Putting Fuel Cells to the Test

If research has its way, an electrochemical device capable of converting energy into electricity and heat will become the impetus behind the next generation of automobiles, superseding the internal combustible engine found under the hoods of vehicles that rule the road today.

The thought of fuel cell technology being able to accomplish such a feat may be dismissed as too futuristic by some, but the truth is that fuel cells have been in play as a source of propulsion since the 1960s, when NASA first used them to generate power onboard the Gemini and Apollo spacecraft for extended space missions. Even more unknown is the fact that fuel cells were and continue to be a source of drinking water for astronauts in orbit, since they produce pure water as a by-product.

NASA is recognized for providing fuel cell technology with the initial research and development it required for safe, efficient use within other applications. Fuel cells have garnered a great deal of attention as clean energy converters, free of harmful emissions, since being adopted by the Space Program. Along with automobile manufacturers, universities, national laboratories, and private companies of all sizes have tapped into this technology.

While the primary fuel source for a fuel cell is hydrogen, there are several different types of fuel cells, each having different energy conversion efficiencies. Alkaline Fuel Cells (AFCs), which use a solution of potassium hydroxide in water as their electrolyte, were one of the first classes of fuel cells developed and are still depended upon during Space Shuttle missions. Phosphoric Acid Fuel Cells (PAFCs), considered the most commercially developed fuel cells, are used in hospitals, hotels, and offices, and as the means of propulsion for large vehicles such as buses. Proton Exchange Membrane Fuel Cells (PEMFCs) are similar to PAFCs in that they are acid-based (although the acid is in the form of a proton exchange membrane), but they operate at lower temperatures (about 170 ºF, compared to 370 ºF) and have a higher power density.

Molten Carbonate Fuel Cells (MCFCs) operate at high temperatures (1,300 ºF) to achieve sufficient conductivity. Solid Oxide Fuel Cells (SOFCs), like MCFCs, operate at high temperatures (2,000 ºF), but are more ideal for using waste heat to generate steam for space heating, industrial processing, or in a steam turbine to create more electricity. Lastly, Direct Methanol Fuel Cells (DMFCs) use methanol directly as a reducing agent to produce electrical energy, eliminating the need

Various modules representing Lynntech, Inc.'s product line of fuel cell test equipment.

for a fuel processor, thus increasing the possibilities for a lighter, less expensive fuel cell engine.

Developers of the various fuel cell technologies require advanced, fully automated, computer-controlled test equipment to determine the performance of fuel cell components, such as electrocatalysts, proton exchange membranes, and bipolar plates, as well as fuel cell stacks and fuel cell power systems. Since 2001, Lynntech Industries, Ltd., an affiliate of College Station, Texas-based Lynntech, Inc., has been manufacturing and selling a complete range of fuel cell test systems worldwide to satisfy customers' demands in this rapidly growing market.

The fuel cell test equipment was invented by Lynntech, Inc., in the early-to-mid 1990s, with funding for design, fabrication, and testing stemming from a Phase II **Small Business Innovation Research (SBIR)** contract with NASA's Glenn Research Center. Glenn awarded the company the SBIR with the intent of utilizing the resulting technology to strengthen NASA's Reusable Launch Vehicle and Space Power programs. First year commercial sales of the fuel cell test equipment were in excess of $750,000, verifying NASA's expense as a sound investment. The test system arising from the work with Glenn has been patented by Lynntech, Inc., and continues to be upgraded to meet current standards.

Lynntech Industries' testing system comes equipped with software called FCPower,™ declared by the company as the most powerful and flexible program for testing in the industry. FCPower enables plug-and-play recognition of hardware, multiple levels of user control, complete automation of configuration and testing, customizable display, and data acquisition and exporting. Even more, the software incorporates safety features that allow for combustible gas monitoring and automatic shutdown of instruments and fuel supply lines.

To match the requirements of individual fuel cell developers, Lynntech Industries adopted a modular approach on designing the test equipment, enabling custom solutions with standard equipment. This entitles customers to select specific modules they may need for any given fuel cell application. Accordingly, Lynntech Industries provides a selection of "all-in-one" test systems and function-specific modules. The components of the company's fuel cell test system include an electronic loadbank; a reactant gas humidifier; gas mixing, handling, and metering systems; instrumentation input/output; methanol and hydrogen test kits; tail gas handling; thermal management; and a cell voltage monitoring buffer board.

It remains uncertain when exactly the average consumer will be able to fully appreciate the impact that fuel cells are making to preserve the environment, but Lynntech, Inc., and Lynntech Industries are in position to bring this moment of realization one step closer to reality.

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A variety of fuel cell components, like the Lynntech Flightweight™ Fuel Cell Stack shown here, require top-of-the-line test equipment to determine their performance.