Harnessing Algae-Based Materials for Carbon Sequestration and Energy Efficiency in the Built Environment

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Abstract

The built environment is a major contributor to carbon emissions and energy consumption, necessitating sustainable solutions. This study explored the potential of algae-based materials as carbon sequestration agents and energy-efficient solutions for buildings. The cyanobacteria, Pseudanabaena amphigranulata (P. amphigranulata) were evaluated under varying pH levels, medium formulations, and photoperiod conditions. The study assessed the growth, carbon sequestration rate (CSR), and light filtration properties of the algae. The findings revealed that a pH value of 6-10 was optimal for the cyanobacteria to grow and achieve a biomass of 0.87 ± 0.41 g/L,

with a photoperiod of 12-24 hours being able to significantly enhance algae growth. The P. amphigranulata exhibited the highest performance at pH 8, achieving a cell density of 2.4, biomass of 0.87 g/L, and carbon equivalent (CO2e) of 1.36 g/L. Additionally, it demonstrated the highest chlorophyll absorbance (4.01) and effectively reduced the light intensity by 66.86% (from 1550 to 620 Lux (lx)). These results highlighted the potential of algae-based materials to integrate carbon sequestration and energy-saving functions in buildings. By reducing indoor light intensity and enhancing sustainability, these materials offer an innovative solution for mitigating climate change in the built environment.

Author keywords

Algae; Built environment; Carbon sequestration; Green energy

Indexed keywords

Engineering controlled terms

Carbon; Carbon cycle; Carbon Economy; Carbon emissions; Carbon sequestration; Energy utilization; Green buildings; Microalgae; Sustainable building; Sustainable development; Zero-carbon

Engineering uncontrolled terms

Built environment; Carbon emissions; Carbon energy; Carbon sequestration; Cyanobacterium; Energy efficient; Energy-consumption; Green energy; Light intensity; Sustainable solution

Engineering main heading

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