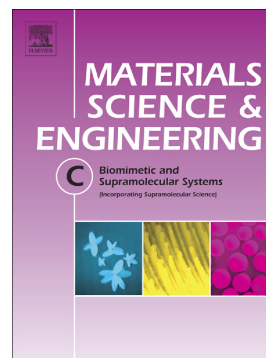


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ZnO-SiO₂ nanohybrid decorated sustainable geopolymer retaining anti-biodeterioration activity with improved durability

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Abstract:

Geopolymer, consists of industrial by-product fly ash, and alkaline activator, possesses similar strength along with durability like conventional cement composite, is an alternative construction substantial of Portland cement in current scenario. Corrosion of the concrete materials resulted mainly from the chemical degradation. Besides chemical degradation, biogenic-deterioration is also another alarming issue especially in the sewer systems, bridge piers, several pipelines and offshore platforms and the need to act on it is long-standing. In this study, application of zinc oxide-silica nanohybrid based sustainable geopolymer (GM_{ZnO-Si}) has been investigated for the development of a sustainable, anti-bio deteriorate cementitious material having significant mechanical strength and durability. Initially, zinc oxide nano-rods (ZnO NRs) have been synthesized and spherical silica nanoparticles were decorated on the surface of ZnO NRs. The ZnO-SiO₂ composite was characterized by various techniques (FTIR, XRD, FESEM, EDS, TEM, and XPS). Ambient temperature cured GM_{ZnO-Si} mortar was further explored in terms of mechanical strength, durability, mechanistic anti-microbial (*E. coli*, *S. aureus*, *A. niger*) influences. Mechanical properties of GM_{ZnO-Si} are found significantly higher than that of control samples. MIC, MBC, and MFC results demonstrate enhanced anti-microbial efficacy of GM_{ZnO-Si}. Inner permeability assay, reactive oxygen species generation and microscopic images of cell wall rupture and DNA damage studies supported the detailed understanding of anti-microbial activities. These experimental findings suggest that incorporation of ZnO-SiO₂ hybrid in geopolymer will pave the way for biodeterioration resistant concrete with enhanced mechanical and structural behaviour.

Keywords: ZnO-SiO₂ nanohybrid, Geopolymer, Anti-microbial activity, Durability, Mechanical and structural behaviour.

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