

## Calculation of PIT 2 Produced Overburden Volume and The Analysis of Preparation of PIT 1 Mine Void Utilization at Supat Block PT. Baturona Adimulya Musi Banyuasin, South Sumatera

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### Abstract

PT Baturona Adimulya is a coal mining company located in Babat Supat Subdistrict, Musi Banyuasin Regency, South Sumatera Province. Based on the calculation of overburden digging volume at Pit 2 with progress survey that is measurement using total station sokkia set 3010 instrument and the processing and calculation using surpac 6.5.1 result in overburden volume or cover ground 251,941 BCM. Coal mining in open pit will cause environmental changes, either small hills or mined holes (voids). The burden removing from Pit 2 by backfilling method in the mining area will minimize the voids that occur. PT Baturona Adimulya has void in Pit 1 as large as 4.8 Ha, and will do backfilling that requires overburden material as much as 295.721 BCM/Ha and top soil as much as 33,600 LCM/Ha. The voids left at the end of the mine without any utilization planning have the potential to cause undesirable impacts on the environment. Therefore, PT Baturona Adimulya is planning to revegetate the void area so it can be utilized and become a green field again as before.

### Keywords

Overburden, reclamation, backfilling

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## 1. INTRODUCTION

Human activities in utilizing natural resources, including in coal mining activities without any conservation actions will cause environmental damage and landscape changes. For example, decreases in soil productivity, soil compaction, erosion and sedimentation, soil / landslide movement, disruption of flora and fauna, disruption of population health and health and micro-climate change, so follow-up needs of forest and land rehabilitation, both inside and outside Forest. Especially for companies engaged in coal mining activities are required to conduct reclamation activities.

PT Baturona Adimulya as a large company has been trying to implement the rules of mining good mining practice with the vision of the environment by conducting post-mining reclamation activities. It is caused the PT. Baturona Adimulya apply the open mine system, it will leave a hole or basin. The existence of these holes can be minimized by backfilling/backfilling in the area of the void or utilized according to designation.

Based on above problems, the authors conducted a study on the area of Pit 2 which is doing overburden digging that will be used to backfill the reclamation field in Pit 1 and will analyze the preparation of the utilization of void in the reclamation

field in order to repair, recover and improve the condition of degraded lands (critical).

In the area of pit 2 being exploited in the form of overburden digging, volume calculation are done by conducting progress survey. Survey activity on mining business is a very important supporting activity, either in the preparation phase (exploration), during operational (exploitation), or at the closing stage of the mine (post operation). Survey or mapping is conducted with the aim of obtaining a description of the preliminary environmental tone or shape of the earth's surface and the data from this survey can be used to create topographic maps, contour maps and mine progress maps (Arnold, 2001).

PT. Baturona Adimulya at the time of exploitation activities conducted a survey with the aim of evaluating the progress of the mine or to determine the total volume of mined material or overburden that has been removed and the remaining reserves of undug materials. After the measurement data obtained then will be carried out data processing. The measurement data processing can use Surpac 6.5.1 software. Then overburden or dumped soil excavated in pit 2 will be used for reclamation at the mine hole area in pit 1. Backfilling and revegetation, are two useful methods to repair the damage caused by open mining

operations, backfilling is to restore the overburden back to the mine voids, while revegetation is replanting the overburden. In post-mining land, land reclamation is the effort to create soil surface can be stable, self-sustaining and can be used for production, starting from the relationship between soil and vegetation, as the starting point for building new ecosystem. The post-mining land reclamation associated with revegetation is essentially to overcome the continuing land destruction and also to create the process of nutrient formation through decay of leaf litter. These activities are expected to be sustainable and can form a new ecosystem (Brundret, 1996).

The legal basis for mining companies that want to open a mining business with IUP or IUPK must be obliged to submit reclamation and post mining plan upon application of IUP or IUPK. Some regulations governing the reclamation are Law no. 4 of 2009 concerning mineral and coal mining, Government Regulation No. 78 of 2010 on reclamation and post mining and Ministry of Energy and Mineral Resources Regulation no. 7 year 2014 on the implementation of reclamation (of Forestry, 1997; Fandeli, 2005).

## 2. EXPERIMENTAL SECTION

### 2.1 Research location

This research was conducted in Pit 1 and Pit 2 PT. Baturona Adimulya, located in Babat Supat Subdistrict, Musi Banyuasin Regency, South Sumatera Province.

### 2.2 Research equipment

The equipment used in this research include total station, Geological Compass, Global Positioning System, Tripod / Statif, Laptop installed Software Surpac 6.5.1, Soil pH Thermometer (Soil Tester)

### 2.3 Method of Data Collecting

Stage of literature study was done by collecting sources of information derived from various references and company data related to the purpose of research, whether it is literature on progress survey activities conducted to calculate overburden production volume and literature on reclamation activities. Observations were made to observe the actual conditions in the field and to find the necessary data related to the issues to be discussed. By doing a direct observation on the mining area, it will know the existing working conditions, such as observations on the area of ex-mole hole (void) that will be dumped. A live review is also conducted on the measurement and retrieval of the coordinate and elevation points in Pit 2 to obtain a comprehensive overview of how the measurement and data processing procedures to obtain the volume of overburden produced in pit 2.

### 2.4 Data Types

#### 2.4.1 Primary data

Data obtained by field observation such as progress survey measurement on pit 2 and measurement of dimension of mined hole (void), in research become primary data are: Coordinate

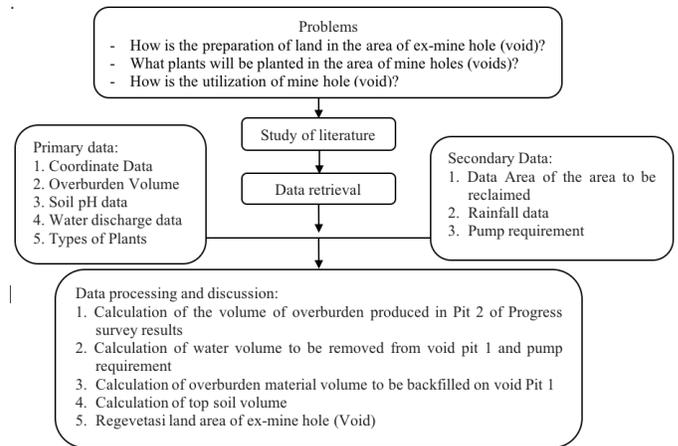


Figure 1. Flow Diagram of Research

data of progress survey results in pit 2, Volume Overburden result of survey progress on pit 2 using Software Surpac 6.5.1, Soil pH data, Water discharge data, Type of plant, Tone of environment using observations and digital cameras, Results of overburden and top soil volume calculations to be used on void PIT 1.

#### 2.4.2 Secondary data

Secondary data is data obtained from the company PT Baturona Adimulya among others, Data Area of area to be reclaimed, Rainfall data, Pump requirements

### 2.5 Research Flow Diagram

The research is run in a few steps, starting from problems identification and then followed by data collecting and data processing respectively, the conclusions made at the end of the process is intended to deploy solutions for the problems previously identified, this steps explained in the following figure 1.

## 3. RESULTS AND DISCUSSION

### 3.1 Overburden Volume Calculation Results on PIT 2

The overburden volume calculation at Pit 2 of PT Baturona Adimulya is influenced by the mining activities carried out and the ability of the load-digger and the trucks vary due to certain circumstances as seen in Figure 2. The main survey tool used by PT Alas Watu Utama as contractor PT Baturona Adimulya in the measurement activity is the total station sokkia set 3010 as seen in figure 3.

The volume of overburden at PT Baturona Adimulya can be determined from survey activities. Measurement of progress survey in order to fulfill the overburden digging volume calculation data at Pit 2 PT Baturona Adimulya resulted in detail point of 1,396 points, including detail toe, crest, spout overburden, road, and disposal.

The measurement data will be stored in total station with SDR file format, then taken (downloaded) by using USB (flash)



Figure 2. Doosan 500 LCV Loader Tool and Caterpillar D400E ADT Transmission Tool



Figure 3. Total Station Set Survey Tool 3010

to be transferred to computer, then processed and calculated to get overburden digging volume, obtained cut volume of 252.190 BCM and fill volume 249 BCM to obtain overburden digging volume based on survey result of 251,941 BCM from calculation variable in the form of topography which has the lowest elevation of 11.38 MSL and highest elevation of 36.43 MSL and variable of the progress situation which has the highest elevation of 7.2 MSL and the highest elevation of 38.17 MSL as seen in Figure 4.

**3.2 Outcome Results on Pit 1**

From the observation in the field there are mined holes (voids) that contain water that comes from the rain water and accommodated in the void. This void is formed because in PT Baturona Adimulya applying open mining which generally will leave a hole (void) or basin at the end of mining. This ex-mine hole (void) is located in Pit I, which has no longer done mining operations and is in reclamation stage. This void has an area of 4.8 Ha and into it about 10 meters. The void will be process dewatering. After that it will be backfilled and will be planted. The mine hole of pit 1 is shown in Figure 5.

Based on the observation of the primary and secondary

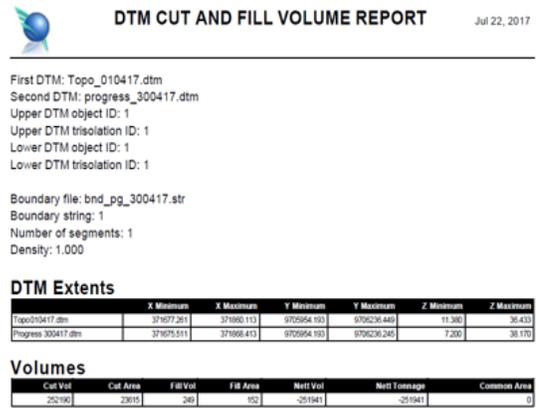


Figure 4. Calculation of Overburden Production Volume At Pit 2 Using Surpac Software



Figure 5. Mine Hole (Void) In Pit 1

data it will be done data processing, in the form of calculation of pump needs to implement the process of dewatering on void pit 1, the calculation of the number of overburden and top soil that will be used to hoard the void and revegetation of the void area.

**3.3 Preparation Process Dewatering Void Pit 1**

Area of void to be executed for dewatering process was 4.8 Ha. The void is estimated to have a water volume of 254,283 m<sup>3</sup>. Type of pump owned by PT. Baturona Adimulya is DND Pump 200 which a specification capable of flowing water of 823 m<sup>3</sup>/hour. With 3 existing DND 200 Pumps and 21 hours of pump work hours a pump specification value of 52,164 m<sup>3</sup>/day is obtained. So to carry out the process of dewatering 254,283 m<sup>3</sup> on void pit 1 takes time for 4.8 days. The Figure 6 shows the image of pump used.

**3.4 Calculation of Closure Volume and Clay Land to Guiding Void Pit 1**

The total volume can be calculated using the pyramidal formula because of the form of the void in the form of a basin, with an area of 4.8 Ha, the width under the assumption of 1.8 Ha and the depth of void 9.3 m then obtained volume

overburden/ground cover needed to accumulate void pit 1 of 295,721.01 m<sup>3</sup>/ha. Top soil spread over the reclamation site after completion of 70 cm overburden dump. So we get total volume as much as 33,600 LCM/Ha of top soil required.

**3.5 Revegetation Plan Void Pit 1**

The mining process, especially in open pit, will remove all vegetation in the location to be mined, such as trees, shrubs, rooting plants, seeds, microorganisms, including the migration of wild animals. This process will of course eliminate the functions of the vegetation area, such as providing various forest products; therefore revegetation is done in the area of ex-mine holes (voids) that have been dumped to restore the land. In selecting plant species of PT Baturona Adimulya choose the type of local plants in accordance with the climate and conditions, but also need to choose another plant in accordance with the type or condition of soil either the nutrients in the soil or low pH, before the plant is planted first seeded. Figure 7 shows the image of plant nursery of PT. Baturona Adimulya.

Factors that need to be considered in the plant species are as follows: Can grow quickly naturally around the mining site, Indigenous plants in the area, Resistant to pests and diseases, Can produce humus quickly, Resistant to heat and dry state.

Then the type of plants used in PT Baturona Adimulya among others: Sea Sengon, a type of protective plant that can absorb air pollution 43% to 69% and can grow in the tropics, Seru Wood, this wood including the original wood (early environmental tone) on the mining area, the use of this replanting this kind of timber is to genetic reservation, Samak wood, this planting as well as the Seru wood that intends so that the authenticity of the plant land is not lost and in accordance with the climate of the area, Rubber and palm oil is used for the insertion plant to reclaim the land to produce something of economic value, Kayuputih (eucalyptus), used because it can adapt to the environment and climate around quickly.



**Figure 7.** Location of Plant Nursery PT. BaturonaAdimulya

planted plants, it must be done pH measurements on top soil to know the value to be planted. Measurements were carried out in the top soil temporary storage area; the method used in measuring time was to measure the pH of soil at 5 points randomly using a pH thermometer as seen in Figure 8. After knowing the value of pH at that point it will be in search of its average. From the results of measurement of pH top soil obtained the average total results are 5.88, which means that the pH of the soil is normal and can be planted.

**Table 1.** Result of Measurement pH Top Soil

No	Point	pH
1	A	5,9
2	B	5,8
3	C	6
4	D	5,9
5	E	5,8
Average Total		6

**3.7 Analysis of Preparation of Reclamation Land in Hole Area of Former Mine (void)**

The scheme of utilize of pit mines is described in Figure 9. The process is divided into several stages as follow:

**3.7.1 Void Dewatering Process**

The first thing is to do the dewatering in the void because there is water, therefore pumping is done. The volume of water to be pumped is 254,383 m<sup>3</sup> and requires a DND 200 pump of 3 units with the capacity of each pump 828 m<sup>3</sup>/hour and the overall time required for the dewatering void Pit 1 process for 4.8 days.



**Figure 6.** Pump DND 200

**3.6 Measurement of Top Soil pH**

Soil pH value is very influential for the process of revegetation activities because it can affect the level of soil fertility to be



Figure 8. pH Top Soil Measurement

### 3.7.2 Backfilling Process

Exhaust hole (void) that has been done pumping and no more water will be backfilled using overburden from pit 2. To hoard a void that has an area of 4.8 ha required overburden of 295,721 BCM/Ha. The hoarding process will be done gradually using the soil cover material from the pit 2 which is done at the time of the study of the volume of cover soil produced is 251,941 BCM/month. Stockpiling is done in accordance with reclamation activities and with appropriate slope to avoid landslide.

### 3.7.3 Top Soil Overlay

Top soil topping is done in the void area that has been stockpiled with overburden. Thus the condition of former mining land is ready for re-planting (Revegetation). For top soil thickness is 0.7 m so that the requirement of soil shoot volume (top soil) for land reclamation area of 4.8 Ha is 33,600 LCM/Ha.

### 3.7.4 Revegetation of Mining Hole

After preparing the land in the void area, revegetation is done by planting in areas that have been stockpiled with overburden and top soil from the preparation of the land, And then it can be done revegetation. Before planting is done the land is stocked cover crop first, then the plant to be planted in the void area is sengonlaut, kayukayu, kayuputih, and plant inset rubber and palm with spacing 6 m x 7 m in area of 4.8 Ha and amount the plant used is 1,088 stems. After that, the arrangement of water channels must also be considered so that water does not enjoy in the planted area.

### 3.7.5 Utilization of Mining Hole

From the result of land preparation and after revegetation planning, it was found that the ex-mine hole will be reforested by planting trees and plants in a place that is considered to be the plant's growth. The benefits of reforestation in mine holes are able to maintain water balance and can prevent flooding, then can prevent erosion and soil erosion that can cause landslides.

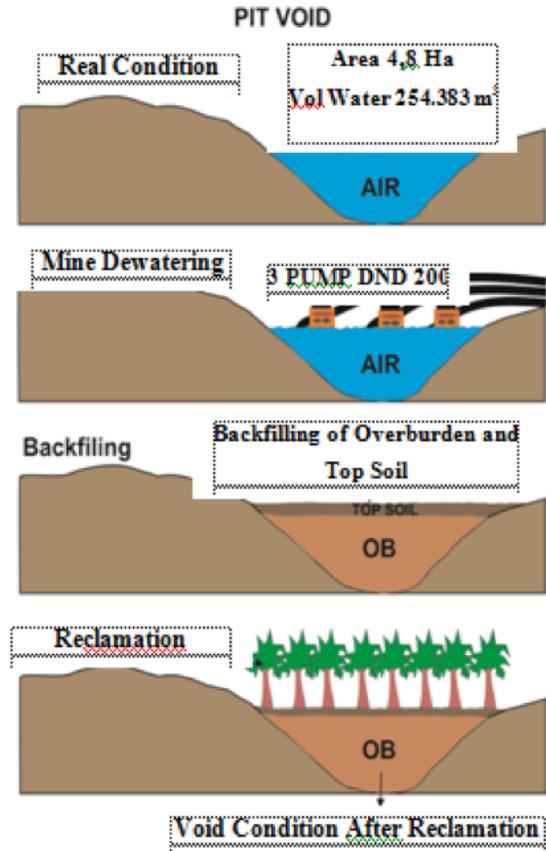


Figure 9. pH Top Soil Measurement

And also able to keep the environment becomes more beautiful, comfortable for the surrounding community.

## 4. CONCLUSIONS

From the results of processing and discussion then obtained the following conclusions:

1. Preparation of land done in the area of the ex-mine hole (void) in the form of dewatering void, backfilling plan well how much volume of overburden needed to accumulate void pit 1 and overburden volume produced on pit 2 ongoing overburden exploitation, top soil exposure order can be done reclamation activities in the void.
2. The types of plants used for revegetation in the area of the void are sea sengon, eucalyptus, Seru wood, rubber and palm selected plants because the plant is native to the area and also can adapt quickly and can help fertilize the soil.
3. Utilization of the ex-mine hole (void) is done re-foresting the area in order to restore the initial tone at the time before the mine.

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## REFERENCES

- Arnold, e. a. (2001). *Reclamation Activities*. Jakarta: Ministry of Forestry
- Brundret (1996). *Improve the growth of forest crops*. Jakarta
- Fandeli (2005). *Analysis of the Basic Environmental Impacts of Development*. Liberty Publishers, Yogyakarta
- of Forestry, M. (1997). *Mine Land Reclamation Guidelines*. Directorate General of Land Rehabilitation and Social Forestry