iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 Issue: V Month of publication: May 2023

DOI: https://doi.org/10.22214/ijraset.2023.53359

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue V May 2023- Available at www.ijraset.com

To Improve the Strength of Concrete by Using Carbon Nanotubes (CNTs)

Prof. Ram B. Ghogare[1], Sanket K. Londhe[2], Shubham A. Hande[3], Chaitrali G. Bhosale[4], Anuradha V. Mane[5]
[1]Assistant Professor, [2, 3, 4, 5]Student Civil Engineering, S.B. Patil Collage of Engineering, Indapur, Maharashtra, India

Abstract: The use of carbon nanotubes (CNTs) in concrete has been gaining attention due to their unique properties, such as high strength, flexibility, and electrical conductivity. This study focuses on investigating the effect of adding CNTs to concrete mixtures on the strength of the resulting material. The concrete specimens were prepared with different percentages of CNTs, and their mechanical properties were measured and compared to those of control specimens without CNTs. The results showed that the addition of CNTs significantly improved the compressive and flexural strength of the concrete. The findings suggest that the incorporation of CNTs in concrete mixtures could be an effective way to enhance the mechanical properties of concrete and improve its performance in construction applications. Compared to the plain cement sample at 28 days. The highest increase in strength at 28 days for the 0.0045 wt.% MWCNTs and the 0.0030 wt.% MWCNTs was 43.4% and 37.79% respectively. It is concluded that nano composites with low concentration of long MWCNTs give comparable mechanical performance to the nano composites with higher concentration of short MWCNTs. Many of the MWCNIs were stretching across the micro-cracks showing CNT's breakage and pull-out. In addition to the compression test we had calculated the split tensile strength by adding the multi-walled carbon nano tubes by increasing the proportion as per the percentage. For 0.0015% MWCNT's, 0.0030% and 0.0045% the percentage of strength increased by 25.6%, 44.63% and 51.21% respectively.
Keywords: Nanotechnology, Nanomaterials, Carbon nanotubes, High Strength Concrete.

I. INTRODUCTION

The incorporation of carbon nanomaterials (CNMs) in concrete has been widely researched in recent years due to their remarkable mechanical, electrical, and thermal properties. This study investigates the effect of incorporating two types of CNMs - multi-walled carbon nanotubes (MWCNTs) and graphene oxide (GO) - in concrete mixtures on the mechanical and durability properties of the resulting material. The concrete specimens were prepared with varying percentages of MWCNTs and GO, and their mechanical properties and durability were evaluated. The results showed that the addition of CNMs significantly improved the compressive and flexural strength of the concrete as well as its resistance to water penetration, indicating an increase in durability. Moreover, the electrical conductivity of the concrete was also enhanced with the use of CNMs. The findings suggest that the incorporation of CNMs in concrete mixtures could be a promising approach in producing more durable, stronger, and more conductive concrete for various construction applications. Nanotechnology has emerged as a promising field for enhancing the properties of concrete, leading to what is often referred to as "nanotechnology in concrete" or "Nano concrete." By incorporating nanomaterials into the cement matrix, researchers and engineers have been able to improve the strength, durability, and other desirable characteristics of concrete. One common approach in nanotechnology for concrete involves the use of nanoparticles, which are particles typically ranging from 1 to 100 nanometers in size. These nanoparticles can be derived from various materials such as silica, alumina, carbon nanotubes, graphene, and titanium dioxide, among others

A. Experimental Program

1) Material

Now-a-days nano materials used in concrete are such as: Carbon nanotubes (CNT's), Carbon nanofibers (CNF's), Nano-silica, Titanium oxide (Tio2), Polycarboxylate. Among this nanomaterials we are using *Carbon Nanotubes".

Carbon nanotubes are tabular channels, formed by single-walled or multi-walled of rolled graphene sheets. Single-Walled carbon nanotubes having diameters ranging between 0.4 to 10nm. Multi-Walled carbon nanotubes having diameters ranging between 4 to 100m. Carbon nanotubes length is not restricted and can reach to micro or millimeter range. The strongest and most flexible molecular material. Strength to weight ratio 500 times greater than Aluminium.It also gives 100 times more strength than steer. Nanotechnology seems to hold the key that allows construction and building materials to replicate the features of natural systems improved until perfection during millions of years.

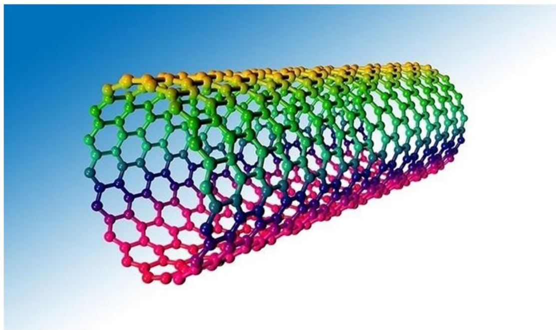


Fig 1.1 Single-Walled CNT's

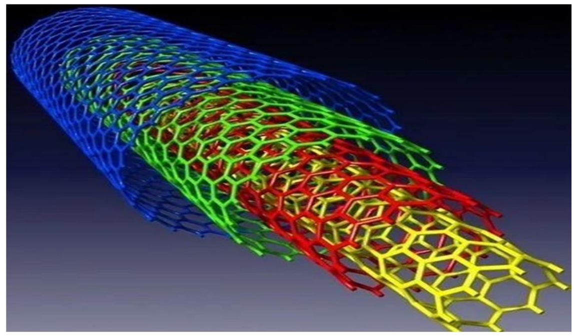


Fig 1.2 Multi-Walled CNT's

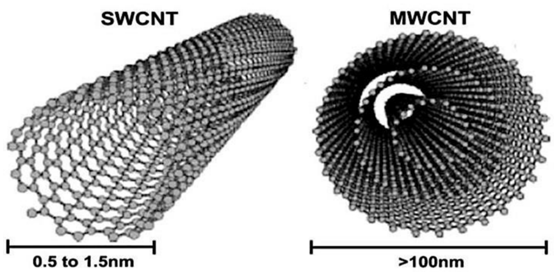


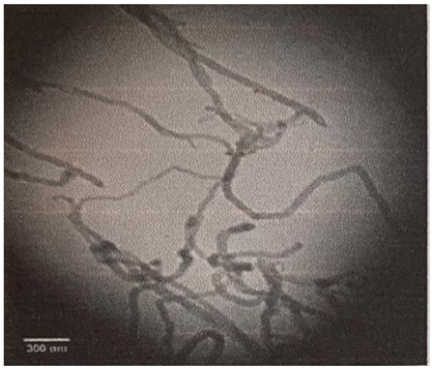
Fig 1.3 Diameter of CNT's

2) *Technical Data Sheet*

Table 1 Technical Data Sheet

Property	Unit	Value
PURITY	wt%	~99%
OUTER DIAMETER	nm	~10-30
INNER DIAMETER	nm	~5-10
LENGTH	microns	>10
SURFACE AREA	m^2/g	110-350*
CNT CONTENT	%	95-99%
BULK DENSITY	g/cm^3	0.04
CHEMICAL FORMULA		C
CAS NO.		308068-56-6
PHYSICAL FORM		FLUFFY, VERY LIGHT POWDER
COLOUR		BLACK COLOUR

Fig 1.4 Multi-Walled CNT's



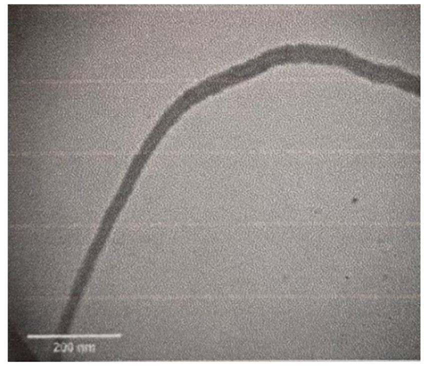


Fig 1.5 Transmission Electron Microscope View

B. Objectives

1) To improve strength and durability of concrete by using different doses of carbon nanotubes.
2) To enhance the properties of concrete by using different doses of carbon nanotubes.
3) Strength comparison between concrete mix with additives and without additives (application of carbon nanotubes).

C. Scope

1) To increase compressive strength and durability in concrete.
2) To improve the efficiency of energy transmission.
3) To reduce cracks from the concrete.
4) Can enhanced resistance to corrosion, fatigue, wear, and abrasion.
5) To increase strength and durability.

D. Methodology

For experimental analysis, we made concrete of M30 grade (IS 10262:2019), we found ingredient proportion i.e., ratio of
Mix is 1:1.55:2.96 with water-cement ratio taken as 0.45. Super plasticizer used 0.5% by the weight of cement to have workable mix. In experimental investigation we have decided to cast cubes, cylinders and beams to evaluate properties like compressive, split tensile and flexural strength of concrete.

Tests taken for results

1) Compression test

The compressive strength of concrete is measured using 150 mm size cubes tested at 28 days, according to Indian Standards (ACI standards use cylinders with a diameter of 150 mm and height of 300 mm). The characteristic strength refers to the concrete strength below which no more than 5% of test results are expected to fall. It is determined by casting and testing concrete specimens as per the specified code of practice, and the cubes should have a minimum strength value that 95% of them should exceed after being cured for 28 days. Concrete mixes will be tested at 3,7 and 28 days for their respective compressive strength.

Fig 1.6 Performing Compression Testing

2) Split tensile test

This test method is used for the determination of splitting tensile strength of cylindrical concrete specimen. Splitting tensile strength is helpful for the following purposes;

- Splitting tensile strength is generally greater than the direct tensile strength and lower than the flexural strength (modulus of rupture).
- Splitting tensile strength is used in the design of structural light weight concrete members to evaluate the shear resistance provided by concrete and to determine the development length of the reinforcement.

T=2P/ (ld)

Where, T = Splitting tensile strength (to be reported in 0.05 MPa multiples)

p = Applied load

1 = length of the specimen (mm)

d = Diameter of the specimen (mm)

Fig 1.6 Performing Split Tensile Testing

E. Results

Result for Compression Strength

Table 2 Result for Compressive Strength

Sr.No.	Curing Days	Control Mix (Mpa)	MWCNTs 0.0015% (MPa)	MWCNTs 0.0030% (MPa)	MWCNTs 0.0045% (Mpa)
1	3	22.8	27.15	32.56	36.31
2	7	33.11	38.68	42.86	44.98
3	28	43.89	49.32	56	60.92

Results for Split Tensile Strength

Table 3 Result for Split Tensile Strength

Sr.No.	Curing Days	Control Mix (Mpa)	MWCNTs 0.015% (MPa)	MWCNTs 0.030% (MPa)	MWCNTs 0.045% (Mpa)
1	28	8.20	10.3	11.86	12.4

II. CONCLUSION

From the experimental investigation following conclusion can be drawn:

1) BY the addition of 0.0015% MWCNTs the compressive strength is found to be increased by 15.74% than the strength of control mix.
2) BY the addition of 0.0030% MWCNTs the compressive strength is found to be increased by 37.79% than the strength of control mix.
3) BY the addition of 0.0045% MWCNTs the compressive strength is found to be increased by 43.4% than the strength of control mix.
4) BY the addition of 0.015% MWCNTs the split tensile strength is found to be increased by 25.6% than the strength of control mix.
5) BY the addition of 0.030% MWCNTs the split tensile strength is found to be increased by 44.63% than the strength of control mix.
6) BY the addition of 0.045% MWCNTs the split tensile strength is found to be increased by 51.21% than the strength of control mix.
7) From the results achieved in lab it is found that compressive strength is being increased with increased percentage of MWCNTs.

A. *Future scope*

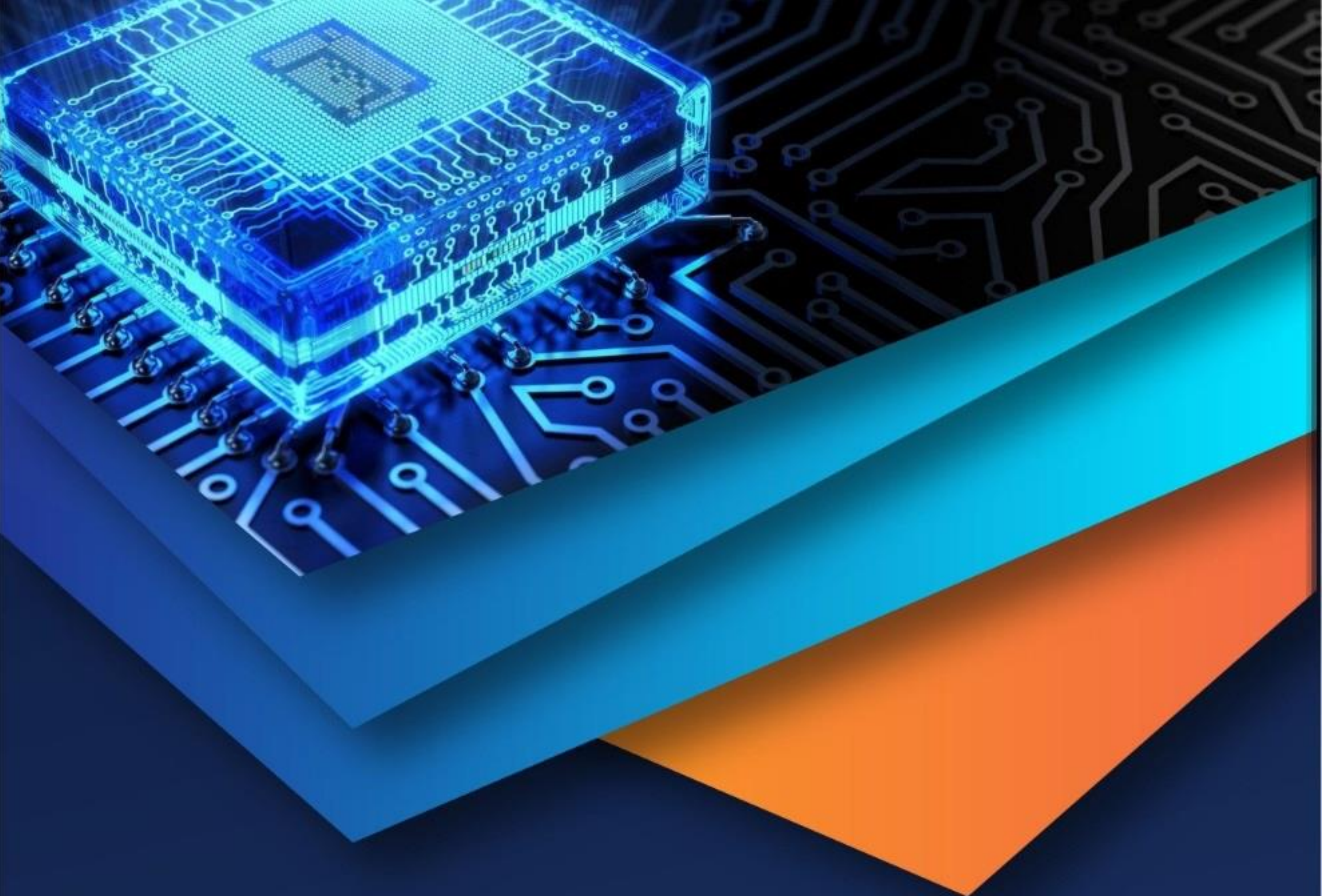
Use of Multi-walled carbon nano tubes and its effect on properties of concrete is need to evaluate. Proper method of mixture proportionating is also need to investigate.

III. ACKNOWLEDGMENT

We have great pleasure in delivering this research work. This research has helped to express extracurricular knowledge. We would like to thanks to the HOD civil department Prof. R.B. Ghogare as well as members of Civil Department, all of them very compassionate and really went off their way to help. We would like to thanks especially to Prof. S.M. Kale, Project coordinator, for his timely help and guidance toward successful completion of our project. We would like to thanks especially to Dr. S.T Shirkande, Principal of S.B.Patil College of Engineering, Indapur, for his guidance toward successful completion of our project.

REFERENCES

[1] U.Abinayaa1, D.Chetha1, S.Chathuska1, N.Praneeth1, R.Vimantha1, K.K. Wijesundara,(2007) “improving the properties of concrete using carbonnanotubes” Volume 9, Issue 5, pp. 23-36
[2] Rushikesh D. Hingmire [1], Samadhan D. Sawant [2], Prof.R.B. Ghogare[3], Mansi R. Kadam[4] “Upgrading Compressive Strength Of Concrete Column Using Fiber Reinforced Polymer”
[3] Bhong Sanket N.1, Devkar Sumit B.2, Gaikwad Rohit K.3, Tobare Shahaji P.4, Prof. Ghogare R.B.5 “Alluminium Dross As a Value Added Productin Mortar”
[4] 1Prof. Kale Sandip Maruti ,2Prof. Ghogare R.B,3Prof. Suryawanshi N.T “Feasibility of Concrete Containing Pond Ash and Micro Silica”
[5] F. Pacheco-Torgal a, Said Jalali b,1 (2011), Nanotechnology: Advantages and drawbacks in the field of construction and building materials. Construction and Building Materials 25 (2011)582-590
[6] P Mahakavi,(2011) “Literature Review on Multiwalled Carbon Nanotube inCement Paste on Mechanical characteristics.” ISSN 2581-8678,Volume II
[7] Puentes, J. Barluenga, G. Palomar,(2012) "Early Age Behaviour Of Self Compacting Concrete With Polypropylene Fibers And Carbon Nanofibers" Fibre reinforced concrete.” Volume 6, BEFIB2012
[8] Syed Shujat-ul-Hussan Gillani, Anwar Khitaba, Sajjad Ahmad,(2014) “Improving the mechanical performance of cement composites by carbon nanotubes addition” Volume 3, Issue 6, PP 32-46
[9] Jayeshkumar Pitroda, Bansri Jethwa, S.K. Dave,(2016) “A critical review on carbon nanotubes” Volume 2, Issue 5, PP 36-42



10.22214/IJRASET

INDEX COPERNICUS 45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY