Portable Kit for Alkaline Membrane Fuel Cell (AMFC)

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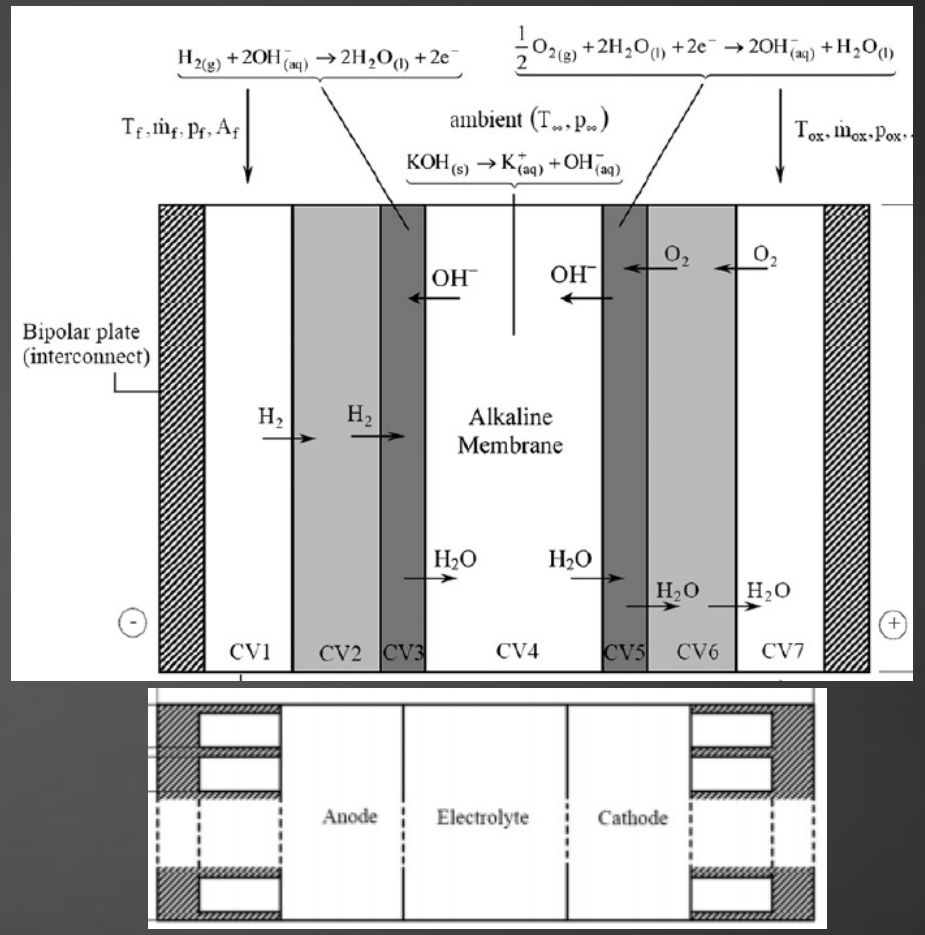
What is an Alkaline Membrane Fuel Cell

- Four Main Components
  - Anode
  - Cathode
  - Membrane
  - Bipolar Plates

- Advantages
  - No environmental pollutants
  - Organic Membrane used
  - Less activation overvoltage



Basic Schematic of an AMFC

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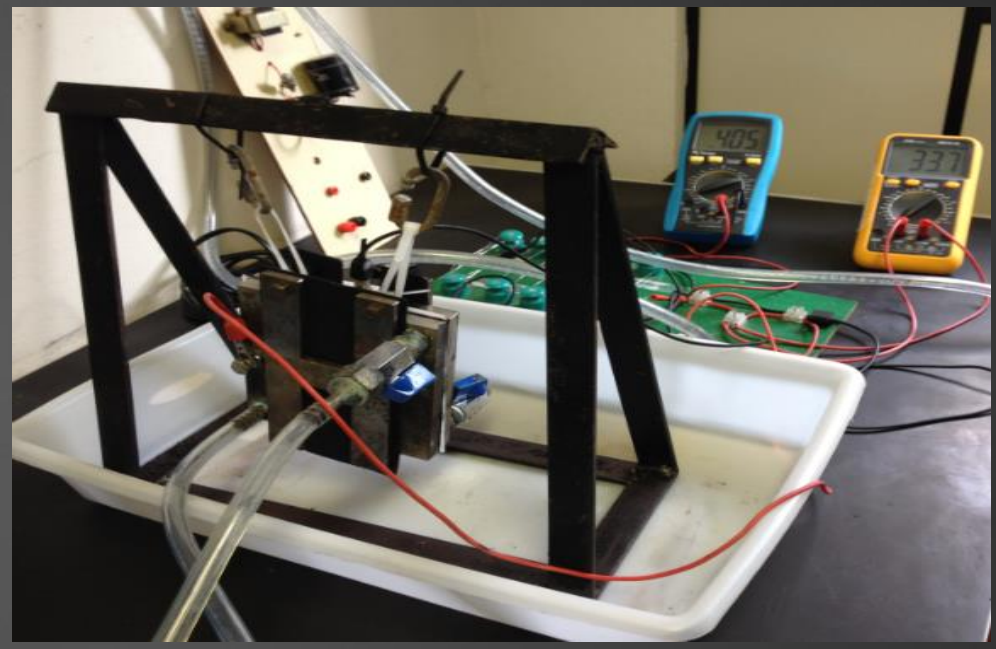
Portable Kit of AMFC

Project Overview

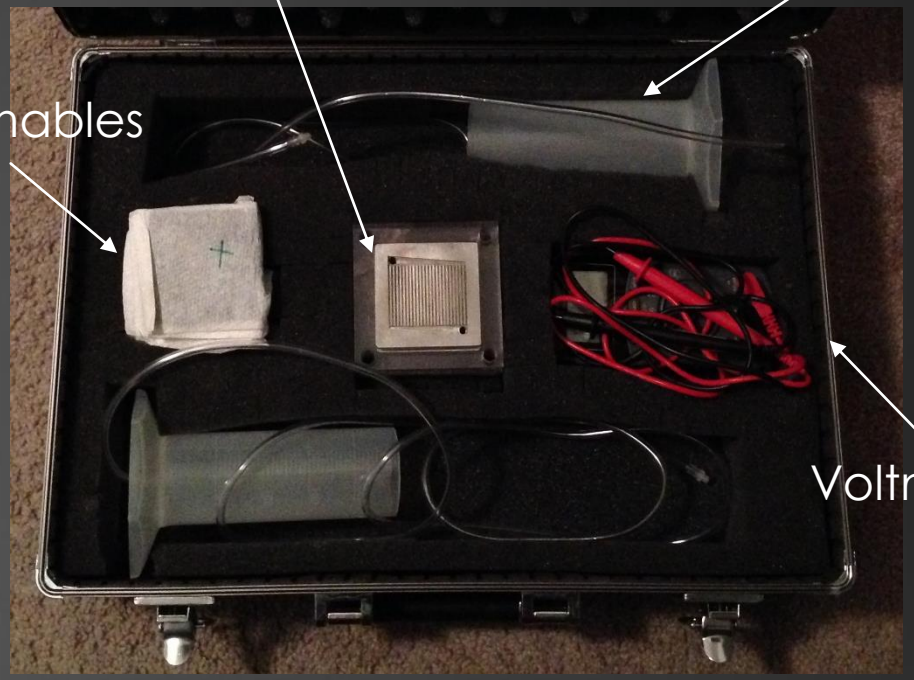
- We are designing a portable AMFC with custom specifications to meet our particular application
- Helping to prove the effectiveness of the organic cellulose membrane and KOH
- This will be done by taking the existing research as a base for introducing some of the new ideas we will be implementing



Existing AMFC in Brazil

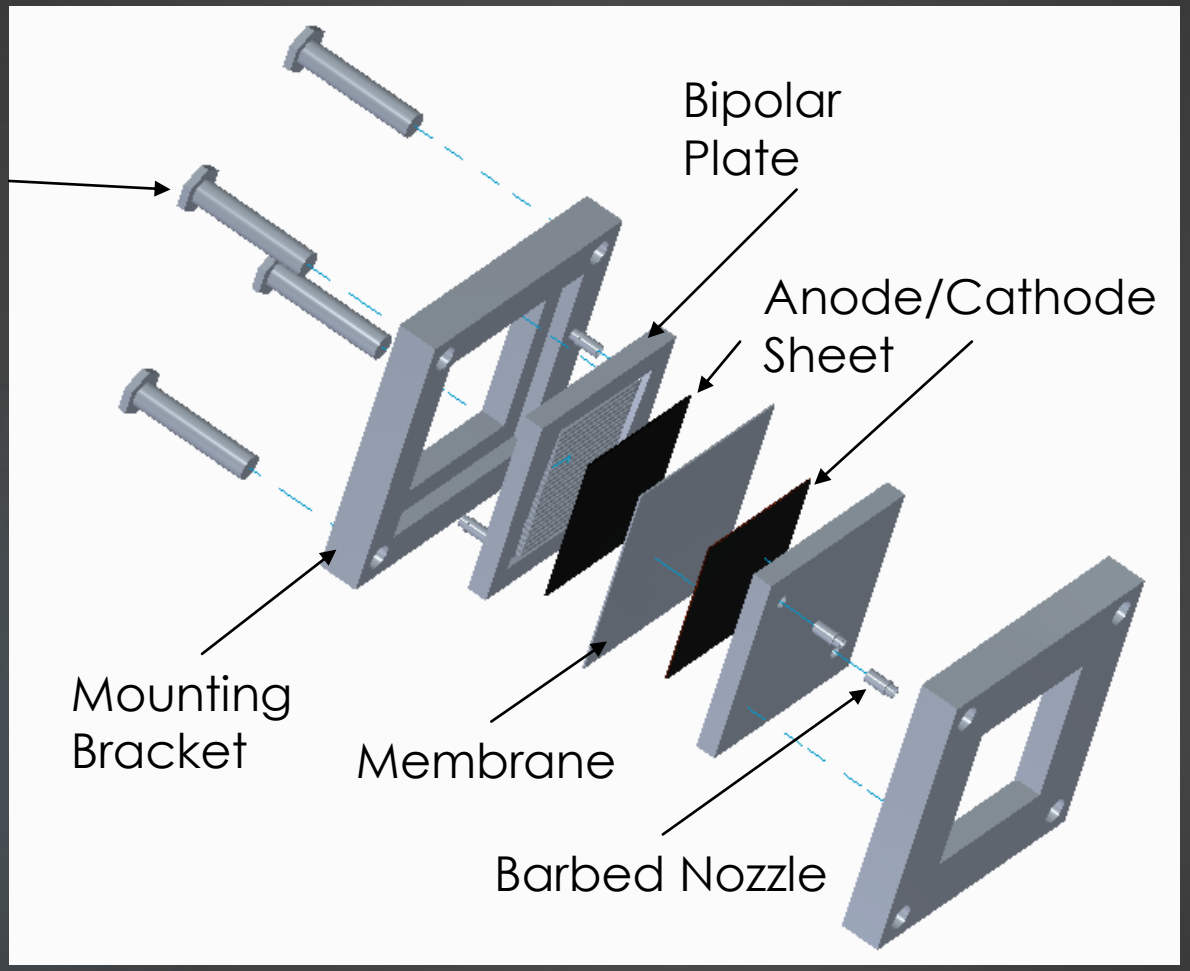
Fuel Cell Kit

- Extremely Portable
  - 18” x 12.75” x 6”
- Has storage space for all of the current components for the cell
- Room for extra consumable components like the electrolyte sheets and the cellulous membrane
- The assumption is made that the user will have the containers to mix the KOH solution



Senior Design AMFC Kit

Exploded View



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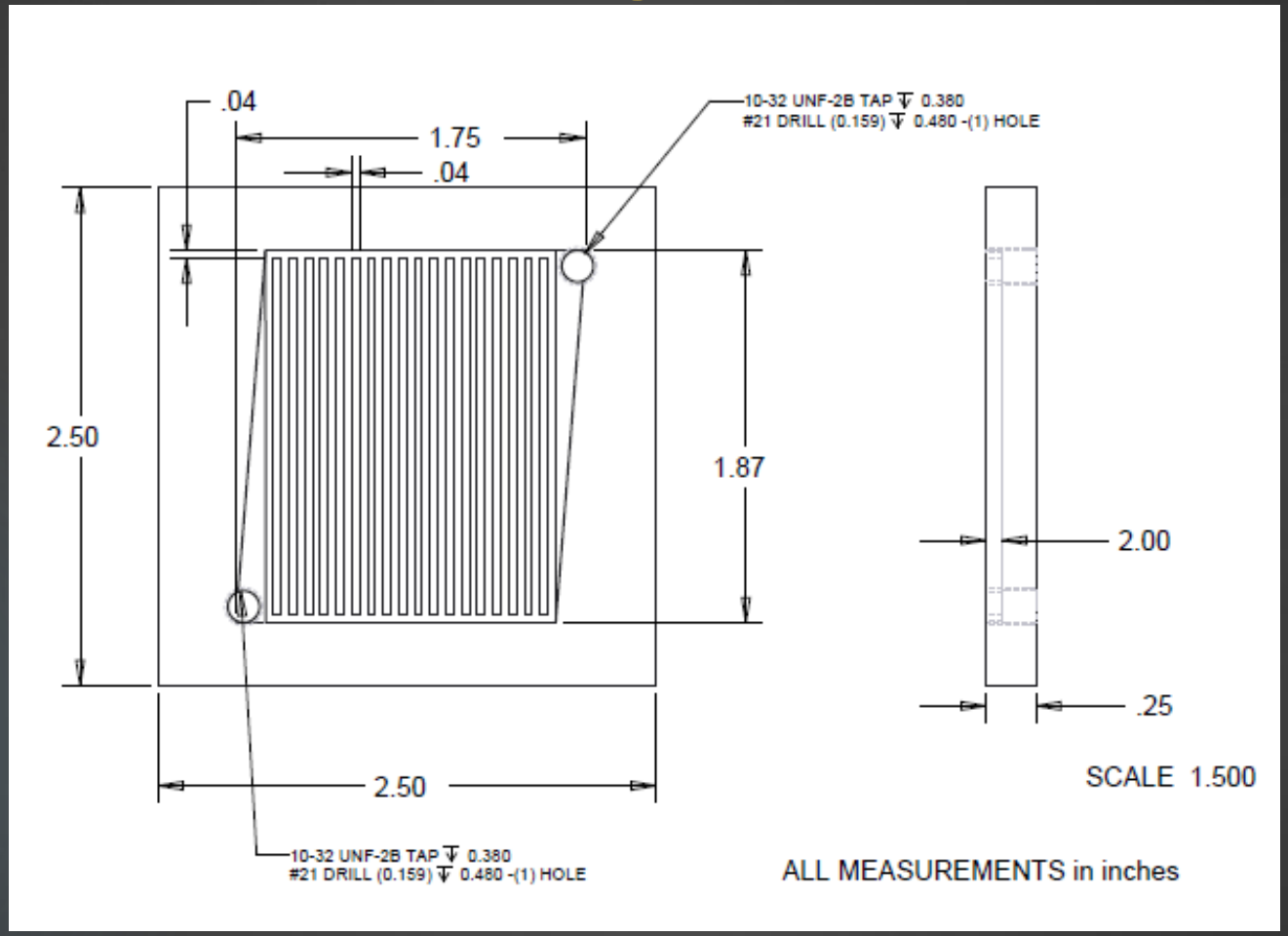
Bipolar Plate Drawing



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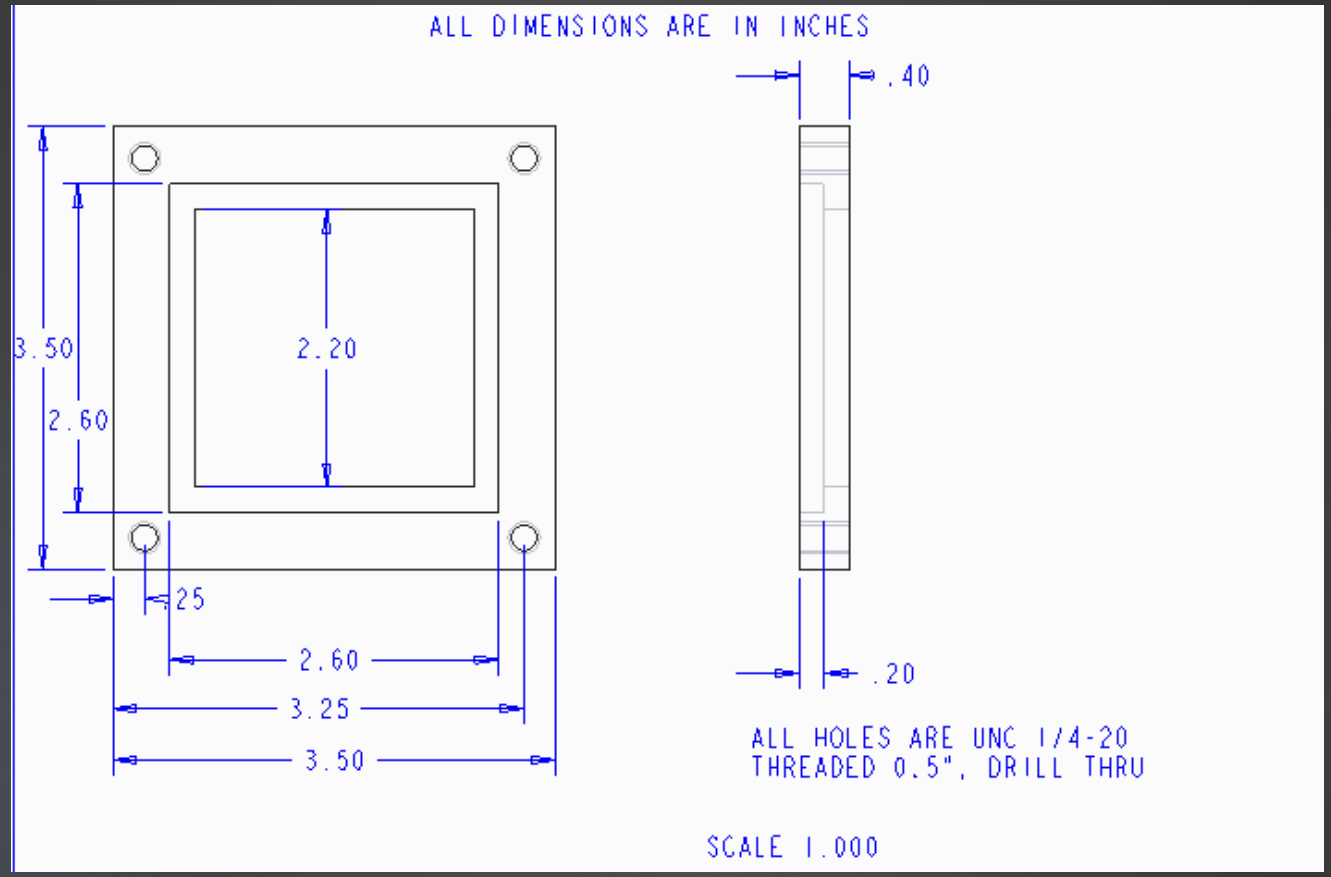
Mounting Bracket Drawing



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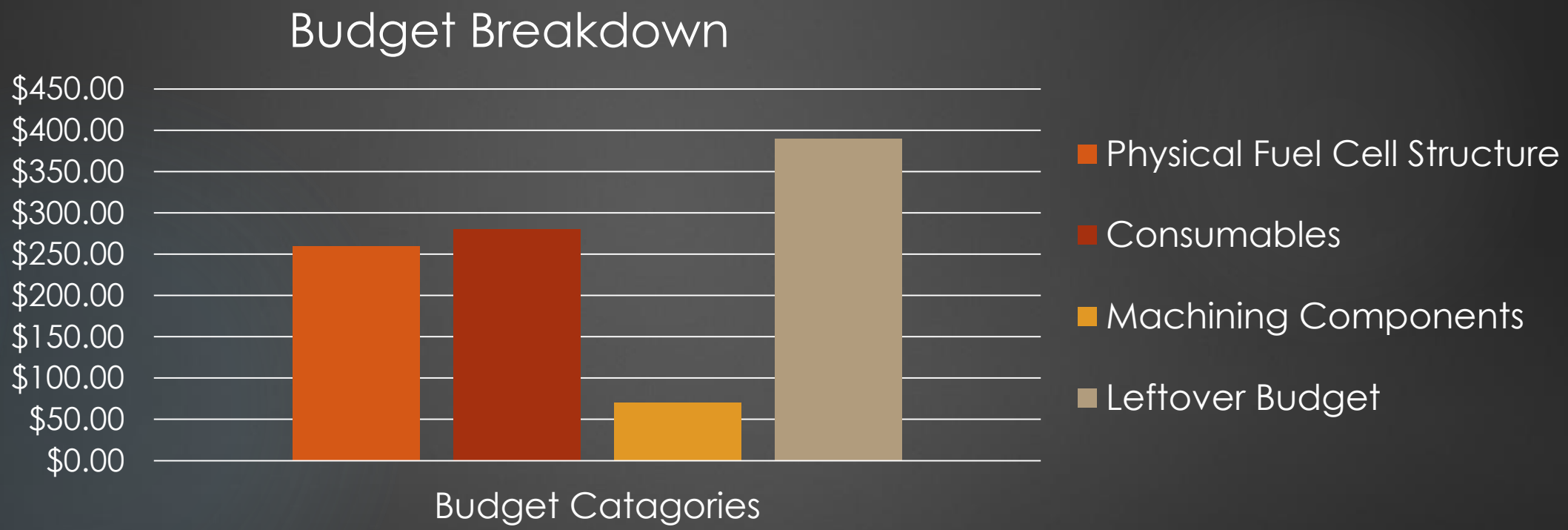
Budget Summary

- 39% of the budget has been used with no more expected costs



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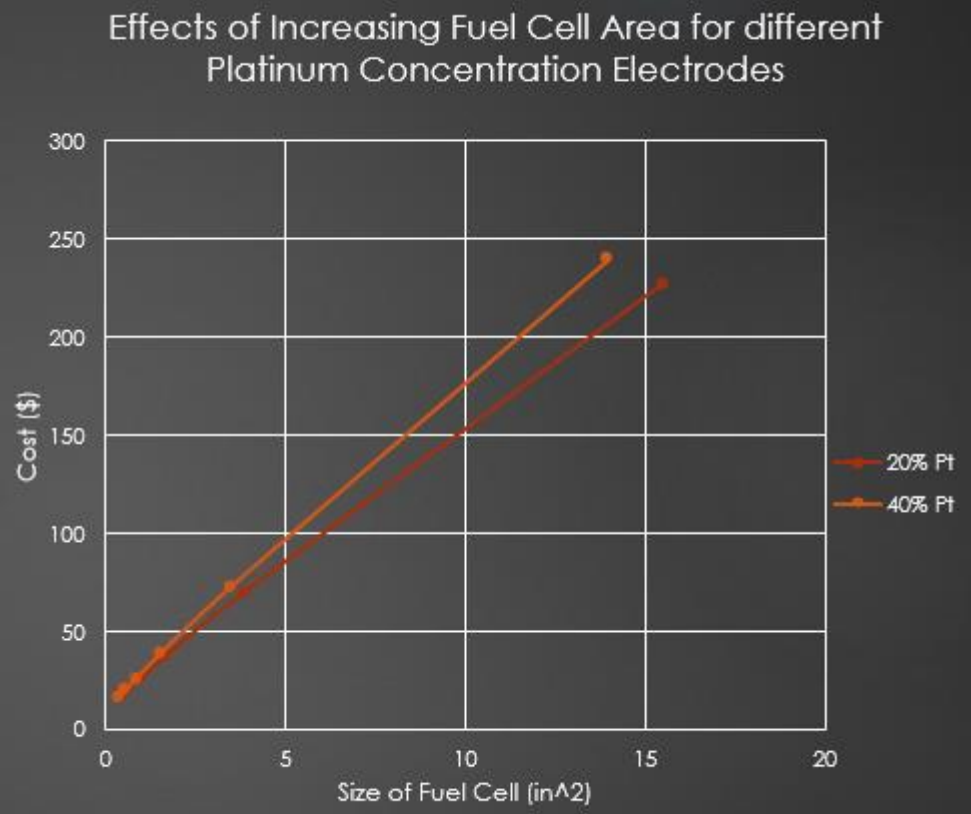
Effects of Sizing

- Limitations on Size without wasting materials
- Some material costs remain constant
- 20% Platinum concentration electrode
  - 20 cm x 20 cm
- 40% Platinum concentration electrode
  - 19 cm x 19 cm
- Benefits/Drawbacks
  - $2.68 difference in cost
  - Increase in efficiency
  - Decrease in operational area



Model of cost increase with increasing Fuel Cell Operational Area

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Fuel Cell Testing Site

- Testing of the fuel cell occurred at the National High Magnet Field Laboratory.
  - The facility had access to compressed hydrogen and oxygen gas as needed, as well as a safe controlled environment to conduct the testing.
  - The laboratory supervisors who approved all aspects of this testing are Mark Vanderlaan, Brian Mastracci, and Ram Dhuley.

Test Results

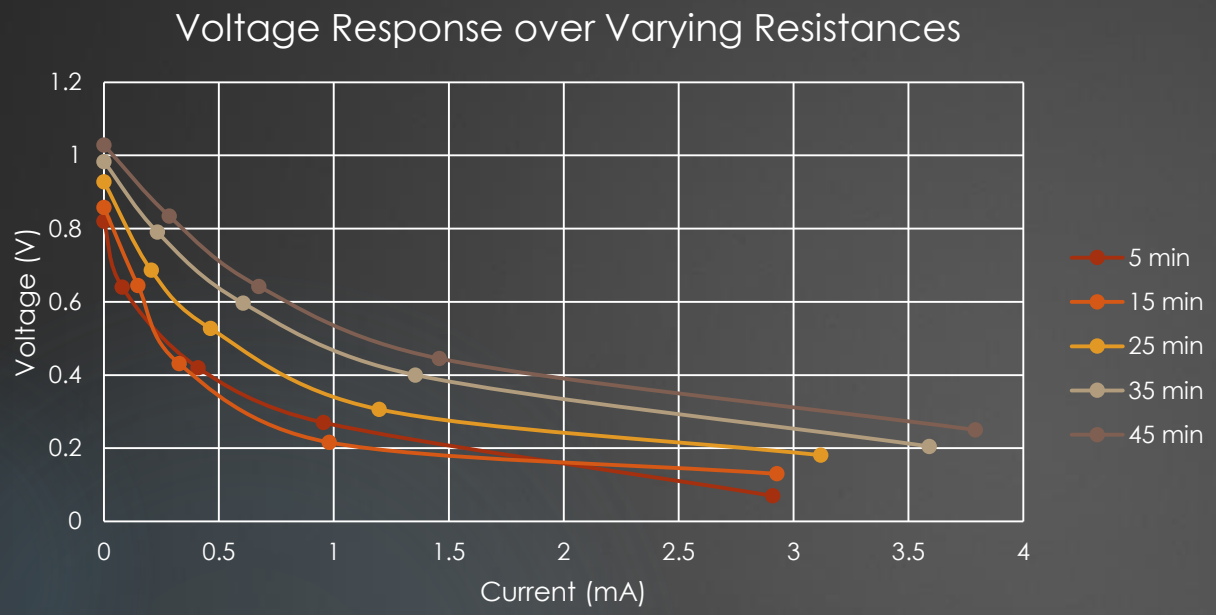


Figure a.

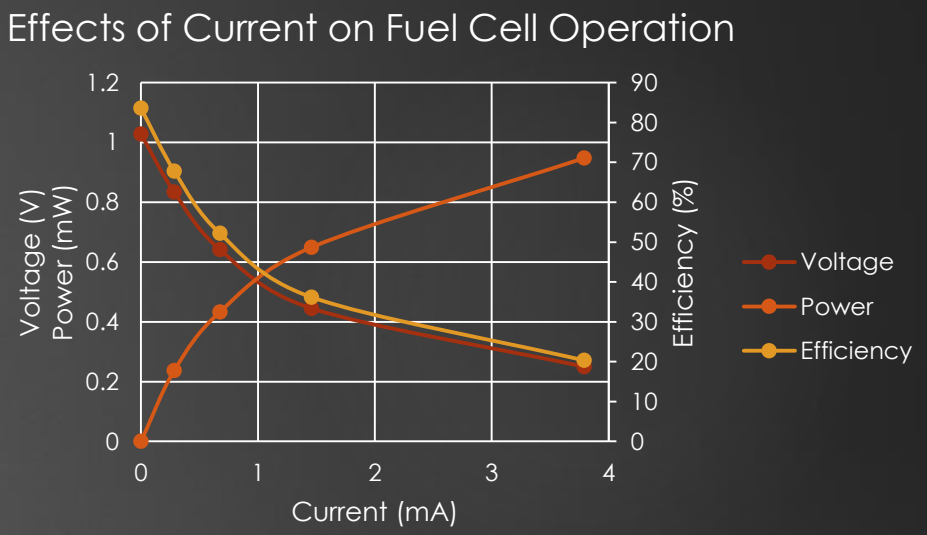
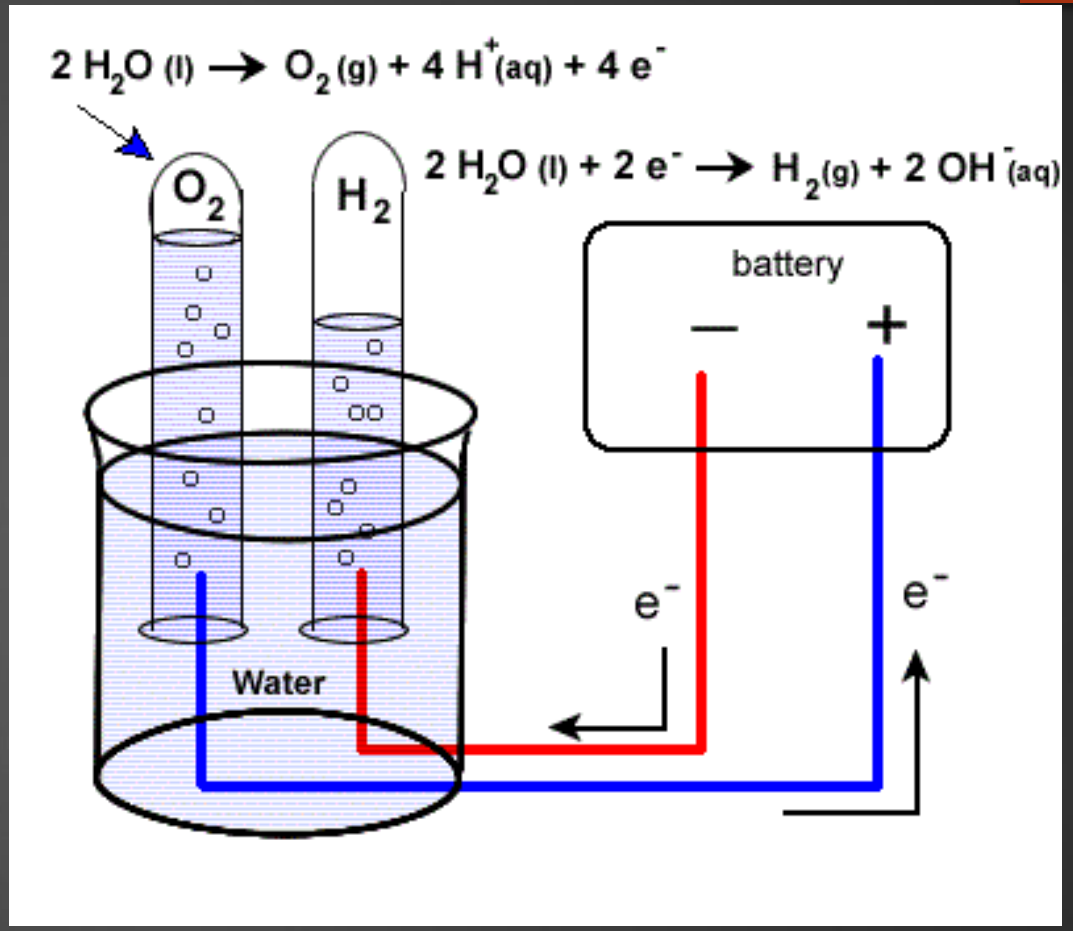


Figure b.

- Tests run with 0.2678 L/hr of hydrogen and 0.1333 L/hr of oxygen
- Measurements recorded at 220 Ω increments
- Max open-circuit voltage was 1.028 V (DC)

Electrolysis of water

- Ideal reaction
  - $2\,H_2O(l) \rightarrow 2\,H_2(g) + O_2(g)$
- H_2 & O_2 Gas production is proportional to the amount of electrical charge added to reaction
- Hydrogen to Oxygen development ratio



Simple Electrolysis Setup

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Challenges Faced

- Communication with the Brazilian team in the fall semester
- Parts changed to make machining process easier
- Finding the necessary facilities for testing
- Communication between Machine Shop
  - Additional unexpected tools needed
- Producing the needed hydrogen and oxygen without compressed gasses

Future Project Goals

- Optimize an electrolysis kit to match the output that is achieved in lab testing
- Investigate different electrodes to reduce overall cost
- Find other methods to reduce overall cost of the fuel cell to allow for stacking

Questions