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Bond-Slip Behaviour and Optimisation Analysis of a High-Strength PVA-Engineered Geopolymer Composite (EGC) Cured at Room Temperature

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Abstract

In recent years, the construction industry has seen a paradigm shift towards sustainable and innovative materials. One such groundbreaking development is the emergence of Engineered Geopolymer Composites (EGCs) high-performance, environmentally friendly materials that exhibit exceptional strength and durability. This article delves into the bond-slip behavior and optimization analysis of a room-temperature-cured, high-strength PVA-engineered geopolymer composite, exploring its characteristics, advantages, and potential applications. EGCs represent a class of advanced materials derived from geopolymerization, a process that involves the chemical reaction between aluminosilicate precursors and an alkaline solution. This reaction results in a three-dimensional, polymeric network with excellent mechanical properties. The addition of Polyvinyl Alcohol (PVA) further enhances the structural integrity, durability, and bond strength of geopolymeric matrices.

Keywords: Fermatean fuzzy hybrid • Materials selection • Fuzzy logic

Introduction

The bond-slip behavior in EGCs plays a pivotal role in determining the structural performance of these composites. Bond-slip refers to the interaction between the reinforcing fibers (such as PVA fibers) and the geopolymeric matrix. Understanding this behavior is crucial for optimizing the composite's load-carrying capacity and ensuring long-term structural integrity. The effectiveness of the bond between the PVA fibers and the geopolymeric matrix significantly influences the composite's mechanical properties. Proper interfacial bonding minimizes the potential for slip and enhances load transfer mechanisms. Room-temperature curing affects the bond-slip behavior of EGCs. Optimizing the curing process can mitigate issues related to bond-slip, ensuring a strong interface between the fibers and the matrix. The arrangement and distribution of PVA fibers within the geopolymeric matrix impact bond-slip behaviour [1-3].

Literature Review

A uniform dispersion and alignment of fibers contribute to enhanced mechanical properties and resistance against slip. The optimization of EGCs involves various parameters and methodologies aimed at enhancing their mechanical properties and overall performance. Optimal selection and proportioning of raw materials, including aluminosilicate precursors, alkaline solutions, and PVA fibers, are crucial. This involves meticulous control over material ratios to achieve the desired mechanical strength and bond performance. Adjusting the mix design parameters such as water-to-binder ratio, curing duration, and mixing techniques can significantly influence the composite's properties. Innovative manufacturing processes can aid in achieving better dispersion of fibers and optimizing bond strength. Rigorous characterization and testing methods, including mechanical tests, microscopic analysis, and bond-slip tests, are essential for evaluating the effectiveness of optimization strategies. These analyses provide insights into the composite's behavior under different loading conditions and help refine optimization techniques [4,5].

Discussion

The exceptional mechanical properties and environmentally friendly nature of room-temperature-cured, high-strength PVA-engineered geopolymer composites open doors to diverse applications. From infrastructure projects to sustainable construction, these composites offer high-strength solutions with reduced

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with reduced environmental impact. EGCs can be employed in structural elements such as beams, columns, and panels, offering enhanced durability and load-bearing capacity. The use of EGCs in repairing and strengthening existing structures can prolong their service life and reduce maintenance costs. With their reduced carbon footprint and utilization of industrial waste materials, EGCs align with the principles of sustainable development. [6].

Conclusion

In conclusion, the bond-slip behavior and optimization analysis of room-temperature-cured, high-strength PVA-engineered geopolymer composites represent a significant advancement in construction materials. Understanding and refining these aspects are pivotal in harnessing the full potential of these innovative materials, paving the way for sustainable and high-performance construction solutions. Room-temperature-cured, high-strength PVA-engineered geopolymer composites represent a promising advancement in construction materials. Understanding the bond-slip behavior and optimizing various parameters are crucial steps toward harnessing their full potential. Through continuous research, innovation, and collaboration between academia and industry, these composites hold the promise of revolutionizing the construction sector with their superior mechanical properties, durability, and sustainability.

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Conflict of Interest

None

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