UNIVERSITI TEKNIKAL MALAYSIA MELAKA

ENHANCEMENT OF THE NEW DRYING APPLICATION

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

by

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APPROVAL

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

……

(Dr Ahmed Salem Seed Bin Ghooth)

ABSTRAK

Kajian ini melibatkan penambahbaikan dalam proses pengeringan. Kebanyakan pengering konvensional yang asal menggunakan elektrik untuk menjana haba, penggunaan elektrik akan memberi kesan terhadap pengunaan tenaga. Pengering konvensional yang asal mengambil lebih banyak masa untuk mengeringkan pakaian, ia membuang masa. Masalah lain yang mungkin pengguna hadapi adalah bahagian-bahagian di dalam mesin pengering mengalami kerosakan yang membuat mesin itu tidak berfungsi. Dalam kajian ini, beberapa sasaran telah ditetapkan untuk memastikan bahawa kajian semasa tidak menyeleweng dari sasaran asal. Kajian utama projek semasa adalah, untuk mempercepatkan kadar pengeringan dan menjimatkan masa dengan menggunakan beberapa penebat dan juga untuk memeriksa jumlah haba yang disediakan dalam kabinet pengering yang melibatkan sumber haba ditutup. Reka bentuk kabinet logam adalah penting untuk mencapai objektif kajian semasa dan projek ini akan berakhir dengan kerja eksperimen ini. Kabinet logam akan dibina berdasarkan saiz sebenar almari yang boleh didapati di pasaran. Dimensi almari logam adalah 2 m (H) × 1 m (L) × 0.5 m (W), dan juga mempunyai beberapa lubang aliran udara untuk menyediakan aliran udara di dalam kabinet logam. Parameter yang paling penting untuk diukur dalam almari adalah suhu, dan perlu mengambil kira tahap suhu yang memberi suhu tertinggi didalam kabinet tersebut. Suhu tertinggi didalam kabinet adalah pada tahap satu dan tahap dua dengan 1.2 m dan 1.5 m dengan suhu tertinggi adalah 62.1°C dan 62.3°C. Objektif kedua eksperimen ini apabila menggunakan grill sebagai penghalang pada kawasan haba sumber, suhu tertinggi di dalam kabinet di peringkat tiga dan tahap satu memberi suhu tertinggi ialah 60.8 ° C dan 61.4 ° C. Ia dijangka bahawa penggunaan penebat untuk mempercepatkan kadar pengeringan di dalam kabinet logam adalah dicapai. Projek semasa bersedia untuk menyumbang kepada pengguna bagi tujuan pengeringan dengan beberapa kebaikan seperti mas untuk pengeringan lebih singkat, penjimatan kos dalam jangka masa yang panjang dan juga pakaian boleh terus dipakai setelah proses pengeringan selesai.

Kata-kata: fabrikasi, tahap suhu yang tinggi, suhu dan kadar pengeringan.

ABSTRACT

This study is representing on enhancement of the new drying application process. Mostly original conventional drying application using electricity to generate heat. Use of electricity will give an effect on energy consumption. The original drying application take more time to dry the clothes, it waste time. In this study, some targets have been set to ensure that the current study is not diverging from the original target. The main study for the current project is, to accelerate the drying rate and save time by using some insulation and also to check the amount of heat provided inside the drying cabinet in case of covering heat source. The design of metallic cupboard is important to achieve the objectives of the current study and this project ends with experimental work. This metallic cupboard is constructed based on actual size of cupboard that is available in the market. The dimension of the metallic cupboard is 2 m (H) × 1 m (L) × 0.5 m (W), and also has some air flow hole to provide air flow inside the metallic cupboard. The most important parameter to measure inside the insulated cupboard is temperature, and need to consider the level of the temperature that provide the highest temperature inside the insulated cupboard. The highest temperature inside the insulated cupboard is on level one and level two where its equal to 1.2 m and 1.5 m with highest temperature is 62.1°C and 62.3°C. Second objective on this experiment when using grill as cover at heat source area, the highest temperature inside the cupboard at level three and level one give the highest temperature is 60.8°C and 61.4°C. Use of the insulation to accelerate drying rate inside the metallic cupboard is achieve. The current project is ready to contribute to the user for a drying purpose with several benefits such as time consuming for drying clothes is shorts, save cost in a long term period by using drying cupboard, also by using the drying cupboard the clothes can wearable after drying process complete.

Keyword: fabrication, level of highest temperatures, temperature and drying rate.

DEDICATIONS

To my beloved parents Asmah binti Ismail and Razali ABD Ghani and to my beloved siblings, who always love, pray for my success and always support me. Also I like to dedicated all my hard work and efforts on finishing this project to my supervisor, Dr Ahmed Salem Seed Bin Ghooth, for supporting me through this project

Lastly, I like to dedicate this project to my entire classmate and friends that always support and help to contribute some ideas and give some help on completing this project.

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I would like to express my appreciation to my supervisor, Dr Ahmed Salem Seed Bin Ghooth, because of his commitment to contribute his time and always keep on guiding me to complete my project. His knowledge helps me a lot to finish this final year project and without any help from him, it would be difficult for to complete this project.

Also thanks to my faculty, Faculty of Engineering Technology (FTK) which provide most of the equipment and tools that impossible for student to have it by our own to complete my final year project. Also thanks to all staff that support and guide during conducting my final project experiment.

Lastly, I would like to thank to all my friends especially to my classmate that keep supporting through completing this project. Hopefully this report will help on future studies.

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°C	Degree celcius
KJ	Kilo joule
KG	kilogram
s	second
K	Kelvin
TS	Temperature surface
Tφ	Temperature surrounding
%	Percentages
ṁ	Gas Mass flow rate
$(T_2 - T_1)$	Temperature difference
$h_2 - h_1$	Enthalpy difference
Wi	Initial weight for propane gas
Wo	Final weight for propane gas
Cp	Specific heat
Ti	Initial temperature
Tavg	Average temperature
h	Heat transfer coefficient
A	Side area

CHAPTER 1
INTRODUCTION

In this chapter introduction the most important topics which contain the project are briefing background, problem statement, objectives, scope of the project and thesis organization of overall chapters and all of these topics are presented with details within this chapter.

1.0 Background

In 1874 the first hand driven washing machine for home use was design by William Blackstone, from that time the technology begins to expand, the combination of the new invention has produced a washing machine and dryer to help to complete the task of laundry. Despite the basic design of the dryer has not changed much in previous hundreds years, nowadays the changes are in the development. New technologies and design that use solar power or microwaves could make the traditional tumbler dryer be outdated as the scrub board. We consider a solar powered dryer today as a new innovation in the up and coming future of drying machines, but solar power was the first source of energy used to dry clothes as people washed, rinsed and wrung out clothes by hand and hung them over rocks, tree branches or later clotheslines to dry in the open sun areas. The first dryer invented was a simple wooden rack to hang clothes near a fire to dry. The first mention of a modern type dryer appeared in the 1800s when a Frenchman by the name of Pochon invented a vented-barrel-shaped drum called a ventilator to dry clothes. Clothes were placed inside the drum and the drum was turned by hand over an open fire. It was not a very reliable method or machine, but opened the doors for future designs. Though there seems to be some controversy over the patent description of George T

Sampson's dryer, he is credited with a ventilator dryer using a stove as its heat source. By 1915, the electric clothes dryer was introduced but it was not until the Hamilton Manufacturing company produced the first automatic dryer in 1938 that the use of the dryer started to become known. (http://esporta.ca/) From 1938 through the 1960s, the cost of owning a dryer remained out of reach for most people with a dryer in the 1950s costing the equivalent of $1600 in today's money. New technologies, production methods, and lower costs put the dryer in more homes by the late 1990s. As technology continues to open the doors to the use of cost efficient designs, the use of new technology is changing the dryer, as we now know it. Using solar dryers, vent-less dryers, also known as compression or heap pump dryers, and dryers that make use of microwave technology may soon make the tumble dryer simply another part of history. The dryer that has not changed much in design or function in over two hundred years is going through rapid change in both design and energy use. These changes will provide a more efficient use of time and resources.

This study is representing on enhancement of the new drying application process. Mostly original conventional drying application using electric to generate heat, use of electricity will give an effect on energy consumption and also consume more cost to consumer. The original drying application also may take more time to dry the clothes, it waste time on waiting the clothes to dry. Other problem that consumer may face on modern drying application is parts in the drying machine might broken or malfunction that make the machine did not function.

The current project aimed to improvise the wardrobe which was done and based on the original idea of drying application to accelerate the drying rate and also to avoided odor coming inside the metallic cupboard cause from using the gas stove by adding some fans to make a good ventilation inside the metallic cupboard.

In general drying refers to the removal of moisture (water vapor from gas or air) and amount of water contains from wetted solid. However heat is the most necessary source for evaporation process with an appropriate air flow to carry away the amount of water in wetted clothes. Although drying daily work can be done in open places naturally, the enhancement of the new drying application process is to be investigated with modification improvement from the original design in order to enrich drying process.

1.1 Problem Statement

Limitations associated with original design included hotness of the Galvanized metallic cupboard outside surfaces, more heat loss, and the occurrence of adverse effect if the clothes fall on the open fire. Avoiding heat loss in all sides of the metallic cupboard and find the appropriate manner to cover the heat of source area with supplying the same amount of heat is the challenge for the current project.

1.2 Project Objectives

In this study, some targets have been set to ensure that the current study is not diverge from the original target when investigations are conducted. The main objectives for the current project are:

1. To accelerate the drying rate and save time by using some insulation.
2. To check the amount of heat provided inside the drying cabinet in case of covering heat source.

1.3 Work Scope

For implementing the project, venue to build the project needs to be considered to ensure the project progress. On design and fabricating the project, lab manufacturing in FTK, UTeM is chosen because of the tool facilities to build the project is comprehensive. To run the experiment, HVAC lab in FTK, UTeM is chosen. Measuring the most important parameters such as temperature, weight and relative humidity inside the Galvanized metallic cupboard is the appropriate way to calculate the required heat, and drying rate.

1.4 Organization Of The Thesis

This report involves of five chapters, which is chapter 1 the introduction of the project that includes the background, problem statements, objectives, as well as work scope of the study. Chapter 2 is written to review the theories, experimental works and findings that have been done in the past researches with respect to the current project. In chapter 3, the methodology used to achieve the current objectives that have been set for this study. Besides, all materials and equipments, procedures, and experimental work used for this study are described and explained clearly. Chapter 4 presents the findings and results of the current study in form of tables and Figures. All the results of the study are discussed in detail within this chapter. Lastly, chapter 5 is the conclusion and recommendation for future work.

CHAPTER 2
LITERATURE REVIEW

In this chapter there are several sub topics described, such as introduction for drying process, types of tumbler dryer, CO_2 as a working fluid for heat pump dryers, humidity and also related work.

2.0 Introduction For Drying Process

Drying is a process to remove water from a substance and it's one of the most widely used operating processes in daily life which is undeniably as an energy-intensive operation (Ah Bing Ng, and Shiming Deng 2008). This process occurs when a wet is involved with thermal drying, it will involve with two process at the same time, first when heat energy is transferd from surrounding environment to evaporate the surface moisture and second, transfer of internal moisture to the surface of the solid and its subsequent evaporation due to the first process (Handbook of Industrial Drying fourth edirtion, Arun S. Mujumdar 2014). Rate of drying is accomplish by determined the rate of the two process occurs (Handbook of Industrial Drying). Heat transfer energy occurs from wet surrounding that result from a convection, conduction, radiation or in others cases, result of a combination of these effects. Clothes dryer is one of the common dryers was produced by industries for people to use either for commercial or residential use. In the past few years, a lot of effort has been made by researcher to ensure that the energy efficient dryer can decrease the total cost and help in contributing on the environment preservation such as replacing use of electricity with hot water, it's because to use electricity for a small appliance such as clothes dryer is such a loss and not efficient in term of energy use (Ah Bing Ng, and Shiming Deng 2008) ,(Pradeep Bansal et al 2010). Mostly use of clothes

dryer depend on the electricity to work, by heat the heating element the hot air supply inside the clothes dryer. For conventional type of clothes dryer there are two categories, air vented dryer and condensing dryer. Conventional dryer operates with same operation where supply power is heating the heating element and with the help of outside air, the hot air enters the clothes dryer and drying process is happend. Tumbler dryer in the market mostly are not very efficient. It can be classified by the rating, which mostly the rating for tumbler dryer is lower compared with the given rating from the manufacturer. (http://www.nwu.ac.za). As stated previously, in order to operate correctly the dryer needs a constant flow of air. The airflow for the tumbler dryer was important; to make sure the tumbler dryer can be operate efficiently without any losses. the important of air flow for tumbler dryer is like this, if the air flow is not there the tumbler dryer will not function , if in tumbler dryer didn't have enough airflow the tumbler dryer will not work correctly. A lot of experiments and researches on conventional tumbler dryer that popular among consumer which is air vented dryer, condensing dryer, heat pump and gas dryer that has been done. A lot of idea that come from research to improve and do an enhancement on all this type of tumbler dryer, some said using heat exchanger it can improve the performance tumbler dryer, some propose an idea by makeing an air pump cycle for this dry also have and suggestion from some researcher that propose by improve the drum seals to reduce the air leakage. There is a considerable leakage of warm air from the recirculation air system in the tumble dryer, which indicates an energy loss from the system. According to the Swedish Consumer Agency 1996:3, it is desirable to decrease the energy consumption by 12% during the drying of a standard 5.0kg load of dry cotton containing 3.5kg of water to reach an energy efficiency classification B for the machine.

2.1 Types Of Tumbler Dryer

As mention before there are several types of tumbler dryer, where each type of tumbler dryer has different drying process to dry the clothes.

2.1.1 Air vented tumbler dryer

The figure below show a schematic of conventional air vented dryer, and some parts inside the air vented dryer.

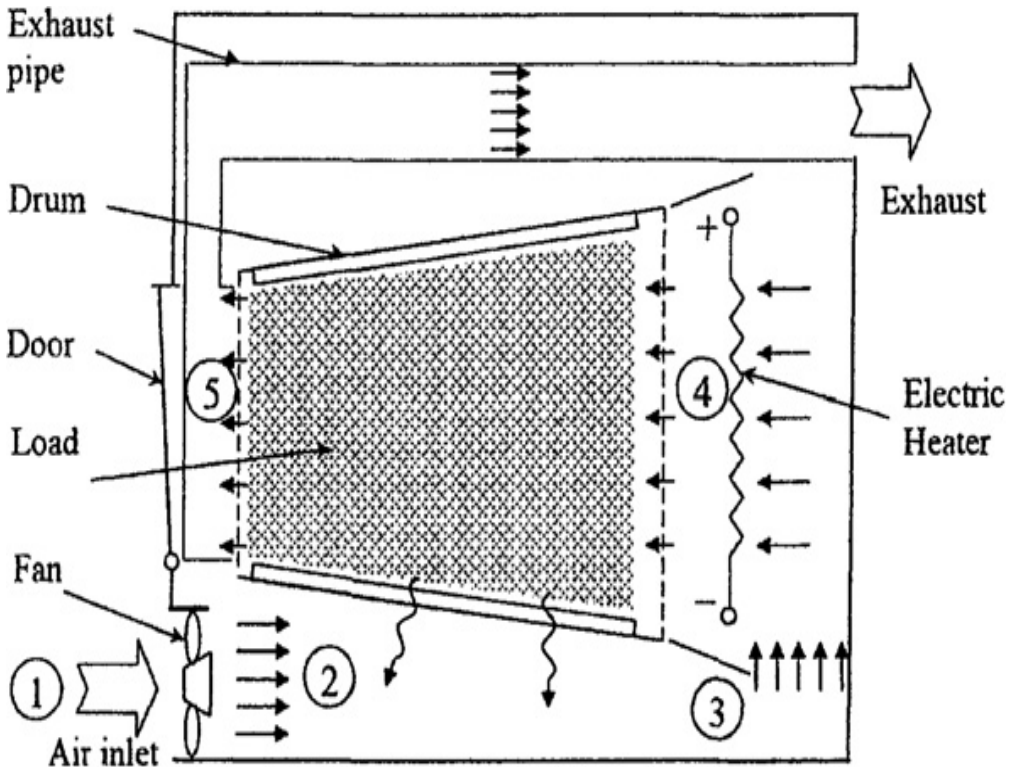

Figure 2.1. Schematics of a conventional air-vented dryer. (Fabric-drying process in domestic dryers)

The air vented dryer required a help from the vent to push out the hot exhaust air to outside of the room where the dryer is operated, and normally the hot air is released either through a wall or a window by the venting kit or hose. Released of exhaust hot air is needed to make sure the condensation problem can be avoid inside the room. This type of tumbler dryer is the less energy efficient because when the exhaust hot air is release on the venting process to the outside of the room, the vented air tumbler dryer need another process to replace the warm air that lost from the venting process (V. Yadav , C.G. Moon 2008)