

Editorial

Special Issue: Emerging Approaches for the Performance Assessment and Prediction of Cement-Based Materials

Nima Farzadnia ^{1,*} and Amin Malek ^{2,*}

¹ Department of Civil, Geological, and Environmental Engineering, College of Engineering and Mines, University of Alaska Fairbanks, Fairbanks, AK 99775, USA

² Department of Computer and Electrical Engineering, California State University, Bakersfield, CA 93311, USA

* Correspondence: nfarzadnia@alaska.edu (N.F.); amalekm@csu.edu (A.M.)

The current Special Issue, entitled “Emerging Approaches for Performance Assessment and Prediction of Cement-Based Materials”, aims to showcase cutting-edge research into the technologies, smart sensing systems, and tools for assessing and predicting the performance of cement-based materials. Special emphasis is placed on understanding innovative strategies for characterizing the microstructure and durability of these materials, as well as harnessing smart sensing systems and data-driven approaches, all of which hold the potential to redefine our modern infrastructure.

Cement-based materials have always been the backbone of our construction industry, providing strength, durability, and resilience to our built environment. Over the years, researchers have delved deep into understanding the intricate physicochemical processes that govern the behavior of these materials, studying hydration processes, the formation of various crystalline and amorphous phases, and interactions with admixtures as well as deterioration mechanisms [1–3]. The advent of smart sensing systems has added a new dimension to this research, allowing for the real-time monitoring of stress, strain, and environmental impacts on concrete structures, thereby enabling timely interventions [4]. Furthermore, data-driven approaches, bolstered by the rise of machine learning and artificial intelligence, are beginning to play a pivotal role in predicting the long-term performance of concrete structures. These methodologies not only rely on historical data but also incorporate real-time feedback from sensors, leading to highly accurate and dynamic predictive models [5].

The research scope of this Special Issue encompasses, but is not limited to, advanced imaging techniques for cement microstructure; novel experimental and computational methodologies for durability assessments; predictive modeling using data analytics; and the integration and utility of smart sensing systems in cement-based constructs. Additionally, leveraging the power of big data to develop high-performance composites with better properties and enhanced performance, remains the focal point of this Special Issue.

Conflicts of Interest: The authors declare no conflict of interest.



Citation: Farzadnia, N.; Malek, A. Special Issue: Emerging Approaches for the Performance Assessment and Prediction of Cement-Based Materials. *Materials* **2023**, *16*, 6974. <https://doi.org/10.3390/ma16216974>

Received: 27 September 2023

Accepted: 7 October 2023

Published: 31 October 2023



Copyright: © 2023 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

References

1. Scrivener, K.; Ouzaia, A.; Juilland, P.; Mohamed, A.K. Advances in understanding cement hydration mechanisms. *Cem. Concr. Res.* **2019**, *124*, 105823. [[CrossRef](#)]
2. Artioli, G.; Bullard, J.W. Cement hydration: The role of adsorption and crystal growth. *Cryst. Res. Technol.* **2013**, *48*, 903–918. [[CrossRef](#)]
3. Marchon, D.; Flatt, R.J. Impact of chemical admixtures on cement hydration. In *Science and Technology of Concrete Admixtures*; Woodhead Publishing: Sawston, UK, 2016; pp. 279–304.
4. Sony, S.; Laventure, S.; Sadhu, A. A literature review of next-generation smart sensing technology in structural health monitoring. *Struct. Control. Health Monit.* **2019**, *26*, e2321. [[CrossRef](#)]
5. Azimi, M.; Eslamlou, A.D.; Pekcan, G. Data-driven structural health monitoring and damage detection through deep learning: State-of-the-art review. *Sensors* **2020**, *20*, 2778. [[CrossRef](#)] [[PubMed](#)]

Short Biography of Authors

Farzadnia is a concrete scientist with expertise in designing, modeling, characterizing, and optimizing cementitious composites, as well as sustainable alternative binders, smart materials, and robotic construction. Farzadnia is an Assistant Professor at the University of Alaska Fairbanks, USA. He contributes to the editorial landscape as a member of the editorial team for the *Crystals* journal and has also taken on the role of guest editor for the Special Issue “Cement-based Crystals.” Additionally, he has participated as a technical or organizing committee member in several conferences and co-chaired the Gordon Research Seminar on Advanced Materials for Sustainable Infrastructure Development in 2020. He has published over 60 journal papers in high-impact-factor journals in the field.

Amin Malek is an experienced researcher with a specific discipline in Electronics, Design, Fabrication, and Data Analysis. He is a Fellow of the UK Higher Education Academy (FHEA), a Senior Member of IEEE, and a member of the Engineering Council (CEng), IET. Malek is an Associate Professor at California State University, Bakersfield, California, USA. He has been awarded over USD 1.5 million in grant monies and endowments. He has published over 100 scientific research papers and a postgraduate textbook and delivered a few keynote speeches at international scientific conferences around the globe. Thus far, he has four patents for digital communication systems.

Disclaimer/Publisher’s Note: The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.