

Cleaner Process for Biotechnological Production of Spirulina

Design, development, and working principle of the automation system for cleaner microalgae cultivation in open raceway pond (Applied to Spirulina Cultivation)

Process control and automation system for cleaner microalgae cultivation in open raceway pond using CO₂-fed pH control strategy has been developed, tested and used for Spirulina cultivation at pilot scale open raceway pond (1400L). The process detail and results are described hereunder.

As an advancement to the traditional method of Spirulina cultivation using sodium bicarbonate and to address the associated bottlenecks, the automation of Spirulina cultivation process was done at pilot scale operations in open raceway pond of capacity 1400 L. An indigenous system for automation of the Spirulina raceway pond has been conceptualized, designed, fabricated and developed. The design philosophy of the process automation includes online measurement and data logging for pH, temperature, light, dissolved oxygen (DO), and agitation. Most of the Spirulina cultivators record all these measurements manually which is very laborious and time consuming. In this system, four different sensors were connected to data logger for the measurement of pH, DO, temperature, and light intensity. The sensors for pH, DO and temperature were submerged in the culture. **The main feature of the system involves control for pH of the cultivation medium via CO₂ supplementation at various concentrations and flow rates.** The automation system is also equipped with a CO₂ supply unit which operates by purging CO₂ based on the pH set points, a gas mixing system with air (generated by air compressor) to control/manage the desired CO₂ concentration, and the control of gas flow rate (using rotameters). Apart from CO₂ based pH control, conventional acid/alkali based pH control system was also added as an optional/additional feature. Furthermore, to conquer the mass transfer limitations associated with gaseous CO₂, the membrane sparger has been provided at the bottom of the culture to enable enhanced CO₂ mass transfer in the growth medium. The membrane sparger helps in better CO₂ dissolution and avoids CO₂ losses. The CO₂ feeding system consisted of a CO₂ gas cylinder, a CO₂ gas regulator, a gas flow meter (0-20 L/min range), a solenoid valve, and a membrane sparger. Finally, the data logger is connected to the automation system that has potential to record the data of each variable at every one minute's time interval. It also has a GSM connectivity through which the pond

operators/supervisors mobile phone numbers can be used/connected to receive the real time data of the set variables, in case the pond operator is not on the site for any reason.

The results indicated that the CO₂-based automation system for algal cultivation is able to perform similar (productivity, protein, phycocyanin) to conventional system using sodium biocarbonate. Also, the CO₂-based system enables lower ash content in algal biomass (< 5%) in comparison to higher ash content (> 15%) in conventional cultivation due to use of sodium biocarbonate. In terms of commercial scale cultivation of microalgae, pH control must be achieved to enhance culture performance of the microalgae that may experience highly fluctuating day-to-day growth conditions. Therefore, the automation system developed and studied here can be utilized for cultivation of any microalgae specie with the good control and higher efficiency (without use of chemicals like sodium biocarbonate and HCl).

Applications and Advantages

- Cleaner algal cultivation for food, feed and fuel application without use of chemicals (sodium carbonate)
- Lower ash content in algal biomass (HCl elimination in downstream processing)
- Improved productivity (up to 30%) due to optimal pH control
- Lower level of microbial contamination due to pH control

RAW MATERIAL

Selected strains (algal culture) and nutrients (without sodium biocarbonate)

PLANT AND MACHINERY (for process control and automation system only)

Rs 6-9 L for automation and control of algae raceway pond with gross volume of 3000 to 10000 L

For Technology and Technical assistance please contact

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