UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN OF COOLING SYSTEM FOR TEG IN GENERATING ELECTRICAL ENERGY FROM WASTE HEAT AT NIGHT MARKET

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor of Mechanical Engineering Technology (Refrigeration and Air-Conditioning System) with Honours.

by

PUNETHEN A/L COOMERASAMY

B071610956

940528-10-6015

FACULTY OF MECHANICAL AND MANUFACTURING ENGINEERING TECHNOLOGY

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I hereby, declared this report entitled Design of Cooling System for TEG in Generating Electrical Energy from Waste Heat at Night Market is the results of my own research except as cited in references.

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APPROVAL

This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of Universiti Teknikal Malaysia Melaka (UTeM) as a partial fulfilment of the requirements for the degree of Bachelor of Mechanical Engineering Technology (Refrigeration and Air-Conditioning System) with Honours. The member of the supervisory is as follow:

Signature: …….

Supervisor : MR. MOHD ARIZAM BIN ABDUL WAHAP

ABSTRAK

Laporan ini merangkumi parameter yang digunakan untuk merangka penjana termoelektrik dengan sistem penyejukan untuk meningkatkan perbezaan suhu modul TEG. Di samping itu, pelaksanaan beberapa parameter kepada sistem penyejukan untuk menjana output kuasa yang lebih tinggi sebagai memanfaatkan haba buangan daripada aktiviti memasak di pasar malam. Penggunaan dapur memasak di pasar malam meluas di Malaysia pada umumnya. Adalah penting untuk meningkatkan kecekapan aktiviti memasak ini. Kebanyakannya, penggunaan penjana kuasa dan sel basah untuk sumber kuasa untuk menyediakan bekalan elektrik di pasar malam. Menambah penjana termoelektrik meningkatkan kecekapan dapur dan dapat memberikan tenaga elektrik yang memuaskan untuk aplikasi di pasar malam. Menurut kajian terdahulu, terdapat kekurangan output kuasa daripada pembangunan sistem TEG dengan aktiviti memasak di pasar malam. Tumpuan projek ini untuk meningkatkan kecekapan penjana termoelektrik untuk menghasilkan output kuasa yang lebih tinggi yang mencukupi untuk digunakan di pasar malam. Selain itu, sebuah dapur memasak yang telah dipertingkatkan telah dibangunkan dan prototaip telah dibina mengikut parameter yang dicadangkan. Objektif projek ini ialah untuk merekabentuk sistem penyejuk untuk penjana termoelektrik dari haba sisa, menentukan kesan parameter yang mempengaruhi prestasi penjana termoelektrik dan membina prototaip baru bagi penjana termoelektrik dengan sistem penyejukan untuk digunakan di pasar malam. Sistem TEG dibina terutama pada sistem penyejukan mengikut perkembangan konfigurasi dalam sistem penyejukan untuk meningkatkan perbezaan suhu. Ujian telah dilakukan pada TEG dengan pelbagai konfigurasi parameter sistem penyejukan untuk menganalisis prestasi TEG. Berdasarkan ujian, output kuasa yang diperoleh adalah mencukupi dari konfigurasi terbaik dengan sistem pendinginan yang menambah aliran pecahan dengan penyejuk nisbah 50%. Daripada ujian, sistem penyejukan yang dicadangkan dalam TEG mencapai had hampir menghasilkan kuasa lebih kurang sekitar 3W sementara kuasa itu telah meningkatkan hampir 4.8W dengan lampiran komponen modul langkah dalam litar yang boleh digunakan di pasar malam untuk digunakan sebagai sumber elektrik untuk peralatan Akhir sekali, pengeluaran penjana thermoelektrik adalah mungkin untuk menyediakan kuasa yang mencukupi untuk permohonan itu.

ABSTRACT

This report covers the parameters applied to design a thermoelectric generator with cooling system to increase the temperature differences of the TEG module . Additionally, the implementation of some parameter to cooling system for generating higher power output as utilize the waste heat from cooking activites at night market. The use of cooking stove at night market is widespread in the Malaysia generally. It is important to improve the efficiency of these cooking activities. Mostly, usage of power generator and wet cell for power sources to provide electricity at night market. Adding thermoelectric generators increases the efficiency of the stove and can provide electricity that satisfies for application at night market. According to the previous study, there are lack of power output from the development of the TEG system with cooking activities at night market. The focus of this project to increase the efficiency of thermoelectric generator to produce higher power output which is sufficient to utilized at night market. Moreover, an enhanced cooking stove has been developed and prototype has been built according to proposed parameter. The objective of this project is to design a a cooling system for thermoelectric generator from waste heat, determine the effect of parameter influenced the performance of the thermoelectric generator and construct a new prototype for thermoelectric generator with cooling system to utilize at night market. The TEG system is construct particularly on cooling system according to the development of configuration in cooling system to increase temperature difference. The test has been done on the TEG with various parameter configuration of cooling system to analyse the performance of TEG. Based on the test, the power output obtained is sufficient from the best configuration with cooling system which is addition of split flow with 50% ratio coolant. From the test, the proposed cooling system in TEG reached almost higher limit of producing power approximately around 3W meanwhile the power has been boost up nearly 4.8W with attachment of step up module component in the circuit which can be utilize at night market to use as electrical source for appliances Lastly, the production of the thermoelectric generator is possible to provide sufficient power for the application.

DEDICATION

To my beloved parents

Mr. Coomerasamy A/L Kandasamy and Mrs. Thangamah A/P Amayappan

My talented supervisor

Mr. Mohd Arizam Bin Abdul Wahap

And

My beloved siblings and friends

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SYMBOLS	DESCRIPTIONS
°C	Temperature degree celcius
ΔT	Temperature differences
V	Voltage
I	Current
Thot	Temperature hot side of TEG
Tcold	Temperature cold side of TEG
Tcin	Temperature of water inlet cooling block
Tcout	Temperature of water outlet cooling block

CHAPTER 1

INTRODUCTION

1.1 Overview

Basically, this chapter offers the idea of this report project. This section will focus on the initiation of the thesis or project research of designing cooling system in waste heat recovery at night market. This chapter consists of background for the project, problem statement, objective, scope of project, project significance, thesis outlines and expected result. The first subject to be discussed concerns the scenario of harvesting waste heat energy, particularly combining cooling system to make production of electrical energy. Second of the subtopic is problem statement of the project, mainly usage source of the electrical energy at night market meanwhile massive quantity of waste heat discharge from cooking activities at night market. The following subtopic is objective will be described behind and scope of project will be explained about aim of the project. Next the project significance is study of provide beneficial to the current situation.

1.2 Background

Energy harvesting is the source energy that is extracted from environmental sources and is transformed effectively into electricity. This way of delivering energy is used when no other source of energy (off – grid utilisation) is available for providing small and medium sized electronic devices and electrical systems with nW to hundreds of mW (Steingart, 2009) (Vullers *et al.*, 2009). The collection of energy is generally a environment with regular and well – evaluated environmental sources of energy.

Furthermore, energy is collected when the energy readily accessible is matched to the energy required (Steingart *et al.*, 2008). A different term, energy scavenging, is a highly uniform and unknown environment in which energy is obtained. Table 1.1 provides some examples of differences between the two terms. Temperature gradient, electromagnetic radiation, light, motion and chemical energy are the ambient energy sources used for energy harvesting (Figure 1.1)

Table 1.1: Difference between the concept of scavenging and harvesting (Steingart *et al.*, 2008)

Type	Scavenging	Harvesting
Thermal	Forest fires	Furnace covers
Photonic	Interior lighting	Diurnal solar cycle
Mechanical	Foot traffic	Motors, ductwork