Study Of Total Suspended Solid (TSS) Reduction In Coal Mine Water Management In Block III Of PT. Antang Gunung Meratus, South Tapin District, Tapin Regency, South Kalimantan Province

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Abstract

PT. Antang Gunung Meratus is a coal mining company with an area of 22,433 Ha with open pit mining method. PT. Antang Gunung Meratus has been equipped with a wastewater treatment system using active control methods, where the pH, Fe, Mn and Cd content of mine water is normal while the total suspended solid (TSS) value is more than 200 ppm in a state exceeding the water quality standard limit set by South Kalimantan Governor Regulation No.36 of 2008. The purpose of this study is to determine the results of water quality before and after it is managed and what methods are used in its management and how much costs are spent in managing the mine water. The research methods used are literature study methods, research in the field, primary and secondary data collection, data processing, data analysis and conclusions. The results showed that mining water in the WWTP area had the highest total suspended solid (TSS) content in July 2022 reaching 4.788 mg/l, while at the outlet the total suspended solid (TSS) value was 23 mg/l, the pH value was 7.22. Iron content (Fe) of < 0.04 mg / l manganese content (Mn) of 0.006 and Cadmium (Cd) content of <0.004 mg / l, the content in the outlet comes from laboratory tests and costs incurred in mine water management worth Rp. 840,854,400 as of July 2022.

Keywords: *coagulation-flocation, mine water treatment, total suspended solids.*

1. Introduction

Coal is one of the energy sources in the world. Coal is a very complex mixture of organic chemicals containing carbon, oxygen, and hydrogen in a carbon chain (Mustasim &; Billah, 2010). According to Law No.4 of 2009 concerning minerals and coal, coal is a deposit of carbonaceous organic compounds that form naturally from plant residues and can burn. Indonesia's coal deposits spread from Sumatra to Papua. These deposits are most commonly found in large basins such as in Aceh, South Sumatra, East Kalimantan, and South Kalimantan. PT. Antang Gunung Meratus is a company engaged in the coal mining industry with an open pit mining system with an area of 22,433 Ha. PT. AGM is also divided into 6 blocks and coal is marketed according to the mined blocks and currently PT. AGM is mining in the South Block III region (Soda Egenius, 2022). This research is based on research in the mining environment of PT. Antang Gunung Meratus, South Kalimantan. Mining method at PT. Antang Gunung Meratus until now is an open pit mining. Coal mining activities at PT. Antang Gunung Meratus has been equipped with a wastewater treatment system using active methods. The content of pH, Fe, Mn and Cd of mining water at PT. Antang Gunung Meratus is in normal condition while the total suspended solid (TSS) value is more than 200 ppm which exceeds the water quality standard limit set by South Kalimantan Governor Regulation No.36 of 2008. Therefore, in this study will be discussed about the processing of TSS values at PT. Antang Gunung Meratus where the TSS value before being managed at the water inlet on average in 1 month reaches approximately 1100 ppm and after being managed and ready to be removed from the water *outlet* must be worth less than 200 ppm. In its processing, PT.

Antang Gunung Meratus has WWTP to manage the mine water using the coagulation-flocculation method where the chemicals used are polyamine and polyacry as coagulants and flocculants and also use PAC. So that the costs that will be incurred in water treatment from the WWTP inlet to the *outlet* are quite large because the materials and tools used are very influential on the amount of coal production at PT. Antang Gunung Meratus precisely in Block III South Warutas.

2. Method

In carrying out this research, it combines literature studies with data in the field so that from both problems a problem-solving approach is obtained. The stages of the method used in data collection in this research are:

1. Literature study
   Literature studies are carried out by looking for library materials that can support the research topics conducted, including:
   a. Library
   b. Research conducted by the company
   c. Scientific journals and other information
2. Research in the Field
   a. Conservation and observation as well as direct interviews in the field and looking for supporting data
   b. Determine the points and boundaries of observation locations so that research does not expand, does not get out of existing problems, and the data taken can be used effectively
   c. Matching existing data, retrieving additional data
3. Data Retrieval
   Direct data collection in the field is used as one of the materials to find out existing problems, while the data taken are:
   a. Primary data
      Primary data is data collected and processed by the organization that uses or publishes the data (Soeratno Arsyad, 2003: 76). Primary data can also be interpreted as data taken directly from environmental measurements and observations such as:
      1. Water Samples
      2. TSS and pH values of water at the parent Settling Pond outlet
      3. Nilai TSS di waste water treatment plant
      4. Documentation
   b. Secondary data
      According to Sugiyono (2015) Secondary data is a data source that does not directly provide data to data collectors, for example through other people or through documents. While secondary data according to Purwanto (2007) is data collected by other people or institutions. Secondary data taken from literature or company reports such as:
      1. Coal mining layout map
      2. Company Profile
      3. Rainfall data
      4. Laboratory data
      5. Dimensi waste water treatment plant
      6. Existing water quality reports
      7. Map of the location of water management facilities
4. Data Processing
   The data processing technique carried out in this study is by combining theory with field data, so that from both of them can approach problem solving. The process in data processing techniques is very dependent on primary data and secondary data.

5. Data Analysis
   The data that has been collected will be analyzed to match the original existing data whether the data is in accordance with existing water quality standards in accordance with South Kalimantan Governor Regulation No.36 of 2008.
6. Conclusion
   After all data has been analyzed, conclusions will be drawn on whether the existing water quality standards are in accordance with Governor Regulation No. 36 of 2008 or not, how the stages of water treatment will be flowed to the community and how much the cost is needed in the water treatment. This conclusion is the final result of all aspects discussed.

3. Results and Discussion

3.1 Mine water sampling location

The location of mine water sampling is carried out at PT. Antang Gunung Meratus precisely in the WWTP settling pond (wastewater treatment plant) and in the main settling pond (water outlet). (Figure 1).

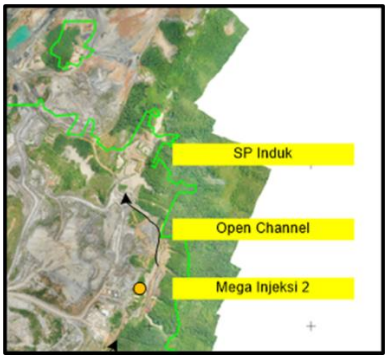

Figure 1. Sampling location

3.2 Mine water flow

Mining water in PT. Antang Gunung Meratus before being flowed into the river will be treated first at the wastewater treatment plant (WWTP). The water to be managed is water from the mining pit. Water in the mining activity area will be collected in the sump area and then pumped using a DND 200 type multiflo pump to go to a temporary water reservoir before treatment. Furthermore, the water in the temporary reservoir is flowed to settling pond crusher 5 after that it only goes to WWTP to be managed using coagulation and flocculation methods. After being managed, the water will flow to the main settling pond, which is the last water reservoir before the water is flowed into the river. (Figure 2).

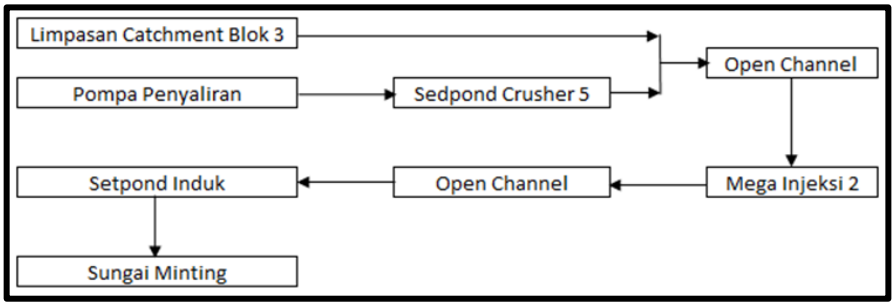

Figure 2. Scheme of drainage of mine water to the river

3.3 Water quality results

The results of water quality taken are water in the WWTP area and main settling pond water (outlet) which will be discharged into natural waters (rivers). Water sampling is not done every day but is taken alternately in the WWTP area and the main settling pond area and taken in morning work shifts.

Then the water sample that has been taken will be matched with pre-existing samples whether the sampling technique is correct or not so that water quality results are obtained in accordance with existing data. In water sampling, a tool called DR 900 type spectrophotometry is used to measure the total suspended solid value and pH in water and uses a flowmeter to measure mine water discharge.

3.1.1 Water quality on wastewater treatment plant (WWTP)

The water parameters taken at WWTP are only total suspended solids (TSS) values. The results of water quality in WWTP are water that has not been managed at all so that it has a high TSS value, as for the results of water quality in WWTP (Table 1).

Table 1. WWTP water quality results

WWTP			
No	Date	TSS Inlet WWTP 03	Quality Standards
1	01 July 2022	687	Not eligible
2	02 July 2022	657	Not eligible
3	03 July 2022	1,022	Not eligible
4	04 July 2022	707	Not eligible
5	05 July 2022	634	Not eligible
6	06 July 2022	491	Not eligible
7	07 July 2022	502	Not eligible
8	08 July 2022	512	Not eligible
9	09 July 2022	498	Not eligible
10	10 July 2022	4,461	Not eligible
11	11 July 2022	2,109	Not eligible
12	12 July 2022	1,368	Not eligible
13	13 July 2022	801	Not eligible
14	14 July 2022	1,200	Not eligible
15	15 July 2022	412	Not eligible
16	16 July 2022	446	Not eligible
17	17 July 2022	562	Not eligible
18	18 July 2022	534	Not eligible
19	19 July 2022	451	Not eligible
20	20 July 2022	832	Not eligible
21	21 July 2022	885	Not eligible
22	22 July 2022	910	Not eligible
23	23 July 2022	548	Not eligible
24	24 July 2022	533	Not eligible
25	25 July 2022	499	Not eligible
26	26 July 2022	3,882	Not eligible
27	27 July 2022	4,488	Not eligible
28	28 July 2022	2,193	Not eligible
29	29 July 2022	678	Not eligible
30	30 July 2022	713	Not eligible
31	31 July 2022	842	Not eligible

3.1.2 Water quality of the main settling pond (outlet)

The parameters taken are the value of pH, TSS and water discharge. Water in the main settling pond is water from WWTP that has been previously managed and ready to flow to the water body, namely the Minting River can be seen in Table 2.

Table 2. The result of water quality coming out of the main settling pond outlet

Settling Pond Induk						
No	Date	pH actual	TSS (Out) - mg/L	Flowrate - m3/s	Volume - m3/day	Quality Standars
1	01 July 2022	7.4	6	0.5	43,200	Eligible
2	02 July 2022	7.5	11	0.3	25,920	Eligible
3	03 July 2022	7.1	18	0.3	25,920	Eligible
4	04 July 2022	7.1	30	0.3	25,920	Eligible
5	05 July 2022	7.2	71	0.3	25,920	Eligible
6	06 July 2022	7.0	65	0.3	25,920	Eligible
7	07 July 2022	7.0	93	0.3	25,920	Eligible

8	08 July 2022	7.2	86	0.3	25,920	Eligible
9	09 July 2022	7.1	65	0.4	34,560	Eligible
10	10 July 2022	6.9	42	0.4	34,560	Eligible
11	11 July 2022	6.9	51	0.4	34,560	Eligible
12	12 July 2022	7.0	62	0.3	25,920	Eligible
13	13 July 2022	7.1	34	0.4	34,560	Eligible
14	14 July 2022	7.1	58	0.5	43,200	Eligible
15	15 July 2022	7.0	20	0.5	43,200	Eligible
16	16 July 2022	7.3	72	0.5	43,200	Eligible
17	17 July 2022	7.4	83	0.5	43,200	Eligible
18	18 July 2022	7.5	76	0.4	34,560	Eligible
19	19 July 2022	7.1	71	0.3	25,920	Eligible
20	20 July 2022	7.1	1067	3	259,200	Not Eligible
21	21 July 2022	7.1	1067	1.2	103,680	Not Eligible
22	22 July 2022	7.1	1067	0.8	69,120	Not Eligible
23	23 July 2022	7.0	65	0.5	43,200	Eligible
24	24 July 2022	7.2	42	0.5	43,200	Eligible
25	25 July 2022	7.1	83	0.5	43,200	Eligible
26	26 July 2022	6.9	76	0.5	43,200	Eligible
27	27 July 2022	6.9	71	0.5	43,200	Eligible
28	28 July 2022	7.0	65	0.5	43,200	Eligible
29	29 July 2022	7.3	93	0.5	43,200	Eligible
30	30 July 2022	7.0	86	0.5	43,200	Eligible
31	31 July 2022	7.1	65	0.5	43,200	Eligible

3.1.3 Mine water quality in laboratory tests

The results of mine water tests in the laboratory in July 2022 can be seen at Table 3.

Table 3. Laboratory test results

Parameters (Physical & Chemical)	Unit	Results		Threshold Limits #	Methods
		Settling Pond Induk (Inlet)	Settling Pond Induk (Outlet)		
Temperature (in situ)**	°C	30.8	30.8	-	SNI 06-6989.23-2005
pH (in situ)**	-	6.50	7.22	6-9	SNI 6989.11-2019
Total Iron (Fe) **	mg/L	<0.04	<0.04	7	APHA 3120B, 3030F*
Total Manganese (Mn) **	mg/L	0.017	0.006	4	APHA 3120B, 3030F*
Total Suspended Solid**	mg/L	75	23	200	SNI 6989.3-2019
Cadmium (Cd) **	mg/L	<0.004	<0.004	0.05	APHA 3120B, 3030F*

3.4 Water treatment at wastewater treatment plant (WWTP)

The water treatment process in the wastewater treatment plant can be seen in Figure 3.

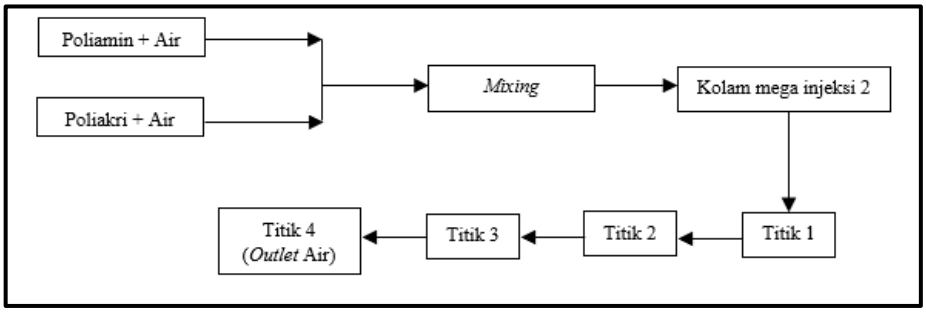

Figure 3. Mine water treatment process scheme at WWTP

In water treatment at WWTP PT. Antang Gunung Meratus uses coagulation and flocculation methods using chemical polyamine as coagulant and polyacry as flocculant, where each chemical has been dosed, namely in 500 ml of water to be treated using a dose of 3.5 ppm in polyamine and 0.5 ppm in polyacry. In the process of chemical mine water treatment must be mixed with clean water first and then mixing can be done because the chemical is in the form of solids, then the water mixed for mixing must not use dirty water, if using dirty water will cause the dirty water to form its own floc so that the results of

mixing the chemical when flowed into the settling pond do not function properly anymore. After the mixing process is complete, the results of mixing clean water and chemicals are directly flowed into the settling pond at WWTP then will flow to points 1 and 2 to points 3 and 4 (settling pond main).

3.5 Mine water treatment costs

3.5.1 Total mine water treatment cost

The total cost of treating mine water is all costs incurred by PT. Antang Gunung Meratus in treating mine water starting from the WWTP to the main settling pond (outlet) can be seen in Table 4.

Table 4. Total mine water treatment cost

No	Item	Unit	Amount
WWTP			
1	Volume in WWTP	m3	1,103,600
2	Average of TSS *inlet*	ppm	1,131
3	Poliamin	kg	1,416
4	Price of poliamin per kg	Rp	130,000
5	Usage price of poliamin	Rp	184,050,000
6	Poliakri	kg	1,619
7	Price of poliakri per kg	Rp	90,000
8	Usage price poliakri	Rp	145,680,000
Total cost		Rp	329,730,000
Settling Pond 7			
1	PAC	kg	2,550
2	Price of PAC per kg	Rp	11,000
3	Usage price PAC	Rp	28,050,000
Total cost		Rp	28,050,000
Tool			
1	Fuel per liter	Rp	14,700
2	Usage fuel	Liter	7,352
3	Total cost of fuel	Rp	108,074,400
4	Rental of mud amphibians	Rp	375,000,000
Total cost		Rp	483,074,400
Full cost		Rp	840,854,400

3.6 Cost of chemical use in mine water treatment

Based on the dose of *chemicals used in the field, it can be calculated the cost of using* polyamine and polyacy chemicals in mining water management at PT. Antang Gunung Meratus so that we can simulate the cost of mine water treatment.

3.6.1 The cost of using *chemicals* in mine water treatment at PT. Antang Gunung Meratus

The cost of using *chemicals* in mine water treatment at PT. The challenge of Mount Meratus can be seen in Table 5.

Table 5. The cost of using chemicals at PT. Antang Gunung Meratus

No	***Item***	***Unit***	***Amount***
1	Average of TSS inlet	ppm	1,131
2	Polyamine	kg	1,416
3	Price of polyamine per kg	Rp	130,000
4	Usage price of polyamine	Rp	184,080,000
5	Polyacry	kg	1,619
6	Price of polyacry per kg	Rp	90,000
7	Usage price of polyacry	Rp	145,710,000
Total		Rp	329,790,000

3.6.2 Simulation of chemical usage costs

In the simulation of the cost of chemical use *in* mine water treatment, in 500 ml of water with a TSS value of 2000 ppm, the dose of polyamine = 3.5 ppm and polyacry 0.5 ppm was determined. Cost simulation can be seen in Table 6.

Table 6. Simulation of the cost of using chemicals in mine water treatment

No	*Item*	*Unit*	*Amount*
1	Average of TSS inlet	ppm	1,131
2	Usage polyamine	kg	3,714.6
3	Price of polyamine per kg	Rp	130,000
4	Usage price of polyamine	Rp	482,898,000
5	Polyacry	kg	554.4
6	Price of polyacry per kg	Rp	90,000
7	Usage price of polyacry	Rp	49,896,000
Total		Rp	532,794,000

From the calculation of mining water treatment costs above PT. Antang Gunung Meratus costs Rp.329,790,000 while the results of the cost calculation simulation, incur costs of Rp.532,729,000 with provisions in 500 ml of water doses of polyamine 3.5 ppm and polyatry 0.5 ppm. The result of the cost calculation above is only the cost of using polyamine and polyacri chemicals excluding other costs

4. Conclussion

From the results of the research that has been done, it can be concluded several things as follows: The result of the quality of water that comes out to water bodies is that the river has met the quality standards for coal mining industry liquid waste set by South Kalimantan Governor Regulation No.36 of 2008 with a pH value = 7.22, total suspended solid (TSS) value = 23 mg/L, Fe value = <0.04 mg/L, Mn value = 0.006 mg/L and Cd value = <0.004 mg/L as of July 2022. In mine water treatment PT. Antang Gunung Meratus uses coagulation and flocculation methods, using chemical polyamine as coagulant and polyacry as flocculant. Each coagulant and flocculant after mixing will be directly flowed into the settling pond. Costs that have been incurred in mine water treatment from the WWTP inlet area to the main settling pond water outlet of PT. Antang Gunung Meratus costs Rp. 840,854,400/ in July 2022 with the volume of wastewater treated in the WWTP area of 1,103,600 m3.

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