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Membrane Carbonation Technology for Efficient CO2 Delivery

In light of environmental concerns and the finite nature of petroleum-based sources, the production of biofuels and other valuable products from microalgae is very promising. Delivering concentrated CO2 is an essential step that enables microalgae cultivation to have high productivity and favorable economics. In order to achieve both benefits, the CO2 must be delivered with near 100% efficiency, but setups today are highly inefficient. More-efficient means of CO2 delivery are needed in order to make microalgal based production systems commercially competitive in the current marketplace.

Researchers at the Biodesign Institute of Arizona State University have developed novel membrane carbonation (MC) technology that enables efficient and bubbleless delivery of CO2 into algal cultures from a wide range of sources and concentrations. This drop-in technology improves growth rate and biomass productivity while ensuring the culture stays within a desired pH range. With near 100% transfer efficiency, this technology significantly decreases CO2 losses which subsequently reduces cultivation costs. Because this MC technology does not need an extended water column for CO2 delivery, it can be placed at any location within the algae culture. Further, exiting gas can be captured to concentrate residual gases for further downstream use, such as purifying methane from biogas.

This MC technology maximizes both efficiency and the production rate of valuable products from microalgal cultures at much more economical costs.

Potential Applications

- Biofuel production
- Animal and fish feed production
- Production of biopharmaceuticals, nutraceuticals, bioplastics/biopolymers, fine chemicals, pigments, cosmetics and other high value products

Benefits and Advantages

- Reduced CO2 expenses – higher efficiency and less waste. This process costs

$3/$CO_2$ -ton to deliver gaseous CO_2 into solution

- Controls pH and prevents carbon limitation in the culture to maintain high algal growth rates and biomass productivity
- Not subject to fouling or deterioration when cultivating outdoors for > 50 days
- Selectively removes CO_2 to enrich other valuable gases, such as CH_4 in biogas
- Lower energy consumption – reduces energy cost associated with operation
- Able to use feed gases with a wide range of CO_2 concentration and handle a broad range of delivery rates
- MC technology can be placed at any location within the algae culture since it does not require an extended water column for efficient CO_2 delivery
- Does not require constant pressure to prevent algae from seeping into the fibers
- Drop-in – addresses only CO_2 delivery and thus can be integrated into any autotrophic aquaculture production business model
- This MC technology can be sized to CO_2 requirements, installed using existing fittings, and requires very low skill levels to install, replace, or maintain

For more information about this opportunity, please see

Rittmann - Technical Report - 2019

For more information about the inventor(s) and their research, please see

Dr. Rittmann's departmental webpage

Dr. Rittmann’s center webpage