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Effect of Operation Parameters on Efficiency of Photovoltaic Thermal Sensor Using Water

Maifi Lyes[a]* Kerbache Tahar[a] Hioual Ouided[a] and Chari Abdelhamid[a]

[a]*Physical Chemistry of Semi-Conductor Laboratory, Physics Department, Exact sciences Faculty, Constantine University, Constantine Algeria.*

Abstract

In this paper we study the thermal behavior of photovoltaic-thermal solar under a concentration with a heat exchanger and water is used as coolant. We present the influence of the external parameters on the electrical and thermal performance of the collector, the parameters affecting PV / T performance such as mass flow, temperature of the collector element, the absorbing impedance and the ratio of parabolic parabolic concentrator CPC are discussed. The intensity of the solar radiation was carried out for the slope of the collector at 30 ° C., which is a typical daily temperature in Constantine (eastern Algeria) to the surface cell. The obtained results are: The temperature increases throughout the system with the concentration compared to the situation without concentration. In addition, the concentration increases thermal efficiency and reduces energy efficiency when the fluid mass increases its temperature and the absorber decreases, the cell increases.

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Keywords: photovoltaic- thermal- -mass flow- temperature - surface cell- efficiency;

1. Introduction

The weather conditions of Algeria, with a good level of insulation, should encourage more development of renewable energies, especially those coming from the direct usage of sun, like photovoltaic and solar thermal collectors with CPC concentrator as application of photovoltaic-thermal (PV/T) systems. The main idea is to increase the electrical production of PV by decreasing the normal operating cell temperature by cooling the panel with water (or air), but also to have higher global efficiency with an enhanced use of solar energy. The photovoltaic-thermal technology has been studied since the 1970 when the energy crises increase the development of alternative ways of producing energy to that of fossil fuels. The different types of photovoltaic cogeneration (ventilated, day lighting, PV/T) are well described [1]. To reduce the costs of any photovoltaic system was developed in 1978 a PV / T system

* Corresponding author. Tel.: +0-000-000-0000 ; fax: +0-000-000-0000 .
*E-mail address:*maifi@umc.edu.dz

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with air or water as a coolant in order to increase the photovoltaic efficiency by reducing the temperature cell [2-5]. The use of heat as the heat transfer fluid enables the indirect reduction of the system costs. This has stimulated a lot of research in simulation of such hybrid systems. However, the wide application of solar energy hybrid PV/T system is still limited because of its expensive investment. In recent years, in order to reduce the cost of combined PV/T system, considerable research were reported in the literature on new solar concentrating photovoltaic/thermal systems (Garg etal.[6], O'Leary et al. [7], Whitfield et al.[8], Othman etal.[9], Chen et al.[10]). In this work, we develop a program that simulates the operation of a hybrid system parabolic concentration by introducing the effect of the mass of the fluid temperatures on its various components.

Nomenclature

A	Area	m^2
E	Electrical energy	W
D	hydraulic diameter	m
G	Solar radiation	$W.m^{-2}$
h	heat transfer coefficient	$W.m^{-2}.K^{-1}$
H	Height	m
L	length	m
V	velocity	$m.s^{-1}$
m	Mass flow rate	$kg{\cdot}s^{-1}m^{-2}$
Q	energy	W
Ra	Rayleigh number	/
Re	Reynolds number	/
T	Temperature	°K
w	thickness	m
x	Direction variable	m

Greek letters

α	Absorptivity	
β	Acceptance angle	°
η	efficiency	
τ	Transmitivity	
ρ	reflectivity	
ρ_R	reflector	
λ	Thermal conductivity	
δ	Thickness	m
ε	Emissivity	
φ	density	$Kg.m^{-3}$
σ	Boltzmann number	$W.m^{-2}.K^{-4}$

Subscripts

a	Ambient
b	Back pate
c	Convective
cb	Top surface of absorber plate
ct	Bottom surface of absorber plate
g	glass
f	fluid
i	inlet
o	outlet
p	Absorber plate