

New Vistas

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Abstract

The rising demand for infrastructure and rapid urbanisation has led to the increased use of cement composites, which are known for their extreme carbon footprint. This necessitates sustainable alternatives to traditional construction materials. Biochar (BC), a carbon-rich byproduct from biomass pyrolysis, has emerged as a promising additive or partial replacement in cement-based composites due to its dual benefits of performance enhancement and carbon dioxide (CO₂) sequestration.

This study aims to evaluate the role of BC in cement-based composites through a scientometric analysis of over a decade of Scopus-indexed publications. The research investigates key questions regarding the types and production methods of BC, its influence on mechanical and durability properties of composites, environmental impact, and carbon capture potential. Using scientometric tools, the study maps global research trends, with China leading in publication volume, followed by India and Italy; the United Kingdom ranks 16th, indicating a research gap and opportunity for advancement in this domain.

Findings reveal that incorporating 1–2% BC improves mechanical properties, while additions beyond 5–6% may lead to performance decline.

BC enhances microstructural characteristics by promoting internal curing, pore refinement, and reduced shrinkage. Notably, BC's carbon sequestration capacity distinguishes it from other sustainable materials, suggesting its potential to contribute to developing low-carbon or even carbon-negative construction materials.

This research underscores the significance of BC-modified composites for sustainable construction and highlights the need for further investigation, particularly in the UK, to harness their full potential in reducing the construction industry's environmental impact

Keywords

carbon-negative concrete, Biochar enhancement