High-pressure electrolysis

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High-pressure electrolysis (HPE) is the electrolysis of water by decomposition of water (H_2O) into oxygen (O_2) and hydrogen gas (H_2) due to the passing of an electric current through the water.[1] The difference with a standard proton exchange membrane electrolyzer is the compressed hydrogen output around 12–20 megapascals (120–200 bar)[2] at 70 °C.[3] By pressurising the hydrogen in the electrolyser the need for an external hydrogen compressor is eliminated, the average energy consumption for internal differential pressure compression is around 3%.[4]

ITM Power's HGas electrolyser stacks, each operating at 80bar pressure

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High-pressure PEM electrolyser.

Approaches

As the required compression power for water is less than that for hydrogen-gas the water is pumped up to a high-pressure,[5] in the other approach differential pressure is used.[6] There is also an **importance** for the electrolyser stacks to be able to accept a fluctuating electrical input, such as that found with renewable energy.[7] This then enables the ability to help with grid balancing and energy storage.

Ultrahigh-pressure electrolysis

Ultrahigh-pressure electrolysis is high-pressure electrolysis operating at 34–69 megapascals (5,000–10,000 psi).[8] At ultra-high pressures the water solubility and cross-permeation across the membrane of H_2 and O_2 is affecting hydrogen purity, modified PEMs are used to reduce cross-permeation in combination with catalytic H_2/O_2 recombiners to maintain H_2 levels in O_2 and O_2 levels in H_2 at values compatible with hydrogen safety requirements.[9][10]

Research

The US DOE believes that high-pressure electrolysis, supported by ongoing research and development, will contribute to the enabling and acceptance of technologies where hydrogen is the energy carrier between renewable energy resources and clean energy consumers.[11]

High-pressure electrolysis is being investigated by the DOE for efficient production of hydrogen from water. The target total in 2005 is \$4.75 per gge H_2 at an efficiency of 64%.[10] The total goal for the DOE in 2010 is \$2.85 per gge H_2 at an efficiency of 75%.[11] As of 2005 the DOE provided a total of \$1,563,882 worth of funding for research.[10]

Mitsubishi is pursuing such technology with its High-pressure hydrogen energy generator (HHEG) project.[12]

The Forschungszentrum Jülich, in Jülich Germany is currently researching the cost reduction of components used in high-pressure PEM electrolysis in the EKOLYSER [13] project. The primary goal of this research is to improve performance and gas purity, reduce cost and volume of expensive materials and reach the alternative energy targets set forth by the German government for 2050 in the Energy Concept published in 2010.[14][15]

See also

- Regenerative fuel cell
- High-temperature electrolysis

References

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14. "Das Energiekonzept der Bundesregierung 2010 und die Energiewende 2011" (PDF).
15. Carmo, M; Fritz D; Mergel J; Stolten D (2013). "A comprehensive review on PEM water electrolysis". *Journal of Hydrogen Energy*. doi:10.1016/j.ijhydene.2013.01.151.

External links

- High pressure electrolyzer (http://ec.europa.eu/research/energy/pdf/efchp_hydrogen1.pdf)
- EC-supported STREP program on high pressure PEM water electrolysis (http://www.cder.dz/A2H2/Medias/Download/Proc%20PDF/PARALLEL%20SESSIONS/%5BS05%5D%20Production%20-%20Water%20Electrolysis/14-06-06/393.pdf)

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