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

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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 environ ment. 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.

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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 prevention of acid mine drainage problems [11]. Therefore, special handling is needed to prevent acid mine drainage, one of which is to identify rocks that can lead to the formation of acid mine drainage. The rocks are classified into two, namely PAF rock and NAF rocks. PAF rock (potential acid forming) is a rock that has the potential to produce acid. While the rock NAF (Non Acid Forming) is a rock that does not have the potential to produce acid.

Table 1. PAF and NAF Characteristics

Material Type	NAPP (kg H_2SO_4/t)	NAG pH
Potentially Acid Forming (PAF)	>10	<4.5
Non Acid Forming (NAF)	Negative	≥4.5
Uncertain	Positive	≥4.5
	Negative	<4.5
	Positive	<4.5

Source : [12]

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 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.

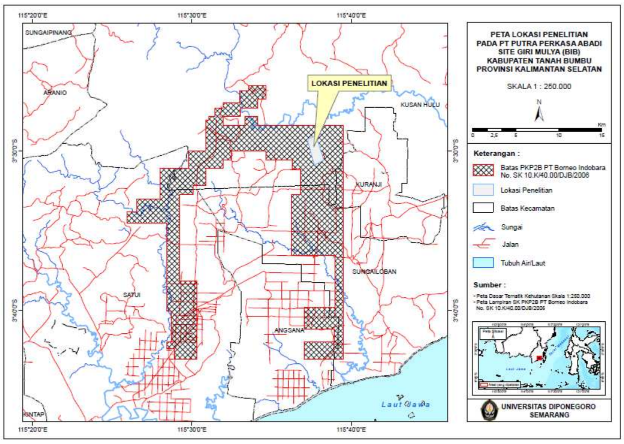

Fig 1. Research Location

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		Apr		Jun	
	PAF	NAF	PAF	NAF	PAF	NAF	PAF	NAF
BL25	-	-	6,098	11,324	-	-	8,663	5,198
BL26	-	-	4,761	8,842	-	-	39,106	3,464
BL27	134,311	67,156	23,885	44,357	-	-	32,523	9,513
BL28	55,583	27,792	44,252	82,181	10,159	60,191	58,886	35,332
BL29	78,287	39,145	79,075	146,851	60,325	63,948	47,706	8,623
BL30	547,084	273,543	142,873	79,621	31,009	79,621	90,426	4,256
BL31	201,595	100,798	67,782	125,879	67,782	125,879	45,863	7,518
BL32	170,655	85,328	106,815	198,371	106,815	136,907	59,308	5,585
BL33	258,406	129,204	66,037	122,640	66,037	122,640	54,197	32,519
BL34	110,522	55,261	35,433	65,804	14,963	4,842	18,952	11,372
BL35	44,615	22,308	62,384	115,857	26,160	86,947	25,589	15,354
BL36								

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Block	Jan		Feb		Apr		Jun	
	PAF	NAF	PAF	NAF	PAF	NAF	PAF	NAF
	278,633	139,317	70,357	130,662	42,993	20,152	6,592	3,956
BL37	16,341	8,170	214,572	212,777	65,895	85,521	21,481	12,887
BL38	13,160	6,580	236,702	253,875	64,947	100,694	29,451	17,671
BL39	37,807	18,904	117,613	218,424	84,828	131,036	40,361	24,216
BL40	14,084	7,042	195,556	177,464	65,627	102,519	51,441	0,866
BL41	26,252	13,126	89,734	166,647	68,501	112,471	45,632	27,379
BL42	18,051	9,026	57,676	107,112	35,675	77,506	53,385	32,032
BL43	6,564	3,282	80,281	149,094	80,281	83,055	70,447	42,269
BL44	95,014	47,507	84,212	156,392	65,707	83,123	67,970	40,782
BL45	26,254	13,126	99,522	184,827	99,522	120,932	114,429	68,657
BL46	31,451	15,726	14,312	26,579	14,312	26,579	100,902	60,541
BL47	140,752	70,376	4,162	7,730	4,162	7,730	30,882	18,530
BL48	215,503	107,752	3,778	7,016	3,778	7,016	24,063	14,437
BL49	1,840	920	9,350	17,365	9,350	17,365	-	-
BL50	3,117	16	-	-	-	-	-	-
Total (BCM)	2,525,881	1,261,405	1,917,222	2,817,691	1,088,828	1,656,674	1,138,255	682,957

Source : Engineering Dept PPA, 2018

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 811.392 BCM and non-acid / NAF material of 487,041 BCM.

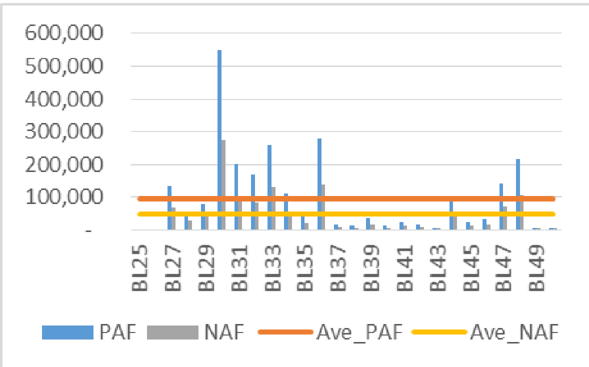

Fig 2. Volume of Overburden in January 2018

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.

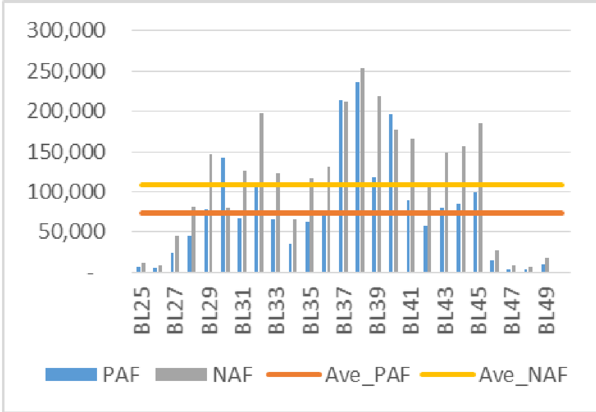

Fig 3. Volume of Overburden in February 2018

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.

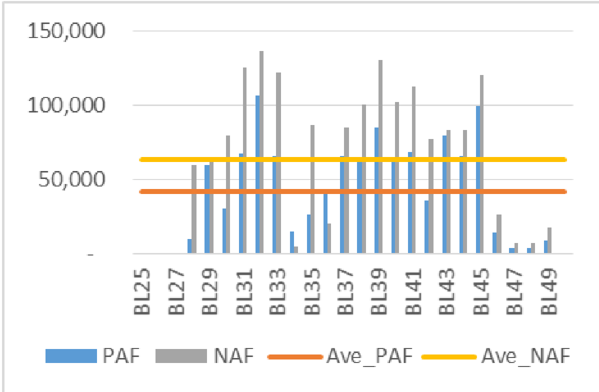

Fig 4. Volume of Overburden in April 2018

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.

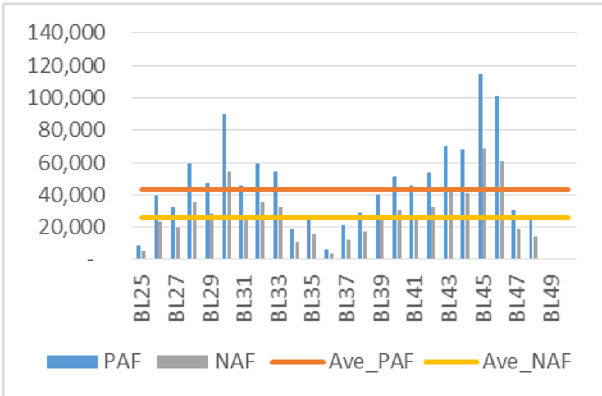

Fig 5. Volume of Overburden in June 2018

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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