

Remote Energy Solution for Powering Fish Screens Using Hydrogen Fuel Cells

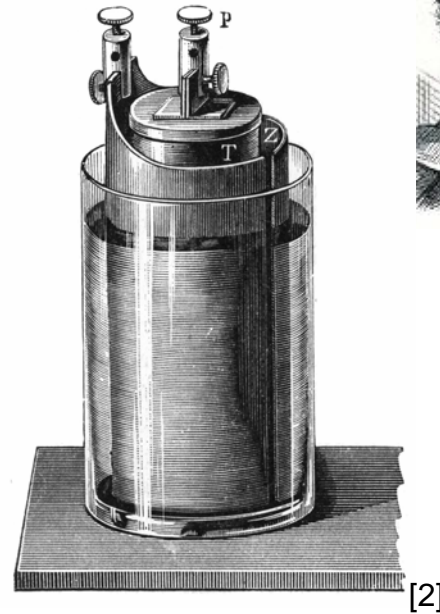
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History of the Fuel Cell

- First fuel cell built in 1845 by Sir William Robert Grove, the Grove Cell [1]
- Fuel Cell improved in 1955 by W. Thomas Grubb by using an improved ion-exchange membrane in place of the porous ceramic pot [1]
- Fuel Cell was further improved in 1958 by Leonard Niedrach by adding platinum to the ion-exchange membrane.[1]

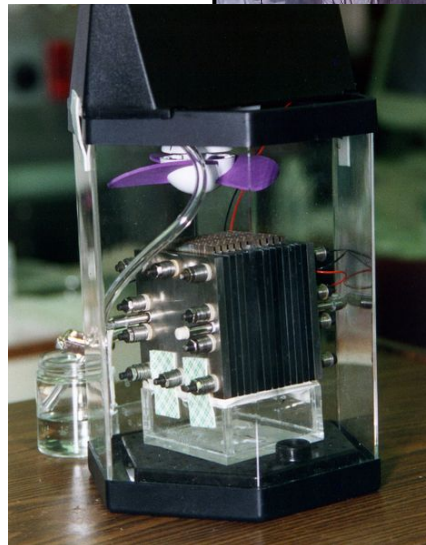


Today's Fuel Cell

- 21 Types of Fuel Cell's
- Proton Exchange Membrane Fuel Cell (PEMFC)



[3]



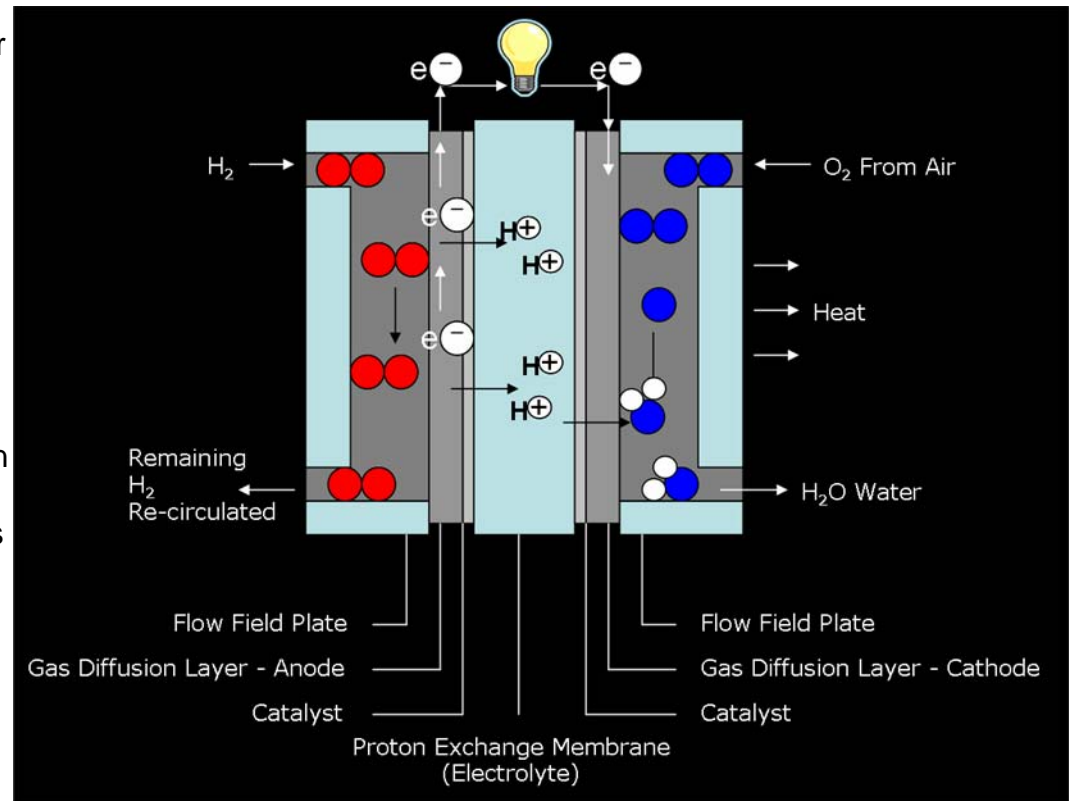
[2]



[3]

How a PEMFC works

- 1. Hydrogen gas is introduced
- 2. The gas contacts the Gas Diffusion Layer – Anode
- 3. The Gas Diffusion Layer (GDL) distributes the hydrogen gas across the catalyst surface
- 4. Catalyst surface splits the hydrogen gas into protons (H^+) and electrons
- 5. Proton Exchange Membrane (PEM) only allows protons to permeate and forces electrons to travel around
- 6. Electrons travel through wires and deliver electricity for screen project and then back to the other side of the PEM
- 7. Protons travel through the PEM and pass through the other GDL
- 8. Oxygen is introduced to the exit side of the PEM from environment
- 9. The exit catalyst combines the Oxygen, Protons and Electrons to form water and heat as by products from the Fuel Cell



Fuel Sources

- Liquid Methanol/Water mixture
 - Proprietary Product (Hydroplus)
- Bottled Hydrogen Gas
 - Readily available at Welding Gas Supply Stores (Airgas, Praxair, etc...)

Methanol Fuel & Reformation^[4]

- Using methanol/water mixture requires a reformer to take the liquid fuel and change it into hydrogen gas to be used by the fuel cell.
- Reformation Process
 - Methanol/water mixture vaporized and fed to the reformer
 - Methanol and water molecules in vapor catalytically react to form Hydrogen gas and Carbon Oxide
 - Hydrogen gas enters the purification chamber.
 - Purification chamber passes hydrogen gas through a palladium-membrane module to remove impurities
 - Remaining hydrogen gas is then purified again on a catalytic bed and then sent to the fuel cell finishing at 99.9% pure.

Methanol Operation Cost

- Idatech iGen 250W system (=1/3HP) [4]
 - Consumes .132 gal/hr to produce 250 Watts at 24V [4]
 - Mid-year 2008 price of fuel (Hydroplus) is about \$4/gal [4]
 - Desire to run a 1/2HP (373W) Motor to turn a traveling belt screen for at least of 5 minutes

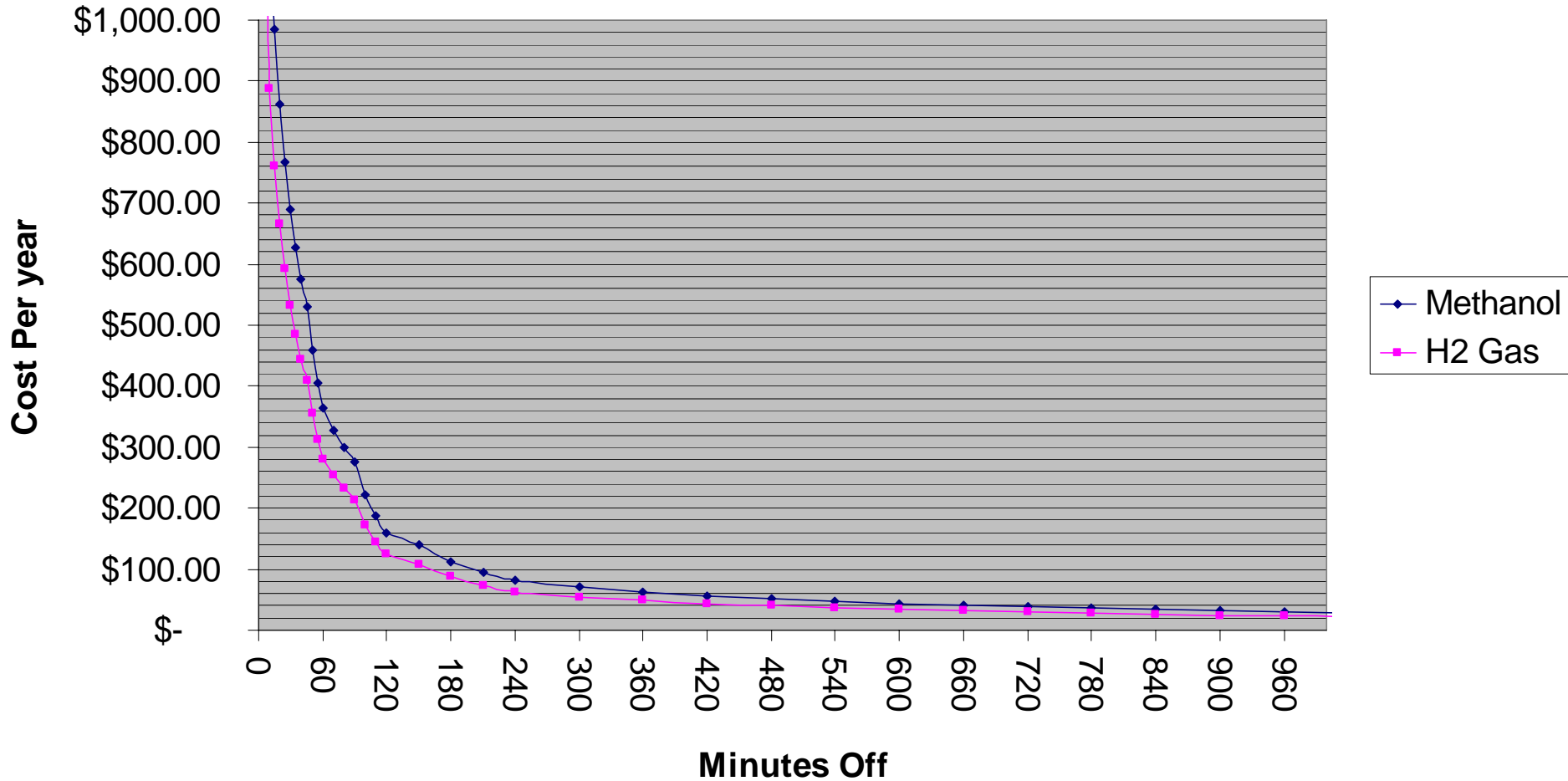
Hydrogen Gas Operation Cost

- Relion T-1000 Fuel Cell 600W system (=0.8 HP)
 - Consumes 7.7 lit/min to produce 600 Watts at 24V
 - Mid-year 2008 price of fuel (H² gas) is about \$.21/lit
 - Desire to run a 1/2HP (373W) Motor to turn a traveling belt screen for at least of 5 minutes

Operation Cost Cont'd

Cost Methanol Vs. H Gas

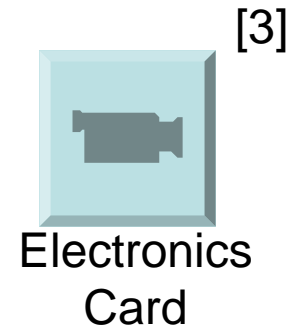
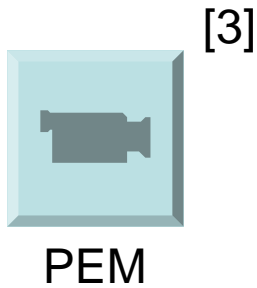
Screen Cleans for 5 Minutes on a 1/2HP Motor



Failure Mechanisms and Life Expectancy^{[3]&[4]}

- With no moving parts how does a fuel cell fail?
 - Dirty Hydrogen Gas (Sulfur and CO pollutes PEM)
 - Pressurized Hydrogen Tears PEM
 - Air Filter Becomes Plugged
 - Electronics Card Failure
- Life Expectancy (Under Warranty)
 - Idatech – 1000 hrs for 250W system
 - Relion – 3000 hrs for 600W system

Changing a PEM or Electronics Card



Maintenance

- Change Filter for Air Intake ^{[3][4]}
- Inspect Hydrogen Supply System (If applicable) ^[3]
- Use periodically to maintain system ^{[3][4]}

Changing an Air Filter^[3]



Designing Fuel Cells Into Project

- **Optimum Use:** provide a back up power system for the screen cleaning system.
- Fuel Cell/Reformer → Battery Bank → Electric Motor w/ Controls to run Screen
- Design = Balance of Power Needs

Design Process

- 1: Determine Motor Size (*How much HP?*)
- 2: Determine Size of Battery (*How long should the motor run before charging?*)
- 3: Choose the Fuel Cell Size (*How many watts and how much voltage?*)
- 4: Determine Consumption Rate (*How much fuel will be used per battery charging?*)
- 5: Choose Cleaning Frequency (*How much fuel will be consumed in a day/week/month?*)
- 6: Choose the volume of the fuel container (*How long will the tank last before refueling?*)

References

1. "[History of Fuel Cells](#)". Johnson Matthey plc.. Retrieved on [2007-05-27](#).
2. Wikipedia. Retrieved on 2008-08-3
3. Relion (www.relion-inc.com). Retrieved on 2008-08-03
4. Idatech (www.idatech.com). Retrieved on 2008-08-03