Cultivation of microalgae via an innovative technology

February 27 2015

Preliminary laboratory scale studies have shown consistent biomass production and weekly a thick microalgal biofilm could be harvested. A new and innovative harvesting device has been developed for ALGADISK able to directly harvest the dense biofilm with a dry matter of 150 gram per litre.

The waters of the world, oceans, seas, rivers, creeks, lakes and even sea or land ice house a tremendous variety of micro-organisms able to use sunlight as the only source of energy to fuel metabolism. These unicellular organisms, micro-algae and cyanobacteria, are also capable of incorporating the greenhouse gas carbon dioxide (CO_2) into their biomass. The process of sunlight capture and conversion to chemical energy (sugar) is the photosynthesis and leads to liberation of oxygen (O_2). With the help of sunlight microalgae thus can be grown on purely inorganic nutrients many of which are considered waste products in our modern society such as nitrogen and phosphorous compounds.

Commercial production of microalgae already has taken place since the 1950's. This production, however, took place in open microalgae raceway ponds with limited control of the production process resulting in low productivity and low product quality. Cost price was still relatively high because of the high costs associated with harvesting of microalgae.

There is a need for a scalable, economically feasible algae production unit that is capable of delivering high value alga-based products as well as biomass, while reducing CO_2 emissions. Current large-scale

microalgae production is inhibited by the large capital and operational costs. Cultivation of algae always requires the downstream processing steps of harvesting and dewatering. One major issue is cost effectively harvesting algae cells from a solution that is about 99.98 % water. Due to the high water content, harvesting and dewatering algae can be very expensive and can account for 30 % of total production costs. In general, the higher the starting concentration of algae, the lower the harvesting cost.

The ALGADISK project aims to develop a biofilm reactor for algae biomass production which could compete with current algae cultivation technologies (e.g. open-pond and tubular photo-bioreactors). Biofilm formation is a widely observed characteristic of microalgae, which is considered as one of the main problems of tubular, flat-plate and other suspended photobioreactors. While in ALGADISK reactor, biofilm formation is enhanced and supported due to its special design, allowing harvesting high dry solid content biomass, reducing water loss and decreasing energy consumption. The reactor is scalable, modular, contains a sensor and control system to follow and keep growth conditions in optimal range, real time (e.g. pH and volume of medium, nutrient concentrations, temperature). Reactor consists of vertically positioned plastic disks and non-transparent tanks, in which disks are placed half way in growth medium. Surfaces of disks are modified in order to intensify primary biofilm formation and provide sufficient cell number for regrowth of biofilm after harvest. Continuous rotation of disks provides proper wetting of the whole surface and light distribution over the biofilm. In addition, negative effects of saturating light intensity are precluded by cyclic movement of biofilm from light part into the dark tank. Due to the position and orientation of disks, light utilization of reactor can reach a high level, resulting in high biomass productivity. Modules are covered with transparent, removable lids in order to reduce risk of contamination and protect biofilm from extreme weather changes. During the process of system development, concept of CO2

capturing from flue gases was one of the main aspects of design. Reactor is capable of enhancing CO2 to dissolve in the growth medium, just as to reach a high CO2 percentage in the air phase, thus microalgae have access to CO2 both in liquid and gas phase, that results in high biomass production. A semi-automatic harvesting system was developed uniquely for the ALGADISK reactor to provide an easy and efficient method of biomass collection.

Provided by CORDIS