

CLEAN AIR SYSTEM FOR ENCLOSED WORKING SPACE

YUSERI MOHAMAD ZAMAN



**Universiti Malaysia Sarawak
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Yuseri Mohamad Zaman
Fakulti Kejuruteraan, Universiti Malaysia Sarawak
Kuching, Sarawak, Malaysia

2001

Yuseri Mohamad Zaman
Fakulti Kejuruteraan, Universiti Malaysia Sarawak

Yuseri Mohamad Zaman

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Fakulti Kejuruteraan, Universiti Malaysia Sarawak
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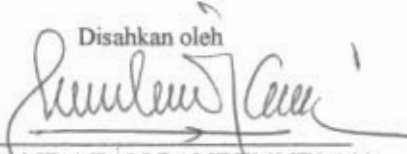
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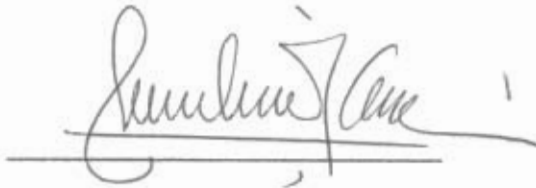
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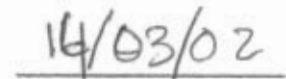
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This project report entitled "CLEAN AIR SUPPLY FOR ENCLOSED WORKING SPACE" was prepared by Yuseri Mohamad Zaman as a partial fulfillment of the requirement for the Degree of Bachelor of Engineering with honours (Mechanical Engineering and Manufacturing System) is hereby read and approved by:

A handwritten signature in black ink, appearing to read 'A. Rahim Md. Amin', written over a horizontal line.

Mr. A. Rahim Md. Amin

Supervisor

A handwritten date '14/03/02' written in black ink over a horizontal line.

Date

Penghargaan

Pengarang bersyukur ke hadrat Ilahi kerana dengan rahmatnya, pengarang telah berjaya menyiapkan projek tahun akhirnya. Ribuan terima kasih kepada Encik A. Rahim Md. Amin yang telah memperkenalkan tajuk yang menarik ini kepada pengarang. Pengarang juga ingin berterima kasih kepada ibu-bapa di atas sokongan dan bantuan mereka semasa pengarang menjalankan projek ini.

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Abstrak

Bekalan udara yang bersih adalah sangat penting terutama dalam kawasan kerja yang tertutup. Udara di dalam kawasan kerja tertutup mempunyai kemungkinan yang tinggi untuk dicemari dan pendedahan dalam jangka masa yang lama mungkin membahayakan pekerja. Thesis ini adalah kajian mengenai kemungkinan menggunakan penapis udara yang berasaskan air untuk membantu dalam membekalkan udara yang bersih kepada kawasan kerja yang tertutup terutama sekali dalam bangunan pejabat. Eksperimen yang ringkas telah dibuat untuk menganggarkan keberkesanan penapis udara yang berasaskan air. Rekaan secara konseptual yang menggabungkan penapis udara berasaskan air dengan sistem pengaliran udara yang biasa digunakan di dalam bangunan (HVAC). Daripada hasil kajian, didapati penapis udara adalah lebih berkesan membersihkan udara jika dibandingkan dengan penapis udara kelas A yang digunakan dalam sistem pengaliran udara di dalam bangunan biasa. Bagaimana pun, penapis udara berasaskan air memerlukan lebih banyak kajian dan pembaharuan sebelum ia dapat memberikan prestasi yang cukup baik.

Abstract

Clean air supply is very important especially in enclosed workspace. Air in enclosed workspace has a very high probability to be polluted and in long term may result in harmful effect to workers. This thesis is about the possibility of using water-based filter to supply adequate clean air in enclosed working space especially office buildings. Simple experiment to estimate the efficiency of water as filtering medium had been conducted and a conceptual design that incorporate water-based air filter with typical enclosed building ventilation system (HVAC) had also been looked into. The experiment indicated that water-based air filtration is found to be more efficient in term of air cleaning than most of Class A filter that is used widely in HVAC system. However, water-based air filtration system needs a lot of improvement before it can be considered applicable and cost effective.

CONTENTS

PENGHARGAAN	iii
ACKNOWLEDGEMENT	iv
ABSTRAK	v
ABSTRACT	vi
LIST OF FIGURES	xii
LIST OF TABLES	xiv
BIBLIOGRAPHY	xv
APPENDIX A	xiv
CHAPTER 1 – INTRODUCTION	1
1.1 Background	1
1.2 Rationale	4
1.3 Problem Statement	4

1.4	Objective	4
1.5	Scope and Limitation	5
CHAPTER 2 – LITERATURE REVIEW		6
2.1	Studies on HVAC system	6
2.1.1	Air Conditioning System	7
2.1.2	Ventilation System	7
2.2	Studies on Filtering Technology	9
2.2.1	Basic Air Filtering Theory	10
2.2.2	Type of Filtering Devices for Home, Office Use.	12
	I. Panel type Filter	12
	a. Oil-Wetted Fibrous Filters	13
	b. Dry Fibrous Filters	14
	c. Continuous or “Roll” Filter	15
	II. Paper Filter	15
	III. Mist Collector	15
2.2.3	Classification of Filter	16
2.3	Water as a Filtering Media	17

2.3.1	Test Setup	17
2.3.2	Test Results	18

CHAPTER 3 – METHODOLOGY **21**

3.1	Type of efficiency tests	21
3.1.1	Testing of filter medium	21
3.1.2	Testing on the complete filter	22
3.1.3	Testing of the filter installation.	22
3.2	Commonly employed expressions for filter medium testing	22
3.3	Methodology	23
3.3.1	Test Objective	24
3.3.2	Test Procedure	24

CHAPTER 4 – ANALYSIS **26**

4.1	Analysis of Experiment Setup	27
4.2	Assumption	28
4.3	Selection of Sample	29

CHAPTER 5 – RESULT AND DISCUSSION

5.1	Results	30
5.2	Discussions	31
5.2.1	Theory of Filtration of Particle in Water	31
5.2.2	Comparison of Water –Based Air Filter With Class A Air Filter	32
5.3	Conclusion of Experiment	33
5.4	Conceptual Design	34
5.4.1	Considerations using water-based Filter in HVAC System	34
	i. Humidity and Bioaerosol	34
	ii. Position of Filter Unit	35
	iii. Fan Energy Consumption	35
	iv. Maintenance	35
	v. Air Diffusion	36

CHAPTER 6 – CONCLUSIONS/RECOMMENDATION 40

6.1	Advantages of Water-Based Air Filter	41
6.2	Recommendations and Future Development	42

LIST OF FIGURES

Figure 1.1	Conventional Air Filter in Ventilation System	3
Figure 2.1	Typical Mechanical Ventilation for HVAC System	8
Figure 2.2	Diagram of Mechanical Ventilation using Centralized A.C	8
Figure 2.3	Particles Size	19
Figure 3.1	Experiment Setup Drawing	23
Figure 4.1	Experiment Setup Picture	26
Figure 4.2	Mesh / Sponge at Air Outlet	28
Figure 5.1	Mesh before Experiment	30
Figure 5.2	Mesh after Experiment (Without Filter)	30

Figure 5.3	Mesh with Water as Filter Medium	31
Figure 5.4	Water Efficiency vs. Particle Sizes Graph	33
Figure 5.5	Typical Control System in HVAC System	36

LIST OF TABLES

Table 5.1	Class A Filter Efficiency	32
Table 5.2	Typical Mechanical Ventilation for HVAC System	32

1.0 Introduction

1.1 Background

Air is very important to human. Survey had shown that most of modern diseases are air borne (Kumar and Clark, *Clinical Medicine*).

A consultant in Contamination Control has estimated that people typically inhale more than two tablespoons of particulates per day. In a comprehensive study reported in Occupational Health and Safety Magazine, it was found that concentrations of total dust fall into the 20 to 40 micrograms per cubic meter in "tight" buildings. When office workers inhale them, respirable particles are deposited on tracheal and bronchial surfaces [United Air Specialist, Inc] This resulted in health problem related to contaminated or dusty air such as asthma.

Closed working space is regarded as a very safe and comfortable place for most people. Actually, closed working space is full with pollutants through several ways:

- Through normal biological process; people and pets generate carbon dioxide, moisture, odors and microbes.
- From the use of consumer products such as spray cans, air fresheners, spray cleaners, construction materials, furnishing and insulation.

- From cigarettes smoke.
- From the soil under and around buildings.
- From appliances such as humidifiers and air conditioners.

[Anthony. L. Hines *et al*, 1993]

Thus, it is very important to have a clean air supply especially in closed working condition. Clean air supply depends on:

- i. Ventilation system
- ii. Air filter used

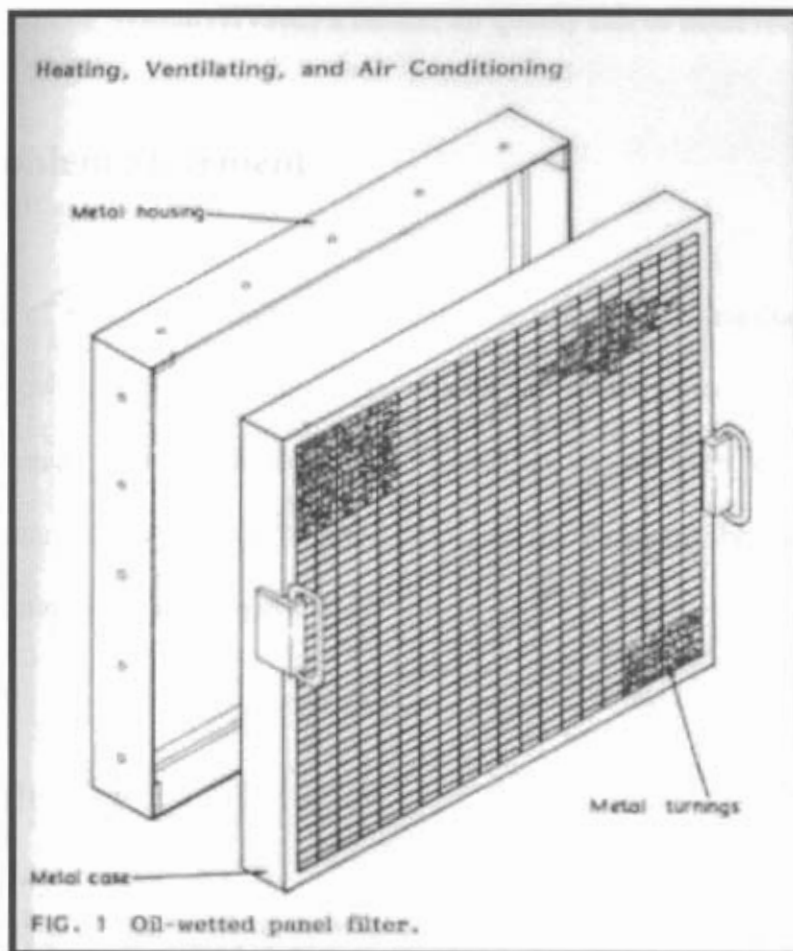
Because of these, supply of clean air is very important. There are basically 3 ways to supply clean air:

- i. Designing a new air cleaning system
- ii. Designing a new air conditioning and ventilation system that emphasize more on clean air supply than just the efficiency of energy use.
- iii. Designing a new filtering system to be embedded into the existing ventilation system.

The last method seems to be more practical and feasible. Typically closed working space for office or public building use Heating, Ventilation and Air Conditioning system (from here on will be called HVAC). It is easier to combine a new filtering system with an establish ventilation system than to design one.

Knowing the important of clean and safe air, a lot of research and design of highly efficient air filter have been conducted. These filters range from conventional air conditioner for home use to high efficiency air filter for hospital and laboratory

use. Even though there is numerous type of air filter, the efficiency of some filter is questionable. Maybe this statement is not true for High-Efficiency filter used in hospital and HEPA filter used in industries (which are of course very expensive) but low cost air filter used in office and has not given a satisfactory result. *Studies conducted by the U.S. Environmental Protection Agency (EPA) and others show that indoor environments sometimes can have levels of pollutants that are actually higher than levels found outside.*



Conventional air filter usually incorporated into air conditioning or ventilating unit

1.2 Rationale

It seems that the conventional filtration and ventilation system is not very dependable. An expensive filtering system (such as High-Efficiency air filter) may seem as a solution but it is impractical and not cost effective to install high cost air filtering system in small office or for domestic use. By designing low cost and very effective filtering device, and combining it with the conventional Heating, Ventilation and Air Conditioning System (HVAC) a cleaner air quality can be achieved.

1.3 Problem Statement

The heart of clean air supply is the choice of correct filter media. If a very effective and low cost filter media can be design (or chosen), and finding a very effective ventilation system to implement the new filter, the problem stated above is solved. It is clear that the main problem is choosing or designing the right filtering media with suitable ventilation system.

1.4 Objective

The objective of this work is to find the possibility of supplying clean air in closed working space (office or public building) by using water (or any fluid based) as a filtering media. The rationale of this is that the conventional filter media have pores, this mean that the smallest particle or dust in air can past through. In the case of fluid, not even the smallest particle in air can get through it. What we are talking here is

about the possibility of designing a low cost filter with efficiency nearly 100%. *Conceptual design* of air ventilation system with water-based filter is also discussed.

1.5 Scope and Limitation

The scope of this thesis is limited to providing clean air in office, house or other public places. Furthermore, the research is done according to Malaysia condition and weather (air humidity is quite high). This research may not be applicable to countries with 4 seasons where air condition changes according to season, due to this, heating system of HVAC system will not be included.

2.0 Literature Review

This chapter will review the past research and study about topics that are related to ventilation and filter such as study on HVAC, filtering, types of filtering devices and its properties and water as a filtering media.

2.1 Studies on HVAC System

“HVAC is the short form of Heating, Ventilation and Air conditioning system. HVAC system will determine the distribution and characteristic of air in closed building and is designed to overcome building heat losses and gains.”

[George Clifford, 1990].

According to George Clifford [1990], HVAC system comprised of:

- Heating System
- Air Conditioning System
- Ventilation System

This thesis is limited to Malaysia climate; thus, the heating component of HVAC system will not be included.

2.1.1 Air Conditioning System

Air conditioning is defined as the simultaneous control of temperature, humidity, air movement, and the quality of air in a given space. [George Clifford, 1990].

Air conditioning can maintain any atmospheric condition regardless of variation in outdoor weather.

2.1.2 Ventilation System

1.1 Ventilation is the process of supplying or removing air by natural or mechanical means, to or from any space [Clifford, 1990]

Basically, there are 4 types of air ventilation:

- i. Infiltration of Outdoor Air
- ii. Natural Ventilation
- iii. Mechanical Ventilation
- iv. Local Ventilation

[Anthony L. Hines *et al*, 1993]

Mechanical ventilation is used mainly for HVAC system. Mechanical system is mainly for ventilation of large building where outside air are taken into the building, conditioned and ventilated into the building.

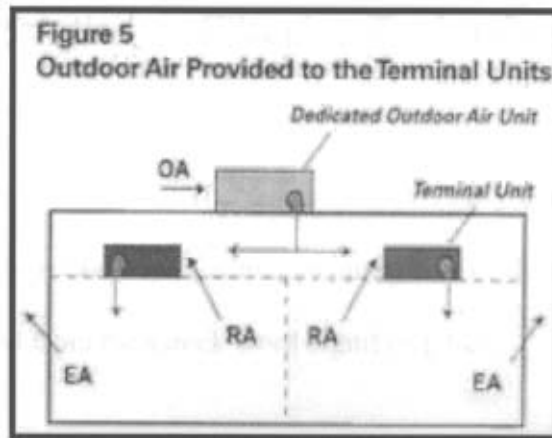


Figure 2.1 Typical Mechanical Ventilation for HVAC System

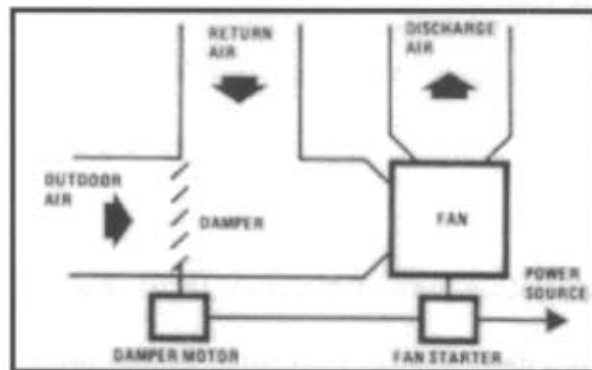


Figure 2.2 Simple Diagram of Typical Mechanical Ventilation of HVAC System
Using Centralized Air Conditioning System.

[<http://www.trane.com/commercial/equipment/sys-eb-3-04.asp>]