

2024년 춘계학술발표대회 : 일반부문

고분산 그래핀 나노리본이 시멘트계 시스템의 수화 및 기계적 물성에 미치는 영향

Effect of highly dispersed graphene nanoribbons on hydration and physical mechanical
of cementitious system

○박 태 염* 진 오 곤 ** 배 성 철***

Piao, Taiyan Chen, Yukun Bae, Sungchul

키워드 : 그래핀 나노 리본, 고성능 감수제, 분산방법, 수화반응, 시멘트 페이스트

Keywords : Graphene nanoribbons, Superplasticizer, Dispersion method, Hydration, Cement paste

1. Introduction

In this work, surfactant-assisted ultrasonic homogeneous dispersion of graphene nanoribbons (GNRs) on hydration and microstructure of cement pastes was investigated. GNRs were found to promote the polymerization of calcium silicate hydrate more effectively than carbon nanotubes (CNTs) due to their higher chemical activity. This leads to the generation of more hydration products in the cement paste and the formation of a denser microstructure.

2. Experiment process

Synthesis of GNRs by deconvolution of CNTs [1]. Distilled water was sonicated with 0.1 wt% of superplasticizers (SPs) and 0.05 wt% of nanomaterials (CNTs and GNRs) for 60 min to make a cement paste. The dispersion solution was mixed with ordinary silicate cement (OPC) with a water/cement ratio (w/c) of 0.3. The hydration properties of GNRs in cement pastes were explored through XRD, thermogravimetric analysis (TGA), scanning electron microscopy with backscattered electrons (SEM-BSE), and solid-state ^{29}Si nuclear magnetic resonance (NMR) spectroscopy.

3. Results and discussions

Figure 1 illustrates GNRs in cement paste generate more portlandite and C-S-H structures, showing a more pronounced effect than CNTs.

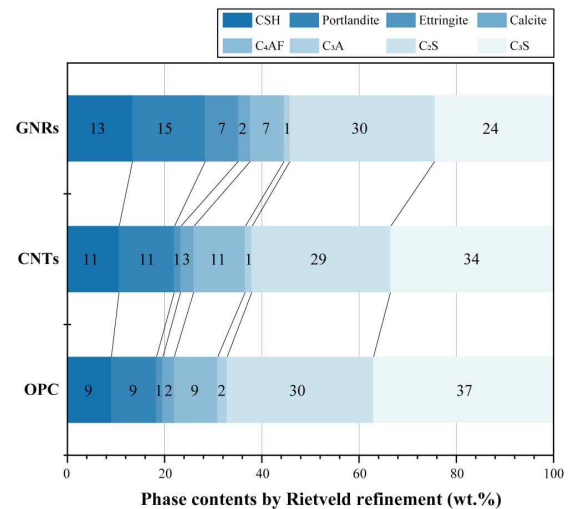


Figure 1. Quantified crystalline phase composition of the samples at 28days.

4. Conclusions

Incorporating 0.05 wt% uniformly dispersed GNRs into cement paste samples resulted in a significant increase in compressive strength and split tensile strength by 17% and 33%, respectively, compared to the control group after curing for 28 days. Well-dispersed GNRs can effectively improve the internal pore structure of the cement paste and reduce porosity.

Acknowledgements

This work was supported by the Technology Innovation Program (RS-2023-00263555, Development of Low-carbon blended cement manufacturing technology using limestone powder).

Reference

1. Kosynkin, D.V., et al., *Longitudinal unzipping of carbon nanotubes to form graphene nanoribbons*. Nature, 2009. 458(7240): p. 872-876.

* 한양대학교 대학원 석박통합과정

** 한양대학교 건축공학과 연구교수, 공학박사

*** 한양대학교 건축공학과 교수, 공학박사

(Corresponding author : Department of Architectural Engineering,
Hanyang University, sbae@hanyang.ac.kr)

This work was supported by the Technology Innovation Program (RS-2023-00263555, Development of Low-carbon blended cement manufacturing technology using limestone powder)