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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

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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.

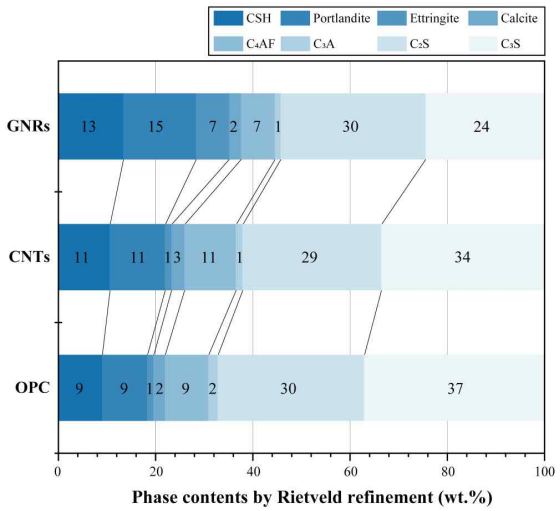

Figure 1. Quantified crystalline phase composition of the samples at 28days.

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.

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Reference

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

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