B11 BATTERIES

FUEL CELLS & ELECTRIC VEHICLES

CHEMICAL INDUSTRIES
RESOURCE PACK

The fuel cell

A fuel cell is an electrochemical device that combines hydrogen with oxygen to produce electric power, heat and water. In many ways, the fuel cell resembles an electrochemical battery. Rather than applying a periodic recharge, a continuous supply of oxygen and hydrogen is provided from the outside. Oxygen is commonly drawn from the air and hydrogen is carried as fuel in a pressurised container.

As alternatives, methanol, propane, butane, natural gas and diesel can be used. Alternative fuels require a reformer to extract the hydrogen. This allows tapping into existing distribution systems. However, reformers are bulky, expensive and sluggish. Some fuel efficiency is lost and a small amount of pollution is produced, but this is 90% less than from a regular car.

The fuel cell does not generate energy through burning; rather, it is based on an electrochemical process. The energy conversion is twice as efficient as through combustion. There are little or no harmful emissions. The only release is clean water. The fuel cell concept was developed in 1839 by Sir William Grove, a Welsh judge and gentleman scientist. The invention did not take off, partly due to the success of the internal combustion motor. The revival occurred when the first fuel cell was used in the Gemini Space Program during the 1960s. Based on the alkaline system, the fuel cell generated electricity and produced the astronauts' drinking water. Commercial application of this power source was impossible at that time because of high material costs. Improvements in the stack design during the 1990s led to reduced costs and increased power densities.

Fuel cell chemistry is simple. The electrolysis of water into hydrogen and oxygen through the application of an electric current ($2H_2O \rightarrow 2H_2 + O_2$) can be reversed to produce water and electricity:

$$2H_2 + O_2 \rightarrow 2H_2O$$

Fuel cells are based on reverse electrolysis. They resemble batteries in that their direct current (DC) electrical output is due to an electrochemical process. However, unlike batteries, fuel cells operate off a continuous stream of air as a source of oxygen, and a source of hydrogen fuel.

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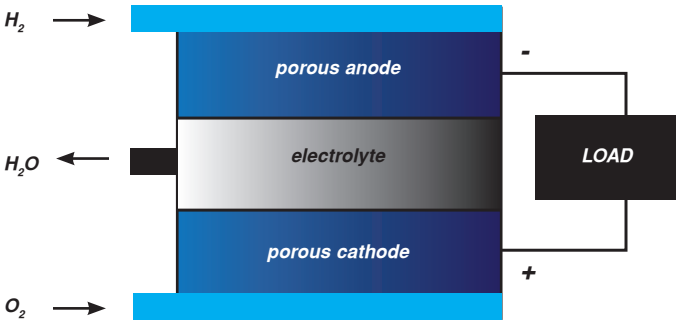
The general fuel cell construction



Source: BatteryUniversity.com

Mobile hydrogen fuel cell system

A hydrogen fuel cell system powering a television Photograph: Rein Weber

A small scale hydrogen fuel cell system

Picture courtesy UCT Chemical Engineering. Photograph by Rothko

SA's electric car developer outlines its battery-swap thinking

4th June 2010

In today's pricing terms, South Africa's Joule electric vehicle will sell at R235 000 to R285 000, with the battery, the most costly component of the car, leased at an additional R1 500 a month, says Optimal Energy spokesperson Jaco van Loggerenberg. The Joule electrical car will be in showrooms in 2013.

The Joule buyers will not own the lithium-ion battery, but only the vehicle body. It also means that owners may be able to swap a depleted battery for a fully charged one in around a minute, instead of waiting for the battery to charge – if such a system is introduced along with the Joule. Optimal Energy is working towards the large-scale manufacture of fully electric cars for the local and exports markets. The company is headquartered in Cape Town. The first test Joules are being hand-built near Port Elizabeth by Hi-Tech Automotive, which is responsible for building a marketing and test fleet of about 100 vehicles. These will double as research and development units, some of which will be on South African roads by the start of the Soccer World Cup on June 11. Full-scale production of the Joule will begin at the end of 2012. Key design goals for the finished product include a range of 230 km to 300 km before recharging is required, a freeway cruising capability, as well as seating for five.

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DID YOU KNOW?

The hybrid car is not new - Ferdinand Porsche designed the series-hybrid vehicle in 1898. Called the Lohner-Porsche carriage, the hybrid function served as an electrical transmission rather than power boost. With Mr. Porsche in the driver's seat, the car broke several Austrian speed records, including at the Exelberg Rally in 1901. The hybrid electric vehicle conserves fuel by using an electric motor that assists the internal-combustion engine on acceleration and harnesses kinetic energy during braking.

Source: www.BatteryUniversity.com

The Joule

South Africa's own electric car - The Joule
Picture courtesy Optimal Energy

Sony develops a bio battery powered by sugar

24 August 2007

Sony has developed a biologically friendly battery that generates electricity from sugar in a way that's similar to what's found in living organisms. The battery generates electricity through the use of enzymes that break down carbohydrates, which is essentially sugar. The bio battery could evolve into an ecologically friendly device, because sugar is a naturally occurring energy source produced by plants through photosynthesis and can be found in most areas of the earth, Sony said. In addition, Sony made the battery casing of vegetable-based plastic.

In other recent ecologically friendly battery research, scientists at the Rensselaer Polytechnic Institute reported that creating a paper-sized device that functions as a high-energy battery and a super-capacitor that can use human blood and sweat to recharge. The device is lightweight, thin, flexible, and geared toward future use for medical implants, transportation, and gadgets.

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