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USE OF ORGANIC MATERIALS WETLAND TO IMPROVING THE CAPACITY SULFATE REDUCTION BACTERIA (SRB) OF REDUCE SULFATE IN ACID MINE WATER (AMW)

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Abstract - Increasing mining activities in several regions in Indonesia, began to face problems, namely of environmental pollution. One of the mining waste that is liquid sulfur, or acid mine water, which can lower the pH of the water and dissolves heavy metals. Countermeasures for the chemical method is to use lime, but this is less effective. The method is good and is environmentally friendly way by using biological bacteria sulphate reduction bacteria (SRB) that naturally there are many in the sediment wetland. Goal of this research is to find the type of sediment wetland most effectively increase the pH and decrease the concentration of sulphate in acid mine water. The sediment wetland is used mangroves, swamp, rice fields and beaches. Treatment bioreaktor made on the filled with sediment underneath the compost is given further incubation for 50 days. The observation of pH and content of sulphate based on the value of OD spectrophotometer and known pH increased to the highest in the pH of 6,9 is in the swamp sediment treatment, while the only other treatment until the pH 5,8-6,4. Increasing the pH in accordance with the decrease in the rate of SO_4 is most sharply in the swamp sediment treatment as well as the most effective treatment.

INTRODUCTION

Increased mining activities in several regions in Indonesia, began to face problems is environmental pollution resulting from various types of waste generated from mining activities like water mines, waste rock, overburden, the remaining solution process, tailings, ore, waste and sludge. One of hazardous mining waste is liquid sulfuric acid which can lower the pH of the water below 3 resulted terlarutkan ions - the metal ion. Sulfuric acid is formed from mining activities is known as acid mine water (AMW) or acid rock drainage. Because of its acid can kill fish and other organisms if the AMW contaminated water. On the ground will inhibit plant growth because it also changes the soil pH becomes acidic. Because dissolved heavy metals, and thus will cause the metal pollution in aquatic environments (Suyasa, 2002). Study of biotechnology to the processing of AMW is a good, and wise, because it will reduce environmental pollution to friendly. One of the many alternatives that are now studied the biological processing of AMW using sulphate reducing bacteria (SRB) for decontamination. In addition, SRB is also able to reduce the concentration of metal through the metal deposition process (Callander and Barford, 1983).

In a laboratory scale, usually a source of energy used is a simple organic chemical compounds, such as lactate. However, the efficiency required in its application, so the use of pure chemical compounds like this are not effective, because its expensive (Mills, 2013).

AMW in the process of biological treatment, needs to be done more efficiently and economically by adding organic matter from the sediments of wetlands. This organic material naturally present many SRB, so no need to microbes inoculated from the outside, and the addition of nutrients. Content of organic materials high in wetland sediments provide an ideal environment for sulfate reducing bacteria populations (May, 2013.). The main purpose of the study was to determine the use types of sediment organic matter is most effective wetland to reduce sulfate and metal precipitation

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AMW. Specifically this study aims to observing the treatment capacity of sediments in the lower levels and the lower content of dissolved metals in the waste AMW.

MATERIAL AND METHODS

Sampling: AMW Samples were collected at Mine Industrial. Wetland sediments consist of mangroves, rice fields; swamp and beaches were collected around Makassar city.

AMW and Sediment characterization: AMW Sample characterize is sulfate content by spectrophotometer method and pH with a pH meter (Greenberg *et al.,* 1985). Each type of wetland sediments and compost is characterization about organic carbon total measured by TOC meter (Nur, 1989), nitrogen content using the Micro Kjehldahl (Black, *et al.,* 1965), phosphorus content with Stanus Chloride method (Greenberg *et al.,* 1985).

Treatments: Treatment was made in a column in anaerobic bioreactor (Suyasa, 2002), a prototype column with mine acidic waste as biological processes. Processing column is equipped with a wire frame at the bottom that serves as a barrier sediments and compost and the liquid is AMW of the column. This treatment is made on each type of wetland sediments with duplicate were used and incubation of treatment performed for 60 days. During the incubation carried out observations of each day 5 consist of sulfate reduction spectrophotometer method and pH increase with pH meter (Greenberg *et al.,* 1985).

RESULTS AND DISCUSSION

Analysis of the four types of wetland consists of organic carbon, phosphorus, nitrogen are shown in Table 1, while introduction analysis of the AMW obtained color is translucent brown turbidity, sulfate content was detected by spectrophotometer at a wavelength of OD 420 with a value of 5.8 at pH 3.2. The results of the analysis used to determine initial conditions in nurtrien mine waste treatment process which is influenced by three main elements of carbon, phosphorus and nitrogen.

In the observation SO_4 content and pH, as shown in Figure 1, SO_4 content of the sharp decline at the beginning of incubation until the day of the 10^{th}, then on day 15 to day 50 decreased to relatively low concentrations of SO_4 or constant, especially at day 40 until day to 50. This indicates that sulphate content in oxidised by SRB that naturally there are many in wetland sediments that supported the growth of simple organic materials found in compost.

Assimilation of organic substrates in the compost is to obtain energy of carbon organik, which is done with the electron transport phosphorylation process that allows assimilation of organic compounds such as organic acids, amino acids, and complex compounds (May, 2013). Reported that important factors to produce sulfid by SRB and precipitate heavy metals on the anaerob condition of electron donor is a simple organic compounds. In the reactor complex organic substrates available to the fermentation activity by a group of other anaerobic bacteria (Suyasa, 2002). SRB requires organic acids of certain short chain for respiration its anaerob (Mills, 2013). In nature, the availability of complex organic substrates will provide a source of carbon for bacteria mixed.

All treatments decreased SO_4 levels are detected based on OD values, especially in swamp treatment experienced a sharp decline since day 5, while the treatment of mangrove, beaches, and rice fields decline after day 15 and decreased content of sulfate reduction to H_2S. Sulfuric acid is the form of sulfate in water is very influential on the pH decrease or increase in acidic nature of water quickly and achieve between pH 2.5 to 3.0.Acidity acid water can be developed with resultant iron sulfate which is a strong oxidant. Thus, iron ions (III) can dissolve minerals such as lead sulfid metals, copper, zinc

Table 1. Content of carbon, phosphorus and nitrogen of samples compost and wetland sediments

Type of samples	Carbon (%)	Phosphorus (%)	Nitrogen (%)
Compost	37,89	2,12	2,0
Mangroves sediment	31,94	0,14	0,26
Swamp Sediment	72.22	0,14	1,24
Rice fields Sediment	34,65	0,03	2,13
Beaches sediment	26,68	0,08	0,45

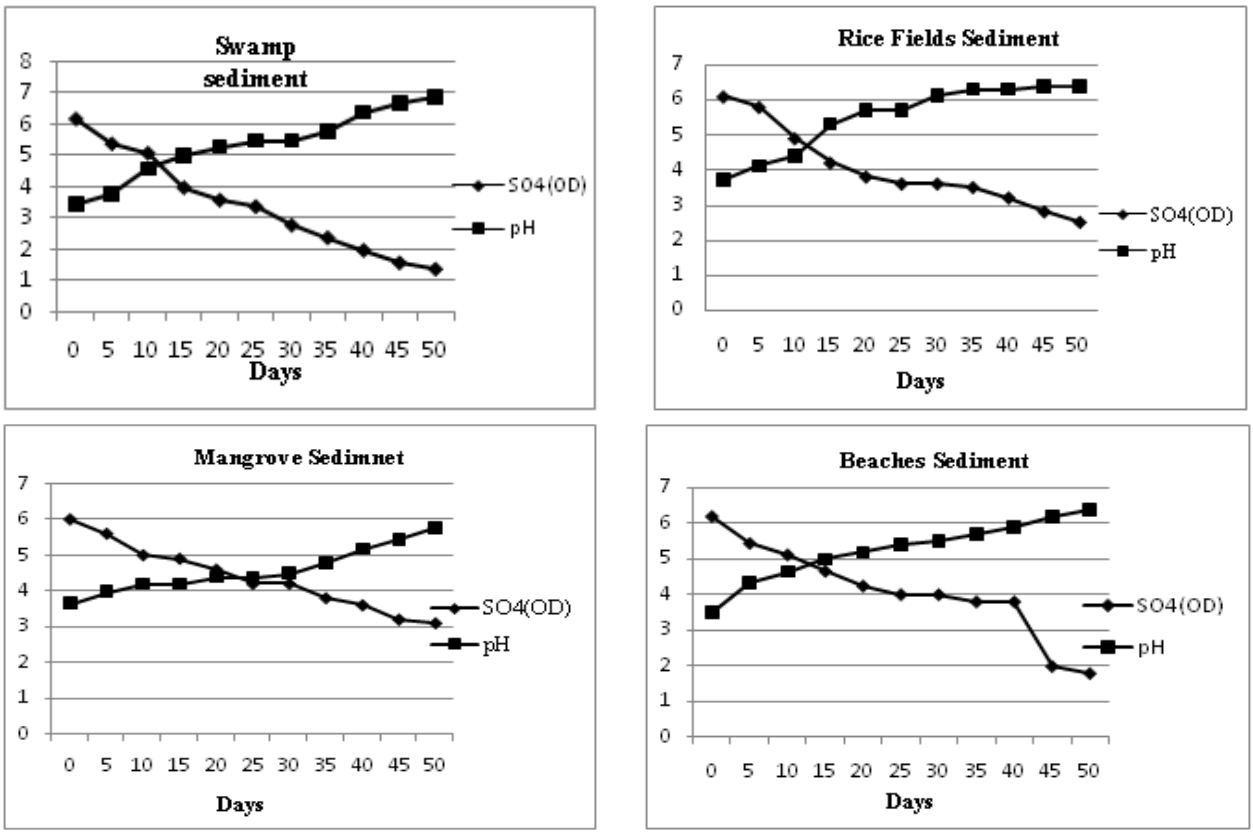

Fig. 1 Changes in pH and SO_4 in the treatment of acid mine water with sediments: A. swamp; B.rice fields; C. mangrove; and D. beaches.

and cadmium (Greenberg *et al.,* 1985). According to SRB is a group heterotrofik using simple organic compounds as a source carbon, are mainly in the dirty mud contained organic materials from anaerobic decomposition. With metabolic capabilities of SRB group living and participating in aquatic sediments to neutralize or reduce the acidity and increasing pH is a reflection of the reduction of sulfate in water. In the process of reduction of sulfate ions produced hydrogen sulfide (H_2S) also produced hydroxyl ions (OH^-) (Zaid *et al.,* 1985). The more sulfate ions are reduced the more the hydroxyl ions are produced, thus increasing pH, as the equation reaction is:

$$4H_2 + SO_4 \xrightarrow{SRB} H_2S + 2H_2O + 2OH^-$$

CONCLUSION

Based on the results of studies on the use of sediment wetland in acid mine waste treatment, that the highest increase in pH until at pH 6,9 is the treatment swamp sediments, whereas the other treatments only until the pH 5,8-6,4 this is in accordance with the decrease in SO_4 content.

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