iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 7 **Issue:** VI **Month of publication:** June 2019

DOI: http://doi.org/10.22214/ijraset.2019.6155

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue VI, June 2019- Available at www.ijraset.com

Study of Strength Characteristics of Concrete by using Carbon Nano Fiber

Pravin Jadhav[1], Apurv Shinde[2], Vishal Kadam[3], Prof. Sheetal Marwar[4]
[1, 2, 3, 4]*Department of Civil Engineering, Genba Sopanrao Moze College of Engineering. Savitribai Phule Pune University, Pune, Maharashtra*

Abstract: Nanoscience and nanotechnology provide enormous opportunities to engineers the properties of materials by working in atomic or molecular level. It has not only facilitated to overcome many limitations of conventional materials, but also tremendously improved the mechanical, physical and chemical properties of the materials as well. Nanoscience has paved the way to tailor the properties of materials based on particular requirement by working in atomic or molecular level. In general, nanotechnology is not an isolated technology for certain purposes, but it is an enabling technology to achieve many goals by engineering a material at nano level. Similar to the fields like energy, medicine, electronics, etc., nanotechnology shows remarkable potentiality of its role to play by opening a new way to solve many of the perennial problems civil engineers do face every day. To develop high performance, multifunctional, ideal construction material, Cement composites with nano-additions have been vastly studied for their functional applications, such as strain and damage sensing. The capacity of a carbon nanofiber (CNF) cement paste has already been tested. However, this study is focused on the use of CNF cement composites as sensors in regular concrete samples.After reviewing various research papers, we found that carbon nano-fibre is a upcoming technology which is need to be used in construction. CNF with various percentages and its effect on the strength of structure is needed to be studied.

I. INTRODUCTION

For several years, research interest has been focused on these so called smart materials, i.e., materials capable of responding automatically to certain external stimuli. Among these composites, cement-based materials have played an important role in construction and civil engineering industries. In the particular case of multifunctional cement composites, multi-functionality is achieved by taking advantage of the structural material itself to develop non-structural functions, without the need of any type of external device. In order to obtain these multifunctional properties, cement materials should be combined with specific conductive admixtures that provide the new composite with a new range of functional applications, while mechanical properties are maintained or even improved Hence, cost would be reduced (Sihai Wen, D.D.L. Chung,2000*)* as design will be simplified minimizing the use of embedded devices. Functional properties affect different fields of applications, such as anodes for electrochemical chloride extraction, electromagnetic wave shielding, structural monitoring and damage detection, temperature sensors, heating and thermal control, and strain/stress sensors.

The strain sensing capacity of a material is determined by the response to its electrical resistivity in relation to the mechanical stresses applied to it. If a unidirectional compressive stress is applied, the electrical resistance in that direction is proportionally reduced. The sensing of strain is relevant to smart structures, structural vibration control, traffic monitoring, weighing, etc. Strain sensing is commonly attained by the use of strain gages attached to the structure. Strain gages are commonly of the resistive type. In other words, the resistance (not resistivity) changes with strain, thereby serving as an indicator of strain.

II. LITERATURE REVIEW

A. Self- Sensing concrete Nano composites for smart structures, Publish Year 2016, A.D' Alessandro, F. Ubertinity, A.L. Materazzi

In this paper Author started an experiment campaign to investigate issue related to the dispersion of the Nano filler into the cementitious matrix, the composition of the nano-modfied materials, the realization of the sensors, the electrical characterization, and the analysis of the sensing abilities. The enhanced electrical characteristics of MWCNTs allowed the implementation of innovative conductive reinforced cement-based material with enhanced properties for structural application. The increase of electrical conductivity, results in the formation of a three dimensional meshwork of fillers. The results of the experiment campaign demonstrate that new nano-modified cementitious materials with carbon nanotubes appear promising for engineering application. Nano-modified cement-based sensors represent an innovation in civil engineering.

B. Piezoresistive Cement-based Materials for Strain Sensing, Publish Year 2002, D. D. L. Chung

Cement-based materials that exhibit piezoresistivity with sufficient magnitude and reversibility contain electrically conductive fibers. The phenomenon allows the materials to sense their own strain.

The fibers are preferably discontinuous. Carbon fibers (15mm diameter) are most effective. Steel fibers (8mm diameter) are less effective. Carbon filaments (0.1mm diameter) are ineffective.

The piezoresistive behavior, mechanism and materials are reviewed, including cement-based materials with continuous and discontinuous fibers. Cement paste containing short carbon fibers is an effective strain-sensing coating, as tested when the coating (with fibers) is on either the tension side or the compression side of a cement specimen (without fiber) under flexure. The resistance is measured with surface electrical contacts on either side.

The resistance increases reversibly on the tension side upon loading and decreases reversibly on the compression side upon loading. The behaviour is similar whether the strain sensing coating contains silica fume or latex.

Cement reinforced with short carbon fibers (15mm diameter) is capable of sensing its own strain, due to piezoresistivity (DC or AC), i.e., the effect of strain on the electrical resistivity.

The resistivity increases for tension, and decreases for compression. Short steel fibers (8mm diameter) and continuous carbon fibers (11mm diameter) are less effective.

Short carbon filaments (0.1mm diameter) are ineffective. In the case of short carbon fiber (15mm diameter) reinforced cement, the piezoresistive behaviour changes at a curing age between 7 and 14 days, and its mechanism involves slight fiber pull-out and push-in upon tension and compression respectively.

III. TEST TO BE CONDUCT ON SPECIMENS

A. Concrete Compression Test

Cubical moulds of size 15cm x 15cm x 15cm are commonly used. The concrete is poured in the mould and tempered properly so as not to have any voids. After 24 hours these moulds are removed and test specimens are kept in water for curing. The top surface of these specimen are made even and smooth. It is done by putting cement paste and spreading smoothly on whole area of specimen.

B. Compressive Strength Test on Concrete Cube

Following are the procedure for testing Compressive strength of Concrete Cubes
Apparatus for Concrete Cube Test
Compression testing machine

C. Preparation of Concrete Cube Specimen

The proportion and material for making these test specimens are from the same concrete that is used in the field.

D. Hand Mixing

Mix the cement and fine aggregate on a water tight none-absorbent platform until the mixture is thoroughly blended and is of uniform color Adding the coarse aggregate and mixing with the cement and fine aggregate until the coarse aggregate is uniformly distributed throughout the batch and then we add water and mix it until the concrete appears to be homogeneous and of the desired consistency
Sampling of Cubes for Test We need to clean the mounds and apply oil on it so that the concrete doesn't stick to it Then we will fill the concrete in the moulds in layers approximately 5 cm thick and compact each layer with not less than 35 strokes per layer using a tamping rod (steel bar 16mm diameter and 60cm long, bullet pointed at lower end) Then we will level the top surface and smoothen it with a trowel

E. Curing of Cubes

The test specimens are stored in moist air for 24 hours and after this period the specimens are marked and removed from the moulds and kept submerged in clear fresh water until taken out prior to test.

F. Precautions for Tests

The water for curing should be tested every 7 days and the temperature of water must be at 27+-2^{o}C.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.177
Volume 7 Issue VI, June 2019- Available at www.ijraset.com

G. Procedure for Concrete Cube Test

Remove the specimen from water after specified curing time and wipe out excess water from the surface and take the dimension of the specimen to the nearest 0.2m Then we will clean the bearing surface of the testing machine and place the specimen in the machine in such a manner that the load shall be applied to the opposite sides of the cube cast and then allign the specimen centrally on the base plate of the machine then we will rotate the movable portion gently by hand so that it touches the top surface of the specimen.

After that we will apply the load gradually without shock and continuously till the specimen fails, then record the maximum load and note any unusual features in the type of failure.

IV. RESULT

A. For Plain Concrete Cube

Age in days	Weight In kg	Load in KN	Strength In N/mm2	Avg In N/mm2
	8.79	520	21.38	
	8.86	518	22.86	
7	8.97	530	21.06	21.76
	8.89	651	24.72	
	8.79	663	27.30	
14	8.90	623	25.48	25.83
	9.03	700	27.70	
	8.97	711	30.28	
28	9.01	703	28.63	28.87

B. For 3% of CNF in Concrete

Age in days	Weight In kg	Load in KN	Strength In N/mm2	Avg In N/mm2
	8.60	602	22.3	
	8.75	589	23.2	22.76
7	8.79	606	22.8	
	8.86	680	25.4	
	8.68	669	24.9	
14	8.91	671	25.2	25.16
	8.76	721	34.5	34.86
28	8.69	723	34.9	
	8.80	719	35.2	

C. For 5% of CNF in Concrete

Age in days	Weight In kg	Load in KN	Strength In N/mm2	Avg In N/mm2
	8.60	660	24.4	
	8.75	650	24.9	
7	8.79	646	24.8	24.70
	8.86	697	28.5	
	8.68	689	28.2	
14	8.91	701	29.3	28.67
	8.76	730	36.9	
	8.69	743	37.3	
28	8.80	739	37.6	37.26

D. For 7% of CNF in Concrete

Age in days	Weight In kg	Load in KN	Strength In N/mm2	Avg In N/mm2
7	8.75	680	26.3	26.76
	8.80	683	27.1	
	8.79	676	26.9	
14	8.82	703	33.2	33.83
	8.26	711	33.9	
	8.45	708	34.4	
28	8.56	751	40.8	40.83
	8.69	759	40.5	
	8.45	771	41.2	

V. CONCLUSION

Form above the experimental work we observed that the strength of the normal concrete is less than the concrete by using CNF. From all above we concluded that

1) In plane concrete the avg strength of plane concrete for 7,14,28 days is 21.76 ,25.83 , 28.87
2) In CNF concrete when the 3% of CNF is add into the concrete then the avg strength of these concrete for 7,14,28 days is 22.76 ,27.16 ,34.86
3) In CNF concrete when the 5% of CNF is add into the concrete then the avg strength of these concrete for 7,14,28 days is 24.70 ,28.67 ,37.26
4) In CNF concrete when the 7% of CNF is add into the concrete then the avg strength of these concrete for 7,14,28 days is 26.67 ,33.83 ,40.83

REFERENCE

[1] "Carbon fiber-reinforced cement as a strain sensing coating", (Sihai Wen, D.D.L. Chung, Composite Material Research Laboratory, Department of Mechanical and Aerospace Engineering, State University of New York at Buffalo, Room 608, Furnas Hall, Buffalo, NY 14260-4400, USA Received 20 September 2000; accepted 1 February 2001)

[2] "Carbon Nanofiber Cement Sensors to Detect Strain and Damage of Concrete Specimens, Under Compression," (Oscar Galao F. Javier Baeza, Emilio Zornozaand Pedro GarcésReceived: 29 September 2017; Accepted: 20 November 2017; Published: 24 November 2017)

[3] Effect of carbon nanofiber addition in the mechanical properties and durability of cementitious materials, Publish year 2011, O.Galao, E. Zornoza, F. J. Baeza, A. Bernabeu, P. Garcés\

[4] Electrical and Self-Sensing Properties of Ultra-High-Performance Fiber-Reinforced Concrete with Carbon Nanotubes, (Ilhwan You , Doo-Yeol Yoo , Soonho Kim , Min-Jae Kim and Goangseup Zi Received: 24 September 2017; Accepted: 27 October 2017; Published: 29 October 2017)

[5] "Nanotube film based on single-wall carbon nanotubes for strain sensing,"Published Year 2014, Prasad Dharap, Zhiling Li1, Satish Nagarajaiah and E V Barrera