Abstract

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Performance Study of Photovoltaic-Water Electrolysis System for Hydrogen Production: A Case Study of Egypt

Solar-hydrogen is expected to play an important role as an energy carrier of the future and is considered an ultimate solution for many energy and environmental problems. Photovoltaic-water electrolysis is a suitable method for solar-hydrogen production in Egypt due to the availability of a lot of water sources such as Lake Nasser, Red Sea, and Mediterranean Sea. Moreover, Egypt is endowed with high solar radiation intensity of 2000-3200 kWh/m2/year from north to south. This Paper presents a small photovoltaic-water electrolysis system for the process of water electrolysis and hydrogen production the system is designed and installed in the solar energy laboratory of desert research Center. The performance of the generation system is investigated under the climatic conditions of Cairo city, Egypt for a sample day. Hourly variation of solar radiation intensity, photovoltaic module output current, and hydrogen production rate are measured accurately and recorded for analysis. It is found that the minimum and maximum hydrogen production rate values are 1.3 ml/min and 3.4 ml/min, respectively. The maximum hydrogen production rate (which is 3.4 ml/min) is obtained at the maximum photovoltaic module output current (which is 0.35 A) that obtained at the maximum solar radiation intensity (which is 980 W/m2) at the solar noon. The effect of solar radiation intensity on the photovoltaic module efficiency and overall system efficiency are also investigated. It was found that the smaller photovoltaic module efficiency decreases the overall system efficiency.