Educational Kit for an Alkaline Membrane Fuel Cell (AMFC)

Team 10

Our Team

Students:

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- **Dr. Juan Ordonez (FSU)**
- **Dr. Jose Vargas (UFPR)**

Sponsors:

- **Florida State University (FSU)**
- **Fund for the Improvement of Post-secondary Education (FIPSE)**

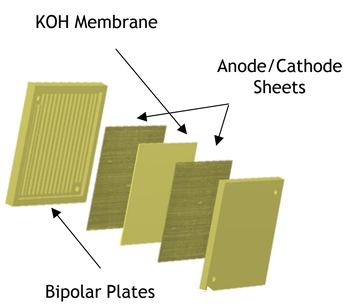


Figure 1a. Key Components to a Fuel Cell

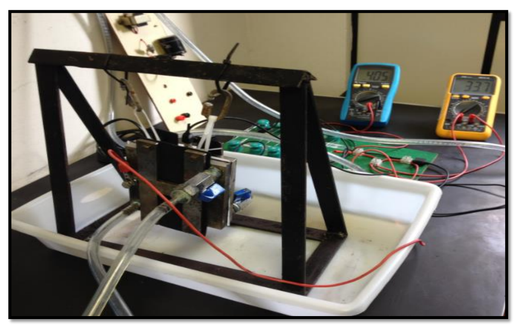
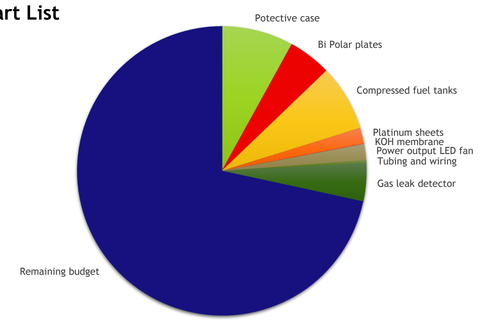


Figure 1b. Experimental setup of Alkaline Membrane Fuel Cell prototype

Parts

AMFC Educational Kit Part List

Protective case
Bi Polar plates
Compressed fuel tanks
Platinum sheets
KOH membrane
Power output LED fan
Tubing and wiring
Gas leak detector
Remaining budget



Background Information

The primary goal of our project is to create and design a functional alkaline membrane fuel cell (AMFC) educational kit. Based on previous AMFC research done by Dr. Ordonez of Florida State University and Dr. Vargas of UFPR, a model of the fuel cell has been analyzed. It is to be noted that the research done was completed on a larger scale. In order to create a proper educational kit, the AMFC must be scaled down to a proper size so that it can be mass produced and potentially sold to universities and schools for learning purposes.

"The current AMFC setup is too large and immobile to be a portable educational kit alkaline membrane fuel cell."

Experimental Results

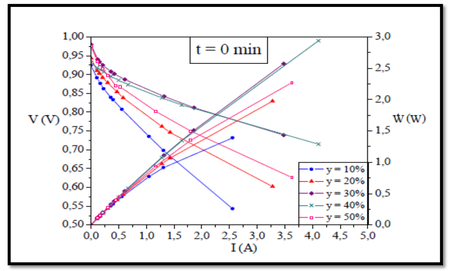


Figure 2a. Theoretical polarization curves for varying potassium hydroxide concentrations of an AMFC prototype (10% - 50%)

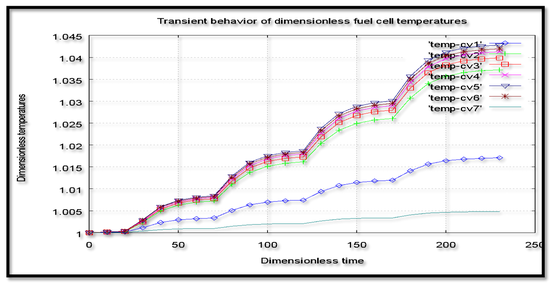


Figure 2b. Theoretical Calculations for the effect of temperature with respect to time during fuel cell operation.

Figure 2a is a representation of the change in voltage and wattage with respect to current at different KOH percentages. Our current wattage is largest at a KOH concentration of 40 percent. This wattage is currently just under 3 watts with a current of around 4.25 amps and a voltage of 0.70 volts. The fuel cell size during these test is 4.5 in^2 As seen in figure 2b above, the overall temperature of the Alkaline Membrane Fuel Cell increases exponentially over time as the reaction takes place, however a temperature gradient is produced within the casing of the fuel cell. The temperatures at the inlets of the H2 and O2 gases (CV1 and CV7, respectively) are significantly lower than the other sections of the fuel cell due to the nature of chemical reactions, and the heat that is given off as atomic bonds are broken.

Our Design

Our design incorporates the hanging fuel cell used in Brazil. The end goal of this design is to focus on safety and ease of use when the fuel cell reaches slightly higher operational temperatures. Also, the cell and all necessary components will be able to fit in the case for easy storage and reuse. This design is not yet final due to possible changes with case size and fuel cell size in the future.

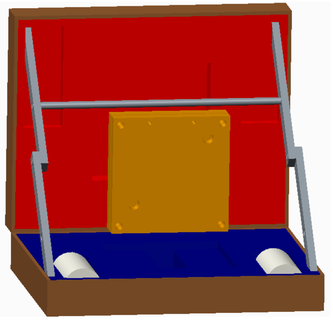


Figure 3. Fuel Cell Design Assembled CAD

Summary

With the final design chosen and the technical data gathered we are ready to begin moving into the production stage. Once the students from Brazil return in the spring we will be able to work much more efficiently. Our current plan to sell the fuel cell will be to local schools. Also, as we enter the production stage we will further optimize our budget to produce the most cost effective fuel cell possible.

References

[1] Vargas, J.V C., and J. C. Ordonez. "Alkaline Membrane Fuel Cell (AMFC) Modeling and Experimental Validation." *Journal of Power Sources* (2012): 1-15.*Www.elsevier.com/locate/jpowsour*. Elsevier, 11 Apr. 2012. Web. 15 Sept. 2014.

[2] Ordonez, Juan, and Jose Vargas. *Design and Development of an Alkaline Membrane Fuel Cell (AMFC) Educational Kit for High School and College Level Laboratory Demonstration*. Tallahassee: Florida State Univeristy, n.d. PDF.