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Technologies

FUEL CELL BACKGROUND & HISTORY

The founder of the field of physical chemistry, Friedrich Wilhelm Ostwald (1853-1932), determined empirically the relationship between the different fuel cell components including the electrodes, electrolyte, oxidising and reducing agent, anions and cations. The following is their definition:

- An electrode is a material that can conduct electricity,
- An electrolyte is a medium capable of conducting ions,
- An oxidising agent is an element/compound that accepts electrons from other species in a reaction,
- A reducing agent is an element/compound that loses electrons to other species in a reaction,
- Anions are negatively charged ions and
- Cations are positively charged ions.

The study of fuel cells is important for two main reasons. The first reason is that they are an emerging technology alternative to the conventional fossil fuel based technology and as such require significant research and development in order to facilitate commercialisation. The second reason involves the understanding of how fuel cells can change and integrate with energy dependent devices.

The fuel cell is an electrochemical device that takes the chemical energy stored within hydrogen(H_2) and oxygen(O_2) and converts it into useful electrical energy, water and heat. There are several advantages that fuel cells offer namely their simple design, efficiency, silent operation and zero emissions.

Unlike batteries, fuel cells are not limited by their internal capacity as their electricity generation is produced by a continual supply and replenishment of reactants. The modular design of fuel cells and their ability to generate electricity cleanly and efficiently makes them ideal for a wide range of applications and markets. Currently, there exists a wide range of fuel cell types distinguished by the fuels used, electrolyte material and operating temperatures. However, all fuel cell types have in common the anode, electrolyte and cathode components.

Low temperature fuel cells include polymer electrolyte fuel cells (PEFCs), direct methanol fuel cells (DMFCs) and alkaline fuel cells (AFCs) which operate between 50 – 100 °C.

Examples of medium temperature fuel cells are phosphoric acid fuel cells (PAFCs) and molten carbonate fuel cells (MCFCs) which operate between 600 – 700 °C.

Solid oxide fuel cells (SOFCs) operate at higher temperatures between 600 – 1,000 °C.

The main difference between low temperature and higher temperature fuel cells is the direction of ion conduction. In low temperature fuel cells, the fuel is oxidised (electrons are lost) at the anode and the ions subsequently travel through the electrolyte to be reduced (electrons are gained) at the cathode whereas in high temperature fuel cells the oxidant is reduced at the cathode to generate ions which migrate through the electrolyte to oxidise the fuel at the anode. In both cases, the flow of electrons remains unchanged. In general, high temperature fuel cells exhibit higher efficiencies and are less sensitive to fuel compositions relative to the low temperature fuel cells.

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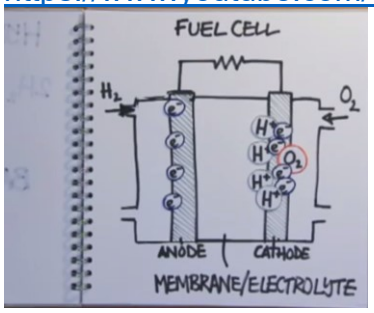
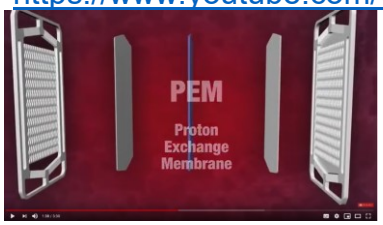
Links to additional resources for this topic			
Technologies Student Powerpoint Technologies Student Powerpoint 1 Technologies Student Powerpoint 2 Technologies Student Powerpoint 3	Technologies Extra Information for Teachers Technologies Extra Information for Teachers 2 Technologies Teacher Answers to Practical Problems Technologies Teacher Support for Technologies Practical Activities	Distribution Case Study - Linde	Kahoot Quiz

Videos – Technologies with descriptions

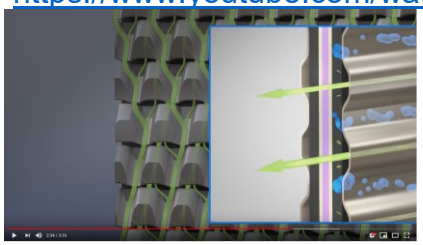
Technologies - Diagram video of how a fuel cell works – 4.01 English with all subs
https://www.youtube.com/watch?v=Tk_iIzOUjTU



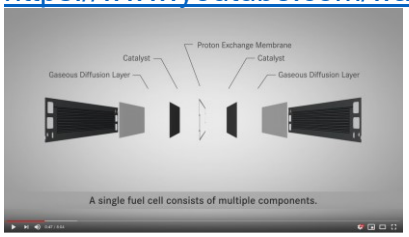
Technologies – Fuel cell technology explained by Honda 3.30 stop at 3.00 English with all subs
https://www.youtube.com/watch?v=8rofx6Gaz40



Technologies – Fuel cell technology explained by Toyota 3.39 English
https://www.youtube.com/watch?v=CPtZsr0cJ9s

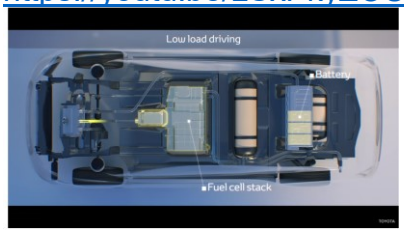


Technologies - Fuel cell technology explained by Mercedes – 8.00 Silent in English until 4.00 then French from 4.00
https://www.youtube.com/watch?v=lgSmdNwMcCA



Technologies – Toyota Mirai full production – Silent 18.00
https://youtu.be/kCRa-5NJOoU

Technologies – Toyota fuel cell – how it works 2.55 Silent with English labels
https://youtu.be/LSxPkyZOU7E



Video Intervista SOLIDpower 03/01/2019: 26.37 (Italian)

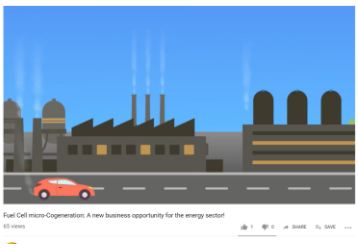
https://youtu.be/epjQWHxFT4E

Video COGEN: 2.24 – Silent with English subs

https://www.youtube.com/watch?v=bJVP4aJvwhU&feature=youtu.be&fbclid=IwAR04ZM288QlGeBnjs5tHicznSax2nf4zr7sgUPdliViBTJxwi9JWRM44Ly8

Video PACE: 2.06 English

https://www.youtube.com/watch?v=QHIQD4QGIK0

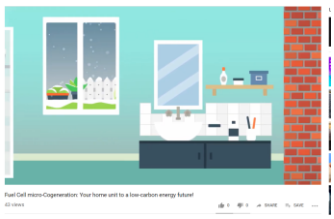


2.26

https://www.youtube.com/watch?v=DdZtIJu-EJI

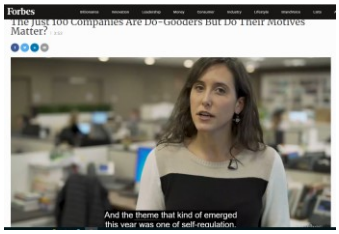
1.37

https://www.youtube.com/watch?v=hLCGIkPA_TI



Video MICROSOFT-BlueGEN ♦ Dic. 2018 3.53 (Not on YouTube)

https://www.forbes.com/video/5976963423001/?fbclid=IwAR0rPvqwJU0RXEe-g2CkR6aKZYTv5FKMQQH9yKlrrnFThkFj4qK5nqdUjUw#74ed310e6267



VINI SolidPower 2.16 (Italian)

https://www.youtube.com/watch?v=CoOeJGavipQ