

## SABIC Innovative Plastics helps SFC's methanol-based fuel cells deliver long-lasting power on demand

Getting energized with the chemical resistance, purity & flame retardance of Ultem<sup>®</sup> resin and film

Fuel cells are a promising new technology for powering electrical equipment ranging from computers to camcorders to cars. SFC Smart Fuel Cell AG (SFC), a German manufacturer, is breaking new ground through the use of liquid methanol instead of hydrogen, which requires pressurized tanks. To produce its new EFOY ("Energy for You") line of miniaturized, portable fuel cells, SFC needed materials that could withstand the effects of methanol, while delivering flame retardance and resistance to temperature extremes necessary for a power source. To find high-performance plastic film and resin for several key components of the EFOY fuel cells, SFC selected Ultem 1000B film and Ultem 1000 resin.



### Challenge

#### Meeting the demands of cutting-edge fuel cell technology

As people become more mobile, battery technology has been unable to keep up with the huge rise in power consumed by the electronic devices they take with them. Batteries either run down and die, or need recharging. Fuel cells are new electrochemical conversion devices that keep on going as long as there is a supply of chemicals – typically hydrogen and oxygen. However, hydrogen presents drawbacks including availability, storage and distribution problems and restrictions from being used on aircraft and in other environments. The use of liquid methanol instead of hydrogen offers a simpler and more convenient solution.

Based in Munich, Germany, SFC is a market leader in portable fuel cells based on DMFC (direct methanol fuel cell) technology. Since 2003, when SFC introduced the world's first fully commercialized fuel cell system together with the infrastructure required for fuel cartridges, the company has achieved several groundbreaking milestones, the latest being the introduction of the new EFOY product family of miniaturized fuel cells.

To produce these small, portable fuel cells, SFC needed materials that could withstand the effects of liquid methanol, an aggressive solvent that can harm many thermoplastics. Other requirements were flame retardance, resistance to extremes of temperature, and purity to prevent migration into

the methanol of chemicals that could impact the fuel cell's efficiency.

Christian Ruf, Development Engineer for SFC said, "We had worked with SABIC Innovative Plastics previously to produce our prototype Fuel Cell Power System. We were familiar with the many performance advantages of Ultem resin and naturally turned to this material again for the EFOY products."

### Solution

#### Ultem resin and film help deliver excellent results in methanol resistance to ensure long fuel cell life

SABIC Innovative Plastics recommended Ultem 1000B film in a thickness range of 0.150 mm to 0.750 mm for the use directly in the cells. The film is cut to size by SABIC HIFI Polymershapes.

For the methanol tank and other components that make contact with methanol, the company selected Ultem 1000 resin, which is injection-molded.

To demonstrate the materials' resistance to methanol, testing was performed (testing was shared between SFC and SABIC Polymershapes). This testing involved immersing the Ultem film or resin part in a water-methanol solution for at thousands of hours. With this solution a special material test for fuel cells developed by SFC was done, to indicate any detrimental additives the material was

## Case Study

# Ultem\* resin and film / Smart Fuel Cell GmbH

dissolving. On the basis of the performance data, the behavior of the material was analyzed. Both Ultem film and resin achieved excellent results in this testing process.

"Although there are other thermoplastics that could potentially have been used for this application, none of them offered the superior methanol resistance in fuel cell conditions combined with other key performance attributes that SFC needed," said Jean-Noel Schilling, Application Development Specialist for SABIC Innovative Plastics. "Ultem resin and film are simply an outstanding choice for this demanding new fuel cell technology. These unique materials can make an important difference in the longevity and performance of the EFOY fuel cells."

## Benefits

### **SABIC Innovative Plastics' materials help bring a new mobile energy source to market**

Fuel cells represent a huge market opportunity that is being pursued by many different companies, which are scrambling to differentiate their offerings. The cutting-edge DMFC technology being pioneered by SFC is a promising approach that may help drive widespread adoption of fuel cells. However, in the face of growing competition, SFC needed a material solution that could help the company stay in a leadership position. As the most methanol-resistant plastics available, Ultem materials were a key factor in the rapid and successful commercialization of the EFOY fuel cell products.

Ultem resin and film also provide inherent flame retardance (FR) that is an important requirement of power sources. Ultem film and resin avoid the use of halogenated FR additives that are being restricted in many areas of the world.

Further, Ultem resin and film provide high purity, which avoids the issue of chemicals leaching from the plastic into the liquid methanol and impacting its efficiency. Even at temperatures as low as -30C and as high as 100C, Ultem resin and film do not impact the methanol or, conversely, become damaged by this aggressive chemical.

In terms of processing, Ultem 1000B film can be cut into precise shapes and formed into complex parts with ease. Injection molding of the Ultem resin supports mass production of the EFOY fuel cells, enabling faster commercialization.

"SABIC Innovative Plastics' materials have enhanced our ability to mass-produce the EFOY products to meet growing demand," said Ruf. "In turn, this has allowed us to cut the price of the fuel cells, further driving adoption. From high performance under demanding conditions to faster cycle times, Ultem resin, film and sheet have played a key role in the success of this new product line."

## Details at

[efoy.eu](http://efoy.eu)

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