CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY

Name(s)

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Project Number

S0612

Project Title

Running on Water: Real Time Production of Hydrogen and Oxygen Optimized to Power a Motor

Abstract

Objectives/Goals

The objective of this research was to demonstrate that real-time production of hydrogen & oxygen could safely and efficiently be generated using electrolysis, and to identify design factors to optimize production to power a motor.

Methods/Materials

A custom device was designed to allow for easy and repeatable adjustment of experimental inputs (voltage, electrolyte, water temperature, water flow rate) and measurement of the resulting hydrogen & oxygen production rate. In addition, the experimental setup was designed to safely produce and capture high rates of hydrogen & oxygen gas, and redirect that gas to a motor for real-time combustion.

Results

The results demonstrated a significant increase in production by increasing voltage, water temperature, electrolyte and in some cases flow rate. Both voltage and temperature drove a linear increase in production rate, when other variables were held constant. Increasing electrolyte concentration drove an exponential increase in production rate. Flowing water through the plates increased production rate when the electrolyte was near or above the saturation point, and had no impact at lower electrolyte levels.

Conclusions/Discussion

As we struggle to reduce carbon emissions, hydrogen offers a promising alternative to gasoline but poses concerns as hydrogen storage is considered unsafe. However, using real-time production of hydrogen and oxygen minimizes this concern. In this experiment, I leveraged this technique to safely power a small motor, using a water temperature of 50 degrees Celsius, non-reactive washing soda (10 mL $NaCO_3$) as the electrolyte, and a 12 volt car battery to power the electrolysis. In addition, I created a novel innovation, running water through the system to clear gas bubbles from the plates so more reactions could occur, improving the production rate when near or above the saturation point of the electrolyte. Future research is needed to collect more data to validate and fully understand this effect.

Summary Statement

In this research, I demonstrated that real time production of hydrogen & oxygen could safely & efficiently power a motor, optimizing the system and creating the novel innovation of flowing water to clear bubbles, enabling more reactions.

Help Received

Dr. Margo Stand for teaching me the chemistry of electrolysis. My father for coaching in safety procedures & providing supplies. My mother for coaching in data analysis, poster preparation & presentation. The Tech Shop for the equipment for me to manufacture my setup.