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Cultivation of Algal Biofuel Feedstock in Desert Area of Southern Nevada using Municipal Wastewater (NVREC Project 1.3)

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Why Grow Microalgae in Southern Nevada

- Impressive lipid productivity and fast growing characteristics offer great promise for microalgae to contribute a significant portion of the renewable fuels.
- Growing microalgae needs
  - space to collect solar energy to be converted into chemical energy stored in biomass,
  - CO2 for photosynthetic process, water and nutrient.
- Southern Nevada provides ample sources for algal growth on a large scale where solar insolation is high, and plenty of arid land is available for growing microalgae.
- 16 of 21 Nevada Power Generation Facilities locate in Southern Nevada, which emits about 42 million tons of CO2 every year.
- Microalgae consume and process CO2 and inorganic components in waste water as if they were nutrients, which is a concomitant benefit of reducing greenhouse gas emission and treating wastewater.
- One million gallon per day wastewater, which is treated by in Clark County region solved the water requirement for growing microalgae in desert.
- Growing algae for fuel also prevents having to convert crop land to grow a biofuel, a challenge the Midwest is constantly facing.
- This new industry could bring much needed revenue to the lagging economies by educating a new workforce, creating jobs, generating payroll taxes, and providing opportunities to do business with other economies.

Scale-up Challenges and Research Needs

- Water conservation, management, and recycling.
- Culture stability
- Nutrient source scaling, sustainability and management
- Reliable material exposed to strong sunshine
- Temperature maintenance without evaporative cooling
- Carbon source from flue gas and its toxic effects
- Periodic cleaning and cost analysis due to bio-film formation

Accomplishment and Ongoing Researches

Closed Photobioreactor System with less water evaporation and more controllable parameters, makes cultivation of microalgae in Southern Nevada practical.

- Several prototype of Photobioreactors were designed and tested in laboratory.
- Accomplished one software design for economic analysis for algal biofuel industry—AlgalBiofuelEcon 1.0
- Development of New Solid Acid Catalyst and Its Application in Biodiesel Production
- Accomplished the investigation of ideal key parameters for microalgae cultivation, which are essential for economic analysis in algal biofuel industry.

- Maximum productivity of algal biomass: The ideal maximum productivity of algal biomass is 0.104 kg/m²/day (or 379.6 ton/ha/yr).
- Minimum ideal requirement of water for growing algal biomass is 0.41 kilogram water is needed if one kilogram CO2 is captured during cultivation process.

- Minimum reflection loss using photobioreactor is about 4% of total incident light if incident angle is kept smaller than 46°.
- On-going researches:
  1. The effect of CO2 concentration to the growth rate of microalgae
  2. Temperature management for out-door Photobioreactor (PBR)
  3. The outdoor reliability test of PBR material—polyethylene
  4. Microalgae screening in outdoor PBR by natural selection using municipal wastewater and flue gas

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