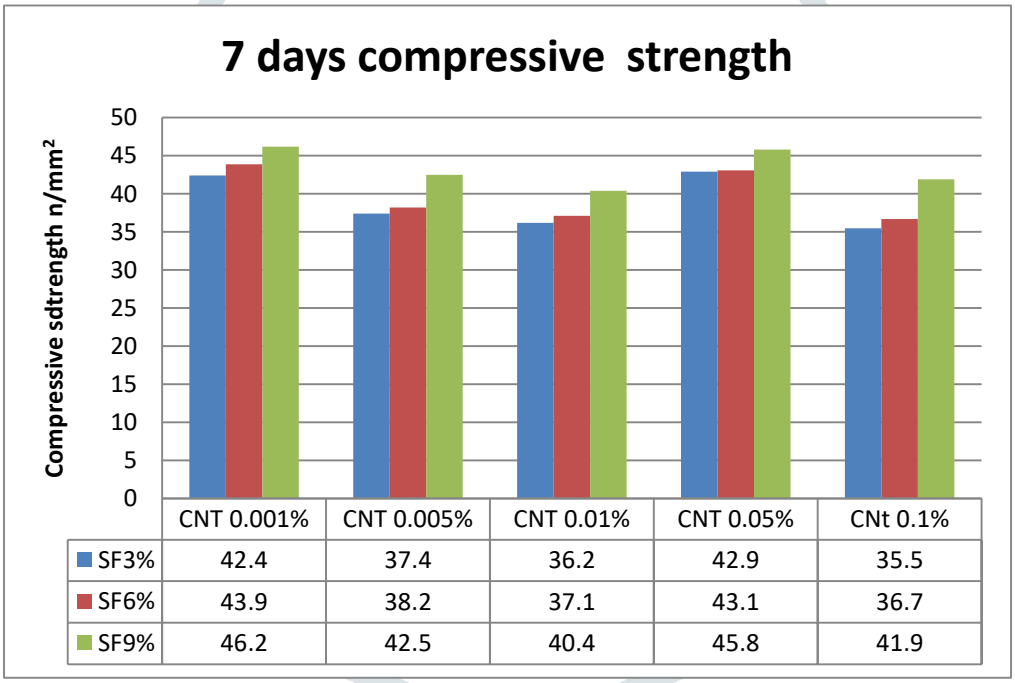
MIX	Compressive strength N/mm^2 in Days		
	3	7	28
S_0CNT_0	24.7	38.8	54.4
$S_3CNT_{0.001}$	32.9	42.4	58.1
$S_3CNT_{0.005}$	29.4	37.4	53.8
$S_3CNT_{0.01}$	27.5	36.2	52.4
$S_3CNT_{0.05}$	31.4	42.9	57.4
$S_3CNT_{0.1}$	27.3	35.5	51.1
$S_6CNT_{0.001}$	33.2	43.9	62.7
$S_6CNT_{0.005}$	32.4	38.2	59.5
$S_6CNT_{0.01}$	31.5	37.1	56.2
$S_6CNT_{0.05}$	33.9	43.1	62.3
$S_6CNT_{0.1}$	28.4	36.7	53.4
$S_9CNT_{0.001}$	36.6	46.2	65.5
$S_9CNT_{0.005}$	34.2	42.5	61.7
$S_9CNT_{0.01}$	33.7	40.4	60
$S_9CNT_{0.05}$	36.4	45.8	64.4
$S_9CNT_{0.1}$	30.4	41.9	54.3

Fig. 3 Compressive Strength Values Comparison 3-Days



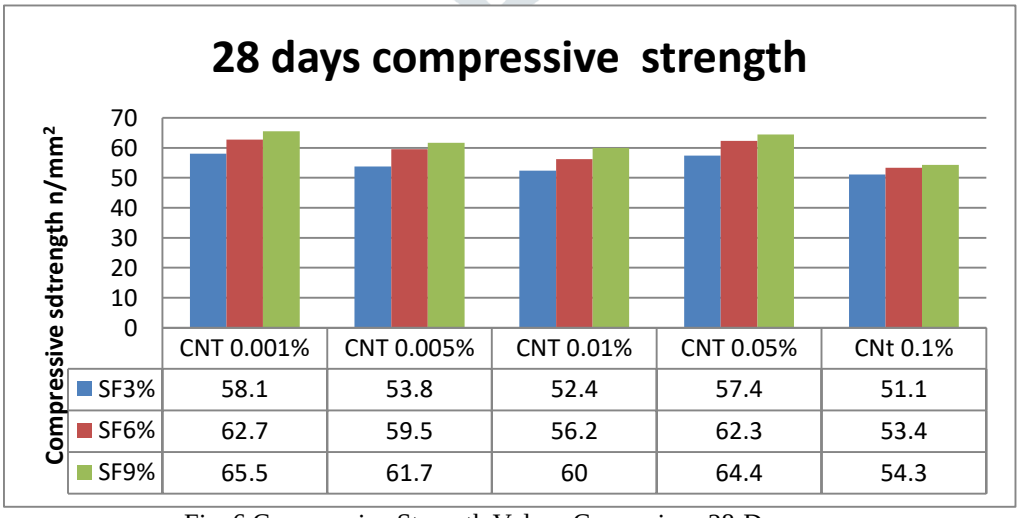
	CNT 0.001	CNT 0.005	CNT 0.01	CNT 0.05	CNt 0.1
SF3%	32.9	29.4	27.5	31.4	27.3
SF6%	33.2	32.4	31.5	33.9	28.4
SF9%	36.6	34.2	33.7	36.4	30.4

Fig. 4 Compressive Strength Values Comparison 7-Days



	CNT 0.001%	CNT 0.005%	CNT 0.01%	CNT 0.05%	CNt 0.1%
SF3%	42.4	37.4	36.2	42.9	35.5
SF6%	43.9	38.2	37.1	43.1	36.7
SF9%	46.2	42.5	40.4	45.8	41.9

Fig. 5 Compressive Strength Values Comparison 28-Days



	CNT 0.001%	CNT 0.005%	CNT 0.01%	CNT 0.05%	CNt 0.1%
SF3%	58.1	53.8	52.4	57.4	51.1
SF6%	62.7	59.5	56.2	62.3	53.4
SF9%	65.5	61.7	60	64.4	54.3

Fig. 6 Compressive Strength Values Comparison 28-Days

I. CONCLUSION

- It is found that there is increase in workability (Slump test) by 57.89% for the M40 grade of concrete treated with $SF_9CNT_{0.001}$ when compared to normal M40 grade of concrete.
- It is found that there is increase in strength by **60.20%** for the M40 grade of concrete treated with **optimum % of CNT and SF** at 28 days when compared to normal M40 grade of concrete.
- It is found that there is **increase in strength in early stage** but later rate of increase in strength decreases with ageing.
- It is found that Optimum percentage of CNT **is 0.001% and SF 9%.**

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