

Investing in Renewable Energy

FLUE GAS CARBON DIOXIDE CAPTURE WITH RAPID GROWTH ALGAE TO PRODUCE BIODIESEL AND RENEWABLE FUELS

Project Description

Algae are plants that feed on Carbon Dioxide (CO₂). Faster growing algae consumes and captures higher amounts of CO₂ to generate more biomass. SarTec selected a fast growing alga that also had high oil content. Alga lipids were extracted from the biomass and converted to biodiesel to produce an easily marketable product. Algae sequestration of CO₂ and the conversion of lipids to biodiesel produce a valuable, renewable, universally consumed fuel while helping to reduce green house gas emissions when fed CO₂ rich flue gas from a coal-burning power plants.

Methodology

The alga species *Dunaliella tertiolecta* was selected from several other algae species for a relatively fast growth rate and high lipid content. Algae growth was studied in both outdoor conditions with natural light and controlled indoor conditions with continuous light and temperature controls. Artificial, fluorescent light is less intense than natural sunlight but is consistent

from day-to-day. Algae were harvested through centrifugation then dried and pulverized, and the lipids were extracted and converted into biodiesel through the McGyan processes developed by SarTec.

Executive Summary

This research investigated a process for using algae to capture CO₂. The basis of this study was to investigate fast growing algae strains for capturing CO₂ and converting the resultant algae into renewable fuels. The biofuel can be sold to produce revenue to partially defray the costs associated with CO₂ capture. It also has the potential to create revenue from carbon credits. Overall, this CO₂ capture/biodiesel process will partially close the carbon cycle at coal-fired plants and reduce fossil carbon emissions.



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RDF Mission: To increase renewable energy market penetration, assist renewable energy projects and companies, and support emerging renewable energy technology through research and development.

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Benefits

- CO₂ emissions from a coal-fired power plant that are directed into microalgae could be a cost effective method for carbon sequestration
- Algae have a value for making biodiesel fuel or biochemicals
- Algal solids can be burned to help fuel the generation of electricity
- Algal components, such as protein, could potentially be sold as additives for animal feed, fertilizer or other products
- Due to competition, *D. tertiolecta* cells decreased in size as their growth rate increased but did not affect biomass production
- Aging algae lose vigor which requires the occasional introduction of new algae organisms to retain rapid growth rates
- Harvesting algae can be time consuming and energy intensive due to the high percentage of water that needs to be removed

Lessons Learned

- Light penetration, circulation of the algae cultures and an uninterrupted flow of CO₂ are essential to a thriving algae population
- Maintaining a pH that is neutral or somewhat acidic ensures more efficient utilization of CO₂ and higher growth rates
- Outdoor cultures are more likely to have problems with competing organisms that also consume CO₂ or feed upon the algae versus a controlled, indoor environment
- To sustain high growth rates, harvesting at the most appropriate stage of growth helps prevent algal self-shading
- There are limitations on re-using the post-harvest algae growth medium due to build up of metabolites such as glycoproteins, which inhibit algae growth
- Significant quantities of carbon were captured by the algae in intensive culture environment and shown to be a viable means to capture CO₂ emissions
- Algae can produce feedstock oil for biodiesel fuel at a higher rate than traditional soybean oil productivity
- Revenue generating products can offset sequestration costs
- Utilizing algae as a feedstock will not compete with food crops to produce fuel

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