

Growth of Algal Biomass in Laboratory and in Pilot-Scale Algal Photobioreactors in the Temperate Climate of Southern Ireland

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Abstract : The growth of *Chlorella vulgaris* was characterized as a function of irradiance in a laboratory turbidostat (1 L) and compared to batch growth in sunlit modules (5–25 L) of the commercial Phytobag photobioreactor. The effects of variable sunlight and culture density were deconvoluted by a mathematical model. The analysis showed that algal growth was light-limited due to shading by external construction elements and due to light attenuation within the algal bags. The model was also used to predict maximum biomass productivity. The manipulative experiments and the model predictions were confronted with data from a production season of a 10m² pilot-scale photobioreactor, Phytobag (10,000 L). The analysis confirmed light limitation in all three photobioreactors. An additional limitation of biomass productivity was caused by the nitrogen starvation that was used to induce lipid accumulation. Reduction of shading and separation of biomass and lipid production are proposed for future optimization.

Keywords : microalgae, batch cultivation, *Chlorella vulgaris*, Mathematical model, photobioreactor, scale-up

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