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Sustainable Construction Materials: Coir Fibre Reinforced Fly Ash Geopolymer Concrete Study

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ABSTRACT

The construction industry is increasingly focusing on sustainable materials to reduce environmental impact, minimize carbon emissions, and utilize industrial by-products effectively. Fly ash-based geopolymer concrete has emerged as a green alternative to traditional Portland cement concrete, offering high long-term strength, durability, and reduced carbon footprint. Incorporating coir fibre, a natural, renewable fibre derived from coconut husks, into fly ash geopolymer concrete further enhances its sustainability and mechanical performance. Coir fibre acts as a natural reinforcement, improving tensile strength, flexural strength, and crack resistance while providing ductility and toughness to the otherwise brittle geopolymer matrix. Experimental studies reveal that optimum fibre content ensures uniform dispersion, better energy absorption during failure, and improved post-cracking behaviour without significantly compromising workability or compressive strength. Additionally, the use of fly ash promotes the utilization of industrial waste, contributing to environmental conservation. The synergistic combination of coir fibre and fly ash results in a durable, eco-friendly, and cost-effective construction material suitable for both structural and non-structural applications.