COMPLIANCE OF AIR CONTAMINANTS WITHIN THE MAIN PRAYER HALL OF MASJID SAYYIDINA ABU BAKAR UTEM, MELAKA WITH MALAYSIA'S INDOOR AIR QUALITY STANDARD

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BACHELOR OF MECHANICAL ENGINEERING TECHNOLOGY (REFRIGERATION AND AIR CONDITIONING SYSTEM) WITH HONOURS

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Faculty of Mechanical and Manufacturing Engineering Technology

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A thesis submitted
in fulfillment of the requirements for the degree of
Bachelor of Mechanical Engineering Technology (Refrigeration And Air Conditioning System) with Honours

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2023

DECLARATION

I declare that this Choose an item. entitled “Compliance Of Air Contaminants Within the Main Prayer Hall Of Masjid Sayyidina Abu Bakar UteM, Melaka with Malaysia’s Indoor Air Quality Standard” is the result of my own research except as cited in the references. The Choose an item. has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : 

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Date : 20 January 2023

APPROVAL

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor of Mechanical Engineering Technology (Refrigeration and Air Conditioning System) with Honours.

Signature : AzwanAziz

Supervisor Name : Ts. Azwan Bin Aziz

Date : 20 January 2023

DEDICATION

To my beloved parents, dear lecturers and fellow friends

ABSTRACT

Poor air quality have been a serious issue that nowadays people always talked about. It has become a global problem as it happen in almost every part of the world. How do we know that it is poor air quality?. In the air contains many particles, matters and gases which human breath in every single time as it part of photosynthesis sycle. In general, the method to measure the level of air quality need a lot of procedure to be taken into because it is a complex and require many resources to refer. This research expected to assess the level of concentration of air contaminants in the main prayer hall of Masjid Sayyidina Abu Bakar UteM, Melaka to see whether it compliance with guideline limit in Industrial Code of Practice ICOP IAQ 2010. In the guideline already provided the acceptable ranges of air contaminants for better quality of air in the a building for its occupant comfort. The parameters to be record is carbon dioxide, particulate matter, total volatile organic compound (TVOC), air temperature and relative humidty. There are variety of sources for air contaminants such as smoke from vehicles, building material, furnishing and many more. These contaminants can lead to serious effect on health as the body breath in more toxins gas. This research use 3M-EVM as an equipment to measure all of the air contaminants as it is an accurate device to assess the level of concentration and identify the contaminants.

ABSTRAK

Kualiti udara yang buruk telah menjadi isu serius yang selalu diperkatakan oleh orang ramai. Ia telah menjadi masalah global kerana ia berlaku di hampir setiap pelusuk dunia. Bagaimana kita tahu bahawa ia adalah kualiti udara yang buruk?. Di udara mengandungi banyak zarah, jirim dan gas yang dihirup oleh manusia setiap masa sebagai sebahagian daripada kitaran fotosintesis. Secara umumnya, kaedah untuk mengukur tahap kualiti udara memerlukan banyak prosedur yang perlu diambil kira kerana ia adalah kompleks dan memerlukan banyak sumber untuk dirujuk. Penyelidikan ini dijangka dapat menilai tahap kepekatan bahan cemar udara di solat utama Masjid Sayyidina Abu Bakar UteM, Melaka untuk melihat sama ada ia mematuhi had garis panduan dalam Kod Amalan Perindustrian ICOP IAQ 2010. Dalam garis panduan tersebut sudah disediakan julat yang boleh diterima. untuk kualiti udara yang lebih baik di dalam bangunan untuk keselesaan penghuninya. Parameter yang perlu direkodkan adalah karbon dioksida, bahan zarah, jumlah sebatian organik meruap (TVOC), suhu udara dan kelembapan relatif. Terdapat pelbagai sumber pencemar udara seperti asap dari kenderaan, bahan binaan, perabot dan banyak lagi. Bahan cemar ini boleh membawa kepada kesan yang serius terhadap kesihatan kerana badan menghirup lebih banyak gas toksin. Penyelidikan ini menggunakan 3M-EVM sebagai peralatan untuk mengukur semua bahan cemar udara kerana ia merupakan alat yang tepat untuk menilai tahap kepekatan dan mengenal pasti bahan cemar.

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Last but not least, from the bottom of my heart i would also like to thank my beloved parents for their endless support, love and prayers. Finally, thank you to all the individual(s) who had provided me the assistance, support and inspiration to embark on my study.

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LIST OF SYMBOLS AND ABBREVIATIONS

IAQ	Indoor Air Quality
ICOP	Industry Code of Practice
AQI	Air Quality Index
IEQ	Indoor Environmental Quality
TVOC	Total Volatile Organic Compound
PM	Particulate Matter
CO_2	Carbon Dioxide
RH	Relative Humidity
DOSH	Department of Occupational Safety and Health

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CHAPTER 1

INTRODUCTION

1.1 Background

Every day, Muslims visit their mosques to pray and engage in other acts of worship. Mosques are considered to be holy places by Muslims. Being in the mosque can help us feel more at ease and relaxed, which is especially beneficial when we are praying in the mosque's main hall. It has also become a location where tourists come to see and see for themselves the one-of-a-kindness and beauty of the mosque with its many unusual wall carvings and the majestic architecture of the mosque. In addition, it has become a place where people gather to pray.

The main prayer hall of the mosque is an indoor area that is open to the public and serves as the location for Muslims to say their prayers five times a day. This area is always full of worshippers. The primary prayer halls are designed to provide the worshippers with an appropriate level of thermal comfort, allowing them to entirely focus on their prayers without being distracted by their surroundings. To ensure that the worshippers have an appropriate environment to pray in, the majority of mosques in Malaysia place carpeting on the floor of the main prayer hall, which is equipped with air conditioning. Because the mosque is open to the public and is used on a regular basis, the air quality needs to be maintained and checked on a regular basis because it is subject to contamination from both interior and outside sources (N. Rasli, 2019).

There are many various types of pollutants that can be found in the air, including carbon monoxide (CO), carbon dioxide (CO2), particulate matter, and many others. Lack of ventilation, bad air quality outside, a lack of maintenance, and many other factors can all have a negative impact on the air quality. All of these factors have the potential to influence the persons inside the prayer hall, whether they are engaged in the act of praying or some other activity. There are standards for Malaysia's Indoor Air Quality that each and every mosque in the country needs to follow in order to maintain a healthy environment and higher standards for air quality (Al-Ajmi, 2017)..

1.2 Problem Statement

Various factors can affect indoor air quality in the main prayer hall of the mosque and there are many indoor air contaminants need to be measure its degree of compliance whether it is acceptable with the guideline limit. For better air quality, all the data obtained need to be within the range set by Malaysia's Indoor Air Quality Standard so that people who come to the mosque can have comfortable and peacefulness while completing their activities.

In order to gather accurate data, the equipments that are used in the process of measuring the levels of indoor air contaminants need to be prepared and properly set up at the location that has been determined. The research is carried out in the middle of the Dhuhr prayer on Friday and the Asr prayer in the afternoon. It takes a significant amount of time to acquire the data.

1.3 Research Objectives

Main objective:

- To assess the extent to which five air contaminants comply to the standards limit outlined in the Industrial code of practise (ICOP) IAQ 2010 during the Dhuhr/Friday and Asr prayer times in the mosque's main prayer halls

Specific objectives

- To measure the mean concentration of five air contaminants in the main prayer halls of Masjid Sayyidina Abu Bakar Utem Melaka.
- To evaluate the level of contamination in the air in relation to the guideline limit recommended by the ICOP IAQ in 2010.

1.4 Scope of Research

The Industry Code of Practice (ICOP) Indoor Air Quality 2010 was used as the base for the standard usage in this research. The primary objective of this study is to assess the extent to which air contaminants are in compliance with the guidelines limit. The main prayer hall of Masjid Sayyidina Abu Bakar Utem, will serve as the location for the study area.

Carbon dioxide, total volatile organic compounds, particulate matter, and relative humidity are the air quality parameters that need to be collected. The research will be conducted over a period of five hours, beginning at noon and continuing through the evening prayer times of Dhuhr and Asr. In order to determine whether there is a significant difference in the air quality outside and inside the mosque, samples will be taken both places.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

The level of cleanliness or filthiness of the air is referred to as the "air quality." Because polluted air can be hazardous to both human health and the environment, the quality of the air must be carefully monitored. The Air Quality Index, often known as the AQI, is used to evaluate the quality of the air. The Air Quality Index (AQI) is similar to a thermometer with a temperature range of 0 to 500 degrees. The Air Quality Index is a daily air quality report index that displays an overall rating of how clean or unclean the air is as well as the potential adverse effects on one's health. The AQI is a tool that measures the potential adverse effects on one's health that can arise from breathing contaminated air within a few hours or days (American Lung Association, What is the air quality index, 2020). When air quality is poor, it can create health problems such as poor respiratory health, which can be traced back to toxins in the surrounding air that have a harmful influence both in the short term and the long term (J. Beitler, 2020).

Due to the steady circulation of air, the quality of the air might change from day to day and even from hour to hour. Both the flow of air through a region and the ways in which people interact with it directly contribute to the quality of the air in that location. Mountain ranges, coastlines, and changes in land use are all factors that can affect whether air pollutants concentrate in a certain location or diffuse away from that place. On the other hand, the kinds and amounts of pollutants that are released into the air have a bigger influence on the quantity of air that is present. Some pollutants are introduced into the

atmosphere as a result of natural processes, such as erupting volcanoes or dust storms; however, the vast majority of pollutants are the result of activities carried out by humans. Aside from that, wind is another factor that plays a role in determining the quality of the air we breathe. A coastal region that contains an island mountain range may experience higher levels of air pollution during the day, but lower levels of air pollution during the night as a result of the breeze blowing in the opposite direction (Rinkesh, 2020).

2.2 Indoor Environmental Quality (IEQ)

The term "indoor environmental quality" (IEQ) refers to how a building environment affects the health of its occupants. IEQ is affected by many factors, such as illumination, air quality, and moisture. It has an impact on the comfort and well-being of residents. In the research of IEQ, other issues including sick building syndrome and poor indoor air quality are also taken into account. The interactions that these factors have with one another complicate the relationship between occupant comfort and well-being parameters and IEQ even more (Al Horr Y, 2016). The environment within is pretty complicated. Building occupants may be exposed to a variety of contaminants, such as office equipment, cleaning supplies, water-damaged building materials, furniture, carpets, and microbiological growth including mould, fungal, and bacterial, in the form of gases and particles.

Construction work, pollution from outside sources, and cigarette smoke are all examples of potential pollutants. Relative humidity, ventilation, and indoor temperatures can all affect how people react to their surroundings. Workers may be able to avoid or recover from illnesses related to the building by comprehending and removing the sources of toxins in the indoor environment. There is practical advice for improving and

maintaining the indoor environment (NIOSH, 2013). People inside a building may get dissatisfied if the inside environment is poor. these factors include thermal comfort, ventilation, indoor air quality, electromagnetic radiation, and many others. Environmental regulations that are improved will make people happier. Figure 2.1 shows the indoor environment quality components.

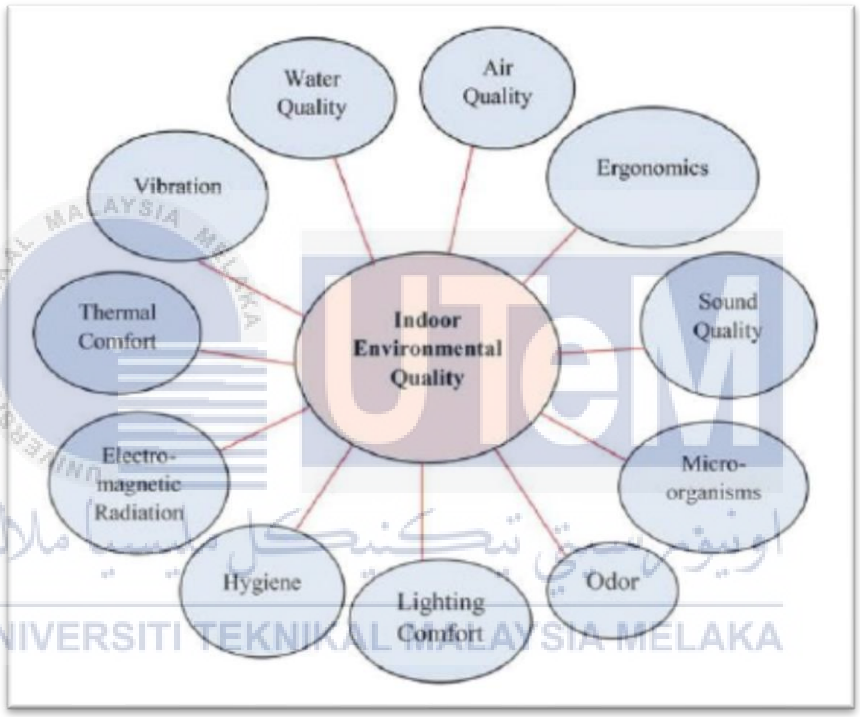

Figure 2.1 Components of IEQ

2.3 Indoor Air Quality (IAQ)

Indoor air quality (IAQ) is the term used to describe the air quality inside and around buildings and other structures, especially as it relates to the health and comfort of occupants. Lowering the probability of having an indoor health issue can be done by identifying and removing prevalent indoor contaminants. The health effects of indoor air pollution may manifest right away or years later**.** (EPA, 2021). Indoor pollutants have many different sources. Studies are conducted into the potential health impacts of indoor combustion products from cooking, heating, and smoking tobacco. Volatile Organic Compounds (VOCs), which are produced by paints, varnishes, solvents, and preservatives, may be particularly significant. If the building's structure keeps deteriorating, exposure to asbestos may also be a substantial risk factor for developing long-term respiratory conditions. (Jones, 1999).

As a result of the fact that individuals spend up to 90 percent of their time indoors, virtually everyone has the potential to be subjected to indoor air pollution, the severity of which is determined by the buildings in which they reside as well as any preexisting health conditions they may have. Children are at a greater risk of suffering the negative health effects of polluted indoor air because of the amount of time they spend in educational institutions. Schools are particularly vulnerable because they frequently suffer from poor interior air quality due to age and a lack of resources to address issues related to the environment found indoors. This presents a challenge on a national scale. Schools are particularly vulnerable because they house children. Because their systems are still developing, children are especially susceptible to this risk because it is physically more difficult for children to process toxins than it is for adults. This makes children more at risk than adults. (Bridger, What cause poor indoor air quality?, 2021).

2.4 Indoor Air Quality (IAQ) compliance range

The Industrial Code of Practice (ICOP) 2010 was developed in order to establish minimal health standards for employees and other occupants of an indoor or enclosed environment that is serviced by a common mechanical ventilation and/or air conditioning system. This was done in order to ensure that the requirements for the indoor air quality compliance rates are met. This code of practise is applicable to all establishments that are not considered to be industrial, including those that are included (Department of Occupational Safety and Health, 2010). Table 2.1 and 2.2 shows the air quality parameters and its acceptable range.

Table 2.1 Acceptable range for specific physical parameters

Parameters	Acceptable range
Relative Humidity	40 – 70%
Temperature	23 - 26°C
Air movement	0.15 – 0.5m/m

Table 2.2 Maximum Allowable Range for Indoor Air Contaminants

Indoor air contaminants	Acceptable range		
	mg/m^3	cfu/m^3	ppm
Carbon monoxide	-	-	10
Formaldehyde	-	-	0.1
Ozone	-	-	0.05
Total Volatile Organic Compound (TVOC)	-	-	3
Chemical contaminant	-	-	-
Respirable particulate	0.15	-	-
Fungal count	-	1000*	-
Bacterial count	-	500*	-
Biological contaminant	-	-	-
Carbon dioxide	-	-	1000
Ventilation of performance indicator	-	-	-

2.5 Sources of Poor Indoor Air Quality

The majority of individuals are unaware of how poor indoor air quality affects overall health, particularly respiratory health. According to the Environmental Protection Agency, indoor air quality (IAQ) is defined as the quality of the air in and around a building or other structure, with a focus on how it affects the health and wellbeing of the occupants in the facility. (Bridger, 2021). Indoor air pollution is the cause of poor indoor air quality. According to the World Health Organization (WHO), about 4.3 million individuals pass away annually as a result of being exposed to the air pollution that is caused by household activities.

2.5.1 Pollutant Sources

Understanding the root causes of indoor air pollution is the first step toward addressing the issue and improving both indoor and outdoor air quality. Toxic substances, poor air circulation, high humidity, and extreme heat are all possible contributors. (Foundation, 2018).

I. Formaldehyde – a bad-smelling, colourless gas that is used to make a variety of household goods and construction materials. additionally serve as carpet glue.

II. Biological pollutants – Examples include viruses, bacteria, animal fur and saliva, trash, and mites. These pollutants can make you sick since they thrive in humid environments.

III. Wooden kitchen, house heaters, fireplaces, and dryers – When they are not properly vented or when they are not vented at all, fuel-

burning appliances release dangerous levels of nitrogen dioxide and carbon monoxide into the atmosphere.

IV. Tobacco produces smoke – occur as a result of the incomplete combustion of tobacco that occurs during the use of tobacco products such as cigarettes, electronic cigarettes, and other products.

V. Artificial fragrances, air fresheners, deodorizers and perfumes – utilise largely uncontrollable substances. The extremely unpredictable and semi-volatile chemical compounds that are produced by these products have the potential to contaminate indoor air.

VI. Varnishes, paints, and a few household cleaning products – pollute the air that is contained within a building.

VII. Fumes of paraffin wax candles – When burned, these substances emit toxic smoke and black soot. Benzene, toluene, naphthalene, and many more compounds are present.

VIII. Dry-cleaned clothing – trichloroethylene and perchloroethylene are present.

IX. Lacquer, paint, glue and plywood – release organic gases that are volatile. Even years after the installation of the building components, harmful volatile organic compounds can still be released.

X. Office supplies and equipment release tiny particles and gases – It is possible for laser printers, copiers, graphics, and craft items to emit VOCs and ultrafine particles. It can make a deep entry into the lungs.

XI. Pesticides – usage to eliminate of rats, bacteria, and fungi, which are all considered domestic pests.

2.5.2 Air Pollution Serious Effects

Due to the potentially lethal consequences, kids and the elderly are expose to the negative effects of indoor air pollution. (Foundation, 2018).

I. Asbestos is the leading cause of asbestosis, lung cancer, and mesothelioma, in addition to several other types of cancer.

II. Dust mites and other animal furs are examples of contaminants that can cause serious consequences including the flu, throat discomfort, and other dangerous diseases.

III. Formaldehyde, a recognised human carcinogen, can trigger allergic reactions and irritate the nose, eyes, and ears.

IV. Tobacco smoke causes serious respiratory irritation, bronchitis, pneumonia, heart issues, lung cancer, and emphysema.

V. Lead can seriously risk a person life because it can harm the brain and nerves, result in renal failure and anaemia, and compromise the cardiovascular system.

VI. Hazardous nitrogen oxide and carbon monoxide are produced by gas and wood kitchen and heaters, which can infect the respiratory system and harm the lungs.

VII. It is known that chemicals perchloroethylene and trichloroethylene in dry-cleaned clothing cause cancer..

VIII. Artificial perfumes contain compounds that are extremely volatile as well as semi-volatile, which can lead to skin irritation, allergic responses, central nervous system disorders, birth defects, and infertility.

IX. As pesticides are used to eliminate household pests, it damages the central nervous system, irritates the throat, nose, and eyes, and increases the risk of developing cancer.

2.6 Ozone

Ozone, which has the chemical formula O3, is a gas molecule that is composed of three atoms of oxygen and has a pungent odour. It is also known as smog, and it is dangerous to breathe in because it aggressively targets the lung through chemical reactions with it. O3 layer, which exists very high in the upper atmosphere, shields the earth from the harmful effects of the sun rays (the stratosphere). On the other hand, when O3 is present at ground level, it might be harmful to our health if we breathe it in. (American Lung Association, 2020). When heat and sunlight are mixed, they produce chemical reactions that involve nitrogen oxides (NOX) and volatile organic compounds (VOC), which are more usually referred to as hydrocarbons. Ozone is produced as a result of this process. Figure 2.2 shows the formation of ozone.

Figure 2.2 Ozone formation

2.6.1 Individuals Who Are Prone to Ozone Breathing

Groups of people included:

I. Adolescents and children.

II. People over the age of 65.

III. Those who do outside labor or exercise.

IV. People who have chronic obstructive pulmonary disease (COPD),

Many factors may have an impact on your health, but the risk is increasing as the ozone layer depletes, and if you work or exercise outside, your breathing rate increases as your time spent outside increases.

2.6.2 Effects of Ozone Pollution on Health

Researchers have regularly discovered that higher levels of ozone increase the rate of premature death in big studies conducted across the United States, Asia, and Europe. According to a recent study, ozone increased the risk of early mortality even when other pollutants were present. (American Lung Association, 2020). Asthma, increasing in respiratory infections, breathing difficulties, coughing and wheezing are issues which require further attention.

2.7 Carbon Dioxide (CO^2)

It gives off the appearance of a colourless gas. The chemical compound known as carbon dioxide, or CO2, has a density that is approximately 53% greater than that of dry air. In spite of the fact that combustion is responsible for producing a significant portion of the atmosphere's carbon dioxide, this gas is only responsible for a very small portion of the atmosphere's total carbon dioxide content. During the process of photosynthesis, it includes carbon-containing materials, fermentation, and animal respiration, all of which are used by plants. (Hanson, 1980). Carbon dioxide (CO2) is an essential component of the air that surrounds the planet, despite the fact that its concentration in the atmosphere is much lower than that of oxygen and nitrogen. The carbon dioxide (CO2) molecule is formed when one carbon atom and two oxygen atoms combine to form it. (Clocke, 2006). Figure 2.3 shows the structure of CO_2

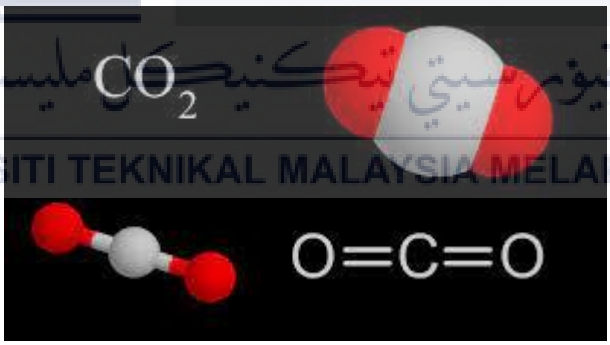

Figure 2.3 Carbon Dioxide bonding

The primary factors influencing CO2 concentration inside a building are human activity (breathing), the introduction of outside CO2, and the building's air flow rate. Due to advancements in energy efficiency and airtightness, the amount of fresh air that people in homes and buildings are able to breathe has decreased. In order to save money on energy costs, many modern ventilation systems recycle air instead of bringing in fresh air.

Poor ventilation and high levels of carbon monoxide are the end result. A significant problem in classrooms, homes, and workplaces, excessive levels are associated with low productivity and high sick leave. (AIRTHINGS, 2022). Figure 2.4 explained the photosynthesis cycle and table 2.3 shows the properties of CO_2

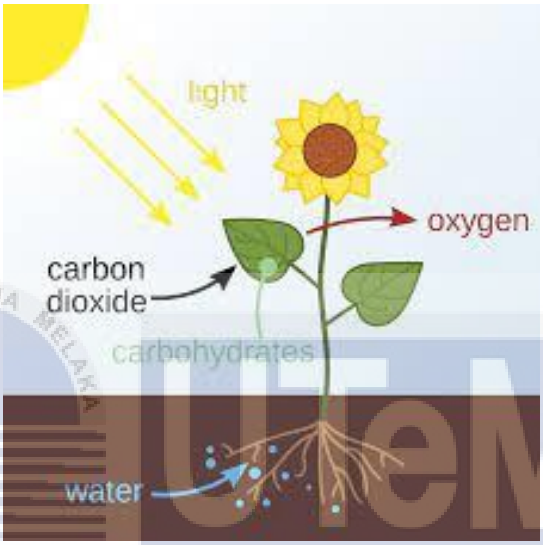

Figure 2.4 Cycle of photosynthesis

Table 2.3 Physical and chemical properties of CO_2

PROPERTIES	VALUES
Density critical	468 kg/m_3
Molecular weight	44.01g/mol
Liquid	Pressure < 415.8 kPa
Specific gravity	1.53 at 21°C
Stability	High
Concentration in air	$370.3x10^7$ ppm
Solid	Temperature < -78°C
Solubility for Henry constant	298.15 mol/kg x bar
Solubility in water	0.9 vol/vol at 20°C

2.8 Carbon Monoxide (CO)

Carbon monoxide, poisonous gas that is odourless, colourless, and produces no byproducts when it is burned in an incomplete manner. If you were to be exposed to CO gas, it would result in poisoning because the CO molecule would compete with oxygen for space in the body. Act as a silent killer because people have no way to trace the problem until they get sick, as the gas can accumulate indoors and reach lethal amounts to the body. As a result, the gas acts as a killer without a trace.(Minnesota Department of Health, 2016). When CO enters the bloodstream, a reaction will take place with hemoglobin, which is a component of red blood cells that are responsible for transporting oxygen throughout the body. If this were to occur, the blood would no longer be able to carry oxygen, which would lead to the death of cells and tissue throughout the body. (Smith G. , 1965).

2.8.1 Carbon Monoxide in the Home

Burning fuel and the use of devices are common sources of carbon monoxide in homes. (Minnesota Department of Health, Carbon Monoxide Sources in the Home, 2016) such as:

I. Water heaters.
II. Dryers for clothes.
III. Wood burning and fireplaces.
IV. Boilers and furnaces.
V. Motor vehicles.
VI. Microwave and gas stove.
VII. Smoke from tobacco.
VIII. Stove made of wood.

2.8.2 Symptoms of Carbon Monoxide

The symptoms are not noticeable, particularly at low levels of exposure. The most common symptom is a headache. (Smith G. , 1965). Other symptoms include:

I. Feeling dizziness
II. Perplexity and fatigue
III. Stomach ache
IV. Feeling sick and being unwell
V. Feeling shortness of breath

2.9 Formaldehyde (CH_2O)

Chemical that is flammable, colourless, and emits a foul odour called formaldehyde can be found in building materials and a number of household items. Fiberboard, particleboard, and plywood are among the materials that contain CH2O. Aside from that, there is paper product coating, permanent suppressor cloth, glues, and some insulating materials. (J. London, 2011). CH2O decomposes quickly in the air, usually within hours, but when mixed with water, it is known as formalin and is commonly used as an industrial disinfectant, as well as a preservative in medical labs and burial homes. CH2O can be used as a preservative in a variety of foods and commodities such as cosmetics, pharmaceuticals, and antiseptics. It also occurs naturally in the environment, with small amounts created by humans and other living animals as part of normal metabolic processes. (The American Cancer Society, 2020). Figure 2.5 shows the structure of formaldehyde.

2.9.1 Sources of Formaldehyde (CH_2O)

Formaldehyde can be found in (U. S. EPA, 2022):

I. Pesticides and fertilizers

II. Construction materials and insulation

III. Smoke from cigarette

IV. Resin used in the production of composite wood products such as plywood and medium-density fiberboard.

V. Some preservative-containing cosmetics, medicines, and fabric softeners

VI. Permanent press textiles, glue, paint and coating also with paper goods

VII. Emissions from unventilated fuel-burning appliances (kerosene space heaters and gas stove)

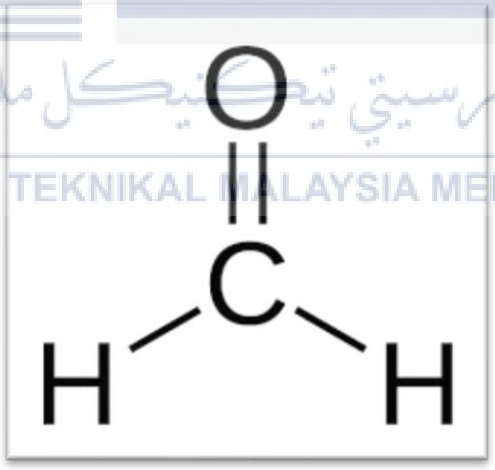

Figure 2.5 Structure of Formaldehyde

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2.10 Total Volatile Organic Compound (TVOC)

Volatile organic compounds are those that have a high vapour pressure but a low water solubility. Total Volatile Organic Compound (TVOC), which has a wide range of chemical properties, refers to a group of substances found in emissions or ambient air. Many (VOCs) are produced by man-made substances and are used in the manufacture of medicines, paints, and refrigerants, among other things. (VOCs) include industrial solvents such as fuel oxygenates, trichloroethylene, and methyl tert-butyl ether (MTBE), while chloroform is a byproduct of chlorination in water treatment. (United States Environmental Protection Agency, What Are Volatile Organic Compounds (VOCs)?, 2019). It is also commonly found in hydraulic fluids, paint thinners, petroleum fuels, and dry cleaning agents. Certain solids or liquids emit volatile organic compounds (VOCs) as gases, which can cause both short- and long-term health problems.

Many (VOC) concentrations are consistently higher indoors than outside (up to five times higher). The EPA's Office of Research and Development's Total Exposure Assessment Methodology (TEAM) study (Volumes I to IV, completed in 1985) found that levels of a dozen common organic contaminants were 2 to 5 times higher inside dwellings than outside, regardless of whether the houses were in rural or heavily industrial areas. According to studies, people who use goods containing organic compounds are more likely to expose themselves and those around them to exceptionally high pollutant levels, which can linger in the air long after the activity has ended. (United States Environmental Protection Agency, 2015). Figure 2.6 shows the cycle of VOCs compound.

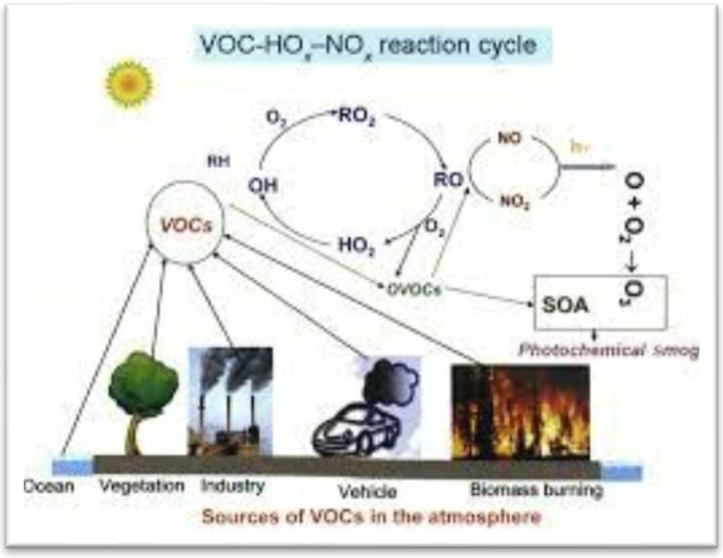

Figure 2.6 Volatile Organic Compound cycle

2.10.1 Sources of VOCs

Product for homes such as:

I. Sprays with aerosols.

II. Disinfectants and cleaners.

III. Preservatives for wood.

IV. Paints, solvents, and paint strippers.

V. Moth repellents and air fresheners.

VI. Pesticides.

VII. Dry-cleaned clothing.

2.10.2 VOC Exposure Has Negative Health Impacts

Inhaling any chemical may result in health problems depending on how long it is in the air, how frequently people breathe in, and for how long. It is critical to remember that (VOCs) are a class of compounds. Each compound has a distinct toxicity and the potential to cause a wide range of health effects. (Smeltzer, Volatile Organic Compund in Your Home, 2021).

Health effects may include:

I. Nausea, headaches, and poor coordination.
II. Irritation of the eyes, nose and throat.
III. Some organics cause cancer in animals, while others cause cancer in humans.
IV. Injurious to the kidney, liver, and central nervous system.
V. Allergic reaction on the skin.
VI. Dyspnea (Difficulty breathing).
VII. Fatigue.
VIII. Cholinesterase levels are declining.
IX. Nosebleeds.
X. Vomiting

2.10.3 Ways to Reduce Levels of VOCs

Search across your house for common sources (VOCs). Look for paints, solvents, adhesives, varnishes, and caulks that have not been used in a long time.

Ways to reduce exposure include (Smeltzer, 2021):

I. Source Control: Reduce or eliminate the levels of VOC emitting items in the home.
II. Kept the leftover of chemicals in shed or garage.
III. Look for paints and furniture with low volatile organic compounds (VOCs).
IV. Ventilation and Climate Control: By increasing the amount of fresh air in the house, the concentration of (VOCs) can be reduced.
V. Use fans to bring in as much fresh air as possible, or open doors and windows to increase airflow.
VI. Keeping the temperature and humidity as low as possible because chemicals release more dangerous gases at high temperatures and humidity.
VII. When the house is empty, renovate it and improve the ventilation.

2.11 Particulate Matter (PM)

A mixture of solid particles and liquid droplets in the air is referred to as a particle solution, which is synonymous with the term particulate matter (PM). Particles such as dust, grime, smoke, and soot are examples of large or dark particles that can be seen with the naked eye, while others are so small that they can only be identified with an electron microscope. (US EPA, 2016). Particles can be found in an extremely diverse assortment of sizes, shapes, and chemical make-ups. In addition to that, it might be made up of inorganic ions, elemental carbon, metallic compound, organic compound, and chemicals derived from the surface of the earth. (California Air Resources Board, Inhalable Particulate Matter and Health (PM2.5 and PM10), 2020). Figure 2.7 shows the size of PM particles of $PM_{2.5}$ and PM_{10}

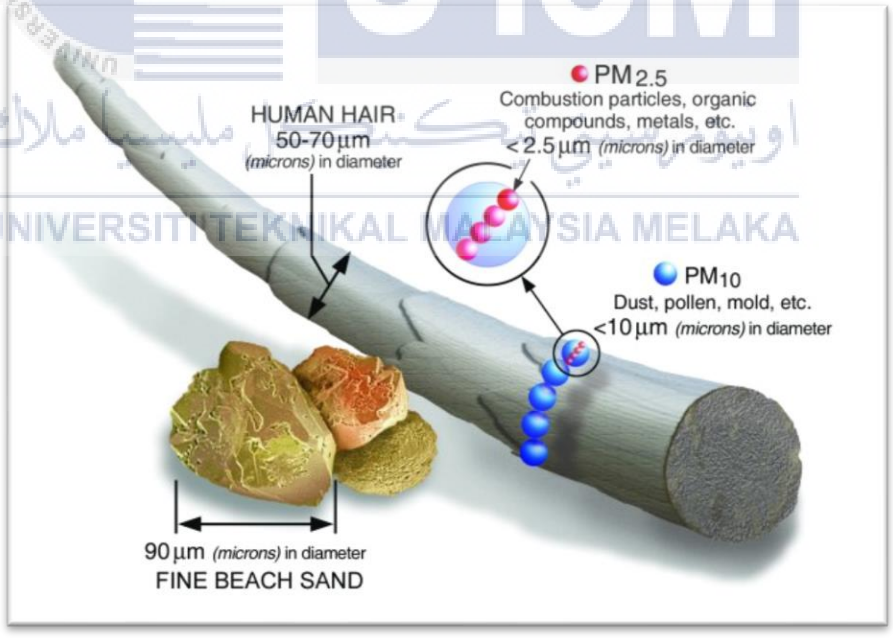

Figure 2.7 Size for PM particles

The majority of the particulate matter that was discovered inside, particularly PM2.5, originates from the environment outside. Doors, windows, and other structural leaks allow the particles to enter the interior spaces of buildings. Components derived from biological sources, the majority of which are referred to as allergens; some examples of allergens that are prevalent in indoor particles include mould spores, pollens, cockroaches, and dust mites. Cooking, the process of burning wood in the kitchen, and smoking tobacco are all examples of activities that take place indoors that generate particles for particulate matter. As a consequence of this, it is also a complicated reaction with gaseous contaminants that are produced by sources such as air fresheners and household cleaners. (California Air Resources Board, 2020). Table 2.4 and table 2.5 shows the 24 hour and annual mean concentration of particulate matter.

Table 2.4 Annual mean concentrations

	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	Basis for the selected level
Iinterim target-1 (IT-1)	70	35	These levels are associated with about a 15% higher long-term mortality risk relative to the AQG level.
Interim target-2 (IT-2)	50	25	In addition to other health benefits, these levels lower the risk of premature mortality by approximately 6% [2–11%] relative to theIT-1 level.
Interim target-3 (IT-3)	30	15	In addition to other health benefits, these levels reduce the mortality risk by approximately 6% [2-11%] relative to the -IT-2 level.
Air quality guideline (AQG)	**20**	**10**	These are the lowest levels at which total, cardiopul-monary and lung cancer mortality have been shown to increase with more than 95% confidence in response to long-term exposure to $PM_{2.5}$

Table 2.5 24 hour concentrations

	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	Basis for the selected level
Interim target-1 (IT-1)	150	75	Based on published risk coefficients from multi-centre studies and meta-analyses (about 5% increase of short-term mortality over the AQG value).
Interim target-2 (IT-2)	100	50	Based on published risk coefficients from multi-centre studies and meta-analyses (about 2.5% increase of short-term mortality over the AQG value).
Interim target-3 (IT-3)*	75	37.5	Based on published risk coefficients from multi-centre studies and meta-analyses (about 1.2% increase in short-term mortality over the AQG value).
Air quality guideline (AQG)	**50**	**25**	Based on relationship between 24-hour and annual PM levels.

- 99th percentile (3 days/year).
- The annual average of the guideline values; the exact number will be obtained by using the local frequency distribution of the daily means.

2.11.1 Exposure to Particulate Matter Leads to Negative Consequences

Particle exposure has been associated to additional hospitalisations and death from heart or lung ailments. Despite substantial epidemiological research, there is currently no evidence that particulate matter exposure has no health consequences. Short-term and long-term health impacts exist. (NSW Health, 2020).

Short-term exposure (hours to days) leads to:

I. Heart disease and arrhythmias (irregular heart beat).

II. Eyes, nose and throat irritation.

III. Asthma and lung illnesses

IV. Premature death and hospitalisation as a result of respiratory and cardiovascular illnesses.

Long-term exposure (years) leads to:

I. Decreasing in life expectancy.

II. A declination in lung function.

III. High disease progression rate.

IV. Development in cardiovascular and respiratory diseases.

2.11.2 PM10

PM10 particles have a diameter of less than 10 m, whilst PM2.5 particles have a diameter of less than 2.5 μm. Particles with diameters smaller than 10 μm are the most dangerous in suspended particles. Anthropogenic activities (industrial, household, agriculture, and transportation) can directly emit them into the atmosphere. Particles can also be created in the atmosphere directly by physicochemical reactions between pre-existing pollutants. (Insee, 2021). Particulate matter is made up of a complicated mixture of soot, metals, smoke, sulphates, nitrates, rubber and dust.

Sources of PM_{10} particles:

I. Industry.

II. Ocean salt.

III. Emissions from automobiles and truck.

IV. Smoke produced by fires.

V. Unsealed roads that emit dust.

2.11.3 Environmental Impacts of Particulate Matter

Particulate pollution has an influence on both the environment and human health. Particulate matter pollution causes both climate change and acid rain. Particle pollution can have devastating environmental consequences, especially in disadvantaged areas of the world. Particulate matter is thought to influence weather on a regional scale. For example, during Indian Monsoons, which occur in the Indian Ocean, it lowers evaporation of seawater, making it less effective and leading to dryness. (Content Team, 2018). The greenhouse effect prevents heat from fleeing the planet, causing polar ice caps to melt and sea levels to increase. Ocean acidification is caused by carbon dioxide particles, which are toxic to marine life.

2.12 Research Summary

The purpose of this study is to determine if the air quality in the main prayer halls of Masjid Sayyidina Abu Bakar UTeM, Melaka meets the guideline limit in the Industrial Code of Practice (ICOP) IAQ 2010 in order to preserve occupant comfort. The following characteristics must be gathered for this study: carbon dioxide, total volatile organic compound (TVOC), particulate matter, relative humidity and temperature. Finding the mean for the level of concentration of the parameters indicates whether or not the air quality is within the recommended limit.

CHAPTER 3

METHODOLOGY

Introduction

This part will discuss the research flow, beginning with research planning, studying the research area, and recording data on the parameters using specified equipment. Once the data has been collected, calculate the mean concentration level of the parameters and compare it to ICOP IAQ 2010 to determine the parameters' compliance rate. To obtain precise data, the study will be conducted across four days with five hours of observation every day.Figure 3.1 shows the research protocol.

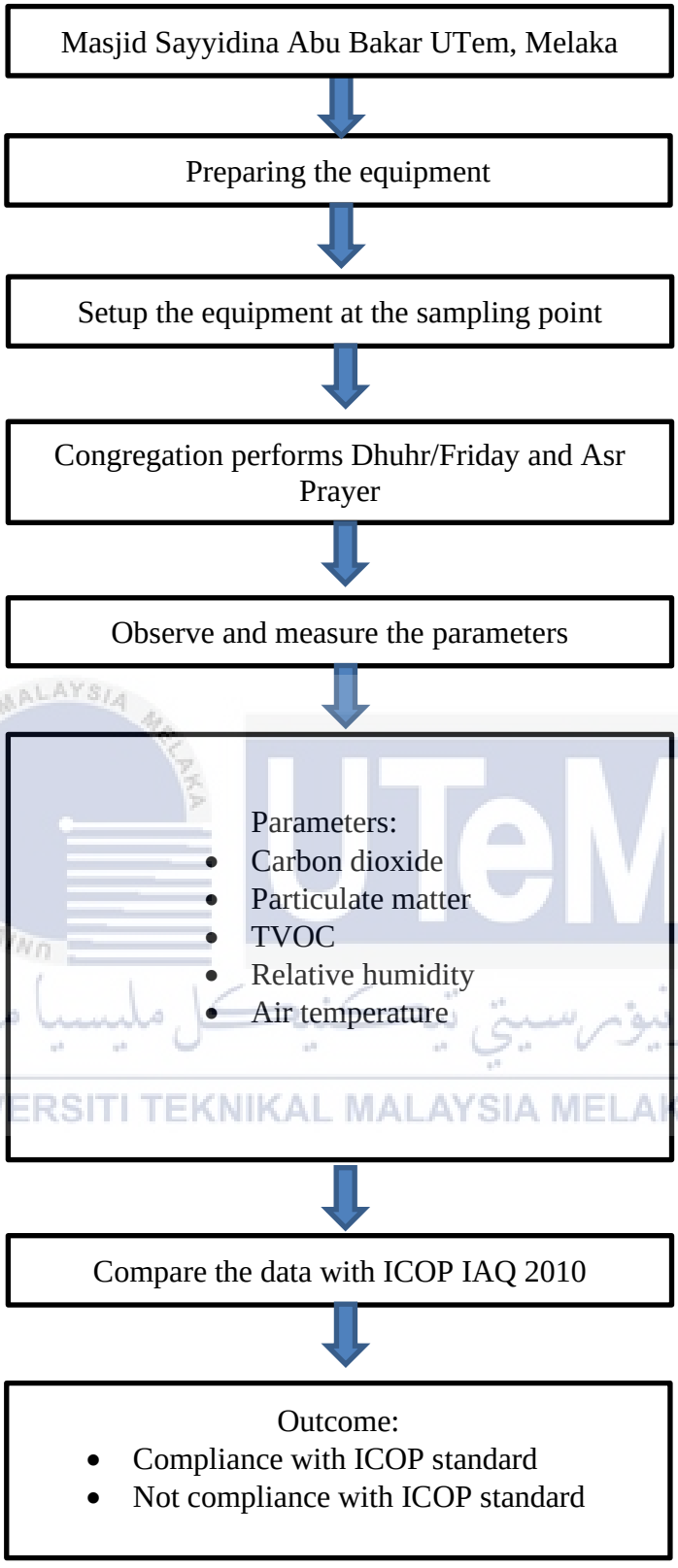

Figure 3.1 Research protocol

3.1 Research Area

This project's research will be conducted in the main halls of Masjid Sayyidina Abu Bakar UTeM in Durian Tunggal, Melaka. The mosque is built within a university and has long drawn attention from the general public. It was a massive mosque that people used to perform prayers and other religious activities with UTeM students and staff. No wonder Masjid Sayyidina Abu Bakar is the ideal location for doing study on the mosque's air quality..

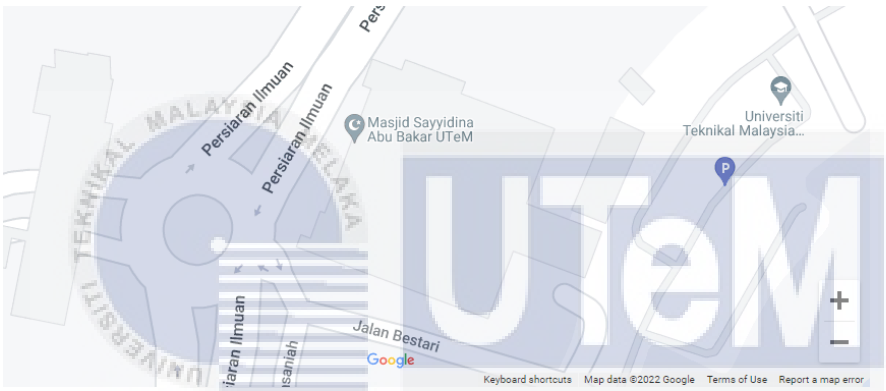

Figure 3.2 Google Maps location of the mosque

3.2 Data Collection

The goal of the research is to collect data based on the parameters. The equipment will be placed at sampling points both inside and outside the building. The purpose is to compare and analyse data collected from both within and outside the main halls. According to ICOP IAQ 2010, there are numerous sources that affect air quality both inside and outside. The time allotted for each sampling inside and outside will be around five hours from 12 p.m. to 5 p.m. during Dhuhr and Asr prayer. The data collection process will be the same for all four days of research.

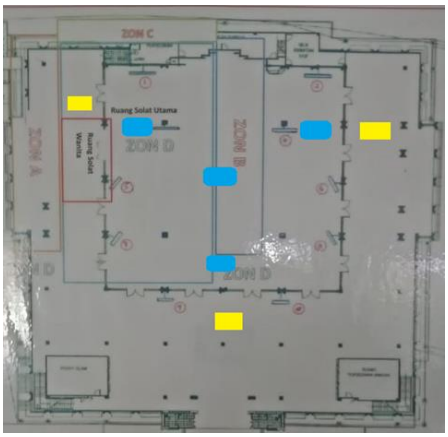

Figure 3.3 Layout of sampling points

Figure 3.4 Sampling point inside and outside main prayer hall

3.2.1 Parameters

To measure the amount of concentration of air pollutants, data must be collected based on the parameters.:

I. TVOC

II. Carbon dioxide

III. Particulate matter

IV. Air temperature

V. Relative humidity

3.2.2 Equipment

The 3M-EVM equipment is what is being used for this research, as shown in figure 3.4. The EVM is a portable area monitoring instrument that is equipped with a laser photometer that is used to measure the concentrations level of airborne-dust over the course of time. Air pollutants, which can be found in the environment as various forms of matter (gases and aerosols), will be measured and identified using this instrument. The optical probe sensor AirProbe-10 was utilised by 3M-EVM in order to sense, measure, and correctly identify all of the air pollutants that the instrument was able to detect.

Figure 3.5 3M-EVM Series

3.2.3 Particulate Sampling (Aerosol/dust vapors)

A component including an air input, an impactor (which operates as a particle size selector), particulate collection, gravimetric sampling, and a pump are all required for the technique. The movement of the particles is illustrated in figure 3.5.

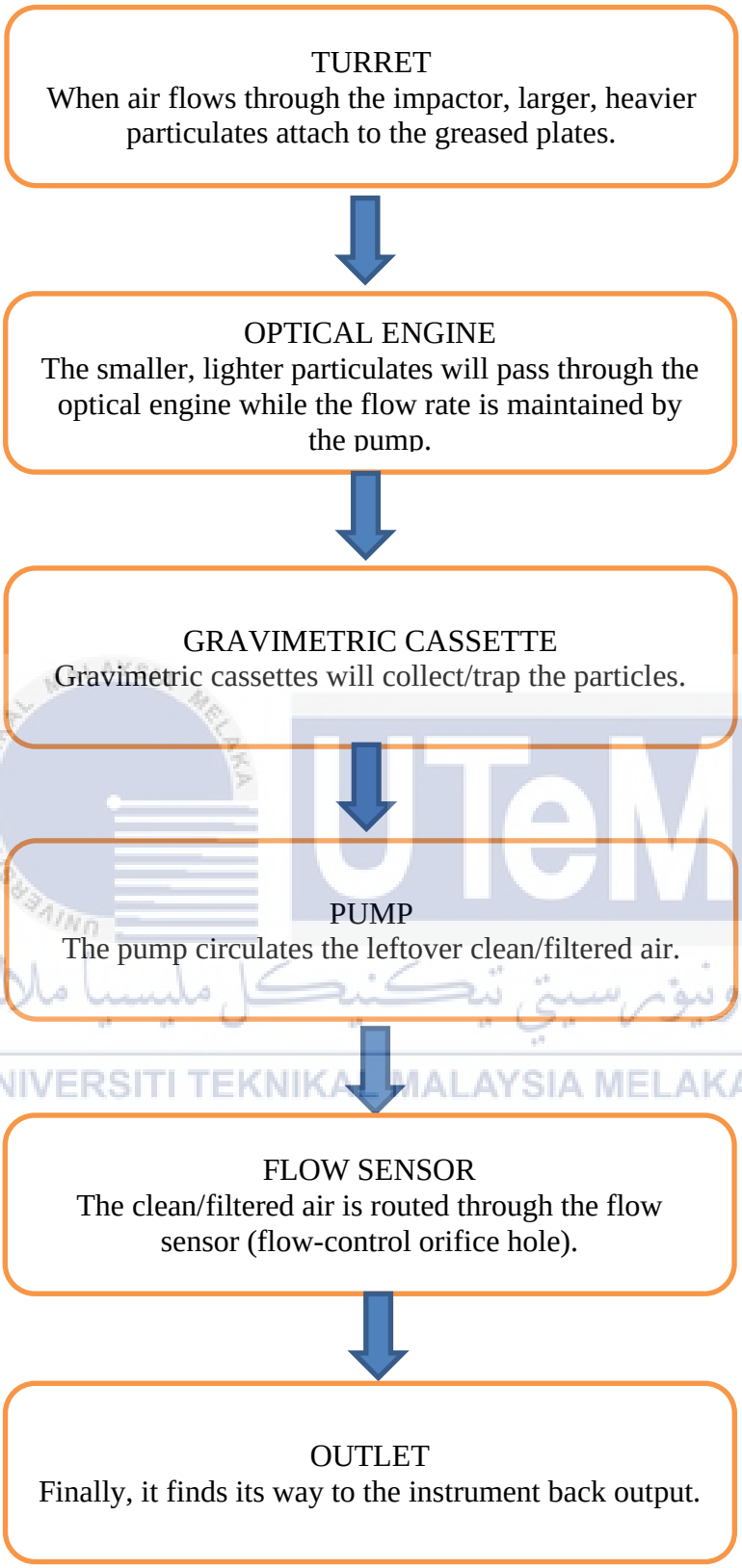

Figure 3.6 Particulate path

3.2.4 Path and Gas Sensors

One of the technologies involves smart sensor, which is one of 3M-distinctive EVM's capabilities. Calibration levels, automatic sensor recognition, temperature compensation information, and other data that passes through the sensor are all possible. Figure 2.3 shows the gas sensor path.

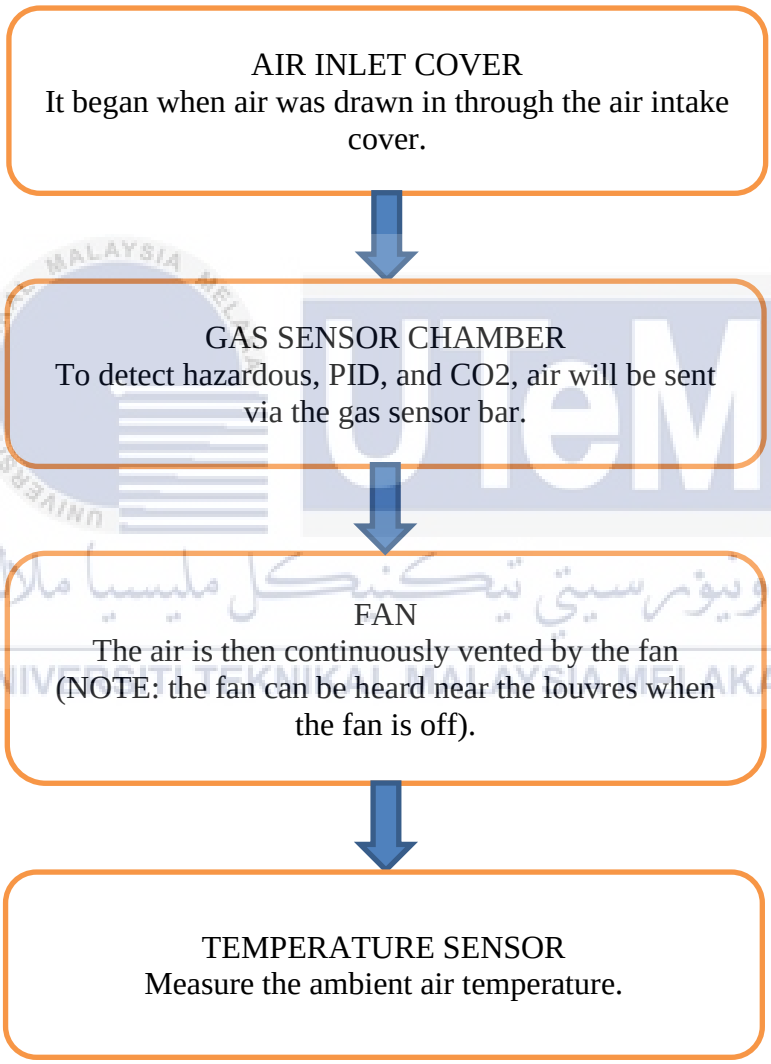

Figure 3.7 Gas sensor path

3.2.5 Descriptive Statistics

A set of basic descriptive coefficients that summarise a data set, which could be a representation of the entire population or a sample of it. Descriptive statistics are classified into two types: measurements of central tendency and measures of variability. Central tendency measures include the mode, median, and mean. The goal of this study is to determine the concentration of mean level of air contaminants in the main prayer halls of Masjid Sayyidina Abu Bakar UteM in Melaka.

3.3 Data Analysis

The data collected and recorded using the 3M-EVM will assist to enhance the air quality in the mosque's main halls, and the data can be compared to the ICOP IAQ 2010 standards established by the Department of Occupational Safety and Health (DOSH). The data is analysed by determining the mean concentration level of air contaminants to determine whether or not it meets the standard.

3.4 Expected Outcome

Increasing levels of air contaminants will result in poor air quality within the main prayer halls. The level of concentration of ait contaminants shall be within the range established by ICOP IAQ 2010.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Introduction

This section explained the result of the work study. The data is being collected which is aimed to measure the mean concentration of air contaminants within main prayer hall of Masjid Sayyidina Abu Bakar Utem, Melaka and the compliance with Malaysia's air quality standard.

4.2 Data collection

The data were collected in four days at Masjid Utem with two sampling point inside the main prayer hall and outside the main prayer hall. Duration of collecting data was five hours which is from 12 pm to 5 pm during Dhuhr prayer. Each day represent one sampling point to be record.

Table 4.1 Value of IAQ parameters inside main prayer hall

Days	**IAQ parameters**				
	CO_2 (ppm)	**TVOC (ppm)**	**PM2.5 (mg/m^3)**	**Temperature (°C)**	**RH (%)**
Day 1	0.007	0	1.068	28.206	78.770
Day 2	0	0	0.703	28.849	76.557
Day 3	0.075	0	4.010	26.895	85.587
Day 4	0.034	0	0.095	27.108	82.637
Acceptable range	1000	3	0.15	23-26	40-70
Mean	0.029	0	1.469	27.764	80.888
Standard deviation	0.034	0	1.741	0.923	4.016

Table 4.2 Value of IAQ parameters outside main prayer hall

Days	**IAQ parameters**				
	CO_2 (ppm)	**TVOC (ppm)**	**PM2.5 (mg/m^3)**	**Temperature (°C)**	**RH (%)**
Day 1	23.103	3.645	3.140	28.748	78.748
Day 2	11.459	4.001	3.923	28.850	79.099
Day 3	18.932	4.342	10.901	26.866	87.908
Acceptable range	1000	3	0.15	23-26	40-70
Mean	17.831	3.996	5.990	28.155	81.585
Standard deviation	5.899	0.349	4.271	1.117	5.485

4.3 Particulaate Matter (PM 2.5)

Particulate Matter is a particles or dust with a mixture of solid particles and liquird droplets in the air. In this study, PM2.5 were collected at four sampling point inside the main prayer hall and three sampling point outisde the main prayer hall. The data were anaylze, tabulated and shown with graph. The outcome of this analysis indicate that high PM2.5 may comes from carpet install inside of the main prayer hall and outside sources such as cooking from nearby food stall at mosque area.

4.3.1 PM2.5 collected inside main prayer hall

The data were collected at four sampling points with each day represent one sampling point.

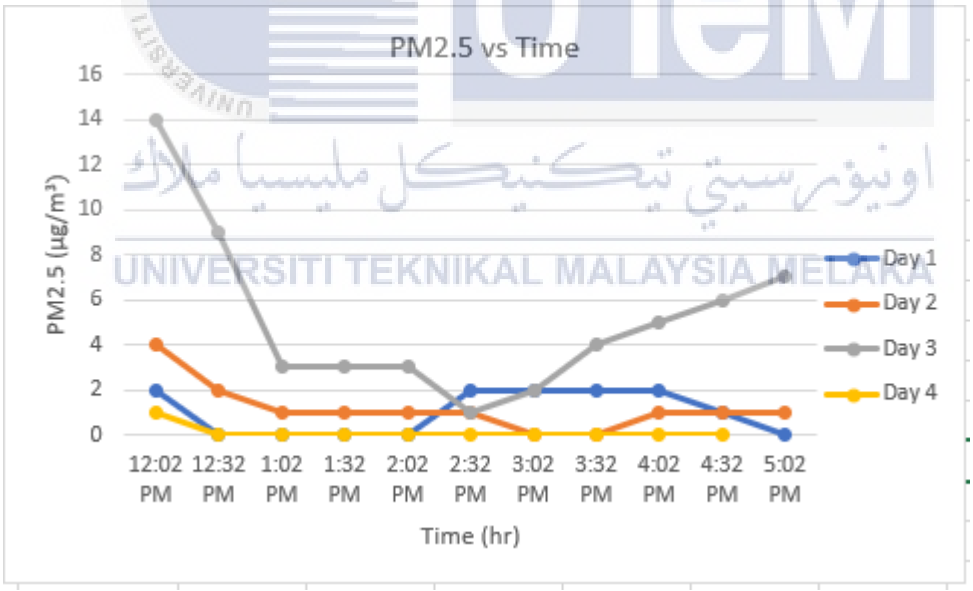

Figure 4.1 Graph of PM2.5 inside main prayer hall

According to figure 4, the highest mean of PM2.5 is Day 3 which is 11 mg/m³ at 12:02:30 PM, while the lowest mean of PM2.5 is Day 2 which is 0 mg/m³ at 12:32:30 PM, 1:02;30 PM, 4:02:30 PM and 4:32:39 PM and Day 1 at 12:32:30 PM.

4.3.2 PM2.5 collected outside main prayer hall

The data were collected outside main prayer hall for three days.

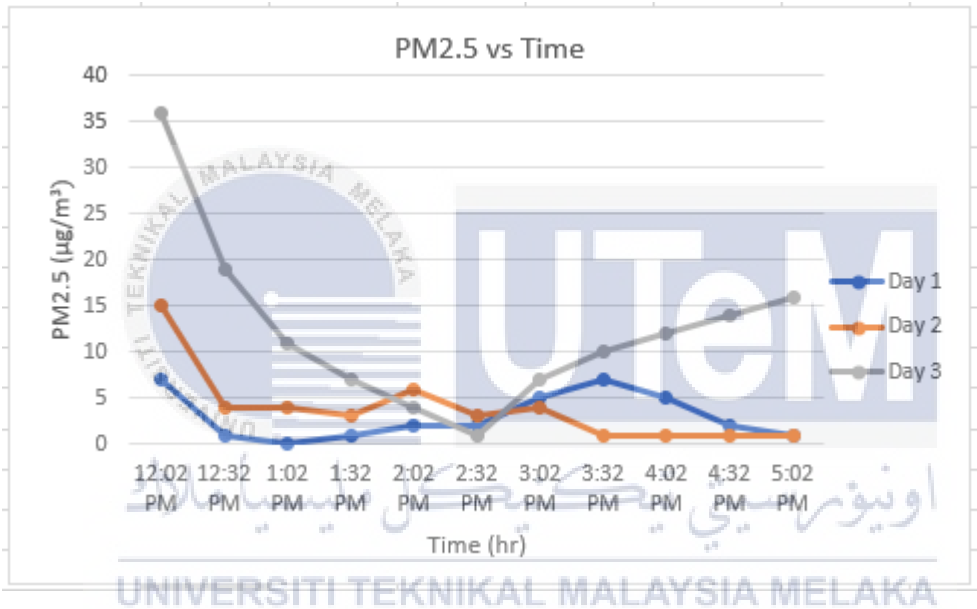

Figure 4.2 Graph of PM2.5 outside main prayer hall

Based on figure 4.2 the highest mean is Day 3 which is 36 mg/m³ at 12:01 PM, while the lowest mean is 0 mg/m³ at 4:31 PM in Day 1.

4.3.3 Comparison of PM2.5 between inside and outside

Table 4.3 P value of PM2.5

Days	Inside	Outside
Day 1	1.068	3.140
Day 2	0.703	3.929
Day 3	4.010	10.901
Day 4	0.096	
Mean	1.469	5.990
Standard deviation	1.741	4.271
P value	0.2001	

Table 4.3 showed P value of PM2.5 is 0.2001 which is the data is not significant with $P > 0.05$.

4.4 Relative humidity (RH)

The ability of the air to contain evaporating water is measured by relative humidity (RH), which is represented as a percentage. High relative humidity comes from heavy air with moisture and become habitat for dust mites and bacterial growth. These particulates irritate the nose, ears, throat and contribute to respiratory condition such as allergies and ashtma

4.4.1 RH collection inside main prayer hall

The data were collected at four sampling point within four days.

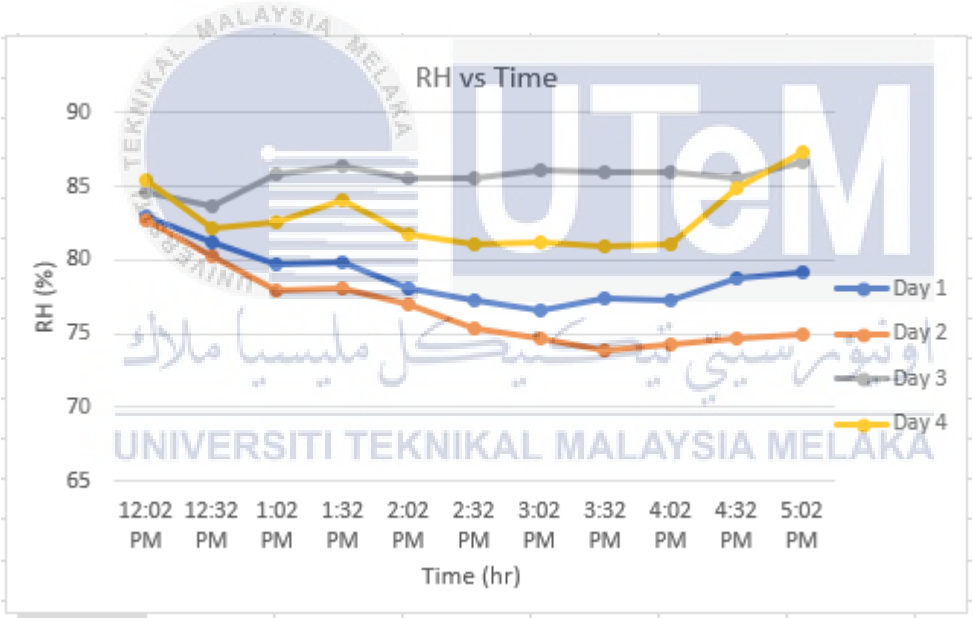

Figure 4.3 Graph of RH inside main prayer hall

According to figure 4.3, the highest mean for relative humidity is 87.3 % at5:02 PM in Day 4 while the lowest mean is 73.9 % at 3:32 PM in Day 2.

4.4.2 RH collected outside main prayer hall

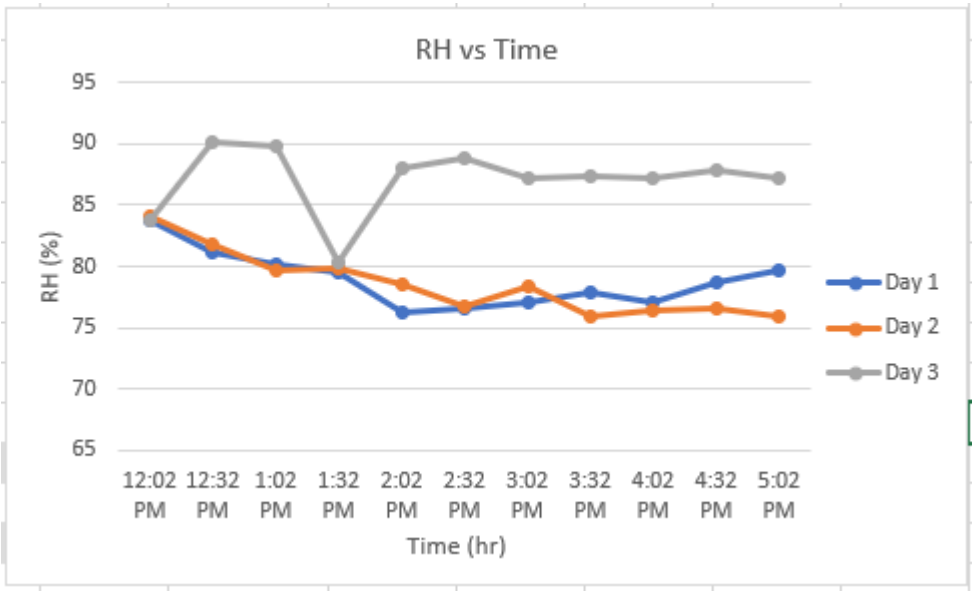

Figure 4.4 Graph of RH outside main prayer hall

The highest mean is 90.2 % which is Day 3 at 12:32 PM and the lowest mean is 76.3 % at 2;02 PM in Day 1.

4.4.3 Comparison of RH between inside and outside

Table 4.4 P value of RH

Days	Inside	Outside
Day 1	78.770	78.748
Day 2	76.557	78.099
Day 3	85.587	87.908
Day 4	82.637	
Mean	80.888	81.585
Standard deviation	4.016	5.485
P value	0.8626	

Table 4.4 showed P value of RH is 0.8626 which is the data is not significant with $P > 0.05$.

4.5 Carbon dioxide (CO_2)

Carbon dioxide is gas emitted by human when breathing and the gas include in photosyntesis process of plant. There are other sources such as natural sources where it comes from decomposing vegetation and biomass and natural occuring wildfires. As from the data, main prayer hall of Masjid Sayyidina Abu Bakar Utem is safe in term of air quality inside and outside main prayer hall. Low presence of human being effect the low mean value of CO_2 at main prayer hall.

4.5.1 CO_2 collected from inside main prayer hall

Data collected from four sampling point in four days shown in graph below.

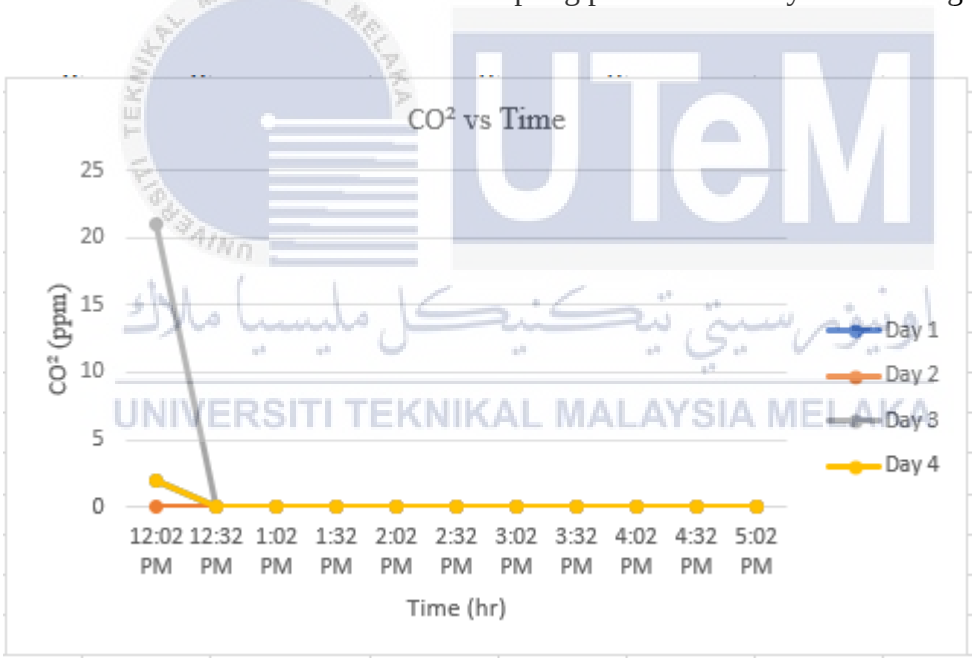

Figure 4.5 Graph of CO_2 inside main prayer hall

The highest mean is 21 ppm at 12:02 PM in Day 3 while the lowest mean for CO_2 is 0 % for all four days of collecting the data.

4.5.2 CO_2 collected from outside main prayer hall

Mean value of CO_2 from outside of main prayer hall is shown in graph below

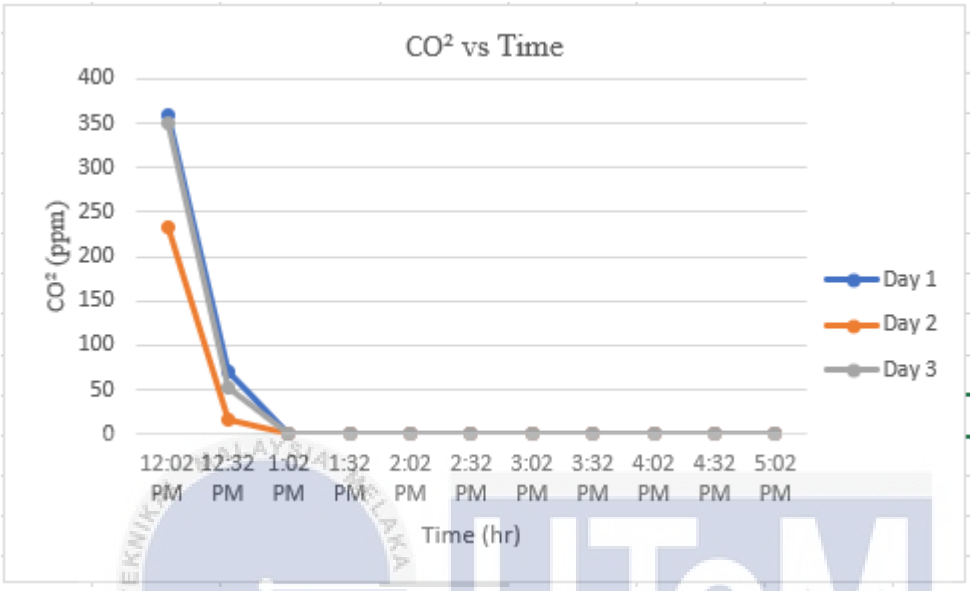

Figure 4.6 Graph of CO_2 outside main prayer hall

Based on the graph, the highest mean for CO_2 is 360 ppm at 12:02 PM in Day 1 while the lowest mean is 0 ppm recorded in all three days.

4.5.3 Comparison of CO_2 between inside and outside

Table 4.5 P value of CO_2

Days	Inside	Outside
Day 1	0.007	23.102
Day 2	0	11.459
Day 3	0.075	18.932
Day 4	0.034	
Mean	0.029	17.831
Standard deviation	0.034	5.899
P value	0.0347	

Table 4.5 showed P value of CO_2 is 0.0347 which is the data is significant with $P < 0.05$.

4.6 Temperature

Ideal temperature is important for building occupant in order to feel comfortable throughout the day. As the data were collected, it showed that the temperature was not in suitable limit according to the standard given.

4.6.1 Temperature collected inside of main prayer hall

Mean value for temperature is shown in graph below.

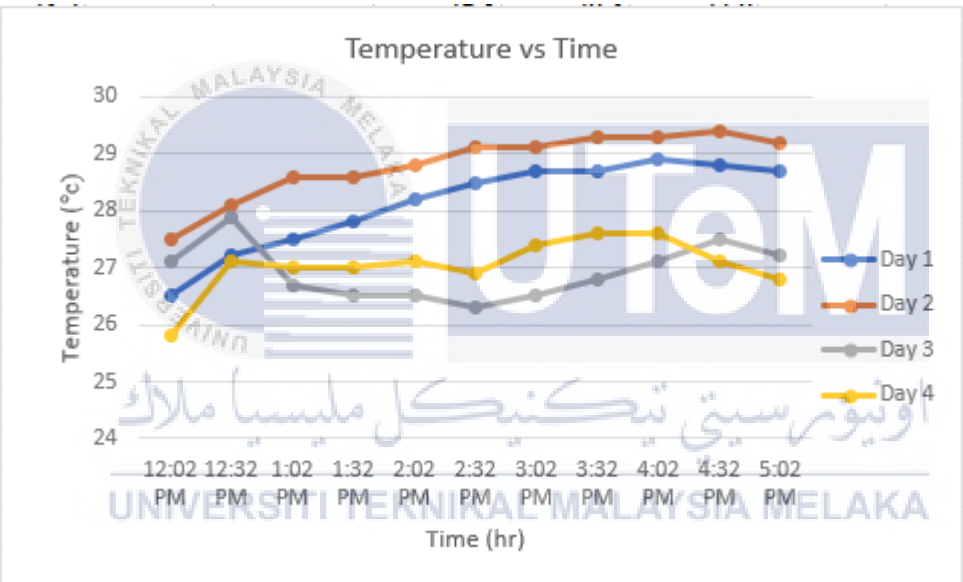

Figure 4.7 Graph of temperature inside main prayer hall

The highest mean temperature recorded is 29.4 °C at 4:32 PM in Day 2 while the lowest mean is 25.8 °C at 12:02 PM in Day 4.

4.6.2 Temperature collected outside of main prayer hall

Data were collected at three sampling point in three days outside the main prayer hall.

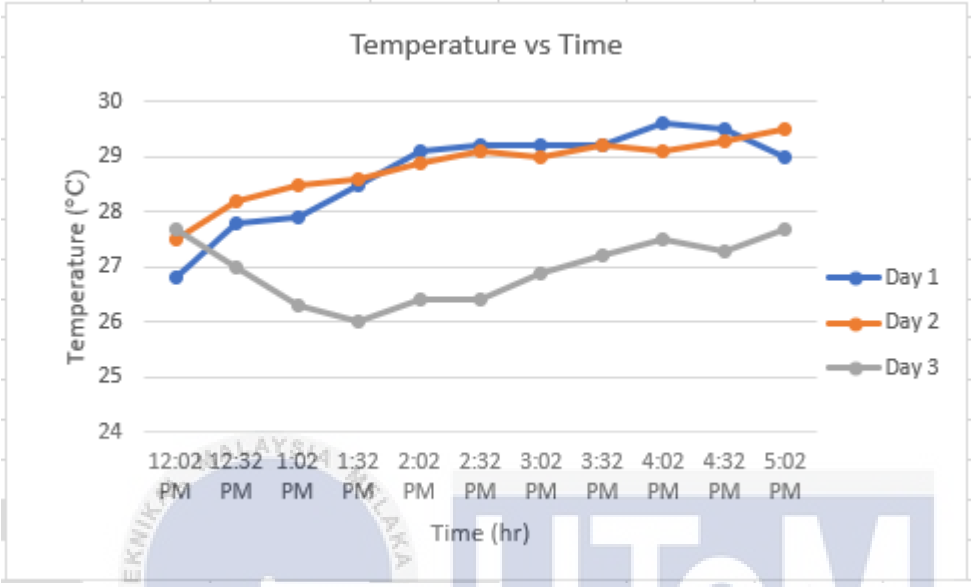

Figure 4.8 Graph of temperature outside main prayer hall

The highest mean is 29.6 °C at 4:02 PM in Day 1 and the lowest mean is 26 °C at 1:32 PM in Day 3.

4.6.3 Comparison of temperature between inside and outside

Table 4.6 P value of temperature

Days	Inside	Outside
Day 1	28.206	28.748
Day 2	28.849	28.850
Day 3	26.895	26.866
Day 4	27.108	
Mean	27.764	28.155
Standard deviation	0.923	1.117
P value	0.6488	

Table 4.6 showed that P value of temperature is 0.6488 which is the data is not significant with $P > 0.05$.

4.7 Total Volatile Organic Compound (TVOC)

TVOC are easy to find around us as it is commonly used in cleaners, disinfectants and spray with aerosols. Because of that, people are expose to its harm and effect the health. Data below shows that TVOC were collected at main prayer hall where the mean for inside main prayer hall is within the range of standard while mean for outside prayer hall is over the acceptable range. It indicates that outside activity such as cleaning and spraying aerosol tanks lead to high TVOC in the area.

4.7.1 TVOC collected inside main prayer hall

The data were collected at four sampling point in four days using specific equipment 3M-EVM.

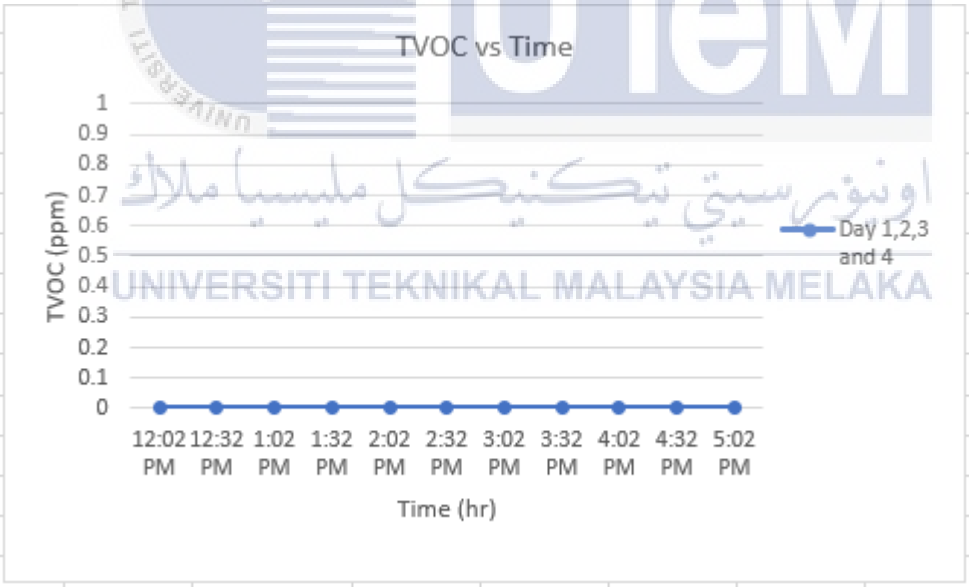

Figure 4.9 Graph of TVOC inside main prayer hall

According to the graph, the highest and lowest mean of TVOC is 0 ppm for all four days.

4.7.2 TVOC collected outside main prayer hall

The data were analyze and shown in the graph below.

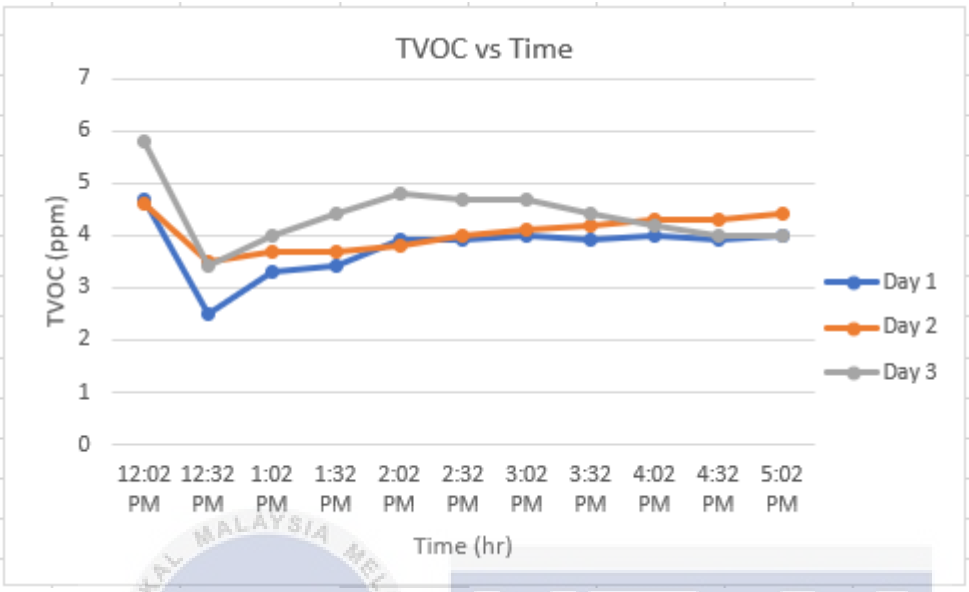

Figure 4.10 Graph of TVOC outside main prayer hall

Based on graph above, the highest mean for TVOC is 5.8 ppm at 12:02 PM in Day 3 while the lowest mean for TVOC is 2.5 ppm at 12:32 PM in Day 1.

4.7.3 Comparison of TVOC between inside and outside

Table 4.7 P value of TVOC

Days	Inside	Outside
Day 1	0	3.645
Day 2	0	4.002
Day 3	0	4.342
Day 4	0	
Mean	0	3.996
Standard deviation	0	0.349
P value	0.0025	

Table 4.7 showed that the P value of TVOC is 0.0025 which is the data is significant with $P < 0.05$.

4.8 Summary

In this section, all the necessary data and information were successfully collected with the help of air quality equipment 3M-EVM for four days according to research methodology. The air quality data were tabulated and analyze in graph to see differences in term of concentration of mean between air contaminants at Masjid Sayyidina Abu Bakar Utem. This study will be conclude in chapter 5 to see whether it is succeeded and all the objective are accomplish.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusion

The outcome from this study showed that exposure to poor air quality and high level air contaminants leads to poor health condition for its occupant. Out of five air contaminants, only two were comply with ICORP IAQ 2010 where the mean concentration for both inside and outside the main prayer hall are within the acceptable range. Carbon dioxide (CO_2) have mean concentration of 8.93 ppm and Total Volatile Organic Compound (TVOC) with mean concentration of 1.998 ppm. While Particulate Matter 2.5 (PM2.5) have mean concentration of 3.729 mg/m^3 which is exceed acceptable range 0.05 mg/m^3. This is because presence of carpet installed inside main prayer hall and dust from outside sources. Next, is temperature with mean concentration of 27.959 °C which exceed acceptable range 23°C - 26°C for better indoor air quality. Relative humidity (RH) have mean concentration of 81.236 % which above acceptable range 40-70 %. This outcome data will change with the increasing number of occupants at Masjid Sayyidina Abu Bakar Utem, Melaka.

5.2 Recommendations

According to the result of this study, the management of Masjid Sayyidina Abu Bakar Utem need to take futher action regarding indoor air quality issues for safer condition of its occupant. Manage well the schedule for cleaning the carpet in the main prayer hall in order to avoid high level of Particulate Matter that leads to respiratory health. The usage of carpet is very important as people perform prayer on it everyday and also for comfortable. The guidance limit of air quality standard need to be obey all the time so that mosque can be a safe area to pray or even take a rest. Urge the people to take care personal hygiene to keep the mosque clean. Ensure safer distance between food stall outside the mosque in order to avoid smoke from cooking enter the main prayer hall and effect the air quality in the mosque.

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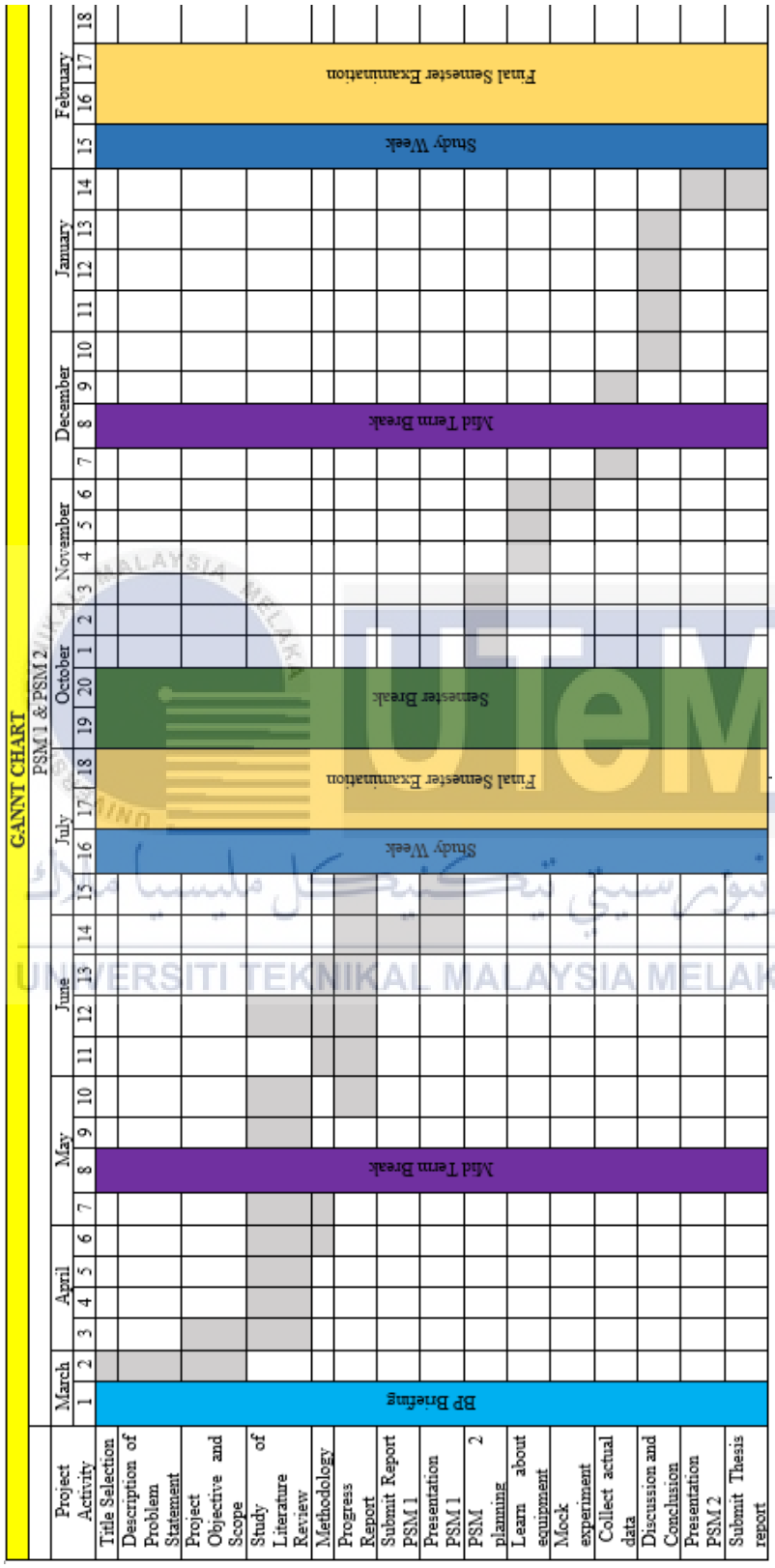
APPENDIX 1



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Tuan

PENGKELASAN TESIS SEBAGAI TERHAD BAGI TESIS PROJEK SARJANA MUDA

Dengan segala hormatnya merujuk kepada perkara di atas.

2. Dengan ini, dimaklumkan permohonan pengkelasan tesis yang dilampirkan sebagai TERHAD untuk tempoh **LIMA** tahun dari tarikh surat ini. Butiran lanjut laporan PSM tersebut adalah seperti berikut:

Nama pelajar: MUHAMMAD SYAHMI BIN MUALIP
Tajuk Tesis: COMPLIANCE OF AIR CONTAMINANTS WITHIN THE MAIN PRAYER HALL OF MASJID SAYYIDINA ABU BAKAR UTEM, MELAKA WITH MALAYSIA'S INDOOR AIR QUALITY STANDARD

3. Hal ini adalah kerana IANYA MERUPAKAN PROJEK YANG DITAJA OLEH SYARIKAT LUAR DAN HASIL KAJIANNYA ADALAH SULIT.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"
"KOMPETENSI TERAS KEGEMILANGAN"

Saya yang menjalankan amanah,

Azwan Aziz
NAMA
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