Algae Systems for CO2 Sequestration, Wastewater Cleanup and Generation of Sustainable Energy

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Microalgae photobioreactor systems at the University of Dayton Research Institute's (UDRI) Carbon Sequestration and Bio Fuel Laboratory are being used to investigate algae's ability to capture CO_2, clean wastewater, and produce algae biomass that can be used for carbon neutral biofuel generation. Algae cultivation is of interest because it does not require arable land or fresh water, and algae are fast growing organisms capable of doubling their numbers in about eight hours.

UDRI is working with Dayton Power and Light (DP&L) to evaluate the possibility of integrating UDRI designed vertical algae photobioreactor system at the DP&L's Killen power plant. UDRI also aims to support the AFRL/RXSC-Environmental and Energy Quality Technologies Program. The goal is the development and implementation of energy efficient and economical technologies that will help (1) develop algae as a viable feedstock for biofuels thus providing a secure energy source that is independent of any foreign influences, (2) cleanup waste streams to protect limited aquatic resources, and (3) lower the GHG footprint and help Air Force installations meet their renewable energy targets and mitigate global warming.

As of today UDRI has performed in-house parametric assessments, identified issues related to various reactor designs, and optimized photobioreactor design and parameters. UDRI has also developed methods to quantify algal lipid, protein, and starch content and to identify potential downstream value added products. The use of algae to clean waste streams containing heavy metals and the use of wastewater rich in phosphates and nitrates as a potential source of nutrients in a scaled up operation has been validated. UDRI has also successfully extracted lipids from algae, converted them to biodiesel and performed engine testing. The heat content of algal biomass and its handling characteristics were also measured in order to evaluate direct cofiring of algal biomass with coal.

Current work is focused on the validation of indoor observations and projected yields by testing outdoors, the development of energy efficient closed loop algae photo -bioreactor system that can operate in colder climates, the determination of the optimal configuration to connect vertical photobioreactors in series, the design of a CO_2 delivery system, the evaluation of different harvesting and drying systems for energy efficiency and the upgrade of biodiesel to jet fuel and green diesel. The team at UDRI is currently testing modular reactor loops and evaluating.