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Sustainable utilization of nanomaterials in reactive powder composite: State of the art review

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Highlights

- Incorporating nanomaterials in RPC and powders leads to significant improvements.
- Nanomaterials improve durability performance by increasing their resistance.
- In addition, the fluidity performance shows increased flow properties.
- Adding nanomaterial increased the homogeneity and dispersion of RPC.

Abstract

Reactive powder concrete (RPC) or ultra-high-performance concrete (UHPC) is known as concrete that has been enhanced in terms of durability, microstructure, and mechanical properties. Reactive Powder Concrete (RPC) has been in greater demand over the past few years due to its remarkable properties. However, some characteristics of the (RPC) may not align with the sustainable growth objectives of the construction industry. These include its high cement and silica fume (SF) concentration, low water-to-binder ratios, and lack of coarse particles. The shrinkage problems and high costs associated with RPC production are additional concerns. To address these challenges, various nanomaterials have been utilized to enhance mechanical strength, fluidity, durability, and microstructure properties, aiming to develop environmentally friendly (RPC) that surpasses conventional (RPC) by determining the optimal percentage of nanomaterials for incorporation. This research aims to analyze the literature on nanomaterials used in (RPC) manufacture and assess their potential as a cement substitute under various scenarios. Studies have shown that up to 5% of cement can be successfully replaced by nanomaterials, with nano-silica being the most commonly employed additive. Nanomaterials greatly enhance the RPC's mechanical strength and durability. The incorporation of nanomaterials significantly enhances RPC's mechanical strength and durability by minimizing voids and reducing porosity, leading to a denser structure. This densification enhances durability against corrosion, consequently extending the lifespan of (RPC).