UNIVERSITI TEKNIKAL MALAYSIA MELAKA

DESIGN AND ANALYSIS OF HEAT FLOW FOR DRYER SYSTEM

This report submitted in accordance with requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Manufacturing Engineering (Manufacturing Design) with Honours.

by

WONG CHENG YEONG

FACULTY OF MANUFACTURING ENGINEERING

APR 2010

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

BORANG PENGESAHAN STATUS LAPORAN PROJEK SARJANA MUDA

TAJUK: **Design and Analysis of Heat Flow for Dryer System**

SESI PENGAJIAN: 2009/10 Semester 2

Saya **WONG CHENG YEONG**

mengaku membenarkan Laporan PSM ini disimpan di Perpustakaan Universiti Teknikal Malaysia Melaka (UTeM) dengan syarat-syarat kegunaan seperti berikut:

1. Laporan PSM adalah hak milik Universiti Teknikal Malaysia Melaka dan penulis.
2. Perpustakaan Universiti Teknikal Malaysia Melaka dibenarkan membuat salinan untuk tujuan pengajian sahaja dengan izin penulis.
3. Perpustakaan dibenarkan membuat salinan laporan PSM ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. **Sila tandakan (√)

☐	SULIT	(Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia yang termaktub di dalam AKTA RAHSIA RASMI 1972)
☐	TERHAD	(Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)
☐	TIDAK TERHAD	

Disahkan oleh:

Alamat Tetap:
P.O.Box 22577,
88785 Luyang,
Kota Kinabalu, Sabah

Tarikh: 8/4/2010

Cop Rasmi:
WAHYONO SAPTO WIDODO
Pensyarah
Fakulti Kejuruteraan Pembuatan
Universiti Teknikal Malaysia Melaka

Tarikh: 14/5/2010

** Jika Laporan PSM ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa/organisasi berkenaan dengan menyatakan sekali sebab dan tempoh laporan PSM ini perlu dikelaskan sebagai SULIT atau TERHAD.

DECLARATION

I hereby, declare this thesis entitled "Design and Analysis of Heat Flow for Dryer System." is the results of my own research except as cited in the reference.

Signature : ……

Author's Name : WONG CHENG YEONG

Date : 8th APR 2010

APPROVAL

The thesis submitted to the senate of UTeM has been accepted as partial fulfillment of the requirement for the degree of Bachelor of Manufacturing Engineering (Manufacturing Design). The members of the supervisory committee are as follows:

……

Supervisor: MR. WAHYONO SAPTO WIDODO

Date: .....

Stamp: .....

……

Co-Supervisor: MR. TAUFIK

Date: .....

Stamp: .....

ABSTRACT

The title of this project is Design and Analysis of Heat Flow for Dryer system. Basically, this project is to define the design verification and identify the calculation parameter in order to develop a dryer system. Besides that, the existing dryer system was analyzed to prove that the system is work under expectation from the past studies and discover how the heat flow was affected to the entire drying process in actual condition. Therefore, by using the 3D CAD software to develop the dryer in 3D modeling is the first step which leads to the progress of this project. Through this step, the dryer system development and function ability can be clearly understood by the end of analyzing process is accomplished. Due to the analysis result, the modification and redesign process of the dryer system is done to ensure that the system drying efficiency is improved and it can apply in actual condition. Before generating the product in 3D modeling, the basic data and information of existing dryer system is required such as dimension of dryer equipment, air and heat source supply range, sizing method and etc. Finally discussion of the result obtained are stated and some recommendations to help improve further research of the project.

ABSTRAK

Tajuk projek ini adalah menkaji tentang “Design and Analysis of Heat Flow for Dryer System”. Projek ini pada asasnya adalah untuk mentakrif pengesahan rekabentuk pada pengering mesin dan mengenal pasti faktor atau cara pengiraan untuk membina sebuah pengering mesin. Selain itu, mesin tersebut akan dianalisis untuk menunjukkan sistem tersebut dapat dijalankan dengan seperti yang dikaji sebelum ini dan juga mendapatkan kajian tentang bagaimana aliran haba memberi kesan kepada proses mengering dalam situasi yang sebenar. Dengan menggunakan “3D CAD” perisian komputer untuk membina mesin tersebut dalam model 3D adalah langkah utama yang perlu dijalankan dalam projek ini. Prosess analisis pada mesin pengering telah memberi informasi dan kefahaman yang secukupnya tentang pembinaan dan keupayaan pada mesin tersebut dengan lebih senang untuk difahami. Pengubahsuaian prosess akan dijalankan dengan menggunakan keputusan analisis yang dilakukan supaya dapat meningkatkan kecekapan sistem mesin tersebut dan dapat diaplikasikan pada situasi yang sebenar. Sebelum menghasilkan mesin dalam model 3D, komponen asas pada mesin perlu didapatkan dahulu seperti dimensi komponen, kuase pembekal aliran haba dan angin, dan lain-lain. Sebagai kesimpulan, perbincangan daripada hasil yang diperolehi seperti yang dinyatakan dan beberapa cadangan dikemukakan untuk memperbaiki penyelidikan lanjut untuk projek ini.

ACKNOWLEDGEMENT

Firstly, I would like to take this opportunity to express my gratitude and appreciation to my respectable supervisor, Mr. Wahyono Sapto Widodo, for his honest guidance and the continuous support and help to accomplish this project. His willingness to share with me his knowledge in the field of my works leads this project to reality.

Besides that, I am appreciated and glad to my co-supervisor, Mr. Taufik, constantly giving support on his knowledge, experience and motivation from the beginning until the end of this project.

In addition, I also would like to special thanks to my friends who have show their knowledge and assisting me in overcoming the difficulties throughout the project. Lastly, I would like to express my appreciation and gratitude to my parents for their understanding and continuous care of me during the course of the project.

TABLE OF CONTENT

LIST OF FIGURES

LIST OF TABLES

LIST OF ABBREVIATIONS

CAD	-	Computer Aided Design
R&D	-	Research and Development
UTeM	-	Universiti Teknikal Malaysia Melaka
RPM	-	Revolution per minute
SFM	-	Surface feet per minute
3D	-	Three dimension
2D	-	Two dimension
CFD	-	Computational fluid dynamics
IGES	-	Initial Graphics Exchange Specification
SLDPRT	-	SolidWork part file
Kg	-	Kilogram (mass unit)
m^3	-	Meter cube (volume unit)
j	-	Joule (energy unit)
k	-	Kelvin (temperature unit)
Pa	-	Pascal (pressure unit)
S	-	Second (time unit)

CHAPTER 1
INTRODUCTION

1.1 Introduction

Tray dryer is an equipment or machine which is very useful in small industrial sector such as food industrial, chemical industrial are using the dryer as their manufacture system to dry up their product for certain purpose or use.

Normally, the development of tray dryer is the simplest and cheapest. It has a very simple drying system, it is require some form air heater and a fan to pass air over the product to reduce moisture or evaporate the moisture into vapor condition, and the drying temperature is set around 30 degree Celsius to 80 degree Celsius and above. The air enters the bottom of the chamber below the trays and then rises, through the trays of product being dried, and exits through the ducting system or opening in the top of chamber. Besides that, this system also reduces back pressure and which is means that the dryer can be build in cheaper cost by using smaller fan and others low cost material.

Due to the drying process, it depends to the moisture content inside the material need to reduce and it also affected by the time is taking to reduce the product moisture content. Therefore, drying process is important especially for food industrial, it's made the food in dry condition for the storage purpose, management purpose and manufacture process purpose. However, most of the tray dryers are facing the same problem in design level and drying process, which is the heat flow in drying chamber uncontrollable and unstable.

Although the development of tray dryer is low, the unbalanced heat flow directly affected to the production process and labor cost. When the heats are supply from the bottom of dryer, the tray which place near by the heat source is dry faster than other trays. If need to dry up all the product in once drying cycle, it is impossible because the product which close to the heat source will damage and may affected to others product quality.

Thus, in some cases, the tray dryer build with lifting mechanism or others additional equipment to assist and lift up the entire tray except the tray close to the heat source is removing out of the drying chamber. To adding the new product into the dryer, the tray will load from the top of drying chamber and the work flow will continue until the entire drying process is stop. Therefore, this type of system requires high labor hour, energy and cost to complete the drying process.

To improve the tray dryer system function more effectively, this project will focus on the design and analysis of heat flow in the dryer system. Besides that, the entire project also involve some technique on how to validate the design and development of heat flow generation by comparing the existing design of tray dryer which done by Stephen and Emmanuel, (2009).

Hence, to accomplish this project, understanding of heat and air supply characteristic and sizing are the main obsession which needs to be done. Besides to understanding about the heat and air thermodynamic properties, the design of the drying chamber and tray system must allow the heat flow easy to run through the system and balanced.

1.2 Objectives

The objectives of this project are:

i. To apply CAD software in designing the tray dryer.
ii. To study the ways to obtain the sizing of heat and air source.
iii. Determine the heat flow by using software application to analyze.
iv. To improve the existing tray dryer heat flow design.

1.3 Scope of study

Through this project, it will focus on the tray dryer heat flow analysis and it also involves software application, ANSYS, to make comparison between the existing design and new design. To validate the design, software SOLIDWORKS is using to develop the tray dryer and require to construct the dryer in three dimension simulation model to expose the dryer efficiency and reliability before proceed into the actual condition. Meanwhile, considerations of sizing the heat and air supply in developing the tray dryer need to be more carefully taken and to prevent any uncertainty and error.

1.4 Problem statement

Basically, the main problem in this project is focus on the existing tray dryer, which cannot provide a proper design in the heat flow and analysis. Besides that, one of the major problems to achieve this project is the heat source sizing and fan population that may cause uncertainty factor and the dryer cannot function properly in the drying process. Therefore, to select a suitable heat supply and fan generator are become difficult and it require advance knowledge and experience in thermo and fluid. Without that knowledge, the whole design of the tray dryer may fail. Hence, further study, parameters and setting need to be consider as good as well.