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Synergistic Impacts and Optimization of Gas Flow Rate, Concentration of CO2, and Light Intensity on CO2 Biofixation in Wastewater Medium by Chlorella vulgaris

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Abstract : The synergistic impact and optimization of gas flow rate, concentration of CO₂, and light intensity on CO₂ biofixation rate were investigated using wastewater as a medium to cultivate Chlorella vulgaris under different conditions (gas flow rate 1-8 L/min), CO₂ concentration (0.03-7%), and light intensity (150-400 µmol/m².s)). Response Surface Methodology and Box-Behnken experimental Design were applied to find optimum values for gas flow rate, CO₂ concentration, and light intensity. The optimum values of the three independent variables (gas flow rate, concentration of CO₂, and light intensity) and desirability were 7.5 L/min, 3.5%, and 400 µmol/m².s, and 0.904, respectively. The highest amount of biomass produced and CO₂ biofixation rate at optimum conditions were 5.7 g/L, 1.23 gL⁻¹d⁻¹, respectively. The synergistic effect between gas flow rate and concentration of CO₂, and between gas flow rate and light intensity was significant on the three responses, while the effect between CO₂ concentration and light intensity was less significant on CO₂ biofixation rate. The results of this study could be highly helpful when using microalgae for CO₂ biofixation in wastewater treatment.

Keywords : bubble column reactor, gas holdup, hydrodynamics, sparger
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