THE EFFECT OF BAUXITE MINING ON WATER QUALITY OF SUNGAI MABUK AT BUKIT GOH, KUANTAN

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To the dearest and beloved mother and wife

Hajjah Rokiah Binti Abu Bakar

Siti Aishah Binti Ali

To my beloved and cuties son and daughters

Muhammad Adib Darwish

Siti Aleesya Khadeeja

Siti Aiman Kaisara

Siti Ameena Khaira

Hope all of you are success in this world and hereafter

Thank you for your support and helpful

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ABSTRACT

The usage of contaminated water can affect especially to the health of human, animals and plants. Bauxite mining in a district of Kuantan, Pahang offers some exciting economic opportunities for various people, especially individual land owners. Nevertheless, the 'bauxite boom', the extensive and uncontrolled mining activities have great potentials to cause adverse impacts on the environment especially water quality in the river nearby. The area of the study is Felda Bukit Goh, Kuantan, whereby Sungai Mabuk is situated at one of the sources of the water intake of Bukit Goh treatment plant. The objectives of the study are to determine the effect of bauxite mining activity to the water quality of Sungai Mabuk according to Water Quality Index (WQI) and National Water Quality Standard (NWQS) including bauxite parameters such as aluminium, ferum and silica. QUAL2E modelling is using in order to predict the water quality. In this study, water samples are taken from three stations S1, S2 and S3 along the river during the sunny and rainy day. The water quality parameters are also used to develop the QUAL2E model of Sungai Mabuk. The results show the values of NH_3N, Al and Fe are among the largest contributor of pollution in Sungai Mabuk. Bauxite mining activity contributed to the increase of Al and Fe parameter in river. However, TSS content in Sungai Mabuk is low and this shows that the bauxite mining activity nearby is manageable and under control. The WQI mean values are 78.59 %, 77.09 % and 73.56 % at stations S1, S2 and S3 respectively during a sunny day and can classified as Class II and III. The WQI value decreases which is 74.63 %, 72.82 % and 69.3 % at stations S1, S2 and S3 respectively during a rainy day and can classify as Class III with moderately pollutedduring a rainy day. The QUAL2E model was successfully used to predict the pattern and trend of the water quality parameters. Beside that, with the pollution that matches effluent Standard B released by DOE or if the pollution situation is worst, it still occurs that Sungai Mabuk is under control and can make a process of purification of the river. The river pollutant parameters are under control and the downward trend occurs at the downstream side.

ABSTRAK

Penggunaan air yang tercemar boleh member kesan terutamanya kepada kesihatan manusia, haiwan dan tumbuh-tumbuhan. Perlombongan bauksit di Kuantan, Pahang meningkatkan pendapatan dan ekonomi terutamanya kepada pemilik tanah persendirian. Walaubagaimanapun, 'bauksit boom', adalah aktiviti perlombongan yang aggresif dan tidak terkawal serta menyebabkan kesan buruk kepada alam sekitar terutamanyakepada kualiti air di sunga iberhampiran. Kawasan kajian ini adalah di Felda Bukit Goh, Kuantan, di mana Sungai Mabuk merupakan sumber bekalan air ke loji rawatan air Bukit Goh yang terletak di kawasan ini. Objektif kajian ini adalah untuk menentukan kesan aktiviti perlombongan bauksit ke atas kualiti air Sungai Mabuk berdasarkan Indeks Kualiti Air (IKA) dan Standard Kualiti Air Kebangsaan (NWQS) termasuk parameter yang terkandung dalam bauksit seperti aluminium, ferum dan silika. Model QUAL2E digunakan untuk meramalkan trend kualiti air disepanjang sungai berkenaan. Dalam kajian ini, sampel air diambil dari tiga stesen iaitu S1, S2 dan S3 disepanjang sungai ketika cuaca panas dan hujan. Nilai parameter kualiti air ini juga digunakan untuk membangunkan model kualiti air QUAL2E bagi Sungai Mabuk. Hasil analisis menunjukkan parameter NH_3N, Al dan Fe adalah merupakan penyumbang terbesar kepada pencemaran air di Sungai Mabuk. Aktiviti perlombongan bauksit menyumbang kepada peningkatan parameter Al dan Fe. Walaubagaimanapun, kandungan TSS di Sungai Mabuk adalah rendah dan ini menunjukkan bahawa aktiviti perlombongan bauksit di kawasan berhampiran adalah terkawal. Nilai IKA adalah78.59 %, 77.09 % dan 73.56 % di stesen S1, S2 dan S3 ketika cuaca panas iaitu berada dalam Kelas II dan III. Nilai IKA adalah lebih rendah iaitu 74.63 %, 72.82 % dan 69.3 % di stesen S1, S2 dan S3 ketika cuaca hujan dan berada dalam Kelas III iaitu sederhana tercemar. Model QUAL2E telah berjaya dibangunkan untuk meramal corak dan trend parameter kualiti air. Dengan kadar dan nilai pencemaran yang sepadan dengan efluen Standard B yang dikeluarkan oleh Jabatan Alam Sekitar atau jika keadaan pencemaran yang lebih buruk berlaku, Sungai Mabuk masih dalam keadaan terkawal dan trend bahan pencemar adalah menurun di bahagian hilir sungai.

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LIST OF ABBREVIATION

DO	-	Dissolved Oxygen
BOD_5	-	Biochemical Oxygen Demand
COD	-	Chemical Oxygen Demand
TSS	-	Total Suspended Solid
NH_3N	-	Ammonical Nitrogen
Al	-	Aluminium
Fe	-	Ferum
Si	-	Silica
H_2SO_4	-	Sulfuric Acid
WQI	-	Water Quality Index
NWQS	-	National Water Quality Standard
DOE	-	Department of Environment, Malaysia
QUAL2E	-	Enhanced Stream Water Quality Model
QUAL2K	-	A River and Stream Water Quality Model
n	-	Value of manning roughness parameters
FLAA	-	Flame Atomic Absorption Spectroscopy
ICP	-	Inductively coupled argon plasma spectroscopy
APHA	-	American Public Health Association
GIS	-	Geographical Information Systems
WHO	-	World Health Organisation
USEPA	-	United States Environmental Protection Agency
UTM	-	Universiti Teknologi Malaysia

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Water is an essential natural gifted for life on this earth. Beside for drinking, the water is used for fisheries activities, industrial, agricultural, hydroelectric power generation and recreation. There are various water resources such as from lakes, groundwater, rivers and sea.

The freshwater resources are very limited and it is only about 2.5 % whereas the other source is salt water from the sea. The freshwater resources especially surface water such as river and lakes is exposed to the pollution problems from human activities especially from industrial and housing activity (Igor Shiklomanov's, 1993). This coincided with the word of Allah in the Quran:

> *And We give and create rain from the sky according to due in measure and We cause it to intrude into the soil, and We certainly are able to drain it off with ease. From it, We grow for you a garden of palms date and vines, besides that, you have abundant of fruits and of them you eat and have enjoyment.*
>
> *(Surah Al Mu'minin: verses 18 - 19)*

The cleanliness and quality of surface water especially from of rivers and lakes should be guarded and monitored systematically and evenly so that the quality of water is always at a good level. It is very important because the river is the main source of fresh water supply in the earth. River pollution usually is occur because of the removal of pollutants especially from housing, mining, agriculture, industrial, manufacturing, and fisheries activity and all of this activity actually affects water quality and its can be reduce the source of clean water in the earth. The usage of contaminated water can affect especially to the health of human, animals and plants(Arms, 1990).

There are some exciting economic opportunities for various people in district of Kuantan, Pahang, especially individual land owners from bauxite mining activities. The impacts on the environment in the bauxite mining areas cause by the extensive and uncontrolled mining activities such as to the water and air (Harison, 1997). It is also impacts to the health and quality life of the people. Due to environmental pollution issues in that area, the bauxite mining activity is very popular issue among to Malaysian. The physical environment and physical illness is the potential environment impacts if the situation is not controlled. Mental distress, anger and community outrage cause by presence of unpleasant red dust at the uncontrolled bauxite mining area and it affect the loss of economic potentials and that area (Noor Hisham et. al., 2016).

Since early 2000, Johor has taken place in bauxite mining especially in Teluk Romania, so that in Malaysia, bauxite mining is a being known and not a new economic activity. There is no much controversy in Teluk Ramunia, even though bauxite mining activity has been operating for more than 17 years. Nevertheless, a scenario is different within a short period of time on bauxite mining in Kuantan. The activity such as transporting and stockpiling of bauxite in large quantities and without proper manageable and controlled cause environmental problems. The controversy in environment issue exists within the time during aggressive and extensive bauxite mining activity (Noor Hisham et. al., 2016).

The environment issue especially that threatens to the ecosystems cause from the aggressive uncontrolled bauxite mining in Kuantan. A number of hazards such as chemical, physical, biological, psychosocial and ergonomic causes throughout the process of bauxite mining activity. Because of the issue of environmental pollution

starting from 15 January 2016, the Ministry of Natural Resources and Environment has imposed and suspension the bauxite mining activity for the period of three month. From this activity it caused the polluted ecosystems and has great potential to create chronic and unpredictable exposures, leading to direct or indirect, immediate and long term potential impacts on health cause (Noor Hisham et. al., 2016).

Without a clearly defined zone of bauxite mining activity the problem is exist. It is because the bauxite mining at Kuantan is occurring near to resident area but scattered. The school and resident areas which is the most of the vulnerable time for children and people doing activity is very close to the bauxite mining area. The extensive land clearing are mainly related to sources of water pollution. The soil erosion and sedimentation is also occurring during the extraction of bauxite(Valeton, 1972). The process of washing the bauxite and the mud and effluent from the bauxite washing pond occur the environment pollution and its flows into the river nearby. The water quality in the river nearby is also impact from the activity of stockpiling of bauxite in large quantities without a proper drainage system. The severe mud flood due to surface runoff and soil erosion of cleared land and polluted the river and sea water cause by poor manageable and control for the bauxite mining activity.

1.2 Problem of Statement

The largest of bauxite mining area at Kuantan is Felda Bukit Goh. The area of bauxite mining consists of water treatment plants including Semambu, Bukit Sagu, Bukit Goh and Bukit Ubi Water Treatment Plant. The bauxite mining activities in that area have great potentials to contaminate the drinking water sources because usually water intake is taken at downstream so. Due to the pollution of Sungai Mabuk and Sungai Riau, on 29 December 2015, the Bukit Goh Water Treatment Plant was closed.

In a wet tropical or subtropical climate, laterite soil that contains bauxite has been severely leached of aluminium, ferum, silica and other soluble materials. Bauxite is the primary content aluminium and mostly all of the aluminium is produced and extracted from bauxite. Actually, there are no specific compositions in bauxite. The

hydrous aluminium aluminium hydroxides, oxides, insoluble materials and clay minerals such as magnetite,quartz, siderite, goethite and hematite is a mixture of and content of bauxite.

In bauxite mining area, the main contaminants of water resources is aluminium and ferum because it is the main composition of bauxite. Besides that, when the natural ecosystem is aggressively removed and excavated, other toxic metals such as mercury, arsenic, nickel, cadmium, manganese and lead may also contaminate drinking water resources. It is depending on the characteristics of the geological of the land surrounding land use activities. Multiple organ toxicity and increase cancer risk is causes from the chronic exposure to toxic metals. Whereas, bone diseases to children is causes from exposure to the high level of aluminium in the stomach and prevent the absorption of phosphate and a chemical compound which is required for health such as chronic Alzheimer disease.

1.3 Aim and Objectives

The objectives of the studies are:

i. Determine the parameter of water quality at Sungai Mabuk nearby bauxite mining area at Felda Bukit Goh, Kuantan including Dissolved Oxygen (DO), pH, Biochemical Oxygen Demand (BOD_5), Chemical Oxygen Demand (COD), Ammonical Nitrogen (NH_3N), Total Suspended Solid (TSS), Aluminum (Al), Ferum (Fe) and Silica (Si).

ii. Classify river water quality based on Water Quality Index (WQI) and National Water Quality Standard (NWQS) including bauxite parameters such as Aluminum (Al), Ferum (Fe) and Silica (Si).

ii. Predict the effect of bauxite mining activities to the water quality of the Sungai Mabuk using the QUAL2E modelling including Aluminum (Al), Ferum (Fe) and Silica (Si).

1.4 Scope of Study

The location of the study is at Sungai Mabuk nearby bauxite mining area at Felda Bukit Goh, Kuantan, Pahang. The sample is taken during rainy and sunny day to identify the effect of bauxite mining activity to the water quality of Sungai Mabuk.

Determination of water quality includes the DO, pH, BOD_5, COD, TSS, NH_3N, Al, Fe and Si which is sampling along the river which is before and after the bauxite mining area. The sample of water will be tested insitu and in lab. While the QUAL2E modelling software is using to predict the effect of bauxite mining activity to the water quality of the river nearby.

1.5 Significance of Study

Environmental pollution may occur caused by uncontrolled bauxite mining operation in Kuantan. The environment issue is very important because most of the water intake is the nearby area. The environment pollution must be controlled for human existences such as water quality nearby due to the destruction of ecosystem threaten our access. The impact may persist if there is no proper action and plan is done to the exploited area. Due to environment pollution especially water and air the mental distress become apparent. To quantify the impact of bauxite mining activity in water quality of the river and water treatment plant nearby more studies are needed. A wider aspect of prevention must be done rather than waiting for the occurrence of diseases before acting is the focus and responsible of all agencies. The important agenda is to implement and emphasise the sustainable mining practices in order to minimise the environmental problem.

1.6 Summary

Bauxite mining activities in Felda Bukit Goh, Kuantan environmental pollution issue especially for water and air. The water intake located at Sungai Mabuk which is the study area. This study was conducted to see the level of water pollution based on the WQI. The water quality parameters based on WQI parameter and include the bauxite parameters such as Al, Fe and Si. Besides that, the QUAL2E model developed and used to predict the water pollution and the trend of pollution of Sungai Mabuk if worst case scenario happens. The results of this study can be used by responsible parties and agencies for monitoring pollution of the river.

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