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An experimental investigation of the multiphase flows in a photobioreactor for algae cultivation ZIFENG YANG, Wright State University, HUI HU, MATTEO DEL NINNO, ZHIYOU WEN, Iowa State University — Algal biomass is a promising feedstock for biofuels production, with photobioreactors being one of the major cultivation systems for algal cells. Light absorption, fluid dynamics, and algal metabolism are three key factors in determining the overall performance of a photobioreactor. The behavior of the multiphase flow (i.e., liquid phase – water, gas phase – CO_2 and O_2, and solid phase – algal cells) and turbulent mixing inside the reactor are the core connecting the three factors together. One of the major challenges in the optimal design of photobioreactors for algae cultivation is the lack of in-depth understanding of the characteristics of the multiphase flows and turbulent mixing. In this study, we present a comprehensive experimental study to investigate the effects of turbulent mixing in photobioreactors on the performance of a photobioreactor for algae cultivation. A high-resolution particle image velocity (PIV) system is used to achieve time-resolved, in-situ flow field measurements to quantify the turbulent mixing of the multiphase flows inside the bioreactor, while algal cultures are also grown in the same reactor with the same experimental settings. The mixing characteristics of the multiphase flow are correlated with the algal growth performance in the bioreactors to elucidate the underlying physics to explore/optimize design paradigms for the optimization of photobioreactor designs for algae cultivation.

Zifeng Yang
Wright State University

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