

## CONSEQUENCE OF CARBON NANOTUBES ON CONCRETE

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**Abstract** - Concrete is a mixture which possesses Strength in compression but weak in tension. The properties of concrete can be modifying by adding non-conventional materials in concrete. Carbon nanotubes are a material which is being added in cement and concrete to modify the properties of cement and concrete.

Past experiments have shown that carbon nanotubes have remarkable effects on the properties of cement and concrete. The aim of this literature survey is to summarize the results of experiments performed on replacement of carbon nanotubes in cement and concrete.

**Key Words:** Nanotubes, Tri-Calcium Silicate (C3S), Quick Setting of Cement

### 1. INTRODUCTION

Concrete is a mixture having well defined proportion of cement, sand, coarse aggregate and water. Cement allows the ingredients of concrete to harden by its binding properties. Majorly four components present in cement allow cement to hard and to gain strength. Tri-calcium silicate (C3S) is responsible for early setting of cement and early strength whereas Tri-calcium Aluminates (C3A) is also responsible for quick setting of cement. Addition of Gypsum in production of cement is responsible for quick setting of C3A. Hydration of Di-Calcium silicate takes long time which is responsible for long term strength. Cement particles are very fine but still have voids. Carbon nanotubes having smaller particle size can be added in cement to fill the voids which may increase the strength. Therefore the objective of this literature survey is to conclude the results of previous experimental research on replacement of carbon nanotubes.

### 1.1 LITERATURE SURVEY

This paper presents the methodology and conclusions of three research papers which performed the same experiments on cement concrete.

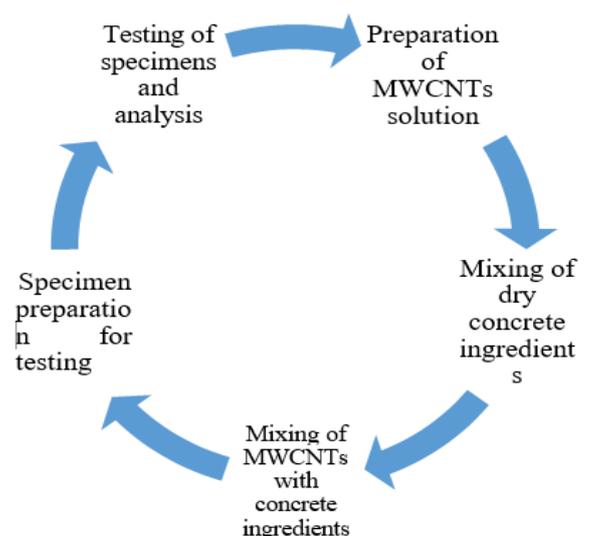
In one experiment, MWCNTs solution was prepared by making solution of MWCNTs and 2-liter water. Ultrasonic vibrations were provided to make MWCNTs solution. After mixing of MWCNTs solution with concrete, specimens were made for Ultrasonic Pulse Velocity Test, Splitting Tensile Strength Test, Flexural Strength Test and Compressive Strength Test were performed and concluded that

mechanical properties of concrete vary according to the concentration of MWCNTs. Higher concentration of MWCNTs in concrete may adversely affect the mechanical properties of concrete whereas lower concentration of MWCNTs may enhance the properties of Concrete like compressive strength and splitting strength.

In second experiment, cement was replaced by 20% fly ash by weight of cement. MWCNTs in 0.025%, 0.048% and 0.08% by weight of cementitious material were added to prepare five specimens. It was observed that Compressive strength, Flexural strength and Tensile Strength were increased at 0.08% of CNTs.

In third experiment, MWCNTs in varying percentages (0.015%, 0.03% and 0.045%) by weight of cement were mixed using sonification. Compressive Strength Test and Split Tensile Strength Test and Water Absorption Test were performed to check the effects. It was concluded that sample containing 0.045% MWCNTs shows increase in water Absorption by 17.76% but there was increase in compressive strength of concrete by 26.69%. Split Tensile Strength of concrete was increased in every case as compared to ordinary concrete.

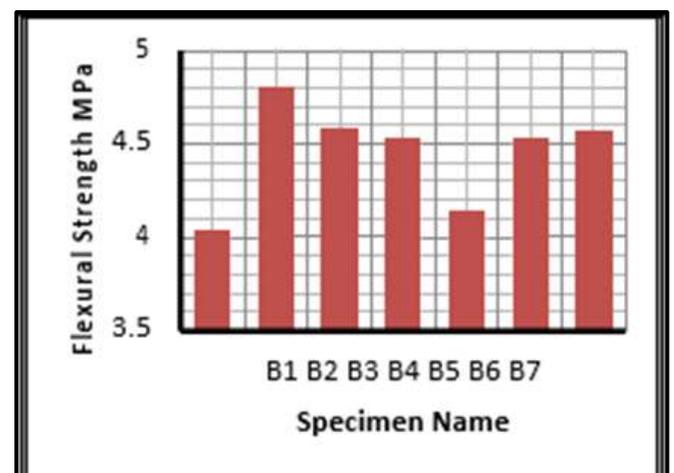
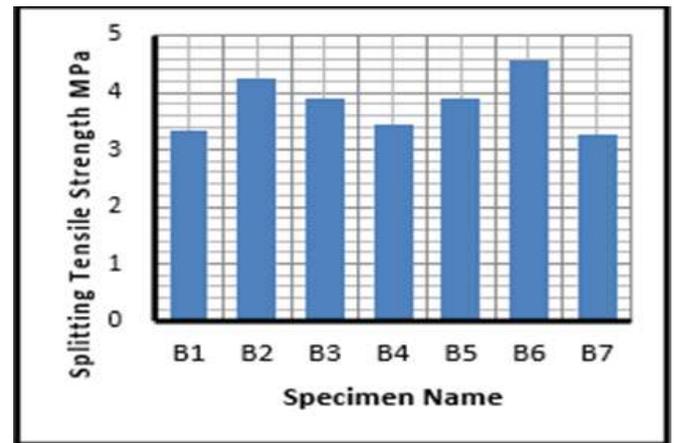
### 2. METHODOLOGY



Various experiments have shown that, there are various techniques to mix MWCNTs with concrete ingredients. Also, it is very important to decide the percentage of MWCNTs. The solution of MWCNTs is mixed with concrete

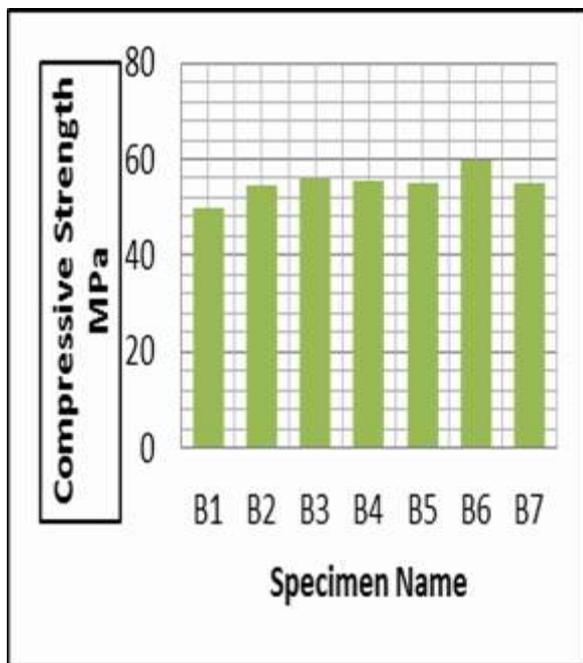
ingredients to get a wet concrete mass. The specimens for various tests (compressive strength, flexural strength and water absorption test) are prepared and testing is performed when specimens attain their maturity.

Specimen Type	Ultrasonic pulse velocity (m/sec)	Density kN/m <sup>3</sup>
B1-reference Specimens	3115.88	23.24
B2- 0.03% short	3179.8	23.62
B3- 0.045% short	3225.5	23.35
B4- 0.06% short	3252	23.31
B5- 0.03% long	3149.7	23.43
B6- 0.045% long	3179.11	23.43
B7- 0.06% long	3157.66	23.30



### RESULTS AND DISCUSSION:

Results of MWCNTs with 2-liter water after providing ultrasonic vibrations.



It was observed that compressive strength of concrete was maximum at 0.045% MWCNTs. There was increase in compressive strength of concrete in every case but a decrease in compressive strength was noted after 0.045%.

### 3. CONCLUSION

MWCNTs can be used as a additive in concrete but up to a limited percentage. More quantity of MWCNTs can adversely affect the physical properties of concrete. Performance of concrete after addition of MWCNTs depends on the mixing of MWCNTs. Results of various experiments with different mixing techniques shows variation in strength.

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