National Aeronautics and
Space Administration

Environment

Algae Photobioreactor Using Floating Enclosures With Semi-Permeable Membranes

Grow algae, clean wastewater, capture carbon dioxide to ultimately produce biofuel

NASA has invented an innovative method to grow algae, clean waste water, capture carbon dioxide to ultimately produce biofuel. The invention consists of floating flexible plastic enclosures, and photo-bioreactors with semi permeable membranes. This new cultivation system is made of lightweight material and deployed offshore. This avoids problems of land costs and competition with other land uses. The surrounding waters provide infrastructure, cooling, and some mixing from wave action. Ideally, this cultivation system is filled with nutrient-rich domestic waste water and a source of CO2 to promote the growth of algae and to remediate pollution.

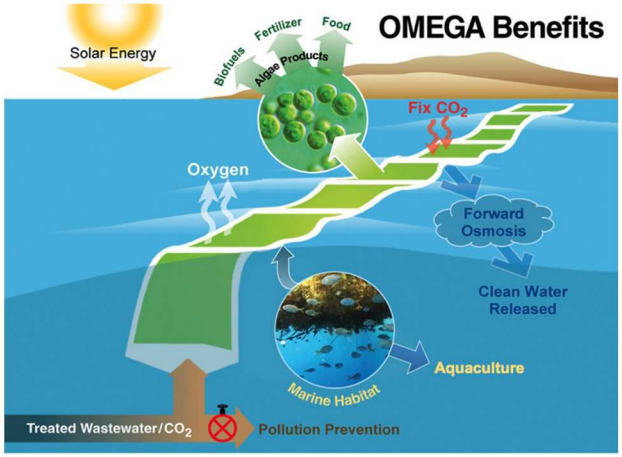
BENEFITS

- Expanded use of protected bays for biomass production
- Biomass produced without competing with agriculture land use
- Advanced wastewater treatment
- Carbon dioxide captured - reduces global warming

technology solution

THE TECHNOLOGY

The photobioreactors allow light to enter through their transparent upper surface and optimizes the efficiency of light utilization with a light-reflective lower surface inside. Deployed in the marine environment, the gradient between the freshwater inside the system and the saltwater outside drives forward osmosis. The water removed through semi-permeable (forward osmosis) membranes is cleaned as it is released into the marine environment. In addition, this process concentrates nutrients in the algae medium to stimulate growth, and concentrates the algae to facilitate harvesting. The harvested algae can be used to make biofuels, fertilizer, animal food, or other products. The photobioreactors are intended for use in naturally or artificially protected marine environments with small waves and gentle currents. The system can also be used in artificial brine pools and freshwater basins or reservoirs, however in freshwater the forward osmosis feature cannot be used.



OMEGA Benefits

APPLICATIONS

The technology has several potential applications:

- Diesel fuel production
- Lipid-based chemical production
- High-value products (e.g., cosmetics, nutraceticals, food additives)
- Fertilizer and animal food products
- Advanced sewage treatment
- Pharmaceutical products
- Renewable energy

PUBLICATIONS

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More Information

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