AMBIENT AIR QUALITY MONITORING OF PARTICULATE MATTER IN AROUND WASTE FACILITIES

AMIR AZIZ
PROF. DR. RIZALMAN BIN MAMAT
PM. DR ABDUL ADAM BIN ABDULLAH
ROZIAH BINTI ZAILAN

RESEARCH VOTE
RDU 140361

Fakulti Kejuruteraan Mekanikal
Universiti Malaysia Pahang

August 2016

ACKNOWLEDGEMENT

The research team would like to express our gratitude to University Malaysia Pahang for providing space and equipment to do the research. We also would like to express our appreciation to Faculty of Mechanical Engineering technical group for the technical advice and machining assistant in completing this project.

Last but not least, an expression of thanks is extended to everyone who has offered their help and support throughout this project. All of their help are very significant to the success of this project

ABSTRACT

The experiment is undertaken to determine the particulate matter concentration in a landfill Jerangau-Jabor., Kuantan Pahang. Air pollution associated with the atmospheric particulate matter has diverse effect ranging from human health to visibility and climate forcing. Operating municipal solid waste (MSW) landfills emit a variety of air pollutants, among them particulate matter (PM) and landfill gas. Much attention has been given to landfill gas emission due to their climatic impact and their potential for energy production. However, particulate matter (PM) has also important effects on local air pollution and human health. The concentration of particulate matter has been taken for 8hours and comparison at 3 different location of landfill also has been performed. The PM measurement in the landfill was performed using a Direct sense monitoring kit model TG 501 which is a portable and battery operate. Base on the experiment testing that has been done; it is shown that the data display data logging was successfully recorded. After the particulate matter measured had been done, data from the probe is gained through iPAQ hx2700 Series Pocket PC, data mass of particulate matter is gained through PC software. The average concentration of particulate matter at the landfill site range 519.41$\mu g/m^3$ –942.54 $\mu g/m^3$. The higher concentration was observed at the point C (the disposal of domestic waste) because the type of municipal solid waste from a residential area, market and business area within 300-500 tonnes/day.

ABSTRAK

Eksperimen dijalankan untuk menentukan kepekatan zarah di tapak pelupusan Jerangau-Jabor., Pahang Kuantan. Pencemaran udara dikaitkan dengan perkara zarah atmosfera mempunyai kesan yang pelbagai bermula dari kesihatan manusia untuk penglihatan dan iklim memaksa. Operasi sisa pepejal perbandaran (MSW) tapak pelupusan mengeluarkan pelbagai bahan pencemar udara, antaranya bahan zarah (PM) dan gas tapak pelupusan. Perhatian yang lebih telah diberikan kepada pelepasan gas tapak pelupusan disebabkan kesan iklim dan potensi untuk pengeluaran tenaga. Walau bagaimanapun, perkara zarah (PM) juga mempunyai kesan penting ke atas pencemaran udara tempatan dan kesihatan manusia. Kepekatan zarah telah diambil selama 8 jam dan perbandingan di 3 lokasi yang berbeza dari tapak pelupusan juga telah dijalankan. Pengukuran PM di tapak pelupusan telah dilakukan dengan menggunakan pemantauan rasa kit model langsung TG 501 yang mudah alih dan bateri beroperasi. Berdasarkan ujian eksperimen yang telah dilakukan, ia menunjukkan bahawa paparan data telah berjaya direkodkan. Selepas bahan zarah yang diukur telah dilakukan, data daripada siasatan diperolehi melalui iPAQ hx2700 Siri Pocket PC serta jisim data perkara zarah diperolehi melalui perisian PC. Kepekatan purata bahan zarah di pelbagai tapak pelupusan 519.41μg / m^3 -942,54 μg / m^3. Kepekatan yang lebih tinggi yang dapat diperhatikan pada titik C (pelupusan sisa domestik) kerana jenis sisa pepejal perbandaran dari kawasan perumahan, pasar dan kawasan perniagaan di dalam 300-500 tan / hari.

TABLE OF CONTENT

TITLE

PAGE

LIST OF TABLES

LIST OF FIGURES

LIST OF SYMBOLS

%	Percentage
g	Weight
s	Time
g/cm^3	Density
^0C	Temperature
ppm	part per million

LIST OF ABBREVIATIONS

FYP	Final Year Project
UMP	University Malaysia Pahang
PM	Particulate Matter
MSW	Municipal Solid Waste
WHO	World Health Organization
RMAAQG	Recommended Malaysia Air Ambient Quality Guideline
API	Air Pollution Index
NO_2	Nitrogen Oxide
SO_2	Sulphur Oxide
AQI	Air Quality Index
OEH	Office of Environment and Heritage

CHAPTER 1

INTRODUCTION

1.1 PROJECT TITLE

Ambient Air Quality Monitoring of Particulate Matter in Around Waste Facilities

1.2 BACKGROUND STUDY

Air pollution is the introduction of particulates, biological molecules, or other harmful materials into Earth's atmosphere, causing diseases, allergies, death to humans, damage to other living organisms such as animals and food crops, or the natural or built environment. Air pollution may come from anthropogenic or natural sources.

Air contamination in Malaysia has not arrived at the level of feedback as in other metropolitan regions in Asia, for example, Manila or Jakarta (Dietrich Schwela, 2000). However, beyond the period of extreme haze, pollution levels rise, especially in the area of landfill in Malaysia. A separate study of air quality in Kuala Lumpur found that the smoke haze was associated with high levels of suspended microparticulate matter, but with relatively low levels of other gaseous pollutants such as carbon monoxide, nitrogen dioxide, sulfur dioxide, and ozone (Afroz, Hassan, & Akma, 2003). Safety measure conceivable amendment of the most costly activism is suggested for Malaysia Since air pollution in landfills has turned into one of the principle issues at present, air quality observing is important to sweep air pollution. Malaysia has its own particular rules for observing air pollution. These rules have got from accessible experimental information and human wellbeing and representing "safe level" underneath which is unfavorable wellbeing impacts is observed. The Recommended Malaysia Air Ambient Quality Guideline, RMAAQG is for the most part tantamount to the comparing air quality

guidelines proposed by the World Health Organization (WHO) and different nations (H & Juliana, 2014).

1.3 PROBLEM STATEMENT

Air pollution is a major environmental problem caused by landfill. This proves the population of nearby landfill who has suffered lungs related problems and many other diseases caused by pollutants that are emitted from landfills. Some of them are not aware of the safety range between community and landfill. Thus, there must be a safety range or distance between the landfill and residential area. So, a research on the particulate matter at the landfill was conducted in order to investigate the safety distance to ensure there is no health effect to the people around the landfill area.

1.4 OBJECTIVES

The main goal of this study is to monitor the air quality of particulate matter around Kuantan landfill

1) To investigate the PM concentration in a landfill (Jerangau-Jabor, Kuantan Pahang).
2) To observe safety distance between landfill and workers.

1.5 PROJECT SCOPE

The scopes of the project are as follow:

1) To monitor the level of air pollution in Jerangau-Jabor landfill.
2) 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.
3) To observe safety distance between landfill and workers.

1.6 FLOW CHART

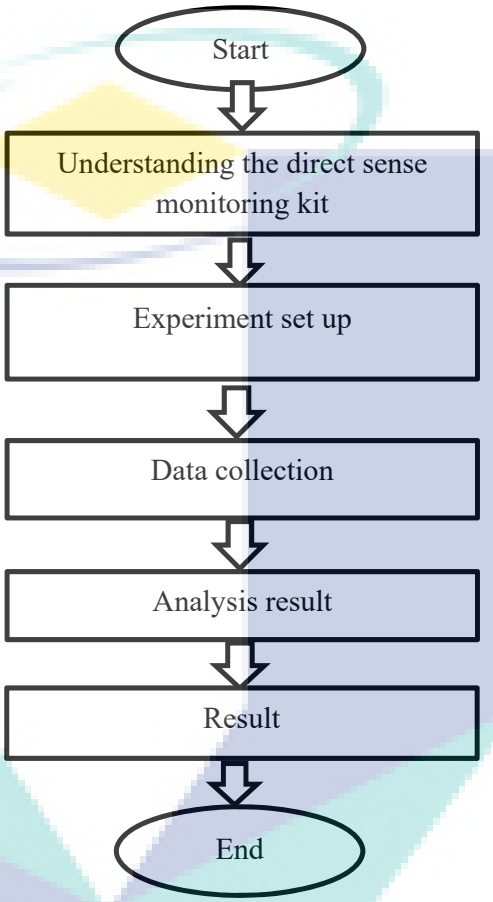


Figure 1.1: Methodology of study in flow chart

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

This study was conducted to review in providing a report which is air quality monitoring, particulate matter, and landfill in Jerangau-Jabor, Kuantan Pahang. This literature review describes on the air quality monitoring of particulate matter from Jerangau-Jabor landfills such as classification of air pollution index, selected material, and data collection. The background can estimate the result before, the excuse of research, methodology or research methods that are relevant, and background theory. The materials used as a reference was taken from journals, books, websites, and departments. It is important to avoid the mistakes made by previous studies and to get facts right. Then, in the presence of all these studies can be performed easily and quickly without much problem.

2.2 AIR QUALITY MONITORING

The term "air quality" means the state of the air around us. Good air quality refers to clean, clear, unpolluted air. Clean air is essential to maintaining the delicate balance of life on this planet — not just for humans, but wildlife, vegetation, water and soil. Poor air quality is a result of a number of factors, including emissions from various sources, both natural and "human-caused." Poor air quality occurs when pollutants reach high enough concentrations to endanger human health and/or the environment. Our everyday choices, such as driving cars and burning wood, can have a significant impact on air quality.

2.2.1 Air Quality of Ambient

Define air quality of ambient is similarly outdoor air quality around the quality of the environment is measured at ground level and away from direct sources of pollution as well as in designated areas.

2.2.2 Quality of Indoor Air

It worse than the air outside the room in enclosed spaces such as schools, factories, homes and workplaces contaminated by pollutants had penetrated from the outside and the pollution caused from internal sources such as tobacco smoke, chemicals, mold, furniture and household products. The internal quality is very important to daily health.

Indoor air quality worse than the air outside the room in enclosed spaces such as schools, factories, homes and workplaces contaminated by pollutants had penetrated from the outside and the pollution caused from internal sources such as tobacco smoke, chemicals, mold, furniture and household products. The internal quality is very important to daily health Indoor air quality worse than the air outside the room in enclosed spaces such as schools, factories, homes and workplaces contaminated by pollutants had penetrated from the outside and the pollution caused from internal sources such as tobacco smoke, chemicals, mold, furniture and household products. The internal quality is very important to daily health

2.2.3 Air Pollution Index

In Malaysia, air pollution index refers to the quality of the air with ease. Air Pollution Index is an indicator of air quality since 1989, which is described in the Department of the Environment (1997) includes five components of the index of pollution, nitrogen dioxide NO_2, ground level ozone, carbon dioxide, pollution particles (called particulate matter) and sulfur dioxide, SO_2. The value of air Pollution Index is important to determine and assess changes in the quality of air status and human well-being (Valley, Latif, Abidin, & Praveena, 2015). From early 2012 an Air Pollution Index updates to Quality Index of Air (AQI) based on health. Air quality reported refers specific values of different air pollutants. Air Quality Index is different for different countries.

Table 2.1: Environment of Air Quality in Malaysia

(Source: Department of Environment, 2013)

Contamination	Time taken	Malaysian Guideline(ppm)	Malaysian Guideline(µg/m3)
Ozon	8am-9am	0.9	210
Ozone	8am-4pm	0.07	120
Carbon Monoxide	8am-9am	30.1	36
Carbon Monoxide	8am-4pm	9.1	15
Nitrogen Dioxide	8am-9am	0.16	310
Nitrogen Dioxide	8am-8am	0.05	10
Sulphur Dioxide	8am-9am	0.14	360
Sulphur Dioxide	8am-8am	0.04	105
Particulate Matter (PM10)	9am-8am		150
Particulate Matter (PM10)	12Month		50
Total Suspended Particulate (TSP)	24Hour		260
Total Suspended Particulate (TSP	12Month		90
Lead	3Month		1.5

Table 2.2: Index of air pollution

(Source: Mabahwi, Ling, Leh, & Omar, 2015)

Class	Condition	Pollution level
<50	Health	Lower of pollution without poor effect on wellness.
>50<100	Modest	Temperate of pollution that does not effect of ill on wellness.
>100<200	Is not healthy	Worsen the situation the wellness of the heart and lung of humans.
>200<300	Very Unhealthy	Make matters worse the wellness of the heart and lungs of humans and also public wellness affected.
>300<500	Danger	Unsafe extreme hazard individuals or general wellbeing
500>	Alarm	Unsafe extreme hazard individuals or general wellbeing

2.2.4 Air Quality Measured

The Office of Environment and Heritage (OEH) work an exhaustive quality of air checking system utilizing condition of-workmanship instrumentation to give the group exact and exceptional data about air quality. Information of checking system is displayed encompassing fixations and values quality of air are overhauled horary and put away in a database.

2.2.5 Collect and Measured Data

To measure pollutants, there are 2 methods, which are not continuous or continuous monitoring. Continuous monitoring of air must be measured over time and data will automatically be transmitted to a central database. The constant monitoring of pollutants not collected on a filter (the device used) during the specified time as 8 hours, 12 hours, a day or a month. After the material has been collected and analyzed in the laboratory.

2.2.6 Equipment or Apparatus to Obtain Air Quality

Table 2.3: Apparatus and benefit of equipment

Apparatus	Advantages	Application
Dusttrack Aerosol monitor model 8520 (Chalvatzaki et al., 2010)	• Carrying case • C size alkaline battery • Spare internal filter element • Sample nozzle removal tool	• Measured of concentration of particulate matter
Series 500 – Portable Air Pollution Monitor	• Fits comfortably in the hand • Compatible with 30 different sensors • Remote sensor capability • Connect direct with PC via USB	• Indoor air quality • Checking indoor air pollution “hotspots”
Mini portable Tactical Air Sampler model TAS-50	• Portable • Low flow and low battery shut off and rechargeable	• Can be configure one of either PM_{10}.$PM_{2.5}$ or TSP • Collected removing impactor
Dust Profiler – Dust and Particle Counter	• Simultaneous measurement of PM10, PM2.5, PM1, AND TSP. • Huge onboard data storage capacity for long-term fail-safe monitoring	• Air Quality Research • Short Term Surveys • Source Apportionment • Roadside Monitoring
Directsense monitoring kit (203)-416-0005	• Up to 20 sensor • Detector and instrument efficiently log data • Configure into a single TG-501 probe	• Store enhance survey information and reporting software include • Long portable spot measurement or trend log • Auto attached photo

2.3 PARTICULATE MATTER

2.3.1 Definition

Particulate matter can be defined particle complexes formed of several types of very small components and liquid droplets. Particulate matter can be categorized into two types of PM_{10} and $PM_{2.5}$. PM_{10} are particles of 10 microns which is 10 micrometers in diameter. PM_{10} can through the throat and nose that allows entry into the lungs to cause human health effects. In addition, $PM_{2.5}$ is particles having a diameter of 2.5 micrometers which is smaller than PM_{10} found in smoke or haze.

2.3.2 Particulate Matter 2.5 ($PM_{2.5}$)

Particulate matter 2.5 can contain toxic inorganics such as metals (W. Xinhua, B. Xinhui, S. Guoying, 2006). Which is vanadium (V), chromium (Cr), cadmium (Cd), nickel (Ni), copper (Cu), lead (Pb), zinc (Zn), arsenic (As), tin (Sn), and selenium (Se) were concentrated in the fine fraction or PM 2.5. Another study done by (N. Jianjun, P. Rasmussen, N. Hassan, 2010) showed increasing concentrations of V, manganese (Mn), Ni, Cu, Zn, Se and Cd with decreasing particulate aerodynamic diameter. The accumulation of metals in PM 2.5 is attributed to the availability of a larger surface area for the adsorption of these metals (F. Kelly, 2012) . Previous studies have likewise shown that the aerosols can serve as carriers of pathogenic microorganisms, which results in an increase in the incidence of respiratory nosocomial infections.

2.3.3 Particulate Matter 10 (PM_{10})

Environmental exposure to urban particulate matter (PM) represents a significant health risk in the world population, mainly associated with morbidity and mortality from cardiopulmonary disease and lung cancer. These particles are a heterogeneous and complex mixture of organic, inorganic and biological compounds, which includes: soil, soot, metals, salts, polycyclic aromatic hydrocarbons (PAHs), aromatic amines, bacterial products (e.g. endotoxins and other components) and fungi. Toxicological studies have reported that PM induces inflammatory response, DNA damage, oxidative stress and formation of DNA adducts (Eugenia, Mel, Petrosyan, Molina-servin, & Vega, 2015).

2.4 LANDFILL IN MALAYSIA

2.4.1 Introduction

There are many landfills in Malaysia that are operating and not operating. Landfills are a collection of waste and residues from factories, residents and from vehicles collected in one place for disposal or described. There are some principles that have been derived from the disposal of such carbon dioxide, methane, and particulate matter that may affect the residents or the public. Table 1 shows the projection made for the year 2015 and 2020. Figure 1 shows the waste produced by each country from 1996 until 2008.

Table 2.4: Generation of MSW in Peninsular Malaysia from (1998-2000) Tonnes

(Source:Noor et al., 2013)

State	1998	1999	2000	2010	2015	2020
Selangor	1170	1200	1241	1594	1772	1322
Kuala Lumpur	1060	1071	1080	1201	1261	1321
Pahang	201	205	210	251	271	1951
Kelantan	122	125	120	86	73	291
Terengganu	118	124	125	156	172	43
N.Sembilan	266	277	291	412	472	184
Melaka	207	215	225	312	352	532
Johor	928	955	1005	1396	1591	394
Perlis	29	29	29	35	36	18
Kedah	5698	568	631	941	1095	384
Penang	612	612	648	834	925	1250
Perak	718	718	763	984	1092	1017

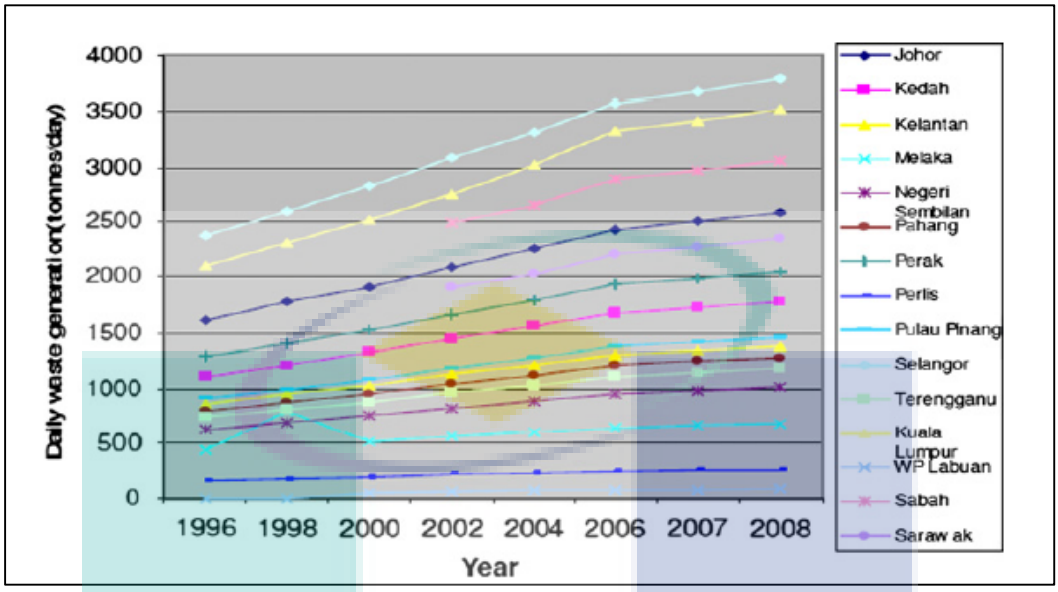


Figure 2.1: MSW generation by state in peninsular Malaysia in thousand tonnes

(Source: Noor et al., 2013).

2.4.2 Municipal Solid Waste Characterization in Malaysia

At present, poor solid waste management become the prime environmental problem in Malaysia. In all aspect of solid waste management system, the fundamental aspect that needs to be considered is the characteristics of solid wastes generated. In characterizing solid waste stream, solid waste should be described by generation rates, composition, sources, and types of waste produced. These information is necessary in order to monitor and control waste management systems as well as to make decisions regarding regulatory, financial, and institutional actions. This can reduce the waste produced by a variety of factors every day. Table 2.5 shows the Record of waste produced by industry, institution, and residents in 2009. The increasing in the rest depends on the development and high population.

Table 2.5: Typical characterization of Malaysia MSW (%)

(Source: Noor et al., 2013)

Material	Higher income of resident	Moderate income of resident	Lower income of resident	Industrial	Institution	Average (%)
Food/organic	59.2	36.6	37.43	68.67	57.0	51.8
Plastic	12.6	30.7	18.92	11.45	15.0	17.734
Paper	8.0	8.9	16.78	6.43	17.0	11.42
Textile	1.4	1.0	8.48	1.50	1.0	2.5
Wood	2.3	0.3	3.78	0.70	-	1.77
Yard waste	7.6	6.7	3.18	-	5.0	5.6
Rubber	0.7	-	1.32	-	1.0	1.0
Glass	1.6	2.8	2.68	1.41	1.0	1.9
Organic fines	4.0	-	4.37	-	1.0	3.1
Metal	2.4	12.1	3.40	2.71	2.0	4.5
Others	-	0.9	7.16	7.13	-	5.1

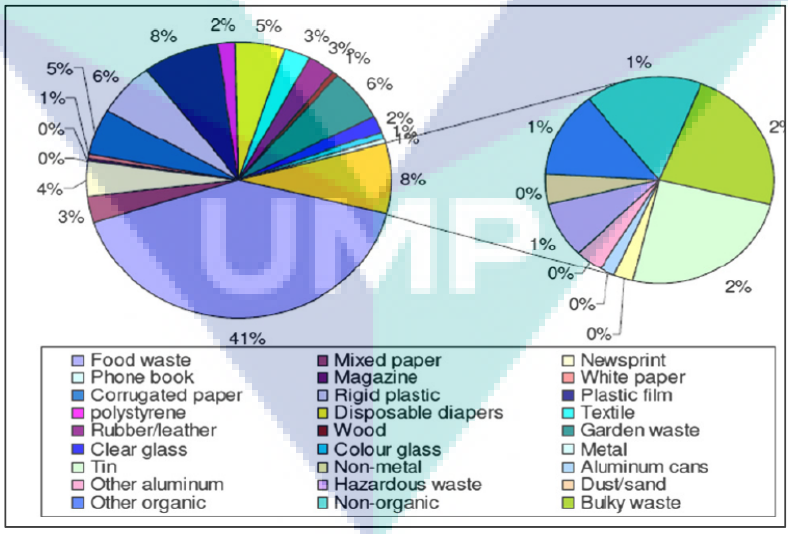


Figure 2.2: Average composition of MSW/generated in Malaysia

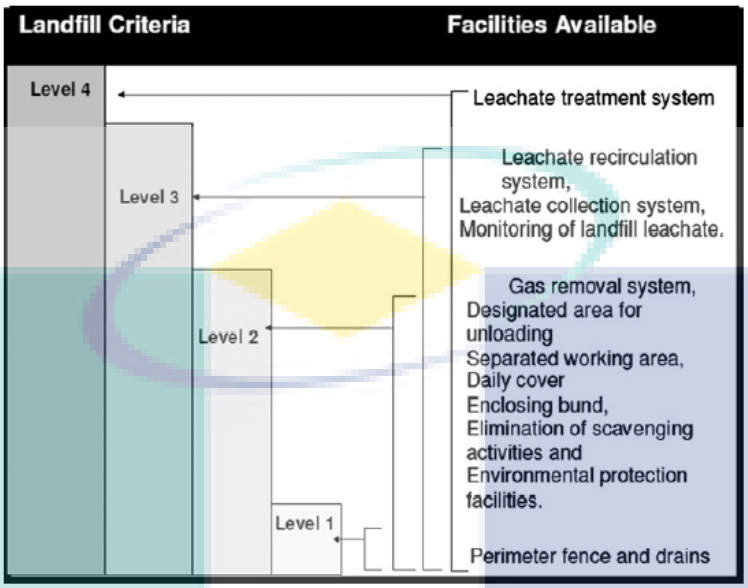


Figure 2.3: Level classification of landfills

Table 2.6: Landfill in operational and not in operational

(Source: Noor et al., 2013)

State	Landfill in operation	Landfill not in operation
Johor	13	21
Kedah	10	5
Kelantan	13	4
Melaka	2	5
Negeri Sembilan	8	10
Pahang	19	13
Perak	20	9
Perlis	1	1
Pulau Pinang	1	2
Sabah	21	1
Sarawak	51	12
Selangor	6	12
Terengganu	9	12
FT Kuala Lumpur	1	7
FT Labuan	1	0
FT Putrajaya	0	0
Total	**176**	**114**

2.4.3 Landfill in Pahang

In Pahang, there are 32 landfills which 19 in operation and 13 not in operation. In Kuantan also have two main landfills where is located at Jerangau-Jabor and Pantai Balok. In this study, Jerangau-Jabor will be the site to be analyzed. Jerangau-Jabor approximately 300 km from Kuala Lumpur and 25 km from the city of Kuantan. The landfill covers an area of approximately 30.0 hectares. This landfill has the capacity to occupied around 500 tonnes solid waste every day and can be used until it reaches the maximum capacity around 5 years period. The composition of Jerangau-Jabor landfill is 60% domestic waste and 40% industrial waste. Figure 2.4 show the site area of the landfill.

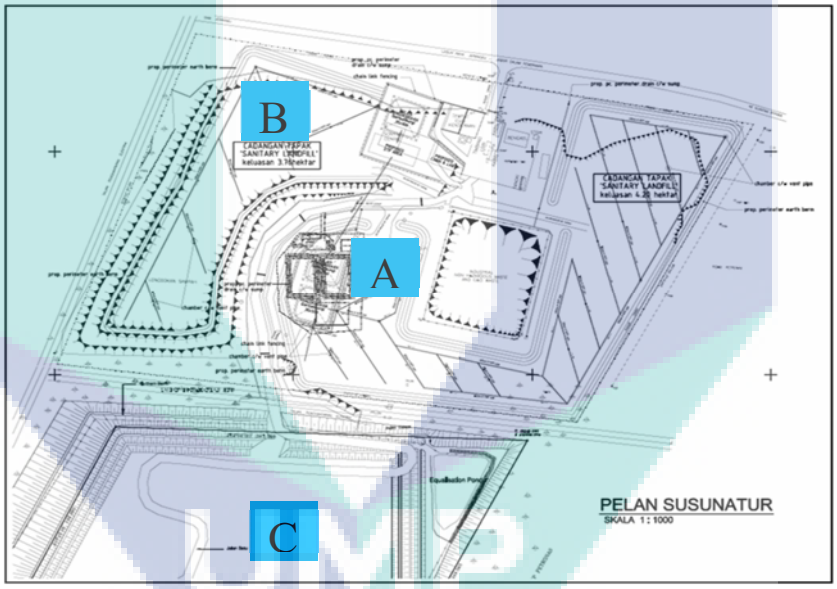


Figure 2.4: Site area of the landfill.

2.4.4 Landfill Method

There are 3 basic methods for landfilling, depending on the circumstances and information site.

1. **Area method**

Should be used when the topography and geological conditions are not suitable for digging trenches to dispose of waste.

2. **Trench method**

Very suitable for areas with sufficient depth, cover material can be found at the site and no water reservoir in the area near the surface.

3. **Cell method**

It involves the disposal of waste in the area of the pre-built bund.

2.4.5 Landfill Level

There is 4 level of landfill was identified:

- **Level 1**: Waste sites defined & tipping controlled
- **Level 2**: Waste disposed of in bunded areas with daily cover, passive gas venting, and leachate drainage
- **Level 3** : Waste contained, gas vented and leachate recirculation
- **Level 4**: Sanitary landfill, gas controls, leachate treated

2.4.6 Solid Waste Generation

Accepted waste:

a) **Domestic:** 300-500 tonnes/day

- Residential Area
- Market
- Business Area

b) **Industrial:** 100-150 tonnes/day

- Small Medium Industry
- Entrepreneur Area

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION

In this chapter describes the overall methodology and techniques to be used in monitoring the air quality around the landfill. In addition, there is a deeper explanation of this experimental design including software and tools.

3.2 METHODOLOGY OVERVIEW IN FLOW CHART

Figure 3.1 shows the flow chart that was used in this study.

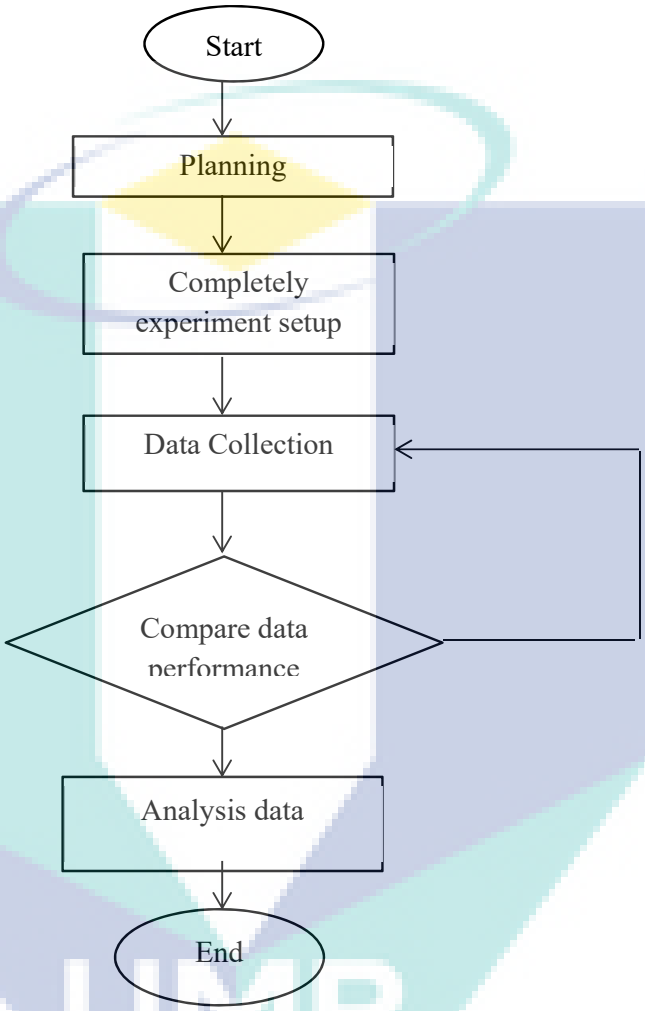


Figure 3.1: Flow chart of the project.

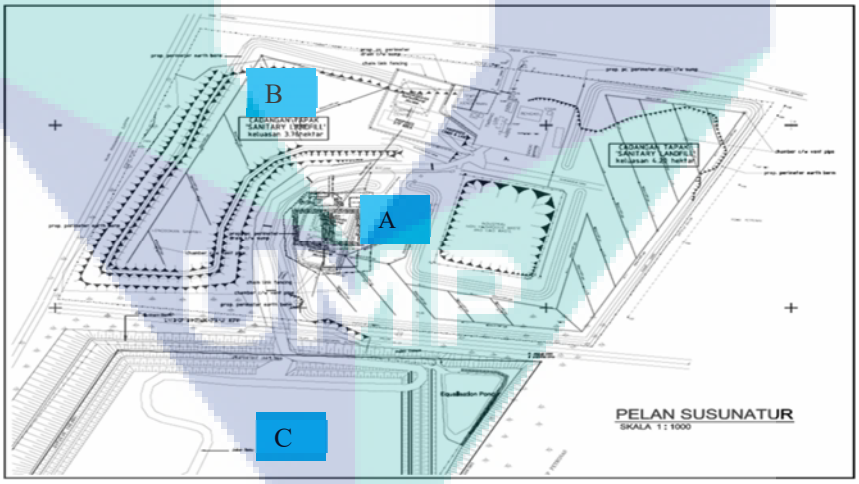
3.3 PLANNING

Planning should be done before the experiment to obtain more detailed and accurate and will facilitate the smooth running of the experiment. Planning must be accounted for in terms of time, facilities, finance and place. Planning also includes the

collection and analysis of data plan how to get more accurate data and how the data was analyzed.

3.4 EXPERIMENT SETUP

The experiments carried out by reference journals, internet and library sources that tell about the proper method of conducting such experiments with equipment selection, site review, the time it takes and how to control the device correctly. Based on figure 3.1 below shows the location where the experiment will be conducted in a landfill in Jerangau- jabor. Thus the experiment will be reviewed in three different places of point A, point B and point C as to compare the air quality of the gas and particulate matter in different places. With the one type of tool used to monitor the quality of particulate matter (TG 501) are placed at each location at different times. The experiment was conducted in a timely manner to ensure the gas particles and is in stable condition and allows the collection of data smoothly. Among the experiments conducted to monitor air quality in landfills are:



Area A
Industrial waste

Area C
Domestic waste

Area B
Sanitary landfill

Figure 3.1: Layout site locations

3.5 DATA COLLECTION

In every area of study, one of the stages is the process of collecting data to be faced. In this process, it is important for the literature review, research and provision made for the program schedule information are authentic and accurate information. The materials gathered from reading journals, textbooks, research papers and references in the library and on the Internet.

In addition, the operation of the landfill should be studied before embarking on research activities to ensure the smooth running of research and data collection more accurate. The study of equipment and hardware also needs to be done to get the collection of data that can be collected for sampling particulate matter or gas. To collect data for particulate matter and gas studies conducted in three different places at different times. Data collection for this study was conducted in 8 hours a day during three days to get the data. Collecting data were taken at different times in the morning, noon, and evening recorded for 25 minutes in each area as shown in figure 3.2.

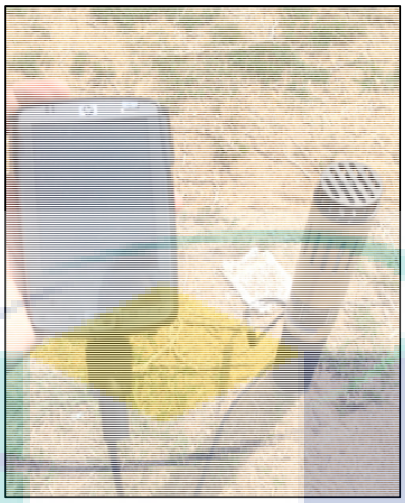


Figure 3.2: Recorded data

3.6 COMPARISON DATA

Before analyzing the data one step should be done is a comparison of data. Before continuing, the process of comparative data and research literature and the reading of the journal are conducted to obtain information and how to compare data more accurately. In the process of comparative data should be carried out to compare the data obtained in each different place. Comparative data is necessary to ensure the data acquired and not much difference with data taken from each place. Thus the data has been recorded repeatedly in the same place for three days to compare the data obtained is not much difference and the data collected was more accurate.

Comparative data is also made between different places to compare the number of gas or particulate matter recorded repeatedly for 25 minutes at each location within 8 hours including time in the morning, noon and evening. Data obtained through the iPAQ hx2700 Series Pocket PC can be synchronizing with a computer for copy file and data collected to make a comparison of data. Figure 3.3 below show the iPAQ hx2700 Series Pocket PC synchronize with the computer. If a lot of difference data that have been collected after data comparison is done, data collection will be done again.

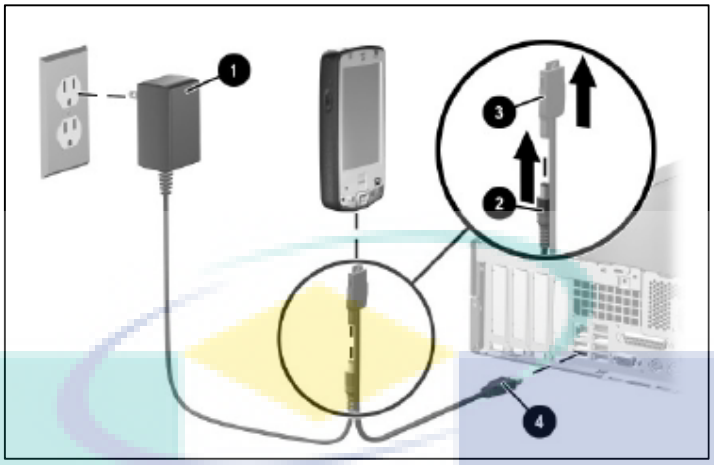


Figure 3.3: iPAQ hx2700 Series Pocket PC synchronize with the computer

3.6.1 Steps to Synchronize With the Computer

a. Plug the AC Adapter into an electrical outlet 1, and then connect the other end of the AC Adapter to the AC connector on the Autosync Cable 2.
b. Connect the 22-pin connector on the Autosync Cable to the universal sync connector on the bottom of iPAQ Pocket PC 3.
c. Connect the other end of the Autosync Cable to the USB port on computer 4.

CAUTION: To avoid damaging your Pocket PC or the Autosync Cable, check to be sure the Pocket PC and cable connectors are properly aligned before pushing the cable into the universal sync connector.

3.7 ANALYSIS DATA

The last step is data analysis done after the process of comparative data. Data analysis was carried out after comparison of the data can be acceptable wear and not much distinction between the data that has been collected. Data analysis is done based on the source of reference journals and the internet as well as investigation or study literature for analyzing data that has been taken. Thus there are many ways to analyze the data correctly including weight calculation or gas. Data matter particles that have been taken and analyze to gain true value and more appropriate for measuring the quality of air to cause particles and gasses in the Jerangau-Jabor landfill. So the quality of the air in the

landfill can be categorized into classes such as health, modest, is not health, danger, and alarm.

3.7.1 Calculation (PM Concentration)

These are formula that involves to analysis data the concentration of particulate matter:

1. Flow meter set point :

$$I_{sp} = \frac{5.0x\left(\sqrt{\frac{P_{act}xT_{std}}{P_{std}xT_{act}}}\right) - b_{vol}}{m_{vol}} \tag{3.1}$$

2. Air flow rate at ambient conditions:

$$Q_{act} = \left(m_{vol}xQ_{ind} + b_{vol}\right)x\sqrt{\frac{P_{std}xT_{act}}{P_{act}xT_{std}}} \tag{3.2}$$

3. Volume at actual ambient conditions:

$$V_{act} = \frac{60_{\min/hr}xQ_{act}xt_{hr}}{1000_{l/m^3}} \tag{3.3}$$

4. Particulate matter concentration:

$$PM_{act} = \frac{M_{PM}}{V_{act}} \tag{3.4}$$

3.8 DEVICE REQUIREMENT

The devices that need to be used to measure the particulate matter content can be found in University Malaysia Pahang itself. The device that is going to be used is:

A Directsense monitoring kit (203)-416-0005:

i. 1 Probe model TG 501
ii. 1 iPAQ hx2700 Series Pocket PC
iii. 1 USB Cable
iv. 2 Li-ion Battery Packs
v. 1 Battery Charger
vi. 1 All-Weather Transport Case

Figure 3.4: Direct sense monitoring kit

CHAPTER 4

RESULT AND DISCUSSION

4.1 INTRODUCTION

The main goal of this project is to determine whether the measurement of particulate matter can be measured by **Directsense monitoring kit model TG 501**. Base on the experiment testing that has been done; it is shown that the data display data logging was successfully recorded.

After the particulate matter measured had been done, data from probes is gained through iPAQ hx2700 Series Pocket PC, data mass of particulate matter is gained through PC software. All the data are collected together for analysis and graph plotting.

4.2 MASS OF PARTICULATE MATTER

Table 4.1 Constant of parameters.

Parameters	**Value**
Standard atmospheric pressure	760 mm Hg
Standard temperature	298 K
Actual ambient pressure	760 mm Hg
Constant, bvol	0.1133
Constant mvol	1.0273
Sampling rate	5 L/min
Sampling period	8hours

Table 4.2: Particulate matters have recorded for three days at the different location in a landfill.

Pollutant Time	Mass of particulate matter PM_{10}, MPM(µg)	Particulate actual of PM_{10}, µg/m3	Mass of particulate matter $PM_{2.5}$, MPM(µg)	Particulate actual of $PM_{2.5}$, µg/m3	Temperature (°C)
9.00am	3200	420.40	5800	761.97	29.0
9.05am	3200	420.40	5800	761.97	29.0
9.10am	3100	407.18	5600	735.55	29.1
9.15am	3200	420.40	5800	761.97	29.0
9.20am	3100	407.18	5700	748.69	29.1
9.25am	3100	407.18	5600	735.55	29.1
12.00pm	3100	402.39	5600	726.89	36.2
12.05pm	3200	415.37	5800	752.86	36.2
12.10pm	3200	415.37	5700	739.88	36.1
12.15pm	3300	428.35	5800	752.86	36.1
12.20pm	3100	402.39	5800	752.86	36.2
12.25pm	3200	415.14	5600	726.49	36.5
15.00pm	3300	427.63	5700	738.63	37.1
15.05pm	3300	427.63	5700	738.63	37.1
15.10pm	3400	440.43	5800	751.31	37.4
15.15pm	3200	414.44	5600	725.27	37.5
15.20pm	3200	414.44	5700	738.22	37.5
15.25pm	3100	401.19	5800	750.61	37.9

4.3 CONCENTRATION OF PARTICULATE MATTER IN LANDFILL

The concentrations of PM in the landfill are identified by specifying 3 different points which are the industry cells (point A), sanitary landfill (point B) and the domestic waste (point C). The sampling was taken 25 minutes each point with a 5-minute interval to identify the concentration of particulate matter over time.

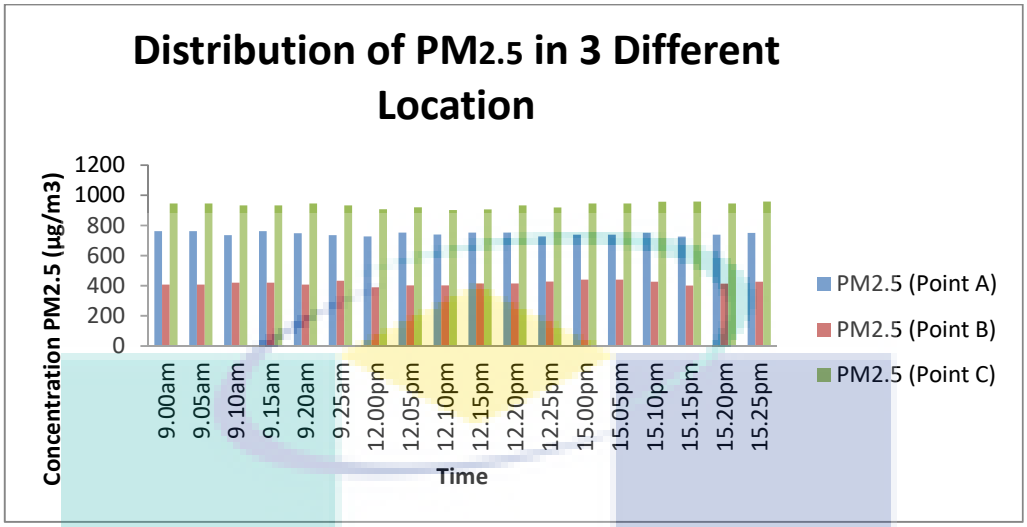


Figure 0.1 : $PM_{2.5}$ concentration at different location in landfill

Extensive particulate matter measurements were performed at several locations at the Jerangau-Jabor landfill from 10 April 2015 until 12 April 2015. Figure 4-1 show the $PM_{2.5}$ concentration at the landfill cell at a different location and it is shown that several concentration peaks were observed from dust generated. The concentration of the $PM_{2.5}$ at point C can be seen as the highest as the activities around the point C is the most significant compared to point A and point B. The particulate matter produced come from the domestic waste and at this location due to dust generated during the unloading of the waste inside the reception building and during waste sorting.

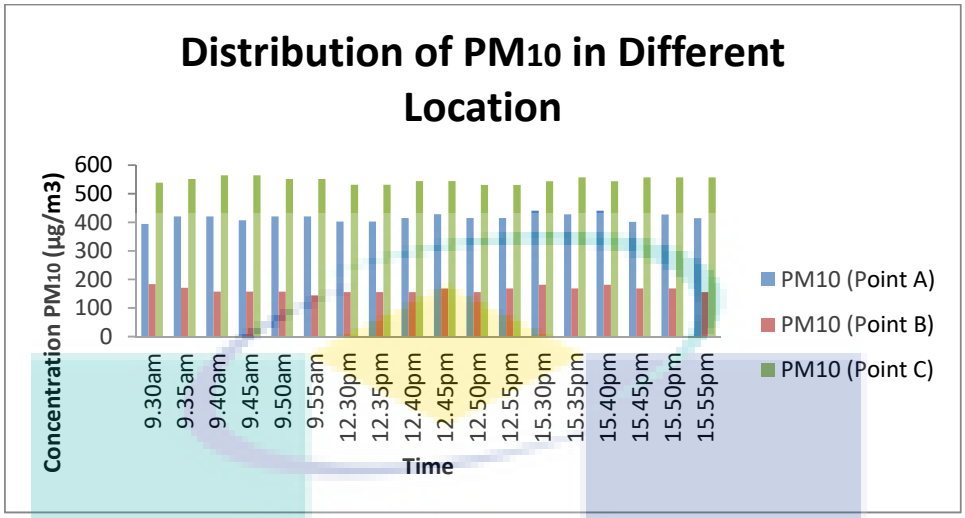


Figure 4.2 : PM_{10} concentration at different location in landfill

In addition, Figure 4-2 show the PM_{10} concentrations at the different location. The concentration for the PM_{10} at point C is the highest compared to point A and point B. The particulate matter produced come from the domestic waste such as rubbish, garbage, and papers. But for the PM_{10}, the concentration is lower than the $PM_{2.5}$ due to its size is much larger where the $PM_{2.5}$ the one that can easily measure during sampling.

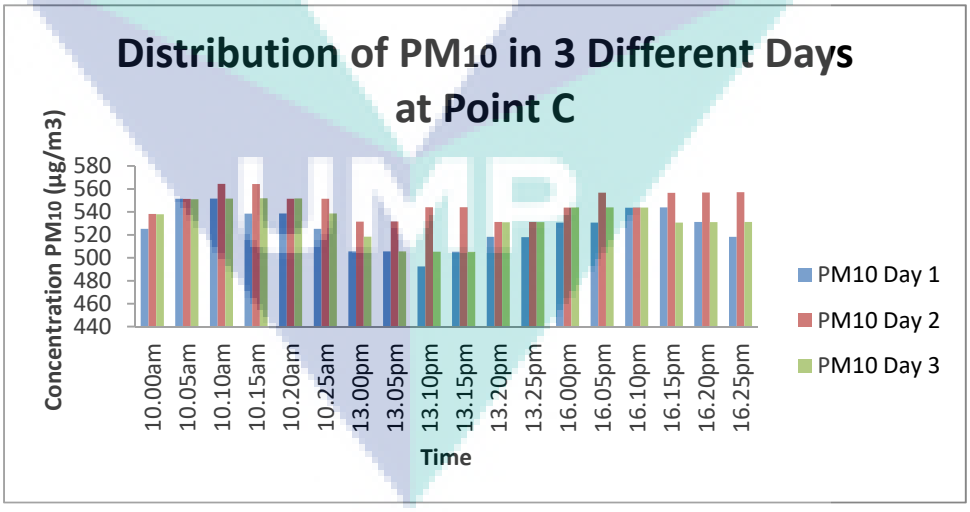


Figure 4.3: PM_{10} concentration at different days in landfill

The concentration was measured for three days at the same location during 25 minutes for each location. Figure 4-3 shown the PM_{10} concentration at day 2 is the highest

concentration compare with the day 1 and day 3. The arid and windy condition may lead to higher levels of entrained PM in the local atmosphere. The temperature in day 2 is the highest compare the temperature on day 1 and day 3 so it can cause the concentration of PM_{10}.

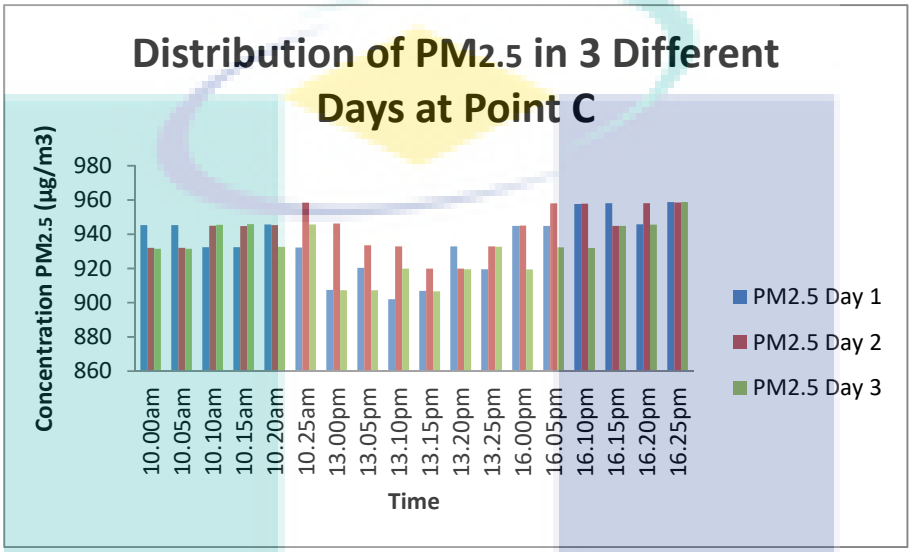


Figure 4.4: $PM_{2.5}$ concentration at different days in landfill

For $PM_{2.5}$ also day 3 the lowest of PM concentration compare the day 2 and day 1 because in day 3 most cloudy so the temperature dropped. Based on the graph pattern are fluctuate because the weather not stable so the temperature will increase and decrease. When the temperature increases the concentration of PM also increase.

4.4 TEMPERATURE EFFECT ON PARTICULATE MATTER CONCENTRATION

In Figure 4-5 and Figure 4-6, the influence of meteorological parameters on the ambient PM_{10} and $PM_{2.5}$ concentration at the landfill site is shown. As seen, both the Fluctuate pattern graph where sometimes the temperature increases the concentration also increases. It can be inferred that arid and weather condition leads to higher levels of entrained PM in the local atmosphere. Higher concentration result in higher resuspension of particulate matter from the surface such as increase temperature values lead to drier soil condition.

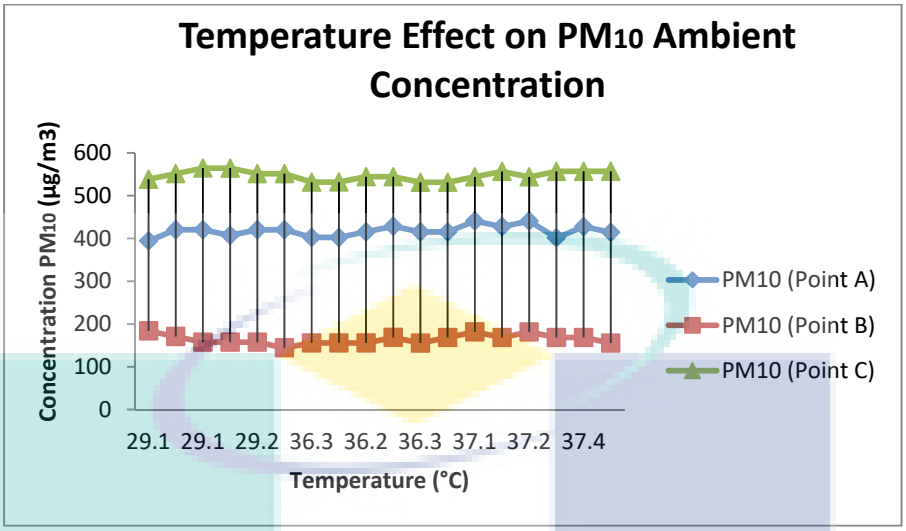


Figure 4.5: Temperature effect on PM_{10} ambient concentration

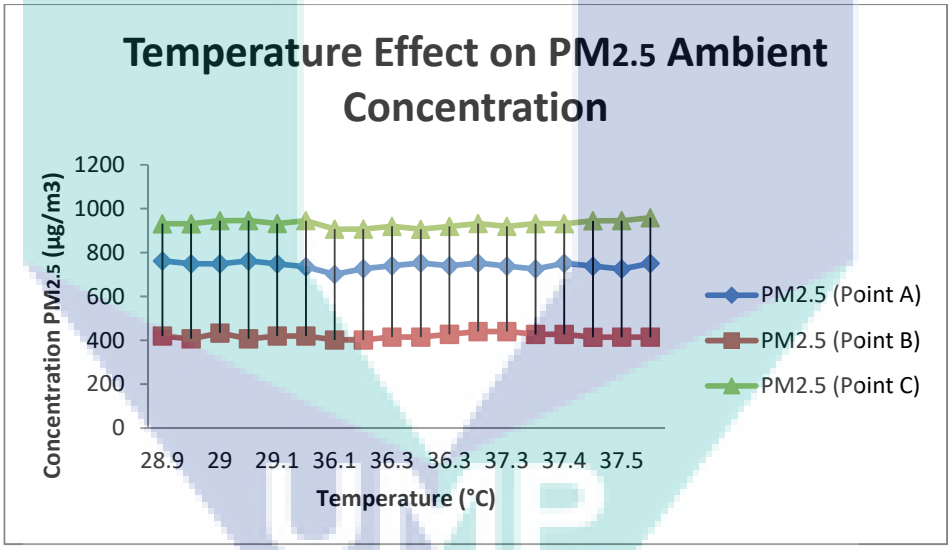


Figure 4.6: Temperature effect on $PM_{2.5}$ ambient concentration

Compares the concentration of PM_{10} Figure 4-7 measures at the Jerangau-Jabor landfill with PM_{10} concentration measured at the three locations on specific days. The daily average concentrations of PM_{10} at the Jerangau-Jabor landfill at a different location between 395.06µg/m3 and 418.39 µg/m3 while the average concentration of PM_{10} at the point C range between 519.41 µg/m3 and 526.32 µg/m3. The comparison shows that the elevated PM_{10} concentrations at the landfill are the result of local activities.

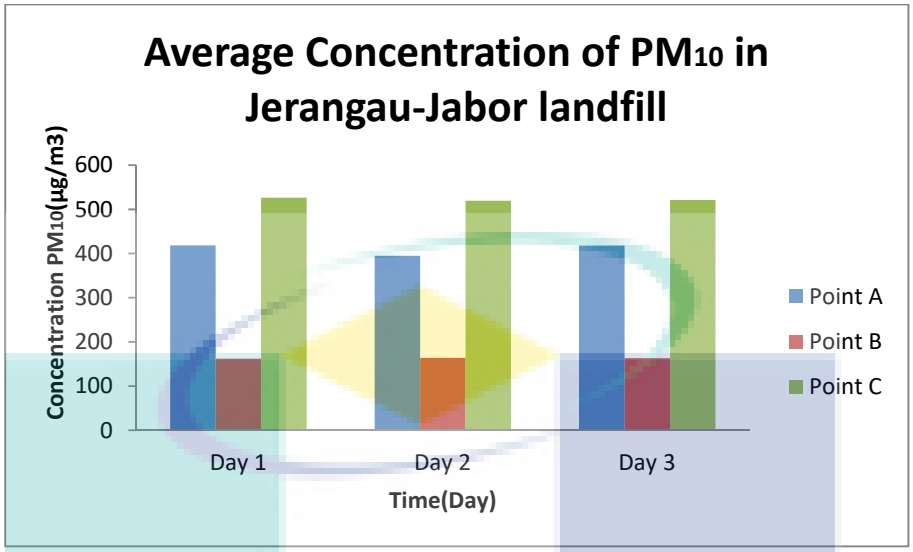


Figure 4.7: Average concentration of PM_{10}

For Figure 4-8 the average concentration of $PM_{2.5}$ in Jerangau-Jabor landfill slightly change because the weather almost stable in different days. The daily average concentrations of $PM_{2.5}$ at the Jerangau-Jabor landfill with different point range between 416.56 µg/m^3 and 421.53 µg/m^3 meanwhile at the point C range between 935.16µg/m^3 and 942.54 µg/m^3.

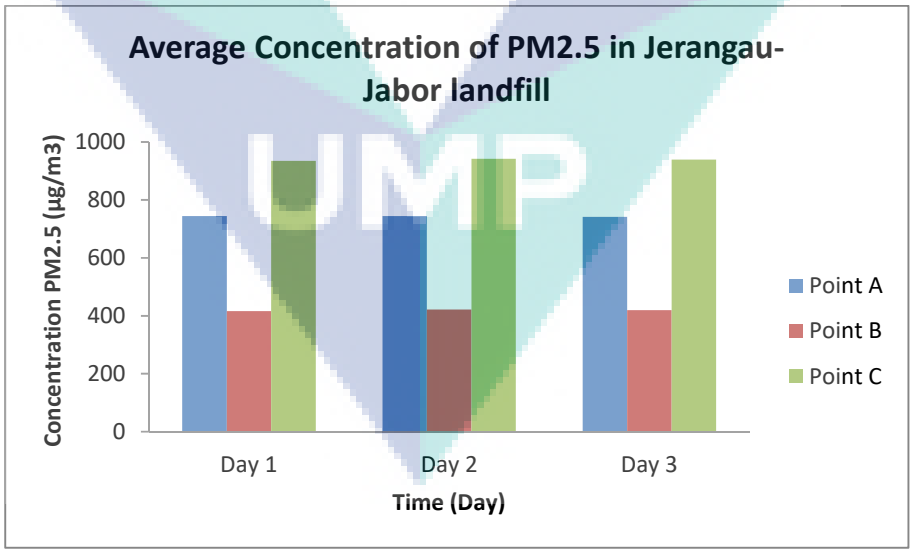


Figure 4.8: Average concentration of $PM_{2.5}$

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 CONCLUSION

Particulate measurements were performed at a Jerangau-Jabor landfill located in Kuantan. From the result and discussion can be concluded about the relationship between the concentration of particulate matter and air quality in the landfill site.

The average concentration of particulate matter at the landfill site range 519.41µg/m^3 –942.54 µg/m^3. The higher concentration was observed at the point C (the disposal of domestic waste) because the type of municipal solid waste from a residential area, market and business area within 300-500 tonnes/day. So, the air quality at the landfill site can be classified are alarm because it is more than 500 µg/m^3 compare the air pollution index.

5.2 RECOMMENDATION

For improvement future test and improvement the safety for workers in the landfill sites the workers for Jerangau-Jabor landfill must wear safety equipment such as mask and gloves. Future research should monitor the PM concentration for the whole year to enhance the results.

REFERENCES

Afroz, R., Hassan, Ã. M. N., & Akma, N. (2003). Review of air pollution and health impacts in Malaysia, *92*, 71–77. http://doi.org/10.1016/S0013-9351(02)00059-2

Chalvatzaki, E., Kopanakis, I., Kontaksakis, M., Glytsos, T., Kalogerakis, N., & Lazaridis, M. (2010). Measurements of particulate matter concentrations at a landfill site (Crete, Greece). *Waste Management*, *30*(11), 2058–2064. http://doi.org/10.1016/j.wasman.2010.05.025

Dietrich Schwela. (2000). Malaysian–German Technical Cooperation.

Eugenia, M., Mel, J., Petrosyan, P., Molina-servin, E. D., & Vega, E. (2015). Induction of c-Jun by air particulate matter (PM 10) of Mexico city : Participation of polycyclic aromatic hydrocarbons, *203*. http://doi.org/10.1016/j.envpol.2015.03.051

F. Kelly, J. F. (2012). source and chemical composition as determinants of toxicity attributable to ambient particulate matter, Atmos Environ (.

H, N. H. N., & Juliana, J. (2014). among Preschool Children at Industrial and Sub-Urban Areas, *8*(15), 149–159.

Mabahwi, N. A., Ling, O., Leh, H., & Omar, D. (2015). Urban Air Quality and Human Health Effects in Selangor , Malaysia. *Procedia - Social and Behavioral Sciences*, *170*, 282–291. http://doi.org/10.1016/j.sbspro.2015.01.038

Miller, E. W. and Miller, R. (1989). Environmental Hazards: Air Pollution.

N. Jianjun, P. Rasmussen, N. Hassan, R. V. (2010). Concentration, distribution and bioaccessibility of trace elements in nano and fine urban airborne particulate matter: influence of particle size, Water, Air & Soil Pollute.

Noor, Z. Z., Yusuf, R. O., Abba, A. H., Abu Hassan, M. A., & Mohd Din, M. F. (2013). An overview for energy recovery from municipal solid wastes (MSW) in Malaysia scenario. *Renewable and Sustainable Energy Reviews*, *20*, 378–384. http://doi.org/10.1016/j.rser.2012.11.050

peavy HS, R. D. and T. G. (1985). Environmental Engineering,International Edition.

Valley, K., Latif, M. T., Abidin, E. Z., & Praveena, S. M. (2015). The Assessment of Ambient Air Pollution Trend in Klang Valley. *World Environment*, *5*(1), 1–11. http://doi.org/10.5923/j.env.20150501.01

W. Xinhua, B. Xinhui, S. Guoying, F. J. (2006). Hospital indoor PM10/PM2.5 and associated trace elements in Guangzhou, China,

APPENDICES A

Gantt Chart SEMESTER 1

	Task	Week													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	**Literature review** • Air quality monitoring • Air pollution index														
2	**Equipment and apparatus** • Model • Benefit • Sample and analyze signal														
3	**Particulate Matter** • PM_{10} • $PM_{2.5}$														
4	**Landfill** • Landfill site • Landfill method														
5	**Testing and data collection** • Recorded data • Type of data														
6	**Thesis Writing** • Introduction • Literature review • Methodology														

APPENDICES B

Gantt Chart SEMESTER 2

No	Task	Week													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	**Experiment set up** • Prepare equipment (TG501) • Identify location of point selected														
2	**Testing and data collection** • Sample time interval • PM_{10} and $PM_{2.5}$ at different location														
3	**Data analysis** • Data calculation • Graph plotting • Writing report														
4	**Finalize Thesis** • Report writing														
5	**Presentation**														