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Study of hydrogen production system by using PV solar energy and PEM electrolyser in Algeria

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ABSTRACT

Hydrogen fuel can be produced by using solar electric energy from photovoltaic (PV) modules for the electrolysis of water without emitting carbon dioxide or requiring fossil fuels.

In this paper, an assessment of the technical potential for producing hydrogen from the PV/proton exchange membrane (PEM) electrolyser system is investigated. The present study estimates the amount of hydrogen produced by this system in six locations using hourly global solar irradiations on horizontal plane and ambient temperature. The system studied in this work is composed of 60 W PV module connected with a commercial 50 W PEM electrolyser via DC/DC converter equipped with a maximum power point tracking. The primary objective is to develop a mathematical model of hydrogen production system, including PV module and PEM electrolyser to analyze the system performance. The secondary aim is to compare the system performance in terms of hydrogen production at seven locations situated in different regions of Algeria. The amount of hydrogen produced is estimated at seven locations situated in different regions. In terms of hydrogen production, the results show that the southern region of Algeria (Adrar, Ghardaia, Bechar and Tamanrasset) is found to have the relatively highest hydrogen production. The total annual production of hydrogen is estimated to be around 20–29 m^3 at these sites. The hydrogen production at various sites has been found to vary according to the solar radiation.

1. Introduction

Hydrogen can be generated by a wide range of technologies such as: reforming of natural gas, liquefied petroleum gas, gasoline …etc.; gasification of coal and biomass; electrolysis of water using nuclear, fossil or renewable energy sources; photoelectrochemical/photocatalytic splitting of water; thermolysis and thermo-chemical cycles [1–5].

But to respect the environment, the solution of renewable energy sources, particularly solar energy, appears most appropriate for a climate of clean future industry.

The coupling of a PV generator and an electrolyser, [6–13], besides the catalytic splitting water [14–22] is the most promising options for obtaining hydrogen from a clean renewable energy source. But at present, the second technology is not well developed as the PV–Electrolyser system, because the challenges of the research to find materials which possess low overpotentials are not solved yet.

A PV–hydrogen system usually consists of supplying electric power to a water electrolyser by a PV generator. The PV's technology is well known. For electrolyser, currently

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