frontiers | Frontiers in Materials

TYPE Editorial
PUBLISHED 18 July 2022
DOI 10.3389/fmats.2022.978032

OPEN ACCESS

EDITED AND REVIEWED BY
John L. Provis,
The University of Sheffield,
United Kingdom

*CORRESPONDENCE
Lijie Guo,
guolijie@bgrimm.com

SPECIALTY SECTION
This article was submitted to Structural Materials, a section of the journal Frontiers in Materials

RECEIVED 25 June 2022
ACCEPTED 30 June 2022
PUBLISHED 18 July 2022

CITATION
Guo L, Zhang T, Guo X and Meng W (2022), Editorial: Non-BF slag-based green cementitious materials. *Front. Mater.* 9:978032. doi: 10.3389/fmats.2022.978032

Editorial: Non-BF slag-based green cementitious materials

Lijie Guo[1]*, Tingting Zhang[2], Xiaolu Guo[3] and Weina Meng[4]

[1]Beijing General Research Institute of Mining and Metallurgy, Beijing, China, [2]School of Civil Engineering, Dalian University of Technology, Dalian, China, [3]School of Materials Science and Engineering, Tongji University, Shanghai, China, [4]Department of Civil, Environmental and Ocean Engineering, Stevens Institute of Technology, Hoboken, NJ, United States

KEYWORDS

slag, cementitious materials, hydration, mechanical properties, minefill

Editorial on the Research Topic
Non-BF slag-based green cementitious materials

This special issue draws attention to "Non-BF slag Based Green Cementitious Materials", focusing on the research progress and achievements of non-BF slag-based green cementitious materials. Metallurgical slag is a kind of by-product of the metal smelting process. For many years, a huge amount of slag was deposited in waste dumps or stockpiles due to the increasing scale of metal production, which causes a series of social, environmental, and economic problems. The sustainable utilisation of waste slag has become one of the major challenges in the field of civil and environmental engineering. The use of slag in cement production as an alternative cementitious material to form new green construction materials is a critical aspect to consume this huge amount of metallurgical solid waste. So far, blast-furnace slag (BF slag) has already been widely used in cement production, however, a large amount of non-BF slag (ferrous and non-ferrous) materials are still under-utilised. At present, a lot of research has been carried out to investigate the use of non-BF slags in cement production. However, only a few examples of industrial applications have been reported. Various Research Topics are available to address this issue related to the role of non-BF slag-based green cementitious materials, including: hydration and microstructure formation of green cementitious materials; assessment of mechanical properties of green cementitious materials; methods to improve the activity of non-BF slag based green cementitious materials; results from laboratory experiments and/or large-scale projects; short and long-term performance of novel cementitious materials; case studies of green cementitious materials for mine filling.

In the present issue of Frontiers in Materials, a total of 29 manuscripts were received and 19 of them were accepted. The editors would thank all the experts and scholars for submitting excellent papers to this special issue, and the reviewers for providing many constructive comments for the special issue.

The first paper by Dong et al. provides a case study of green cementitious materials for mine filling, they studied the application of using mixed gangue composed of equal-quality washed gangue and crushed gangue is proposed as a raw material for solid filling,

and experimental work was carried out to compare and analyze the compression characteristics of solid filling. The findings show the degree of relative compaction of mixed gangue is 1.226, which is significantly lower than that of washed gangue, which is 1.33. The deformation modulus of mixed gangue is 23–135 MPa, which is better than that of washed gangue (26–100 MPa), indicating that the compressive resistance of mixed gangue is significantly improved. And the case study in the Tangkou mine also suggests that mixed gangue greatly promotes the consumption of wasted gangue and can effectively control the surface deformation. In the paper by Deng et al. the case study was done for the filling treatment of surface subsidence resulting from underground mining in a high-altitude mine.

For the use of green cementitious materials in mine filling, Huan et al. studied the pore structure characteristics and their effect on the mechanical performance of cemented paste backfill in his paper, Wang et al. studied the effect of the alkalized rice straw content on strength properties and microstructure of cemented tailings backfill. Gan et al. did a study on the mechanical properties and hydration mechanism of tailings backfill made by green cementitious materials. The paper by Hou et al. illustrates the mechanical characteristics and stress evolution of cemented paste backfill A experimental investigation on the strength and failure characteristics of cemented paste backfill was done by Zhang and Li. Zhu et al. studied the durability of concrete with coal gasification slag and coal gangue powder. Feng et al. predicted the strength of coal-based solid waste filler based on the BP neural network. In the paper done by Hao et al. mechanical modification of nanomaterials on fully saturated concrete in groundwater reservoir under long-term water immersion was studied. Basic properties of fly ash/slag -concrete slurry waste geopolymer activated by sodium carbonate and different silicon sources was also done by Cao et al.

In the paper by Wu et al., the effect of iron tailings and slag powders on the workability and mechanical properties of concrete were studied. It demonstrates that the proper addition of iron tailing powder is beneficial to the working performance of concrete and can effectively reduce the time-loss of concrete fluidity. When the content of iron tailings powder in the composite admixture is 50%, the 1080d long age strength of C30 and C50 concrete can reach 50.3 and 80.7 MPa. Based on the 28d compressive strength, the relative strength-age prediction model of iron tailings powder concrete was established. The calculation and experimental results show that the model can accurately predict the compressive strength of micro-powder concrete of iron tailings at long age, and the error rate is less than 1%. The results lay a theoretical foundation for the utilization of iron tailings in concrete.

In the paper by Liu et al., the effects of the silicate modulus of water glass on the hydration and mechanical properties of alkali-activated blast furnace ferronickel slag were studied. In the paper by Niu et al., the synergistic excitation mechanism of $CaO\text{-}SiO_2\text{-}Al_2O_3\text{-}SO_3$ quaternary active cementitious system $CaO\text{-}SiO_2\text{-}Al_2O_3\text{-}SO_3$ was provided. Wu et al. also presented the improvement of calcium aluminate cement containing blast furnace slag at 50 and 315°C. In the paper by Fu and Cheng, the effect of Cr^{6+} on the properties of alkali-activated slag cement, the effect of aluminum incorporation on the reaction process, and reaction products of hydrated magnesium silicate was done by Jia et al. The occurrence state of carbon and electrolyte in anode carbon residue from electrolytic aluminum was studied in the paper by Mao and Zhang.

In the paper by Li et al., they explored an innovative approach for rapid repair mortar preparation using solid waste-based calcium sulfoaluminate cement. The test results showed that the 2-h compressive and flexural strength and 1-day bonding strength of the prepared rapid repair mortar were 32.5, 9.2, and 2.01 MPa, respectively, indicating the excellent early-age mechanical performance of the high-performance rapid repair mortar. In addition, the 28-days compressive and flexural strengths of the rapid repair mortar reached 71.8 and 17.7 MPa. And a life cycle assessment and economic analysis indicated that this approach achieved environmental-friendly utilization of industrial solid wastes and cost-effective and energy-saving natures.

Overall, we hope the contribution of this collection builds up the understanding and interest of all researchers and practitioners who are focused on the recent developments and advancements in studying green cementitious materials based on solid wastes. It is hoped that the results of this issue can provide a reference for future research on non-BF slag-based green cementitious materials, and contribute to promoting the development of green cementitious materials.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication

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.

Publisher's note