A STUDY OF INDOOR AIR QUALITY IN DORMITORIES OF UNIVERSITI MALAYSIA PAHANG

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A thesis submitted in partial fulfillment of the
requirement for the award of the degree of
Bachelor of Civil Engineering

Faculty of Civil Engineering and Earth Resources
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NOVEMBER 2010

ABSTRACT

The study is all about the findings of air quality recorded in the dormitories of college students Universiti Malaysia Pahang. This concern for the poor quality of air in the room of college students will cause health problems, such as flu, respiratory disorders, fever, and invite many more. In general, there are several factors that lead to changes in the readings on the air quality index in the building. The improper ventilation and aeration system inside the building will as much affects student's daily life. Exposure to bad air quality can cause symptoms of "Sick Building Syndrome" (SBS). This study was carried out based on the hypothesis that ventilation factors, location, temperature and number of occupants that will play an important role in contributing to the effects of air quality of the hostel. The research has been conducted by doing a survey and air quality sampler method.The data has been analysed by using statistics approach. The highest major indoor airborne pollutants from this findings which is recorded without the aid of proper ventilation is Hydrogen Sulphide (H_2S) 0.7 ppm, Ammonia gas (NH_3) 0.4 ppm, Chlorine Gas (Cl_2) up to 0.2 ppm and the particulate matter is weighted to 55.15 $\mu g/m^3$. To compare with the control data(with the aid of ventilator) ,the results of using proper ventilation shows a reduction in the reading down to 30%. The highest major indoor airborne pollutants from this findings which is recorded during the daytime is Hydrogen Sulphide (H_2S) 0.6 ppm, Ammonia gas (NH_3) 0.2 ppm and the particulate matter is weighted to 42.28 $\mu g/m^3$ to compare with the reading during night time which is 38.24 $\mu g/m^3$.Major indoor airborne pollutants from this findings which is recorded also gives an exert value when the distance between the dormitories to the cafeteria is relatively low approximately 4.5 m is Hydrogen Sulphide (H_2S) 0.8 ppm, Ammonia gas (NH_3) 0.2 ppm, Chlorine Gas (Cl_2) up to 0.07 ppm, Nitrogen Dioxide (NO_2) is 0.06 ppm and the particulate matter is weighted the highest value which is 58.95 $\mu g/m^3$. The highest major indoor airborne pollutants from these findings are recorded when the number of occupant is the high within the populated space. The value of Chlorine Gas (Cl_2) is 0.05 ppm, Ammonia gas (NH_3) 0.8 ppm, Nitrogen Dioxide (NO_2) is 0.04 ppm and Hydrogen Sulphide (H_2S) is recorded to be 0.8 ppm. Whereas the particulate matter is recorded the highest when the number of occupants is also the highest which is 52.19 $\mu g/m^3$. We can conclude that the number of occupants, location, type of ventilation system used plays a major part in the reading of indoor air pollutants. There are several parameters were considered to define the actual air quality. Referring to this, an attempt has been made through a study to assess the level of satisfaction regarding the quality of internal environment and healthy living in the study area. Results showed that there are several residential colleges that have indoor air quality environment that is less healthy as a result of certain factors, in particular due to the location and effect of external pollutants.

ABSTRAK

Kajian mengenai kualiti udara dalam yang direkodkan dalam bilik kolej kediaman pelajar Universiti Malaysia Pahang. Hal ini mendapat perhatian kerana kualiti udara yang buruk di dalam bilik kolej kediaman pelajar akan menyebabkan masalah kesihatan,seperti selsema,gangguan pernafasan, demam serta mengundang banyak lagi permasalahan. Secara umumnya terdapat beberapa faktor-faktor yang mengakibatkan perubahan bacaan pada indeks kualiti udara di dalam bangunan. Proses pengudaraan yang tidak berkualiti akan menjejaskan aktiviti seharian pelajar.Pendedahan kepada kualiti udara yang tidak baik akan menyebabkan gejala "Sick Building Syndrome"(SBS). Kajian ini dijalankan berdasarkan hipotesis yang menyatakan bahawa faktor pengudaraan,lokasi,suhu dan bilangan orang akan memainkan peranan penting dalam menyumbang kepada kesan kualiti udara kepada di dalam hostel. Berdasarkan hasil kajian yang diperoleh mendapati apabila tidak terdapatnya bantuan ventilasi bacaan kualiti udara di dalam bilik adalah lebih tinggi dengan rekod hidrogen sulfida(H_2S) sebanyak 0.7ppm,gas ammonia(NH_3) pula mencatatkan 0.4 ppm,gas klorin (Cl_2) sebanyak 0.2ppm dan kewujudan bendasing sebanyak 55.15 $\mu g/m^3$.Apabila dibandingkan hasil bacaan dengan penggunaan ventilasi udara,hasil kajian menunjukkan penurunan sebanyak 30%.Untuk membandingkan hasil bacaan apabila menggunakan parameter faktor suhu, bacaan menunjukkan rekod tertinggi apabila siang hari dengan bacaan hidrogen sulfida (H_2S) 0.6 ppm,gas ammonia (NH_3) 0.2 ppm dan berat bendasing yang direkodkan pada siang hari adalah lebih tinggi iaitu 42.28 $\mu g/m^3$berbanding pada malamnya iaitu sebanyak 38.24 $\mu g/m^3$.Apabila rekod dijalankan di bilik kolej kediaman yang berdekatan dengan kafetaria dengan jarak 4m, hasil menunjukkan bacaan tertinggi berbanding tempat-tempat lain dengan rekod bacaan hidrogen sulfida (H_2S) 0.8 ppm, gas ammonia (NH_3) 0.2 ppm, gas klorin (Cl_2) meningkat sebanyak 0.07 ppm,nitrogen dioksia(NO_2) is 0.06 ppm dan bendasing mencatatkan 58.95 $\mu g/m^3$.Berdasarkan kajian yang dibuat turut mendapati apabila meningkatnya bilangan pelajar didalam sesebuah ruang bilik,maka bacaan indeks kualiti udara juga meningkat. Terdapat beberapa parameter telah dipertimbangkan bagi mentakrif keadaan kualiti udara sebenar. Merujuk kepada perkara ini, satu usaha telah dibuat menerusi satu kajian bagi menilai tahap kepuasan pelajar berkenaan kualiti persekitaran dalaman dan tahap hidup sihat di kawasan kajian. Keputusan kajian menunjukkan terdapat beberapa buah kolej kediaman yang mempunyai kualiti persekitaran dalaman yang kurang sihat akibat daripada faktor-faktor tertentu,khususnya akibat daripada lokasi dan kesan bahan pencemar luaran.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

NHRMC	-	The National Health and Medical Research Council
SBS	-	Sick Building Syndrome
US	-	United States
EPA	-	Environmental Policy Agent
PM	-	Particulate Matter
WHO	-	World Health Organisation
CO	-	Carbon Monoxide
NO_2	-	Nitrogen Dioxide
SO_2	-	Sulfur Dioxide
COHb	-	Carboxyhemoglobin
UMP	-	Universiti Malaysia Pahang
SBS	-	Sick Building Syndrome
IEQ	-	Indoor Environmental Quality
NIOSH	-	The National Institute for Occupational Safety and Health
ASHRAE	-	American Society of Heating Refrigerating and Air-Conditioning Engineers
WHO	-	World Health Organisation
ISO	-	International Standards Organisation
ET	-	Effective Temperature
NAAQS	-	National Ambient Air Quality Standards
OSHA	-	Occupational Safety and Health
CDPL	-	Carbon Dioxide ppm Levels
DOSH	-	Department of Safety and Health
NH_3	-	Ammonia
Cl_2	-	Chlorine
ACCA	-	Air Conditioning Contractors Association
TLV	-	Threshold Limit Value

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background Study

The National Health and Medical Research Council (NHMRC) defines indoor air as air within a building occupied for at least one hour by people of varying states of health. This can include the office, classroom, dormitories, shopping centre, hospital and home. Indoor air quality can be defined as the totality of attributes of indoor air that affect a person's health and well being.

Increasingly, as dwellings have become better sealed from the external environment, pollutants being released from indoor sources are being found at higher concentrations.

Sick building syndrome (sometimes referred to as SBS) becomes evident when occupants of a home or building experience health problems which have an unknown cause. SBS usually occurs when much time is spent in a home or building. In many cases the actual cause of the problem cannot be identified. The health problems may be evident

with occupants who spend much time in a certain room or area of the structure, or may be a problem throughout the entire structure.

In most cases problems become known when a building is operated or maintained in a manner that is inconsistent with its design. Indoor air problems can begin because of poor building design or poor maintenance of the building. In other cases found problems can result because of activities happening within the structure that can have an environmental effect and make matters worse. It is generally recognized that Malaysians spend 90% or more of their time indoors.

Despite this, relatively little research has been done on the quality of air in our homes, universities, recreational buildings, restaurants, public buildings, offices, or inside cars

Poor indoor air quality can result in significant adverse impacts on our health and environment. Moreover, these impacts carry a significant cost burden to the economy. In recent years, comparative risk studies performed by the US EPA and its Science Advisory Board have consistently ranked indoor air pollution among the top five environmental risks to public health (US EPA, 1993).

1.2 Particulate Matter versus Health

Particulate matter (PM) is an air pollutant consisting of a mixture of particles that can be solid, liquid or both, are suspended in the air and represent a complex mixture of organic and inorganic substances. These particles vary in size, composition and origin. Their properties are summarized according to their particle size.

i. The coarse fraction is called PM_{10} (particles with an aerodynamic diameter smaller than10μm), which may reach the upper part of the airways and lung.

ii. Smaller or fine particles are called $PM_{2.5}$ (with an aerodynamic diameter smaller than 2.5 μm); these are more dangerous because they penetrate more deeply into the lung and may reach the alveolar region.

The size of the particles also determines the time they spend in the atmosphere. While sedimentation and precipitation removes PM10 from the atmosphere within few hours of emission, $PM_{2.5}$ may remain there for days or even a few weeks. Consequently, these particles can be transported over long distances. The systematic data assessment completed in 2004 by the WHO European Centre for Environment and Health, Bonn, indicates that:

i. PM increases the risk of respiratory death in infants under 1 year, affects the rate of lung function development, aggravates asthma and causes other respiratory symptoms such as cough and bronchitis in children

ii. $PM_{2.5}$ seriously affects health, increasing deaths from cardiovascular and respiratory diseases and lung cancer. Increased $PM_{2.5}$ concentrations increase the risk of emergency hospital admissions for cardiovascular and respiratory causes.

iii. PM_{10} affects respiratory morbidity, as indicated by hospital admissions for respiratory illness.

The gaseous pollutants from combustion sources include some identified as prominent atmospheric pollutants - carbon monoxide (CO), nitrogen dioxide (NO_2), and sulfur dioxide (SO_2).

Carbon monoxide is an asphyxiant. An accumulation of this odorless, colorless gas may result in a varied constellation of symptoms deriving from the compound's affinity for and combination with hemoglobin, forming carboxyhemoglobin (COHb) and disrupting

oxygen transport. The elderly, the fetus, and persons with cardiovascular and pulmonary diseases are particularly sensitive to elevated CO levels.

Nitrogen dioxide (NO) and sulfur dioxide (SO_2) act mainly as irritants, affecting the mucosa of the eyes, nose, throat, and respiratory tract. Acute SO_2-related bronchial constriction may also occur in people with asthma or as a hypersensitivity reaction. Extremely high-dose exposure (as in a building fire) to NO_2 may result in pulmonary edema and diffuse lung injury. Continued exposure to high NO_2 levels can contribute to the development of acute or chronic bronchitis.

The relatively low water solubility of NO_2 results in minimal mucous membrane irritation of the upper airway. The principal site of toxicity is the lower respiratory tract. Recent studies indicate that low-level NO_2 exposure may cause increased bronchial reactivity in some asthmatics, decreased lung function in patients with chronic obstructive pulmonary disease, and an increased risk of respiratory infections, especially in young children.

The high water solubility of SO_2 causes it to be extremely irritating to the eyes and upper respiratory tract. Concentrations above six parts per million produce mucous membrane irritation. Epidemiologic studies indicate that chronic exposure to SO_2 is associated with increased respiratory symptoms and decrements in pulmonary function. Clinical studies have found that some asthmatics respond with bronchoconstriction to even brief exposure to SO_2 levels as low as 0.4 parts per million.

1.3 Problem Statement

The quality of indoor air is concerned more and more by the government and the public in Malaysia nowadays and the indoor air regarding the health effects are becoming a serious challenge in both urban and rural areas of Malaysia. In order to further study the factors which affects of the indoor air quality and population exposure to dormitories of Universiti Malaysia Pahang, it is very important for us to know clearly what the major indoor airborne particulate pollutants is in dormitories to get the information that can lead to analysis of sick building syndrome.

Adherence to the increasing awareness towards protecting the environment in development, this study emerges as a tool to help and enable the determination of the factors that increase of PM (particulate matter) levels within the house. We need to contribute to the environment that receives or possibly receives the impact from the test conducts, through self-commitment and provision of resources to make an environmental management system successful (Siah, 2005).

Various studies have shown that presence of occupants, outdoor air speed, location characteristics and quality of ventilation system are large contributor to the generation of particulate matters concentration. In order to improve the quality of indoor air pollution, existing research works will be developed on the methods which will be discussed in the following chapter.

1.4 Objectives of The Study

The pace of changes and development of the Malaysian economy have been rapid and have inevitably boosted the lifestyle of its citizens. Without jeopardizing the ability of future generation to meet their own needs, effective indoor air quality strategies within each dormitories should be developed and implemented. One of the ways to achieve it is to identify the sources that could assist in the reducing of the air pollutant particulate matters. Hence, the objectives of the study are twofold:

i. To investigate and record the major airborne particulate matters within student dormitories in Universiti Malaysia Pahang

ii. To compare and analyse the data results which shows the concentration levels of particulate matter major airborne particles.

1.5 Scope of Study

The study focuses on the dormitories in Universiti Malaysia Pahang(UMP),Reasons mainly due to location accessibility and availability. In this case, several dormitories will be chosen based on certain characteristic. They were made up of mainly dormitories with variety of characteristics such as number of occupants, location either located nearby cafeteria or waste disposal center, with or without natural or mechanical ventilation, and temperature. As this case study will involve exposure monitoring which takes at least 8 hours in order to make this case study a success.

Dormitories will be chosen depending on room configurations and structural characteristics that affect ventilation. In choosing the dormitories, a survey will be conducted to understand the lifestyle of the student, and whether the dorm is good enough for the health of the occupants. The upcoming information will be taken from the student health's information by doing short survey to strengthening the data collected to consider whether the dormitories in UMP are safe to health.General question about the importance of sustainable development also been asked to require the information on how the knowledge of sustainability of development of the environment being perceived by the randomized student of UMP.

The phase of designing the ventilation system to improvised the system will not be taken into consideration since the designing part is way too far from the scope of the study to be completed within the estimated time. Furthermore, a more careful research need to be conducted to implement it and need to be conducted as a group by group.

Table 1.1: Lists of parameters that will plays a vital role to the change of reading

Parameter	Details
Temperature	• Day • Night
Number of Occupants/Students in one dorm	• 5 students • 6 students • 7 students • 8 students
Ventilation (mechanical/natural)	• Windows (open/close) • Fan (on/off)
Location of the dormitories	• Near cafeteria • In between two buildings • Facing open space
Presence of occupants	• With occupant • Without occupant

1.6 Significance of Study

The study was conducted in order to represent local satisfaction of the students regarding the quality of indoor air inside the dormitories due to impact of surroundings. On the other hand, this study also might also help in improving the air quality and measuring and enhancing pollutants levels by applying strategies of controlling the source, improving the current ventilation systems and providing air cleaners in future development. Apart from that, this study also investigated the degree of understanding for local inhabitant corresponds to development planning. To sum it all up, the finding of the