Design and Development of Optimized Flow Channels for an Alkaline Membrane Fuel Cell (AMFC) Educational Kit
Team 16

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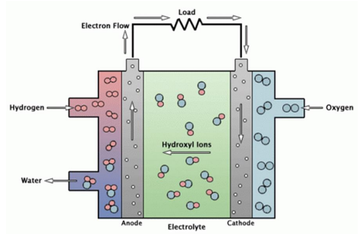
PROJECT GOAL

The goal is to investigate the performance of an alkaline membrane fuel cell, while optimizing it for use in an educational kit.. This investigation involves improving the design of the current fuel cell kit to produce a safe, and reliable product. The kit will include different flow configurations and designed experiments in order to allow users of different age groups learn the fundamentals of fuel cell operation, as well as gain an eye into the world of sustainable energy.

BACKGROUND



- Converts chemical energy into electric potential energy
- Requires an electrolyte solution, hydrogen gas, and oxygen gas for operation
- Generates pure water and electricity

OBJECTIVES

- Include multiple flow configurations to compare performances
- Conduct thermal fluid systems analysis to analyze flow configurations
- Include operation procedures for different education levels and a product specification sheet
- Incorporate a motivation to integrate fuel cells into other green energy systems for STEM interests
- Develop a model for commercialization of the kit.

ACKNOWLEDGEMENTS

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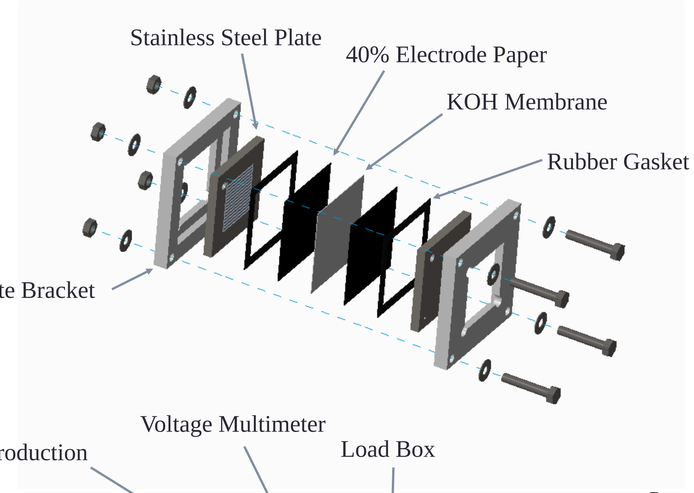
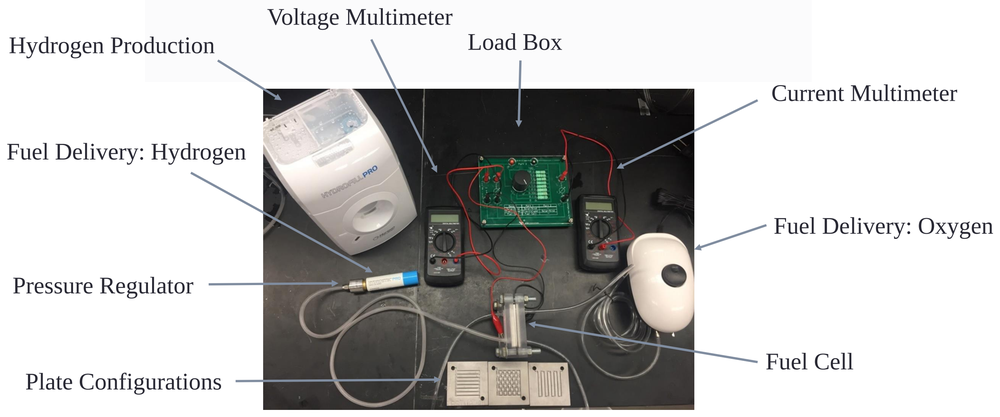
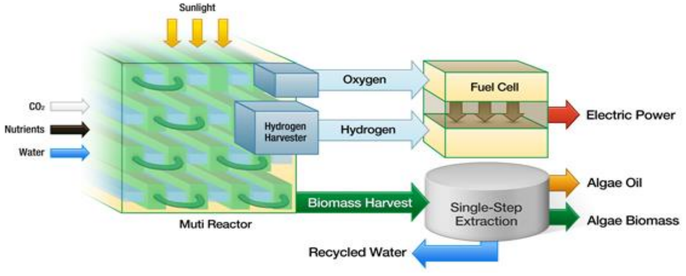
DESIGN AND EXPERIMENTAL SETUP



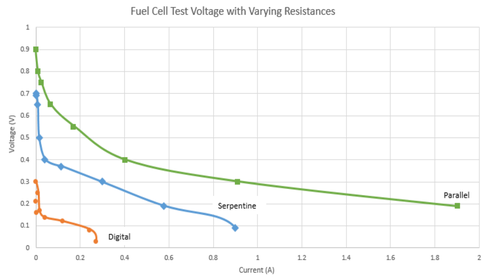


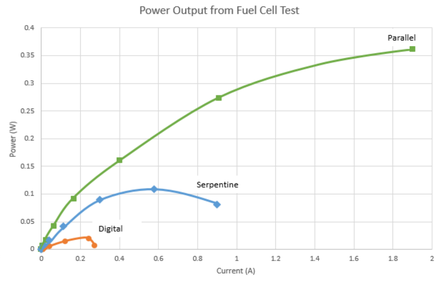
MOTIVATION FOR APPLICATION



- Incorporates fuel cell operation into a microalgae bioreactor
- Increases efficiency; uses byproduct to power fuel cell

RESULTS

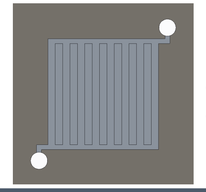




Minimal Voltage drop for best performance

$$\Delta V = \frac{RT}{2F} \ln\left(\frac{P_2}{P_1}\right)$$ Concentration loss

$$\text{Gas usage} = \frac{I}{2F} \text{ moles s}^{-1}$$ Fuel loss



Parallel Configuration
- Highest contact area
- Lowest Pressures Drop

SUMMARY

- Parallel configuration is the most efficient with a max power output of 0.36 W
- Fuel cell reached average temperatures of 62°C after 10 minutes of testing
- The kit can be used effectively as a learning tool as early as 6th grade, with significant applications during collegiate academia
- Good material selection leads to longevity use of the kit and successful commercialization
- Fuel cells can be incorporated into other green energy systems.

REFERENCES

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[2] Paulino, Andre L.R., Eric Robalinho, Edgar F. Cunha, Rainmundo R. Passos, and Elisabete I. Santiago. "Current Distribution on PEM Fuel Cells with Different Flow Channel Patterns." (n.d.): n. pag. Https://www.comsol.com/paper/download/181391/paulino_paper.pdf. CAPES (Coordenação De Aperfeiçoamento De Pessoal De N ível Superior) and CNPq (Conselho Nacional De Desenvolvimento Científico E Tecnológico, 2013. Web. 2016.