

RESPIRATORY HEALTH PROBLEMS AMONG
LIBRARY STAFFS AT UNIVERSITI TEKNIKAL
MALAYSIA MELAKA: INDOOR AIR QUALITY
PERSPECTIVE

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UNIVERSITI TEKNIKAL MALAYSIA MELAKA
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STAFFS AT UNIVERSITI TEKNIKAL MALAYSIA
MELAKA: INDOOR AIR QUALITY PERSPECTIVE**

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

by

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Date : 10 December 2014

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 Mechanical Engineering Technology (Refrigeration & Air-Conditioning Systems) (Hons.). The member of the supervisory is as follow:

.....

(Project Supervisor)

ABSTRAK

Kajian yang bertajuk Masalah Kesihatan Pernafasan Pekerja di Perpustakaan Utama Universiti Teknikal Malaysia Melaka: Perspektif Kualiti Udara Dalam ini merupakan kajian bagi mengenalpasti kewujudan masalah kesihatan pernafasan dalam kalangan pekerja di akibat daripada kualiti udara dalaman yang kurang memuaskan. Masalah terhadap kesihatan pernafasan boleh terjejas sekiranya kualiti udara dalaman tidak dipantau. Objektif utama kajian ini adalah bagi mengaitkan hubungan antara masalah sistem pernafasan di kalangan kakitangan dengan status kualiti udara dalaman yang disebabkan oleh sistem penyaman udara di Perpustakaan Utama tersebut. Dua kaedah telah digunakan bagi mendapatkan data untuk mengaitkan perhubungan ini, iaitu dengan mengedarkan borang soal selidik kepada seluruh kakitangan dan dengan pengukuran tahap pencemaran udara dalaman di dalam pejabat. Kaedah- kaedah ini dijalankan dengan merujuk Kod Amalan Industri tentang Kualiti Udara Dalam 2010. (ICOP IAQ 2010). Parameter yang dikaji adalah kepekatan zarah ($PM_{2.5}$), kepekatan karbon dioksida (CO_2), suhu bilik, dan halaju udara. Hasil kajian menunjukkan halaju udara dan suhu bagi ketiga- tiga aras bangunan dalam tempoh kajian, adalah rendah dan tidak mematuhi paras ICOP IAQ 2010. Kepekatan $PM_{2.5}$ dan CO_2 juga diuji dan didapati kedua-dua kepekatan $PM_{2.5}$ dan CO_2 di semua lokasi tidak melebihi nilai yang disarankan. Gejala-gejala pernafasan yang paling lazim berlaku dalam tempoh tiga bulan sebelum kajian ini dilakukan adalah selesema, yang memberikan sejumlah 42.6% bagi semua lokasi manakala aduan tertinggi untuk semua gejala datang daripada pekerja di tingkat pertama (22.2%). Kajian ini diharap dapat membekalkan maklumat dan data yang baru dan berguna tentang hubungan antara kualiti udara dalaman dengan kesihatan sistem pernafasan kakitangan perpustakaan tersebut.

ABSTRACT

This research entitled Respiratory Health Problems Among Library Staffs at Universiti Teknikal Malaysia Melaka: Indoor Air Quality Perspective is a study carried out to determine the prevalence of respiratory health problem among the staff at the library due to poor indoor air quality (IAQ). Respiratory problems could be faced by the staffs who spend almost eight hours a day in the office, if the IAQ is not maintain at a good condition. The main purpose of this research is to determine the relationship between general respiratory health symptoms (RHS) among staffs and the IAQ status caused by VAC system in the Main Library, Universiti Teknikal Malaysia Melaka. The data that is used to relate the respiratory health and IAQ is obtained using two methods, which is by distributing self-administered questionnaires and through IAQ parameter measurement around the working area. The parameters that have been measured are room temperature, level of Carbon Dioxide (CO₂), concentration of particulate matter (PM_{2.5}) and the air velocity. Both methods were conducted by referring the Industrial Code of Practice IAQ 2010 by DOSH Malaysia. The results showed that the air velocity and temperature in all three floors are significant ($p < 0.005$) respectively. Both specific parameters during the research period are not comply with the ICOP IAQ 2010 standard. Both concentration of PM_{2.5} and CO₂ concentrations were also tested by comparing with the three levels. Both PM_{2.5} and CO₂ concentrations at all sites does not exceed the recommended value. The most prevalence respiratory symptom that occurs is flu (42.6%) for all sampling location while the highest compalains for all the symptoms came from occupants in the first floor (22.2%). From this research, it is hope that some new valuable information and valid data about the relationship between IAQ and respiratory health can be obtained.

DEDICATION

I would like to dedicate this Degree dissertation to my beloved parents, Nik Zulkifli Bin Nik Yusoff and Fatimah Bt Ibrahim. There is no doubt in my mind that without their continued support and advice I could not have completed this project.

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LIST OF ABBREVIATIONS, SYMBOLS AND NOMENCLATURE

IAQ	-	Indoor Air Quality
HVAC	-	Heating Ventilation and air conditioning
VAC	-	Ventilation and air conditioning
PM _{2.5}	-	Particulate Matter (2.5 is the diameter of the particle)
CO ₂	-	Carbon Dioxide
ICOP	-	Industrial Code of Practice
RHS	-	Respiratory Health Symptoms
ASHRAE	-	American Society of Heating, Refrigerating, and Air- Conditioning Engineers
SPSS	-	Statistical Package for the Social Sciences
Sig.	-	Significant value
F	-	F Test (ANOVA)
χ^2	-	Value of chi square test
n	-	Number of samples
%	-	Percentage of samples
>	-	More than
≤	-	Equal or less than
<i>p</i>	-	Significance value

CHAPTER 1

INTRODUCTION

The quality of air that is inhaled plays an important role in every aspect in human health, especially for respiratory system as it functions to transport, filter and process the air intake to other parts of the body. As human nowadays spends most of the time indoors, hence the effect of indoor air quality towards respiratory health systems is so crucial to be scrutinized. This is important to ensure that occupant inside the building is in optimum health condition and so that the person inside the building can undergo their routine without any harm. This chapter discusses about the overview of indoor air quality and its effect towards human respiratory health, about respiratory health symptoms (RHS) and its relation with IAQ, about Malaysia's condition, the problem statements of this research, general and specific objectives, scope of the research, and the significance of this research.

1.1 Overview on Indoor Air Quality (IAQ)

Indoor Air Quality (IAQ) can be defined as the quality of air inside and within a space or building. Presence of dust, microbial contaminants like bacteria, virus and mold, insufficient temperature, high concentration of gasses and high concentration of volatile organic compounds could diminish the level of IAQ. As a result, the occupants will suffer Sick Building Syndrome (SBS), including respiratory health problems. Hence IAQ is an important element as it can affect occupants' health and comfort, leading to low productivity of work (Kamaruzzaman, and Sabrani, 2011).

Besides, Nur Fadhilah and Juliana (2012) define the ideal IAQ as the air inside the building that we inhale is free from any form of contaminants such as biological form, chemical, or physical forms. Contaminant in the form of chemicals, for example, carbon dioxide and volatile organic compounds will become poisonous when their concentration in the surrounding air is excessive. As well as other types of contaminants, it could give a bad effect to human health if they are exposed to it physically or even worst if these impurities entered the respiratory system.

1.2 Respiratory Health Symptoms (RHS)

Buildings are designed with the ability to maintain the indoor environment more efficiently by sealing up the building after the energy crisis in 1970s. This action on the other hand causes ventilation rate in the building to be lower (WHO, 1986). Low ventilation rates will lead to increase in concentration of gasses (carbon dioxide, carbon monoxide and formaldehyde), increase in concentration of dust particles and Total Volatile Organic Compounds (TVOCs), which generally causing the presence of Sick Building Syndrome (SBS).

Furthermore, poor IAQ level will contribute to upper respiratory (nasal, eye and throat) and mucous membrane symptoms, for example, nasal allergies, running nose and eyes, and others respiratory health symptoms (RHS). The other respiratory health symptoms that might be experienced by the occupants is on the lower respiratory, for example, cough, tight chest, wheeze, or shortness of breath (SOB) (Michael *et al.*, 2000).

1.3 Malaysia's Condition

However, Malaysia is still lack of awareness of the importance of maintaining and servicing the Ventilation and Air Conditioning (VAC) systems in the building. This has likely happened because of financial issue problems incurred by the buildings'

management and the attitude of take it easy. As a result, the level of IAQ is decreasing as the pollution from harmful gasses, microbial contaminant and dust inside the building is increasing from time to time. This neglect on the other hand can give bad effect on human health, especially for the respiratory system.

Hence, this study is conducted to determine the relationship between respiratory health symptoms (RHS) among staffs and the poor IAQ status caused by HVAC system in the UTeM Main Library.

1.4 Problem Statement

Jaakkola *et al.*, (1994) have stated that indoor air quality is affected by the performance of heating, air conditioning, and ventilation technology. This situation also happened related to the quality of outdoor air and emissions from the indoor environment and the building's occupants.

Poor Indoor Air Quality (IAQ) can cause several troubles like respiratory problem to the occupants who spend almost half a day inside the building. Some of the factors that might cause problems to respiratory system are the presence of dust around the bookshelf area, chemical used to preserve the reading materials in the library, chemicals that dissipated from photocopy machines and even the air conditioning systems itself.

As reported in United States Environmental Protection Agency website (n.d.), the presence of these contaminants does not mean that an adverse health effect will automatically experience by the occupants. However, continuous exposure of these contaminants can result in increased incidence of the types of ailments that often involves respiratory systems and others, such as asthma, allergies, chemical and biological sensitivities, sinus infections, headaches, nausea, chronic coughs, respiratory distress, and potentially cancer.

Nevertheless, the duration and intensity of exposure and sensitivity of the individual will determine if an effect will occur. Seltzer (1997) states that the time taken for the person to become ill from the presence of a contaminant depends on many factors, for example the individual sensitivity towards the contaminant, concentration of the existed contaminant, the current state of the person psychological and physical health and also depend on the duration and frequency of exposure.

Besides, this research is conducted at UTeM's Main Campus Library, and it is categorized as new building. It is reported by Michael *et al.*, (2000) that compared to old building, new building is normally having a higher concentration of contaminant, mainly total volatile organic compounds (TVOCs). This substance, is known as one of the major contributors to low indoor air quality level, which finally helps to trigger respiratory health symptoms to the occupants.

Public awareness regarding the risk associated with poor IAQ in the office and home is recently increasing, due to increasing in research about this problem (Berntein, *et al.*, 2004). However, according to the Department of Safety and Health (2006), in Malaysia, the indoor air quality is still having a big issue and the study on the effect of IAQ in Malaysia's library to the occupants' respiratory health is still rarely been done, hence the information about its effect is still in general.

In the rostrum by Jonathan A. Bernstein, *et al* (2007), to complicate matters, environmental exposures are often more subtle and not readily recognized. As the symptoms suffered by the occupant in nonindustrial occupational settings is almost similar, hence the terms of sick building syndrome (SBS), the toxic mould syndrome and others have been created to explain and characterized the syndrome. This statement strengthens the fact that the information related to indoor air quality is still insufficient. This study, on the other hand, hopefully will gain and provide some new beneficial information and new data about the status of IAQ and its effect on respiratory health.

On the subject of to completing this research, there are some problems that have been identified. Since the questionnaire method is used, it is doubt that the respondent did not answer the questions provided as honest as it should and some of the staffs did not fully understand or misunderstood the question. Apart from that, during the data collection period, the number of occupants in the library sometimes is not constant, hence the level of IAQ that have been measured might exaggerate by this condition. These problems are affecting the data and results that will be evaluated.

1.5 General Objective

The objective of this study is to determine the relationship between general respiratory health symptoms (RHS) among staffs and the IAQ status caused by HVAC system in the Main Library, UTeM.

1.6 Specific Objectives

The specific objective of this study are :

- (a) To measure the level of IAQ parameters such as percentages of relative humidity, carbon dioxide, carbon monoxide, concentration of total volatile organic compounds (TVOC) and others related parameters in the building of UTeM Main Campus Library.
- (b) To determine the concentration of particulate matter PM_{2.5} in the occupied area in UTeM's library in the Main Campus.
- (c) To identify the respiratory health symptoms among staffs in UTeM Main Library.
- (d) To correlate the relationship between the level of IAQ parameters in the occupied space and RHS.

1.7 Scope

A cross sectional study was carried out at University Teknikal Malaysia Melaka (UTeM) Main Library in Durian Tunggal, Melaka on September 2014 to October 2014. A total number of 62 staffs of UTeM's Main Library will be selected on behalf to complete this study. From the sum of 62 staffs, 34 are male, while the rest are female. The respondents are selected by using the universal sampling method. Two types of measurements are used to gain the data needed;

- (a) Level of IAQ using Air Velocity Meter, Advanced Particulate and Air Quality Monitor.
- (b) Symptoms of respiratory illness and health condition experienced by occupants using a self-administered questionnaires of RHS.

For the first method, data on the IAQ parameters are measured in 8-hour Time Weighted Average (TWA) in seven areas as below:

- (a) Administration unit
- (b) Circulation unit
- (c) Indexing unit
- (d) Media unit
- (e) Procurement unit
- (f) Automation unit
- (g) Reference unit

The questionnaire consists of demographic data of the respondents, employment data and respiratory symptoms related to IAQ of the building. The data are collected and analyzed using the Statics Package for Social Science (SPSS) version 21.0.

1.8 Project Significance

A better levels of IAQ of the air conditioning system will prevent the workers from facing respiratory health symptoms, preserve the occupants health and respiratory condition at an optimum level. Besides, this study will provide new available data about the level of IAQ and its effect on respiratory symptoms among occupants. Moreover, from this study will help to increase the awareness of the building manager to maintain the air conditioning system inside their buildings at its most advantageous state for the occupants sake.

1.9 Conclusion

Indoor air quality plays a major contribution to human health as people spend most of the time indoors. There are a lot of consequences may be occur when occupants are exposed to low level of IAQ, especially for the respiratory system. Hence, this study is helping to identify the relationship between respiratory health problems among staffs in UTeM's Main Campus Library with the level IAQ in the building.

CHAPTER 2

LITERATURE REVIEW

This chapter will focus on the theory and terms mainly related to this research, which is about respiratory health problems and its relationship with indoor air quality. The sources of theory are from previous research and related articles. This chapter aim to give a better understanding about this research and to give strong evidence, support and reasons why this research should be done. Lately, there is numerous studies have been conducted about the level of IAQ and its effect on human health, but there is still lack of studies focusing on the effect of IAQ towards respiratory health in a non- industrial working place, such as a library. Thus, this research aims to reveal the cause of respiratory health problems of library staffs in UTeM Main Campus Library whether it has a relationship with the level of IAQ.

2.1 General Information Related to Indoor Air Quality

Nowadays, people spent most of their time in the building rather than being exposed to the outdoor environment and hot sunlight. This is most likely because the level of comfort for the people to undergo outdoor activities is relatively decreasing as the level of outdoor temperature and outdoor air pollution is keep increasing or we can say unstable from day to day. The existence of Heating, Ventilation and Air Conditioning (HVAC) system also may be the factor that attracted people to choose to spend their time and to make money for their living indoors. Hence, it is very important to make sure that the indoor air quality is at its optimum level. This is because it will help to create a healthy indoor work environment (ICOP IAQ, 2010).

There are some parameters that have been pointed out to indicate IAQ status, which summarized to four main points, including its examples:

Table 2.1: Parameters to indicate IAQ status (ICOP IAQ, 2010)

IAQ parameter	Example
Chemical contaminants	Carbon dioxide, carbon monoxide, formaldehyde, and environmental tobacco smoke (ETS)
Physical conditions	Air temperature, air velocity, and humidity
Biological agents	Mites, virus, and spores
Radiation	Radon

The ASHRAE, (2011) defines indoor air quality as quality of air that relate to the concentration of contaminants that might or will affect human comfort, health, environmental satisfactions, and working or school performance. Besides, depending on the presence of contaminants itself, thermal condition also should be noted in controlling the level of IAQ as temperature and humidity can trigger the growth of microorganisms, affect pollutant emission rates and the survival of the source of allergens such as house dust mites.

Table 2.2: Acceptable range for specific physical parameters (ICOP IAQ, 2010)

Parameter	Acceptable Range
Air Temperature	23 to 26°C
Relative Humidity	40 to 70%
Air Velocity	0.15 to 0.50 m/s

Indoor air quality is very plays an important role in human everyday life. There are many factors that have been identified by former researchers, which may affect the level of IAQ. The materials used to build the building, or the material presence in the room and level of occupancy are part of the major contributors that will give some effect to IAQ level. Besides, Shaw (1997) added two more factors which are building design and operation, presence of contaminant and ventilation rate.

It is almost confirmed that ventilation has something to do with IAQ as Nur Fadilah and Juliana (2012) state in their research that indoor air quality is like an indicator to determine the cleanliness and quality of air in term of ventilation efficiency and