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Study on Environment Characteristics for Mining Management at East Pit 3 West Banko Coal Mine

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***Abstract*— The management on mining environment is closely related to the environmental characteristics and the condition of mining itself. In East PIT 3 West Banko Coal Mine Tanjung Enim mine drainage system has been developed which refers to the open pit method employed by the company. The observation and analysis showed that the sludge settling ponds have been constructed as well as adequate catchment area. To discharge water into the channel at 0.3016 m 3 / sec can still be accommodated due to the dimensions of the channel that can accommodate an intake capacity of 1,639 m 3 / sec. While the use of lime made in the settling ponds with the ratio of 0.7 g: 1 liter of water indicates the water quality test results that meet the environmental quality standards that the pH is 6.7 with a TSS of 12mg / l Fe content was 2.1580 mg / l and Mn content of 1.3 mg / l.**

***Keywords*— mining environment, mine drainage system, mine water**

I. INTRODUCTION

This Mining, especially coal mining by open pit methods require large tracts of land to be disturbed. This raises a number of environmental problems, including soil erosion, dust pollution, noise and water, as well as impacts on local biodiversity. The actions performed in a modern mining operation to suppress the impact. Planning and good environmental management will reduce the impact of mining on the environment and help preserve biodiversity [1] .

Exploration and exploitation of coal mining contributed to the degradation of the environment in which the activities to open and clear the land and the excavation process, exfoliating layers and drilling will have an impact on its biological environmental damage in the mine area. In some studies it appears that coal mining has removed most of the area of plants and animals that live in various areas of mining as well as further impact to the environment where there is a huge pit on land structure, that has been abandoned by large scale mining in this area. [2]

The establishment of the mine water will have serious consequences for the environment if not handled and minimized. The impact of acid mine water for the environment is the main disturbance in aquatic ecosystems, plants and microorganisms that live in the mine area. [3] As well as if the water flowing and consumed by humans will have a negative impact. The emergence of this mine water certainly can not be ignored due to the large impact on the environment and for the people who are around the mining area, and it is a big challenge for mining companies to deal with environment.

The main Influence on the quality of the environment essentially affect to the human and other ecosystems that utilize water as a necessity and a variety of daily activities.. Therefore, in the process of coal mining, one of the things that needs to be considered is the mine water management system mainly on water control. water control is an effort to prevent further ingress of water that infiltrating the mining environment in mining areas. The mine water then mixed with pollutants from coal material such as carbon and sulfur that are part of the elements that exist in the coal so it has the potential to pollute. In essence the problem of coal has CO_2, NOx and SOx and containing inorganic materials (minerals and trace elements) that may be a problem for health and environment [4] . Mine water management system contained in the mining area of PT. Bukit Asam East Pit 3 West Banko by pumping system using the pump series, to remove water from the surface / front mine. This because the area of

the mine that has been excavated and is located at a depth of ± 100 m, thus allowing the ponding of ground water and surface water if not removed will disturbing production activities.

In the next stage it is known that the pumping of mine water carried in front mine, then pumping the water to drainage system which is intended to removing water on the surface area of mine, and the water flowed into the mud settling ponds. In many cases mining companies generally use lime to neutralize the water stood before draining the water lines enter the mud settling ponds.

One of the important problems faced by the coal industry is water pollution by coal mine (Acid Mine Drainage = AMD), which is a liquid that is formed by the oxidation of sulfide minerals, mainly pyrite (FeS 2), which produces sulfuric acid [5] [6]. With a high level of acidity, coal mine water can dissolve minerals and release of other cations such as Fe, Mn, Al, Cu, Zn, Cd, Ni and Hg. If carried to the water source, it can degrade the biological productivity of aquatic systems. In severe conditions, the water becomes unsafe for consumption and other uses [7].

This study aimed to observe and analyze the existing environmental conditions in the mine in relation to the level of pollution caused by mining activities and using environmental characteristics to managing the mine to be sustainable.

II. METHOD

This study is to investigate the effective management of mine water in the coal mining region in order to minimize and mitigate environmental pollution contained in Bukit Asam Coal Mine East Pit 3 West Banko-Tanjung Enim, South Sumatra province. Stages of discussion over the matter observed is by doing the following:

Initial studies, by collecting literature study relating to the rationale and further support the theory associated with previous studies on similar object in this case is coal and coal mines. Further field visits / observations to the coal mines of East PIT 3 West Banko to observe the existing of mine drainage system, as well as taking environmental samples such as water.

A. Types and Sources of Data

The secondary data were used as contained in the following table:

Map Location, topography, mine drainage systems, rainfall, mining and production volume, area, sewage treatment, geography, population, agriculture and plantation as well as socio-economic population. While the primary data taken include: water quality, environmental plants, aquatic biota and management of mine water and materials and tools used.

B. Data Collection Techniques

The technique used to obtain the required data source in connection with research activities is to do:

a. Observation (observation) directly to the object of research, followed by sampling and primary data for the object under study.

b. Literature study a pad object, to collect supporting data such as location maps, topographical and geographical conditions, and others.

Method of Analysis

1. Physical and Environmental Analysis mine

a. Rainfall

b. Topography

2. Analysis of Water Quality

Methods of analysis of water quality conducted as follows:

Water Table Measurement Method Parameters

No..	Parameter	Method
1	pH	SNI
2	TSS	SNI
3	Levels of metals (Fe, Mn)	SNI

C. Mine Environmental Management

1) Mine Drainage System

Mine Drainage system built is essentially an attempt to drain the water from the mine front to mud settling ponds to prevent deposition and infiltration of precipitation. Infiltration and precipitation chance to create acid mine drainage as a result of the reaction of oxygen and water to mine material.

The analysis is done through climatic and geographical and topographical conditions provide identification for effective draining system development, in relation to the functioning of a sump pump system that is in front of the mine. Furthermore, the mine water flowing in the trenches constructed based on the condition of the slope, the slope of the land to the next can flow into the settling ponds. This is directly related to the effort to minimize infiltration of precipitation and for the environment, which in turn creates pollution.

2) Analysis of Existing Conditions

In this stage, the observation of the condition of the environment, especially in front of the existing mines, namely to:

a. Sampling data in the study site

b. measurement on water quality parameters such as pH, Fe, Mn, TSS.

c. Documentation of existing conditions in the location and data collection for existing variables such as geographical, topographical, climate, ecosystems and other supporters.

Further analysis of the existing conditions which include: analysis of rainfall, precipitation, hydrological risk, and discharge flow rate, dimensions of Mud settling ponds.

III. RESULTS AND DISCUSSION

D. Applied mine drainage system

Mining method done by PT. Bukit Asam in mining activities is by open pit methods that perform stripping the soil surface followed by excavation on the surface. So that will form the excavation area is very large and spacious. This will have implications for the production of mining activities if the weather changes occurred primarily due to the rain, because it will form a puddle areas, given the existing mine site will form a basin.

As a result of this open pit mining system then there needs to be a good draining system in order to prevent the formation and accumulation of stagnant water concentrations mine. It is intended that the negative impact of the mine water formation, a barrier against disruption of production activities with tools and mining equipment as well as the environmental impact of the mine water with the formation of long-term and large volumes can be minimized will be very dangerous.

One of the measures contained in the draining system or attempt to remove the water from the mine is by way of pumping and dewatering, where the water formed from mining activities and the rain will be concentrated in the sump. Then the water is pumped out of the existing mine area through pipes made to flow into the channel next to the pool and mud deposition.

The draining system is applied to the coal mines of PT. Bukit Asam is the draining system directly and indirectly. By using an open sump. Direct draining system is to prevent the entry of rain water into the mine by applying the manufacture of ring canal, trenching and channel functions as well as to prevent the entry of rain water also seeks to accommodate the pumping of water from the sump to the front mine before heading to the MPA. While not directly draining the system by allowing rain water entering the mine for the next front to flow into the sump is made in front of the mine. In relation to the mining regions East Pit 3 West Banko is currently built sump which is part of the catchment area to accommodate water runoff in the region for the next mine in the Mud pumped into settling ponds.

On mine there are several sump to accommodate the water that goes into the mine area. Pumping activity is done because the existing sump located at the lowest elevation is 22 meters above sea level while the + ring + canal located at 68 meters above sea level making it impossible to perform drainage system open pit mine.

E. Catchment area

Catchment (Catchment area) is to put the concentration of discharge water runoff that enters the mine site. So that accumulates within the catchment area will be with exact implementation of pumping and dewatering the mine to further supplied to the mud settling ponds.

On mine Bangko East West Pit 3 area cachment is the lowest region in front of mine with dimensions of 52m wide and 6m depth of 230m long with such a broad catchment area is 60.04 Ha.

F. Rainwater Runoff discharge

Discharge surface runoff that accumulates in the sump and pumped to be measured by the following calculation [8]:

$$Q = C \times I \times A \quad (1)$$

Where:

Q = discharge storm water runoff (m 3 / h)

C = coefficient of runoff

I = Intensity of rainfall (m / h)

A = Area of Catchment Area (m 2)

From the measurement results it is known that the amount of rainfall during the plan period of 10 years is 281.969 mm / month with rainfall intensity is equal to 0.387 mm/hour. Rainwater runoff amounted to 209.637 m 3 / h, which means there is a large volume of rain water and should receive attention and observation bigger so that it can cope with runoff that has the potential formation of acid mine drainage and pollution. The vast catchment area is 600.400 m 2. While the coefficient is 0.9, while the total discharge of water that comes into play sump is 0.058 m 3 / sec.

G. Pumps and Pipes

Banko mine drainage system in the East Pit 3 system using mine drainage and mine dewatering. Mine drainage system is seen with the ring canal around the mine pit openings to prevent water does not enter the mine area, where the water that goes into the ring Canal will then be channeled to the mud settling ponds, while the water that enters the mine will be accumulated into the front-sump sump built in front then pumped into the mine to the ring canal.

Banko mining activities in the East Pit 3 has reached 22, the elevation where there are sump is located close to the front mine this would worry if the dimensions and capacity sump pumps can not cope with the incoming flow of water into the mine front and we do now will interfere with the operation and activities mining production. While draining the system design is to build a trench was good enough to help the reduction of water into the mine to directly drain into the settling ponds.

The location is in the sump - 22 meters above sea level which houses a sump pump discharges of water from the catchment area and the other in the area of the mine sump. At present there are two sump pumps Sulzer X 385 NS. This pump is used to drain water from the sump - 22mdpl up towards the ring canal. With a system like this required accuracy in putting the pump. But can also be done with enlarged reduce or adjust the rotation speed of the pump. Besides, also the size and type of pump that is should be the same in order to provide effective and maximum on pumping performance.

Pipe used in East Pit 3 west Banko using pipes HDPE (High Density Poly Ethylene) is very easy on handling with type PE 100 and nominal pressure of 12.5 bar. The size of the pipe used is 160 mm, 200 mm and 400 mm (outside diameter) or 130 mm, 160 mm and 330 mm (inside diameter).

Capacity capability by both the pass dewatering pump water from the mine sump sludge settling ponds to be known / measured. The real discharge pumps are as follows:

Actual discharge pump at Research Sites

Brand	**Power**	**Location**		**Actual discharge (m^3 / min)**
		Suck	**Throw away**	
Sulzer	385 kw	*Main sump*	Ring canal	7.4
Sulzer	385 kw	*Main sump*	Ring canal	7.2

H. Ring Canal / channel threshold

Channel or canal ring is meant to drain water that could potentially go into the mine with the front of the line passes. Sump dimensions that exist in the East Pit 3 West Banko

adapted to the catchment area of the sump, sump current has a length of 40 m width 15 m and a depth of 5 m.

The calculation of results note that the discharge of water into the channel at 0.3016 m 3 / sec can still be accommodated by the channel because the channel dimensions as above, the channel can accommodate an intake capacity of 1,639 m 3 / sec.

While the dimensions of the channel are as follows

1. Channel base width (b) = 2 meters
2. Channel depth (H) = 1 meter
   Channel depth plus 1/3 to avoid floodwaters, so the depth of the channel becomes = 1.3 meters
3. Hypotenuse projection onto a flat surface (ZD) = 0.4 meters
4. Surface width of the channel (L) 2zd = b + m + 2 = 2 (0.5 m) = 3 meters

Thus it can be said that the dimensions of the existing channel will be sufficient and able to accommodate runoff water in the mine area.

F. Mud Settling ponds

The Observations and measurements of the deposition of the mud pool in the mine area of east Pit 3 west Banko shows the condition rate of flow is equal to 0.2433 m 3 / sec with a spillway dimension of 0.7367 m 3 / sec, it can be said that the mud Settling ponds that there is still sufficient to accommodate the overflow of water coming into the Mud settling ponds. The spillway dimensions as follows:

h = 0.75 m
b = 0.75 x 3.5 = 2.63 m
z = 0.09 m
Q = 0.35 xbxh √ 2. g. z
= 0.35 x 2.25 x 0.75 √ 2 x 9.8 x 0.09
= 0.7367 m 3 / sec

The dimensions of the mud settling ponds to accommodate the flow rate of 0.2433 m 3 / sec is as follows:

B: Width siltation pond = 30 m
L: length = 131.7 m settling ponds
H: depth = 3 m settling ponds
h: In the spillway = 0.75 m
b: Width = 2.25 m spillway
z: Height above water level spillway = 0.09 m

it can be said the MPA is still quite able to accommodate flow rates. MPA design Bangko East West Pit 3 rectangular zig zag made in order that the deposition of sediment suspended in water as a whole. At MPA also liming is done to help neutralize the water coming out of the mine is not acidic. Limitation of pH (acidity) of the water coming out into the river is at pH 6-9 and levels of suspended solids (TSS), which may come out is 400 mg / liter

G. Placement and Use of CaO

CaO Lime was used to neutralize the mine water that could potentially have a negative impact on the environment as indicated by kualits water (pH, TSS, content of Fe and Mn). As the mine is lime East Pit 3 is placed between MPA 3-4 exactly on track before entering the river channel. From the data obtained is used is lime calcium oxide with a ratio of the number by 0.7. Kg: 1 liter of water mines.

The results of water quality testing on the MPA showed that water pH is at 6,7 which shows the conditions were pretty good for the environment. [9] [10] As for other water quality indicators also show a tendency quite well for TSS of 12 mg / l, Fe content of 2.1580 mg / l and Mn of 1.3 mg / l.

IV. CONCLUSION

From the results of the discussion were made to the mine drainage system on East PIT 3 West Banko mine summarized as follows: Rainfall during the plan period of 10 years is 281.969 mm / month with rainfall intensity is equal to 0.387 mm / h, while maximum rainfall for the past 10years amounted to 0.85104 m / jam. The average rainfall is 41.95 hours per month. Mine drainage System done at the east Pit 3 west banko is the direct and indirect systems. Channel conditions was sufficient to accommodate surface water runoff. The use of pumps and mud settling ponds will be sufficient to accommodate the flow of water runoff and can provide a good influence in the process of neutralizing the mine water.

Liming activities conducted in the settling ponds with the ratio of 0.7 g: 1 liter of water indicates the water quality test results that meet the environmental quality standards which are about 6, 7 on pH and with TSS of 12 mg / l Fe content at 2, 1580 mg / l and Mn content of 1, 3 mg / l.

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