UNIVERSITI TEKNIKAL MALAYSIA MELAKA

Performance of a Cloth Drying Cabinet Using Utilizing Waste Heat from a Split Type Air Conditioner Condenser.

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

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This report is submitted to the Faculty of Mechanical and Manufacturing Engineering Technology of UTeM as a partial fulfillment 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:

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(Ts.Dr. Mohamad Haidir Bin Maslan)

ABSTRAK

Tehasilnya produk ini yang menggunakan sisa haba dari kondenser jenis "split unit" sebagai inisiatif yang terbaru dalam usaha untuk mengeringkan pakaian selain menggunakan cara semula jadi dan juga mesin pengering pakaian yang banyak menggunakan tenaga elektrik. Matlamat produk ini adalah untuk mencipta sesuatu benda yang baru yang dapat menghasilkan produk seperti mesin pegering pakaian. Seterusnya, penggunaan mesin pengering pakaian menjana penggunaan elektrik yang maksimum. Penggunaan tenaga elektrik yang banyak dan berleluasa akan memberi kesan kepada alam sekitar dan juga akan menyebabkan penipisan lapisan ozon. Sebagai langkah awal untuk menjaga alam sekitar, kaedah ini dapat membantu menggurangkan penggunaan tenaga elektrik dan juga dapat memanfaat sisa haba daripada kondenser untuk mengeringkan pakaian. Hasil daripada projek ini, kita dapat melihat bagaimana pakaian dikeringkan dengan menggunakan udara panas dari kondenser berdasarkan perbezaan jisim awal pakaian yang sudah dilembapkan dan jisim pakaian yang dikeringkan. Beberapa data telah diambil sepanjang menjalankan kajian ini antaranya seperti suhu, kelembapan, masa pakaian dikeringkan dan membuat pengiraan untuk kadar pengeringan dan juga SMER. Untuk masa pengeringan satu saluran, jisim permulaan yang optimum, kadar pengeringan optimum dan SMER adalah 55 minit, 1.89 kg, 0.398 kg / h, dan 0.752 kg / kWh. Kemudian, untuk jangka masa pengeringan dua saluran, jisim permulaan optimum, kadar pengeringan optimum dan SMER adalah 45 minit, 1.89 kg, 0.487 kg / jam, dan 0.974 kg / kWh. Sebagai kesimpulan, Kesimpulan utama kajian ini ialah ruang pengering untuk pengeringan pakaian menggunakan haba sisa dari jenis unit pendingin udara yang berpecah memakan masa dan tenaga yang cekap.

ABSTRACT

This product which uses heat from split-unit type condensers as the latest initiative in the effort to dry clothes besides natural and even electric appliances that use a lot of electricity. The goal of this product is to create something new that can produce a product such as a clothes dryer. Further, the use of clothes dryer generates maximum electricity consumption. Excessive use of electricity will have an adverse effect on the environment and will also cause depletion of the ozone layer. As a first step towards protecting the environment, this method can help reduce electricity consumption and also benefit from heat from condensers to dry clothes. As a result of this project, we can see how the clothes are dried using hot air from the condenser based on the difference between the initial mass of the clothing being wet and the mass of the clothing being dried. Some data were collected during the course of this study, such as temperature, humidity, drying time of clothes and calculations for drying rate as well as SMER. For single inlet drying time, optimal initial mass, optimum drying rate and SMER was 55 min, 1.89 kg, 0.398 kg / h, and 0.752 kg / kWh. Then, for multi inlet average drying time, optimal initial mass, optimum drying rate and SMER was 45 min, 1.89 kg, 0.487 kg / h, and 0.974 kg / kWh. As the conclusion, The main conclusion of this study is that the dryer space for drying clothes using waste heat from split unit type air conditioning is time consuming and energy efficient.

DEDICATION

This wholeheartedly dedicated to my beloved parent, who have been my source of inspiration and gave me strength when I thought giving up, who continually provide their moral, spiritual, emotional and financial support.

To my brothers, relatives, supervisor, friends and classmate who shared their words of advice and encouragement to finish study.

And lastly, I dedicated this book to the almighty god and my prophet, thank you for the guidance, strength, power of mind, protection and skills and for giving me a healthy life.

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LIST OF ABBREVIATIONS

WTE	Waste To Energy
AD	Anaerobic Digestion
COP	Coefficient of Performance
AC	Air Conditioning
SMER	Specific Moisture Extraction Rate
USA	United States of America
TXV	Thermal Expansion Valve
RAC	Residential Air Conditioner
G	Gram
Kg	Kilogram
Tin	Temperature In
Tout	Temperature Out
Hin	Humidity In
Hout	Humidity Out
A	Ampere
W	Watt
kW	Kilowatt
H	Hours

CHAPTER 1

INTRODUCTION

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1.0 Waste Energy

Waste To Energy (WTE), is a term used to describe the various technologies that transform non-recyclable waste into usable forms of energy including heat, fuel and electricity. WTE can occur through several processes such as burning, gasification, pyrolysis, anaerobic digestion, and landfill recovery. The term WTE is commonly used in special reference for high-temperature combustion fires that allow for energy recovery. Modern combustion facilities use pollution control equipment to prevent discharge emissions to the environment. At present, combustion is the only WTE technology that can be implemented economically and commercially. Another example of WTE is anaerobic digestion (AD), an old but effective technology that biologically converts organic matter into compost as well as biogas for energy.[(Environmental Protection Agency 2014). The AD system has great potential and can range from low to high technology, so they can serve the public from all income levels. Another process, called pyrolysis, can thermo-chemically convert waste products into clean liquid fuels. Finally, landfill recovery refers to the process of gas capture from the municipal landfill and transforms it into energy. The most common form of collection is to drill vertically or vertically into the landfill and use eraser and vacuum to collect gas for treatment.

1.1 Project Background

This is a project to investigate the potential of waste heat by the condenser split unit for fabric drying. The main concern is to see the potential heat exchanger that the hot air from the condenser will be distributed into space using natural circulation. The purpose of this project is to observe and understand the use of waste heat from the split condenser unit to become another heating application. This project was held in UTeM, Kampus Teknologi, Melaka. This experiment will determine the single inlet and multi inlet efficiency of this method.

The concept for this experiment is similar to the basic cycle for air conditioning fraction units but the condenser part is made as a drying room for drying purposes as shown in Figure 1. In order to carry out experiments, drying chambers are designed and designed. The drying room uses residual heat from the condenser split unit. The experiment starts with the measurement of the weight of the garment, then hangs parallel clothing with the direction of the hot air flow from the condenser. During inspection, clothing weight, humidity and hot air temperature are collected. COP air conditioning is once again calculated from experimental data. Experiment will finish when the dress is dried after the weight of the dress does not change. In this study, drying clothes with and without additional fan units are carried out to compare drying rates and an appropriate way to use residual heat from the condenser split unit.

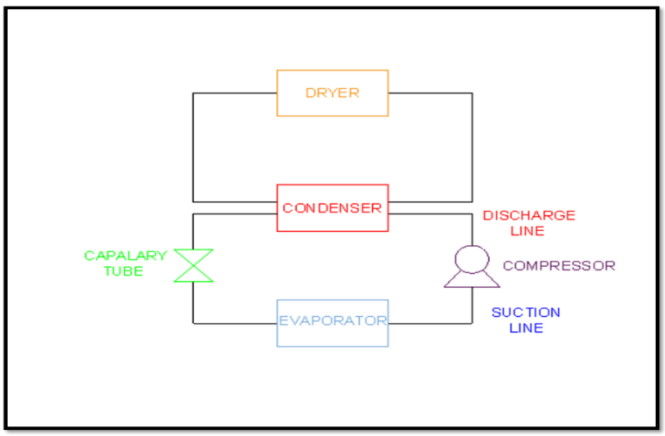

Figure 1.1: Project Schematic Drawing

1.2 Research Problem Statement

In the past, drying clothes usually use a natural way of using solar and wind, but today the technology is growing and clothing dryers using electricity or other energy are widely used, especially in urban areas where people live in high-rise buildings. Later, people living in buildings have boundaries in the area by wearing garments from the sun. However, its can dry their clothes on the balcony. To maintain the appearance of acceptable building faces, drying clothes using natural means by hanging clothes on the balcony should not be allowed. Moreover, drying clothes have been limited to houses that wear drying clothes, especially drying clothes in the humidity period as high as the rainy season. An internal ventilation channel with natural ventilation can take a long time and still results in unsatisfactory results. On the other hand, in the heat of the cooling cycle is absorbed in the evaporator and the compressor work is released back to the condenser. Rather than removing this heat quantity by removing it into the environment, appropriate measures can be used to put this heat stream for useful purposes for heating purposes because of its temperature so that the drying room and the experiment is examined. It is evident that the use of waste heat from the condenser is functional and realistic for drying clothes. Therefore, to collect more data on drying of clothing using residual heat from the condenser split unit, a study on drying clothes is examined in this work.

1.3 Research Question

1. Does this method can dry clothes faster and efficiently?
2. How does this method work?
3. Which faster drying clothes between single inlet dryer and multi inlet dryer?

1.4 Research Hypothesis

This method uses wasted heat through condensers to dry clothes. Therefore, this method does not guarantee that it will be able to dry clothes quickly and efficiently as a clothes dryer but by using this method it will be able to reduce the use of electricity and also recycle waste heat that is thrown through the condenser. Then, this method works by using heat residues from the condenser. When the hot air generated from the condenser is left, it flows into the drying chamber filled with clothing through a ducting that has been specially designed to carry hot air. The hot air will be trapped in the drying chamber, where we can see the fast and efficiency of the hot air from the condenser to dry out clothes. In fact, the functions of these two methods are the same. That distinguishes them is single inlet and multi inlet. where the singles only have one direction that brings a hot wind from the condenser to enter the drying chamber. While the multi has two directions to bring the hot wind from the condenser to the drying chamber. Certainly, multi inlet, because of the quantity of hot wind that goes into the drying chamber more and will speed up the drying process.

1.5 Objective

The objective this project is:

1.5.1 To develop cloth dryer by using heat waste from condenser split unit.

1.5.2 To study the performance of drying heat transfer from waste heat to drying purpose by single inlet and multi inlet type.

1.6 Research Scope

The scope of this project is mainly research activities related to data collection, a collection of journals that can be used for analysis and development including research on the current status of relevant research involving experiments. By using Split air conditioning 1 horsepower consists of an external unit and a internal unit. The external unit is mounted on or near the outer wall of the room want to cool down. This unit places compressors, condenser coils and expansion coils or capillary tubes. Most heat from the condenser part will disappear into the air. If this heat is not used, it becomes heat excreted. By converting waste heat recovery systems, this waste heat can be recovered and can be used for drying. Dryers of clothing produced can be used for residential and commercial use. In our main project, we had designed, fabricated and experimentally analyzed a waste heat recovery system for condenser split unit use for drying the clothes by using two types of flow which is single inlet dryer and multi inlet dryer. Using two types of clothes will be placed in the drying chamber is cotton and five different types of mass. we will be able to find the waste heat efficiency used for drying clothes. The parameter measurement for this project is take a data for mass clothing, drying time, temperature and humidity.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

The largest sector that used the too much energy is drying clothes. This is because based on a experiment in USA, Electricity consumption in the United States is estimated at 71 hours of Terawatt (TWh) for clothes dryer only to up to 9% of electricity consumption in the country(Meyers et al. 2010). In other ways in Indonesia, in this country do not use electricity to dry clothes. On the contrary in the country it is using natural means by using the sun for solar energy. Sectors such as hotels and hospitals, use commercial drying machines for drying clothes. The commercial clothes dryer apparatus is a rotary drum of the plant and is discharged by hot air 40-60 ° C (PK Bansal, JE Braun 2001). In Indonesia, the housing of urban dwellers does not provide enough space for them to dry naturally. Therefore, they use places around the house to dry naturally like windows, balconies, garages, front doors and so on. However, this natural drying method disturbs the surrounding landscape and may cause dirty clothing to return. Therefore, laundry business in Indonesia is increasingly developing due to this problem. For clothing dryers in Indonesia, they use various methods including electricity, kerosene, and natural gas as a source of energy. Not only uses electricity. On the other hand, the cause for Indonesia's economic growth and slower climate in Indonesia, in the city full of residents the use of RAC air conditioners is increasing as RAC condenser releases heat to the environment freely. Instead of removing such heat residues, it is best to use this heat to dry out clothes.

2.1 Waste energy

Waste to Energy (WTE), is the word used to describe various technologies like heat, fuel and electricity that convert to non-recyclable waste into a usable form of energy. WTE can occur with certain methods such as combustion, gasification, pyrolysis, anaerobic digestion, and landfill recovery (United States Environmental Protection Agency n.d.) . WTEs are often used in reference sources for burning burn-outs all at extremely hot temperatures which enable the recovery of energy. modern combustion using pollution control equipment to disperse spread to the environment.

At present, combustion is one of WTE technologies that can be implemented on a daily basis and operate on a scale. Another way of WTE is anaerobic digestion (AD), an outdated technology but being organic material converted to biological methods into compost and biogas for energy [(Environmental Protection Agency 2014)]. The AD system has high performance and can rotate from low technology to high technology, so it's can contribute to the community of all income levels. Another process, called pyrolysis, can thermo-chemically convert waste products into clean liquid fuels. At this point, the earth has acquired 1.3 billion tons of Municipal Solid Waste (MSW) annually. It is estimate that on 2025, the world can earn 2.2 billion tons of MSW per year.

The stated thing makes to think and look for other methods to overcome our future waste management barrier (WM) [(Hoornweg, Daniel 2012)]. Some of the ways to overcome it are WTE technology that will facilitate the sustainable WM program by removing waste from landfill for energy production.

More worryingly, WTE practices are less applicable by most world communities that are still using landfills as their primary means of disposal. Using this method will cause the soil to be polluted or damaged and will also affect the environment such as water and air.

Sweden and Denmark among countries that have recycled more than 99% MSW, 50.3% of household waste burned for power repairs and 16% were used in ADs with a mix of WTE technology and also contributing to good WM infrastructure. [(AvFall Sverige. 2014)]. Denmark has highlighted the proposed "hedonistic resilience" [(Ingels 2011)] which is a development that gives rise to community-conscious environmental and social growth. Of the percentage of garbage in Copenhagen only 3% of the waste is in the landfill. In addition, 54% are used in incinerators to obtain heat and electricity. the whole population benefited from this [(C40 Cities. 2011)]. In WTE technology this is a sacred energy source that can be obtained by using the rest

2.2 Air Conditioning Split Unit System

The weather in Malaysia today is in the heat. The ambient temperature are reaches up. This causes the people in this country to be uncomfortable because of the extreme heat of doing outdoor activities. So, the people are more than happy to be in the house. If the environment is hot, then inside the house will be hot as well. So, they are looking for solutions to get rid of the heat inside the house by installing air conditioning to find comfort in the weather that disturbs their outdoor activities. Split unit is divided into two units, namely indoor and outdoor units. In this system there are four basic components in the air conditioning system. The four systems are compressors, condensers, expansion valves and evaporators.

Figure 2.1 shows typical split system schematic. The important thing that shows this as the split system is:

• Cooling is working fluid

• Physical separation of evaporator and condenser (condensing unit).