J E M T
Journal of Earth and Marine Technology
homepage URL: ejurnal.itats.ac.id/jemt

Calculation of coal resources using the cross-section method in the mining plan area of PT. Sentosa Prima Coal in Mersam District, Batang Hari District, Jambi

Muhammad Jundi Haikal Azis [1], Yazid Fanani [1], Yudho Dwi Galih Cahyono [1]
[1] Department of Mining Engineering, Institut Teknologi Adhi Tama Surabaya, Indonesia
*e-mail: muhammadjundihaikalazis@gmail.com

Article info
Received:
August 26, 2022
Revised:
September 16, 2022
Accepted:
September 20, 2022
Published:
September 30, 2022

Keywords:
Coal, Model, Resource, Resources, Overburden

Abstract
PT. Sentosa Prima Coal is a company engaged in the Coal sector. This company is located in Mersam District, Batanghari Regency, Jambi Province. The area of the mining business permit of PT. Sentosa Prima Coal of 2000 Ha. Mining activities require resource calculations before mining activities are carried out, including making a coal deposit model, calculating coal resources, pit design, and calculating the stripping ratio (SR) value, so that later the number of coal resources can be obtained and obtain a deposit model. The modeling and calculation of resources were carried out using the "cross-section" with the help of Surpac 6.6.2 software. Based on the Cross Section's estimation results, coal resources for PT. Sentosa Prima Coal amounted to 8,073,932 tons, and coal resources 6,662,514 tons, the volume of Overburden for the planned mining activity area was 24,779,981 BCM, and the stripping ratio value was obtained 1:4.

1. Introduction

The calculation of resources plays an important role in determining the amount, quality, and ease of commercial exploration of a deposit. Because the results of a good calculation can determine the investment that investors will invest in, determine production targets, and mining methods to be carried out, and even estimate the time required by the company to carry out its mining business [1-3]. This is the background for doing research as a final project with the calculation of the coal resources of PT. Sentosa Prima Coal.

PT. Sentosa Prima Coal as the owner of the Mining Business Permit area covers an area of ± 2,000 Ha. In calculating the resources of a mineral deposit, a method is needed according to the mineral deposit conditions [4-6]. Against this background, to calculate coal resources at PT. Sentosa Prima Coal used the cross-section method. In line with the company's plan to anticipate market demand for increasing coal demand and the company's efforts to use coal as a substitute for oil, the company conducts exploration to find a substitute for petroleum [7], namely coal. Calculation of resources is a job determining the amount of volume or tonnage of minerals that are economically feasible to cultivate [8-9]. This resource calculation is carried out to increase confidence in the amount of (measured) coal resources prior to mining in an area.

2. Methodology

The methodology used in this study is a quantitative method, namely observing actual measurements in the field, which aims to obtain results/images which data will later process to provide an actual figure of the field [10]. The data collection technique was carried out by literature study, field observation, interviews, and data analysis.

The Literature Study phase was carried out by collecting information sources related to research activities originating from references related to the problems at hand. The field Observation stage is carried out through field observations to directly observe the research location's situation, conditions,

and activities. The data obtained in this technique are topographic, geological data, drill data, and the direction of the slope of the coal seam [11]. During field observations/observations, discussions were held, which included field data processing and analysis of the results of data processing obtained. Interviews with field instructors and people who are competent with discussions about the company.

Data Analysis Techniques, data processing is carried out with the help of Surpac 6.6.2 software. The preparation of the report is accompanied by the presentation of data in the form of maps, pictures, and tables that can assist in the delivery of information on research results. For coal volume calculation, the cross-sectional method is more suitable for sediment types with sharp contacts such as tabular shapes (bedding or veins). Exploration patterns (drills) are generally regular along the cross-sectional line, but in the case of deposits to be mined underground, they generally have irregular drill patterns (e.g., fan drilling systems) [13]. The weighted average of the sections will be extended to volume up to half the distance between the sections [14]. This method can be applied horizontally to vertically dispersed deposits such as intrusive bodies and reef limestone. Besides that, it can also be applied vertically (cross-section) for sediments that tend to spread horizontally, such as sill and layered deposits.

$V = L \,.\, (S1 + S2) / 2$ ……(1)
Where: V = Resource volume (m^3), $S_1 + S_2$ = Area of each cross-section (m^2), L = Distance between one cross-section to another (m)

3. Results and discussion

3.1 Topography

The shape of the surface, which is the surface of the research location, is topographic data, which is primary data in the research area. The topographic data consists of point coordinates and elevation data, which describe the topographical conditions at the research site as a surface boundary that will be a reference in modeling coal deposits, in-pit design, and calculations to determine the volume of Overburden [6].

The data needed to calculate the volume of coal using the cross-section is the upper limit which is limited by the highest elevation of the research area, namely at an elevation of 78 masl, for the lower limit (seam c floor), which is limited to the lowest elevation from the modeling results with the help of the Surpac software is 32 m.

3.2 *Coal Modeling*

Coal modeling determines the shape and distribution of coal seams, including the location/position, depth, slope, and several coal seams contained in the research area. Coal modeling is done by correlating drilling data consisting of thickness, elevation, roof, floor, and outcrop data [1].

Table 1. Coal Resource Volume

Seam	**Volume (BCM)**	**Tonnage (ton)**
a	1.831.804	2.381.345
b	1.652.518	2.148.273
c	1.640.689	2.132.896
Total		6.662.514



Figure 2. The modeled coal resource

From the drilling carried out as many as ± 199 points with the spacing between drill holes ranging from 50 - 100 m, the drill hole data used in this study was 107 points based on the results of data processing that the researchers determined based on the prospect area boundaries that had been determined previously [1]. The drilling, survey, and coal quality data are processed, analyzed, and then re-evaluated to determine the number of seams, rock stratigraphic sequences, and coal distribution. The results of this evaluation are then processed using software to determine the geological model. The ultimate goal of this evaluation is to determine the number of coal resources and measured resources with a stripping ratio to be followed up towards mining [3].

The coal modeling process is carried out in the following stages, determination of coal seams and correlations from drilling and outcrop data, namely data containing survey data containing coordinates, elevation, and total depth of drilling points and outcrop points [4-5]. In addition, lithological data contains roof elevation, floor elevation, thickness, and naming of coal seams. Determination of coal seams and correlations from drilling and outcrop data, namely data containing survey data containing coordinates, elevation, and total depth of drilling points and outcrop points. In addition, lithological data contains roof elevation, floor elevation, thickness, and naming of coal seams. Determination of the rules in the modeling that will be used [8-9]. The method used is the cross-section method, with the distance between sections being 100 meters which are used as the continuous direction of coal distribution. Processing survey and lithology data with the help of software. Topographic data is used as the upper limit of the coal modeling. Examination of the results of the coal modeling that has been carried out, if it produces a model that is not suitable, then the survey data and lithology and the determined modeling rules are carried out, and then repeats the modeling stages that have been carried out (figure 1).

The modeling result is a geological model of coal, which is displayed in the form of floor and sub-crop contours of the coal seam based on the drilling data; three coal seams can be modeled, namely seam A and seam B, and seam C with a thickness for each seam, namely seam A 1.25 m - 4.24 m, seam B 0.4 m - 2.5 m and seam C 1.3 m - 3.7 m. The distribution of coal is generally in a northwest-southeast direction with a strike N of 3250° E with a seam slope of 9^0 – 17^0, with a dip of 14°. Based on the calculation of coal resources using the *cross-section*, there are 3 (three) seams; the number of coal resources in the research area is 2,753,488 tons in *Seam* A, 2,462,694 in *Seam* B, and 2,857,750 in *Seam* C. The number of coal resources is calculated using the method *cross-section* contains 3 (three) seams, total coal resources in the research area are 2,381,345 tons in *Seam* A, 2,148,273 tons in *Seam* B, and 2,132,896 tons in *Seam* C (table 1).

3..3 Geotechnical Recommendations

The stability of a slope in rock is influenced by the geometry of a slope, rock structure, physical and mechanical properties of rock, and external forces acting on the slope (figure 2). The slope and height of a slope greatly affect its stability; the greater the slope and height of a slope, the less stable it is. The safety factor of the rock types in the study area is considered [5].

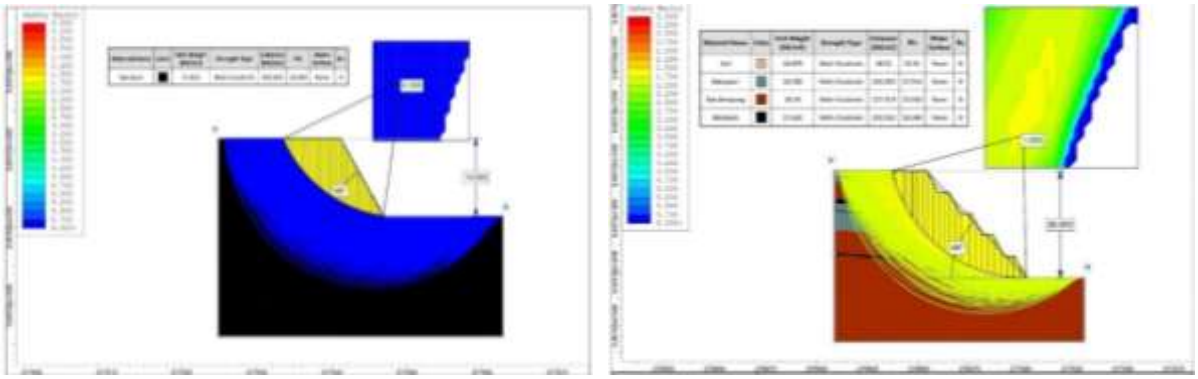


Figure 2. Single slope (left), Overall slope (right)

Single slope obtained a level geometry of 60^0 with a height of 10 meters and a bench width of 5 meters. The safety factor value shown from data processing results using Slide software is 6.3, and it can be ascertained that the level is in the safe category [7]. The slope on the overall slope is designed to be the same as the *single slope*; the processing results obtained an overall height of 50 meters with an overall angle of 46^0. The safety factor value is shown in the results [11].

3.4 Pit Limits

The determination of limits for mine planning at PT Sentosa Prima Coal is based on the topography of the research area and the coal floor of Seam C and the level conditions recommended by the company, which have a limit of SR 1.4 with an area of 115 Ha. On the second style of figure placement, you should show which picture you mean, such as Figure 2 left or figure 2 right [13].

4. Conclusion

The number of coal resources is calculated using the method *cross-section* contains 3 (three) seams, total coal resources in the research area are 2,381,345 tons in *Seam* A, 2,148,273 tons in *Seam* B, and 2,132,896 tons in *Seam* C. Resources Modeling of coal resources that have been produced for a mining plan of 115 Ha there is 3 (three) resulting in a *stripping ratio* (SR) of 1:4 with *of the volume* of measured coal resources of 6,662,514 tons and *volume of Overburden* (OB) of 24,779,981 Bcm.

5. Acknowledgment

The authors just want to say thank you to my family, lecturers, company, and all my friends who have helped me in doing this project.

References:

[1] Government of Indonesia, "Guidelines For Reporting Exploration Results, Resources And Coal Resources," *SNI 5015:2019,* 2019.

[2] Government of Indonesia, "Reporting Guidelines, Resources and Coal Resources," *SNI 5015:2011*, 2011.

[3] Syafrizal S, Lilah.dkk, "Resource Calculation Method TE-3231," *Department of Mining Engineering ITB,* 2005.

[4] Syafrizal S, Lilah, "Basic Principles in Estimating Resources," *FFTM ITB,* 2014.

[5] KCMI, "Code for Reporting Exploration Results, Mineral Resources and Mineral Resources of Indonesia," *KCMI*, 2017.

[6] De Coster G.L, "The Geology of The Central and South Sumatra Basin," *IPA,* 1974.

[7] Gafoer S, "Geologic Map of The Lahat Quadrangle South Sumatra," *Center for Geological Research and Development,* 1986.

[8] Mertosono, S, "The Tertiary Basinal Area Of Central Sumatra," *IPA,* `1974.

[9] Suwarna, N, *"Geological Map of Sarolangun Quadrangle, Sumatra," Research and Development Center for Geology,* 1992.

[10] Kasiram, "Qualitative and Quantitative Research Methodology." *UIN Malang,* 2008.

[11] Silalahi BE, Saur Maruli, "*Dictionary of Mining, Technology and Coal Utilization,"UPN Yogyakarta.* 2002.
[12] Eka NHP, Esthi K, Yudho DG, "Pit Design and Coal Mining Production Scheduling At Pit X PT. Prolindo Cipta Nusantara, Site Sie Loban, Tanah Bumbu Regency, South Kalimantan Province," *ITATS*, 2020.
[13] Ahlul Nazar, *"*Analysis of Coal and Overburden Measured Resources Using Circular Methods and Polygon Methods At PT. Inti Bara Nusalima," *Sekolah Tinggi Teknologi Industri Padang*, 2020.
[14] Arie Andyano, A.A Inung, "Estimation of Coal Resources Using Mining Software at the DE Pit at Rocky Site PT. Pipit Mutiara Jaya, Tana Tidung Regency, North Kalimantan," *STTNAS Yogyakarta*, 2017.