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UNIVERSITI PUTRA MALAYSIA

AIR POLLUTION TRENDS IN PETALING JAYA, SELANGOR, MALAYSIA

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AIR POLLUTION TRENDS IN PETALING JAYA, SELANGOR, MALAYSIA

By

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Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

AIR POLLUTION TRENDS IN PETALING JAYA, SELANGOR, MALAYSIA

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Petaling Jaya experiences the worst air pollution in the Klang Valley. The main source of air pollution in Petaling Jaya is found to be from vehicular exhaust. This is because Petaling Jaya is a mixed commercial-residential-industrial area which has the highest population in the Klang Valley. Moreover, the industrial area in Petaling Jaya is surrounded by the residential area. These factors are believed to be one of the contributors for air pollution in Petaling Jaya. In addition to these, there are universities, colleges and schools in this area. Hence, it is important to monitor the air quality in Petaling Jaya.

An investigation of trends for major air pollutants such as particulates matter (PM_{10}), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and ozone (O_3) in compliance with Recommended Malaysia Ambient Air Quality Guidelines (RMAAQG) and Air Pollutant Index (API) analysis have been carried out to identify the main pollutant in Petaling Jaya for the year 2005. From this analysis, PM_{10} has

been identified as the main pollutant contributes to the API value. Therefore, PM_{10} is the main pollutant for year 2005 in Petaling Jaya.

The relationships between pollutant-pollutant and pollutant-meteorological parameter are also being investigated by using matrix correlation and wind sector analysis. From the matrix correlation analysis, there is a high correlation between PM_{10}-CO (R=0.78) which indicates that they originate from the common source which is vehicle exhaust. The correlations between O_3-Temperature (R=0.40), O_3-NO_2 (R=0.24), and NO_2-Temperature (R=0.06) illustrate that the photochemical reaction occur actively in the urban area atmosphere such as Petaling Jaya. The findings also indicate that rainfall and wind speed also influence the PM_{10}, SO_2, CO and NO_2 concentration by the washout and dilution effect but their correlations are low.

Wind sector analysis reveals that wind direction plays an important role in pollutants distribution. The pollutants concentration is distributed differently according to wind direction. In this analysis, North-East and South-West direction experience high pollutants concentration especially for PM_{10} and CO. More interesting, the correlation between PM_{10}-CO at these directions is high which is 0.5 and 0.6 respectively. This indicates that they originate fully from the common source which is vehicle exhaust in these wind directions. However, there are still unknown sources for PM_{10} (15.5 $\mu g/m^3$) in Petaling Jaya. On the other hand, concentrations for NO_2, SO_2 and O_3 are quite similar at North-East, South-East and South-West directions. In conclusion, meteorological conditions play an important role in influencing the air pollutants concentration in Petaling Jaya.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai keperluan untuk ijazah Master Sains

ALIRAN PENCEMARAN UDARA DI PETALING JAYA, SELANGOR, MALAYSIA

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Petaling Jaya mengalami pencemaran udara paling kritikal di Lembah Klang. Punca utama pencemaran udara di Petaling Jaya adalah daripada kenderaan. Ini kerana, Petaling Jaya adalah kawasan komersial-perumahan-industri, di mana ia mengandungi jumlah penduduk yang paling tinggi di Lembah Klang. Di samping itu, kawasan perindustrian di Petaling Jaya di kelilingi oleh kawasan perumahan. Faktor-faktor ini dipercayai salah satu penyumbang kepada pencemaran udara di Petaling Jaya. Selain daripada itu juga, terdapat universiti, kolej dan sekolah di persekitaran kawasan industri tersebut. Oleh kerana itu, adalah penting untuk mengawasi kualiti udara di Petaling Jaya.

Penyiasatan aliran untuk menentukan pencemar utama di Petaling Jaya untuk tahun 2005 telah di jalankan ke atas bahan pecemar udara yang utama iaitu habuk halus (PM_{10}), karbon monoksida (CO), sulfur dioksida (SO_2), nitrogen diokside (NO_2) dan ozon (O_3) selaras dengan 'Recommended Malaysia Ambient Air Quality Guidelines'

(RMAAQG) dan analisis Indeks Pencemar Udara (IPU). Daripada analisis ini, PM_{10} telah dikenal pasti sebagai penyumbang kepada nilai IPU. Oleh itu, pencemar udara yang utama adalah PM_{10} pada tahun 2005 di kawasan Petaling Jaya.

Kaedah kolerasi matrik telah digunakan dalam menganalisa hubungan diantara parameter pencemar-pencemar dan pencemar-meteorologi. Daripada analisis ini, hubungan diantara PM_{10}-CO (R=0.78) adalah paling kuat dimana ini menunjukkan dua bahan pencemar ini terhasil daripada sumber pencemar yang sama iaitu daripada kenderaan. Hubungan diantara O_3-Suhu (R=0.40), O_3-NO_2 (R=0.24), and NO_2-Suhu (R=0.06) menunjukkan tindakbalas 'photochemical' berlaku dengan aktif di kawasan bandar seperti Petaling Jaya. Selain daripada itu, hujan dan halaju angin juga mempengaruhi kepekatan PM_{10}, SO_2, CO dan NO_2 melalui kesan 'washout' dan pencairan tetapi pada kadar yang rendah.

Selain daripada kaedah kolerasi matrik, analisis menggunakan arah angin utama telah digunakan dan ia menunjukkan arah angin memainkan peranan penting dalam penyebaran pencemar udara di atmosfera. Di dalam analisis ini, kepekatan bahan pencemar adalah tinggi pada arah angin Utara-Timur dan Selatan-Barat terutamanya PM_{10} dan CO. Kolerasi diantara kedua-dua pencemar ini adalah tinggi pada arah tersebut iaitu 0.5 dan 0.6. Ini menunjukkan PM_{10} dan CO terhasil daripada sumber yang sama iaitu daripada kenderaan. Walaubagaimanapun, tidak kesemua PM_{10} terhasil daripada kenderaan kerana masih terdapat sumber-sumber PM_{10} (15.5 $\mu g/m^3$) yang tidak ketahui. Manakala, kepekatan pencemar udara lain seperti NO_2, SO_2 dan O_3 adalah seragam pada arah angin Utara-Timur, Selatan-Timur dan Selatan-Barat.

Kesimpulannya, keadaan meteorologi memainkan peranan penting dalam mempengaruhi kepekatan pencemar udara di Petaling Jaya.

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I certify that an Examination Committee has met on date of viva to conduct the final examination of Amnorzahira Amir on her Master of Science thesis entitled "Air Pollution Trends in Petaling Jaya" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulations 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I declare that the thesis is my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously, and is not concurrently, submitted for any other degree at Universiti Putra Malaysia or at any other institutions.

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LIST OF ABBREVIATIONS

U	Wind speed	m/s
(T)	Temperature	°C
PM_{10}	Particulate Matter	-
NO_2	Nitrogen Dioxide	-
SO_2	Sulfur Dioxide	-
CO	Carbon Monoxide	-
O_3	Ozone	-
DOE	Department of Environment	-
MMS	Malaysia Meteorological Service	-
RMG	The Recommended Malaysia Air Quality Guidelines	-
API	Air Pollutant Index	-
Eq.	Equation	-

CHAPTER 1

INTRODUCTION

1.1 In General

The definition of air pollution is the presence in the outdoor atmosphere of one or more air contaminants such as dusts, fumes, gas, mists, odor, smoke, or vapor in sufficient quantities, of such characteristics, and of such duration threaten to cause injuries to human, plant, animal life or to property, or which reasonably interferes with the comfortable enjoyment of life or property (Peavy *et al.*, 1985). Miller (1989) defined air pollution as air that contains one or more chemicals or possesses a physical condition like heat at high concentration to harm humans, other animals, vegetation or materials.

The air pollution in Malaysia has not reached a critical level as in other metropolitan areas in Asia, like Jakarta or Manila. (Malaysian–German Technical Cooperation, 2000). However; even outside extreme haze periods, pollution levels increased despite tight regulations and this is exacerbated by the increase in the number of vehicle, distance travelled and growth in industrial production. Prevention action, which is perhaps the most expensive corrective activism, is recommended for Malaysia.

Since air pollution has become one of the major issues nowadays, air quality monitoring is necessary in order to scan the air pollutants such as sulphur dioxide,

carbon monoxide, ozone, nitrogen oxides and particular matter dispersion in the urban area. The information obtained from the monitoring process will assist in evaluating the air pollution distribution profile in urban area and its impact toward human health.

Malaysia has its own guidelines for monitoring the air pollution which is based on the Recommended Malaysia Ambient Air Quality Guidelines (RMAAQG). The RMAAQG serves as a basis for calculating the Air Pollutant Index (API). These guidelines have been derived from available scientific and human health data, and represent "safe level" below which no adverse health effects have been observed. The RMAAQG is generally comparable to the corresponding air quality standards recommended by the World Health Organization (WHO) and other countries.

1.2 Statement of the Problems

Petaling Jaya is located in the Klang Valley with the coordinate of 3^{o} 08'N latitude and 101^{o} 44'E longitude. Hence, the air movement and pollutant levels in the study area are affected by the Klang Valley topography. This condition contributes a stagnant condition, where all the air pollutants are trapped down to the valley area (Awang *at.el*, 2000). Moreover, there is dense population which is 417,030 people in the study area (MPPJ, 2005).

Due to this factor, the atmosphere in Petaling Jaya is polluted with varies of toxic and non-toxic air pollutant especially ozone (O_3) and particulates matter (PM_{10}) as reported by the Department of Environment in 2001 until 2004. These pollutants are

very harmful to human health and environment. Moreover, Petaling Jaya has been reported as the most polluted area in Klang Valley where the level of pollutant's concentration is not always at acceptable levels according to the national ambient air quality standard. Therefore, this study was carried out to investigate the atmosphere in Petaling Jaya.

1.3 Objective of the Study

The main goal for this study is to monitor and have a better understanding on air pollution trends at Petaling Jaya. In order to achieve the above goal, the following objectives have been set:

i. To monitor the trends of air pollution in the study area

ii. To investigate the trends of major air pollutants in compliance with the Recommended Malaysia Air Ambient Quality Guideline (RMAAQG) and Air Pollutant Index (API) analysis.

iii. To evaluate the relationship between the pollutants and the influence of meteorological conditions

1.4 Significance of the study

The study on the air pollution in Malaysia is very limited. Hence, this study is designed to provide more comprehensive information on the trend and the characteristic of the air pollutants in the atmosphere especially in urban area such as Petaling Jaya. Moreover, the findings from the study also help to understand and get

the idea of air pollutant index (API) which is present in the air quality status in Malaysia.

1.5 Overview of the thesis

This thesis presents the full investigation on the one year study on trends of air pollutants, air quality status and characterization of pollutant concentration with respect to meteorological condition. There are seven chapters included in this thesis.

Chapter 1 is an introduction for the study of the air quality monitoring in Petaling Jaya. This chapter comprises the statement of the problem and the objectives of the study. Chapter 2 consists of literature review and related previous studies on the air monitoring and trends of air pollutant concentration in the atmosphere with respect to meteorological condition. This chapter gives an idea of how air pollution research is carried out in a tropical country such as Malaysia.

The methodology of the study is presented in Chapter 3. It describes the exact location of the sampling station and the equipment used to collect air pollutant data in DOE's monitoring station. Chapter 4 reports the trends of air pollutants concentration and how they are influenced by the meteorological parameter such as wind speed and rainfall at Petaling Jaya.

Chapter 5 presents the analysis of pollutants concentration compliance with the Recommended Malaysia Ambient Air Quality Guideline (RMAAQG). Then the analysis is extended to determine the air pollutant index (API) which indicates the air

quality status in Petaling Jaya. Chapter 6 reports the relationship between air pollutants concentration and meteorological parameters. Chapter 7 concludes the overall conclusion of the study and recommendation on the air pollution for future study.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Malaysia's environment in the field of air quality is fairly recent. Officially, its involvement began after the gazette of the Clean Air Regulations in 1978.The air quality monitoring work was first carried out by the Division of Environment in 1977 but it consisted mainly of short surveys. These surveys produced limited data in which little analysis could be done.

Subsequently, more air quality monitoring programs were conducted by the Division, although more often than not, these were directed at problematic areas (May, 1979). Related studies were also carried out, from time to time, by other interested bodies and individuals, notably Sham Sani (1982).

Most of the findings from the various studies do give an indication of the air quality in Malaysia, if not all, suffered from one serious shortcoming. However the sampling was not conducted continuously. A continuously sampling system is necessary to obtain a more reliable and accurate information about the air quality in our atmosphere.

2.2 Air Quality Management in Malaysia

The Department of Environment (DOE) monitors the country's ambient air quality through their network of monitoring stations. These monitoring stations are strategically located in both residential and industrial areas to detect any significant change in the air quality which may be harmful to human health and the environment. There are 51 air monitoring stations throughout the country.

Five criteria pollutants are being monitored continuously by DOE namely Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Ozone (O_3), Sulphur Dioxide (SO_2), and Particulate Matter (PM_{10}). There are two types of monitoring which are Continuous Air Quality Monitoring Stations (CAQM) and Manual Air Quality Monitoring Station (MAQM).

Alam Sekitar Malyasia (ASMA) is responsible to carry out air quality monitoring work for DOE. ASMA is awarded a 20-year concession to provide air quality monitoring data to DOE. To date, under the Concession, ASMA is credited with the installation and management of 51 continuous air quality monitoring stations (CAQM).

The establishments of the Malaysian Air Quality Guidelines in 1989, Air Pollution Index and Haze Action Plans in 1997 are among the important tools for air quality management that are endorsed and put into practice by the Malaysian Government.

2.3 Air Quality Status

Air quality in Malaysia is a major concern as the nation forged ahead to become an industrialized nation by the year 2020. The Malaysian Air Pollution Index (API) is obtained from the measurement of fine particles (PM_{10}) and several toxic gases such as SO_2, CO, NO_2, and O_3. The air quality status in Malaysia is determined accordingly to API which indicates the level of pollution in the atmosphere. The API system of Malaysia closely follows the Pollutant Standard Index (PSI) system of the United States of America

Table 2.1 presents the API values with respect to the air quality status and level of pollution and health measurement in Malaysia.

Table 2.1: API values with level of pollution and health measurement

API	Status	Level of Pollution
0 -50	Good	Pollution Low and has no ill effects on health
51-100	Moderate	Pollution Moderate and has no ill effects on health
101-200	Unhealthy	Mild aggravation of symptoms among high risk person, i.e. those with heart or lung disease
201-300	Very Unhealthy	Significant aggravation of symptoms and decreased exercise tolerance in person with heart or lung disease
301- 500	Hazardous	Severe aggravation of symptoms and endangers health
Above 500	Emergency	Severe aggravation of symptoms and endangers health

(Source: Department of Environment Malaysia, 2000)