Decrease in light/dark cycle of microalgal cells with computational fluid dynamics simulation to improve microalgal growth in a raceway pond

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PII: S0960-8524(16)31222-6
DOI: http://dx.doi.org/10.1016/j.biortech.2016.08.094
Reference: BITE 16997

To appear in: *Bioresource Technology*

Received Date: 29 May 2016
Revised Date: 24 August 2016
Accepted Date: 25 August 2016

Please cite this article as: Yang, Z., Cheng, J., Ye, Q., Liu, J., Zhou, J., Cen, K., Decrease in light/dark cycle of microalgal cells with computational fluid dynamics simulation to improve microalgal growth in a raceway pond, *Bioresource Technology* (2016), doi: http://dx.doi.org/10.1016/j.biortech.2016.08.094

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Abstract

In this study, computational fluid dynamics (CFD) was used to systemically analyze the movement of algae in a vortex flow field produced by up-down chute baffles. The average cell light/dark (L/D) cycle period, vertical fluid velocity, fraction of time the algae was resides in light zone and the L/D cycle period were investigated under different paddlewheel speeds and microalgal concentrations. Results showed that the L/D cycle period decreased but the vertical fluid velocity increased when the up-down chute baffles were used. The L/D cycle period decreased by 24% (from 5.1 s to 3.9 s), and vertical fluid velocity increased by 75% when up-down chute baffles were used with paddlewheel speed of 30 r/min. The probability of L/D cycle period of 3 s increased by 52% from 0.29 to 0.44 with the up-down chute baffles. This led to approximately 22% increase in biomass yield without changing the paddlewheel speed.

Keywords: Computational fluid dynamics, flashing light, microalgae, raceway pond

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