Biosequestration of CO$_2$ using algal photo-bioreactors

PhD Research (January 2016-December 2018)

The demand for energy has surged in recent years while resources are depleting at exponential rate. This global energy crisis has led to major issues such as greenhouse gases emissions, global energy problems, climate change. Microalgae have grabbed world's attention for their potential to solve these most pressing issues, as they sequester carbon dioxide (CO$_2$) for photosynthesis and can generate a wide range of products. Microalgae are simple photosynthetic autotrophs submerged in aqueous environments which offer them an efficient contact with water and CO$_2$ inducing a better conversion of solar energy into biomass. Microalgae have potential to use brackish water on non-arable land to grow, thus reducing the drawbacks of the first and second generation biofuels. Microalgae have been extensively studied for the production of variety of a biofuels such as biodiesel, bioethanol, and bio-hydrogen. They also have a great potential to produce value added chemicals simultaneously with biofuels increasing the overall process efficiency.

This research will evaluate the potential of microalgae for biorefinery approach. Initially, CO$_2$ sequestration will be studied with different CO$_2$ sources, such as pure gas, synthetic biogas from anaerobic digester, and H$_2$S containing gas stream within batch tests. A bubble column photo-bioreactor will then be developed and operated under different hydrodynamic and operating conditions to provide an optimal environment for the growth of algae. The algal biomass will be harvested for generation of bio-hydrogen and bioactive compounds. The overall process will be optimized using bioprocess principles and software. In the end, a life cycle assessment (LCA) analysis will be performed to evaluate and compare the investment and technical outcomes of the research.

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