

THE EFFECT OF ASH CONTENT ON COAL QUALITY IN THE LABANAN FORMATION IN BERAU DISTRICT, EAST KALIMANTAN PROVINCE

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Abstract— The ash content is a residual material from burning coal. The higher the ash content, the lower the coal quality value. This shows that the ash content affects the value of coal quality. The purpose of this study was to determine the effect of ash content on the calorific value of coal in the Labanan Formation. The research method used is drilling and laboratory analysis on each coal seam. The mean quality of the coal seam in the study area is total moisture 40.13%, innate moisture content 13.47%, ash content 4.57%, volatile matter 42.61%, solid carbon 39.35%, total sulfur content 0.18 % and calorie value 5427 Kcal/kg (ADB). Based on the calorific value parameter, the research area is classified as low-calorie coal (brown coal).

Keywords: Ash, coal quality, Labanan Formation

I. INTRODUCTION

Ash is a residual material from coal combustion. The higher the ash content, the lower the coal quality value, this shows that the ash content affects the value of coal quality [1]. The availability of coal resources in Indonesia is quite abundant. Sourced from ESDM data for 2021, total surface coal resources in Indonesia are 143.43 billion tons with reserves of 38.80 billion tons, and subsurface coal resources of 43.533 billion tons with reserves of 173.51 million tons. In 2019, around 48% of coal use in Indonesia was for the benefit of domestic power plants, which amounted to 67.01 million tons [2]. One of which factors detrimental to the use of coal in the industry is the high content of impurities contained in coal, one of which is the ash content [3].

Coal is one of the natural resources in Berau Regency, East Kalimantan. This study is a study of the quality and classification of coal based on the calorific value in the Mining Business Permit (IUP) area of PT. Archipelago Berau Coal in the Labanan Formation. Administratively, the research area is located in Tasuk Village, Gunung Tabur District, Berau Regency, East Kalimantan Province.

The research area is geologically part of the Tarakan Basin, especially the Berau Sub-Basin. The Tarakan Basin is one of the Tertiary basins in eastern Kalimantan [4] and is part of the delta in a passive margin-type basin with minor lateral shear tectonic control [5]. There are 4 (four) sub-basins in the Tarakan Basin, namely the Bulungan Sub-Basin, Tidung Sub-Basin, Berau Sub-Basin, and Muara Sub-Basin [6]. Physiographically, the study area is included in the Berau Sub Basin. The Tarakan Basin is bounded by the subduction zone on the Samporna Peninsula, on the west by the Sekatak Height which is a Pre-Tertiary sedimentary layer, and on the south by the Schwaner Mountains and the Mangkalihat height [7]. The Berau sub-basin is located in the southern part of the Tarakan Basin,

The Berau Regency area has bituminous – sub-bituminous coal-bearing formations, namely the Latih Formation, the Labanan Formation, the Domaring Formation, the Sajau Formation, and the Sembakung Formation [9]. The presence of coal begins in the middle of the formation and develops well at the top of the formation, but it is very rare to find coal seams at the bottom of the formation [10]. The quality of coal is affected by the depositional environment, this environment shows the composition of the coal constituents [11].

Coal has a hardness value of less than 3 on the Mohs scale and is also called autogenous rock or rocks derived from plant diagnosis [12]. Based on SNI 13–6011-1999, types of coal based on calorific value are divided into 2 types, namely low-calorie coal (brown coal) and high-calorie coal (hard coal). Low-calorie coal (brown coal) has the characteristics of being brittle, soft, high water content (10% -70%) with a calorific value of less than 7000 kcal/kg (dry-ASTM), and high-calorie coal (hard coal) is compact, hard to brittle, hard, low water content with a calorific value greater than 7000 kcal/kg (dry-ASTM) [13]. Coal quality is affected by mineral or organic content composition. This paper wants to see to what extent ash affects the quality of coal in the Labanan Formation.

The purpose of this research is to obtain proximate analysis (*inherent moisture*, volatile matter, ash content, and fixed carbon), understand the effect of ash content on the calorific value of each coal seam, and get the classification of coal in the Labanan Formation.

II. RESEARCH METHODS

The research method carried out in the research area of PT Nusantara Berau Coal's IUP area is direct and indirect activities in the field. Direct activities include drilling, while indirect activities include drilling, regional geology analysis, topography, and laboratory (proximate analysis).

A. Regional Geological Analysis

Searching and observing rock and coal outcrops is the first step in mapping activities, then measurement and data collection of rock and coal outcrops is carried out, to get an accurate description of the direction of distribution, slope, and thickness of rock and coal, composition and several layers, as well as research on the local geological conditions of the area study. Data collection of the rock layers below (floor) and above (roof) or coal overburden layers as well as inserts in the coal seams (parting) is also carried out, this is to help correlate the coal seams, the condition of the geological structure and the characteristics of each coal seam. Regional geological analysis using a 1:250.000 scale map to obtain general research area information, such as rock composition, layer position, and regional geological structure.

Situation map analysis and topographical maps are used to provide direction and guidance for further work to run effectively and efficiently. This analysis was carried out by studying the results of previous research which provided an overview of the activity area so that initial conclusions could be formed regarding the situation as well as the high and low morphology of the area.

B. Drilling and Sampling

Drilling is carried out to determine the thickness of the coal, the distribution of the coal seams including dimensions, the number of seams, and vertical seam thickness, in addition to obtaining coal samples from below the surface, know the thickness of the overburden, interburden and interburden layers, and the accompanying rock stratigraphy.

Geophysical activities, namely well logging, are carried out after the completion of drilling activities using the geophysical logging tool "FGDC" (Formation Gamma Density and Caliper) with parameters Long Density, Short Density, Gamma Ray, and Caliper.

C. Sampling

Samples were taken from 12 coal seams originating from three drilling points. At these three points it is known that there are seams of varying thicknesses, where the sample represents each seam.

D. Laboratory Test

The analytical method used by the American Society for Testing and Materials (ASTM) for testing moisture content, ash content, volatile matter content, solid carbon, and caloric value [14]. Implementation of coal analysis carries out in PT. Ithaca Resources laboratory is located at the Sambarata site, Berau Regency. The ash content in coal is an important parameter to analyze because it affects the environment [15]. Figure 1 shows the flowchart of research methods and implemented in the study area.

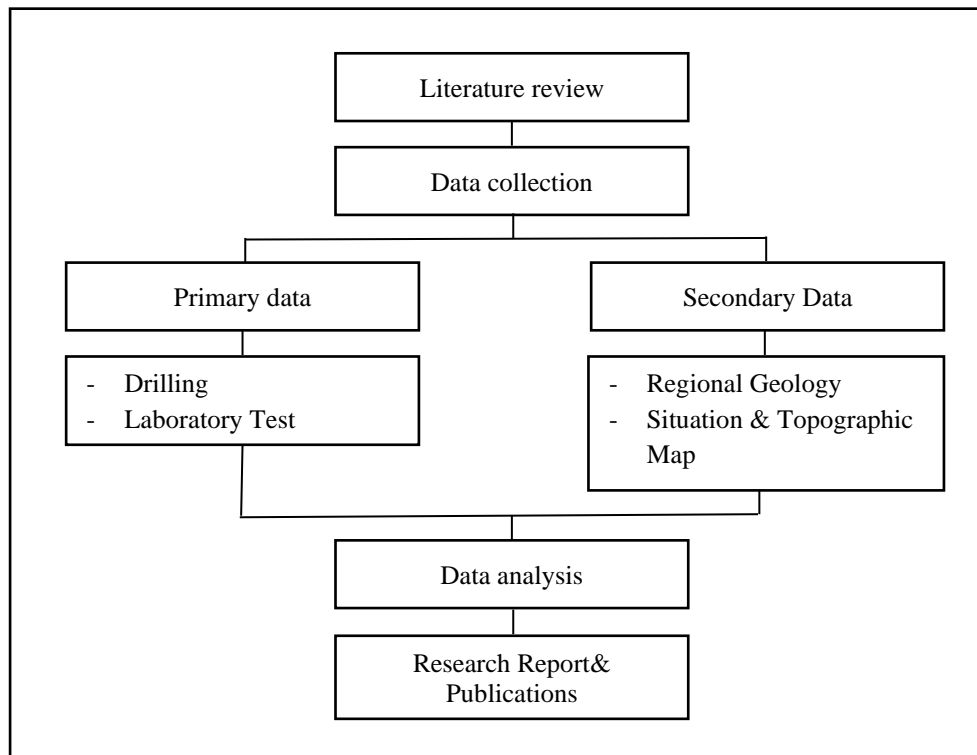


Figure 1. Flowchart of research methods in the study area

III. RESULTS AND DISCUSSION

A. Geology of the Research Area

In the Mining Business Permit area of PT. In the Berau Coal Archipelago, there are 2 rock formations, namely the Early Miocene - Middle Miocene Latih Formation (Tml) and the Late Miocene - Pleistocene Labanan Formation (Tmpl) [16].

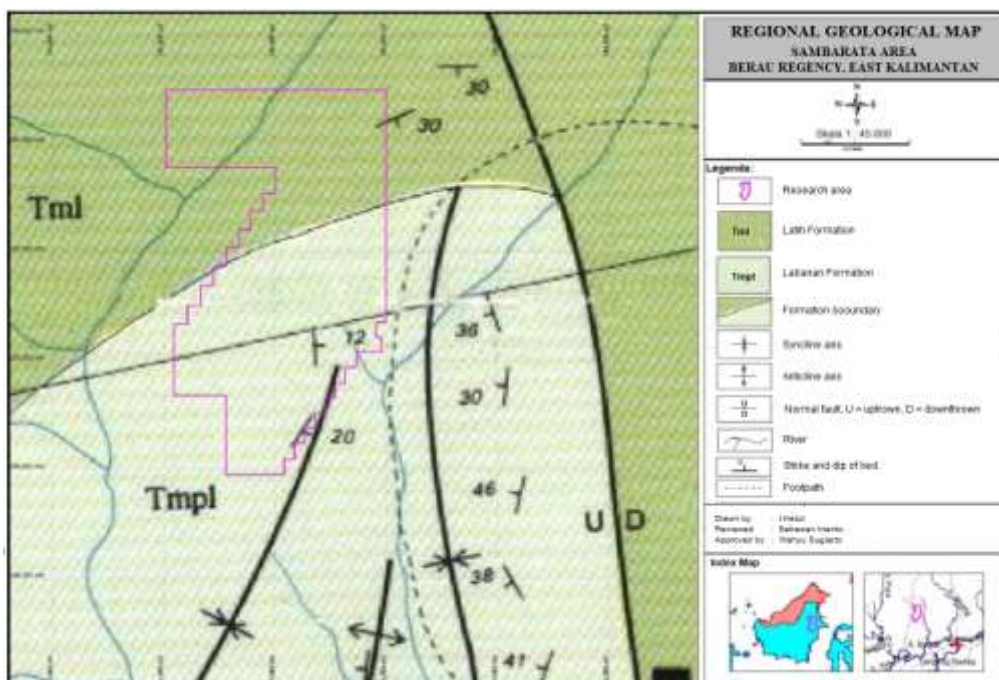


Figure 2. Regional geological map of research area [16]

The distribution of coal in the Latih Formation in the northern part of the study area is relatively northeast in the direction of N 35°-80° E with a coal slope of 30°-50° relative to the southeast. This area is dominated by quartz sandstone, claystone, siltstone, coal, sand shale inserts, and limestone at the bottom with coal inserts. The distribution of coal in the southern part (Labanan Formation) of the study area is relatively northeast-southeast with directions N 60°-100° E and N 240°-280° E with a coal slope of 11°-34° relatively southeast-south for the north plane and relatively northwest-north for the south plane. The research area in the Labanan Formation is dominated by coarse conglomerate sandstone, siltstone, intercalated claystone, and coal.

The distribution of lithology in the study area is divided into 3 (three) rock units as shown in Figure 2, namely the claystone, the sandstone, and the sandstone units. The claystone unit is a brownish-gray-dark-gray claystone, with parallel and massive sedimentary structures, rather hard-soft, carbonaceous, and plastic in nature, and is often found organic. The sandy claystone unit is composed of sandy claystone which is light gray to dark gray, rather hard-compact, locally forming pinnacles, minerals of quartz and carbon, which are plastic and sometimes carbonate. The sandstone unit is sandstone, grayish-white descriptively, fine-coarse grain size, locally conglomeratic, circularly tapered, quartz mineral composition.

B. Subsurface Coal Geology

Based on the results of coal drilling at 3 points in the Labanan Formation area of the study area, there are 12 coal seams with varying thicknesses, namely 0.52 m - 4.96 m. Based on the cross-section of the Labanan Formation coal seam (Figure 3), the names of the coal seams in the Labanan Formation are X, X1, X1L, X1LL, X1LU, X1U, X2, X2L, X2U, XL, XU, and Y.

C. Coal Quality

The results of laboratory analysis obtained are in the form of parameters total moisture (TM), inherent moisture (IM), ash, volatiles matter (VMs), fixed carbon (FC), total sulfur (TS), and calorific value (CV) with units ash received (AR) on total moisture (TM) and others are water dried base (ADB) for each coal seam in the Labanan Formation in the study area, as shown in Table 1. The value of ash content to the value of coal quality in each coal seam can be observed in the table.

Table 1. Coal seam parameters in the Labanan Formation in the study area

NO	SEAM ID	AVERAGE THICKNESS (M)	TM% (AR)	IM% (ADB)	ASH% (ADB)	VM% (ADB)	FC% (ADB)	TS% (ADB)	CV Kcal/kg (ADB)
1	X	0.67	42.61	12.86	4.69	42.97	39.48	0.22	5418
2	X1	1.52	41.2	11.51	1.65	44.53	42.3	0.18	5793
3	X1L	0.8	40.95	13.4	4.57	42.88	39.15	0.19	5421
4	X1LL	0.52	39.89	13.46	4.81	42.44	39.29	0.18	5410
5	X1LU	0.79	39.89	13.46	4.81	42.44	39.29	0.18	5410
6	X1U	0.95	41.42	14.38	3.41	42.39	39.82	0.17	5462
7	X2	2.96	38.9	14.55	5.31	41.85	38.29	0.15	5316
8	X2L	1.61	37.98	13.22	7.33	42.41	37.04	0.19	5223
9	X2U	4.96	39.04	14.4	3.83	42.08	39.69	0.14	5442
10	XL	0.53	39.89	13.46	4.81	42.44	39.29	0.18	5410
11	XU	0.66	39.89	13.46	4.81	42.44	39.29	0.18	5410
12	Y	0.17	39.89	13.46	4.81	42.44	39.29	0.18	5410

The correlation between ash content and calorific value in the Labanan Formation in the study area is shown in Figure 4. The X1 seam, which has a lower ash content of 1.65% (ADB) than the other seams, has a higher calorific value of 5793 Kcal/kg (ADB). In contrast, the X2L seam with the highest ash content, namely 7.33% (ADB), had a low calorific value of 5223 Kcal/kg (ADB). Figure 4 shows that the low ash content has a high calorific value, and the high ash content has a low calorific value. This correlation is due to the presence of unburned mineral matter in the coal seam samples, thereby disrupting the combustion process and resulting in a small calorific value. The high or low calorific value of coal does not only depend on the ash content, other parameters determine the calorific value of coal.

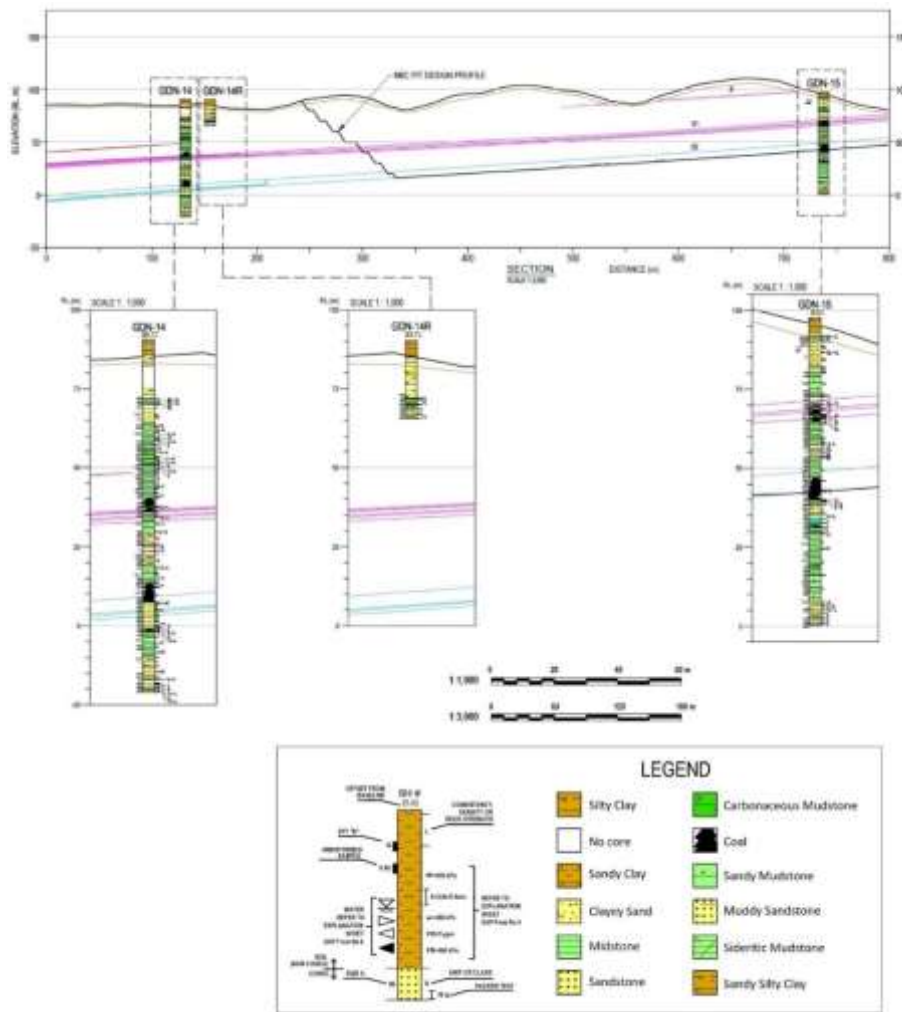


Figure 3. Cross section of the Labanan Formation coal seam in the study area

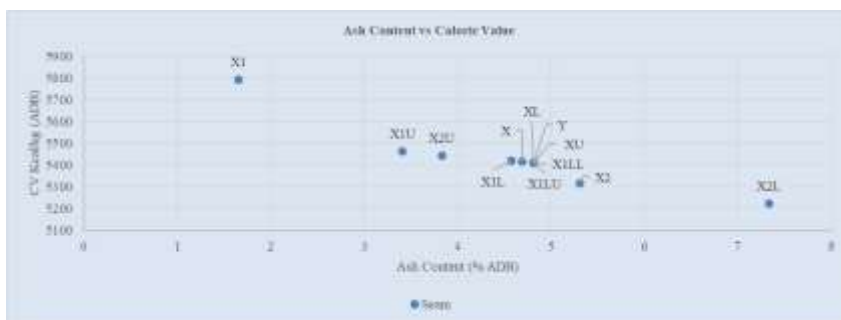


Figure 4. The value of ash content to the calorific value of coal in the Labanan Formation in the study area

V. CONCLUSION

From the results of the proximate analysis and calorific value, the average quality of the coal seam in the study area is total moisture 40.13%, inherent moisture) 13.47%, ash 4.57%, volatiles matter 42.61%, fixed carbon 39.35%, total sulfur 0.18%, and calorific value 5427 Kcal/kg (ADB).

The coal in each seam of the Labanan Formation in the Berau Sub Basin is classified as low-calorie coal (brown coal) with an average total water content of 40.13% (AR) and a calorific value of 5427 Kcal/kg (ADB). The higher the ash content (% ADB), the lower the calorific value (Kcal/kg) of coal, and vice versa. This shows that the ash content affects the calorific value of coal in the Labanan Formation in the study area.

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