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EDITORIAL
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Editorial: New Technologies for Investigating Microstructures and Enhancing Performance of Cementitious Materials

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Editorial on the Research Topic

New Technologies for Investigating Microstructures and Enhancing Performance of Cementitious Materials

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INTRODUCTION

Cementitious material, including Portland cement concrete, polymer cement-based composites, etc., are highly complex in phase compositions. The increase in demand for high-performance cementitious material in recent years has resulted in renewed interest in the study of the new technologies for investigating microstructures and enhancing performance of cementitious materials.

Development of advanced and effective experimental techniques during the last decade, such as X-ray diffraction(XRD) (Ruan and Unluer, 2017), thermogravimetry analysis (TG) (Lv et al., 2020), scanning electron microscopy (SEM) (Wang et al., 2021a), infrared spectroscopy (IR) (Hou et al., 2020; Li et al., 2021), air void analyzer (Wang et al., 2021b), nanoindentation (Lv et al., 2021), mercury intrusion porosimetry (MIP) (Wang et al., 2021c), and nuclear magnetic resonance (NMR) (Wang et al., 2020), has revealed that the micro-scale properties of materials have a significant effect on their macro-scale properties. However, traditional technologies have not been able to keep up with the increasing complexity of the cementitious materials. In addition, some new construction materials (e.g., 3D Printing material and new industrial waste) have been widely investigated but their microstructures are still poorly presented.

This special issue gathers six papers and aims at providing the fundamental innovations in the development of new technologies to investigate the microstructure and to enhance the performance of traditional Portland or alternative cementitious materials.

OVERVIEW OF THIS SPECIAL ISSUE

To investigate the hydration products and the microstructure of 3D Printing cementitious materials (3DPC) containing nano-$CaCO_3$ (NC), Yang et al. used the backscattered electron (BSE) and TG, and found that NC refined the pore structure of 3DPC due to its filler effects and accelerating effects.

An accurate quantification of periclase in high magnesia Portland cement (HMPC) is vital to evaluate the expansive property of HMPC. In a study conducted by Ma et al., a new technique to quantitatively determine the periclase content in HMPC was estiblished by combining the autoclave test, TG and chemical analysis. According to this study, the technique was of high accuracy.

Ruan et al. synthesized a foamed alkali-activated glass (FAAG) *via* the use of milled waste glass and foaming agent in low-temperature. By using thermal conductivity meter and XRD, they characterized the phase formation and thermal conductivity of FAAG. They also proposed that the new FAAG was superior to other commercial products in terms of thermal conductivity, density, strength and CO_2 emissions.

To investigate the relationships between the mechanical properties of internally cured concrete containing super absorbent polymer (SAP concrete), the uniaxial mechanical properties of SAP concrete with different internal curing water-cement ratios were studied by Xie et al. They proposed the equations among the splitting tensile strength, compressive strength, and flexural strength of SAP concrete based on the conversion formulas of different strength indexes.

In a study performed by Xiao et al., the bonding behavior between engineered cementitious composite (ECC) and steel bars were determined by direct pull-out tests. They demonstrated that failure modes between ECC and steel bars were mainly pull-out failure. Besides, they found that the bond strength increased with fiber content.

MgO expansive agent can be used in dam concrete to prevent the temperature cracking. In Chen et al.'s study, the autogenous deformation of MgO-admixed concrete with different specimen sizes up to 6 years were investigated. The MIP results confirmed that the pore structure became finer with increasing hydration age and the expansion caused by MgO hydration would not damage the concrete structures.

CONCLUSIONS

In this special issue, six papers were collected about the new technologies for investigating cementitious materials and enhancing performance. They are the state-of the-art researches, aiming at providing information on the advances of these new technologies. The technologies probing other construction materials such as the metal and ceramic materials are beyond the scope of this special issue.

AUTHOR CONTRIBUTIONS

LW: writing-original draft and preparation. EC: review. SR: editing. ST: review and supervision. All authors contributed to the article and approved the submitted version.

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.