



Proto-type Fuel Cell Forklift and Hydrogen Refuelling Station at Refineries



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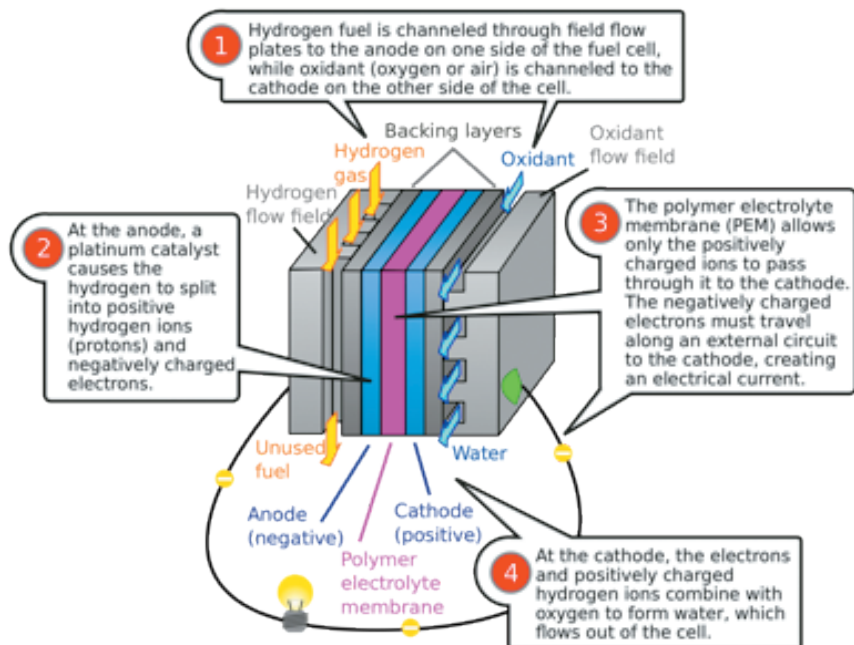
Impala Refineries are proud and excited to be at the forefront of technology developments as they launch a fuel cell powered forklift in the Dispatch area of the BMR.

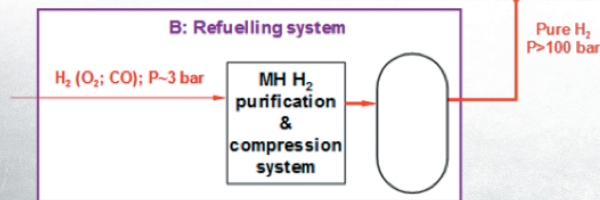
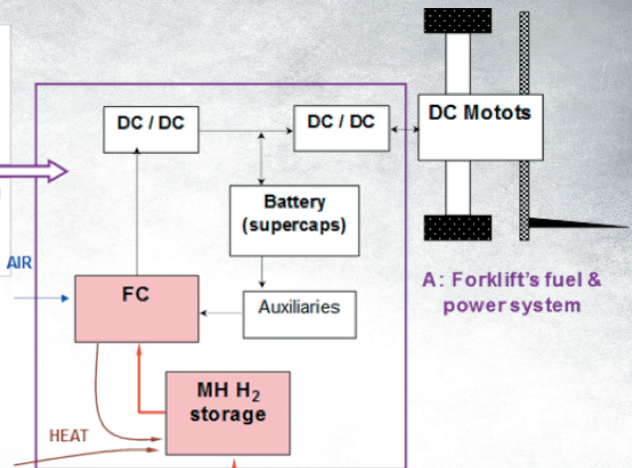
What is a fuel cell?

Fuel Cells are a family of technologies that utilise electro chemical processes rather than combustion to produce power. It utilises hydrogen as a fuel source and produces electricity and water. Fuel Cells can be classified as per three major applications: • Stationary • Mobile (vehicles) • Portable

The 3 tonne Still forklift utilises a PEM (Proton Exchange Membrane) Fuel Cell.

Proton exchange membrane fuel cell





How does a fuel cell work in a forklift?

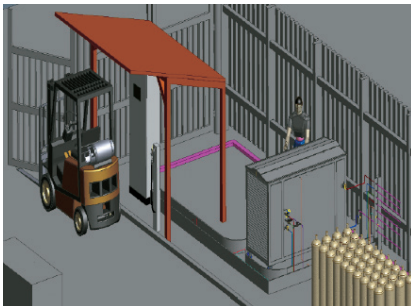
The fuel cell supplies the base load power for normal driving. This is combined with a battery to allow for operation at peak power loading, which is during lifting, inclined acceleration, and so on.

The on-board metal hydride containers store the hydrogen at lower pressures (180 Bar compared to conventional operation at 350 Bar) thus making it safer to operate and cheaper to manufacture. The metal hydride containers feed the fuel tank with hydrogen required to drive the forklift – similar to petrol or diesel in your car.

How is Hydrogen supplied to the forklift?



Refineries have an installed hydrogen supply pipeline (operating between 55 – 75 Bar). The hydrogen is compressed further using a steam compressor to 180 Bar. The higher pressure hydrogen is stored in a cylinder pack. The pack feeds the refuelling nozzle by pushing the 'start' button.



The hydrogen being filled is controlled via a timer and pressure within the fuel cell unit. The system was designed so that it requires only 1 refuelling for the day.

Operating the forklift in the dispatch area has shown that the 'fuel' lasts between 2 – 4 days of operation.

How is this forklift beneficial to Impala?

The forklift is being used at the Dispatch area in the Base Metals Refinery (BMR). This is an enclosed area. Diesel forklifts produce fumes and are noisy.

The fuel cell forklift only produces power to drive the forklift and water.

This unit does not produce any fumes and operates more silently.

In addition, fuel cells utilise platinum. The metal hydride uses nickel.

Thus it allows for an increase in demand for our metals, it provides additional avenues for beneficiation of our metals and it is aligned with our strategy to utilise 'Green' technologies that improve the environmental and safety conditions within our operations.

What do our employees have to say?

Stoney: I am very happy with the forklift. It is environmentally friendly, it has enough power to do what it is supposed to do, and it is comfortable to drive once you know the differences in positioning of the controls in comparison to our diesel forklifts. We shall definitely use this forklift well in the Despatch warehouse.

Musa: I like the fact that the forklift operates without fumes. It also has power - it can lift a load without you having to press the accelerator, like you have to on a diesel forklift. The power is there.

Johannes: I find the forklift comfortable and easy to operate. I like the fact that it is very quiet when operating. And it can do the job.

Lucky: It is safer to operate because there are no fumes. Also, one can use it for the whole day, even with a heavy workload. Depending on the workload, we have to refuel the diesel forklifts every second day. This forklift compares well with them.

Bheki: I think this forklift is a good idea. There are no noise and no fumes. We do not have to wear respirators.



Safety Measures within this system?

The fuel cell has a hydrogen detector which shuts off hydrogen supply if a leak is detected. The refuelling station has been designed with pressure sensors which would activate a safe venting sequence if the pressure increases above 200 Bar. This will also shut off the compressor and refuelling systems. The compressor and refuelling systems have been designed with additional emergency shut off switches as an added precaution.

CONTACT DETAILS

For further information visit Implats' corporate website:

www.implats.co.za

Group Executive: Corporate Relations

Johan Theron

Tel: +27 (11) 731 9013

E-mail: johan.theron@implats.co.za

Group Corporate Relations Manager

Alice Lourens

Tel: +27 (11) 731 9033

E-mail: alice.lourens@implats.co.za

HEAD OFFICE

2 Fricker Road, Illovo, 2196

Private Bag X18, Northlands, 2116

Tel: +27 (11) 731 9000

Fax: +27 (11) 731 9254

E-mail: investor@implats.co.za