A 3kW WATER-COOLED PROTON ELECTROLYTE MEMBRANE FUEL CELL (PEMFC) THERMAL PERFORMANCE ANALYSIS

SHAHIR BIN SABTU

(2006690002)

A thesis submitted in partial fulfillment of the requirement for the award of Bachelor Engineering (Hons)(Mechanical)

Faculty of Mechanical Engineering Universiti Teknologi MARA (UiTM)

MAY 2010

"I declare that this thesis is the result of my own work except the ideas and summaries which I has clarified their sources. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any degree."

Signed : .....

Date : 20/5/2010

SHAHIR BIN SABTU

UiTM No: 2006690002

ACKNOWLEDGEMENT

First of all, I would like to thank to Allah for all the blessing Allah has gave to me in order to finish this final year project report. Next, I would like to express my appreciations to Mr. Mohd Fairuz Bin Remeli and also Mr. Wan Ahmad Najmi for their full commitments on supervised me to finish this report. I also want to say thank you very much to them for all their kindness for the guidance and information they had given to me based on the title of this project especially information related with thermodynamics and heat transfer. Besides, they are very helpful and always encourage me to produce a high quality and excellent final year project report. Before I forgot, I also want to give my appreciation to the technicians who involved during my time finishing my final year project. They had given me the guidelines especially about the practical work when I run the experiment on the fuel cell at the fuel cell lab. Finally, with no doubt, many thanks to everyone including my family and friends who always give full supports to me in completing this final year project. Only Allah can pay back all of their kindness. Thank you very much.

ABSTRACT

Fuel cells are static energy conversion devices that can generate electricity by using the combustion of hydrogen. Experimental works on one of the type of fuel cell which is a 3 kW water-cooled Proton Exchange Membrane Fuel Cell (PEMFC) was conducted at the Fuel Cell Lab of the Faculty of Mechanical Engineering of University of Technology Mara (UiTM). The main objective of the project is based on the thermal performance analysis of the PEMFC. Variable input parameters to the reactants are needed to allow the comparative performance study to be conducted. Therefore, in order to determine all the important parameters, a series of experiment have to be carried out. There are several measuring instruments used during the experiment which are two MIDI loggers, a thermal camera, a clamp meter, a multimeter, a stopwatch and several meters of thermocouple probes (K-type). The main purpose of this experiment is to obtain the temperature distributions of PEMFC. The data will be used for the calculation of heat content of the stack, rate of heat transfer of cooling water, the rate of heat transfer of air, heat generation of the stack and the efficiency of the fuel cell. In general, the results showed that the efficiency of the fuel cell, η_{cell} ranges approximately between 40% to 75%. Other than that, active cooling by air was approximately between the ranges of 83% to 99% which was quite high. Based on the results obtained, the fuel cell can be improved by doing continuously improvement on the cooling system which can contribute more to the higher fuel cell efficiency.

TABLE OF CONTENT