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Chapter 14 - Computational analysis and modeling of algal bioreactors performance

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Abstract

Modeling of algal bioreactors shows a crescent interest by the potential of algal biomass as a renewable source of energy. Bioreactors may accelerate the algal growth for applications like bioenergy. This process requires uptaking a nutrient through algal inner or surface, which defines the kinetics of algal energy conversion. The ways account for direct and indirect biophotolysis, fermentation either dark or light, and electrochemical either photo- or electrolytic. Considering the first way, algal capacity of fixing a nutrient using sunlight as a photosynthetic organism is attractive, compared with former biofuels that used cane or crops as a source of biomass. In this sense, light transmission is a premise for the success of algal photobioreactors, open and closed. However, control is needed to optimize light transmission and algal motion in water, which naturally allows algal growth through its dispersion. Therefore, understanding photobioreactor hydrodynamics is crucial to make algal growth an efficient process, such as developing new techniques to improve both biomass productivity and energy harvesting. For instance, a centrally illuminated vortex reactor may compete with a parallel plate, which is the most studied photobioreactor. Recent studies showed that a rotating-cylinder promotes Taylor–Couette vortex flow with less energy-consuming in square-section reactors, than using pallets impellors or baffles.

Furthermore, this reactor may enhance the exposure of culture to light and increase mass and heat transfer due to controlled flow dynamics. The reactor size and design impacts algal growth and performance.

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