PHOENIX ANALYSIS & DESIGN TECHNOLOGIES

We Make Innovation Work

Project Name: Portable Power Supply
Industry: Personal Electronics
Customer: PolyFuel

PORTABLE FUEL CELL POWER SUPPLY

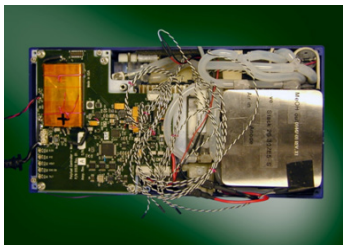
BACKGROUND AND PROJECT CHALLENGE

Proton Exchange Membrane (PEM) fuel cells are being developed as an alternative method for powering many things including as a way to provided extended use for laptops. PEM fuel cells produce DC electrical power which can be used to power electronics or to charge a main battery pack. The most energy dense type of fuel cell is one that employs a liquid fuel – in this case methanol. The main challenge with this project was to integrate all of the system components into a completely self contained, self controlled package. The final proof-of-concept power supply was about 8.5" x 4.5" x 2".

PROCESS AND SOLUTION

Since the entire system was based on fuel cell stack performance, we started this project by designing and building a POC stack that allowed PolyFuel to optimize their electrode and catalyst technology and to establish requirements for the fuel cell to function properly. With that in hand, PADT worked with PolyFuel to develop a conceptual design of the entire system that allowed us to identify key components and especially high risk subsystems. We used our in-house analysis expertise to aid in this evaluation.

After this evaluation, parallel efforts were initiated to develop the CO2 scrubber, the anode loop cooling system, the methanol fuel cartridge, and the embedded system control architecture. Early prototypes were made of each of these subsystems to test them for performance. Several iterations were required, but once these subsystems were functioning reliably, then it was possible to create a 2-D brassboard of the entire system.



PADT worked with PolyFuel for 18 months to develop a fuel cell based, laptop power supply that was powered from a methanol fuel stock. We started with a blank sheet and developed a POC system that included the fuel cell stack, all of the custom components and controls, and was hybridized with a Lithium-ion battery pack. During that period Polyfuel was able to raise Venture Capital to develop their product.

DISCIPLINES EMPLOYED

Electrical engineering

Embedded software

Fuel cell expertise

Mechanical engineering

Hydraulic and pneumatic system design

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At PADT, with complex systems like this one, we often employ a 2-D "brassboard" to aid in the development. A brassboard is simply a board with all of the components mounted to it over an extended surface. The components are all electrically, hydraulically, and pneumatically connected and thus the overall system performance can be evaluated. Using this 2-D brassboard, the software for the embedded control system was developed. Finally, the hybridization of the entire system with a 4 cell lithium-Ion battery pack allowed us to make the system startup and operate completely autonomously as long as Methanol fuel was available.

The final prototype was completely self contained, autonomously controlled, and was only 8.5" x 4.5" x 2" in dimension. The system provided 60 W-hr of energy for each fuel cartridge the user would supply. This supplies up to 6 hours of additional laptop usage for each fuel cartridge.

PROJECT HIGHLIGHTS

Helped design proof-of-concept direct methanol stack

Worked closely with PolyFuel's team as they verified stack performance with PolyFuel's electrodes

Integrated the stack into a fully functioning portable power supply fueled by a methanol cartridge

Anode and Cathode process flows were provided by miniature pumps that PADT integrated

Custom components were developed for CO2 scrubbing and anode loop cooling

Fuel cell was hybridized with a lithium Ion battery pack

PADT developed electronic design and embedded software control system that managed the system operation

The final proof-of-concept power supply was about 8.5" x 4.5" x 2"

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