Group D-2 | An analysis of the cradle-to-gate life cycle of hempcrete in the United States to determine its potential to cause global warming.

COA SHOWCASE

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Achieving a 90% reduction in greenhouse gas emissions from building construction by 2050 in the United States requires major changes in the construction sector. This includes the adoption of advanced building methods and the use of bio-based materials like hempcrete. This research examines the development of hempcrete mix designs and evaluates their environmental impacts with the goal of reducing embodied emissions and achieving carbon negativity. As hempcrete is increasingly utilized in both traditional and innovative construction techniques, such as large-scale 3D printing, it is recognized for being carbon-negative due to the carbon stored in its materials. Given the high carbon emissions associated with traditional Portland cement concrete, hempcrete emerges as a practical, low-carbon, or even carbon-negative alternative for new construction methods. The ability of hempcrete to achieve carbon negativity depends on the ratio of hemp to lime in its composition. Therefore, a detailed Life Cycle Assessment (LCA) is crucial to assess hempcrete's potential for carbon reduction. This study performs a cradle-to-gate LCA on various hempcrete mix designs, including a hybrid LCA that considers the environmental impact of hemp grown domestically. The findings reveal that industrial hemp has a global warming potential (GWP) of -1.72 kg CO_2e per kilogram. The LCA indicates that carbon negativity is achieved when hemp makes up at least 20% of the hempcrete by weight. Additionally, the results emphasize the importance of accounting for lime's carbon absorption in calculations to reach carbon negativity, as relying solely on hemp may not be enough. The study concludes that optimizing hempcrete's ingredients to achieve carbon negativity is critical for effective strategies in climate mitigation and adaptation.