Technical analysis backfilling plans of integrated on post mining plan

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Technical analysis backfilling plans of integrated on post mining plan

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Abstract

Based on Minister of energy and mineral resources of the Republic Indonesia number 07 years 2014 on the reclamation and post mining, every mining industry must have post mining planning to obtain mining operation. The objectives of research to know the direction of mining, the volume of pile plan and the design of the embankment. PT Samantaka Batubara is one of the coal mining companies geographically located in Riau Province. The study refers to the direction of mining from the beginning of 2017 from the southwest side to the end of the mine in 2022 to the northeast. The volume of overburden material stockpiles planned for the post mining plan program is 2,500,850 LCM in the 1st in 2021 and 3,000,665 LCM periods of the 2nd in 2022 period. The backfilling design in this study follows the recommendation of geotechnical analysis with every 5 meter hump should be formed in a slope angle of 300, with the direction of the heap toward the east. Period prior to entering the post mining program that is in 2017 the embankment forms the highest elevation of +83 whereas in 2018 to 2020 the highest elevation is flat at +63 elevation. Entering the post mining period of the highest elevation plan established at +63 elevations in 2021 and 2022.

Keywords

Ministerial Regulation, Dump Volume, Design of Backfilling

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1. INTRODUCTION

Humans need mining commodities to meet their daily needs such as motor vehicles, mobile phones, electronic equipment, and others. The mining industry is there to meet those needs. Mining commodities in government regulation no. 23 of 2010 concern about the implementation of mineral and coal mining business activities comprising of radioactive minerals, metal minerals, nonmetallic minerals, rocks and coal.

Mining of mineral and coal is done to get the mining commodities through production operation (Juniah, 2017). PT Samantaka Batubara is one of the coal mining company geographically located in Kecamatan Peranap (Desa Pauh Ranap and Gumanti), Kecamatan Batang Peranap (Desa Punti Kayu), Kecamatan Rakit Kulim (Desa Talang Durian Cacar) Kabupaten INHU, Riau Province.

Natural forest and coal resources provide economic benefits for forest areas. Mining benefits arising from mining business activities for the state are a source of state revenue and foreign exchange earners. Other benefits that arise are as a producer of industrial raw materials, facilities and infrastructure to be built, providers of employment, absorption of labor. The utilization of the coal's natural resources by mine is exposed to forest areas in addition to obtaining such benefits, on the other hand causing environmental losses (Juniah et al., 2017).

The post mining plan requires a backfill cover material design using minescape software (MSC, 2011). Base into PERMEN ESDM RI Number: 07 Year 2014 Attachment that activity of Post-plan will start in 2 (two) years before age of mine ends that is year 2022 (ESDM, 2014).

The period of implementation of coal mining activities of PT Samantaka Batubara starts from year 2017 until year 2022. Actual planning of backfilling hole of PT Samantaka Batubara long-term mining has not existed yet. The actual backfilling done by PT Samantaka Batubara in 2017 was 96.12% with a volume of 2,433,000 LCM stockpiles of overburden production of 2,531,000 BCM. While a number of overburden material production of 98,000 BCM stockpiled to the disposal outside pit.

Supporting theories used to support this research include the geometry of the embankment covering the size of the ladder, the width of the ladder, the height of the ladder, and the minimum level of length at the time of mining (Indonesianto, 2000), the productivity of the loading and hauling tools, the productivity is the ratio of the whole resources used (input) with the result achieved (output) (Rostiyanti, 2008). The basic principle of calculating the volume capacity of backfilling is by calculating the volume of the

pyramid is cut off (Kennedy, 1989). The main theory used in this research is the design model of embankment using minescape software.

The formula used in theoretically calculating the volume of backfilling piles:

$$Volume = \frac{1}{3}xh(A1 + A2 + \sqrt{A1.A2}) \quad (1)$$

Information:

h = Heap Height
A1 = Area of Dredge
A2 = Area of Dredge Peak

The productivity of the loading and hauling tools became the most important part of this study, since the amount of material the stockpile as backfilling will be measured for achievement based on the level of the tool's capability (Prodjosumarto, 1995).

Backfilling method is a method used to extract the mine that has been taken in the form of overburden material and then dumped back into the open pit hole (Setyawan, 2004).

The above problem is the background for research on technical analysis of backfilling plan with minescape software. The formulation of the problem in this study includes how the drill direction design plan ends up to the post mining stage, the required stockpile volume for the backfilling plan for revegetation at the time of entering the post mining period, and how the material backfilling plan designs as it enters the post mining period. This study aims to determine the direction of the mining plan, to analyze the volume of material needed for the backfilling plan and to analyze the design of the overburden material in the backfilling plan integrated with the post mining plan of PT Samantaka Batubara.

2. EXPERIMENTAL SECTION

The location of the research is located on the Area of Mining Business License of PT Samantaka Batubara geographically located at Kecamatan Peranap (Desa Pauh Ranap and Gumanti), Kecamatan Batang Peranap (Desa Punti Kayu), Kecamatan Rakit Kulim (Desa Talang Durian Cacar) Kabupaten INHU, Riau Province. The research was conducted on December 10, 2017 until January 10, 2018 in the engineering division. Research starts from the stages of literature study to obtain materials related to research conducted and conclusions from the results of research. This study was conducted to study and implement theories related to mining plans, calculation of production of heavy equipment to produce heap volume and embankment design. The source of this literature study comes from research-related journals, archives of PT Samantaka Batubara, Mining Service. Field orientation is done by observing directly mining activities especially stripping overburden. Files collected to obtain primary files and secondary files.

The primary files was generated is by calculating the actual time of the loader equipment and the haulage, this calculation is done to get the time required of mechanical equipment in producing the overburden material to be used as the embankment material. Extensive design of mine and mining openings by coordinating with engineering teams to get an overview of mining constraints and pile areas. The function of know the type of material in this study site was to determine the ability of the pile volume while the types of flora around the research area to know the original ecosystem prior to mining.

Secondary files are supporting from literature and company files supporting in research covering ANDAL document of PT Samantaka Batubara, document of Ijin Pinjam Pakai Kawasan Hutan (IPPKH), result of public consultation with stakeholders, type and amount of loading and tooling tools transport, and type of mechanical equipment to be planned in post mining activities.

Files processing is performed on the overburden material production balance files which will be stockpiled to determine the backfilling technical plan, equipment productivity and em-

Table 1. Total calculation of long-term production balance (yearly) based on reserves and IUP period

Year	2016	2017	2018	2019	2020	2021	2022	TOTAL
COAL Target (Million TON)	Infra	0,411	0,502	0,500	0,500	0,500	0,508	2,922
OB Target (Million BCM)	Infra	2,531	3,000	3,000	3,000	3,000	3,000	17,531
Inpit Dump Volume (Million LCM)	Infra	2,431	2,500	2,500	3,000	2,500	3,000	15,931
Outpit Dump Volume (Million LCM)	Infra	0,100	0,500	0,500	-	0,500	-	1,600
Open Mine Area (Ha)	Infra	16,690	10,400	12,150	11,790	12,100	11,900	75,030
Inpit Dump Area (Ha)	Infra	16,690	10,400	12,150	11,790	12,100	11,900	75,030
Outpit Dump Area (Ha)	Infra	1,196	5.981	5.981	-	5.981	-	19,140
SR (Stripping Ratio)	Infra	6,200	6,000	6,000	6,000	6,000	6,000	6,033

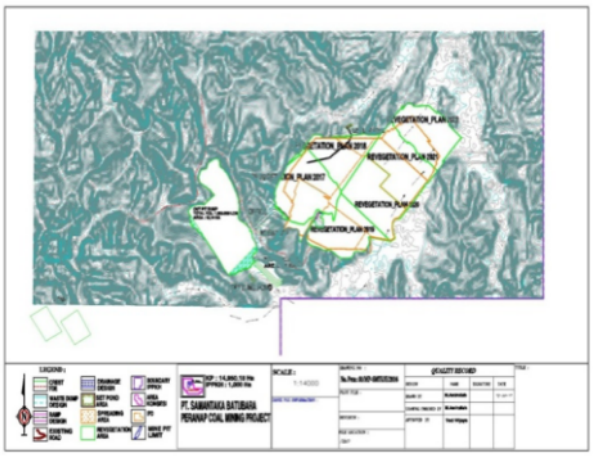

Figure 1. Map of mining and reclamation plan of PT Samantaka Batubara

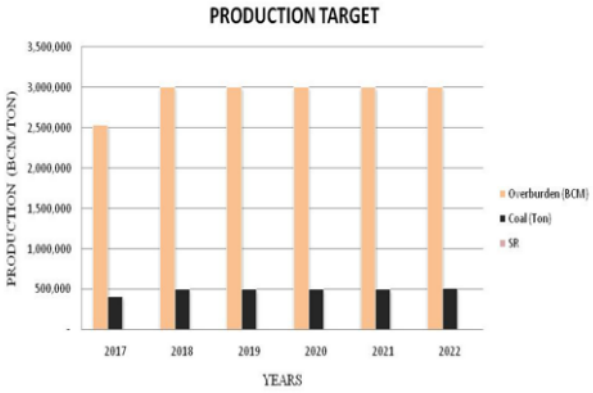

Figure 2. Production target of 2017-2022 PT Samantaka Batubara

bankment design. Backfilling plans are undertaken to produce a land-clearing plan to be replanted (revegetation) upon entering the post mining period.

Analysis filse is done by processing the files that has been taken by manual calculation using Microsoft Office Excel based on the theory obtained from literature study and assisted using software software minescape. The analysis was carried out on a mine progress plan synchronized with the post mining plan using minescape software and Microsoft Office Excel. The results of the analysis using the minescape software were analyzed again to find other variables that could affect the work efficiency in the post mining plan.

3. RESULTS AND DISCUSSION

The mining plan at PT Samantaka Batubara adjusts to the distribution of existing coal deposits within the Production Operation Mining Permit. The form of coal deposits starts from the southwest (the highest elevation / lowwall) to the lowest elevation of the northeast (the lowest elevation / highwall). The direction of the mining plan from start to finish is useful as a reference to the boundaries and areas to be backfilled.

3.1 Mining direction

The mining direction planned by PT Samantaka Batubara can be seen in Figure 1. The beginning of mining in 2017 starts from the southwest side then in 2018 continues towards the northeast side, whereas in 2019 mining starts on the southeast side of the mine, and continuously towards the northeast year 2022. Outpit dump disposal located in the northwest of the mining area with a distance of ± 1.2 km.

The calculation of overburden production in the mining area of PT Samantaka Batubara was expressed in units Bcm. Therefore, to determine the production of the the material is used the development factor (swell factor). The calculation results of mechanical device production have included influential factors in the calculation such as time of distribution, bucket capacity and work efficiency. Production of long-term (annual) mechanical tools operating on the mining front is listed in Table 1.

The appropriate amount of reserves mined by ± 25,000,000 tonnes, taking into account the target market, 500,000 tonnes with SR 6 in the 2nd year to post mining with the same level of production / flats can be explained in Figure 2. The amount of overburden material volume to be backfilled ± 2,500,000 lcm first year to third and rises to ± 3,000,000 lcm annually to digging tool and the conveyance must be multiplied by post mining.

Figure 2 explains that the production target during the life of the 6-year mine from 2017 to 2022 has increased. The increase only occuss in 2017 until 2018 and then the amount of production become flat until 2022. The planned production amount is adjusted to the marketing target of PT Samantaka Batubara. The production target which is the reference in this research is the production plan in the last 2 (two) years of the mine.

Production target which become the reference in this research is Table 2. The amount of overburden production in Table 2 is known as ± 3,000,000 bcm (bank cubic meter) / year. The number of overburden volumes to be dumped at a former mine of 2,500,000 lcm (loose cubic meters) in 2021 and 3,000,000 lcm (loose cubic meters) in 2022.

The production target is shown in Figure 4. is the volume of embankment which will be the basic assumption in the implementation of the research. Target given is the last 2 (two) years target before entering the post mining period. The embankment form is one of the parameters of post mining success, in order to revegetate activities.

Circulation time is the time that a mechanical device needs to perform certain activities from start to finish and ready to start again. The haul road condition, workplace conditions, the condition of the equipment itself, and also the loading pattern

Table 2. Results of long-term (yearly) production balance calculations for post mining plans

Year	2021	2022	TOTAL
COAL Target (Milion TON)	0.5	0.508	1.008
OB Target (Million BCM)	3	3	6
Inpit Dump Volume (Million LCM)	2.5	3	5.5
Outpit Dump Volume (Juta LCM)	0.5	-	0.5
Open Mine Area (Ha)	12.1	11.9	24
Inpit Dump Area (Ha)	12.1	11.9	24
Outpit Dump Area(Ha)	5.981	-	5.981
SR (Stripping Ratio)	6	6	6

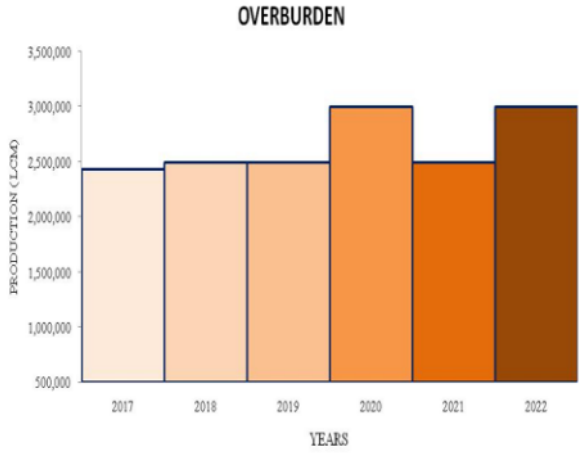

Figure 3. Volume Target backfilling 2017 - 2022 PT Samantaka Batubara

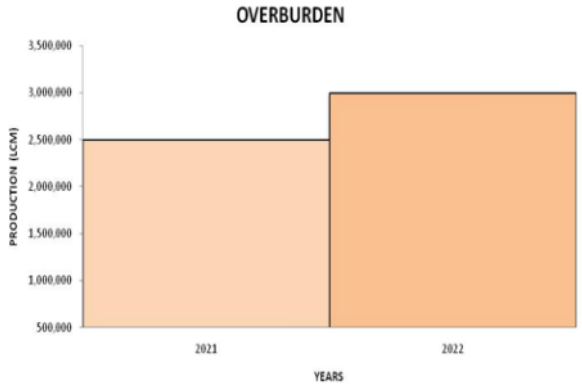

Figure 4. Volume Target of Backfilling 2021-2022 PT Samantaka Batubara

undertaken strongly influence the timing as shown in Table 3.

Work efficiency is the time required by operators with mechanical tools for production activities. Analysis of the effective work efficiency of each conveyance and available loading device can be done by determining the value of the availability of the loading and transport tool which is a function of working time, standby time, and repair time of a device.

The availability of tools is one of the things that affect the productivity of the digging tool and the means of transport. The degree of willingness of mechanical means to produce in the overburden material mining activity at PT Samantaka Batubara can be used to determine whether the physical condition of the device is in a ready to use state, good mechanics and whether or not to be used for production can be judged by the willingness to use the tool.

Modeling this embankment form used software minescape. Design of embankment used additional files obtained from the technical team of PT Samantaka Batubara both topography and mining design. Planning of embankment design has several references such as forest area spatial layout, public consultation result, and recommendation of embankment slope.

3.2 Design Backfilling

Based on the Dinas Kehutanan of Kabupaten Indragiri Hulu Number: 522.3 / sekr-IV / 2012/378 dated April 18, 2012 regarding the Confirmation of Forest Area Status in the Mining Permit Area of PT Samantaka Batubara. PT Samantaka Batubara is mostly located in the area of Hutan Produksi Terbatas (HPT) and is under the permit of IUPHHK-TI (Ijin Usaha Pemanfaatan Hasil Hutan

Table 3. Average cycle time of mechanic equipment

No.	Mechanic Equipment	Cycle Time (minutes)	Distance (meter)
1	Loader - Excavator PC 400 VS CWB	0.34	-
2	Hauler - Dump truck Nissan CWB	10.15	± 1,500

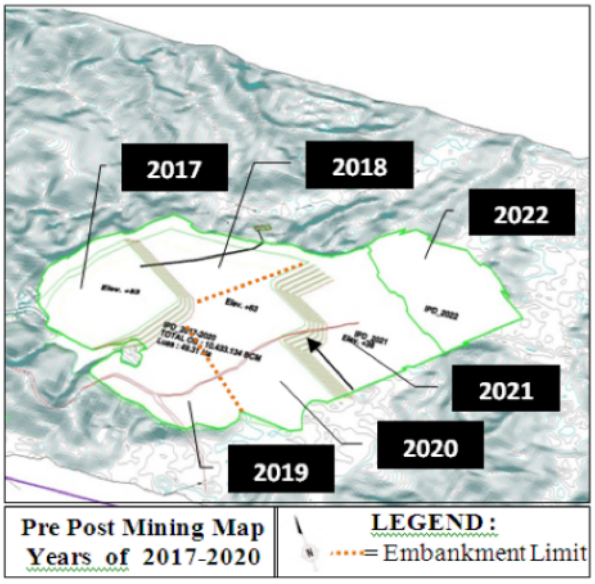

Figure 5. Design embankment (2017-2020) pre-post mining

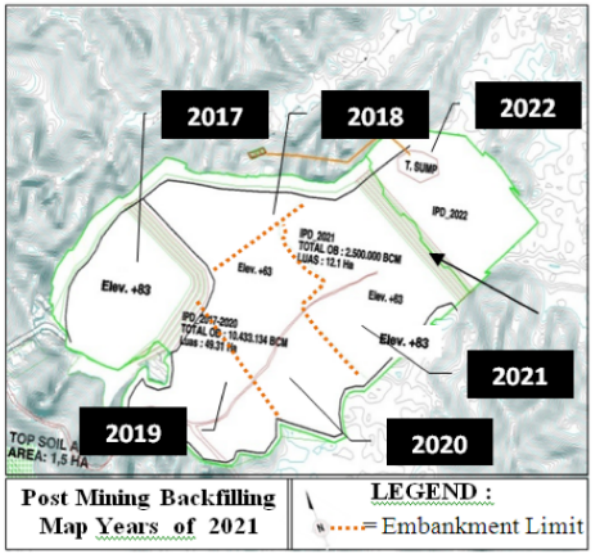

Figure 6. Design embankment (year 2021) backfilling year-1st

Kayu pada Hutan Tanaman Industri).

The results of stakeholder consultation are known to be one of the reasons that led the community to support the project, and became the basic reference in backfilling. The community, represented by village officials around the mine, called for a post mining program aimed at replanting rubber trees. Therefore, the form of backfilling plan is adjusted to the type of plants demanded by communities around the mine.

Implementation of post mining program, it is necessary to design the form of pile that is allocated to the ex-mining area. It is useful to provide the location of planting plants planned for revegetation. Based on the recommended geotechnical shear angle in the recommended is 300 and each increase of embankment of 5 meters with a bench width of 5 meters.

The rock characteristics used for the analysis of steepness of the embankment slope are 50% of the average residual cohesion (Cr) and shear angle in the mean residual (Dr) and 70% of the average saturated density value (ysat) and the water level the soil is considered to follow the height of the slope (the slope is saturated).

The result of a single embankment slope analysis is considered to be steady if it has a FK greater than 1,300 and the overall slope of the heap with FK is greater than 1,500. The calculation of steepness slope stability is performed for each slope-forming material, using two parameter variations, namely: High Slope (m): 5, 10, 15, and 20; and angle of slope (0): 30, 45, 50, 60, 70, 80.

The morphological form of the research area, especially those included in the first-stage licensing under the IPPKH document (Permit for Use of Forest Areas), tends to enter hilly areas and still in the green zone (Suwarna et al., 1991).

The backfill shown in Figure 5 is a form of embankment that has been implemented before entering the post mining period (2 years before the mine's life). In the present study, the peak elevation of the embankment plan must be considered, because when mining is no longer operational, the water entering the mine is designed to be removed without pumping.

Modeling this embankment form used software minescape. Design of embankment using additional files was obtained from the technical team of PT Samantaka Batubara both topography and mining design.

Figure 6 is an embankment design in the first year of the post mining plan period, showing that the intensive hoarding direction is heading east with the highest elevation target of the embankment +63. The highest elevation is a safe elevation of the puddle, so the plant is not eroded or waterlogged when the mine is no longer active.

The shape of the embankment at the end of the post mining in Figure 7 is averaged +63 elevation, while on the southwest side of the IUP (Mining Business License) which is mining in 2017 the peak of the embankment is at +83 elevation. The embankment design is tailored to the planned post mining plan, so that post mining activities can be effective and efficient. The highest elevation target on the embankment design is intended to allow the water into the mining area to be exhausted overflow.

4. CONCLUSIONS

The design of the backfilling form based on the geotechnical recommendation of PT Samantaka Batubara every 5 meter increments of heap must be formed in a slope angle of 300, with the direction of the heap to the east. Backfilling designs from

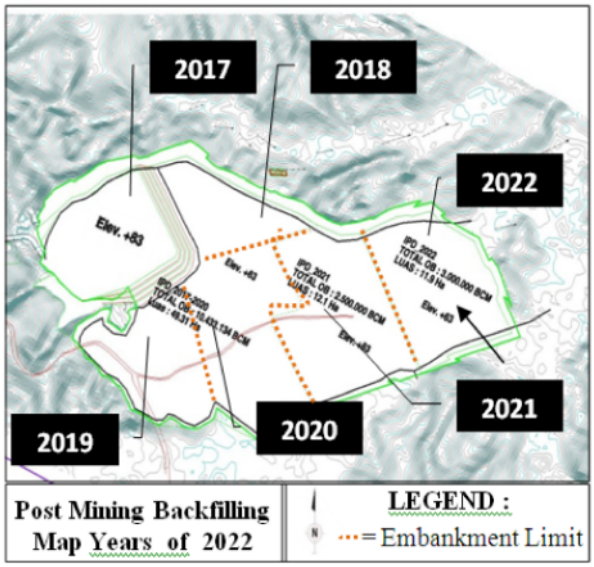

Figure 7. Final pile design (year 2022) backfilling year 2nd

2017-2020 (before entering the post mining program) the highest elevation of 2017 at elevations +83 and 2018 to 2020 are flat at +63 elevation, whereas in 2021 (the first post mining year) is at elevation +63 flats until the end of the mine in 2022.

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