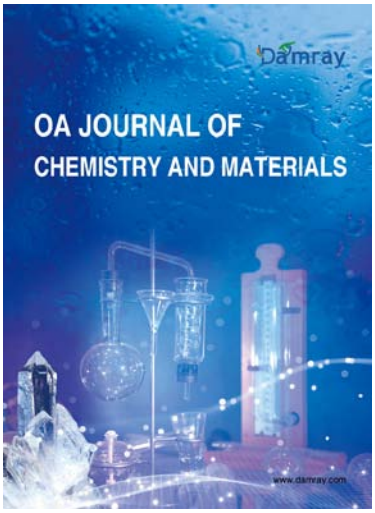
Damray | OA Journal of Chemistry and Materials

2022, 1(1), 10-12

Experimental Study on Physical and Mechanical Properties of Carbon Nanotube Cement-Based Composites



https://oajcm.damray.com/

OPEN ACCESS

DOI:
Received: June 28, 2022
Accepted: July 24, 2022
Published: August 5, 2022
Copyright: ©2022 Jianfeng Li. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

Jianfeng Li

School of Mechanical Engineering, Shenyang University of Technology, Shenyang, Liaoning, China.

Abstract

The advantages of cement concrete materials are economical and reasonable, simple construction, strong durability, and wide sources, but the corresponding determination is that the toughness is not strong and easy to crack, etc. These deficiencies also hinder and restrict its development. The carbon nanotube itself has strong toughness and strength, and its mechanical properties are also outstanding, which can improve the cement base. This article mainly starts from carbon nanotubes, and explores and analyzes the effective mechanism of enhancing the physical and mechanical properties of cement-based composites.

Keywords

Cement-based, composite materials, mechanical properties

Introduction

At present, there is no systematic study on the physical and mechanical properties of carbon nanotubes cement matrix composites in China, and multi-walled carbon nanotubes water-based slurry is usually used to strengthen them. The ultimate fiber material of carbon nanotubes itself belongs to ultra-high aspect ratio, and has excellent thermal stability, chemical stability, micro absorption, electrical properties, etc., and its unique nano effect makes it an ideal component to enhance various collective materials.

1. Summary of test

(1) Raw materials: Dongyue Brand Portland cement, multi-walled carbon nanotubes, 5% concentration of carbon

nanotubes dispersion liquid.

(2) Test instrument and ratio: Six groups of multi-walled carbon nanotube cement net slurry composite specimens with different additives were prepared respectively. The size of the specimens was 160mm*40mm*40mm, and the proportion of carbon nanotube additives was 0.02%, 0.20%, 0%, 0.05%, 0.30%, 0.10%, 0.9% naphthalene series high efficiency water reducing agent. Water cement ratio is 0.35.

(3) Methods: According to the specific methods in the relevant specifications and policies for the strength of cement mortar and carbon nanotube cement and composite materials, the specimens were cured until the strength age could be measured. The four-point bending method was used to test the toughness of carbon nanotube cement matrix composites, so as to determine the load deflection curves of the specimens.

2. Exploring the test results

2.1 About compressive strength and flexural strength

The compressive strength and flexural strength of the composite material have a certain overlapping trend. The actual amount of carbon nanotubes incorporated has a maximum peak value, which is kept at about 0.10%. If the amount of carbon nanotubes incorporated is within the peak value, The change of compressive strength and flexural strength in the load-deflection curve showed a trend of first rising and then falling. When 0.05%, 0.02%, 0.10% of carbon nanotubes are added, the compressive strength and flexural strength of carbon nanotube cement-based composite specimens themselves are usually improved within 28, 7, and 90 days of age. The flexural strength of the specimen is at its peak in the 0.10% carbon nanotube doping amount, and the 0.10% carbon nanotube doping amount can be increased by 22.38%, 24.74%, 28, 7, and 90 days, respectively. The flexural strength of 21.28%; the cement-based material specimens will have a significantly greater increase in flexural strength at 28 and 7 days of age than at 90 days of age after carbon nanotubes are used. The 0.10% content of carbon nanotubes in the 7-day age can effectively improve the flexural strength of the specimens by 6.29%; At the maximum value, they increased by 18.49% and 17.26% respectively; the compressive strength of the specimens with 0.30% carbon nanotubes content decreased significantly at 28 and 90 days of age, but the compressive strength and the benchmark specimens It is still a significant increase compared to 9.13% and 8.27% respectively.

2.2 About toughness characteristics

The benchmark specimens without carbon nanotubes can be compared according to the failure characteristics of the loaded specimens. The benchmark specimen does not incorporate carbon nanotubes in the specific failure process, and the time spent in the specific failure process is not long, and the fracture phenomenon will occur under small load conditions, and the fracture surface is not rough; the cement-based composite carbon nanotube beam specimen The fracture does not occur mid-span, and it is a brittle failure, the fracture surface is not smooth, and usually does not split in half after fracture. The deformation ability of the specimen itself is at the best stage with the addition of 0.05% carbon nanometers. If the addition amount is increased, the deformation ability of the carbon nanotube cement-based composite beams will not show an upward trend. The toughness of carbon nanotube cement paste composite trabeculae specimens will show different enhancement effects with different carbon nano-doping amounts. The toughness index of the specimens with 0.1% and 0.05% of carbon nanotubes was significantly improved, especially when the amount of carbon nanotubes was 0.05%, the toughness index of the composite specimen itself was the maximum value. This is because the high-quality toughness of carbon nanotubes can avoid cracks and prevent them from extending. At the same time, the carbon nanotubes in the cement paste composite have a good dispersion state and maintain efficient interfacial compatibility with the cement matrix. Therefore, the hydration product has efficient fiber pull-out effect, Qiaolian pull-out effect, and microscopic filling effect, which effectively improves the toughness of the composite material itself. Compared with the benchmark specimen, the improvement of the 0.30% and 0.20% specimens is not large, which can be effectively analyzed because the carbon nanotubes cannot be evenly divided into the cement-based composite materials after increasing the dosage, which is easy to make the material. In the case of agglomeration, entanglement or agglomeration, the high interface compatibility of the cement matrix material cannot be maintained, and the toughness index of the material cannot be greatly increased by the weakened nanotubes.

3. Conclusion

That cement base composite material through the above experiment after the use of carbon nanotubes on the mechanical properties and the effect of different degree of adding amount of toughness characteristic, the conformity of strength and flexural strength are also different, according to the practice of all kinds of data prove that its compressive

strength and bending degree in 0.10% of the amount of carbon nanotubes doped with maximum value, In order to effectively enhance the toughness of carbon nanotubes, it is necessary to add appropriate amount of carbon nanotubes.

References

[1] Zhang Xi'e. (2015). Study on mechanical properties and frost resistance of carbon nanotube cement-based composites [J]. Silicate bulletin, 2015-09.

[2] Chang Liwu, Sun Yuzhou, Le Jinchao. (2014). Experimental study on bending properties of carbon nanotube reinforced cement mortar beams [J]. Concrete, 2014-10.