Potential Formation of Acid Mine Drainage In Putra Perkasa Abadi Coal Mining Company - Girimulya Site (BIB), Tanah Bumbu Regency, South Kalimantan

Sri Maharani 1, Purwanto Purwanto2,3, Jafron Wassiq Hidayat4 and Joko Triraharjo5

1Magister Program of Environmental Science, School of Postgraduate Studies, Diponegoro University, Semarang - Indonesia
2School of Postgraduate Studies, Diponegoro University, Semarang – Indonesia
3Department of Chemical Engineering, Faculty of Engineering, Diponegoro University, Semarang – Indonesia
4Department of Biology, Faculty of Science and Mathematics, Diponegoro University, Semarang – Indonesia
5Putra Perkasa Abadi Coal Mining Company - Indonesia

Abstract. Coal is a combustible fossil fuel, formed from plants that have been consolidated between rock strata and can be used by geothermal. World Energy Council said Indonesia is the fifth world coal producer after China, United States, India and Australia. Acid Mine Drainage is become one of environmental damage from coal massive exploitation in Indonesia. Precautions are required to reduce risks and minimize the formation of acid mine drainage at overburden disposal in order to meet the quality standards set by the Government. The action is carried out by isolating Potential Acid Forming (PAF) materials with non-acidic (NAF / Non Acid Forming) materials to avoid exposure to air and water with sulphide minerals. Good PAF and NAF material management in the disposal area will minimize the potential of acid mine drainage.

Keywords: coal mining, acid mine drainage (AMD); Potential Acid Forming (PAF); Non Acid Forming (NAF); management materials.

1. Introduction

Mining of minerals and metals has become a major industry as one source of employment and economic improvement. In addition to producing useful minerals, it also produces some unwanted and dangerous byproducts such as mine waste and tailings material. This waste is rich in sulphides, mainly because of the high content of sulphide iron such as pyrite (FeS2) and pyrrhotite (Fe1 - xS). Generally also contains elements such as Si, Cr, Zn, Ni, As, Mo, Co and Cu. However, the structure and composition of mine waste varies greatly, depending on the geology of the mine site and the type of mineral or metal extracted [1].

Mining, processing and purification activities are potential environmental impacts to the environment. Mining activities are characterized by excavation and stockpiling activities. Excavation and stockpiling activities will cause exposed parts of the rock to allow contact with air or rainwater so that the weathering process occurs, if it occurs in the rock for a certain period of time will cause physical and chemical changes of rocks. The result of weathering or chemical reactions between air and minerals when washed by rainfall or groundwater seepage and also the reaction between water and minerals may lead to changes in the quality of rainfall or groundwater runoff [2].

To minimize risks to the environment and implement environmentally friendly remedial measures, it is important to know the impacts resulting from reclaimed land [3].

Coal is a combustible fossil fuel, formed from plants that have been consolidated among other rock strata and altered by a combination of the effects of pressure and heat over millions of years to form a layer of coal [4]. Coal is genetically formed in a reduction condition so characterized by iron sulfide content of FeS2. Coat layers (peat) tend to oxidize and release sulphide minerals and will potentially reduce the pH or increase the acidity of the surrounding water. With the increased acidity of ground water and runoff water, the water will have the potential to dissolve heavy metals and chemical elements it passes [5].

World Energy Council [6] said Indonesia is the fifth world coal producer after China, United States, India and Australia. Based on data from the Geological Department (December 2017), there are approximately 125,117.59 million tonnes of resources and 24,239.96 million tonnes of coal deposits scattered throughout Indonesia, mainly on the islands of Kalimantan and Sumatra.
For this reason, Indonesian government must immediately rely on clean coal technology and seek alternative energy sources that are environmentally friendly and develop it to reduce carbon emissions in an effort to achieve climate reduction targets.

Acid mine drainage (AMD) is a general term used to refer to leachate, seepage or drainage occurring due to the natural oxidizing effects of sulphide minerals (sulfur minerals) contained in aid exposed during mining, acidic (high acidity and often characterized by low pH values below 5) [7]. In open mining, AMD has the potential to form in active mining areas and in disposal. The presence of AMD in the environment, especially surface water and groundwater, has the potential to affect the disruption of environmental quality and habitat [8].

Acid mine drainage is one of the most serious challenges facing the coal mining industry worldwide. According to Ozoko (2015) that acid mine drainage with low pH values (<4) usually increases the dissolution of heavy metals and silica in water [9].

At the post-mining, the treatment plan is generally by eliminating pollutants from mine water effectively. However operating costs, maintenance and capital costs need to be considered such as calculating the alkalinity required to raise the pH high enough, thereby reducing operating costs [10]. There are 2 (two) major issues to be considered in overburden removal are minimizing transport costs and capital costs need to be considered such as generating (Net Potential Ratio), NPR, NAG (Net Acid Generating) [13].

2. Results and Discussion

Putra Perkasa Abadi Coal Mining Company is one of mining contractor company in Indonesia engaged in coal mining. The company is mining using an open pit system. There are 5 active jobsites currently scattered in Kalimantan Island, one of the mining location is at Girimulya site (BIB), at owned by Borneo Indo Bara Coal Mining Company located in Tanah Bumbu Regency, South Kalimantan.

In determining the nature of PAF or NAF rocks, an acid balance calculation is required by looking for parameters such as MPA (Maximum Potential of Acidity), ANC (Acid Neutralizing Capacity), NAP (Net Acid Forming), NPR, NAG (Net Acid Generating) [13].

### Table 1. PAF and NAF Characteristics

| Material Type          | NAP pH (kg H₂SO₄/t) | NAG pH |
|------------------------|---------------------|--------|
| Potentially Acid Forming (PAF) | >10 | <4.5 |
| Non Acid Forming (NAF) | ≥4.5 | Positive |
| Uncertain              | ≥4.5 | Negative |

Source : [12]

Putra Perkasa Abadi Coal Mining Company has been operating in Site Girimulya since 2013 with a land area of ± 800 Ha, with a coal production target of 12 million tons of coal per year and 54 million BCM overburden.

2.1. Geological Modeling

Based on geological modeling Volume of Overburden at PPA Coal Mining Company, Girimulya pit is presented in table 2.

**Table 2. Volume of Overburden**

| Block | Jan | Feb | Mar | Apr | May | Jun |
|-------|-----|-----|-----|-----|-----|-----|
| BL25  | -   | -   | 6,098 | 11,32 | 4 | - | 8,665 | 5,19 |
| BL26  | -   | -   | 4,761 | 8,842 | - | 39,10 | 3,46 |
| BL27  | 114,3 | 67,15 | 23,88 | 44,35 | 11 | 6 | 32,52 | 9,51 |
| BL28  | 55,58 | 27,79 | 44,25 | 82,18 | 10,15 | 60,19 | 58,88 | 35,3 |
| BL29  | 78,28 | 39,14 | 79,07 | 146,8 | 60,32 | 63,94 | 47,70 | 8,62 |
| BL30  | 547,0 | 273,5 | 142,8 | 79,62 | 31,00 | 79,62 | 90,42 | 4,25 |
| BL31  | 201,5 | 100,7 | 67,78 | 125,8 | 67,78 | 125,8 | 45,86 | 7,51 |
| BL32  | 170,6 | 85,32 | 106,8 | 198,3 | 106,8 | 136,9 | 59,30 | 5,58 |
| BL33  | 258,4 | 129,2 | 66,03 | 122,6 | 66,03 | 122,6 | 54,19 | 52,5 |
| BL34  | 110,5 | 55,26 | 35,43 | 65,80 | 14,96 | 4,842 | 18,95 | 11,3 |
| BL35  | 44,61 | 22,30 | 62,38 | 115,8 | 26,16 | 86,94 | 25,58 | 15,3 |
| BL36  | 5,8 | 8 | 4 | 57 | 0 | 7 | 9 | 54 |
The data in table 2 indicates that the removal obstruction on BL30 block has the most potent acid / PAF material compared to the other blocks of 811.39 BCM and non-acid / NAF material of 487,041 BCM.

Based on figure 2, the most potent acid / PAF material is found in block BL30 of 547,084 BCM with non-acid / NAF material of 273,543 BCM.

Based on figure 3, the most potent acid / PAF material is found in block BL38 of 236,702 BCM with non-acid / NAF material of 253,875 BCM.

Based on figure 4, the most potent acid / PAF material is found in block BL32 of 106,815 BCM with non-acid / NAF material of 1,20,932 BCM. In figure 5, the most potent acid / PAF material is found in BL45 block 114,429 BCM with non-acid / NAF material of 68,657 BCM.

In figure 2 and figure 5 shows that the average volume of the material containing the acid / PAF has a greater amount than the non-acid / NAF material. While in figure 3 and figure 4 shows the average volume of the material containing acid / PAF has a smaller amount compared to non-acid / NAF materials. The removal volume will be used as a basic...
for treating acid mine drainage by the separation of potentially acidic material with non acid potential to place the material into a dump design.

2.2. Overburden Stockpiling Method

The hoarding method used is the encapsulation method of making the dump design done by arranging the location of potentially acid / PAF materials containing sulphide minerals capping by non-acid / NAF materials in order to avoid contact with water and air which will form acid mine drainage.

3. Conclusion

The Girimulya site has considerable potential for acid mine drainage formation. This is due to the limitation of material that can be used as cover material or capping material to prevent acid formation of mine acid.

Precautions have been taken by the company to reduce the risk and minimization of acid mine formation at disposal area in order to meet the quality standards of waste established by the Government. The action is one of them by isolating PAF / Potential Acid Forming material with non-acidic (NAF / Non Acid Forming) material to avoid contact between water, oxygen and sulphide minerals. Therefore, good PAF and NAF material management in the disposal area will minimize the potential of acid mine drainage.

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