

## Improving Carbon Dioxide Mass Transfer in Open Pond Raceway Systems for Improved Algal Productivity

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**Abstract :** Open raceway ponds are currently the most used system for the commercial cultivation of algal biomass, as it is a cost-effective means of production. However, raceway ponds suffer from lower algal productivity when compared to closed photobioreactors. This is due to poor gas exchange between the fluid and the atmosphere. Carbon dioxide (CO<sub>2</sub>) mass transfer is a large concern in the production of algae in raceway pond systems. The utilization of atmospheric CO<sub>2</sub> does not support maximal growth; however, CO<sub>2</sub> supplementation in the form of flue gas or concentrated CO<sub>2</sub> is not cost-effective. The introduction of slopes into the raceway system presents a possible improvement to the mass transfer from the air, as seen in previous work conducted at CeBER. Slopes improve turbulence (decreasing the concentration gradient of dissolved CO<sub>2</sub>) and can cause air entrainment (allowing for greater surface area and contact time between the air and water). This project tests the findings of previous studies conducted in an indoor lab-scale raceway on a larger scale under outdoor conditions. The addition of slopes resulted in slightly increased CO<sub>2</sub> mass transfer as well as algal growth rate and productivity. However, there were reductions in energy consumption and average fluid velocity in the system. These results indicate a potential to improve the economic feasibility of algal biomass production, but further economic assessment would need to be carried out.

**Keywords :** algae, raceway ponds, mass transfer, algal culture, biotechnology, reactor design

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