Utilization of Waste Heat from GT-MHR in Hydrogen Production

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Abstract

The Gas Turbine Modular Helium Reactor (GT-MHR) uses two compression stages to compress the helium and two heat exchangers used to reduce the compressor inlet temperature, this dissipates around 308.3616 MWth in the precooler and intercooler at the optimum values of compressor pressure ratio PR_c 2.9 and turbine inlet temperature T1 900 ºC. An energy analysis is conducted for the hydrogen production by combined Gas Turbine Modular Helium Reactor/Organic Rankine Cycle (GT-MHR/ORC) with Proton Exchange Membrane (PEM) electrolyzer. The optimum values of the new cycle are obtained by using the Engineering Equation Solver (EES) software and MATLAB codes. The efficiencies at turbine inlet temperature of 900 ºC under optimum conditions for simple GT-MHR, combined GT-MHR/ORC adding the work produced from ORC to the work produced by GT-MHR and GT-MHR/PEM inserting the hydrogen produced in the efficiency calculation is as following respectively 0.4860, 0.5068 and 0.4980 and the mass flow rate of hydrogen produced at the same operating conditions is 0.0644 Kg/s. A parametric study carried out by changing the following variables, The turbine inlet temperature, Compression pressure ratio and the compressor inlet temperature. Increasing low pressure compressor (LPC) inlet temperature would increase the amount of hydrogen produced. Mass flow rate of hydrogen produced decreases with increasing PR_c till it reaches a minimum then increases slightly, at low PR_c the rate of hydrogen produced increases with increasing the turbine inlet temperature, however it decreases by increasing the turbine inlet temperature at high PR_c.