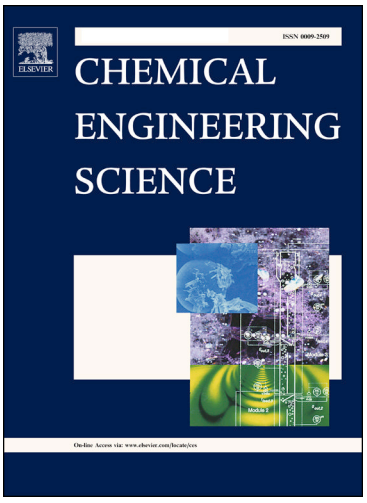

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Mapping of Microalgae Culturing via Radioactive Particle Tracking

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Abstract

In this study, an advanced radioactive particle tracking (RPT) technique was used to investigate for the first time the details of the cells' movements (trajectory) and multiphase flow hydrodynamics during microalgae culturing in a cylindrical split airlift photobioreactor. The cells' trajectory, liquid velocity field, distributions of shear stresses, and the turbulent kinetic energy field were studied under superficial gas velocity of 1 and 3 cm/s. The structures of the flow in the whole reactor, the riser, the downcomer, as well as the structure above and below the split plate were characterized. The effects of the cells' concentration and different aeration rate at different axial levels on the studied parameters were discussed. It has been found that the cells' fluctuations reduced and its movement frequency between the light (wall) and dark zone decreased during the culturing particularly when the cells concentrations becomes large after 30 days of culturing. Distinguishing behaviors were observed for all the parameters, with a higher magnitude at the superficial gas velocity 3 cm/sec than at 1 cm/sec. This effect positively enhanced the liquid circulation and the movement between the reactor sides, the riser, and the downcomer. This circulation and good mixing phenomena had a large positive impact on the culture's continuity. The obtained results are reliable as benchmark data to validate computational fluid dynamics (CFD) simulation and other models that can be later used to be integrated with dynamic growth and light intensity models for optimized.

Keywords: Split airlift photobioreactor, microalgae culture, *Scenedesmus*, noninvasive technique.