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Editorial

Advances in Cement Research

Editorial: Geopolymers and alkali-activated cements for a sustainable future

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The urgency of reducing the environmental footprint of cementitious materials production has led to an intensified focus on alternative binders that offer both performance and sustainability. Among these, **alkali-activated materials (AAMs) represent a broad class of cementitious materials**, which include but are not limited to geopolymers. This special issue of *Advances in Cement Research* brings together cutting-edge research on geopolymers and alkali-activated cements, addressing both fundamental material science and practical applications.

Wen *et al*. explore novel fly ash-based porous geopolymers through the replica method, emphasising how process parameters influence porosity, thermal conductivity, and mechanical strength. Their work highlights the potential of these geopolymers for insulation applications and the role of optimized alkaline activation in enhancing performance. Singh and Kapoor studied fly ash geopolymer concrete incorporating recycled aggregates, showing that while high replacement levels of fine and coarse recycled aggregates can impact durability, optimized mixtures maintain mechanical integrity and contribute to sustainable construction practices.

Song *et al*. investigated calcium hydroxide activation in ferronickel slag–Portland cement blends, showcasing its role in enhancing early-age hydration and mechanical strength. Their study shows that alkali activation is not limited to pure geopolymerization but extends to blended systems with traditional cements, expanding potential applications of this technology. He *et al*. focus on alkali-activated slag foamed concrete, developing a predictive model to optimise porosity and mechanical properties, making it suitable for lightweight and thermal insulation applications. This model offers a valuable tool for tailoring the properties of foamed concrete for specific needs. Finally, Lou *et al*. assess one-part geopolymer mortar's resistance to magnesium sulfate erosion, identifying key factors that influence long-term durability under aggressive environments. Their research provides critical insights for ensuring the longevity of geopolymer structures in challenging conditions.

These studies reaffirm AAMs as viable, scalable solutions for the construction industry, spanning applications from structural concrete to insulating materials and blended cementitious systems, while offering a path toward decarbonization. They showcase the versatility and potential of geopolymers and alkali-activated cements in addressing both environmental and performance challenges. The research presented here advances our understanding of these materials and provides practical guidance for their implementation in real-world applications.

Advances in Cement Research has recently published several key studies on geopolymers and alkali-activated systems. Readers are encouraged to explore related articles on: *Microstructure and properties of fly-ash-based geopolymer with expanded vermiculite* (https://doi.org/10.1680/jadcr.23.00006), *Corrosion of Portland cement and metakaolin geopolymer in nitric acid* (https://doi.org/10.1680/jadcr.22.00108), and *Using recycled geopolymers as aggregates* (https://doi.org/10.1680/jadcr.17.00120).

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