A STUDY ON A SULFATE SOIL AND ACIDIC RIVER OCCURANCE IN SEMBERONG RIVER

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ABSTRACT

Rivers have many benefits to every life in the world. It gives us food, water and sometimes it is used for transportation. Nowadays, some of the rivers have been polluted because of human activities or its own bad condition. Semberong river is one of the thousands rivers in Malaysia that have been polluted for years. Geological map of Malaysia shown that Semberong river is located in the sulfate soil area. It was found from previous studies that leaching of the sulfur mineral in the soil to the environment would lead to acidic river resulting from the oxidation process. This study was carried out to determined sulfate content in soil along the river which causes acidity in river basin. Besides, sulfate content in soils can be related with the occurrence of acidic river. This study is conducted by collecting soil samples at selected stations. A leaching column of an undisturbed soil was constructed in the laboratory to collect leachate sample from the soils. The concentration of sulfate in the samples was analyzed by using DR 5000. It also studied to determine the selected metal like aluminum, ferum and manganese content in soils, which were analyzed by using Atomic Absorption Spectrometry (AAS). This study contributes high content of metals (Al, Fe and Mn) in the river. This study has carried out with the location of the soil which contain sulfate and the relationship of sulfate with the occurrence of acid river.

Key Words: Sulfate Soil, Acidic River, Leaching Column.

1.0 INTRODUCTION

Water is one of the most valuable sources in the world which had been formed from a combination of two atoms hydrogen and an atom of oxygen. A case of acidic river is not occurred from pollutions to environment but also because of acid sulfate that formed in the soil. The formation of acid sulfate in the soil occurs when one of the soil compounds that is pyrite (FeS2) reacted with water and oxygen. This reaction will form acid compound that is acid sulfate.
The study would focus on the beginning point of sulfate formation in soils at Semberong River, Batu Pahat and its relations with the acidic river. Several processes that happen in soils and the damp environment gave effect to the transformation of sulphur. Some of the processes are absorption and desorption of sulfate (SO$_4^{2-}$), oxidation of inorganic sulphur and the changes of organic sulphur.

In Peninsular Malaysia, most of the acid sulfate soils are found in the coastal plains of the wet coast. Acid sulfate soils are found mostly in Kelantan (Kemasin-Semerak IADP), Terengganu (Kuala Nerus,Batu Rakit), Pahang (Paya Besar), Johor (Batu Pahat,Pontian),Melaka (Pulau Gadong, Tanjung Minyak,Linggi), Selangor (Pulau Carey,Pulau Indah), Perak (Bagan Datoh) and Kedah (Yan, Kubang Pasu).

1.1 Problem Statement

In Berita Harian report on May 2005, about 350 consumers of water resource from Bekok River and Semberong River were infected by skin disease. It was because of the content of iron, manganese and aluminum in the river. The content of metals has affected the quality of that river until now. Therefore, this study is used to identify the latest condition of the river.

1.2 Objective of Study

The objectives that have been identified for this study includes:

i. To determine the content of sulphate in leachate from soils sample that caused acidic river.
ii. To determine the contents of selected metals that is ferum, manganese and aluminum in the leachate at Semberong River.
iii. To relate between sulfate in soils with acidic river.

1.3 Scope of study

The study that will be conducted includes a study of acid sulfate in the soils samples that have been taken at Semberong River which is located in Batu Pahat, Johore. Apart from that, the study also would determine the selected metals in the soils samples. The method used for this study is Column Leaching Test.

This study includes two main levels which are a study at the site and the experiment in laboratory. Study at the site involves station selection, soil sampling and parameters of water quality at the selected stations the experiment in laboratory involves analyzing the soils samples with the suitable tests to fulfill the objectives of the study.

1.4 Location of study

The location of this study is Semberong River that is located in the region of Batu Pahat. The area which is nearer to this river is Air Hitam, Parit Raja and Batu Pahat. Semberong River met up with Simpang Kanan River at Tanjung Semberong at Parit Raja, Batu Pahat as shown in Appendix A.
2.0 LITERATURE REVIEW

2.1 Sulfate

Acid sulfate soil is the common name given to coastal floodplain deposits (mainly silty clays) containing oxidizable, or partly oxidized, and sulfide minerals. The general form of these sulfide minerals is cubic iron pyrite (FeS\(\text{\textsubscript{2}}\)) although other forms of sulfide compounds can also exist in small concentrations (Bush and Sullivan, 1999). Pyrite oxidizes when it is exposed to atmospheric oxygen, which result in the formation of acidic oxidation products namely Fe\(^{2+}\), SO\(^{2-}\) and H\(^{+}\).

High level of sulfate in water tends to form hard scales in pipes and other equipment under high temperature, give water a bad taste, and may induce diarrhea. Sulfate-rich waters are commonly found in areas where the geologic strata in rich in sulfides (V.P Evangelou, 1998).

2.2 Ferum(Fe)

Ferum is the fourth mineral found in the earth’s crest. This mineral is very important for soil especially clay. Ferum is a necessary to plants and animals. However, it could be toxicity in a large quantity. A river has about 0.5-1 mg/L while water in soil has about 100 mg/L of ferum. Ferum is known as complex organic and inorganic and dissolves in water (Suhendrayatna, 2001).

2.3 Manganese(Mn)

Manganese is a common compound and known as one of 3 toxics that are very dangerous. Manganese is not dangerous with lower concentration and become necessity among human but it will be dangerous and toxicity. The ideal concentration of manganese is among 0.01-0.05 mg/L (Suhendrayatna, 2001). Manganese produces a brownish color in clothes washed in manganese-rich water.

2.4 Aluminum (Al)

Aluminum is one of the most abundant elements in the earth’s crust. Acid rain and acid mine drainage are two major causes of increased aluminum in freshwater systems. As acid water goes through soil, pH decreases and aluminum dissolves. The process may increase aluminum concentration to toxic level (>2 mg/L). Aluminum is toxic to both humans and aquatic organism, especially to humans undergoing dialysis (V.P Evangelou, 1998).

2.5 Column Leaching test

The NEN 7343 column test (Netherlands Normalization Institute 1993b) is believed to simulate the leaching behavior of a waste material in the short, medium, and long term (van der Sloot 1995). This is done by relating contaminant release, expressed as mg/kg leached, to the liquid to-solid ration (van der Sloot 1995). The time scale relation is obtained from the height of the column and rate of infiltration (van der Sloot 1995).
The procedure involves passing demineralized water (pH = 4) upward through ground material (95% < 4mm). There were seven consecutive leachate fraction collected, corresponding to a liquid-to-solid ratio range of 0.1 to 10 L/Kg (de Groot and Hoede 1994).

The advantage of column test compared to the usual shaking test is that bulk density and the porosity of the sample are closer to field conditions, artifacts such as emulsions or suspensions are avoided and the change of effluent concentration with time can be easily monitored (this allows the prediction of the long term decrease in contaminant release rates) (Bernd Susset and Peter Grathwohl, 2001).

3.0 DATA ANALYSIS AND RESULT

Laboratory analysis of pH, concentration of sulfate, aluminum, manganese and ferum were carried out for both river water and leachate samples. The basis of comparison of quality parameters was INWQS standard. The summary of the data collected for all the quality parameters considered was shown in appendixes overleaf.

Conclusion and recommendations results of data analysis of sulfate and heavy metals content in the leachate samples showed a relationship between sulfate content in the leachate sample and stream water sample. The pH of the leachate and stream water sample shows that the river was acidic. There was sulfate content in the stream water sample due to the complete weathering process of pyrite that leached sulfuric acid to water bodies.

REFERENCES


Figure 1: Location of study

![Location of study](image)

Figure 1: Location of Semberong River in Batu Pahat

Figure 2: Analysis of pH value

![pH Analysis](image)

Figure 2: Analysis of pH value

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Figure 3: Analysis of Aluminum Concentration

![Graph showing aluminum concentration levels for leachate and stream water samples.]

Figure 4: Analysis of Manganese Concentration

![Graph showing manganese concentration levels for leachate and stream water samples.]
Figure 5: Analysis of Ferum Concentration

![Graph showing ferum concentration analysis.](image)