Prototyping an Algae-Based Martian in situ Oxygen Generation System

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The current mainstream idea for oxygen production on Mars has inefficiencies and produces the dangerous byproduct of hydrogen. I have developed a system that offers a resource-efficient alternative using algae to produce oxygen from the Martian atmosphere. The engineering goal of this project was to design and test a small-scale, algae-habitable system that is able to input in-situ carbon dioxide, produce oxygen, and then separate the carbon dioxide from the oxygen, thus leaving oxygen for breathable use. The intermediate goals include engineering an environmental valve transfer system and evaluating the separation of carbon dioxide chemically using sodium hydroxide. The biological constraint is that the system must be environmentally viable for sustained algae growth and photosynthesis. Key engineering constraints consisted of complexity, volume, power consumption, and scalability. Building the physical system required multiple subsystems including gas flow systems (managing oxygen and carbon dioxide), electrical systems (microcontroller for sensors, data collection, and valve control), algae life support (growth medium and algae growth), mechanical systems (pump, valves, vacuum chamber, piping), and environmental systems (temperature, light control). Through experimentation, my system was found to be successful with both producing oxygen and has a high potential for increased scalability. It also has the potential to provide supplemental resources like nutrition and biofuel for Mars-based astronauts.

Awards Won:

Fourth Award of $500