OPTIMISATION OF ALGAE GROWTH IN FLAT PANEL PHOTOBIOREACTORS

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Problem statement

The position of algae in the production of biochemicals and biofuels is emerging. Large-scale production facilities are necessary to fulfil the expected future demand for biodiesel and biochemicals produced with algae. With this development the challenge arises for efficient design of large-scale production facilities. The design of such large scale systems is not straightforward. Wijffels et al. (2010) show that biomass productivity and economic feasibility are related to the type of reactor, the cultivation location, the production scale, substrates and operating conditions. The designs for algae cultivation used in most life cycle analysis (LCA) studies are based on experimental work which was not necessarily performed under optimal conditions. Most experimental studies concern only the effect of a few decision variables at a time. So the outcome of the studies does not reflect the optimal possible performance.

Proposed solution

To overcome these problems we state that with predictive models on the interaction between light and algae growth and how decision variables affect the productivity, the accurateness of design of large-scale units and LCA studies will significantly improved. Moreover, such a model allows to perform the design and LCA studies under optimal conditions and supports the up-scaling of laboratory and pilot research.

We have developed a predictive model for yearly biomass production using algae in flat panel photobioreactors (PBR) under a range of decision variables like light path, panel distance and biomass concentration and dynamic weather input. With this model the performance of algae cultivation at a certain location of the world with given reactor layout can be determined. Uncertainty is cancelled by using dynamic light data.

Results

The model allows the optimisation of algae productivity for the decision variables. The results indicate how biomass production on lab-scale can be improved to yield high biomass productivities on a commercial scale of production. Besides the optimization, the effect of parameter uncertainties on the optimal biomass production is quantified.

Reference

Wijffels RH, Barbosa MJ, Eppink MHM. 2010. Microalgae for the production of bulk chemicals and biofuels. Biofuels, Bioproducts and Biorefining 4(3):287-295.

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