SA INVENTOR PLANS TO BUILD WORLD'S FIRST COMMERCIAL "GREEN" AIRCRAFT

By Hilka Birns

Above: *A computer-generated impression of what the Version 2 UAV will look like.* **Below:** *A homemade four-cell stack showing the bipolar plates that route the hydrogen (through the snake-like gas flow fields) over the membrane electrode assembly.*

A SOUTH African inventor is planning to build the world's first commercial two-seater hydrogen fuel cell-powered aircraft.

Mark van Wyk, a technology developer at Travellab – a sister company to online travel agency Travelstart that is sponsoring the research – sees home-made hydrogen as a major solution to energy supply and availability problems.

"While I didn't invent the fuel cell nor the aircraft, I believe I have achieved an excellent balance in blending the two technologies and would like to see this technology commercialised in aviation. This could be the dawn of a new age in aviation," he said.

Mark van Wyk

"Our companies want to do something substantial about the threat to the environment," Travelstart spokesman, Stephan Ekbergh explained. "Carbon offset programmes will not combat the real issues, but alternative power sources and innovations such as hydrogen fuel cell technology could make a huge difference."

Hydrogen fuel cells operate like batteries, combining a fuel (hydrogen) and an oxidant (oxygen from the air) to create electricity by an electro-chemical process, without any combustion. Van Wyk explained: "The process creates heat, electricity and water as an exhaust. This means that as long as the hydrogen is obtained from a renewable source, the entire process is neutral and truly environmentally friendly."

Before attempting to built the two-seater aircraft, Van Wyk will test the concept by building two prototype unmanned aerial vehicles (UAVs).

UAV Version 1 will weigh 7 kg, be 1,5 metres long and have a wingspan of four metres. It will use a customised fuel cell manufactured in Hong Kong.

UAV Version 2 will use a fuel cell developed almost entirely in South Africa using local materials. The fuel cell will be reversible, meaning the plane could be plugged into an external power source and generate its own hydrogen. Van Wyk already has built a test PEM (proton exchange membrane) reversible fuel cell, which is solar powered and produces about one litre of hydrogen per hour.

For UAV Version 2 he will use new techniques that are a world first and that will contribute to research being done internationally on the subject.

These include the design of a cylindrical shaped fuel cell specifically suited to aviation with maximum effective use of space; the use of cooling fins directly coupled with the fuel cell unit; ram-air intake to compress the air for the fuel cell; and the use of hybrid technology (including solar panels on wings) to generate electricity/hydrogen.

The technology for electro-chemical power plants has been in existence since 1839, but they are still not in widespread use. Latest research includes a NASA study into a solid oxide fuel cell (SOFC) powered aircraft the size of a Boeing 737 within its revolutionary aero-propulsion concepts programme.

Boeing has tested an SOFC auxiliary power unit (APU) on one of its B737s. Boeing's studies have found that fuel cells are not economic at current costs, but projects that the technology will reach maturity by 2010 at which time the APU could be offered on future versions of the Boeing 787.

Today the SOFC takes 40 minutes to reach operating temperature so the technology is far from commercial. In Spain a month ago, Boeing also tested a one-seater motor-glider using hydrogen fuel cell technology.

A study by the UK's Cranfield University has identified the following problems relating to hydrogen fuel cell power for commercial aircraft operations, compared to conventional turbines:

- Fuel cells are still far too heavy for propulsion. A large aircraft requires many megawatts generated from at least two turbine engines weighing around 3 900 kg each. Today's best fuel cells would generate 670-1 000 kW on average and would weigh over 3 200 kg each.
- Hydrogen and oxygen storage onboard requires large pressure vessels.
- Fuel cells still have to beat the turbine in terms of the cost per kilowatt required to purchase and install them.

Van Wyk believes smaller fuel cells can be made by using flexible graphite. He says storage problems can be tackled using chemical hydrides.

Hydrogen can be stored onboard dissolved into newly developed magnesium-based chemical hydrides that can store 6-7 times more hydrogen in the same amount of space. His prototype UAV will use oxygen from the air eliminating the need to store it onboard. ✈