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Microalgae Biorefinery - Industrial Symbiosis

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Integration of processes to allow residual heat, nutrients and value products to be reused

Utilization of industrial wastewaters

Kalundborg, Denmark has been recognized for developing the world’s first working industrial symbiosis. In this system wastes or residuals from one business become the raw material for another business. In the last year, a collaboration between DTU and Cluster Biofuels Denmark has begun to investigate ways to use waste-water, heat and nutrients to support microalgae cultivation and high-value product extraction. There are three major components of this project: development of screening methods to identify promising species of microalgae for growth on waste-nutrients from various industries; creation of a waste-water infrastructure that makes an efficient more suited to growth of green algae; establishment of a pilot photobioreactor at the municipal wastewater treatment facility.

Screening and lab-scale cultivation

Microplates illuminated from below can be used to measure exponential growth rates in thin cultures (left), while photobioreactors (right) are used to measure actual reactor performance. When cultivating microalgae, it can often be difficult to translate results obtained at the lab scale to the industrial scale. For this reason, we have examined a microwell plate system which was designed to screen different strains of algae on different industrial wastes. Preliminary results have shown it is possible to increased the observed period of exponential growth by measuring the fluorescence of low-density cultures in microwell plates, thereby allowing better quantification of the exponential growth rate. Work is currently underway to use a previous developed model (1) to validate that the exponential growth rates observed in the low-density microplate cultures can predict performance of high-density industrial cultures.

TRENS System: Enhanced resource recovery

Design and implementation of a cost-effective, bacteria based wastewater treatment process that can provide optimum conditions for the downstream cultivation of mixed green microalgae. A unique process configuration and operation strategy allows TRENS (left) to transform wastewaters into media suitable for optimal algae cultivation. The algae suspension produced would be directly used as fertilizer or digested for biogas depending on seasonal requirements.

Process configurations and operation strategies for “Nutrient Rich, Carbon Depleted” (NRCD) water with:
- Balanced N : P ratio
- Optimum pH

Bioextraction technology in a symbiotic industrial wastewater treatment concept creating added value

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