

AIR POLLUTANTS FROM BAUXITE MINING ACTIVITY AT BUKIT GOH,  
PAHANG

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A project report submitted in partial fulfilment of the  
requirements for the award of the degree of  
Master of Engineering (Civil)

Faculty of Civil Engineering  
Universiti Teknologi Malaysia

JUNE 2017

## **DEDICATION**

This project is dedicated to my parents for the full support that they gave me during my studies and to my loved husband, the person who is always giving me the strength to fulfill all my goals.

## **ACKNOWLEDGEMENT**

I would like to thank many people who have supported my project report during this long journey. My first special thanks should go to my supervisor, Associate Professor Dr. Johan Bin Sohaili. The completion of this project report was only possible through his advice, support, encouragement and the continuous intellectual challenges that he thoughtfully offered throughout my project report. My appreciation also dedicated to Dr. Shamila Binti Azman from Universiti Teknologi Malaysia (UTM) for all the advice and comments about my project report. Special thanks to Miss Khalida Binti Khalid for helping me to do a proof reading on project report. Last but not least, thanks to my husband, Mahyudin Bin Yusoff who supported me and believed in me. Deep appreciations are also dedicated to anyone who directly or indirectly involved in this study.

## ABSTRACT

Air pollution is a major environmental risk to human health. Bauxite mining activity is not known to most Malaysian except recently due to environmental pollution issues in Kuantan, Pahang. These studies focus on the air pollutants from the bauxite mining activity at Bukit Goh, Pahang. Uncontrolled bauxite mining activity is a phenomenon that causes deterioration of air quality at Bukit Goh. Aluminium (Al), iron (Fe), silicon (Si), titanium (Ti), ozone (O<sub>3</sub>), nitrogen dioxide (NO<sub>2</sub>), and total suspended particulate (TSP) are the seven pollutants that were measured in this study. The concentration of air pollutants was measured at four air monitoring stations i.e. station 1, 2, 3, and 4. The air monitoring stations located based on the difference coordinates. From the study, the content of Al, Fe, Si, Ti, and TSP were determined by using the MiniVol Portable Air Sampler. Al, Fe, Si, and Ti were determined by the analysis of the TSP trapped on the filter paper. The readings were recorded for 24 hours. O<sub>3</sub> and NO<sub>2</sub> were measured using Toxic Gas TG-501. The readings were recorded for 1 hour. The samples collected were analysed using the Gaussian Plume Dispersion Model (GPDM) to estimate the concentration of a pollutant. While Surfer 8 Software was used to determine the air pollution distribution. The data of wind speeds were obtained from the Jabatan Meteorologi Pahang. The result of air pollutants was compared using the mean speed of 1.8 m/s and maximum speed of 2.7 m/s. It was found that the maximum concentrations of air pollutants exist at the mean speed of 1.8 m/s. From the results analysis, the concentrations of O<sub>3</sub>, NO<sub>2</sub>, TSP, Al, Si, and Ti are 82.250µg/m<sup>3</sup>, 263.784µg/m<sup>3</sup>, 306.330µg/m<sup>3</sup>, 27.496µg/m<sup>3</sup>, 110.449µg/m<sup>3</sup>, and 0.5080µg/m<sup>3</sup> respectively. But Fe is not found in this study. TSP shows a high value of concentration because it is higher than the value in the Recommended Malaysian Air Quality Guidelines. According to the Recommended Malaysian Air Quality Guidelines, the maximum concentration of TSP is 260µg/m<sup>3</sup>. This shows that the environment in Bukit Goh is polluted. In this study, the concentrations and distributions of air pollutants are influenced by meteorological factors.

## ABSTRAK

Pencemaran udara penyumbang utama terhadap risiko kesihatan manusia. Aktiviti perlombongan bauksit Sebelum ini aktiviti perlombongan bauksit di Malaysia tidak diketahui sehinggalah baru-baru ini terdapat isu pencemaran alam sekitar yang berlaku di Bukit Goh, Pahang yang berpunca daripada aktiviti perlombongan bauksit. Kajian ini fokus kepada pencemaran udara daripada aktiviti perlombongan bauksit di Bukit Goh, Pahang. Aktiviti perlombongan bauksit yang tidak terkawal adalah satu fenomena yang menyebabkan kemerosotan kualiti udara di Bukit Goh. Aluminium (Al), besi (Fe), silikon (Si), titanium (Ti), ozon (O<sub>3</sub>), nitrogen dioksida (NO<sub>2</sub>) and jumlah zarah terampai (TSP) adalah tujuh pencemaran yang diukur dalam kajian ini. Kepekatan pencemaran udara diukur di empat buah stesen pemantauan udara iaitu stesen 1, 2, 3 dan 4. Keempat-empat stesen ini diletakkan berdasarkan kepada koordinat-koordinat yang berbeza. Daripada kajian ini, kandungan Al, Fe, Si, Ti and TSP ditentukan dengan menggunakan alat *MiniVol Portable Air Sampler* Al, Fe, Si dan Ti ditentukan dengan menganalisis jumlah TSP yang terperangkap pada kertas turas. Bacaan direkod selepas 24 jam kemudian. O<sub>3</sub> and NO<sub>2</sub> diukur dengan menggunakan alat *Toxic Gas TG-501*. Bacaan direkod selepas 1 jam kemudian. Kesemua data yang diperoleh dianalisis dengan menggunakan *Gaussian Plume Dispersion Model (GPD)* untuk menganggar kepekatan bahan pencemar. Manakala *Surfer 8 Software* pula digunakan untuk menentukan pengedaran bahan-bahan pencemar udara. Data kelajuan angin diperolehi daripada Jabatan Meteorologi Pahang. Hasil keputusan daripada bahan-bahan pencemar udara dibandingkan dengan menggunakan halaju min pada 1.8 m/s dan halaju maksimum pada 2.7 m/s. Didapati kepekatan bahan-bahan pencemar udara maksimum adalah pada halaju min iaitu pada 1.8 m/s. Daripada analisis keputusan, kepekatan bagi O<sub>3</sub>, NO<sub>2</sub>, TSP, Al, Si, and Ti masing-masing adalah 82.250µg/m<sup>3</sup>, 263.784µg/m<sup>3</sup>, 306.330µg/m<sup>3</sup>, 27.496µg/m<sup>3</sup>, 110.449µg/m<sup>3</sup>, and 0.5080µg/m<sup>3</sup>. Tetapi Fe tidak ditemui dalam kajian ini. TSP menunjukkan nilai kepekatan adalah tinggi berbanding dengan *Recommended Malaysian Air Quality Guidelines*. Menurut *Recommended Malaysian Air Quality Guidelines*, nilai kepekatan maksimum bagi TSP adalah 260µg/m<sup>3</sup>. Ini menunjukkan bahawa persekitaran Bukit Goh adalah tercemar. Dalam kajian ini, kepekatan dan pengedaran bahan-bahan pencemar udara adalah dipengaruhi oleh faktor meteorologi.

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## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Introduction**

Air is the most precious natural resources that sustain the existence of man, animals, plants as well as the general ecosystem regulation. It is a mixture of gasses which serves as a spacesuit of the biosphere and held by the force of gravity. Air helps to retain heat that warms the earth surface, reduces temperature extremes between day and night as well as absorb ultraviolet solar radiation. The quality of air is determined by measuring the concentration of gaseous pollutants and sizes or number of particulate matter emitted from natural or anthropogenic sources. Air is polluted when particulate toxic elements and gasses released into the atmosphere build up in the concentration is sufficiently high to cause damage. Atmospheric air pollution has an adverse effect on the environment and health status of a given population. This is because air is polluted from various sources and its complexity is largely dependent on the meteorological characteristics, topography and the nature of the pollutants that have been emitted. Rapid advancement in the level of industrial activities and population concentration within the second half of the twentieth century poses a serious threat to atmospheric air quality and well-being. Furthermore, much accidental discharge of air pollutants results in acute exposure and potential risk on human health (Ahmad, 2015).

Depletion of fisheries, air and water pollution as well as contamination by industrial wastes have become more serious in Malaysia recently. Among them, air

pollution is the major issue that has been affecting human health, agricultural crops, forest species, and ecosystems (Afroz, *et al.*, 2003).

Today, most of the country's economic development activities are affecting the environment. Pollution can be defined as the removal of objects or materials as a result of human activity to the environment is causing disruption to the comfort.

According to the Environmental Quality Act 1974, contamination was no change either directly or indirectly to the properties of physics, chemistry, biology or levels of radiation to any part of the environment with the release, issue or lay waste to the detriment of the uses advantageous, that potential to dangerous or potentially harmful to the health, safety or welfare of the public or other organisms, plants and animals.

Observing air quality criteria is a cause-effect relationship which need to be experimentally and epidemiologically, when human beings, plants and animals are exposed to various ambient levels of specific pollutants. Hence, air quality standards are set based on air quality criteria for specific pollutants. The standards prescribe the pollutant levels that cannot be exceeded during a specific time period in a specific geographic location. Standards for air pollution are concentrations over a given time period that are considered to be acceptable regardless the effects of each pollutant on health and environment. They can be used as a benchmark to see if air pollution is getting better or worse (Jimoda, 2012).

Air pollution is one of the main issues faced by the community. Furthermore, open mining involves substantial clearing and removal of land. The processes of excavating, removal of top soil and vegetation, transportation of bauxite and unwanted elements and stockpiling of bauxite cause degradation of air quality mainly related to dust pollution. Bauxite mining is not a new economic activity in Malaysia. The mining of bauxite has taken place in the state of Johor since the early 2000. Whilst bauxite mining operation in Teluk Ramunia Johor has been operating for more than 15 years without much controversy, bauxite mining in Kuantan has created a different scenario within a short period of time. Extensive and aggressive mining which include transporting and stockpiling of bauxite in huge quantities

cause environmental problems to emerge within a short period of time leading to community outrage (Abdullah, *et al.*, 2016).

## 1.2 Problem Statement

The economic resources of Felda Bukit Goh residences are the oil palm plantation. Exploration of the land began in 1966 for a year at the first stage and so on until the fourth stage in 1973. The discovery of bauxite in Bukit Goh opens the eyes of the miners to mine bauxite in the area. Thus, the greed of the miners indirectly caused air pollution.

Atmospheric air pollution has an adverse effect on the environment and health status of a given population. This is because air is polluted from various sources and its complexity is largely dependent on the meteorological characteristics, topography, and the nature of the pollutants that have been emitted. Rapid advancement in the level of industrial activities and population concentration within the second half of the twentieth century poses a serious threat to atmospheric air quality and well-being. Furthermore, much accidental discharge of air pollutants results in acute exposure and potential risk on human health (Ahmad, 2015).

Bauxite is the rock that mainly composed of various minerals. Most important bauxite is the primary ore for aluminium (Al). Al is a very crucial element as its uses are varied and diverse. In Malaysia, the active bauxite mining is located in Gebeng, Pahang. Despite strengthening the economy and as well as serving as a lucrative source of income for many people, the mine is also causing intense suffering to the local people.

The excavation of bauxite soil has left the Kuantan landscape littered with holes. The village populations nearby are exposed to red dust that is potentially contaminated with heavy metals.

Bauxite mining indeed has caused the pollution around Bukit Goh, Gebeng and Kuantan Port. Certain areas in the district, particularly Bukit Goh, has suffered serious air pollution from bauxite dust and residue released by the processing plants or leaked during its transportation process to Kuantan Port. Bauxite dust and residue also has polluted and damaged the road. Few fatal accidents were also caused by lorries transporting bauxite. These lorries also caused traffic congestion as the drivers parked their lorries along the road. The irresponsible bauxite mining practices also cause adverse health effect on the people who live near the mining site.

Although bauxite mining activity was stopped temporarily, lorries are still observed transporting the bauxite through Felda Bukit Goh. These trucks also operate at night. During the site surveying, there is still a heap of stockpile in several locations. Moreover, the excavators were hidden in the palm oil plantations. This marks that bauxite mining activity will eventually continue in the near future. Therefore, it is necessary that the research is done to provide a study of air quality in the area of Bukit Goh, Pahang.

### **1.3 Background of Study**

Felda Bukit Goh is the area which rich with the palm oil plantations for a long time ago. Most sources of income of the people in Felda Bukit Goh come from the cultivation of oil palm. Felda Bukit Goh is now widely known after the discovery of the mineral bauxite, which is said to be among the essential ingredients to make plane body parts. In recent years, production of bauxite in Kuantan has increased sharply. It became a major issue for local residents, especially for the residents in Rancangan Tanah Pemuda (RTP) Bukit Goh, Kuantan. Arguably the demand for bauxite is ubiquitous due to the high demand for the production of product from Al.

The discovery of bauxite in Felda Bukit Goh causes the economic resources some settlers had shifted from oil palm cultivation to bauxite. Bauxite is an economic resource for many residents in Felda Bukit Goh. Most of the old palm trees that are not needed now had been cut down. The lands of the former site of oil palm

plantations are being cleared. These lands were said to contain bauxite. It was sold to the bauxite miners who are mostly Chinese. Felda Bukit Goh environment is no longer clean and healthy as ever. Previously, the flying dust attached to the palm trees. But now the dust was flying free in the air because many trees have been cut down.

Bauxite excavated in Kuantan is exported to China. Other countries which also supplies bauxite to China are Indonesia, Australia and India. In 2014, Malaysia is the main supplier of bauxite to China because Indonesia has stopped their production. As a result, the supply of raw materials to meet the demand for Al increases. Unfortunately, due to the high demand of bauxite from China, the local community around Kuantan fall victim to pollution and environmental damage on a critical level.

Undoubtedly bauxite is a source of income for the population and the country's economy. Regardless, bauxite gives negative impact for a long period of time. Although bauxite is said to contain the elements that are harmful to human health, but it is still ignored by some people who are obsessed with bauxite.

#### **1.4 Aim and Objectives**

The objectives that are outlined in the study of air quality in the Bukit Goh area are as the followings:

- i. To determine the content of Aluminium (Al), Iron (Fe), Silicon (Si) and Titanium (Ti) by analysing the TSP trapped on the filter paper.
- ii. To obtain the concentration of pollutants such as Aluminium (Al), Iron (Fe), Silicon (Si) and Titanium (Ti), ozone (O<sub>3</sub>), nitrogen dioxide (NO<sub>2</sub>) and total suspended particulates (TSP) using the Gaussian Plume Dispersion Model (GPDMD).
- iii. To develop air pollution distribution of the study area using Surfer 8 Software.

## **1.5 Scope of Study**

This study focuses on the air quality surrounding the area of Bukit Goh, Pahang. The parameters that are monitored in this research are the concentration of gases i.e. O<sub>3</sub>, NO<sub>2</sub>, Al, Fe, Si, Ti and TSP. The area surrounding Bukit Goh, Pahang is chosen due to the activity of bauxite mining. Four stations were decided to be set up in this area based on the wind direction. The concentrations of gases were measured using the Toxic Gas TG-501 Probe equipment. Mini Vol Portable Air Sampler was used to measure the TSP. The dispersion of pollutants was determined when the data collection transferred to software. Surfer 8 Software and Gaussian Plume Dispersion Model are two tools that were used as a modelling of air pollution. Surfer 8 Software was used to develop air pollution distribution of the study area. While the concentration of air pollutants was determined using the Gaussian Plume Dispersion Model.

## **1.6 Significance of Study**

In this study, it is found that the main elements of bauxite are aluminium (Al), iron (Fe), silica (Si) and titanium (Ti). The results of the observation of gases, it found that the air containing pollutants namely ozone (O<sub>3</sub>) and nitrogen dioxide (NO<sub>2</sub>). The total suspended particulate (TSP) is also recorded with the highest reading. The high reading of TSP indicates the area is not clean and safe for the residents. Thus, they are threatened by health problems.

The findings of this study will help the researchers in the study regarding air quality impacts from mining bauxite. The long-term implications of this study will affect the environment. From this study, it is hoped that the government could consider the issues of bauxite mining and its effect on human health and ecosystem.

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