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Optimization of a meter-cubed ($1m^3$) upscaled PBR (a focus on the light distribution of culture-agitation)

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Introduction: Microalgae, being unicellular microorganisms thrive under suitable lighting, nutrient and cell densities and contribute in the direct capture of CO_2 from the atmosphere. They play a vital role in the mitigation of the impacts of greenhouse gases generated from the combustion of fossil fuels and require the development of large scale and sustainable growth systems (PBRs). Large PBRs require adequate lighting (quantity and quality) and agitation (mixing) for optimized microalgae growth; these are key parameters to be considered when designing these systems. This work aims to optimize the lighting and mixing systems of an existing one meter cubed cube-shaped tank PBR.

Light distribution: The appropriate levels of light exposure within PBRs ensure that the growth rate of the culture is optimal. Excessive lighting would result in photoinhibition (bleaching) while low lighting conditions would result in poor growth.

Agitation (Mixing): High-cell-density micro algal cultures could be as high as 10^9 cells/mL which may result in drastically reduced transmission of light, increased rates of CO_2 consumption and DO accumulation, as well as quick increase of culture temperature. Mixing prevent biomass sedimentation and ensures uniform average exposure to light and nutrients. It also facilitates heat transfer and helps avoid thermal stratification and improves gas exchange within the culture medium. The length of time employed in mixing is very vital factor to consider when designing photo bioreactors. Good mixing would ensure high cell concentration and lower the probability of photoinhibition.

Biography

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