



UNIVERSITI TEKNIKAL MALAYSIA MELAKA

STUDY OF CHEMICAL PROPERTIES OF INDOOR AIR QUALITY AT UTEM LIBRARY

This report is submitted in accordance with the requirement of the Universiti Teknikal Malaysia Melaka (UTeM) for the Bachelor Degree of Engineering Mechanical and Manufacturing Technology (Air Conditioning and Refrigeration System) with Honours

by

Mohd Faez Azrin Bin Sulong

B071610924

950801036177

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DECLARATION

I hereby, declared this report entitled “Study of Chemical Properties of Indoor Air Quality at UTeM Library” is the results of my own research except as cited in references.

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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 Mechanical Manufacturing HVAC with Honours. The member of the supervisory is as follow:

.....
(Dr. Mohamad Haidir Bin Maslan)

ABSTRACT

Indoor Air Quality (IAQ) refers to the air quality in and around buildings and structures, particularly as it relates to the occupant's health and comfort. The guidelines for selected pollutants (chemicals) for indoor air quality of the World Health Organization are intended to prevent health risks from these pollutants, which are often present indoors in health-care concentrations. The IAQ levels has a standard that Industry Code of Practice on Indoor Air Quality 2010 (ICOP 2010) has stated. It will be compared with the data collected. The indoor environment in any building depends on how the building system, where the building was constructed, what the building materials, processes and activities were in the building and the occupants of the building. Four elements involved in developing indoor air quality problems, which are sources, the building's HVAC system, pathway, and occupants. Source is when the source of contaminants comes from the building's inside, outside, or mechanical system. The result of indoor air quality chemical parameter from the study shows that both of Administration Unit and Reference Unit at UTeM Library were below the maximum range from Industry Code of Practice (ICOP) 2010. The concentration of carbon dioxide and PM 2.5 experienced fluctuations from morning to evening.

ABSTRAK

Kualiti Udara Dalam (IAQ) merujuk kepada kualiti udara di dalam dan di sekitar bangunan dan struktur, terutamanya yang berkaitan dengan kesihatan dan keselesaan penghuninya. Garis panduan untuk bahan pencemar yang dipilih (bahan kimia) untuk kualiti udara dalaman Pertubuhan Kesihatan Sedunia bertujuan untuk mencegah risiko kesihatan daripada pencemar ini, yang sering terdapat di dalam rumah dalam kepekatan penjagaan kesihatan. Tahap IAQ mempunyai piawaian yang menyatakan Kod Amalan Industri Kualiti Udara Dalam 2010 (ICOP 2010) telah dinyatakan. Ia akan dibandingkan dengan data yang dikumpulkan. Persekitaran tertutup di mana-mana bangunan bergantung kepada bagaimana sistem bangunan, di mana bangunan itu dibina, apa bahan bangunan, proses dan aktiviti berada di dalam bangunan dan penghuni bangunan itu. Empat elemen yang terlibat dalam membangunkan masalah kualiti udara dalaman, yang merupakan sumber, sistem HVAC bangunan, laluan, dan penghuni. Sumber adalah apabila sumber pencemar datang dari dalam bangunan, di luar, atau sistem mekanikal. Hasil parameter kimia kualiti udara dalaman dari kajian menunjukkan bahawa Unit Pentadbiran dan Unit Rujukan di Perpustakaan UTeM berada di bawah julat maksimum dari Kod Praktik Industri (ICOP) 2010. Kepekatan karbon dioksida dan PM 2.5 mengalami turun naik dari pagi hingga petang.

DEDICATION

To my beloved parents, I acknowledge my sincere obligation and appreciation to them for their love, vision and sacrifice throughout my life. I am humble my thankful for their sacrifice, tolerance and consideration that were inevitable to make this effort thinkable. From the day I learned how to read, write, and think until what I became now, their sacrifice inspired me. I disable negotiating the right words to properly describe my appreciation for their devotion, support and faith in my ability to achieve my dreams. Finally, I would like to express my gratitude to any person who either directly or indirectly contributes to my final year project. I would like to acknowledge their comments and suggestions, which are essential for this research to be successfully completed.

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LIST OF SYMBOLS AND ABBREVIATIONS

| | | |
|-------------------|---|---|
| ASHRAE | - | American Society of Heating, Refrigerating, and Air-Conditioning for Engineer |
| °C | - | Degree Celsius |
| CFM | - | cubic feet per minute |
| cfu/m | - | colonies per cubic meter |
| CO | - | Carbon Monoxide |
| CO ₂ | - | Carbon Dioxide |
| DOSH | - | Department of Occupational Safety and Health |
| EPA | - | Environmental Protection Agency |
| HVAC | - | Heating, Ventilation, and Air-Conditioning |
| IAQ | - | Indoor Air Quality |
| ICOP 2010 | - | Industry Code of Practice 2010 |
| m/s | - | meter per second |
| mg/m ³ | - | milligram per cubic meter |
| O ₃ | - | Ozone |
| PM | - | Particulate Matter |
| PM _{2.5} | - | Particulate Matter smaller than 2.5 µm in diameter |
| ppm | - | parts per million |
| RH | - | Relative Humidity |
| SBS | - | Sick Building Syndrome |
| TBC | - | Total Bacteria Count |

| | | |
|----------|---|---|
| TFC | - | Total Fungal Count |
| TVOC | - | Total Volatile Organic Compounds |
| U.S. EPA | - | United States Environmental Protection Agency |
| UTeM | - | Universiti Teknikal Malaysia Melaka |
| VOC | - | Volatile Organic Compound |

CHAPTER 1

INTRODUCTION

This chapter discuss the overall information about the research. It is the guide for the reader to apprehend the detailed fact in later sections. It covers the background of research, research problem and hypothesis, research objective, scope of the research and significant of study.

1.0 Research Background

Indoor Air Quality (IAQ) refers to the air quality in and around buildings and structures, particularly as it relates to the occupant's health and comfort. Comprehension and control of common indoor pollutants can help to reduce your risk of indoor health concerns. Shortly after exposure or possibly years later, health effects from indoor air pollutants may be experienced (Agency, 2017b). Shortly after a single exposure or repeated exposures to a pollutant, some health effects may appear. These include eye, nose, and throat irritation, headaches, dizziness, and tiredness. Normally, these immediate effects are short-term and can be treated. Sometimes, if it can be identified, the treatment simply eliminates the exposure of the person to the pollution source. Shortly after exposure to some air pollutants indoors, symptoms of certain diseases such as asthma can appear, worsen or worsen (Agency, 2017b).

The probability of immediate reactions to air pollutants indoors depends on several factors, including age and pre-existing medical conditions. In some situations, depending on individual exposure, whether a person responds to a pollutant varies tremendously from person to person. After frequent or high-level exposures, certain people may become sensitized to biological or chemical pollutants (Agency, 2017b). Many immediate effects are identical to those caused by colds or other viral diseases, so it is often difficult to

determine whether the symptoms arise from indoor air pollution exposure. This is why it is important to pay attention to the symptoms that occur in time and place. Of example, if the symptoms diminish or disappear when a person is away from the area, an effort should be made to identify possible triggers of indoor air sources. Many symptoms can be exacerbated by an insufficient supply of outdoor air coming indoors or from the indoor conditions of heating, cooling or humidity (Agency, 2017b).

Outdoor or indoor sources can generate pollutants, including building maintenance activities, pest control, housekeeping, renovation or remodeling, new furnishings or finishes, and building activities for occupants (Agency, 2017a). Several different factors affect how occupants are impacted by indoor air contaminants. Many toxins, such as radon, are alarming because exposure to high pollutant levels over long periods of time increases the risk of serious life-threatening diseases, such as lung cancer. Other toxins, such as very high levels of carbon monoxide, can lead to death in minutes. Some pollutants can cause health problems in both the short and the long term. Long-term exposure to ambient tobacco smoke can cause lung cancer, and for some people, especially young children, short-term exposures can lead to irritation and serious respiratory problems (Agency, 2017a).

When exposed to the same pollutants at similar levels, people may react very differently. For example, certain people can experience severe allergic reactions to biological pollutants that will not be reacted to by others. Similarly, some people may be upset by exposure to very low levels of chemicals, but not others. In people with asthma and other pre-existing conditions, exposure to irritants such as smoke from ambient cigarettes or gasses or pollutants from different indoor sources may cause more severe reactions than would otherwise be the same exposure (Agency, 2017a).

1.1 Research Problem & Hypothesis

1.1.1 Statement of Research Problem

- What are the chemical parameters IAQ level in UTeM library at Administration Unit and Reference Unit?

1.1.2 Research Question

1. What is the effect of chemical pollutant on quality air inside the building?
2. Why the fresh air will affect the quality air inside the building?
3. What are the types of pollutant and the effect to the occupants in the building?
4. Which of the effect if the carbon dioxide is too high?

1.1.3 Hypothesis

The past researchers have actually shown that Health effects associated with indoor air pollutants include irritation of the eyes, nose, throat, headaches, dizziness, fatigue, respiratory diseases, heart disease, and cancer. There is a very well-established connection between some important indoor air contaminants such as radon, particle pollution, carbon monoxide, Legionella bacterium, and health effects. Such as carbon monoxide is dangerous and can be fatal in indoor environments with short-term exposure to high concentrations of carbon monoxide.

Like the lungs, the house needs to breathe to keep the air fresh and the dirty air out. In indoor air can build moisture, odor, gas, dust, and other air pollutants. To ensure safe air in the home, fresh outdoor air is required to melt this internal pollutant. To provide good air quality, sufficient air must be brought in and distributed so that it reaches all areas of the house. For almost all houses, windows and structural elements contribute to bringing fresh air.

Many different factors affect how indoor air pollutant can risk the occupant's health. Some of the pollutants, such as radon, are noteworthy because exposure to high levels of pollutants over a long period of time increases the risk of serious, life-threatening diseases, such as lung cancer. Besides, contaminants such as carbon monoxide at very excessive levels can cause loss of life within minutes. Some pollutants can cause each brief and long time period health problems. Some people can make severe allergic reactions to biological contaminants, which others will not react. Likewise, exposure to low levels of chemicals may be annoying to some but not others.

Carbon dioxide (CO₂) is a by-product of combustion in living organisms as well as a result of the metabolic process. Moderate to moderate carbon dioxide levels can cause headaches and fatigue, and higher levels can cause nausea, dizziness, and vomiting. At extremely high levels, loss of consciousness can occur. Fresh air should be supplied to the area to prevent or reduce high carbon dioxide concentrations in a building or space. Concentrations of carbon dioxide within a building are often used to indicate whether the building receives adequate fresh air.

1.2 Research Objective

1.2.1 Main Objectives

- To study the chemical parameters on IAQ in UTeM Library at Administration Unit and Reference Unit.

1.2.2 Specific Objectives

- 1) To measure the IAQ level which is chemical parameters including carbon dioxide (CO₂), carbon monoxide (CO), volatile organic compound (VOC), and particulate matter (PM 2.5).

- 2) To compare the data get from parameters with the standard Industry Code of Practice on Indoor Air Quality 2010 (ICOP IAQ 2010).

1.3 Scope and Limitation of Study

This study was carried out at University of Technical Malaysia Malacca located in Jalan Hang Tuah Jaya, 76100 Durian Tunggal, Malacca. This study involved the measurement of IAQ chemical parameters, which is at Administration Unit and Reference Unit. There are four parameters of IAQ that measured by using the IAQ measuring instruments. Four IAQ parameters including:

- Carbon Dioxide (CO₂)
- Carbon Monoxide (CO)
- Particulate Matter (PM 2.5)
- Volatile Organic Compound (VOC)

After the data was collected, the data was compared to the acceptable range of air contaminants and indoor air quality in the building. There is limitation in this research and study. The biological contaminants such as total bacteria count (TBC) and Total Fungal Count (TFC) was not measured due to the equipment constrain.

1.4 Significant of Study

The significant of this study are results of this research as an input to the authority to improve the quality of the office building's IAQ to ensure the occupant's health. This study also to identify what and where the biggest contribution come from to the carbon dioxide, total volatile organic compound, carbon monoxide and particulate matter.