UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ENHANCEMENT THE PERFORMANCE OF AIR HANDLING UNIT USING HYDRONIC HEATING SYSTEM

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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I hereby, declared this report entitled "Enhancement The Performance of Air Handling Unit Using Hydronic Heating System" is the result of my own research except as cited in references.

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Name **: MOHAMAD RIDZUAN BIN PAWANTEH**

Date **: 9 DECEMBER 2016**

APPROVAL

This report is submitted to the Faculty of Engineering Technology of UTeM as a partial fulfillment of the requirements for the degree of Bachelor of Engineering Technology (Refrigeration and Air-Conditioning System) (Hons.). The member of the supervisory is as follow:

……………………………….

(Mr. AMIR ABDULLAH BIN MUHAMAD DAMANHURI)

ABSTRAK

Mengekalkan tahap keselesaan haba adalah satu isu yang penting bagi manusia. Rasa ketidakselesaan akan berlaku jika suhu yang terlalu panas atau terlalu sejuk. Dalam era ini, sistem pemanasan adalah keperluan penting untuk penyejukan berlaku. Kebanyakan penghawa dingin sedia ada di pasaran yang menggunakan pemampatan wap kitaran berbanding serapan kitaran. Dalam kes itu, ia memerlukan penggunaan tenaga tinggi yang beroperasi. Dandang adalah tujuan khas dengan menggunakan Pemanas air. Sistem tangki mengagihkan haba dalam air panas dengan pam, sehingga air panas melalui pemanas gegelung atau peranti lain dan menghantar ke ruang panas yang diperlukan. Air sejuk akan kembali ke dalam tangki untuk dipanaskan semula. Sistem air panas sering dipanggil sistem hidronik. Selain itu, kipas dan salur sistem, dandang yang menggunakan pam untuk mengedarkan air panas melalui paip ke unit atau bekas udara. Tujuan kajian ini adalah untuk menentukan optimum parameter sistem hibrid pemanas, melalui suhu dan bolong kawasan yang mempunyai keadaan keselesaan haba. Oleh kerana kitar pemampatan wap tersebut tidak digunakan untuk menyerap dan mengalih keluar udara sejuk dari ruang yang memerlukan haba. Oleh itu, keadaan ini boleh dianggap sebangai mesra alam seperti sumber air digunakan untuk pelepasan. Kerja-kerja eksperimen dilakukan untuk membandingkan suhu sebelum dan selepas pemasangan dan pelaksanaan sistem pemanas hidronik. Sistem ini adalah bergantung kepada iklim di luar kawasan sekitar, jika suhu luar - 5^0c suhu di dalam kawasan bilik memerlukan suhu yang lebih tinggi dalam anggaran 30^0c supaya ruang bilik mendapatkan keselesaan yang diingini.

ABSTRACT

Maintaining a good thermal comfort is an important issue for human being. Discomfort feeling will happen if the temperature is too hot or too cold. In this era, heating system is the important requirement to cooling place. Most of the existing air-conditioning in the market using vapour compression cycle compare to absorption cycle. In that case, it requires a high energy consumption to operate. Boilers are special-purpose by using water heater. Tank system distribute the heat in hot water by pump, which gives up heat as it passes through heating coil or other devices in chambers throughout the condition space. The cooler water will returns to the tank to be reheated. Hot water system is often called hydronic system. Instead of fan and duct system, a boiler uses a pump to circulate hot water through pipes to the chamber. The aim of this study is to determine optimum hybrid heating system parameters, such as temperature and vent area to have thermal comfort conditions. Since the vapour compression cycle is not used which absorb and remove cool from a space that need to be heated. Hence, these can be environmental friendly as source of water is used for emission. The experimental work is carried out to compare the temperature before and after the installation and implementation of the hydronic heating system. This system is depends on climate of outside the environment, if the outside temperature is -5^{0}c so the condition space should deserve high temperature in 30^{0}c to get an desired comfort.

DEDICATIONS

To my beloved parents, I acknowledge my sincere indebtedness and gratitude to them for their love, dream and sacrifice throughout my life. I am really thankful for their sacrifice, patience, and understanding that were inevitable to make this work possible. Their sacrifice had inspired me from the day I learned how to read and write until what I have become now. I cannot find the appropriate words that could properly describe my appreciation for their devotion, support and faith in my ability to achieve my dreams Lastly, I would like to send my gratitude to any person that contributes to my final year project whether it is directly or indirectly. I would like to acknowledge their comments and suggestions, which are crucial for the successful completion of this study

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HRC	-	Hydronic Radiant Heating
HVAC	-	Heating, Ventilating and Air-conditioning
A	-	Area
h	-	Height
m	-	Mass
$\dot{m}$	-	Mass Flow Rate
P	-	Pressure
R	-	Radius
T	-	Temperature
ΔT	-	Difference in temperature
W	-	Weight
σ	-	Stefan BoltzmannConstant
T_{mr}	-	Mean radiant temperature
A_N	-	Area of surface
T_{mr}	-	Mean radiant temperature
^{o}c	-	degree celcius

CHAPTER 1

INTRODUCTION

In this chapter introduction is the most important topics which contain some subtopics which are briefing background of the study, problem statement, objectives, scope and organization of the thesis.

1.0 Background of study

Central system is an air conditioning system which uses a series of equipments to distribute heating media to exchange cool and supply conditioned air into space (Siddharth,2013). It commonly uses water and refrigerant as a heating media for a small building**.** This process involves the application of chiller, air handling unit and cooling tower. Air handling unit (AHU) is a important device in a central system and it is used to re-condition and circulate air as part of a heating, ventilating, and air-conditioning (HVAC) system. Usually a large metal box containing a blower, heating coil, filter, drain pan, and dampers. Air handler normally is connected to a duct system to distribute the condition air into space (Yin Yan,2014).

This study foccuses on the performances of air handling unit (AHU) design to improve the heating effect on the system. It's also concentrate on the important parameter that affected the performances. In vapor compression cycle, a compressor use a lot of energy to compress a refrigerant into a system. Therefore , this idea has been created to not using a compressor . This project will only use a hydronic radiant system (heat water) because water is one of the most efficient medium to transfer heat. The system also does not require high energy consumption and the cost of material is low.

1.1 Problem statement

In overcome the excessive cooling climate area to distribute heating air that led many building by use air conditioning in getting comfort temperature. The total energy consumption will increase and cause a large impact on economy (Chan & Qin,2011). Most of the existing air-conditioning in the market using vapour compression cycle compared to absorption cycle. Compressor is one of the basic components in the vapor compression cycle and it is assigned to compress the refrigerant into the system. In case of that, vapor compression cycle use a refrigerants as a medium transportation which absorb and remove heat from a space to be heated. These can be less environmental friendly as they require refrigerants for emission. The study is looking for possibility source of heating associate with air handling unit (AHU) with less energy consumption to be assigned by using heating hydronic system.

1.2 Objective

a) To fabricate hydronic heating system chamber for heating case experiment.
b) To investigate the possibility of hydronic heating in hydronic chamber.
c) To examine multiple coil effect in hydronic system for heating case.

1.3 Scope Project

For implementing the project, venue to build the project need to be considered to ensure the project progress. On design and fabricating the project, air distribution and fundamental HVAC laboratory in FTK, UTeM is chosen because of the tool facilities to build the project is comprehensive. By narrowing the needs for this project, a few guidelines are proposed to ensure that this project will achieve it objective. The scope covered for this project are to design chamber that includes coils location and it distance between fan and to study the suitable distance with number of coils. In addition, heater capacity is considered to get desired temperature on water tank.

1.4 Organization of the thesis

These report have been divided into five chapters, thus the chapter consists of introduction, literature review, methodology, results and analysis, conclusion and recommendation. Chapter 1 explain the background of the study; determine the problem statement, and explaining the area the area under consideration of this project. Chapter 2 is designed to survey past works published in the open literature that are in line with the theme of current research. The design of previous inventor is presented in the chapter. Chapter 3 demonstrates the methodological approach that is adopted to achieve the objectives. Details on the work procedure, materials, and apparatus are describes. Chapter 4 describes all results and discussion with analysis of the project. The aftereffect of the venture has been talked about in detail inside this section. Lastly chapter 5 shows the demonstrated of the clarifications about the conclusion and suggestion for future works is exhibited.

CHAPTER 2
LITERATURE REVIEW

2.0 Introduction

In this chapter, the basic knowledge of system air-conditioning and air handling unit (AHU) will be discussed. Firstly the theory will be introduced. Next will discuss and review a previous project that had applied hydroning heating system concept and theory.

2.1 Background HVAC System

HVAC is in common use in the heating and cooling industry. It stands for "heating, ventilation and air conditioning," three functions often combined into one system in today's modern homes and buildings. Warmed or cooled or dehumidified air flows through a series of tubes - called ducts - to be distributed to all the rooms of your house. A central HVAC system is the most quiet and convenient way to cool an entire home. Unless you live in an amazingly temperate climate, the HVAC system in your home uses more energy and drains more energy dollars than any other system in your home. HVAC systems have improved in energy efficiency over the years. As a result, you can save money and increase your comfort by properly maintaining and upgrading your HVAC equipment (Retrieved May,2016).

2.2 Air Conditioning

Air conditioning often referred to as A/C or AC is the process of altering the properties of air primarily temperature and humidity to more comfortable conditions, typically with the aim of distributing the conditioned air to an occupied space such as a building or a vehicle to improve thermal comfort and indoor air quality. In common use, an air conditioner is a device that lowers the air temperature. The purpose of most systems is to provide thermal comfort and an acceptable indoor air quality (IAQ) for occupants. With the improvement of standard of living, occupants require more and more comfortable and healthful indoor environment. People spend 80% to 90% of their time indoors, and indoor environment has important effects on human health and work efficiency(Yu et al., 2009). Air-conditioning systems are widely developed and applied in office and commercial buildings to save more energy. However, VAV systems tend to have more faults due to their complex control systems. If faults can not be detected, diagnosed and removed, they will bring about abnormal operation which subsequently increases energy consumption of the system, decreases comfort ability of human beings and makes the air-conditioning equipment wear down(Wang, Chen, Wang, Chan, & Qin, 2011).

2.2.1 Principles of Refrigeration

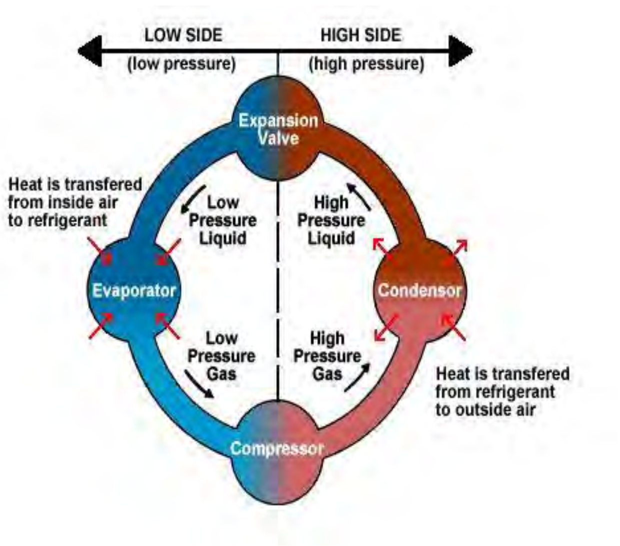

Figure 2.1 Refrigeration cycle

(Air Conditioning Basic Refrigeration Cycle,2016)

a) Liquids absorb heat when changed from liquid to gas

b) Gases give off heat when changed from gas to liquid.

c) For an air conditioning system to operate with economy, the refrigerant must be used repeatedly. For this reason, all air conditioners use the same cycle of compression, condensation, expansion, and evaporation in a closed circuit. The same refrigerant is used to move the heat from one area, to cool this area, and to expel this heat in another area.

d) The refrigerant comes into the compressor as a low-pressure gas, it is compressed and then moves out of the compressor as a high-pressure gas.

e) The gas then flows to the condenser. Here the gas condenses to a liquid, and gives off its heat to the outside air.

f) The liquid then moves to the expansion valve under high pressure. This valve restricts the flow of the fluid, and lowers its pressure as it leaves the expansion valve.

g) The low-pressure liquid then moves to the evaporator, where heat from the inside air is absorbed and changes it from a liquid to a gas.

h) As a hot low-pressure gas, the refrigerant moves to the compressor where the entire cycle is repeated.

Note that the four-part cycle is divided at the center into a high side and a low side This refers to the pressures of the refrigerant in each side of the system (Air Conditioning-Basic Refrigeration, 2016).

2.3 Air Handling Unit (AHU)

According from Norris and sreenivas members of 1997, a typical air handling unit (AHU) in a heating, ventilation, and air-conditioning (HVAC) system consists of an outside-air, return-air and exhaust-air damper. Air from the outside is drawn into a HVAC system via the outside-air damper. This air is usually mixed with recycled air and circulated to the rooms in a building. A portion of the net volume flow out of the rooms is exhausted, while the remainder is recycled, The quantity of outside-, exhaust- and recycled-air is modified by appropriate changes to the outside-, exhaustand return-air damper angles. The duct work in an HVAC system is equipped with a supply-fan. The speed of the supply-fan is determined by the current thermal load of the HVAC system, and is therefore not constant. In the absence of any control, varying speeds of the fan will result in different volume flows of outside air into the system.

2.3.1 Location

The major challenge in AHU fault diagnosis is the incompleteness and inaccuracy of the AHU measurements. Firstly, AHU measurements are rich