World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:18, No:12, 2024

Assessment of a Coupled Geothermal-Solar Thermal Based Hydrogen Production System

Authors : Maryam Hamlehdar, Guillermo A. Narsilio

Abstract : To enhance the feasibility of utilising geothermal hot sedimentary aquifers (HSAs) for clean hydrogen production, one approach is the implementation of solar-integrated geothermal energy systems. This detailed modelling study conducts a thermo-economic assessment of an advanced Organic Rankine Cycle (ORC)-based hydrogen production system that uses low-temperature geothermal reservoirs, with a specific focus on hot sedimentary aquifers (HSAs) over a 30-year period. In the proposed hybrid system, solar-thermal energy is used to raise the water temperature extracted from the geothermal production well. This temperature increase leads to a higher steam output, powering the turbine and subsequently enhancing the electricity output for running the electrolyser. Thermodynamic modeling of a parabolic trough solar (PTS) collector is developed and integrated with modeling for a geothermal-based configuration. This configuration includes a closed regenerator cycle (CRC), proton exchange membrane (PEM) electrolyser, and thermoelectric generator (TEG). Following this, the study investigates the impact of solar energy use on the temperature enhancement of the geothermal reservoir. It assesses the resulting consequences on the lifecycle performance of the hydrogen production system in comparison with a standalone geothermal system. The results indicate that, with the appropriate solar collector area, a combined solar-geothermal hydrogen production system outperforms a standalone geothermal system in both cost and rate of production. These findings underscore a solar-assisted geothermal hybrid system holds the potential to generate lower-cost hydrogen with enhanced efficiency, thereby boosting the appeal of numerous low to medium-temperature geothermal sources for hydrogen production.

Keywords : clean hydrogen production, integrated solar-geothermal, low-temperature geothermal energy, numerical modelling
Conference Title : ICHCT 2024 : International Conference on Hydrogen Carriers Technology
Conference Location : Sydney, Australia
Conference Dates : December 02-03, 2024