HIGH TEMPERATURE POLYMER FUEL CELLS

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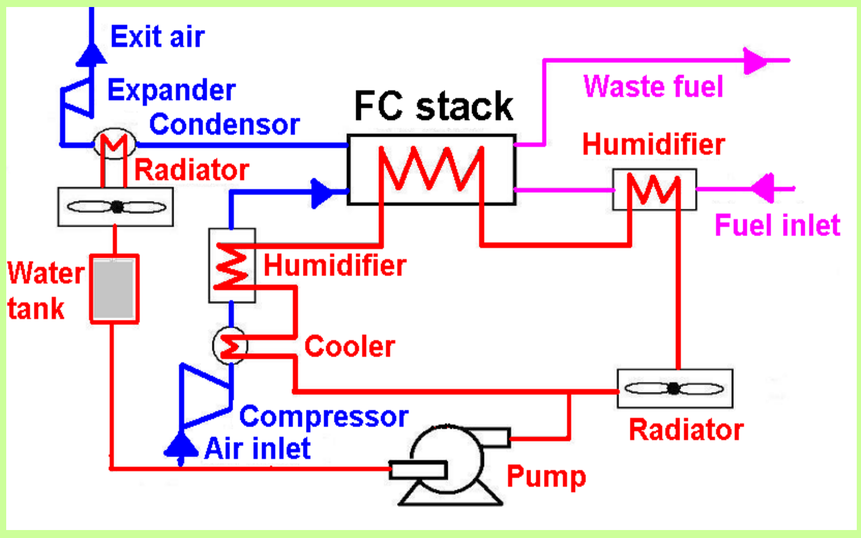
High temperature proton exchange membrane fuel cell (PEMFC) is the focus of recent development. Compared with the technology based on perfluorosulfonic acid (PFSA, e.g. Nafion®) membranes, the new PEMFC using acid doped polybenzimidazole (PBI) membranes can operate at temperatures up to 200°C. At higher temperatures, the kinetics for electrode reactions is enhanced. Over its boiling point, the water management is easier. In fact the acid doped PBI membranes can operate at very low atmospheric humidity. Tolerance to fuel impurities e.g. CO is dramatically enhanced, which in turn will decisively simplify the fuel processing system. The thermal management, i.e. cooling will be simple due to the increased temperature gradient. The heat from the fuel cell stack can be recovered in several way so that the overall system efficiency will be increased. The following is an illustration of these technical features.

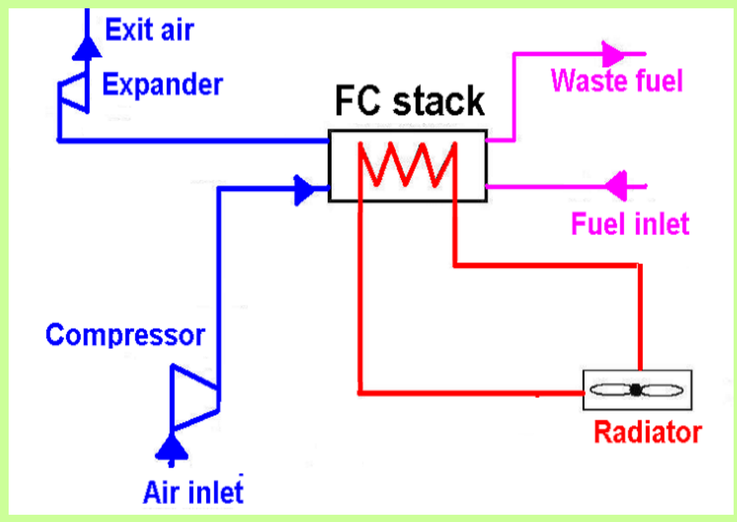
1 kW high temperature PEMFC stack, consisting of 40 cell stack with electrode area of 256 cm². Constructed in the AMFC project (EUFP5)

Water management - system construction and operation

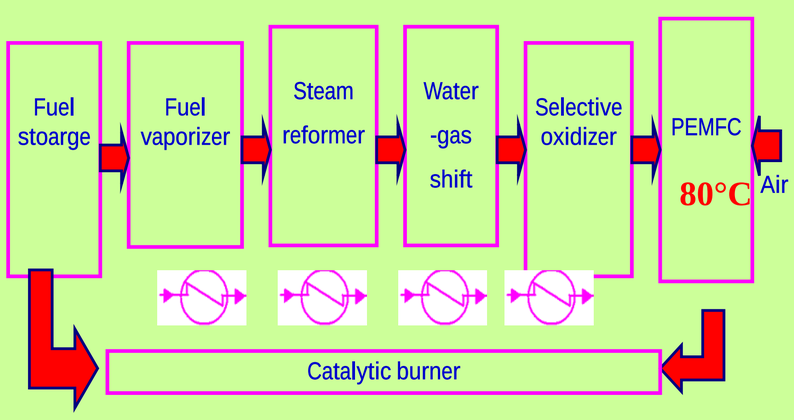


Water is a necessity for FC operation, i.e. both fuel and oxidant need to be carefully humidified by the water condensed from the exhaust. A cooling loop is normally integrated.

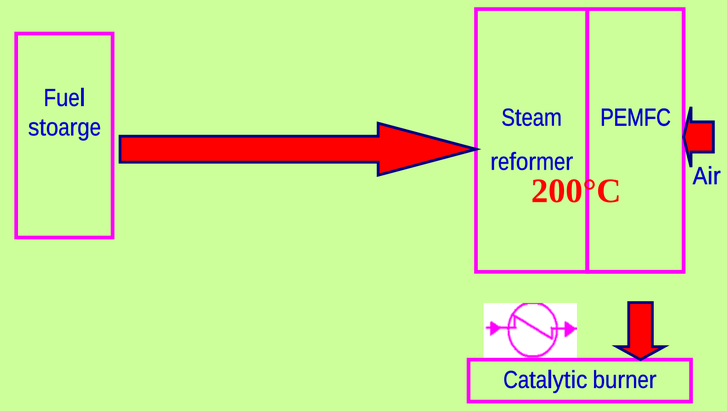
HT-PEMFC does not need the water management.



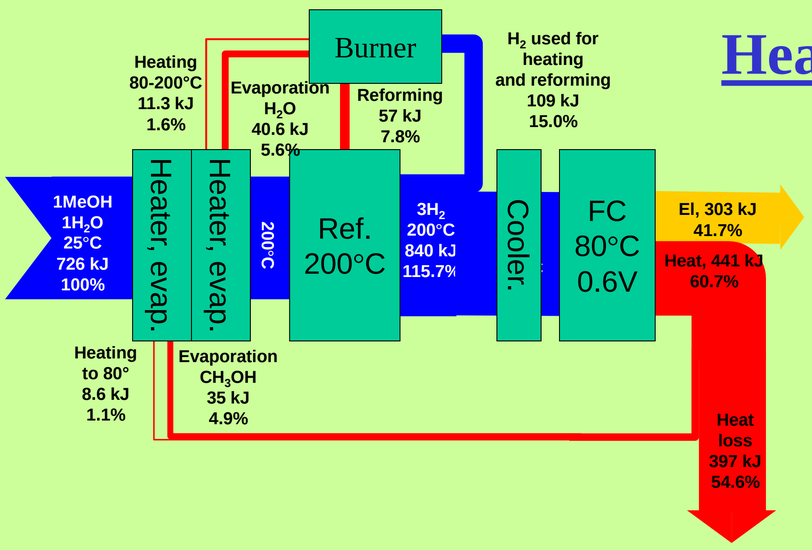
CO tolerance and the fuel processing system



The FC tolerance to CO at 80°C is 10-100 ppm while at 200°C is 30,000 ppm. High CO tolerance make it possible to use reformate hydrogen directly from a reformer or even possible to integrate the reformer and FC stack.



Heat utilization in systems with the fuel cell at 80 and 200°C



For FC at 80°C with a methanol reformer or with a hydrogen storage tank at 200°C, the heat for reforming or desorption is from burning of fresh fuel.