

DEVELOPMENT OF EMISSION INVENTORY OF MAJOR AIR POLLUTION FOR
POINT SOURCE IN MALACCA HISTORIC CITY COUNCIL

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SUPERVISOR DECLARATION

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COUNCIL**

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This thesis is submitted in partial of fulfilment of the requirements for the Bachelor
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DECLARATION

“I hereby declare that the work in this report is my own except for summaries and quotations which have been duly acknowledged.”

Signature:

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Date:

Dedicated to my beloved family

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ABSTRACT

The demand in the industrial sector due the investment of the economics contributes high emission to the atmosphere. The emissions of the hazardous gases to the atmosphere are harmful to the entire living thing. The release of the pollutant leads the decreasing of air quality for the world. For this emission inventory, it was done in the MBMB territory, focusing on the refinery plant, power plant, hospital and hotel. It is used to develop in order to account the amount of emissions that have been discharged to the atmosphere for the year of 2012. This was done to find ways to reduce the causes of the emissions. The area of study for the point source covers in Sungai Udang Refinery, power plant in Tg. Keling and Bandar Hilir (Hospital and Hotel). The pollutants that has been cover in this study is PM₁₀, CO, SO₂, NO_x, CO₂ and NMVOC as they are the main pollutant. The data will be based in the emission factor of the pollutant from the CORINAIR Guidebook 2013 with the activity rate produce from the point sources which is gathered from the questionnaire and interviews. The collected data was analyse by using Tier 2 approach for all point source. The total emissions of gases from hotel for CO₂, SO₂, NO_x, NMVOC, CO and PM₁₀ are 116.0570, 0.2193, 0.1566, 0.0156, 0.0626 and 0.0336 tons per year. As for the power plant in Tg. Keling, it emit for SO₂, NO_x, NMVOC, CO and PM₁₀ are 317.0198, 1709.4965, 48.7754, 719.4114 and 32.0790 tons per year. Last for the refinery, it gives out total emission rates of 14013.8767, 14.71235 and 2084.667 tons per year for NO_x, SO₂ and CO₂. A policy on maintaining the quality and cleanliness of the air will be proposed for the refinery plant as they contribute the most emissions to the atmosphere.

ABSTRAK

Permintaan dalam sektor perindustrian kerana pelaburan ekonomi menyumbang pelepasan tinggi ke atmosfera. Pelepasan gas berbahaya ke atmosfera berbahaya kepada hidupan keseluruhan. Pelepasan pencemar yang membawa penurunan kualiti udara untuk dunia. Untuk inventori pelepasan ini, ia dilakukan di wilayah MBMB ini dengan fokus kepada kilang penapisan, loji kuasa, hospital dan hotel. Ia digunakan untuk membangunkan untuk akaun jumlah pelepasan yang telah dilepaskan ke atmosfera bagi tahun 2012. Ini dilakukan bagi mencari jalan untuk mengurangkan punca-punca pencemaran. Kawasan kajian untuk sumber titik yang meliputi di Sungai Udang Refinery, lojikuasa di Tg. Keling dan Bandar Hilir (Hospital dan Hotel). Bahan pencemar yang menjadi tumpuan dalam kajian ini adalah PM_{10} , CO, SO_2 , NO_x dan NMVOC kerana mereka adalah pencemar utama. Data ini berdasarkan faktor pelepasan bahan pencemar yang diambil dari Buku Panduan CORINAIR 2013 dengan hasil kadar aktiviti dari sumber titik yang dikumpul daripada soalselidik dan temubual. Data yang dikumpul adalah menganalisis dengan menggunakan pendekatan Tier 2 untuk semua sumber mata. Jumlah pengeluaran gas dari hotel untuk CO_2 , SO_2 , NO_x , NMVOC, CO dan PM_{10} adalah 116,0570, 0,2193, 0,1566, 0,0156, 0,0626 dan 0,0336 tan setahun. Bagi loji kuasa di Tg. Keling, ia membebaskan gas bagi SO_2 , NO_x , NMVOC, CO dan PM_{10} adalah 317,0198, 1709,4965, 48,7754, 719,4114 dan 32,0790 tan setahun. Akhir sekali untuk kilang penapis, ia membebaskan jumlah kadar pelepasan 14013.8767, 14,71235 dan 2084,667 tan setahun untuk NO_x , SO_2 dan CO_2 . Dasar dalam mengekalkan kualiti dan kebersihan udara akan dicadangkan untuk kilang penapis kerana mereka merupakan penyumbang paling tinggi. Dengan adanya inventori pelepasan ini, kualiti udara dan kebersihan udara dapat dikawal.

TABLE OF CONTENT

CHAPTER	TITLE	PAGES
	DECLARATION	ii
	DEDICATION	iii
	ACKNOWLEDGEMENT	iv
	ABSTRACT	v
	ABTRAK	vi
	TABLE OF CONTENT	vii
	LIST OF TABLE	x
	LIST OF FIGURE	xi
	NOMENCLATURE	xii
CHAPTER 1	INTRODUCTION	
	1.1 Background	1
	1.2 Problem Statement	2
	1.3 Objectives	3

1.4	Scope	3
CHAPTER 2 LITERATURE REVIEW		
2.1	Introduction	4
2.2	Atmospheric emissions	5
2.3	Sources of air emission	6
2.3.1	Point source	7
2.3.2	Area source	9
2.3.3	Mobile source	9
2.3.4	Agricultural source	10
2.3.5	Natural source	10
2.4	Type of gases emissions	10
2.4.1	Particulate matter (PM)	11
2.4.2	Carbon monoxide (CO)	12
2.4.3	Nitrogen oxide (NO _x)	13
2.4.4	Carbon dioxide (CO ₂)	13
2.4.5	Hydrocarbon (HC)	14
2.5	Effect of the air emissions	15
2.6	Emission inventories (EI)	17
2.7	Emission factor	18
2.8	Activity data	19

2.9	Emission inventory techniques	19
2.10	Area of study	20
2.11	Summary of previous study	21
CHAPTER 3 METHODOLOGY		
3.1	Introduction	22
3.2	Emissions sources of data domain	24
3.3	Data collection	24
3.4	Three methodological tiers	24
3.5	Estimation of emission approach	26
3.6	Emission Factor	26
3.7	Summary	27
CHAPTER 4 RESULT AND DISCUSSION		
4.1	Point Source Emission	28
4.1.1	Hotel	29
4.1.2	Power Plant	31
4.1.2.1	Sulphur Dioxide (SO ₂)	33
4.1.2.2	Oxides of Nitrogen (NO _x)	34
4.1.2.3	Non-Methane Volatile Organic Compound (NMVOC)	34
4.1.2.4	Carbon Monoxide (CO)	35
4.1.2.5	Particulate Matter (PM ₁₀)	36

4.1.3 Refinery	36
4.1.3.1 Total emission in refinery	41
4.2 Summary	44
CHAPTER 5 CONCLUSION AND DISCUSSION	
5.1 Conclusion	50
5.2 Limitation	51
5.3 Recommendation	52
REFERENCES	53
APPENDIX A	55
Questionnaire	
APPENDIX B	56
Gantt Chart PSM 1	
Gantt Chart PSM 2	

LIST OF TABLE

TABLE	TITLE	PAGES
2.1	Types of pollutants and sources	6
2.2	Human response on the effects of CO	12
2.3	Type of pollutant with the effects	15
3.1	Definition of methodological tiers	25
3.2	Emission factors for Hotel	26
3.3	Emission factors for Power Plant	27
3.4	Emission factors for Refinery	27
4.1	Emission Type and number of respondent to questionnaire	28
4.2	Fuel consumption of the hotel for a year	29
4.3	Emission factors from combustion activity fuel	29
4.4	The total emission rate from Hotel	30
4.5	Fuel consumption from power plant	31
4.6	Emission factors from combustion activity fuel	31
4.7	The total emission rate from Power Plant	33
4.8	Total fuel consumption and production in refinery	37
4.9	Emission factor for refinery plant	37
4.10	Fuel gas discharge rate	38
4.11	Fuel gas discharge ratio for every process	38
4.12	Emission rate for natural gas	40
4.13	Emission rate for refinery fuel gas	40
4.14	Emission rate for all point source	44

LIST OF FIGURES

FIGURE	TITLE	PAGES
2.1	Air emission sources	5
2.2	Conceptual scheme showing the emissions sources	7
2.3	Emission of pollutants to the atmosphere from point sources through power plants, Malaysia, 2011 and 2012	8
2.4	Particulate matter	11
2.5	Carbon dioxide molecule	13
2.6	Cycle of Carbon dioxide	14
2.7	Example of hydrocarbon	14
2.8	Role of the emission inventory for air quality management	17
2.9	National Emission in Asia in 2006 (units: Gg/year)	18
2.10	Map of the MBMB territory	20
3.1	Flow chart of the Emission Inventory in Malacca municipality	23
4.1	Comparison on annual emission rates of SO ₂	33
4.2	Comparison on annual emission rates of NO _x	34
4.3	Comparison on annual emission rates of NMVOC	35
4.4	Comparison on annual emission rates of CO	35
4.5	Comparison on annual emission rates of PM ₁₀	36
4.6	Comparison on annual emission rates of NO _x in refinery	42
4.7	Comparison on annual emission rates of SO ₂ in refinery	42
4.8	Comparison on annual emission rates of CO ₂ in refinery	43
4.9	Mapping area for SO ₂ emission rate	45

4.10	Mapping area for NO _x emission rate	46
4.11	Mapping area for NMVOC emission rate	47
4.12	Mapping area for CO emission rate	48
4.13	Mapping area for PM ₁₀ emission rate	49

NOMENCLATURE

CO	Carbon monoxide
CO ₂	Carbon dioxide
NO _x	Nitrogen oxide
SO ₂	Sulphur dioxide
PM	Particulate matter
NH ₃	Ammonia
VOC	Volatile organic compound
Pb	Lead
GHG	Greenhouse Gas
EPA	Environment Protection Agency
US EPA	United State Environment Protection Agency
ONA	One Nation's Air
COESM	Compendium of Environment Statistics Malaysia
EIIP	Emission Inventory Improvement Program
AQMD	Air Quality Management District

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Emission can be said as the production and discharge of something, especially gas or radiation. It is describe a s a particle or gases that been released to the atmosphere from different kind of sources. Some of the gases are good and most of them are very harmful not only to human, but even to the environmental. For example, the carbon dioxide (CO₂) are very important for the trees where it use as food by photosynthesis. So trees can be used to control the emissions. However, the excessive production of CO₂ also can cause a lot of problems. As to be know, the effect of CO₂ are very dangerous for the human health. It can cause fatal death to human as the gases are colourless. Not only CO₂ is dangerous, other gases like sulphur dioxide (SO₂), particulate matter (PM), carbon monoxide (CO), and nitrogen dioxide (NO₂) also bring bad effect to breathing system of human. Therefore, Environmental Protection Agency (EPA) create the emission inventory which are used in controlling the emissions. There are around 187 type of hazardous gases in the air pollutants. But, after many type of research was done, the gases that being

considered as very harmful in the emissions inventory were particulate matter (PM), carbon monoxide (CO), nitrogen dioxide (NO₂), carbon dioxide (CO₂), hydrocarbon (HC) and ozone (O₃). These gases are the mainly emit to the air from industrial activities, refinery plant, development of technology and many more. This inventory was very concern on controlling the emission factor of several places to get better air quality. Therefore, Malacca city will be analysing on the emissions inventory and creating the emission standardization to lead the state to have clean air quality.

1.2 PROBLEM STATEMENT

Earth is being covered by layer of gases that surrounds the earth and retained by Earth gravity. These gases remain in the atmosphere of the Earth. The gases that consist in this air is 78.08% nitrogen, 20.95% oxygen, 0.93% argon, 0.039% carbon dioxide, and others small amounts of other gases. But now, as the growing of modernization, there is a lot of pollution happening. The clean air being polluted by other gases due to irresponsibility and lack of awareness in human being. Polluted air will affect the environment and harms human health.

Along with harming human health, air emission pollutant can cause a variety of environmental effects such as acid rain, eutrophication, haze, ozone depletion and global climate change. This issue was highlighted in Malacca Historic City Council where some area may lead to contribution of air emissions. It is believed that the main causes of emission in MBMB region comes from refinery and power plant. Therefore there is a need to come up with an emission inventory in order to avoid harmful condition to the population and tourists as Malacca is a historical and vacation city.

A research will be done on air quality in area under MBMB territory, focusing on the refinery plant, power plant, hospital and hotel. The results from the research for the emission of air from the refinery and other sources will be studied to

get a clearly visualize on the emission rate. To control this, the activity data from all sources have to be obtained to analyse the emission rate of each source. Every device or appliance that is being used that may cause emission have to be clearly stated for easier of analysis to be done.

This case study will be focusing on studying and analyzing the emission rate of each air pollutant in Malacca Historic City Council under MBMB territory. This case was made for making the air emission standard in the contributing area. The air emission standard will be the rule for the main major emission donor which is the refinery and power plant so that it will follow the standard air emissions. Also it will be used to controlled and reduce the gas emission from the major donor.

1.3 OBJECTIVES

- i. To developed emission inventory of major air pollution for refinery and power plant in Malacca Historic City Council under MBMB region.
- ii. To study and analyze the emission rate of each air pollutant in MBMB territory.

1.4 SCOPES

- i. The emission inventory covers the specific area of territory of Malacca Historic City Council or MBMB which are refinery plant (Sungai Udang), Power Plant (Tg. Keling), hospital and hotel.
- ii. The types of gasses that affect major pollutants consist of SO₂, NO_x, CO, CO₂, PM₁₀ and NMVOC that are included in this inventory.
- iii. Using of emission factors based on CORINAIR guidebook, 2013.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

Atmospheric emissions of various pollutants from mobile source, point source, area source, natural source, agricultural source, and stationary sources affect quality of life and public health. The impact of these emissions may appear in a small scale or regional scale as a result of the pollutants in the atmosphere. Moreover, mankind is facing global air pollution problems, like the greenhouse effect and the depletion of the ozone layer, that are both associated with local air pollutant emissions. These emissions will produce out gases from substance used in making of product or the process use in the particular activity. Most of common gas that is being release to the atmosphere is carbon dioxide (CO₂), which will give benefit to the trees for the photosynthesis process. However, a lot of production of CO₂ also will commit to the atmospheric emissions. CO₂ is the primary greenhouse gas emitted through human activities. It is also found to be hazardous for the human breathing if the production is excessively. The emissions to the atmospheric occur due to no circulation of usage of the gas to reduce the rate of the gases in the

atmospheric. The other type of gases that being concern that contribute to the emissions are carbon monoxide (CO), sulphur dioxide (SO₂), nitrogen oxide (NO) and particulate matter (PM). The excess of these gases that emitted to the atmospheric will cause air pollution that may reduce the air quality and harmful the human health due to breathing the affected air (US EPA, 2010).

2.2 ATMOSPHERIC EMISSIONS

Atmospheric or air emissions are very dangerous and can affect human health in many ways. The variety of health problem including aggravation of respiratory and cardiovascular disease, decreased lung function, increased frequency and severity of respiratory symptoms such as difficulty breathing and coughing, increased susceptibility to respiratory infections, effects on the nervous system, including the brain, such as IQ loss and impacts on learning, memory, and premature death. Air emission also damaging the environment such as vegetation, adversely impacting the growth of plants and trees. The impacts from the emission reduce the ability of plants to uptake or absorb CO₂ from the atmosphere and this causes to affect the ecosystems (ONA, 2010). Figure 2.1 show the example of the pollutant sources.

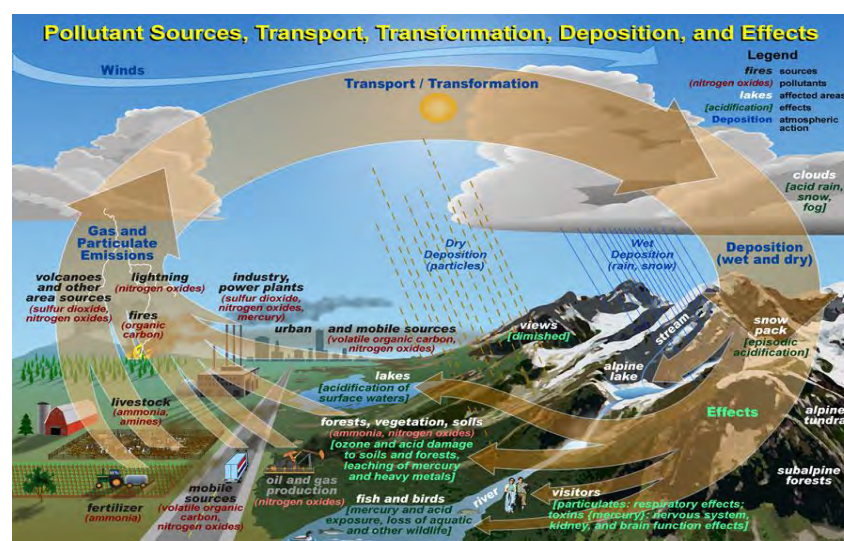


Figure 2.1: Air emission sources

(Source: National Wildlife Refuge System)

2.3 SOURCES OF AIR EMISSIONS

Air emissions consist of gases and particle contaminants that are in the atmosphere as to be said naturally or made in pollution. Some pollutants were released directly to the atmosphere. When the gas pollutants released to the atmosphere, they will be react each other depending on the temperature, humidity and other environmental conditions. These gases are emitted from large stationary sources such as fossil fuel fired power plants, smelters, industrial boilers, petroleum refineries, and manufacturing facilities as well as from area and mobile sources. They are corrosive to various materials which causes damage to cultural resources, can cause injury to ecosystems and organisms, aggravate respiratory diseases, and reduce visibility (NPS, 2014). Table 2.1 listed the most harmful gases that polluted to the atmosphere.

Table 2.1: Types of pollutants and sources
(Source: European Lung Foundation, 2011)

POLLUTANTS	SOURCES
Sulphur Oxide / Sulphur Dioxide	From burning coal and oil
Nitrogen Oxides / Nitrogen Dioxide	From burning fuel in cars and other industrial process
Carbon Monoxide	From combustion process low in oxygen, burning wood, coal, fuel (also from cars)
Carbon Dioxide	From volcanic activity and hot springs, combustion process, cars and power plants
Violate Organic Compound	Evaporates from sources such as vehicle exhausts, cleaning agents, furniture polish and fabric softeners
Particulate Matter	Fine particles from natural erosion and from human processes such as burning fossils fuels
Ammonia	Used to fertilise crops and emitted from this agricultural process and farm animals
Lead	Naturally occurring, produced by lead smelters, contained in old paints and plumbing
Ozone	Formed from a chemical reaction during sunlight

Persistent organic pollutants (POP's)	Produce through industrial processes and waste incineration.
---------------------------------------	--

There are five types of sources that were contributed in the emissions of pollutants. The sources are point, area, mobile, agriculture and natural sources. On the other hand, some of the sources can be classify and being considered by the USEPA as anthropogenic (point, area, mobile sources) and the natural sources. Figure 2.2 show the relationship and example of the sources.

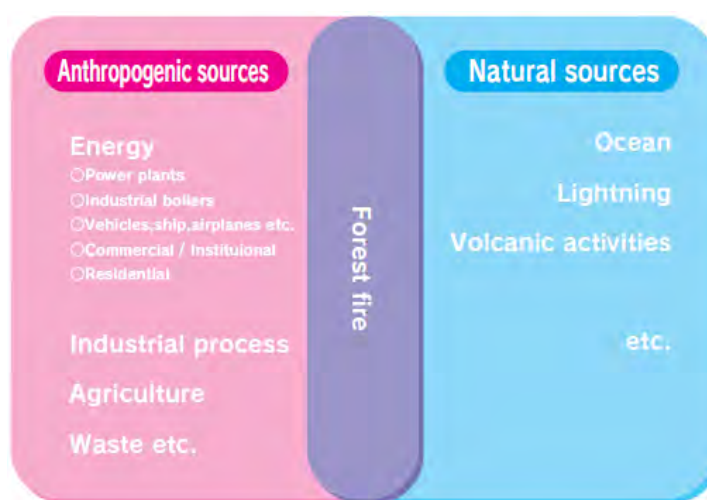


Figure 2.2: Conceptual scheme showing the emissions sources

(Source: Ministry of the Environment of Japan)

2.3.1 Point Sources

Point source is referred to as the source of majorly focus in the industry facilities such as refinery, power plants, incinerator, hospital and hotel (Sopajaree, 2012). The point source emission category includes those sources that are recognized by point locations, typically because they are regulated and their locations are available in regulatory reports. It also can be said as pollutant loads that discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or from individual waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main