IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

A REVIEW ON TO FIND OPTIMAL DOSES OF CARBON NANOTUBES IN CONCRETE MIX FOR DIFFERENT SAND TO CEMENT RATIO

[1]Prof. Supriya Shinde, [2] Mr. Baswaraj Pandhare, [3] Mr. Abhishek Jadhav, [4] Mr. Siddharth Kudale, [5] Mr.Omkar Jadhav, [6] Ms.Shweta Ghogare

[1]Asst Prof APCOER, [2]Superintendent Engineering/Deputy Secretary PWD Government of Maharashtra, [3]Student of APCOER, [4]Student of APCOER, [5]Student of APCOER, [6]Student of APCOER

[1]Civil Engineering Department

Anantrao Pawar College of Engineering and Research, Pune, India

Abstract: Carbon Nanotubes (CNT) is the most prospective advanced material for application in cement based products for the construction industry, due to their excellent material properties ,in this study, their application in cement mortor was comparatively studied there mechanical properties, 28-days compressive strength, flexural strength and tensile strength of CNT and sand /cement ratios were utilized addition of CNT demonstrated significant increase in compressive, flexural and tensile strengths , as compared to plain mortar control samples.

Index Terms - *Multiwalled Carbon Nanotubes, Carbon Nanotubes, Compressive strength, Flexural strength, Tensile strength.*

I. INTRODUCTION

The brittleness of cementitious materials is the main reason for concrete cracking. The discovery of carbon Nanotubes (CNTs) brings with it the opportunity to improve the microstructure of cementitious materials. The strength, toughness, and specific surface area of CNTs are far superior to those of ordinary fibers. Nanoparticles have wide applications in modifying various aspects of concrete and cementitious mixtures, such as mechanical properties, porosity and frost resistance etc. The tensile strength of CNTs is between 11 and 63 GPa, which is 100 times higher than that of steel. The Young's modulus of CNTs is around 1 TPa and the fracture strain is as high as 280 %. CNTs possess excellent mechanical and chemical properties, which make them the ideal reinforcing material. Proper dispersion and mixing methods are known to be key factors affecting the performance of Nano composites, as poor dispersion of MWCNTs leads to several defects in the Nano composites and decreases the reinforcing effect of the MWCNTs. Additionally, unreasonable dispersion too leads to the damage of MWCNTs. Currently, and there are two methods that are commonly used for CNT dispersion. The first is chemical modification, which introduces functional groups on the surface of CNTs using chemical reagents, high energy discharge, ultraviolet radiation or other processes. The second is physical modification, which employs mechanical stress through processes such as crushing and ultrasonic dispersion to activate the surface of the CNTs. Carbon Nanotubes are tubes made of carbon with diameters typically measured in nanometers. Carbon Nanotubes are seamless, carbon cylinders which have unique mechanical and electronic properties. Carbon Nanotubes are a form of carbon having a cylindrical shape, the name coming from their nanometer diameter. Millimeters in length and can have one "layer" or wall (single walled Nanotubes) or more than one wall they can be several (multi walled Nanotubes) .Nanotubes are members of fullerene structural family and exhibit extraordinary strength and unique electrical properties, being efficient thermal conductors. For example, it has five times the Young's modulus and eight times (theoretically 100 times) the strength of steel, whilst being 1/6th the density expected benefits of carbon Nanotubes are: mechanical durability and crack prevention in concrete enhanced mechanical and thermal properties in ceramics and real-time structural health monitoring capacity.

II. OBJECTIVES

Design concrete mix for to compare strength of concrete with or without use of CNT. Review and analyze about optimum doses of CNTs for varying sand to cement ratio.

III. LITERATURE REVIEW

a. Suman Kumar Adhikary, Zymantas Rudzionis and R Rajapriya , October 2020.
Excellent mechanical properties and chemical stability make carbon Nanotubes (CNTs) some of the most promising nonmaterial's that can be used in cementitious composites to improve their performance. However, the difficulty of CNTs' dispersion within the cementitious structure still exists and thus prevents the homogeneous distribution of CNTs. The homogeneous distribution of CNTs within a composite structure plays an essential role that can have a positive effect on the mechanical performance of CNT-cement composites. This paper introduces the methods for the production of CNTs and provides useful information about the influence of CNTs on the flow ability, mechanical performance, micro structural changes and hydration of cement composites. The influences of water-cement ratio, used surfactants and various doses of CNTs on the properties of cementitious composites were also studied.

b. Ba Rahma Ahmed, Al-Jaberi Hussein, Dahi Saleh and Raizal S. M. Rashid, November 2019.
The result shows CNTs has distinctive properties that have a positive effect when added to cement. Electrical conductivity and fire resistance of cement matrix have been increased significantly by adding CNT. To obtain positive benefits of CNT in cement composite an appropriate dispersion required. In the paper different methods were found where improvement of mechanical achieved. Adding particular proportions CNTs with appropriate dispersion method leads to high compressive strength and it improve and increase flexural strength of cement.

c. Mohamed O. Mohsen , Mohamed S. AL Anasari , Ramzitaha ,Nasser AL Nuaimi, and Ala Abu Taqa ,Oct 2019.
In this paper author concluded that high CNT contents of 0.15 and 0.25 wt.% CNTs would increase the flextural strength of concrete by more than 100%.and also CNTs would increase the ductility oc concrete by about 150%. The permeability coefficient decreased by at least 45% when CNTs were added to concrete. The addition of CNTs to concrete resulted in a denser composite with higher flexural strengths and strain capacity and lower permeability when compared to plain concrete.

d. Dr. B.Vidivelli , B.Ashwini , July 2018
In these paper author described about review of CNT from various literature which are integrating Carbon Nanotube as 0.15% to 2.5% on strength characteristics and durability of the concrete. It is observed that there are different types of shapes inside the structure at microscopic level which were formed due to presence of Bogues Compounds. In between them voids are present. It is major cause for the weakening of the strength in concrete. Thereby, nanotubes are used to fill in these voids. The addition of small amounts 1 % of CNT can improve the mechanical properties. In result, Oxidized multi-Walled Nano tubes show the best improvements both in compressive strength +25 N/mm2 and flexural strength +8N/mm2 compared to the sample without reinforcement.

e. Syed Shujat-ul-Hussan Gillania , Anwar Khitaba, Sajjad Ahmada , Rao Arsalan Khushnoodb , Giuseppe Andrea Ferroc , Syed Minhaj Saleem Kazmia, Liaqat Ali Qureshid, Lcciana Restuccia , March 2017.
The remarkable improvement in the mechanical properties of concrete was observed by adding small fractions of MWCNTs in concrete matrix. The effect and behaviour of MWCNTs addition is purely dependent upon the dispersion of MWCNTs in the mix. Many other factors other than dispersion, are also associated with effective outcomes of the inclusion of MWCNTs in concrete of MWCNTs being utilized in the mix. From the present study it may be concluded that the same amount of MWCNTs may exhibit different behavior in certain mechanical properties of concrete mix i.e. the lower amount of MWCNTs are fruitful in case of enhancement of tensile and flexural strength but in case of compressive strength the larger fraction was more effective.

f. Yakovlev G. I.a, Skripkiunas G.b, Polianskich I. S.a , LahayneO.c , Eberhardsteiner J.c, Urkhanova L.A. d, Pudov I. A.a , Sychugov S. V.a , Karpova E. A.a , Sen'kov S. A.e, February 2017.
The research found that main effect of the modification of cement binding matrix using complex Nano dispersed system comprising MWCNT and nano silica and subsequent crystallization of new products in hardened cement paste. Carbon nanotube dispersion and nano sized silica being added the binding matrix is forming a perfect sense shell from crystalline hydrates on the surface of solid phase that provides strong binding matrix in cement concrete. Cement concrete addition of carbon nanotube is analysed and quantified inspecting in each case one sample with nanotube and one without the help of nano indenter and another scanning electron.

g. Tomas Jarolim, Martin Labji , Rudolf Hela , and Kamila Michnova, July2016.
In this paper authors observed that when the CNT mixture was added to standardized cement mortar the increase in observed physicomechanical properties was from 5.5 to 10.4%. With advanced methods like UV/Vis spectroscopy and optical microscopy, the optimal acoustic energy for CNT's effective dispersion was determined, 800 J/Ml in many industrial fields, nanotechnology is slowly becoming the construction industry's "next big thing." There are many potentially usable nanoparticles, but probably the most promising ones are carbon nanotubes. These extremely small fibers present both benefits and problems, and one of which was examined in this paper.

h. Josef Foldyna , VladimírFoldyna , June 2016
In these paper author presents importance of dispersion of CNT. Proper dispersion of CNTs in water and subsequently in cement paste leads to successful use of CNT. The tests performed so far show that standard methods commonly used for CNTs dispersion i.e sonication can cause destruction of CNTs in result it causes adverse influence on their properties. Therefore, a novel technique of CNTs dispersing using acoustic generator of pulsating jets was proposed. The technique should allow controllable action of high-frequency pressure pulsations, cavitation and impact pressure on CNTs dispersion without CNTs damage or disintegration.

i. Shantanu Kumar, Prabir K.Kolay , Sanjay R Mishra, October 2015.
In this paper authors concludedthat an increase in compressive and flexural strength was seen in cement CNT composites having a CNT content of 0.5 % by weight of cement .the increase in the strength with respect to the control mix were 15 and 35 %. Cement –CNT composite with 0.75 % of CNT was 18% higher than that of the control mix. Cement –CNT composite with 1.0 % CNT showed 29% reduction in compressive strength compared to equivalent strength of control mix.

j. Qinghua Li, Jintao Liu, and Shilang Xu, July 2015.
In this review, the literatures on MWCNTs reinforced cement composites are comprehensively reviewed, and the effects of MWCNTs on the cement-based material were summarized. MWCNTs composite systems are being investigated in the fields of metal, polymer, and ceramic, so MWCNTs can play a significant role in improving the strength, fracture toughness, Young‘s modulus, and porosity of cementitious materials. MWCNTs affect the hydration process of cement by providing attachment sites for the C–S–H gels which acts as filler resulting in a higher strength and denser microstructure of matrix. The strengths are found to be increased with the inclusion of MWCNTs, and they are influenced by the type, length, and concentration of MWCNTs. In addition, good interaction between MWCNTs and the cement hydration productions has been observed. Debonding and crack bridging of MWCNTs are the main reason for the enhancement of matrix.

k. U.Abinayaa , D.Chetha , S.Chathuska , N.Praneeth , R.Vimantha , K.K. Wijesundara , 2014
In these paper author described about improvement in properties of concrete using CNT. In a result we understood that increasing the proportions of functionalized MWCNT into concrete increases the compressive strength. In fact the compressive strength of the concrete with a proportion of 0.045% of functionalized MWCNT increases by 26.69%. The split tensile strength increases with the increase in MWCNT. In fact, the split tensile strength increased by 66.3% for 0.045% of MWCNT. With the increase in MWCNT, the rate of increase of tensile strength is greater than that of the rate of increase of the compressive strength.

l. Dr.T.Ch.Madhav, Pavithra.P, Sushmita Baban Singh S.B,Vamsi Raj, Surajit Paul, June 2013.
The slump value remains constant for various proportions of MWCNT in concrete mix. From the results, it is understood that increasing the proportions of functionalized MWCNT into concrete increases the compressive strength. The compressive strength of the concrete with a proportion of 0.045% of functionalized MWCNT increases by 26.69%. By increasing the percentage of functionalized MWCNT to the concrete, the water absorption is reduced to a greater extent which helps in improving the concrete to be more durable and water resistant. The water absorption for 0.015%functionalized MWCNT into concrete decreases by 10.22% and for 0.045 % addition, the water absorption decreased by 17.76%.Split tensile strength increased by 66.3%.

IV. CONCLUDING REMARK

A proper dispersion of CNT is necessary. CNT helped to improve the cement composite in terms ofdurabilityandmechanicalpropertiesincludingcompressiveandflexuralstrength. There are different types of shapes inside the structure in between them voids are present. Thereby, nanotubes are used to fill in these voids. CNT mixture was added to standardized cement mortar the increase in observed physiomechanical properties wasfrom5.5to10.4%. MWCNTs affect the hydration process of cement by providing attachment sites for the C–S–H gel hence it reduce water absorption to greater extent.

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