

Developments in Photobioreactor Lighting

Algaenesis Enlighted Technology

Company's Profile

- Algaenesis Ltd is a privately-held start-up devoted to the development and commercialization of highly productive microalgae cultivation systems
- Headquartered at Jerusalem, Israel
- Patented optimal "light distribution" system that is able to collect all available sunlight, throughout the day, and deliver optimal intensities to growing algae.
- Produces Omega-3 polyunsaturated fatty-acid and products for the nutritional-supplements and pharmaceutical markets from Spirulina.

Enlighted Technology –an overview

- The basic objective behind the technology is to overcome the barrier of ineffective utilization of sunlight to grow algae that results in 75% loss in production potential
- The company's innovative light distribution system constitutes an optic system that changes the economic equation
 - The strong solar light is directed towards the light channels of the optic system
 - Each light channel with large illuminated surface collects the light from all angles
 - Dilutes the intensity by a factor of 10 (out effecting over dosage of light to algae)
 - Transfers the light deeply and evenly into all corners of culture volume
- The technology enables to reach 5 times greater yields than conventional technologies
- Significant augmentation of this technology is the cost reduction thus increasing the profitability & widening the scope of microalgae industry
- To put it simply, Algaenesis combines microalgae biotechnology with optics technology to develop unique and revolutionary method of growing microalgae

Current Status of the Project

- Completed lab-scale testing of the technology indoors using artificial sunlight and outdoors
- Having the prototype system, company plans to set-up a pilot system to use phototrophic algae produce omega-3 fatty acids, specialty chemicals and feedstock for biofuel production

Source: <http://www.algaenesis.com/>

Bodega Algae Optical Technology

Company's Profile

- Bodega Algae is the developer of efficient scalable photobioreactors (PBRs) whose patented light-guiding optics addresses critical pain points in industry and science.
- Headquartered at Boston, MA

Optical Technology – an overview

- Bodega has provisionally patented an optical, closed indoor system that optimizes algae growth using lighting technology proven in the consumer goods industry.
- The current cultivation systems are limited to very small cultivation volumes because the light can not penetrate more than five centimeters into a tank at the densities necessary for industrial cultivation. The proprietary low-cost lighting technology developed by Bodega Algae overcomes these problems by delivering solar energy internally within the photobioreactor.
- This technology makes indoor, smaller scale algae harvesting more cost efficient than current laboratory methods, which often use powerful, expensive electric lighting
- The unique optical technology solves three technical challenges that have prevented the realization of the advantages of algae as a feedstock for biofuel and greenhouse gas remediation:
 - Culture density
 - Light Penetration
 - Doubling time
- Preliminary research indicates that the bioreactor will increase algae production by two orders of magnitude over current open-pond reactors, and four times over closed tank reactors, by increasing the quantity of light necessary to algal photosynthesis.

Current Status of the Project

- Bodega Algae and Bigelow have collaborated to study the effects of the lighting technology on the growth of algae.
- This effort is supported by a grant of \$150,000 (January 2010) from the National Science Foundation SBIR program to test methods of light delivery developed at Bodega Algae for their effect on cell growth rates for a range of algal strains.

Source: <http://www.bodegaalgae.com/technology.html>

Furthermore, there is another interesting research that has designed an integrated solar and artificial light system for internal illumination of photobioreactors.

Integrated Solar and Artificial Light System

Features & Benefits

- The system is an internally illuminated stirred tank photobioreactor which is simple, heat sterilizable and mechanically agitated
- A device was installed for collecting solar light and distributing it inside the reactor through optical fibers
- It was equipped with a light tracking sensor so that the lenses rotate with the position of the sun. This makes it possible to use solar light for photosynthetic cell cultivation in indoor photobioreactors
- As a solution to the problems of night biomass loss and low productivity on cloudy days, an artificial light source was coupled with the solar light collecting device
- A light intensity sensor monitors the solar light intensity and the artificial light is automatically switched on or off, depending on the solar light intensity
- In this way, continuous light supply to the reactor is achieved by using solar light during sunny period and artificial light at night and on cloudy days

Source: <http://bit.ly/biZtRN>

As an inference to the above notified techniques, there are consistent efforts in developing optimal lighting technologies to be implemented in a photobioreactor. These efforts are being made mainly to ensure commercial profitability in algal cultivation using photobioreactors.