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A REVIEW ON DEVELOPMENT ULTRA-HIGH STRENGTH CONCRETE BY USING MULTIWALLED CARBON NANOTUBES

(Development of High- Strength Concrete)

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Abstract: This paper discusses with the review of using Carbon Nanotube (CNT) for development of Ultra-high strength concrete (U.H.S.C.). MWCNT'S will be used as nano reinforcement in cement, this improves microstructure of cement. Hence objective of this literature survey is to collect past data on properties of concrete by application of carbon nanotube. The CNT are highly recommended because of their high strength behaviour with less quantity of dosses. CNT is majorly known for properties such as high tensile strength, stable chemical nature, corrosion resistance & high thermal behaviour. But we will study only few properties such as microstructure behaviour, compressive strength, tensile strength & flexural strength. contains.

Index Terms *- Multiwalled carbon nanotubes, compressive strength, microstructure behaviour*.

I. INTRODUCTION

New types of concrete such as High Strength Concrete (HSC), High Performance Concrete (HPC), Self-Compacting Concrete (SCC), Ultra High-Performance Concrete (UHPC) and Ultra-High Strength Concrete (UHSC) are being constantly developed in order to meet the increasing demand for improved mechanical properties and durability. Probably the most promising material to use as filler is CNTs to improve concrete nanocomposite properties. Carbon nanotubes are cylindrical nanostructures formed from rolled up graphene hexagonal nets into nano meter diameter tubes. CNTs are divided into two groups: single-walled carbon nanotubes (SWCNTs) and multi-walled carbon nanotubes (MWCNTs). SWCNTs are composed of single graphene sheet and MWCNTs are nested arrays of SWCNTs. In the present research, an attempt has been made to develop UHSC mixtures with locally available materials. This paper is part of first stage of research which represent synthesis of MWCNTs which is proper to be used in construction. Because of the low yield and high cost of MWCNTs, previous studies have focused on the effect of MWCNTs on the performance of cement pastes or mortars; however, the properties of concrete, especially ultra-high strength concrete (UHSC) have been rarely reported. Currently, the use of nanomaterials in construction is reduced, mainly for the following reasons: the lack of knowledge concerning the suitable nanomaterials for construction and their behaviour; the lack of specific standards for design and execution of the construction elements using nano-materials; this nano materials have four types which are using for concrete Nano silica, carbon nanotube, titanium, carbon fibre the reduced offer of nanoproducts; the lack of detailed information regarding the nanoproducts content; high costs; the unknowns of health risks associated with nanomaterials.. Modern high-rise buildings are built higher and larger and in ever increasing numbers, and the application of UHSC has become an inevitable trend. The compressive strength of UHSC is >100 MPa, but its safetyhas been questioned because of possible ultra-brittle failure behaviours. Although there have been some successful applications of carbon-based materials to cementitious binders, achieving both effective conductivity and superior mechanical properties remains an engineering challenge. This is because effectively dispersing conductive filler materials in a structural binder requires a high solution ratio, which is detrimental to the development of mechanical strength of ultra-high strength concrete.

II. OBJECTIVES

Review and design concrete mix to comparison of concrete mix with Multiwalled carbon nano tubes and without MWCNTs.

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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