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.
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


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.