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Exploring the Mechanical Enhancement of Hydrogel-Treated Construction and Demolition Fines

ABSTRACT

The escalating volume of construction and demolition (C&D) waste poses a dual challenge of environmental impact and resource management. This study integrates hydrogel technology into C&D waste management, specifically applying Ca-alginate hydrogel to enhance mechanical properties. Unconfined compression tests reveal significant strength improvement and ductile behavior in hydrogel-impregnated C&D waste compared to traditional materials. An optimal reaction time of approximately 3 days balances enhanced strength with potential degradation. The influence of sodium alginate content shows increased mechanical properties with a 4% mixture ratio, reducing hydraulic conductivity and improving material integrity. Curing temperature significantly affects strength and ductility, with air-dried conditions exhibiting superior behavior. Leaching tests confirm environmental safety, supporting the material's suitability for sustainable construction and geotechnical applications. The study highlights the transformative potential of hydrogel technology in addressing environmental challenges posed by C&D waste in the construction industry.