Pengaruh Perlakuan Induksi dan Inhibisi terhadap Pembentukan Air Asam Tambang pada Pertambangan Batubara oleh *Thiobacillus ferrooxidans*

Mahasiswa : Rizka Febriana
Skripsi (2009), Program Studi Mikrobiologi SITH

Pembimbing: Sri Harjati Suhardi[1]
[1] SITH-ITB, email : renni@hayati.itb.ac.id

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Abstrak

Kegiatan penambangan sangat erat kaitannya dengan lingkungan. Proses penambangan mengakibatkan perubahan lapisan batuan khususnya di daerah timbunan. Apabila perubahan lapisan ini mengakibatkan terdedahnya batuan yang mengandung mineral sulfida, maka dapat terbentuk Air Asam Tambang (AAT). AAT terbentuk dari oksidasi mineral sulfida yang melepas asam ke air akibat reaksinya dengan air dan oksigen. Reaksi ini juga dipercepat dengan keberadaan bakteri pengoksidasi sulfida (*Thiobacillus ferrooxidans*). Beberapa penelitian telah dilakukan untuk menganalisis potensi pembentukan AAT baik dengan melihat karakterisasi geokimia batuan (uji statik), mensimulasikan kinetika oksidasinya (uji kinetik), maupun dengan mengkaji besar pengaruh mineral dalam pembentukan AAT. Keseluruhan penelitian ini dilakukan untuk mendapatkan solusi tebaik bagi pencegahan dan penanganan AAT. Penelitian lanjutan dilakukan untuk mengkaji lebih jauh pengaruh *Thiobacillus ferrooxidans* terhadap pembentukan AAT. Pada penelitian ini dilakukan simulasi pelindian pada 3 buah sampel tanah pertambangan yang telah diuji secara statik. Simulasi ini diikuti dengan pemberian beberapa perlakuan, yaitu: dengan penambahan médium pertumbuhan, $CaCO_3$, kompos dan limbah cair pabrik kertas. Sebelum dan sesudah simulasi dilakukan, sampel batuan diukur kandungan Fe, N dan P. Air hasil pelindian ditampung, diukur pH-nya dan dikumpulkan untuk diukur kandungan logamnya. Setiap seminggu sekali dilakukan pula pengukuran jumlah sel bakteri pada tanah sampel dengan menggunakan médium spesifik (WAYE médium untuk *Thiobacillus ferrooxidans*). Dari hasil yang diperoleh didapatkan kesimpulan bahwa pertumbuhan *Thiobacillus ferrooxidans* pada batuan dipengaruhi oleh pH, kandungan Fe dan kadar sulfur. Pemberian induksi pada sampel 1 dan 3 tidak berpengaruh banyak pada pertumbuhan bakteri spesifik. Pada sampel 2 pemberian induksi meningkatkan pertumbuhan *Thiobacillus ferrooxidans* dengan peningkatan jumlah sel rata-rata sebesar $4.05 \times 10^{6.}$ Hanya saja, pertumbuhan ini tidak diikuti dengan penurunan pH air lindian. Pemberian $CaCO_3$ pada sampel dapat menurunkan jumlah sel bakteri spesifik dengan penurunan rata-rata jumlah sel pada sampel 1 sebesar 1.1×10^5, sampel 2 sebesar 7.17×10^6 dan sampel 3 sebesar 8.2×10^3. Pemberian $CaCO_3$ juga dapat menaikan pH air lindian hingga berada pada kisaran netral, menurunkan kelarutan logam Fe, Al dan Mn pada air lindian. Pemberian kompos dapat menghambat pertumbuhan *Thiobacillus ferrooxidans*, dan penurunan kelarutan logam Fe sebesar 176,12 ppm, tetapi tidak menaikan pH air lindian secara signifikan.

Kata Kunci : Air Asam Tambang, *Thiobacillus ferrooxidans*, oksidasi sulfida

Effects of Induction and Inhibition Treatment to the Acid Mine Drainage Formation in the Coal Mining by *Thiobacillus ferrooxidans*

Student : Rizka Febriana
Final Project (2009), Degree Program in Microbiology
School of Life Science and Microbiology - ITB

Advisors : Sri Harjati Suhardi[1]
[1] School of Life Science and Microbiology - ITB,
email : renni@hayati.itb.ac.id

Degree : Bachelor of Science (B.Sc), Conferred April 18th, 2009

Abstract

Mining activities are closely related to the environment at issues. The mining process causes change to rock layers, especially in the dump areas. In the case that the rock layer containing sulfida minerals exposed to the air and water, the water can then form acid mine drainage (AMD). Acid mine drainage formed as a result of oxidation of sulfida minerals that remove acid to the water resulted from the reaction with water and oxygen. The reaction can also be accelerated by the existence of the sulfida oxidation bacteria (*Thiobacillus ferrooxidans*). Various research has been done to study the potential forming of acid mine drainage, such as characterization of geochemical rocks (static test), simulating oxidation's kinetic (kinetic test), and the review of the influence of minerals in the formation of acid mine drainage. The research ware conducted to obtain the best solutions for preventing and handling the acid mine drainage. Therefore, a further research to examine the influence of *Thiobacillus ferrooxidans* to the forming of acid mine drainage was conducted. In this study, a leaching column simulation on 3 soil mining samples which has been tested by static test is performed. This simulation was followed by treatment of the addition of the growth medium, $CaCO_3$, compost and liquid waste paper factory. Before and after the simulation was done, the content of Fe, N and P in the soil sample was measured. Leached water from the simulation is collected, and its pH and metal content were measured. Measurement of the number of bacterial cells in the soil sample by using a specific medium (WAYE medium for *Thiobacillus ferrooxidans*) was done weekly. Induction in the sample 1 and 3 has no effect on the growth of specific bacteria. In the sample 2, however, the induction increases the growth of *Thiobacillus ferrooxidans* by 4.05×10^6 CFUs/ml in average. However, this growth was not followed by a decrease in pH rate of the leached liquid. Addition of $CaCO_3$ in the sample can reduce the number of *Thiobacillus ferrooxidans* cells (sample 1 decreased by 1.1×10^5 CFUs/ml in average, sample 2 decreased by 7.17×10^6 CFUs/ml in average, and sample 3 decreased by 8.2×10^3 CFUs/ml in average). Addition of $CaCO_3$ may also increase the pH rate of the leached liquid to the range of neutral, reduce solubility of Fe, Al and Mn metal in the leached liquid. Addition of compost to the sample can inhibit the growth of *Thiobacillus ferrooxidans*, and decrease the solubility of the metal Fe by 176.12 ppm, but it does not increase the pH rate of the leached liquid significantly. A conclusion was obtained from the results that the growth of *Thiobacillus ferrooxidans* in the rock sample was influenced by pH, organic compound, and content of Fe.

Key Word : Acid Mine Drainage, *Thiobacillus ferrooxidans*, sulfida oxidation