UNIVERSITI TEKNIKAL MALAYSIA MELAKA

HARVESTING OF WASTE ENERGY FROM 1.0 HP AIR CONDITIONER IN PRODUCTION OF FREE HOT WATER

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Mechanical Engineering Technology (Maintenance Technology) with Honour.

by

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FACULTY OF ENGINEERING TECHNOLOGY

2017

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **HARVESTING OF WASTE ENERGY FROM 1.0 HP AIR CONDITIONER IN PRODUCTION OF FREE HOT WATER**

SESI PENGAJIAN: **2017/18 Semester 1**

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APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelors of Mechanical Engineering Technology (Maintenance Technology).The member of the supervisory is as follow:

……

(**AZMAN BIN IBRAHIM**)

ABSTRAK

Sistem penghawa dingin jenis pemisah menghasilkan haba buangan yang panas dibahagian unit luar semasa proses penyejukan dan banyak penyelidikan telah dilakukan bagi menggunakan haba buangan dari penghawa dingin. Di sektor lain pula peningkatan permintaan terhadap bekalan air panas begitu tinggi terutamanya di kawasan perumahan dan bangunan komersial. Penggunaan alat pemanas air adalah suatu keperluan kepada setiap isi rumah pada zaman sekarang. Oleh yang demikian penggunaan haba buangan sebagai alat ganti bagi menghasilkan air panas menjadi sangat popular. Ini kerana jika haba buangan tersebut tidak digunakan dengan baik boleh menyebabkan pemanasan global dan penipisan lapisan ozon. Projek ini bertujuan untuk merekabentuk dan membuat prototaip bagi penghasilan air panas dari haba buangan penyaman udara jenis pemisah. Penghasilan air panas tersebut daripada haba pemampat yang akan digunakan sebagai sumber utama projek ini. Projek ini akan dibangunkan dengan menggunakan penyaman udara jenama Panasonic 1.0 HP, gas R22, pam air dan singki. Proses fabrikasi melibatkan modifikasi pada bahagian pemampat yang akan disalurkan kedalam tangki penyimpanan air panas. Hasilnya, projek ini dapat menuai haba buangan bagi menghasilkan air panas daripada unit penyaman udara dengan jayanya.

ABSTRACT

An air-conditioning system produces waste heat during the cooling process and many researches had been done to utilize the waste heat from the air conditioner. In other sector, demand on hot water supply is quite higher in particular sector which in this case was residential and commercial sector. Thus, the utilization of waste heat for heating hot water is become essential and popular. The project aims to design and fabricate a prototype energy harvested from an air conditioner. The heat from compressor will be used as the main source for heating process. The project will be developed by using Panasonic 1.0 HP, R22 refrigerant, fibre, water pump and sink. The fabrication processes involve the tapping on compressor and connect to sink. As the result, the project should be able to harvest heat water from the air conditioner waste heat successfully.

DEDICATION

To my beloved parents

To my kind lecturers

And no forgetting to all my fellow friends

For their

Love, Sacrifice, Encouragement, and Best Wishes

ACKNOWLEDGEMENT

Sometime recently, while and after I doing my business to finish this venture, I have gotten such a variety of assistance from my chiefs, instructors, specialists, relatives furthermore my kindred companions.

As a matter of first importance, I need to give my gratitude to my director, Mr Azman Ibrahim and co-director, Mr Amir Abdullah who gave me a great deal of consolation, a genuine direction and extremely strong.

Furthermore, I additionally appreciative to my folks for supporting me on rationally and monetarily in part of this venture. It's the most things that I require.

Not forget also to my fellow friends, very kind housemates of "RumahUkhwahFillah" that help me constantly with support, advices and technical skills on Engineering.

Last but not least, thanks to all people those help me directly or indirectly. Without all of them that I appreciate, this project would not be successful.

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kW h	Kilo Watt per Hour
HP	Horse Power
ACWH	Air Conditioning Water Heater
HPWH	Heat Pump Water Heater
CO_2	Carbon Dioxide
CPC	Compound Parabolic Concentrator
SEHRAC	Storage Enhanced Heat Recovery Room Air Conditioner
TEV	Thermostatic Expansion Valve
CT	Capillary Tube
COP	Coefficient of Performance
MDACWH	Multi-functional Domestic Air Conditioner with Integrated Water Heater
LPG	Liquid Petroleum Gas
HEX	Heath Exchanger
CAD	Computer Aided Design
EQ	Equation
2D	Two Dimension
3D	Three Dimension
MIG	Metal Inert Gas

G.I	Galvanized Iron
PVC	Polyvinyl Chloride

CHAPTER 1

INTRODUCTION

1.1 Project Briefing

In this modern era, hot water supply has become essential for many routines such as cleaning and bathing. The nearest example should be bathing in the morning and cleaning linen in hotel. The following examples should explain the demand of hot water supply is quite higher in particular sector which in this case was residential and commercial sector. Based on the routine, it can be easily assumed that the consumption of hot water in a day is higher. However, behind the high demanding of hot water supply, the generating of hot water itself is consuming high in costing due to high electrical consumption.

Every day demanding of using energy increase tremendously day by day, but lacks in energy supply. No option for proper and efficient utilization and conservation of energy. Energy is a one of the common thing what human need survive on their daily life. Commercial source of energy come from coal, oil and natural gas, nuclear power plant and hydroelectric can generate energy source and provide to country. For this project main is what can give on energy conservation on technique of utilization waste heat from air-conditioner system (Lokapure and Joshi, 2012).

In additional, waste heat can be used for daily application such as sauna, public baths, and others. Clothes drying cabinet by utilizing waste heat from air conditioner had been introduced (Himsar Ambarita, et al., 2016). A heat source from the condenser

in a conditioner is utilized to supply hot air in the cloth cabinet and control by computer.

The major key for home energy management is improving the efficiency, reducing energy and use of building integrated renewable energy resources. Increasing power consumption in household appliances become problem in recent year causes increasing load in residential. Air conditioning and electric water heater load for the purpose residential demand response applications (Maytham et al, 2016).

Nowadays, people focus on conservation and efficient utilization of energy compared to conventional energy sources. Waste heat is one of the most important energy. Most of the operations in a system generate waste heat. If the heat is dumped into the surroundings, it may still be used for other beneficial purpose. (Jiang et al.,2008). In this case, the harvested waste heat from outdoor unit of air conditioner is not being utilized well. Therefore, this project is all about determining the capability of harvested waste heat from outdoor unit of air conditioner in generating hot water.

1.2 Problem Statement

Malaysia suffering a hot humid climate all years long and in the same time the situation encouraged Malaysian to install own air conditioning system for providing thermal comfort. Besides that, the usage of air conditioner is to overcome the issue of getting a thermal comfort. The air conditioner systems basically releasing a waste heat energy to the surrounding at the outdoor unit.

Nowadays, air-conditioner and electric water heater are the important elements in people's daily life. The project is about the attachment of water heater principle into air conditioner system. Through that, both elements may get the high energy efficiency in terms of electricity consumption. Furthermore, the project is all about the utilization of waste energy which in this case was heat as the alternative energy sources besides

than main energy sources in generating hot water. The main intention of doing this project is because generating hot water using electric water heater is highly in costing.

The average electricity tariff in Peninsular Malaysia will be up 4.99 cents per kWh or 14.89% from the current average rate of 33.54 cents per kWh to 38.53 cents per kWh. The user of electric water heater and air-conditioner is increasing times to times in Malaysia. Both electric water heater and air-conditioner are most contributed to high usage of electricity in a house. In addition, air-conditioner also generated heat and it is released to the surrounding sand contributed to global warming. Moreover, since the water heater also contributes to increasing of the utility bill therefore waste heat produced from the air-conditioner may be used to heat the water.

1.3 Project Objective

The objectives of this project are as follows:

a) To design of a prototype energy harvested from 1.0 HP air conditioner
b) To fabricate a prototype energy harvested from 1.0 HP air conditioner

1.4 Work Scope

In this project the scope are covered the waste heat produced from condenser air conditioning system. From the waste heat in piping condenser can make a hot water to using in bathroom. This parameter involve in this project are air-conditioner split unit types used, the temperature of water outlet from a tank after the heat transfer into water, the time of air-conditioner can make hot water, and the efficiency of air-conditioner. All this prototype tank and concept drawing by using SolidWorks Software. The development of system involves Panasonic 1.0 HP, refrigerant R22, 1/4 and 3/8 inch copper's thickness. Figure 1.1 shows a diagram to harvest waste heat from air-conditioner for heating a water tank.

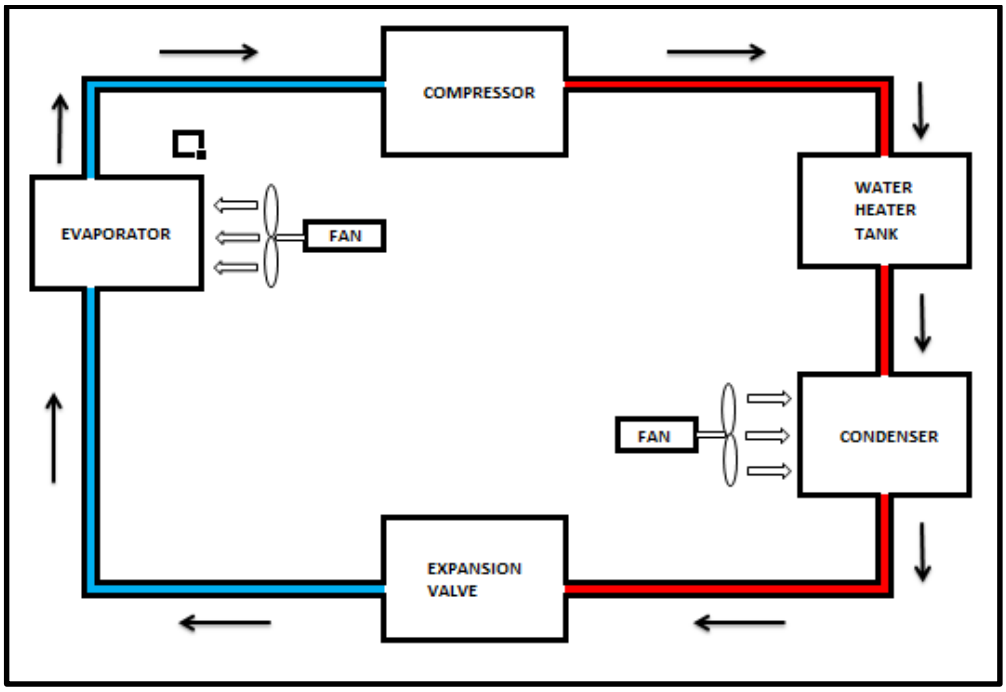

Figure 1.1: Modified refrigerant line

CHAPTER 2

LITERATURE REVIEW

2.0 Heat Generation

Heat generation in a heating process can be done by a heat pump and a boiler. The heat pump more complex device compare to the boiler. Most boiler use some type of fuel to keep them running while heat pump needs electricity as a supply.

2.1 Heat Pump

A heat pump is a device that extracts heat from one place to move it to another and widely used in a cooling and heating system such as air conditioner and refrigerator. Circulating a substance by transferring heat is known as refrigerant and it can be done by the heat pump. A cycle of the heat pump is reversible from heating, cooling and dehumidifying process. When it's hot outside, heat pumps extract outside and transfer it inside and vice versa.

The heat pump can be used to upgrade the low temperature waste heat to useful high temperature heat. The heat pump has four main components which are compressor, evaporator, condenser and expansion device.

Process to remove heat from a closed area and cooling the air can be done by air conditioning system. Heat pumps are used for air conditioning due to it can moves energy in and out in a system. In cooling operation, air conditioner extracts heat from the air in the closed area, yielding a cooler atmosphere and takes the heat from the house. However, the heat is wasted into the outdoor. The wasted heat can be used for many applications such as for water heater, drying cabinet and others. Many theoretical and experiment studies had been conducted to find the way and solution of the waste heat from air conditioner. Figure 2.1 shows a heat pump diagram with a compressor, evaporator and condenser.

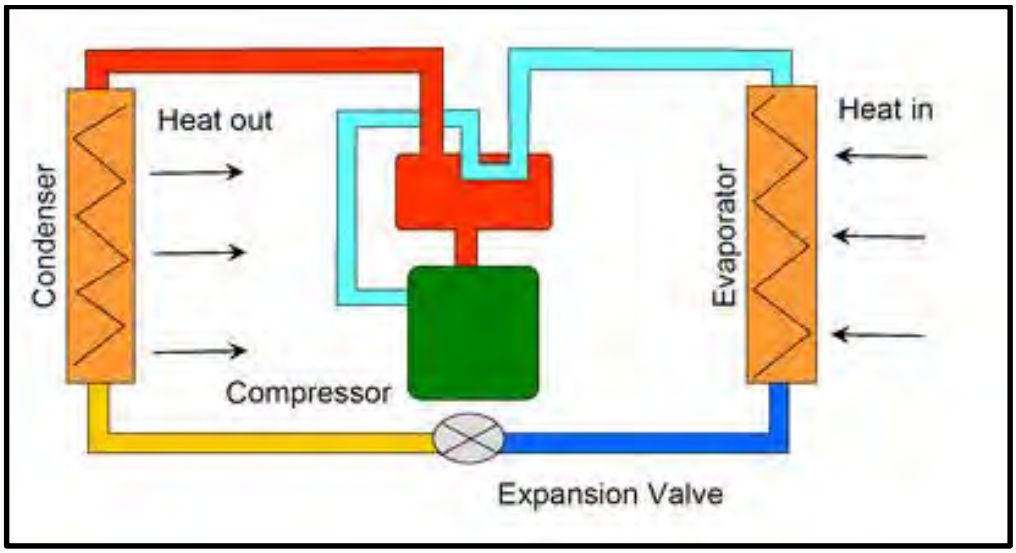

Figure 2.1: A heat pump

Hepbasli and Kalichi (2009) studies on the heat pump water heating systems. The air conditioning water heater (ACWH) system can operate in five modes: space-cooling and water-heating, water-heating only and space-heating.In air conditioning system, heat pump used for absorbing heat energy from the ambient air to acquire hot water. Heat transfer from a source in HPWH is done by heat pump and can be used for both space heating and cooling air conditioning. The heat pump acts as a pump to move the heat and reverses the heats flow from higher to lower temperature flow and to move the. In previous studies, many designs of heat pump water heater (HPWH) have been introduced with more practical and higher reliability. The study involved many aspects including its structure, thermodynamics, working fluids, operation controlling, numerical simulation and economical analysis. In additional, HPWH have been