Modeling to enhance attached microalgal biomass growth onto fluidized beds packed in nutrients-rich wastewater whilst simultaneously biofixing CO_2 into lipid for biodiesel production

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ABSTRACT

One way to reconcile an issue associating with the harvesting of microalgal biomass is via the application of attached growth cultivation mode, whereby the mature microalgal biomass can be facilely harvested from the support material. Accordingly, the objectives of present works were to model the attached growth of *Chlorella vulgaris* onto polyurethane foam support material in a fluidized bed bioreactor while simultaneously bioremediating real nutrients-rich wastewater and biofixing CO_2 for biodiesel production. The mathematical models accounting the impact of various interactions between light intensities and CO_2 concentrations in culture medium on growing attached microalgal biomass were initially improved. The successful practicality of models was confirmed from the analysis of statistical accuracy while predicting the growth of attached microalgal biomass in real nutrients-rich wastewater. When the microalgal growth reached the stationary growth phase, all the nutrients (nitrogen and phosphorous sources of compounds) were completed impoverished, accentuating the bioremediation potentiality in satisfying the effluent discharged requirements. Subsequently, the modeling of microalgal CO_2 biofixation also unveiled that the highest CO_2 biofixation rate was transpiring in parallel with the growth rate of attached microalgal biomass during the exponential growth phase. Upon the harvesting, the neutral lipid from mature attached microalgal biomass was found to contain 97.7% (by wt. of lipid) of fatty acid methyl esters (FAMEs) mixture, heralding the biodiesel purity. Assessment of biodiesel quality showed a balance composition among the saturated, monounsaturated and polyunsaturated FAMEs mixture with high in C16 and C18 FAME species for the materialization of efficient combustion.

KEYWORDS:

Modeling; Attached growth microalgae; Light intensity; CO_2 concentration; CO_2biofixation; Biodiesel