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Estimation Of Coal Resources Using the Method Polygon In Bulungan Regency North Kalimantan Province

Anshariah[1], Achmed Bintang Akbar[2], Agus Ardianto Budiman[3*]
[1-3] Department of Mining Engineering, Faculty of Industrial Technology, Universitas Muslim Indonesia, Indonesia
Correspondence e-mail: agusardianto.budiman@umi.ac.id

ABSTRACTS
This research was conducted at one of the national companies engaged in coal mining. The Mining Business Permit (IUP) area in Bulungan Regency, North Kalimantan Province, has an area of 1,000 Ha Mining Business Permit (IUP). The purpose of this research is to find out the average thickness of coal and the measurable resources of coal and its tonnage. The polygon method is a calculation with the basic concept, which states that a certain point represents all sediment characteristics of an area. The data needed in this study are survey data, geological data, collar data, thickness, and topographic data (str). From observational data in the field, 31 drill logs were obtained with an average drill log depth of 6.75 meters with a measured volume of coal resources of 33,341,065 and a measured tonnage of coal resources of 50,711,759 MT, with a density of (1.3 tonnes/m^3).

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INTRODUCTION

Coal is a sedimentary rock that can be formed from organic deposits, which are mainly plant remains, and are formed through the process of coalification. Coal is a solid object containing carbon, hydrogen, and oxygen in chemical combination with a small content of sulfur and nitrogen elements, which is found in the layers of the earth's crust and comes from the remains of plants that have undergone a metamorphosis in long time brackets (Anggayana, 1999). Vegetation in the environment dies, and then peat is formed. Then the peat undergoes compression and deposition between layers of sediment and experiences an increase in temperature due to the geothermal gradient. As a result of this process, there will be a reduction in porosity and a reduction in moisture resulting in the release of the OH, COOH, OCH3, and CO groups in liquid and gaseous forms (Kadir et al., 2017). Due to the release of a large number of oxygen and hydrogen elements, the relatively increased carbon element resulted in the formation of lignite (brown coal) (Shabiruddin et al., 2022).

Until now, natural asphalt mining has only been carried out in the Kabungka and Lawele areas using the open pit method (surface mining). Mining is carried out by stripping the overburden; the asphalt rock is exploited by blasting, size reduction, grade selection, and mixing (AJM, 1999). This is the background of the research to analyze the water content in soft asphalt based on the effect. Then, with continuous compression and an increase in temperature, sub-bituminous and bituminous coals are formed with higher calorific levels than brown coal. The earth never stops; therefore, the compression continues with increasing temperature, so there is very little moisture. Many carbon elements change the previous coal to a higher level, namely anthracite, the highest caste in coal (Cook, 1982).

The potential for coal in Indonesia is so great that it can be alternative energy as petroleum fuel continues to decrease. So, exploring to find new potential resources to be exploited and continue with the next mining activity is necessary. Indonesia is one of the countries with the highest level of consumption of fuel oil in the world. The increase in fuel energy consumption is different from depleting petroleum reserves. This prompted the government to search for new energy sources to ensure energy security in the future. Coal exploration is the right choice because it still has great potential for mining. Coal resources in Indonesia are estimated at 61,366 billion tons and are spread over Sumatra, Kalimantan, and the remainder in Java, Sulawesi, and Irian Jaya. On the island of Kalimantan, several companies are engaged in coal mining, one of which is in Bulungan Regency, North Kalimantan

Province. One method of calculating reserves, namely the polygon method, is used to estimate new coal resources.

Coal resources are part of coal deposits that are expected to be utilized. This coal resource is divided into resource classes based on the level of geological confidence determined qualitatively by geological conditions (level of geological complexity) and quantitatively by the distance of the information point to the boundary of the area of influence (SNI 5015-2011). The Tarakan Basin is one of the 3 (three) main Tertiary Basins located in the eastern continental margin of Kalimantan (from north to south, namely the Tarakan Basin, Kutai Basin, and Barito Basin), which are characterized by the presence of clastic sedimentary rocks as the dominant constituent, fine to coarse in size with some carbonate deposits. Physiographically, the Tarakan Basin includes land areas and partly offshore areas. In the north, it is bounded by the Semporna elevation, which is slightly north of the Indonesia – Malaysia border, and in the south by the Mangkalihat Ridge, which separates the Tarakan Basin from the Kutai Basin (Fraser & Schram, 1999).

In addition to fault structures, the Tarakan Basin develops five large arches or anticlines, especially in the western part. These arcs are called Sebatik, Ahus, Bunyu, Tarakan, and Train bows from north to south (Husain et al., 2022). These arcs are large plunging flexures trending southeast formed by northeast-southwest transpression and north-northwest-southeast orientation. The age of compression is getting younger towards the north (Jafar et al., 2022). The intensity of the folds also increases to the north, where the arc getting bigger offshore produces sharp and narrow folds on land, namely in the Simenggaris area (Juradi et al., 2021). The Practice Arc and the minor anticlines developing in the southern part of the Tarakan Basin (Muara sub-basin) also have a northwest-southeast orientation (Fraser & Schram, 1999). The log is a graph of depth (it can also be time) from a data set that shows parameters that are measured continuously in a well (Harsono, 1997).

METHODS

The research applied in this research includes:

1. Facts; In this research area, coal mining activities have been carried out since 2006 until now. In order to support the continuation of mining activities, it is necessary to carry out exploratory drilling at other mining locations in the company's IUP area. This drilling activity aims to obtain renewable coal resources in that location (Akhsanul et al., 2018; Anshariah, 2015).
2. Problem Stage; Exploration drilling activities have been carried out at one of the mining sites in the research area (Thamsi, 2017).
3. Data Collection; Data collection was carried out at the research location in the form of drilling log data, which included survey data, geological data, and collar data.
4. Data Analysis; After data collection, data analysis was carried out using Microsoft Excel and then continued using the Arcgis 10.3 program.
5. Calculation Analysis of Coal Resources Using the Polygon Method; Inside the grade polygon, grade values are assumed to be constantly equal to the grade at the drill points inside the polygon. (Hustrulid & Kutcha, 1995). The method used to estimate coal is by calculating coal reserves and the total volume of coal (Anshariah, 2016). Analysis of the calculation of estimated coal resources using the polygon method uses the following formula:

$$P_{avg} = ({}^{n}\sum_{i=1} A_i \times P_i)/ A$$

Where,
Pi = Precipitation recorded at various stations.
A_i = Area of Thiessen polygon I
n = Number of stations.

RESULTS AND DISCUSSION

Calculation of Reserves of the Polygon Method

The basis for choosing the polygon method for calculating estimated coal resources includes the following:

1. Homogeneous deposit characteristics and simple geological conditions. Based on observations at the research location, it was found that the characteristics of a homogeneous deposit were said to be homogeneous because the distribution of this coal evenly followed the distribution pattern of the coal. As well as having simple geological conditions, it is said to be simple because, based on observations at the research location, there were almost no faults, almost no folds, and also almost no branching. Moreover, the condition of the area is very sloping.

2. Calculations can be carried out briefly and precisely. This is based on the homogeneous characteristics of the sediment, so this calculation is carried out based on the area of influence multiplied by the thickness of the coal.

Geological Conditions of the Study Area

The research location is in the Tarakan Basin, which is one of the 3 (three) main tertiary basins located in the eastern continental margin of Kalimantan (from north to south, namely the Tarakan Basin, Kutai Basin, and Barito Basin), which is characterized by, the presence of clastic sedimentary rocks as the dominant constituent, fine to coarse with some carbonate deposits (Manik & Asmiani, 2019). The location of this research area is relatively sloping in terms of elevation, which ranges from 50 – 100 MDPL.

Database Creation

The data used in this study is divided into three parts, namely:

1. Survey data contain coordinate position data for drill holes in the form of nesting, easting, and elevation.
2. Geological data contains information about layer lithology data at each drill point.
3. The data collar contains information about total depth, dip, and azimuth.

The database *, which will be processed using the Arcgis 10.3 program, is created using the Microsoft Office Excel application in a comma-separated value (CSV) format. This is intended to simplify the data processing process because importing data in the Arcgis 10.3 program is generally in the form of comma-separated values (CSV).

Data import is entering databases (survey, geological, and collar data) into the Arcgis 10.3 program as the software used to estimate coal resources using the polygon method. If an error occurs when entering data, it can be corrected based on the verified database and then imported the data again.

Drill Point Distribution

This exploration drilling operation uses a JACK ROW 200 type drilling machine with the direct rotary drilling method, which has a drilling capacity of up to 250 meters. During the drilling activities carried out in Bulungan Regency, North Kalimantan Province, 31 drill logs were drilled with coal outcrops located at different depths and different drill point distances with a linear (straight) drilling pattern. To determine the estimated measured coal resource, the distance between one drill point and another is ≤ 500 meters.

The coal thickness data from each drill log is shown in Table 1. From the total thickness of the coal from 31 drill logs, the thickness of the coal is 209.32 meters.

The following is the average thickness of coal based on drill logs in Bulungan Regency, North Kalimantan Province:
Is known :
Total drill log depth = 209.32 meters
Total drill log = 31 points
Have you asked about the average thickness of coal?

Resolution:
Average thickness B=(Total depth of drilled logs)/(Number of drilled logs)
The average thickness of BB = 209.32/31 = 6.75 meters
So, the average thickness of coal is 6.75 meters.

Table 1. Drill log data and thickness of coal

Log Bor	Coal Thickness (meters)
BHD20	10,7
BHD02	6,3
BHD24	5,8
BHD34	8,5
BHD35	5,3
DPG01	13.47
DPG02	11,6

DPG03	7,2
DPG04RI	12.95
DPG05	10.08
DPE01	13.63
DPE05	7,4
DPE04	13,26
DPE06	10.58
GPH33	5,1
DHN1702	2.95
DHN1708	5.95
DHN1902	2.35
DHN1903	14,4
DHN1906A	4,5
DHN1907	3
DHN1907A	10.5
DHN2103	0.3
DHN2106A	7,5
DHN2303	0.7
DHN2306	1,3
DHN2309	2.75
DHN2506	1.5
DHN2506A	4,2
DHN2507	1,1
DHN1901A	4.45

Resource Estimation

I calculated measured coal resources with an area (A) obtained from processing results in the Arcgis 10.3 Program by making a polygon shape (area of influence) with a Radius of 0 – 1200 m from the information point. Based on this processing, the total area is 4,939,417 m2. The volume of coal in the study area was calculated using the variable area of the corrected area A multiplied by the average thickness of the coal from the total drill log (6.75 meters), so the total volume of the indicated coal resource was 33,341,065 m3.

The measured coal resource tonnage is obtained from the calculation of coal volume multiplied by coal density (1.3 tons/m3), so the measured coal resource tonnage is 50,711,759 MT. The following is an example of calculating indicated coal resources based on drill logs using the polygon method, namely:

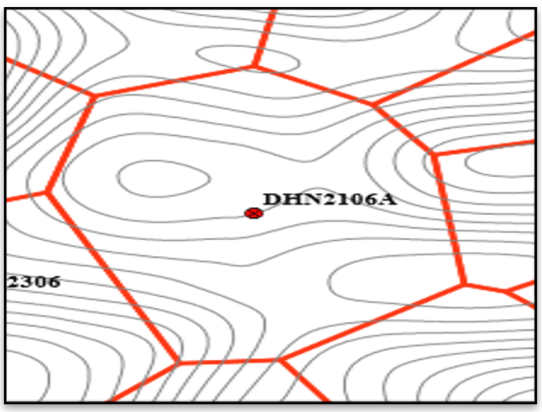

Figure 1. Polygon Construction Method

The image above is a construction of the polygon method from the results of data processing carried out in the Arcgis 10.3 program with an area of m2. The following is a calculation of indicated coal resources representing one of the drill points, namely the drill point code DHN2106 A, including the following:
The formula for calculating the volume of coal using the polygon method:
Is known:
t (coal seam thickness) (m) drill log DHN2106 A = 7.5 meters
A (area of influence) (m2) drill log DHN2106 A = 132500 m2
Asked:
The volume of coal in influence?
Resolution:

V = (7.5 meters) × 132500 m2
= 993,750 m3

So, the total volume obtained from one DHN2106 A drill log is 993,750 m3. To find out the tonnage of coal, we first know the density of the coal. The coal research location has a density of (1.3 tons/m3). So that the tonnage of coal in the DHN2106 A drill log is obtained, namely the volume of coal multiplied by the density (1.3 tons/m3), then the tonnage is 1,291,875 MT.

CONCLUSION

The conclusions obtained from the results of research in Bulungan Regency, North Kalimantan Province, are as follows:

1. The average coal thickness based on 31 drill logs is 6.75 meters deep.
2. With a measured coal resource with a radius of ≤ 500 meters and an area of 4,939,417 m2, the indicated coal volume is 33,341,065 m3. Moreover, the density of coal is 50,711,759 MT (1.3 tons/m3).

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