A SIMULATION STUDY ON PHOTOVOLTAIC THERMAL NANOFLUID SILICON CARBIDE USING COMPUTATIONAL FLUID DYNAMICS

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to fulfillment of the requirement for the master degree of

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DECLARATION

I declare that this project report entitled “A Simulation Study on Photovoltaic Thermal Nanofluid Silicon Carbide Using CFD” is the result of my own work except as cited in the reference.

Signature :………………………………..

Author : **MOHD AHASSOLEHIN BIN MOHD AHADLIN**

Date : ……………………………….

APPROVAL

I hereby declare that I have read this project report and in my opinion this report is sufficient in terms of scope and quality for the award of the master degree of Master of Mechanical Engineering (Energy Engineering).

Signature :………………………………..

Name of supervisor : **DR. MOHD AFZANIZAM BIN MOHD ROSLI**

Date : ……………………………….

DEDICATION

To my beloved mama and abah.

Also to my lovely wife and son.

ABSTRACT

Hybrid collector of photovoltaic thermal solar collector (PVT) produced electricity and thermal energy simultaneously. The electricity generated can be connected to grid or be used to operate the fan or pump. This research is aimed at investigating the type of nanofluid for PVT. There are having the three concentration nanofluid SiC at 0.5 wt%, 1.0 wt% and 1.5 wt%. The computational fluid dynamics (CFD) simulation was carried out by the program ANSYS Fluent. For this research, water was selected as the heat transfer fluid for the verification and validation, although at difference concentration for the analysis based on nanofluid SiC. The geometry model was drawn Design Moduler (DM) and meshing to generated mesh model. The viscous model, radiation model, and material properties have been built in system simulation, and the heat transfer flow is laminar flow. The coupled wall model was thus used in radiation model, the photovoltaic panel used in this photovoltaic cell based on silicon study. Validation was done by comparison to prior research. On the other hand, in comparison between previous research and current, the root mean square error was 9.37 per cent. The influences of velocity and solar irradiance intensity on performance PVT nanofluid were determined by using CFD simulation. The highest numbers of total efficiency are at concentration nanofluid 0.5 wt% and velocity 0.010 m/s at value 49.42%.

KAJIAN SIMULASI TERHADAP FOTOVOLTAIC TERMAL CECAIR NANO SILIKON KARBIDE MENGGUNAKAN PENGKOMPUTERAN DINAMIK BENDALIR

ABSTRAK

Pemungut hibrid pengumpul suria termal fotovoltaik (PVT) menghasilkan tenaga haba dan tenaga elektrik secara serentak. Tenaga elektrik yang dihasilkan dapat dihubungkan ke grid atau digunakan untuk mengoperasikan kipas atau pam. Tujuan penyelidikan ini adalah untuk mengkaji jenis cecair nano untuk termal fotovoltaik. Terdapat tiga kepekatan cecair nano silicon karbide pada 0.5 wt%, 1.0 wt% dan 1.5 wt%. Perisian ANSYS Fluent melaksanakan simulasi pengkomputeran dinamik bendalir (CFD). Bagi kajian ni, pengesahan dibentuk bagi air sebagai cecair penghantaran haba sementara untuk analisis berdasarkan cecair nano silikon karbida pada kepekatan perbezaan. Model geometri dilukis Lukisan Modular (DM) dan menghubungkan ke model jaring yang dihasilkan. Dalam simulasi persediaan, model likat, objek radiasi dan kategori bahan telah dibina dan aliran penghantaran haba ialah laluan lamina. Objek radiasi ini, model dinding gandingan digunakan sehingga panel fotovoltaik digunakan dalam sel fotovoltaik berasaskan silikon penyelidikan ini. Pengesahan dilakukan dengan merujuk kepada karya sebelumnya. Sebaliknya, ralat punca kuadrat punca adalah 9.37% dibandingkan antara kajian sebelumnya dengan semasa. Pengaruh halaju dan intensiti pancaran matahari pada prestasi cecair nano termal fotovoltaik ditentukan dengan *menggunakan simulasi dinamik cecair komputasi CFD. Jumlah kecekapan tertinggi adalah pada kepekatan cecair nano 0.5% wt dan halaju 0.010 m/s pada nilai 49.42%.*

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CFD	Computational Fluid Dynamics
SiC	Silicon Carbide
UTeM	Universiti Teknikal Malaysia Melaka
PVT	Photovoltaic Thermal
FPC	Flat Plate Collector

LIST OF SYMBOLS

T	=	Temperature
Δ	=	Increment
%	=	Percent
$\dot{m}$	=	Mass flow rate
L	=	Length
v	=	Velocity
ρ	=	Density

CHAPTER I

INTRODUCTION

1.1 Background

Solar energy is the most dominant source of energy accessible to the planet and its occupant. It is the source of energy which triggers the reaction to photosynthesis. Solar power is theoretically capable of producing any place on earth but less area are stronger than another. Locations where the sun shines regurlarly and consistently is preferred to regions with normal cloud layer. The better the sunlight, the bigger the production and the more favorable the economics of the generation factory. Most developing countries around the world, Where electricity demand is increasing rapidly, give good conditions for solar power generation.

There are two ways to turn the energy generated at daylight into electricity. The first, called solar thermal generation, required the simple use of the sun as source of heat. The second way to capture and convert solar energy to electricity involves the use of solar cell photovoltaic. The sun is a origin of big standard heat and can simply be used for power origination. This was recognized as early as 1907, when the first obvious for a solar collector in Germany was granted to Dr. W. Maier. The forming of current solar thermal ability technology begin in the 1970s and in the end demonstrated in the late 1980s by a sequences of mercenary solar thermal power plants in California.

Photovoltaic thermal collector (PVT) may be divided into two common types; water-based PVT and air-based PVT, based on the fluid used in the device. Recently, numerous studies have been carried out in developing water-or air-based PVT collectors. PVT collectors had been discussed in this segment, with a focus on PVT collector based on nanofluid.

1.2 Problem Statement

Basically, all the energy sources worldwide, as we know, come from solar. Carbon, coal, natural gas, and forests were to begin with developed via the photosynthesis cycle, follow by a composite chemical reaction in which rotting vegetation was expose to extremely big temperatures and long-term pressures. Even wind and tide energy has solar sources, since it is caused by variance in temperature in different parts of the world.

The problem statement is photovoltaic cells typically reach an electrical efficiency between 15 % and 20 %, while the largest share of the solar spectrum (65 % - 70 %) is converted into heat, increasing the temperature of PV modules. PVT collectors, on the contrary, are engineered to transfer heat from the PV cells to a fluid, thereby cooling the cells and thus improving their efficiency. In this way, this excess heat is made useful and can be utilized to heat water or as a low temperature source for heat pumps, for example. Thus, PVT collectors make better use of the solar spectrum.

In a standard fluid-based system, a working fluid, typically water, glycol or mineral oil circulates in the heat exchanger behind the PV cells. In the arts, silicon carbide is a popular abrasive in modern lapidary due to the durability and low cost of the material. The earliest electrical application of SiC was in lightning arresters in electric power systems. These devices must exhibit high resistance until the voltage across them reaches a certain threshold V_T at which point their resistance must drop to a lower level and maintain this level until the applied voltage drops below V_T. Silicon carbide is used as a support and shelving material in high temperature kilns such as for firing ceramics, glass fusing, or glass casting. SiC kiln shelves are considerably lighter and more durable than traditional alumina shelves.

Energy is appraised a leading factor in the production of wealth and a particular element in commercial growth. The role of energy in commercial growth is widely identified, and prior evidence indicates a clear relationship between energy supply and economic activity. Renewable energy technologies make in demand energy by transform pure occurrence into usable energy sources that harness the sun's energy and its straight and unintended impact on the planet.